Appendix D - AECOM (2024) Flora and Vegetation Assessment

Prepared for
Western Power
ABN: 18 540 492 861



Clean Energy Link Swan Coastal Plain Flora, Vegetation and Fauna Assessment

25-Jun-2024

Clean Energy Link Swan Coastal Plain Flora, Vegetation and Fauna Assessment

Client: Western Power

ABN: 18 540 492 861

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Executive Summary

AECOM Australia Pty Ltd (AECOM) was engaged by Western Power to undertake a spring flora, vegetation, fauna and black cockatoo assessment for defined linear corridors within the Perth Metropolitan Region on the Swan Coastal Plain (SCP). This Project is referred to as the Clean Energy Link (CEL). The five sites include: Padbury - Wangara, Pinjar Terminal, Neerabup Terminal and East Wanneroo, NT-NOR to HBK 132kV Line and Northern Terminal.

A summary of the Padbury - Wangara results is presented below:

- One patch of -Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain Threatened Ecological Community (Tuart Woodlands TEC) listed as Critically Endangered under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and as Priority 3 by Department of Biodiversity, Conservation and Attractions (DBCA). The patch extends for 0.54 ha.
- No significant flora listed under the EPBC Act or the *Biodiversity Conservation Act 2016* (BC Act) or by DBCA were recorded during the survey.
- Three conservation significant fauna species were recorded during the survey, including two bird species and one mammal species:
    - Carnaby's Cockatoo (*Zanda latirostris)* listed as Endangered under the EPBC Act and the *Biodiversity Conservation Act 2016* (BC Act)
    - Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso)* listed as Vulnerable under the EPBC Act and BC Act
    - Quenda (*Isoodon fusciventer)* listed as Priority 4 by DBCA.

A summary of the Pinjar Terminal results is presented below:

- No significant flora listed under the EPBC Act, BC Act or by DBCA were recorded during the survey.
- Banksia Woodlands of the Swan Coastal Plain (Banksia Woodlands TEC) listed as Endangered under the EPBC Act and as Priority 3 by DBCA, mapped for 14.75 ha.
- One conservation significant fauna species was recorded during the survey, Quenda (*Isoodon fusciventer*) listed as Priority 4 by DBCA.

A summary of the Neerabup Terminal and East Wanneroo results are presented below:

- Eight patches of Banksia Woodlands TEC were confirmed and mapped for 15.13 ha. In most instances, this TEC is synonymous with a Priority 3 Ecological Community (PEC) unless assessment through Floristic Community Type analysis determines otherwise.
- One patch of Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain TEC was mapped within the survey area for 1.71 ha.
- One Priority 3 PEC listed by the DBCA (2023) was confirmed to occur through FCT analysis, FCT 21c – Low lying Banksia attenuata woodlands or shrublands, mapped for 0.6 ha.
- One Priority 4 species, *Jacksonia sericea,* was collected and formal identification confirmed at the WA Herbarium. One individual was recorded within the survey area, with a second individual recorded in a quadrat adjacent to the survey area.
- A sample of *Calectasia* sp. was collected and may represent the Priority 2 species *C. elegans.* The record was more than 800m from the survey area therefore no further verification is required at this time.
- Three conservation significant fauna species were recorded during the survey:
    - Quenda (*Isoodon fusciventer*) listed as Priority 4 by DBCA.

- Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksia naso*) listed as Vulnerable under the EPBC Act and BC Act.
- Carnaby's Cockatoo (*Zanda latirostris*) listed as Endangered under the EPBC Act and BC Act.

A summary of the NT-NOR to HBK 132KV results are presented below:

-
- No significant flora listed under the EPBC Act or the BC Act or by DBCA were recorded during the survey.
- Three conservation significant fauna species were recorded during the survey:
  - Quenda (*Isoodon fusciventer*) listed as Priority 4 by DBCA.
  - Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksia naso*) listed as Vulnerable under the EPBC Act and BC Act.
  - Carnaby's Cockatoo (*Zanda latirostris*) listed as Endangered under the EPBC Act and BC Act.

A summary of the Northern Terminal results is presented below:

- No significant flora listed under the EPBC Act or the BC Act or by DBCA were recorded during the survey.
- No significant vegetation communities were recorded in the survey area.
- Two conservation significant fauna species were recorded during the survey:
  - Quenda (*Isoodon fusciventer*) listed as Priority 4 by DBCA.
  - Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksia naso*) listed as Vulnerable under the EPBC Act and BC Act.

The survey was undertaken by experienced personnel during the ideal detection period for significant flora. Survey effort was considered satisfactory, and no access issues were encountered that affected the outcome of the results.

1.0 Introduction

1.1 Background

In support for the WA state decarbonisation goal, and in line with Western Power's corporate strategy, an investment for North Region strategy titled Clean Energy Link Program (CELP) was created to conduct scoping phase activities for future works.

AECOM Australia Pty Ltd (AECOM) was engaged to undertake spring flora, vegetation, fauna, and black cockatoo assessment to be used to analyse options for new line routes. The details outlined in this report are in relation to the spring surveys conducted for five discreet survey areas within the Swan Coastal Plain (SCP) between Malaga and Pinjar (the survey areas). These areas and the Western Power shapefiles they represent is outlined in Table 1.

1.2 Location

The survey area represents multiple discreet corridors extending between Malaga and Pinjar within the SCP. The southern portion of the survey area is located approximately 14km north/northeast of the Perth Central Business District (CBD) and extends north to Pinjar Terminal, located approximately 55km north of the Perth CBD. The survey areas intersect the Cities of Wanneroo, Joondalup and Swan (Figure 1). The locations are presented in the Table below (Table 1).

Table 1 Locations of survey areas

Survey areas	Area (ha)	Location	Associated Figure
Padbury-Wangara	31.26	Along Whitfords Ave	Figure 1.2
Pinjar Terminal	16.58	East of Perry Rd	Figure 1.3
Neerabup Terminal and East Wanneroo	204.98	North of Gnangara Rd, South of Skink Rd. This comprises six survey areas including: • Neerabup Terminal • NBT-WGA 81 • NBT-WGA 81 STR 49-60 • NBT MUL Option 1 via Lenore Rd • NBT MUL Option 2 via Badgerup • NT-NBT 330kV Clearing Shapefile	Figure 1.4
NT-NOR to HBK 132kV	119.00	Along Drumpellier Dr	Figure 1.5
Northern Terminal	25.78	North of Beach Rd, South of Vale St	Figure 1.6

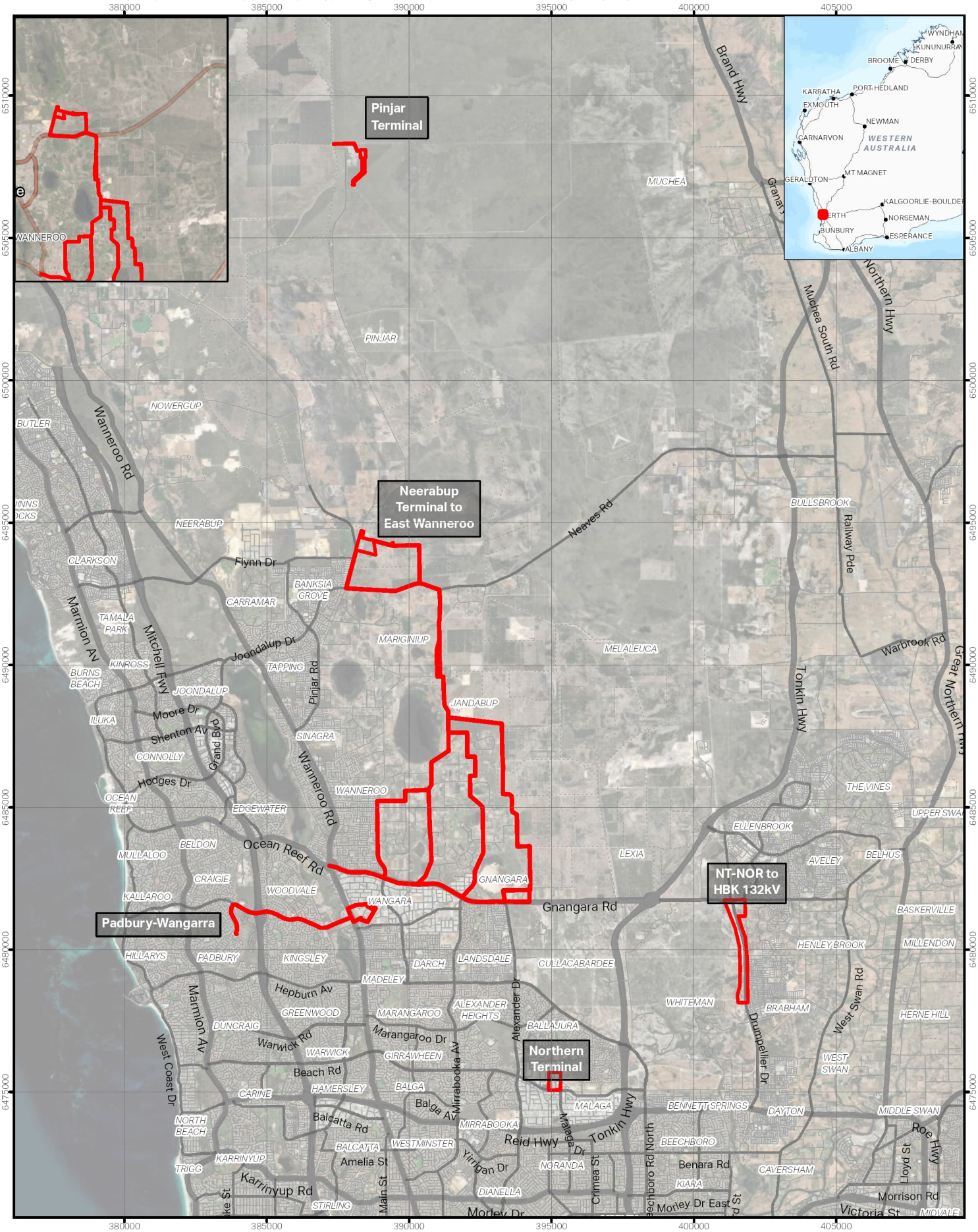
1.3 Objectives

The purpose of the flora, vegetation, fauna, and black cockatoo assessment was to define the environmental values present within the survey area. The scope included:

- A desktop assessment and literature review for flora, communities, and fauna.
- Field surveys to record floristic data, define vegetation communities, vegetation condition and fauna habitat, and search for conservation significant flora, fauna, and communities, targeted black cockatoo habitat assessment.
- Technical report and data package.

This document represents the final technical report covering the desktop assessment, literature review and field surveys for the five areas within the SCP.

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LEGEND

Survey Area

Survey Area - All

WESTERN POWER

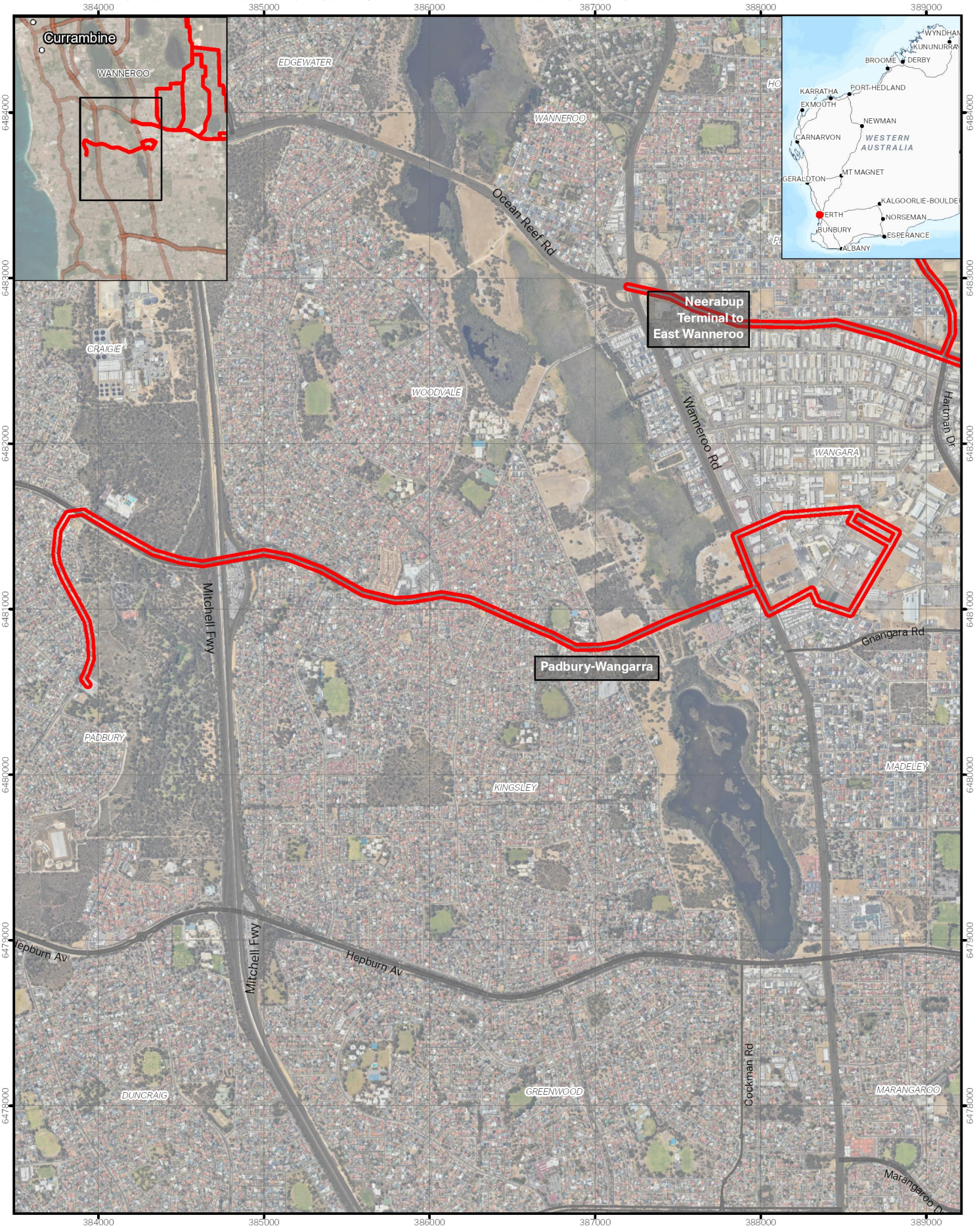
CLEAN ENERGY LINK SWAN COASTAL PLAIN FLORA, VEGETATION AND FAUNA ASSESSMENT

Figure 1.1

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LEGEND

Survey Area

Survey Area - Padbury - Wangarra

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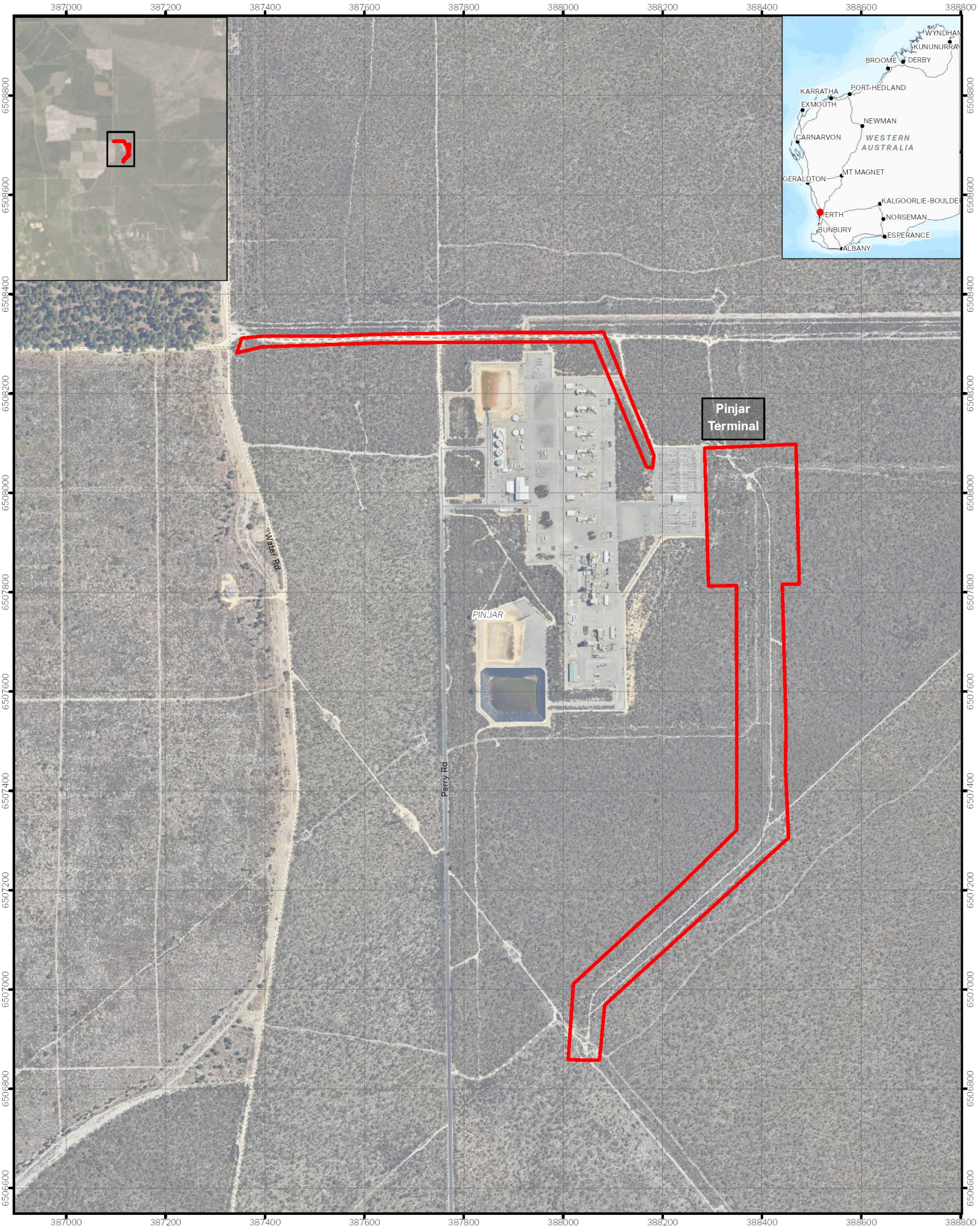
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Figure **1.2**

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LEGEND

Survey Area

Survey Area - Pinjar Terminal

WESTERN POWER

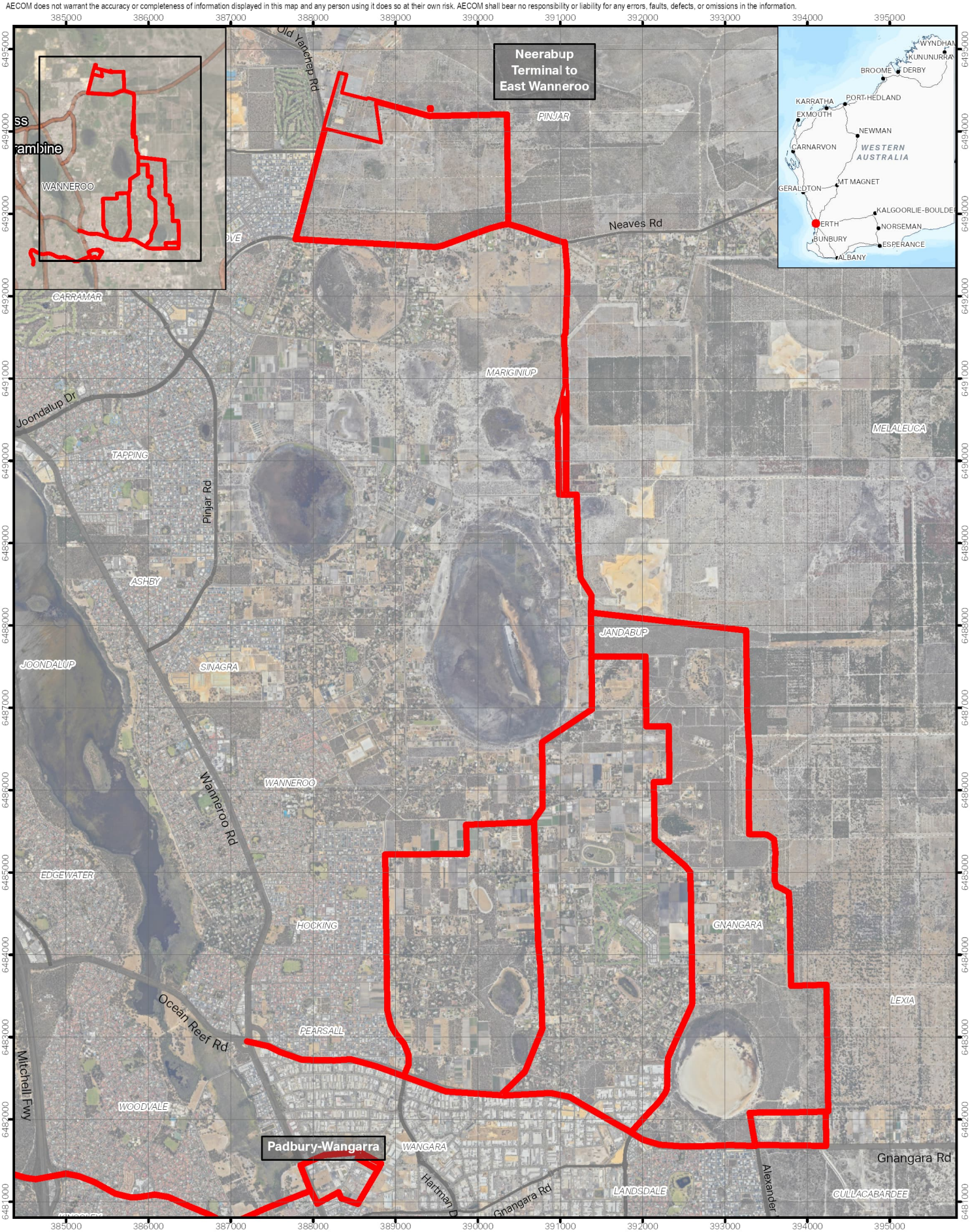
CLEAN ENERGY LINK SWAN COASTAL PLAIN FLORA, VEGETATION AND FAUNA ASSESSMENT

Figure **1.3**

A4 size

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Layout: G60713462_Fig1_NREP_South_SurveyArea_A4P_v1, Last exported: 20/05/2024 10:08 AM

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DATE MODIFIED	13 JUN 2024	APPROVED BY	F. DE WIT

N

1:60,000 (when printed at A4)

0 580 1,200 metres

GDA2020 MGA ZONE 50

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LEGEND

Survey Area

Survey Area - Neerabup Terminal and East Wanneroo

WESTERN POWER

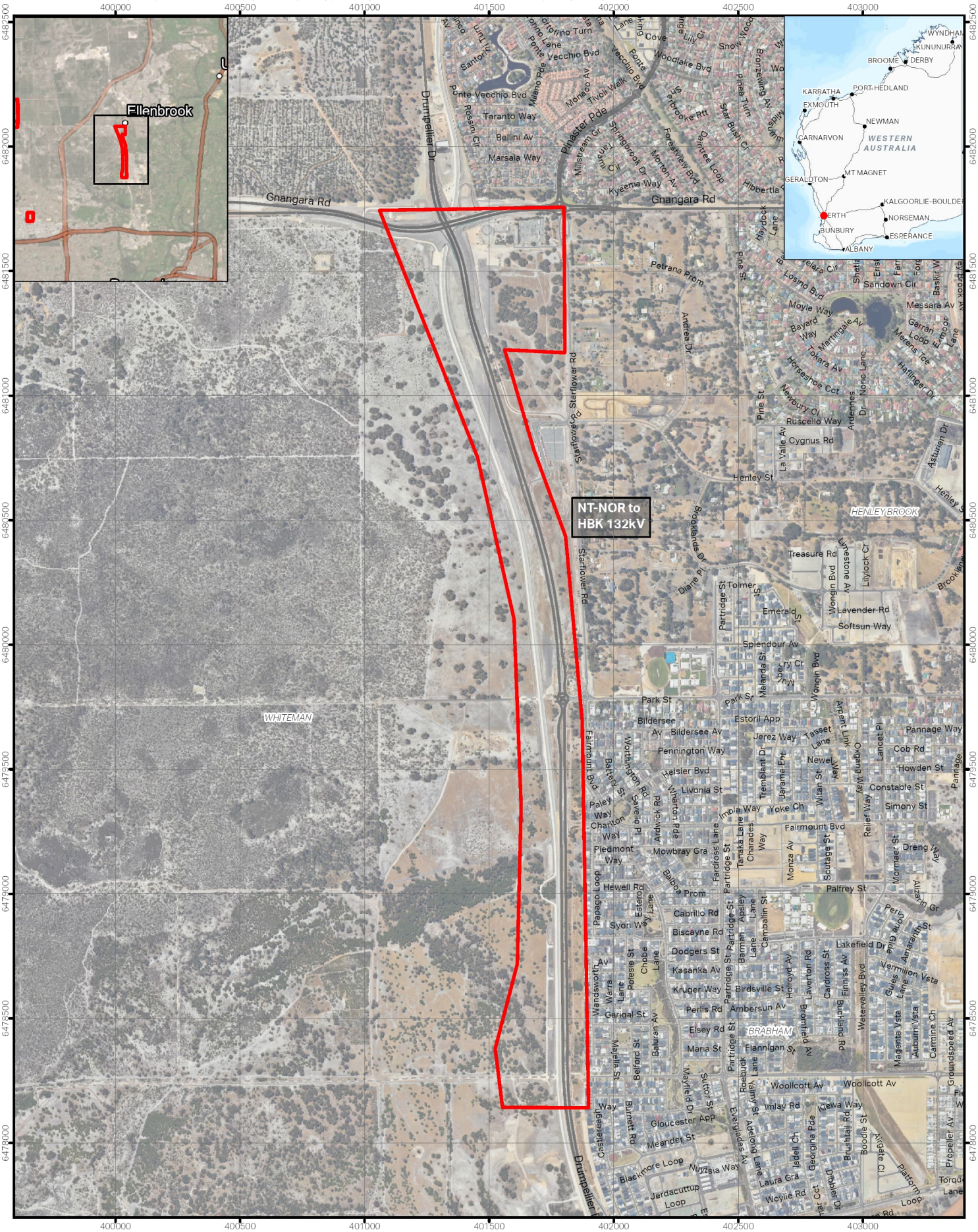
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Figure **1.4**

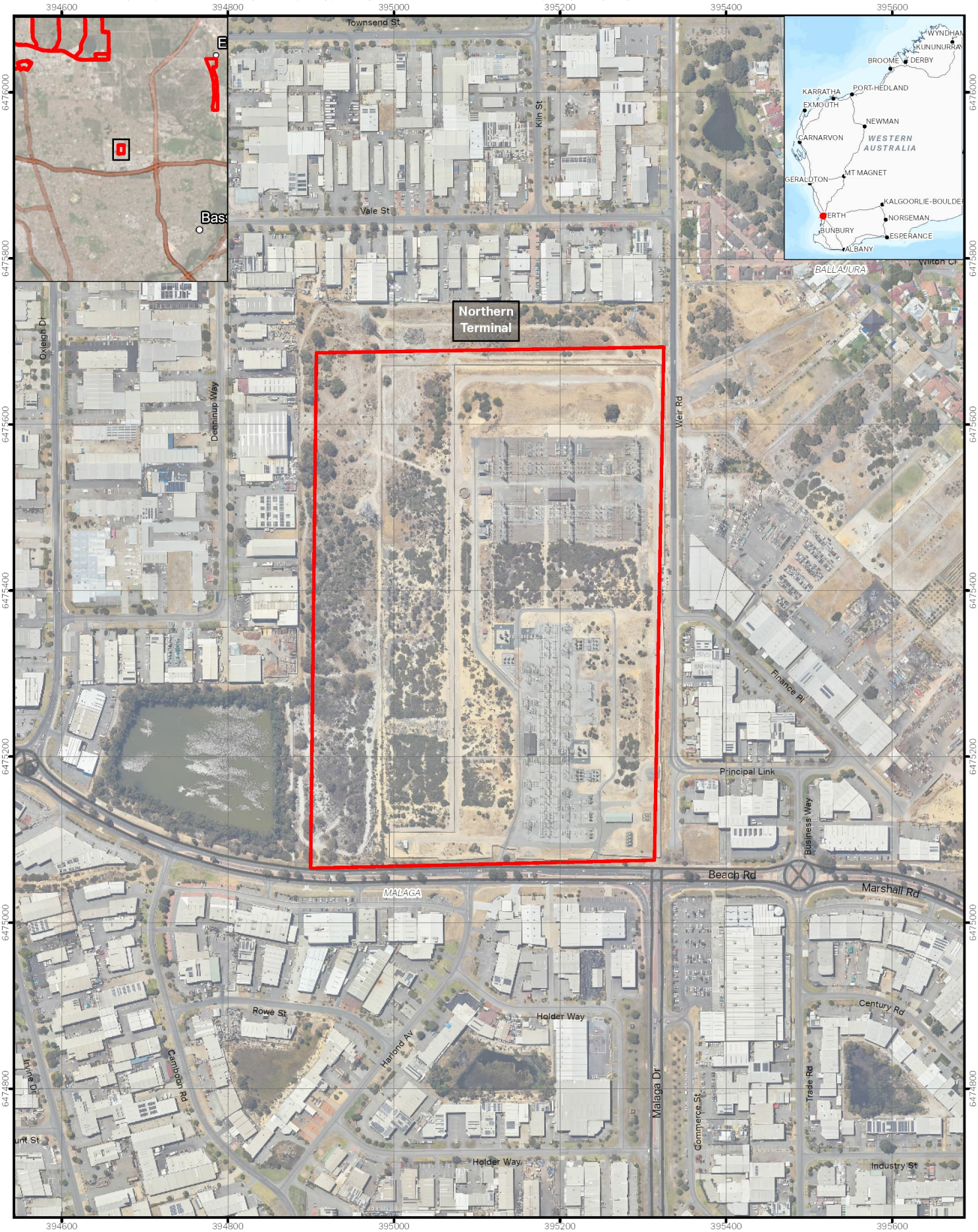
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Ellenbrook
WYNDHAM
KUNUNURRA
BROOME
DERBY
KARRATHA
PORT HEDLAND
EXMOUTH
NEWMAN
CARNARVON
WESTERN AUSTRALIA
GERALDTON
MT MAGNET
KALGOORLIE-BOULDER
PERTH
NORSEMAN
BUNBURY
ESPERANCE
ALBANY
NT-NOR to HBK 132kV
Gnangara Rd
Drumpellier Dr
Pinaster Pde
Starflower Rd
Petrana Prom
Andrea Dr
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Woylie Rd
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Isdell Ch
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Malanda St
Park St
Bartley St
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Fairmount Blvd
Piedmont Way
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Amaranth St
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Lakefield Dr
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Finniss Av
Buchanan Rd
Cardross St
Laverton Rd
Horoyd Av
Birdsville St
Ambersun Av
Mayfield Dr
Sutton St
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Valley Lane
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Burnett Rd
Marjella St
Bellbrook Pl
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Warra Lane
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Estero Lane
Apsley Lane
Barman Lane
Cambalin St
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Carmine Ch
Groundspeed Av
Propeller Av
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Platform Loop
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Pine St
La Valle Av
Asturian Dr
Haflinger Dr
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Baskin W
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Ford Cl
Farnham Cl
Ellis Cl
Velara Cir
Losino Blvd
Haycock Lane
Hibbertia Cl
Star Bush Cl
Pinea Turn
Bonnie Loop
Forestview Blvd
Springbrook Dr
Millstream Cr
Tivoli Walk
Monaco Av
Milano Rd
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Ponte Vecchio Lane
Santorini Lane
Snow Wood Cove
Lily Cr
Brookmeadow Av
Wo
Ardwick Rd
Wharton Rd
Savello Pl
Paley Way
Charlton Way
Impala Way
Yoke Ch
Wilan St
Newell Way
Oolong Way
Tasset Lane
Jarana Ent
Tremblant Dr
Fardoss Lane
Balboa Prom
Estoril App
Mulberry Cr
Wongin Blvd
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Arpent Link
Pannage
Perlo Gate
Groote Gate
Vermilion Vista
Auburn Vista
Magenta Vista
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Gloucester App
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Syon Ws
Estero Lane
Apsley Lane
Barman Lane
Cambalin St
Auburn Vista

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0 50 100
metres

GDA2020 MGA ZONE 50

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LEGEND

Survey Area

Survey Area - Northern Terminal

WESTERN POWER

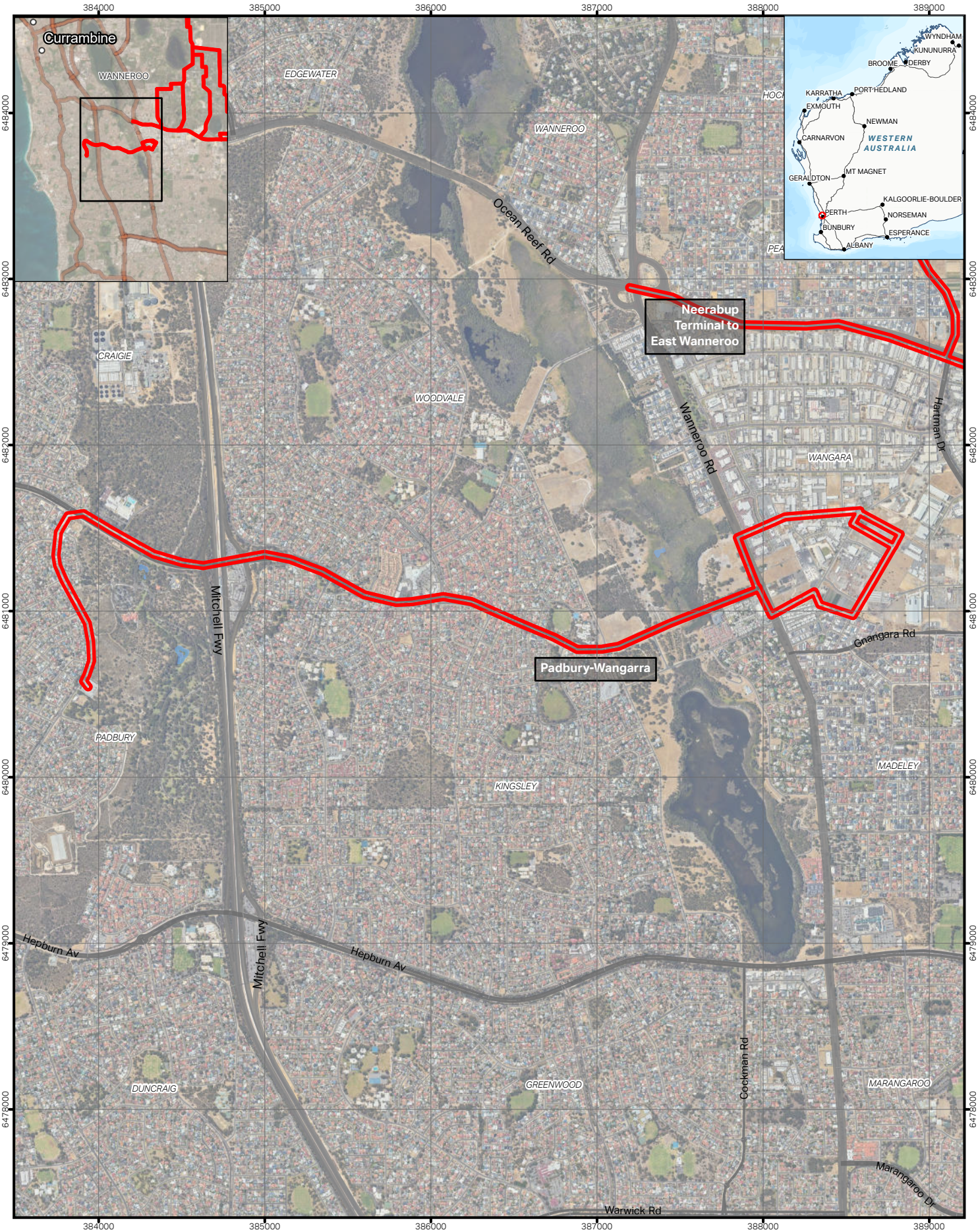
CLEAN ENERGY LINK SWAN COASTAL PLAIN FLORA, VEGETATION AND FAUNA ASSESSMENT

Figure **1.6**

A4 size

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1:30,000
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metres

GDA2020 MGA ZONE 50

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LEGEND

Survey Area

Survey Area - Padbury - Wangarra

WESTERN POWER

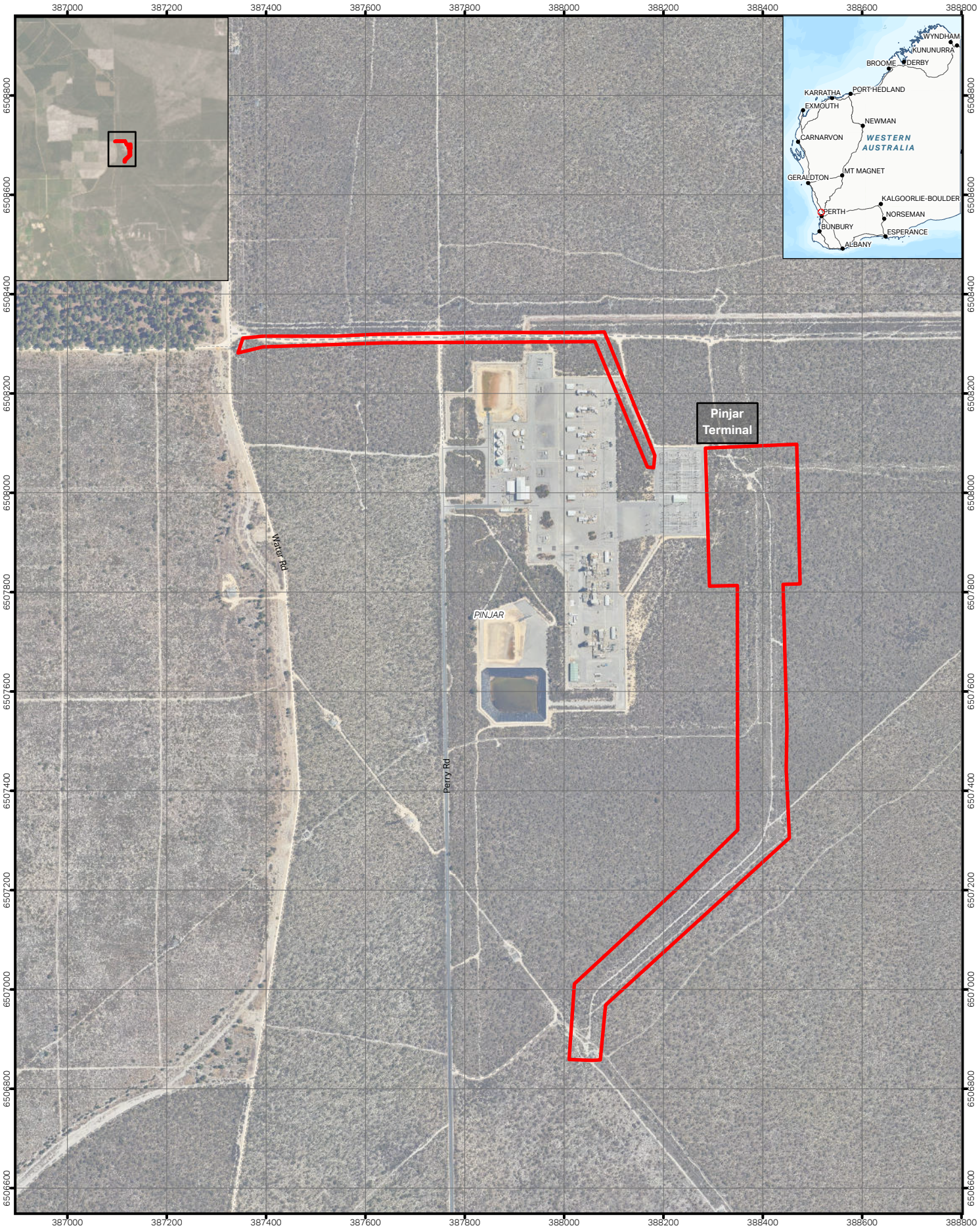
NREP SWAN COASTAL PLAIN FLORA, VEGETATION AND FAUNA ASSESSMENT

Figure 1.2

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A4 size

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1:10,000
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metres

GDA2020 MGA ZONE 50

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LEGEND

Survey Area

Survey Area - Pinjar Terminal

WESTERN POWER

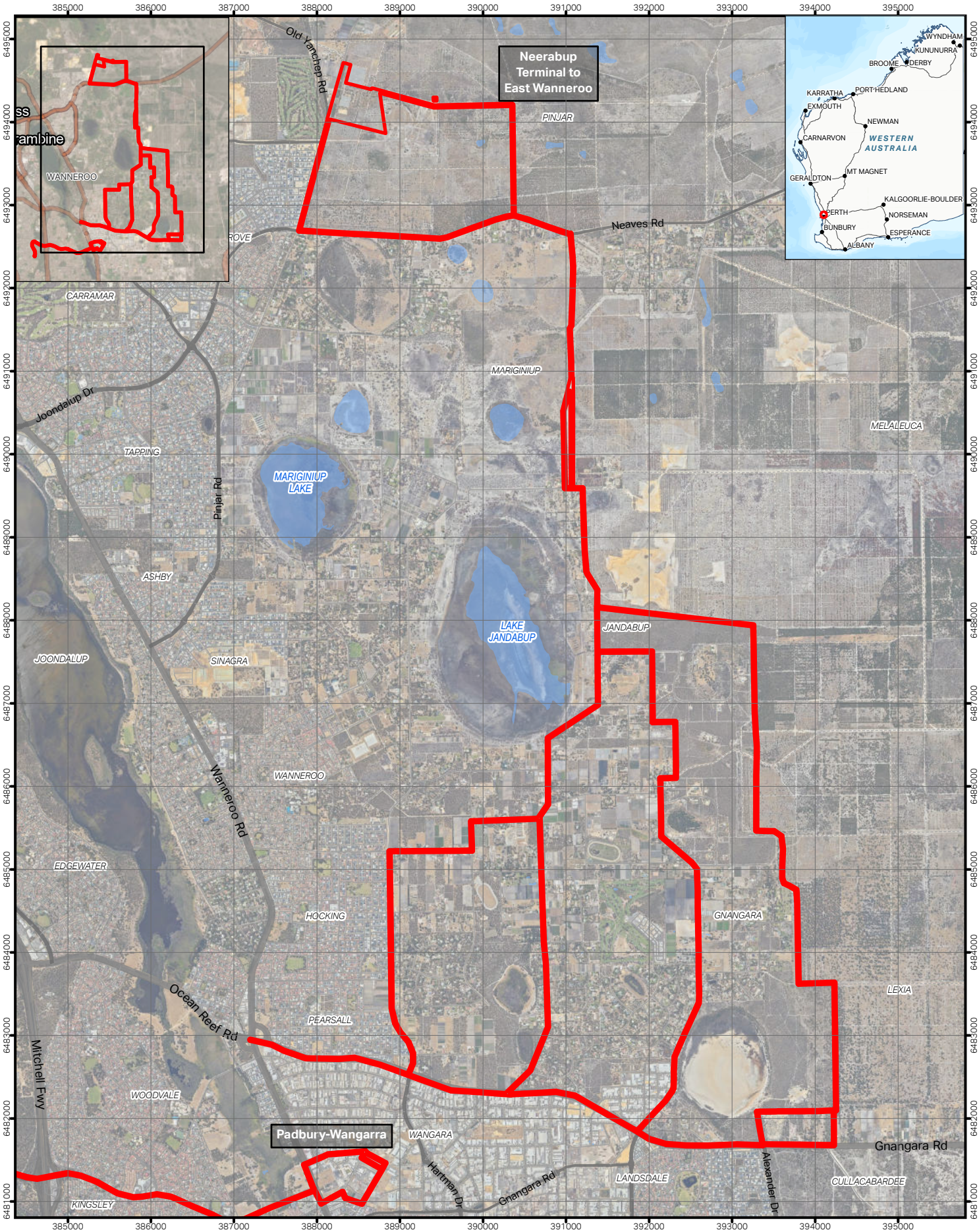
NREP SWAN COASTAL PLAIN FLORA, VEGETATION AND FAUNA ASSESSMENT

Figure 1.3

A4 size

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0 580 1,200 metres

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LEGEND

Survey Area

Survey Area - Neerabup Terminal and East Wanneroo

WESTERN POWER

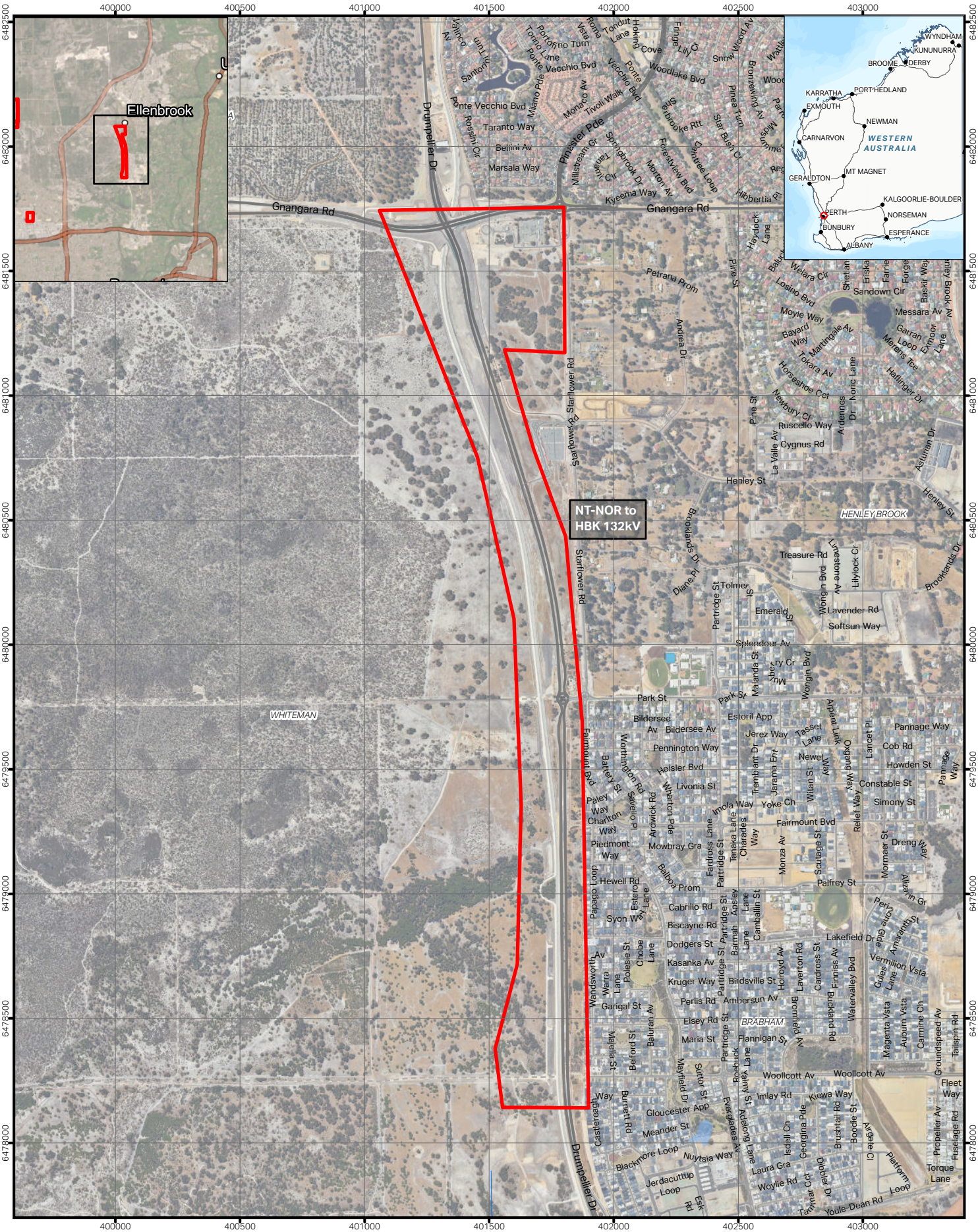
NREP SWAN COASTAL PLAIN FLORA, VEGETATION AND FAUNA ASSESSMENT

Figure 1.4

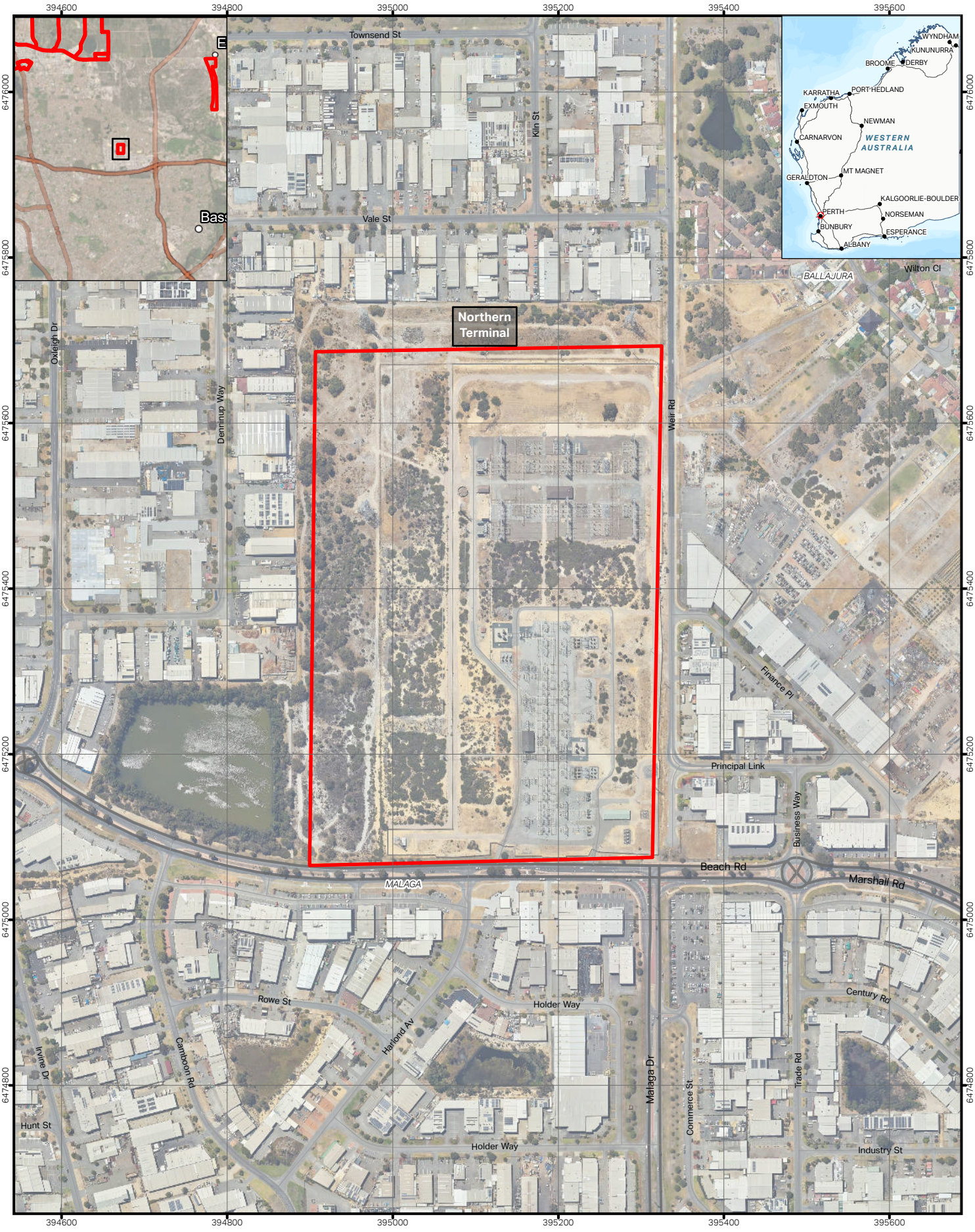
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KUNUNURRA
BROOME
DERBY
KARRATHA
PORT HEDLAND
EXMOUTH
NEWMAN
CARNARVON
WESTERN AUSTRALIA
GERALDTON
MT MAGNET
KALGOORLIE-BOULDER
PERTH
NORSEMAN
BUNBURY
ESPERANCE
ALBANY
Gnangara Rd
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Starflower Rd
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Henley St
HENLEY BROOK
WHITEMAN
BRABHAM
Treasure Rd
Softsun Way
Lavender Rd
Splendour Av
Park St
Bildersee Av
Pennington Way
Heisler Blvd
Livonia St
Fairmount Blvd
Piedmont Way
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Hewell Rd
Cabrillo Rd
Biscayne Rd
Dodgers St
Kasanka Av
Kruger Way
Perlis Rd
Garigal St
Elsey Rd
Maria St
Flannigan St
Woollcott Av
Imlay Rd
Gloucester App
Meander St
Blackmore Loop
Nuytsia Way
Jerdacuttup Loop
Youle-Dean Rd
Woylie Rd
Laura Gra
Kiewa Way
Lakefield Dr
Vermilion Vsta
Magenta Vsta
Auburn Vsta
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Perion Tce
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Tasset Lane
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Ruscello Way
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Asturian Dr
Ardennes Dr
Horseshoe Cct
Tokara Av
Martingale Av
Bayard Way
Moyle Way
Losino Blvd
Sandown Cir
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Garran Loop
Exmoor Lane
Merans Tce
Haflinger Dr
Baskil Way
Forge
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Erska
Shetland
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Pine St
Haydock Lane
Hibbertia Pl
Kyeema Way
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Millstream Gr
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Marsala Way
Bellini Av
Taranto Way
Ponte Vecchio Blvd
Rosini Cir
Milano Pde
Monaco Av
Tivoli Walk
Ponte Vecchio Turn
Portofino Turn
Ponte Lane
Valinco Av
Santorini Turn
Vista Roma
Tondut Lane
Hoking Cove
Fringe Lily Ct
Woodlake Blvd
Snow Wood Av
Bronzewing Av
Pinea Turn
Star Bush Ct
Forestview Blvd
Morton Av
Entree Loop
Brookwater Rtt
Brooklands Dr
Diane Pl
Partridge St
Tolmer St
Emerald St
Wongin Blvd
Lilylock Cr
Limestone Av
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Mayberry Cr
Park St
Bildersee Av
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Ardennes Dr

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0 50 100 metres

GDA2020 MGA ZONE 50

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LEGEND

Survey Area

Survey Area - Northern Terminal

WESTERN POWER

NREP SWAN COASTAL PLAIN FLORA, VEGETATION AND FAUNA ASSESSMENT

Figure 1.6

A4 size

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2.0 Existing Environment

2.1 Climate

All survey areas occur north of the Perth CBD within the Perth Metropolitan Region. The climate is warm Mediterranean with mild wet winters and hot dry summers. Precipitation occurs predominantly during the winter months, with the possibility of some summer storms.

Rainfall data was obtained from Wanneroo Station (Station Number 009105), located approximately 5.5km from the centre of the Survey Area (Gnangara Lake). Temperature data was obtained from Pearce RAAF WA (Station Number 009053), located approximately 18.7km from Gnangara Lake. These stations represent the closest mid-point to all survey areas, thus representing average conditions across all areas. The long-term rainfall and temperature data is compared against data from November 2023 to December 2022 in Figure 2 (BOM, 2023), to determine if climatic conditions posed a constraint to the survey.

The survey was undertaken across multiple days, from 16 to 20 of October and 6 to 8 of November in 2023. This followed a year of below average rainfall, with a total of 550.2 mm recorded, 241.2mm less than the long-term average of 791.4 mm. Rainfall was particularly low across the late spring and summer months (October to February). Lower than average rainfall did not appear to affect the germination of annual species, with ample present during the field survey which were confidently identified in the field or at the herbarium.

Maximum temperatures were higher for eight of the ten months, relative to the long-term average prior to the survey. Minimum temperatures varied less from the long-term average, with three months experiencing lower than average minimum temperatures. For both months of the field survey, as well as the month prior to the survey, both minimum and maximum temperatures exceeded the long-term average. During periods of increased temperature, fauna struggle to lose excess body heat through evaporation, and have an elevated probability to develop heat stress. As a result, fauna will likely seek shelter from the sun. This would in turn reduce the number of sightings of fauna during the survey, however as habitat assessments were conducted this does not have a significant impact on the survey efforts.

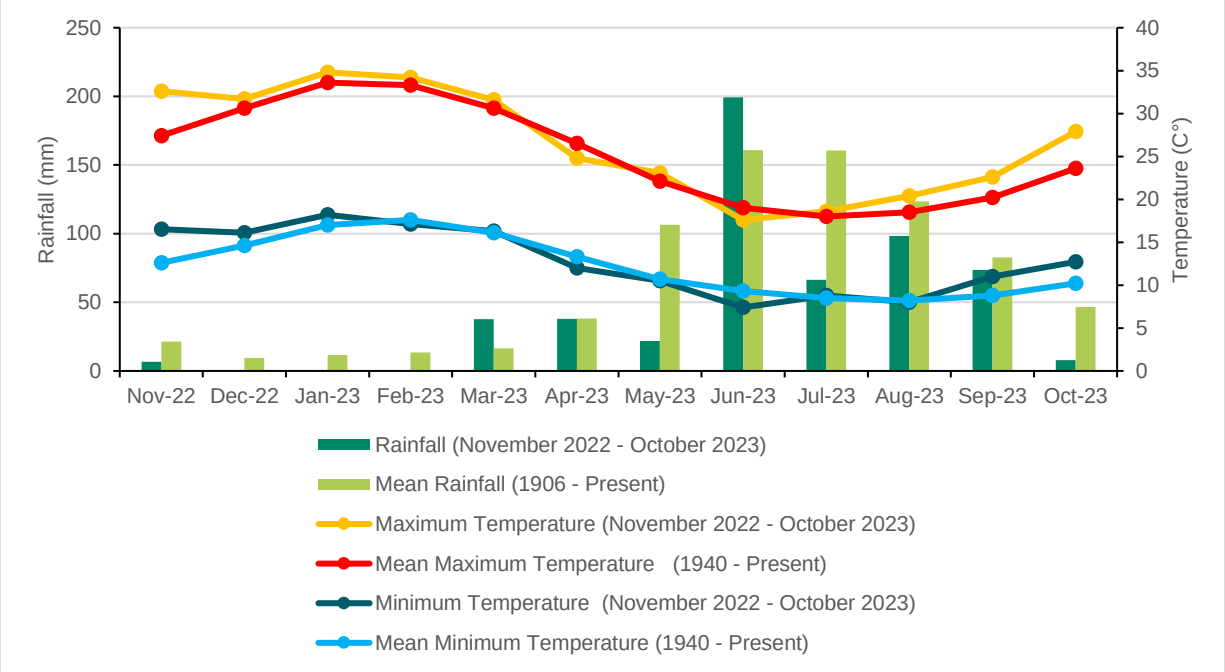


Figure 2 Rainfall data from Wanneroo Station (Station Number 009105) and temperature data from Pearce RAAF WA (Station Number 009053) (BOM, 2023).

2.2 Interim Biogeographical Region of Australia Regions

The largest regional vegetation classification scheme recognised by Environmental Protection Authority (EPA) is the Interim Biogeographical Region of Australia (IBRA). The IBRA regions provide the planning framework for the systematic development of a comprehensive, adequate, and representative (CAR) national reserve system. There are 89 recognised IBRA regions across Australia that have been defined based on climate, geology, landforms and characteristic vegetation and fauna (IBRA7, 2012). The survey area is situated within the Swan Coastal Plain IBRA Region.

The Swan Coastal Plain bioregion, described in CALM (2002), includes Perth and the outer suburbs (excluding the Hills suburbs). The Swan Coastal Plain is comprised of a narrow belt less than 30km wide of Aeolian, alluvial and colluvial deposits of Holocene or Pleistocene age (Gibson et al, 1994). A complex series of seasonal freshwater wetlands, alluvial river flats, coastal limestone and several offshore islands are included in the bioregion. Younger sandy areas and limestone are dominated by heath and/or tuart woodlands, while Banksia and Jarrah-Banksia woodlands are found on the older dune systems. Extensive clearing has occurred on the Swan Coastal Plain for urban and agricultural development.

The Swan Coastal Plain subregion, described by Mitchell et al. (2002), is a low-lying coastal plain covered with woodlands dominated by Banksia or Tuart on sandy soils, *Casuarina obesa* on outwash plains, and paperbark in swampy areas. The area includes a complex series of seasonal wetlands and includes Rottnest, Carnac and Garden Islands. Land use is predominantly cultivation, conservation, urban and rural residential. The area contains a number of rare features including Holocene dunes and wetlands and a large number of threatened species and ecological communities.

2.3 Soil Landscape Mapping

The survey is situated across four land systems. A depiction of the soil landscape of the survey areas can be found in Figure 3 and Table 2.

Table 2 Soil Landscape mapping systems

Soil System	Description	Padbury-Wangara	Neerabup Terminal and East Wanneroo	NT-NOR to HBK 132kV	Northern Terminal	Pinjar Terminal
Spearwood System	Sand dunes and plains on yellow deep sands, pale deep sands and yellow/brown shallow sands.	Occurs across the majority of the west of survey area	Small patch intersects land system	NA	NA	NA
Quindalup System	Coastal dunes of the Swan Coastal Plain, with calcareous deep sands and yellow sands with coastal scrub.	Intersects with western most portion of survey area	NA	NA	NA	NA
Bassendean System	Sand dunes and sandplains with pale deep sand, semi-wet and wet soils with Banksia-Paperbark woodlands and mixed heathlands.	NA	Occurs across majority or all of the survey area			
Pinjarra System	Poorly drained coastal plain with variable alluvial and aeolian soils. Vegetation is variable and includes Jarrah, Marri, Paperbark, Sheoak and Flooded Gum.	NA	NA	NA	Intersects with southern extent of survey area	NA

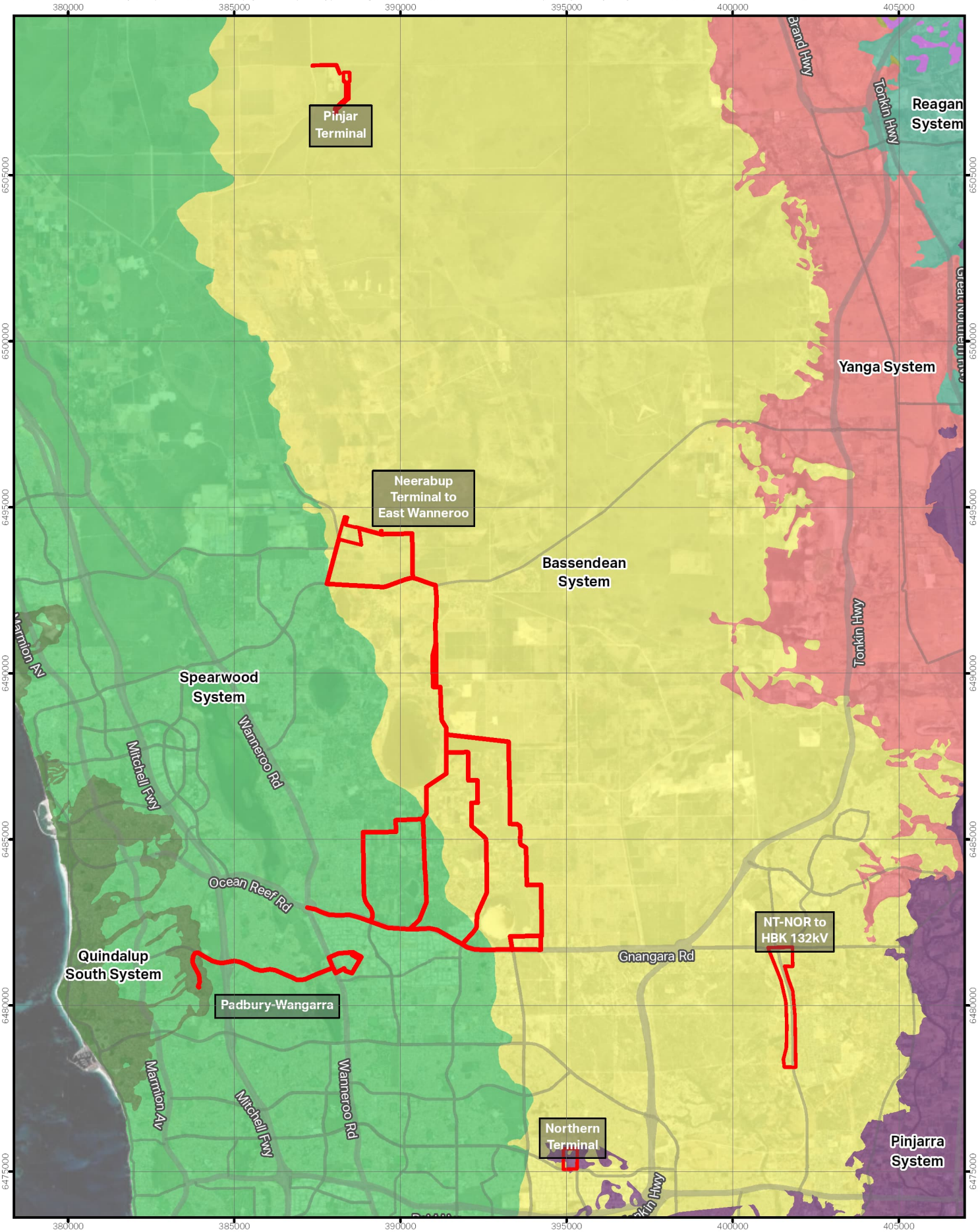
2.4 Geology

The survey area is situated across five geological systems. These are described below in Table 3. A depiction of the soil landscape of the survey areas can be found in Figure 4.

Table 3 Geological systems of the Survey Area

Code	Description	Padbury-Wangara	Neerabup Terminal and East Wanneroo	NT-NOR to HBK 132kV	Northern Terminal	Pinjar Terminal
Qpb	Quartz sand, fixed dunes		X	X	X	X
Qrw	Swamp and lacustrine deposits-peat, peaty sand and clay	X	X	X		
Qpcs	Predominantly quartz sand	X	X			
Qpck	Predominantly calcarenite and kankar	X				
Qrs	Eolian and beach lime sand, slightly lithified	X				

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LEGEND

- Survey Area
- Soil Landscape Mapping - Systems (DPIRD-064)
  - Bassendean System
  - Coonambidgee System
  - Mogumber System
  - Pinjarra System
  - Quindalup South System
  - Reagan System
  - Spearwood System
  - Yanga System

Land Systems

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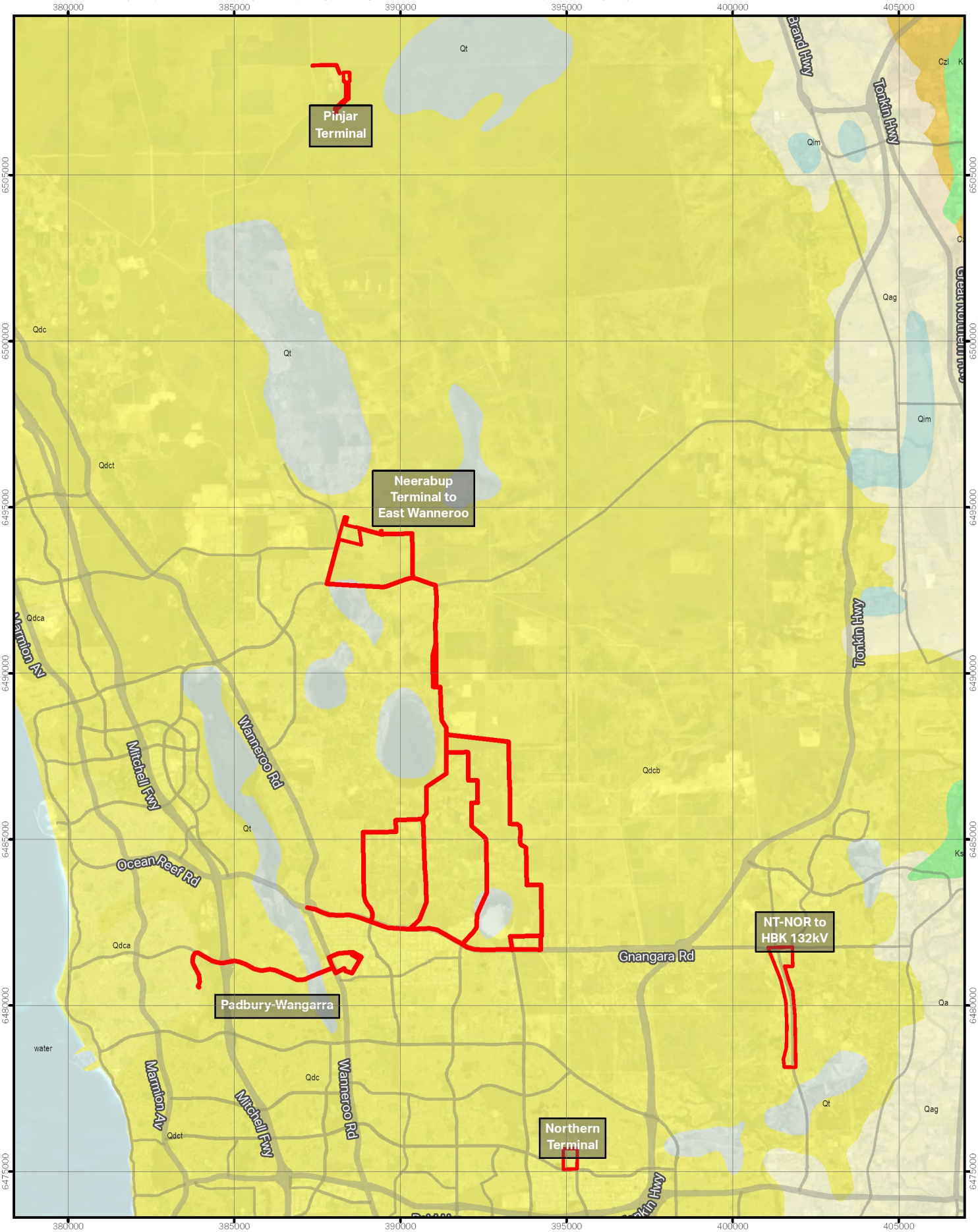
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Figure **3**

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LEGEND

Survey Area

Geoscience Australia (2012) Surface Geology of Australia, 1:1 000 000 scale, 2012 edition

water

QUATERNARY

Qa
Qag
Qdc
Qdca
Qdcb
Qdct
Qim
Qt

CENOZOIC

Czl
Czs

CRETACEOUS

Ksco

Geology and Soils

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Figure **4**

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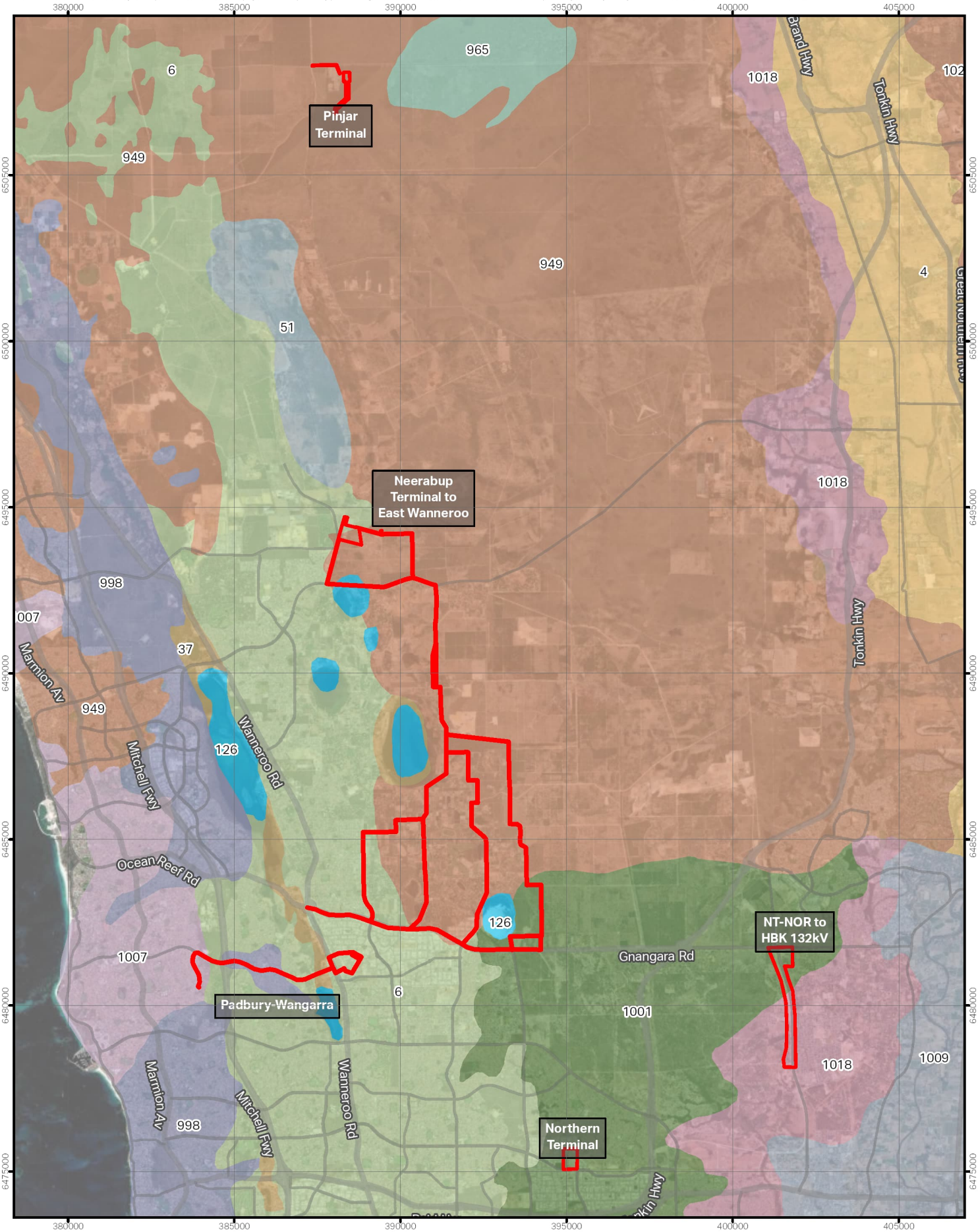
2.5 Vegetation

Beard et al. (2013) mapping is used to determine the current extent of remnant vegetation remaining when compared to pre-European vegetation extent. The survey areas span eight Vegetation Associations within three Local Government Areas (LGAs), described below in Table 4 and depicted in Figure 5.

Table 4 Beard et al (2013) Vegetation Associations and Percentage Remaining (Govt. of WA, 2019).

Vegetation Association	Description	Percentage Remaining (%)				
		WA	SCP	City of Wanneroo	City of Joondalup	City of Swan
Padbury-Wangara						
6	Medium woodland; tuart & jarrah	23.72	23.72	21.94	14.24	
37	Shrublands; Teatree thicket	62.92	34.61	47.60	51.58	
998	Medium woodland; tuart	36.25	36.35	60.13	9.62	
1007	Mosaic: Shrublands*; Acacia lasiocarpa* & *Melaleuca acerosa* heath / Shrublands*; Acacia rostellifera* & *Acacia cyclops* thicket	68.05	68.68	59.94	8.03	
Pinjar Terminal						
949	Low woodland; banksia	56.42	57.28	46.30		
Neerabup Terminal and East Wanneroo						
949	Low woodland; banksia	56.42	57.28	46.30		
6	Medium woodland; tuart & jarrah	23.72	23.72	21.94		
1001	Medium very sparse woodland; jarrah, with low woodland; banksia & casuarina	22.05	22.05	22.71		
126	Bare areas; freshwater lakes	40.72	23.61	36.24		
NT-NOR to HBK 132kV						
1018	Mosaic: Medium forest; jarrah-marri / Low woodland; banksia / Low Forest; Teatree / Low woodland; *Casuarina obesa*	17.39	17.39			16.42
1001	Medium very sparse woodland; jarrah, with low woodland; banksia & casuarina	22.05	22.05			26.18
Northern Terminal						
1001	Medium very sparse woodland; jarrah, with low woodland; banksia & casuarina	22.05	22.05			26.18

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LEGEND

Survey Area

Only those intersecting Survey Areas shown in legend

949,Low woodland or open low woodland,Other acacia, banksia, peppermint, cypress pine, casuarina, York gum Acacia spp., Banksia spp., Agonis flexuosa, Callitris spp., Allocasuarina spp., Eucalyptus loxophleba.

6,Woodland southwest,Jarrah, marri and wandoo Eucalyptus marginata, Corymbia calophylla, E. wandoo.

37,Thicket,Wattle, casuarina and teatree acacia-allocasuarina-melaleuca alliance.

126,Freshwater lake,

998,Woodland southwest,Jarrah, marri and wandoo Eucalyptus marginata, Corymbia calophylla, E. wandoo.

1001,Low forest, woodland or low woodland with scattered trees,Jarrah, banksia or casuarina Eucalyptus marginata, Banksia spp., Allocasuarina spp.

1007,Scrub-heath / Thicket,

1018,Woodland / Low woodland / Low forest or Woodland,

Pre-European Vegetation

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Figure **5**

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2.6 Conservation Reserves and Environmentally Sensitive Areas

2.6.1 Conservation Reserves

Approximately 104.15 ha of the survey areas occurs within the Class A Gnangara-Moore River State Forest, located on crown land. This State Forest is vested under the Conservation Commission of Western Australia. A further 0.64 ha of the survey areas intersects the gazetted Class A Jandabup Nature Reserve, for the purpose of conservation of flora and fauna, located on crown land. Approximately 0.34 ha of land is classified as Crown Freehold (department managed).

The conservation reserves and the percent of each survey area that they intersect is presented in Table 5 and depicted in Figure 6.

Table 5 Conservation Reserves intersecting the survey areas.

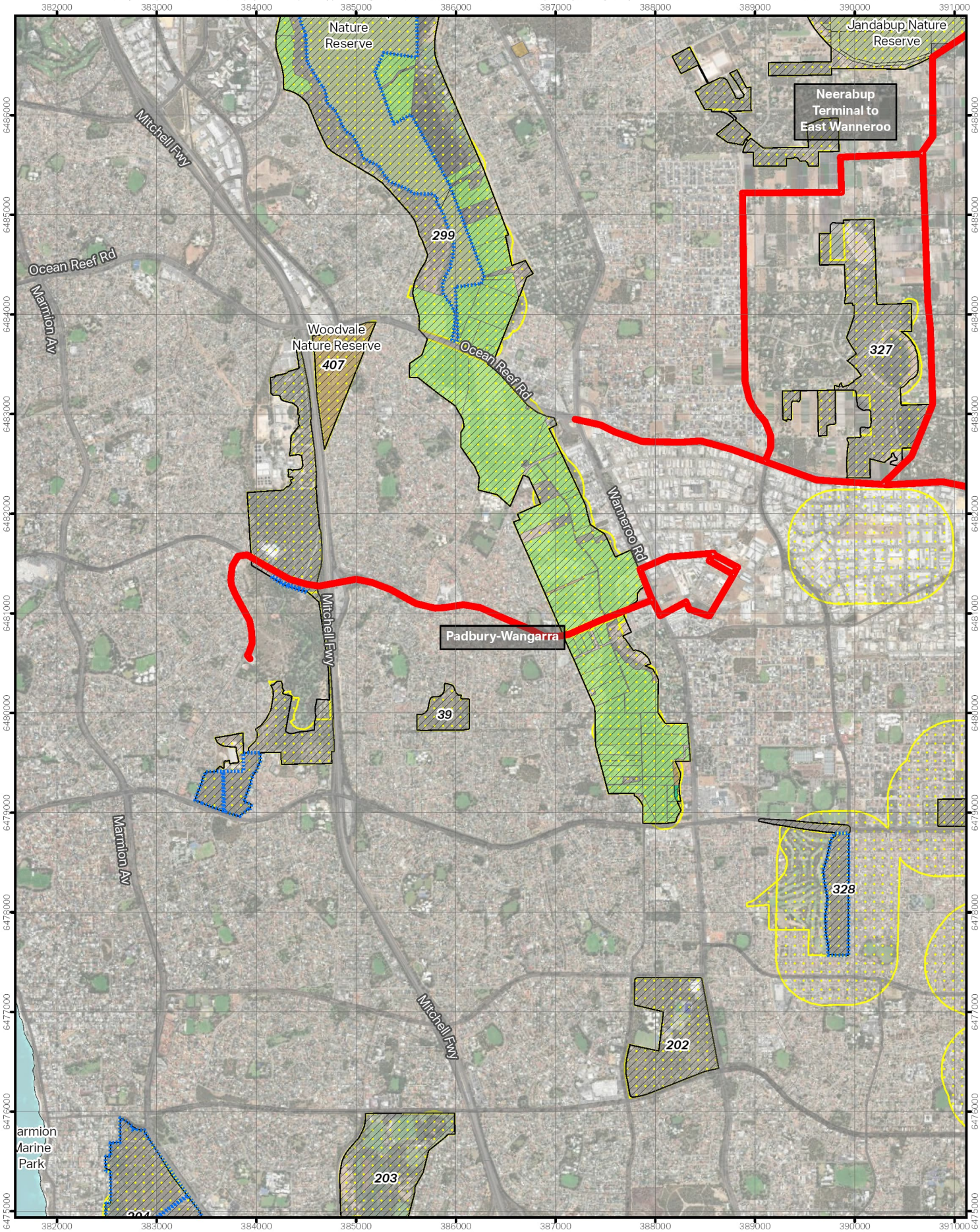
Survey Area	Conservation Reserve Intersected	Area (ha)	Percentage of Survey Area (%)
Neerabup Terminal and East Wanneroo	Gnangara-Moore River State Forest	99.30	48.44
	Jandabup Nature Reserve	0.64	0.31
Pinjar Terminal	Gnangara-Moore River State Forest	4.85	29.25
Padbury-Wangara	Un-named Crown Freehold land – Represents Bush Forever Site 303.	0.34	1.09

2.6.2 Bush Forever Sites

There are nine Bush Forever Sites that intersect the survey areas (Figure 6). They are listed below:

- Neerabup: Site 193, 463, 327, 326, 324.
- Pinjar: Site 280.
- NT-NOR: Site 304.
- PADBURY - WANGARA: Site 303, 299.

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LEGEND

- Survey Area
- DBCA - Legislated Lands and Waters (DBCA-011)
  - Nature Reserve
  - Conservation Park
  - Section 5(1)(h) Reserve
  - Marine Park
- Crown Freehold - Dept Managed
- Clearing Regulations - Environmentally Sensitive Areas (DWER-046)
- Bush Forever Areas - 2000 (DPLH-019)
- A Class Reserve

Conservation Reserves, Bush Forever Sites and ESAs

WESTERN POWER

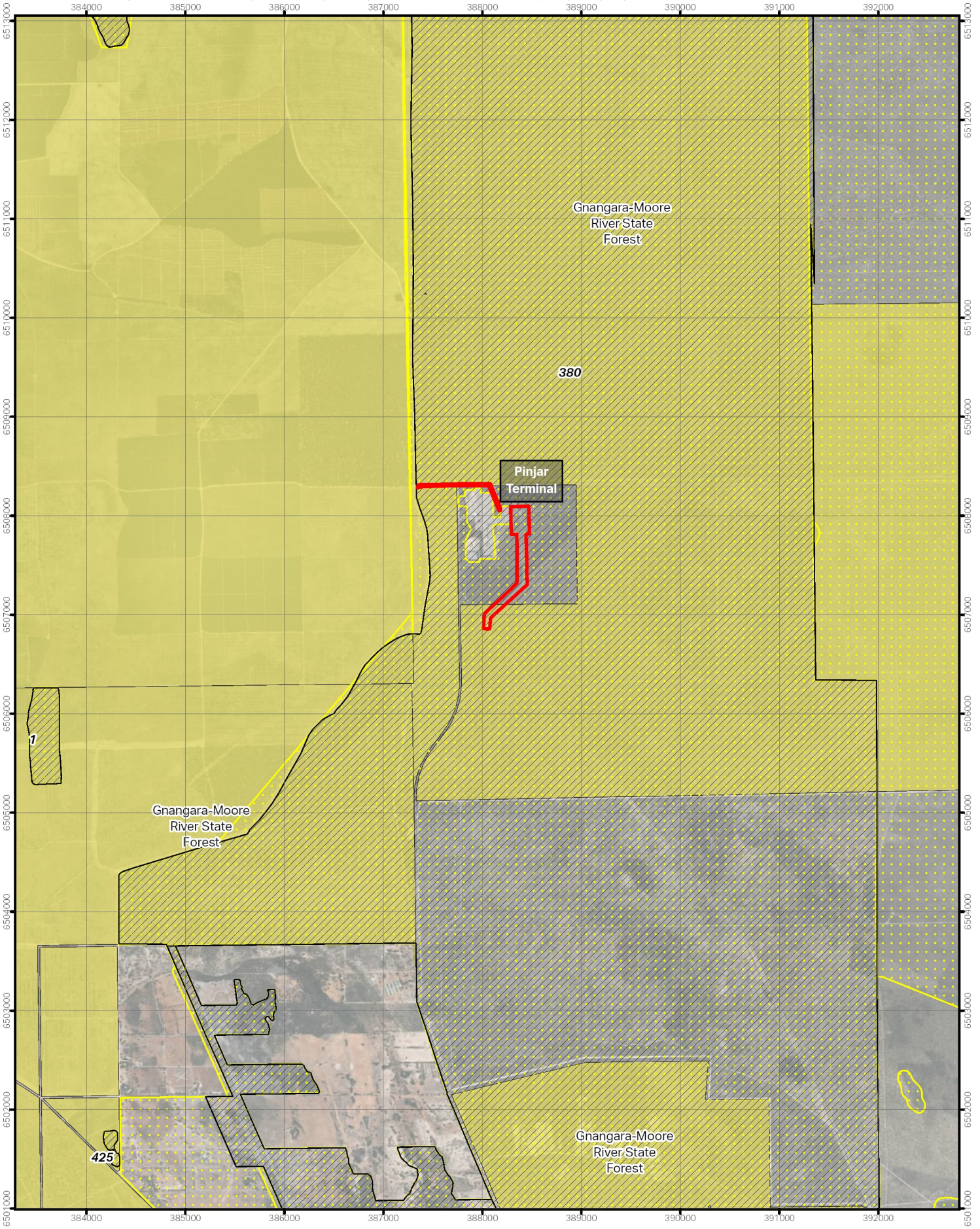
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Figure 6.1

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LEGEND

- Survey Area
- DBCA - Legislated Lands and Waters (DBCA-011)
- State Forest
- Clearing Regulations - Environmentally Sensitive Areas (DWER-046)
- Bush Forever Areas - 2000 (DPLH-019)

Conservation Reserves, Bush Forever Sites and ESAs

WESTERN POWER

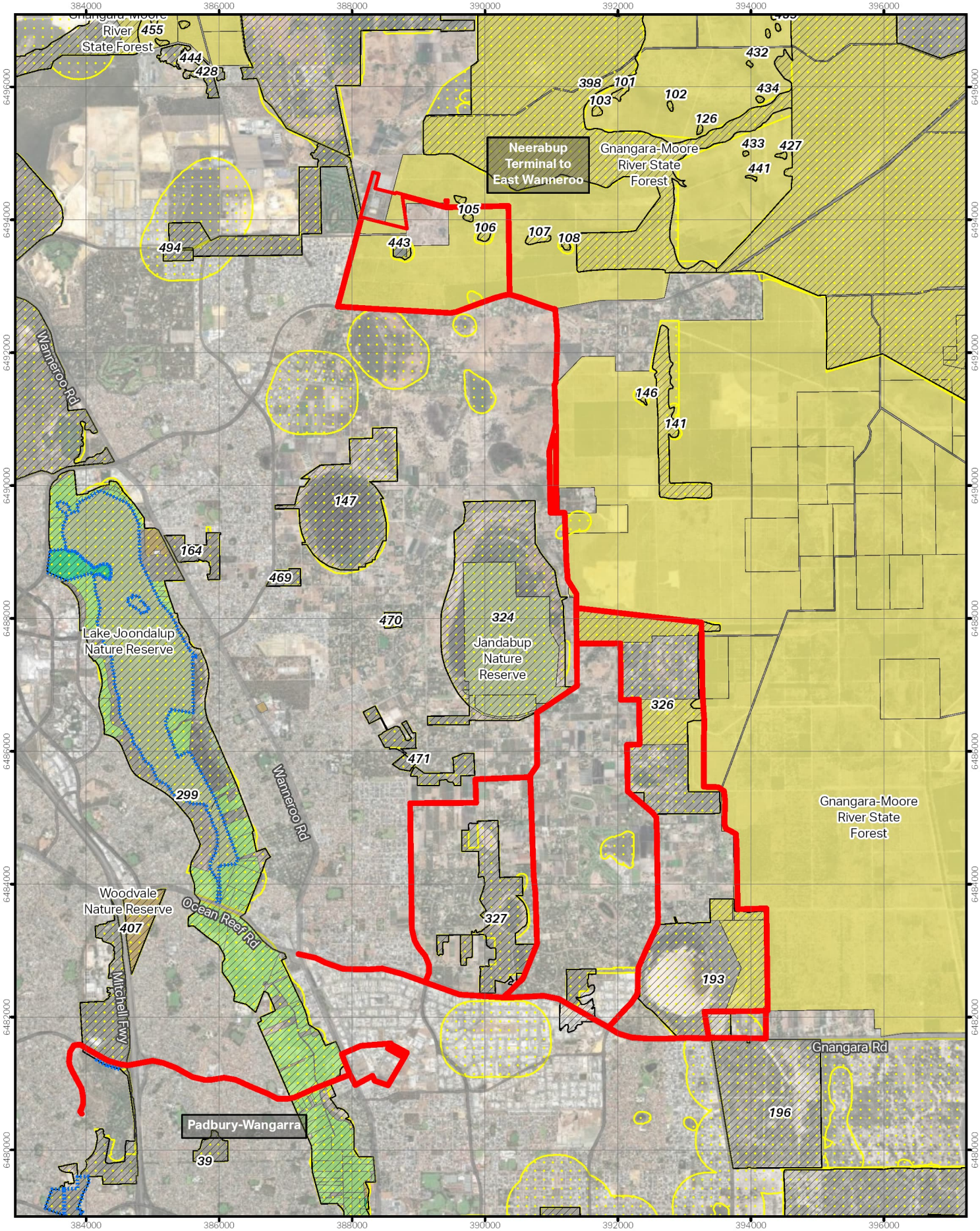
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Figure 6.2

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LEGEND

- Survey Area
- DBCA - Legislated Lands and Waters (DBCA-011)
  - Nature Reserve
  - Conservation Park
  - Section 5(1)(h) Reserve
  - State Forest
- Crown Freehold - Dept Managed
- Clearing Regulations - Environmentally Sensitive Areas (DWER-046)
- Bush Forever Areas - 2000 (DPLH-019)
- A Class Reserve

Conservation Reserves, Bush Forever Sites and ESAs

WESTERN POWER

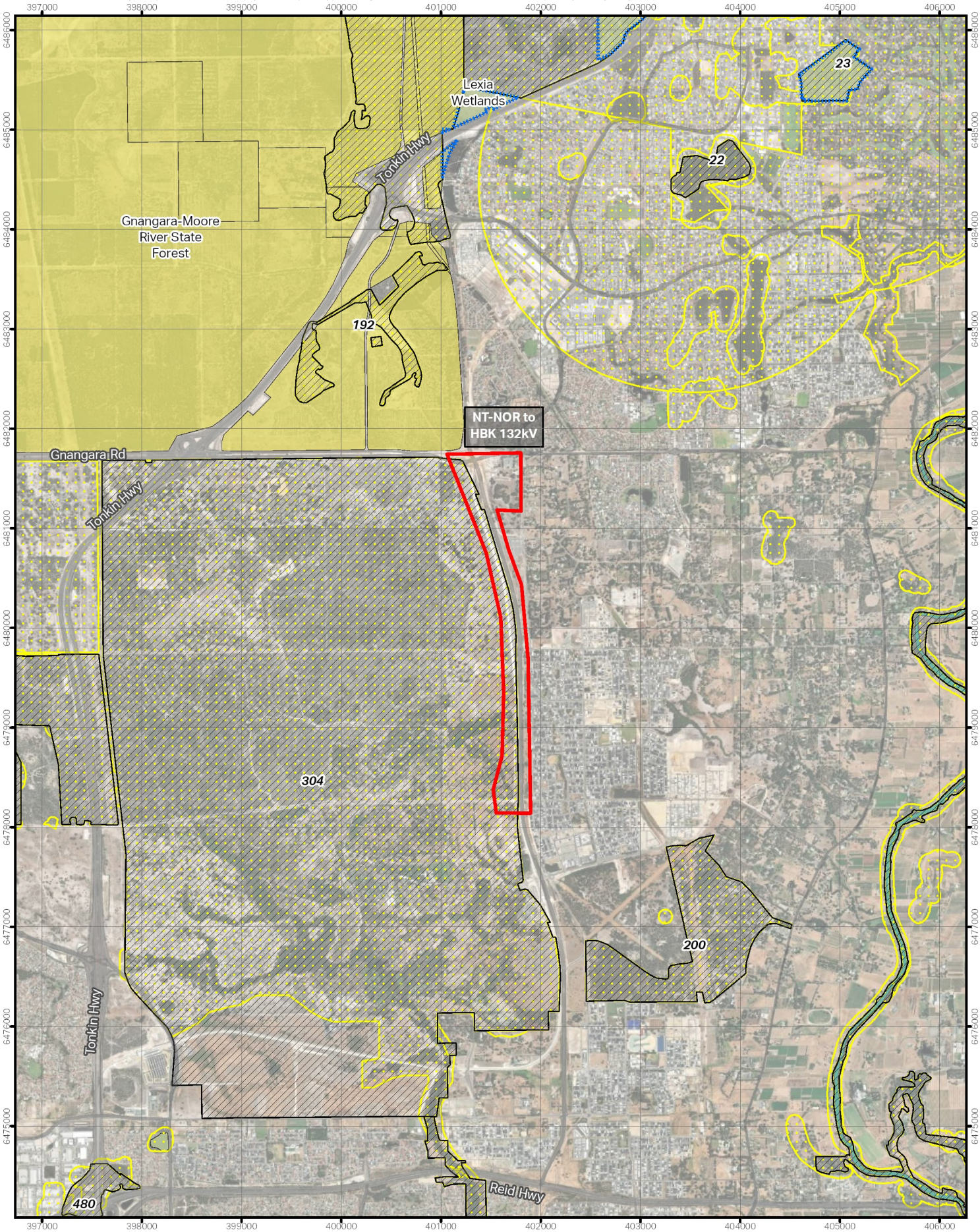
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Figure 6.3

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LEGEND

- Survey Area
- DBCA - Legislated Lands and Waters (DBCA-011)
  - Nature Reserve
  - State Forest
  - SCRM Act - River Reserve
- Clearing Regulations - Environmentally Sensitive Areas (DWER-046)
- Bush Forever Areas - 2000 (DPLH-019)
- A Class Reserve

Conservation Reserves, Bush Forever Sites and ESAs

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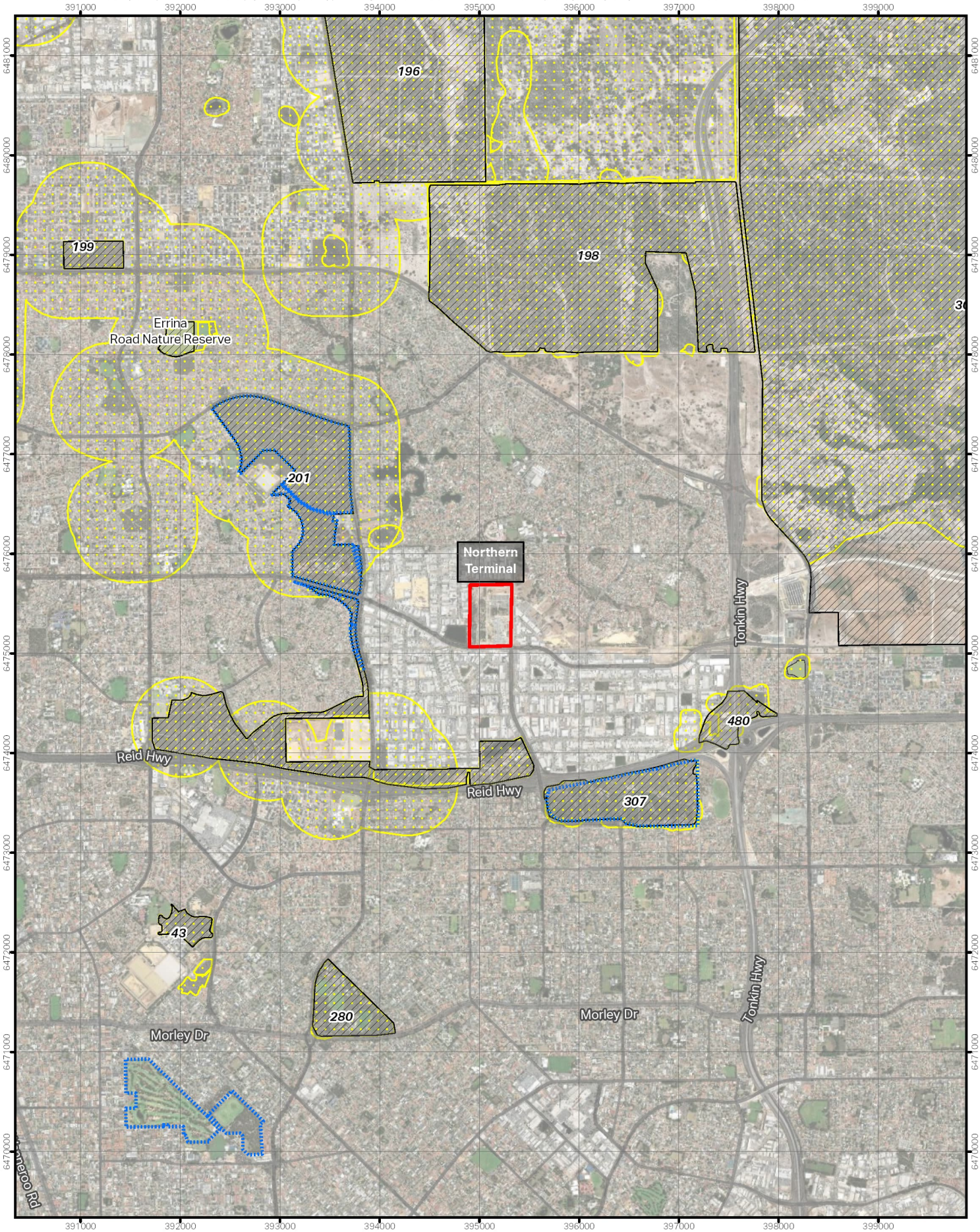
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Figure 6.4

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LEGEND

- Survey Area
- DBCA - Legislated Lands and Waters (DBCA-011)
- Nature Reserve
- Clearing Regulations - Environmentally Sensitive Areas (DWER-046)
- Bush Forever Areas - 2000 (DPLH-019)
- A Class Reserve

Conservation Reserves, Bush Forever Sites and ESAs

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Figure **6.5**

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3.0 Conservation Codes

3.1 Flora and Fauna

Species at risk of extinction are recognised at a Commonwealth level under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and are categorised as outlined in Table 6.

Table 6 Categories of species listed under Schedule 179 of the EPBC Act

Code	Category
Ex	**Extinct Taxa** A species which at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.
ExW	**Extinct in the Wild Taxa** A specie which is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or 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.
CE	**Critically Endangered Taxa** A specie which 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.
E	**Endangered Taxa** A specie which is not critically endangered, and it is facing a very high risk of extinction in the wild in the immediate or near future, as determined in accordance with the prescribed criteria.
V	**Vulnerable Taxa** A specie which is not critically endangered or endangered and is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.
CD	**Conservation Dependent Taxa** A specie which at a particular time if, at that time: 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 the following subparagraphs are satisfied: • the species is a species of fish, • 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 the plan of management is in force under a law of the Commonwealth or of a State or Territory cessation of the plan of management would adversely affect the conservation status of the species.
Mi	**Migratory Taxa** The EPBC Act also requires the compilation of a list of migratory species that are recognised under international treaties including the: • Japan Australia Migratory Bird Agreement 1981 (JAMBA) • China Australia Migratory Bird Agreement 1998 (CAMBA) • Republic of Korea-Australia Migratory Bird Agreement 2007 (ROKAMBA) • Bonn Convention 1979 (The Convention on the Conservation of Migratory Species of Wild Animals). All migratory bird species listed in the annexes to these bilateral agreements are protected in Australia as a MNES under the EPBC Act.
Ma	**Marine Taxa** A specie established under s248 of the EPBC Act.

Flora and fauna species that are considered Threatened and need to be specially protected because they are under identifiable threat of extinction are listed under the *Biodiversity Conservation Act 2016* (BC Act). These categories are defined in Table 7.

Table 7 Conservation codes for WA flora and fauna listed under the BC Act (DBCA, 2019)

Code	Category
CR	**Critically Endangered Taxa** Threatened species considered to be facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines. Listed as critically endangered under section 19(1)(a) of the BC Act in accordance with the criteria set out in section 20 and the ministerial guidelines.
EN	**Endangered Taxa** Threatened species considered to be facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines. Listed as endangered under section 19(1)(b) of the BC Act in accordance with the criteria set out in section 20 and the ministerial guidelines.
VU	**Vulnerable Taxa** Threatened species considered to be facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with criteria set out in the ministerial guidelines. Listed as vulnerable under section 19(1)(c) of the BC Act in accordance with the criteria set out in section 20 and the ministerial guidelines.
EX	**Extinct Taxa** Species which have been adequately searched for and there is no reasonable doubt that the last individual has died, and listing is otherwise in accordance with the ministerial guidelines (section 24 of the BC Act).
MI	**Migratory Taxa** Fauna that periodically or occasionally visit Australia or an external Territory or the exclusive economic zone; or the species is subject of an international agreement that relates to the protection of migratory species and that binds the Commonwealth; and listing is otherwise in accordance with the ministerial guidelines (section 15 of the BC Act). Includes birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and fauna subject to the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), an environmental treaty under the United Nations Environment Program. Migratory species listed under the BC Act are a subset of the migratory animals, that are known to visit Western Australia, protected under the international agreements or treaties, excluding species that are listed as Threatened species.
CD	**Species of special conservation interest (conservation dependent fauna)** Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened, and listing is otherwise in accordance with the ministerial guidelines (section 14 of the BC Act).
OS	**Other specially protected species** Fauna otherwise in need of special protection to ensure their conservation, and listing is otherwise in accordance with the ministerial guidelines (section 18 of the BC Act).

Species that have not yet been adequately surveyed to warrant being listed under the BC Act, or are otherwise data deficient, are added to a Priority List as Priority 1, 2 or 3 by the state minister for Environment. Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are listed as Priority 4. Categories and definitions of Priority Flora and Fauna species are provided in Table 8.

Table 8 Conservation codes for WA flora and fauna as listed By DBCA and endorsed by the Minister for the Environment

Code	Category
P1	**Priority One – Poorly Known Species** Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.
P2	**Priority Two – Poorly Known Species** Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.
P3	**Priority Three – Poorly Known Species** Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.
P4	**Priority Four – Rare, Near Threatened and other species in need of monitoring** Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands. Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for vulnerable but are not listed as Conservation Dependent. Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

3.2 Vegetation Communities

Threatened Ecological Communities (TECs) are naturally occurring biological assemblages that occur in a particular type of habitat and that may be subject to processes that threaten to destroy or significantly modify the assemblage across its range. TECs are listed by both State and Commonwealth legislation.

Communities can be classified as Threatened Ecological Communities (TECs) under the EPBC Act. Categories of EPBC Act listed TECs are described in Table 9.

Table 9 Categories of TECs that are listed under the EPBC Act

Code	Category
CE	**Critically Endangered** If, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future.
E	**Endangered** If, at that time, it is not critically endangered and is facing a very high risk of extinction in the wild in the near future.
V	**Vulnerable** If, at that time, it is not critically endangered or endangered, and is facing a high risk of extinction in the wild in the medium-term future.

Vegetation communities in Western Australia are described as TECs if they have been endorsed by the Western Australian Minister for Environment following recommendations made by the Threatened Species Scientific Committee. TECs are listed under the BC Act in one of four categories defined in Table 10.

The Department of Biodiversity, Conservation and Attractions (DBCA) maintains a database of state listed TECs which is available for online searches via their website. Possible TECs that do not meet survey criteria or are not adequately defined are listed as Priority Ecological Communities (PECs) under Priorities 1, 2 and 3. Ecological communities that are adequately known and are rare but not threatened, or meet criteria for Near Threatened, or that have been recently removed from the threatened list, are placed in Priority 4. Conservation dependent communities are classified as Priority 5. PECs are endorsed by the Minister for Environment and are described in Table 11.

DBCA requires that all Priority and Threatened ecological communities are considered during environmental impact assessments and clearing permit applications.

Table 10 Conservation codes for State listed Ecological Communities

Code	Category
PD	*Presumed Totally Destroyed*
CR	*Critically Endangered*
EN	*Endangered*
VU	*Vulnerable*

Table 11 Categories for Priority Ecological Communities

Code	Category
P1	**Priority One**: poorly known ecological communities
P2	**Priority Two**: poorly known ecological communities
P3	**Priority Three**: poorly known ecological communities
P4	**Priority Four**: ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list.

3.3 Biosecurity and Agriculture Management Act 2007 (BAM Act)

Biosecurity is the management of the risk of animal and plant pests and diseases entering, emerging, establishing or spreading in WA to protect the economy, environment, and community. Biosecurity is managed under the BAM Act which came into effect 1 May 2013. Exotic animals and plants can become an invasive species if they can establish in new areas where local conditions are favourable for their growth. Each organism listed under the BAM Act comes with certain legal / import requirements:

- Declared Pest (DP), Prohibited - s12. Prohibited organisms are declared pests by virtue of section 22(1) and may only be imported and kept subject to permits.
- Permitted - s11. Permitted organisms may be subject to an import permit if they are potential carriers of high-risk organisms.
- Declared Pest - s22(2). Declared pests may be subject to an import permit if they are potential carriers of high-risk organisms and may also be subject to control and keeping requirements once within Western Australia.
- Permitted, Requires Permit - r73. Regulation 73 permitted organisms may only be imported subject to an import permit.

- Declared pests can be assigned to a C1, C2 or C3 control category under the Biosecurity and Agriculture Management Regulations 2013:
  - C1 Exclusion - Organisms which should be excluded from part or all of Western Australia
  - C2 Eradication - Organisms which should be eradicated from part or all of Western Australia
  - C3 Management - Organisms that should have some form of management applied that will alleviate the harmful impact of the organism, reduce the numbers or distribution of the organism, or prevent or contain the spread of the organism.
- Unassigned - Declared pests that are recognised as having a harmful impact under certain circumstances, where their subsequent control requirements are determined by a Plan or other legislative arrangements under the BAM Act.

4.0 Methodology

4.1 Desktop Assessment

A comprehensive desktop assessment was undertaken prior to the field survey to identify significant environmental values likely to be present in the survey area including flora, fauna and vegetation communities. Desktop database searches were requested from the following government databases (including a 10 km radius):

- DBCA Threatened Species and Communities database including Threatened and Priority flora, communities, and Threatened and Priority fauna.
- Western Australian Herbarium (WAH, 1998) records
- EPBC Act Protected Matters Search Tool (PMST)
- BirdLife Australia Black Cockatoo data.

Additional sources utilised included the following reports:

- AECOM, 2016. Ellenbrook Bus Rapid Transit Biological Assessment. Unpublished report prepared for Public Transport Authority of Western Australia.
- AECOM, 2022a. Scar 4 – Flora, Vegetation and Black Cockatoo Assessment. Unpublished report prepared for Western Power.
- AECOM, 2022b. North Region Energy Program - Flora, Vegetation and Fauna Assessment. Unpublished report prepared for Western Power.
- RPS, 2020. Detailed flora and vegetation assessment – METRONET Morley-Ellenbrook Line. Unpublished report prepared for Public Transport Authority of Western Australia.

Significant flora and fauna species likelihood of occurrence was assessed systematically using a point-based system which takes into account proximity (defined as less than 5 km) and date of known records (defined as less than 20 years old), presence within the Local Government Area (LGA) and habitat suitability (Table 12 and Table 13).

Due to the overlapping nature of some survey areas, a centre point was taken to calculate the distance from the Neerabup Terminal and NBT Group and the nearest DBCA records.

The likelihood of significant ecological communities occurring depends on the presence of suitable landforms, land systems, known occurrences and distance of known occurrences.

Table 12 Categories of likelihood of occurrence for flora species

Likelihood of Occurrence	Score	Definition
Known	6	Species is known to occur in the survey area.
High (Likely)	5	Not known to occur in the survey area however there are records nearby and suitable habitat for the species is known or likely to be present within the survey area.
Moderate (Possible)	4 (if suitable habitat is known to be, or likely to be present) 3 (if suitable habitat may be present within the survey area)	Species is not known to occur within the survey area however there are nearby records AND/OR recent records OR records within the LGA AND suitable habitat for the species is known or likely to be present within the survey area. OR Not known to occur within the survey area but there are records nearby AND recent records AND records within the LGA, and suitable habitat for the species may be present (marginal habitat).

Likelihood of Occurrence	Score	Definition
Low (Unlikely)	2,3	Species is not known to occur within the survey area but there are records nearby OR recent records OR within the LGA AND suitable habitat for the species may be present (marginal habitat).
Negligible (Suitable Habitat not Present)	1,2,3	Despite records nearby OR being present within the LGA OR recent records, no suitable habitat is present within the survey area and therefore the likelihood of the species occurring is negligible.

Table 13 Categories of likelihood of occurrence for fauna species

Likelihood of Occurrence	Score	Definition
Known	5	Species is known to occur in the survey area
High (Likely)	3,4	Not known to occur in the survey area but there are records within close proximity of the survey area and suitable habitat for the species is known to be, or likely to be, present within the survey area OR not known to occur within the survey area but there are recent records in close proximity of the survey area and suitable habitat for the species is known to be, or likely to be present within the survey area OR not known to occur within the survey area but there are recent records and suitable habitat for the species may be present.
Moderate (Possible)	2,3	Not known to occur within the survey area but there are recent records in close proximity/within the LGA and suitable habitat for the species may be present (marginal habitat) OR suitable habitat present.
Low (Unlikely)	1,2	Records present within the LGA, and marginal suitable habitat is present within the survey area, therefore the likelihood of the species occurring there is low OR marginal habitat present OR recent record within LGA
Negligible (Suitable Habitat not Present)	0,1	No nearby records or suitable habitat OR recent record with no suitable habitat within the survey area OR records nearby with no suitable habitat within the survey area

4.2 Flora and Vegetation Survey

A detailed flora and vegetation assessment was undertaken utilising methods outlined in the *Flora Survey Technical Guide* (EPA, 2016). The field surveys were undertaken by Cassandra House (collection permit FB62000118-2) assisted by Environmental Scientist Nina Sergeev (collection permit FB62000544) and Graduate Environmental Scientists Deborah Robinson and Beau Eaton. Cassandra has over 8 years' experience undertaking flora and vegetation assessments. Cassandra completed a Bachelor of Science in Conservation Biology and Environmental Science and a Master of Science in Conservation Biology.

The survey was undertaken across multiple days in October (16/10-20/10) and November (6/11-17/11) in 2023. Floristic data was collected from 16 quadrats, 21 Relevés, and multiple observation points as well as mapping notes. Data collected included the presence of plant species, their cover abundance, structural composition of vegetation, physical environment, and presence/absence of disturbance.

Each site was given a unique site number, and the following parameters recorded:

- date
- location using hand-held GPS (accuracy of 5 m)
- sample site type and size
- photograph (north-west corner)
- soil details (type, colour, moisture)

- landform
- vegetation condition
- fire history
- species list including:
  - estimated height
  - estimated percentage cover (for trees both percentage within relevé and within community was recorded to enable better description of vegetation community).

Any species unable to be identified in the field were collected for identification in AECOM's in-house herbarium and the specimens and taxonomic references and keys at the Western Australian Herbarium (WAH). Naming of species followed the convention of the WAH (1998).

4.2.1 Vegetation Mapping

Vegetation communities were described and mapped based on changes in dominant species composition and landform. Vegetation community descriptions were based on the Association Level V in accordance with the National Vegetation Information System (NVIS) Framework (DotEE, 2017a). Delineation of vegetation communities was supported by analysing floristic data collected within quadrats.

Vegetation condition was determined using the Keighery (1994) vegetation condition scale as recommended in the *Flora Survey Technical Guide* (EPA, 2016).

The Keighery (2012) SCP dataset was used for the Floristic Community Type (FCT) analysis. The survey data was reconciled with this dataset and analysis was undertaken using Primer-e.

The Bray Curtis dissimilarity measure was used to quantify the compositional similarity between the quadrats based on presence absence data. This method is easily interpretable and provides meaningful results. A sense check was completed incorporating appropriate geology, soils, landscape and the description provided in the Gibson *et al*. (1994) reference material and Bush Forever (Government of WA, 2000).

FCT analysis was undertaken using methods recommended by DBCA. That is, one quadrat was incorporated into the dataset at a time, and a resemblance matrix was produced. For a dataset of this size, finding the SCP quadrats it most closely resembles seems a reasonable method of inferring FCTs. Some issues that are constantly encountered with inferring FCTs include:

- Survey effort is not comparable between a single visit for Projects and multi-seasonal and ongoing survey effort.
- Nomenclature of the 2012 Keighery and 1994 Gibson dataset have been superseded. It is often times not possible to accurately align species with their former phrase names. Some have split into multiple species; others have been grouped together. This includes complexes such as *Thysanotus patersonii/manglesianus, Hibbertia hypericoides, Hemiandra incana,* to name a few.
- The validity of original clustering and grouping method is dubious. Often a quadrat will resemble a variety of FCTs within a supergroup.
- FCTs are mapped at a larger scale compared to project datasets.
- New FCTs are not considered, one is therefore forced to select the nearest neighbour / closest resemblance which may or may not be accurate.

Furthermore, in some instances it is not accurate to extrapolate the inferred FCT from the point data across an entire community. This again represents a scale issue.

4.2.2 Banksia Woodlands TEC Mapping

The survey area lies within the known range of the Banksia Woodlands of the Swan Coastal Plain Threatened Ecological Community (Banksia Woodlands TEC). Patches that included a dominant or co-dominant overstorey of *B. attenuata, B. menziesii B. prionotes* or *B. ilicifolia* were considered for further assessment. Patches that were clearly not associated with Banksia Woodlands, e.g. had no Banksia overstorey species, were excluded.

For each patch the key diagnostic characteristics, condition, size and relevant contextual information was considered as published in the Conservation Advice (DEE, 2016). The condition of the patch was informed by species richness of quadrat data compared to available datasets, most notably the Keighery et al. (2012) Swan Coastal Plain (SCP) dataset and weed cover. The condition of the patch and size thresholds are then used to determine whether the quality of the patch is suitable to meet the federally protected ecological community standards.

4.2.3 Tuart Woodlands TEC Mapping

The Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain TEC was assessed using the Approved Conservation Advice (DEE, 2019). All mature Tuart trees with a Diameter at Breast Height (DBH) of 15 cm or more were captured with a hand-held GPS unit. A 5 m canopy buffer was applied, followed by the 30 m buffer that depicts the edge of a discreet patch. Each patch was represented by at least one relevé or quadrat to inform the condition assessment.

Each patch was assessed against the key diagnostic characteristics:

- Occurs on the Swan Coastal Plain Bioregion, Western Australia.
- Primarily occurs on the Spearwood and Quindalup dune systems but can on Bassendean dunes and Pinjarra Plain. Can occur on banks of rivers and wetlands.
- Presence of at least two living established *E. gomphocephala* trees in uppermost canopy layer, although they may co-occur with trees of other species. There is a gap of no more than 60 m between the outer edges of the canopies of adjacent Tuart trees (single-stemmed or mallee growth form).
- Occurs as woodland or forest, open forest, woodland, open woodland and various mallee forms.
- Other canopy or sub-canopy species may be present including *Agonis flexuosa, Banksia grandis, Banksia attenuata, Eucalyptus marginata, Corymbia calophylla, Banksia menziesii* and *Banksia prionotes*.

The condition and size thresholds pertain to patches smaller than 5 ha, outlined in Table 14.

Table 14 Condition categories and thresholds for the Tuart Woodland TEC

Patch Size	≥2 ha <5 ha	≥0.5 ha <2 ha
Biotic Thresholds		
Very high condition ≥80 % of all understorey^ vegetation cover is native# Or At least 12 native understorey^ species per 0.01 ha (10x10 m)	Medium sized patches with very high condition understorey. Considered TEC	Smaller patches with very high condition understorey. Considered TEC
High condition ≥60 % of all understorey^ vegetation cover is native# Or At least 8 native understorey^ species per 0.01 ha (10x10 m)	Medium sized patches with high condition understorey. Considered TEC	Smaller patches with high condition understorey. AND That either: have an important landscape role (≤100 m to native vegetation)* OR have a habitat role (≥2 very large trees per 0.5 ha)* OR show regeneration (≥15 seedlings and/or saplings per 0.5 ha)* Considered TEC
Moderate condition ≥50 % of all understorey^ vegetation cover is native# Or	Smaller patches with high condition understorey.	Not the TEC but may be a focus for local protection or restoration

Patch Size	≥2 ha <5 ha	≥0.5 ha <2 ha
Biotic Thresholds		
At least 4 native understorey^ species per 0.01 ha (10x10 m)	AND That either: have an important landscape role (≤100 m to native vegetation)* OR have a habitat role (≥2 very large trees per 0.5 ha)* OR show regeneration (≥15 seedlings and/or saplings per 0.5 ha)* Considered TEC	
Poor Has minimal or no native cover and species richness. That is: <50 % of all understorey^ vegetation cover is native# And Less than 4 native understorey^ species per 0.01 ha (10x10 m)	Not the TEC but may be a focus for local protection or restoration	Not the TEC but may be a focus for local protection or restoration

4.2.4 Targeted Flora Searches

Targeted searches were undertaken for conservation significant flora species that were known or likely to occur. A detailed field guide was produced which included photographs and describing morphological features that would assist in identifying the species in the survey area.

Where a potential Priority species was encountered, the following was recorded:

- location (using a hand-held GPS accuracy 5m)
- the number of individuals in the immediate population, or an estimate of the size (number) of the population with an estimated radius of its spatial extent plant height
- vegetation condition
- associated dominant species
- soil type and colour
- topography
- additional information relevant to the area including key characteristics and landforms.

4.3 Fauna Survey

A basic fauna survey was conducted in accordance with *Technical Guidance – Terrestrial Fauna Surveys* (EPA, 2020). The fauna survey was conducted in conjunction with the detailed flora and vegetation survey in October and November 2023. Conducting the two surveys concurrently enabled consistent and clear mapping of the fauna habitats and vegetation communities.

Fauna habitats were assessed for specific habitat components, including consideration of structural diversity and refuge opportunities for fauna, to determine the potential for these habitats to support conservation significant species. Eighteen detailed habitat assessments were completed throughout the survey area. The fauna habitat assessments include:

- location
- general habitat description
- habitat condition and disturbance types
- dominant / characteristic flora species and vegetation layers

- presence and abundance of key habitat features such as large mature trees, small and large hollows, fallen logs, course and fine litter, decorticating bark, bare ground, grass, stones and boulders, rock crevices, soil cracks, vines, dense shrubs, water bodies etc.
- presence of fauna and secondary signs (e.g. scats, diggings, tracks, burrows, eggshells, bones, feathers, etc.)
- connectivity of habitat.

The fauna survey primarily focused on mapping of fauna habitat and searching for the evidence of presence of conservation significant fauna. Other data recorded included observations (direct and indirect) of fauna species present. This can include distinctive calls, scats, tracks and diggings. All observations were made between daylight hours of 0700 and 1700. Attention was given to searching for conservation significant species identified in the desktop assessment as having the potential to occur in the area. Nomenclature adheres to the Checklist of Terrestrial Vertebrates of Western Australia (WAM, 2023).

4.4 Targeted Black Cockatoo Survey

The survey targeted all three Threatened Western Australian black cockatoo species which are Carnaby's Cockatoo, Baudin's Cockatoo, and the Forest-Red-tailed Black Cockatoo. Breeding, foraging and roosting assessments were completed in the survey areas. Methodologies for these assessments have been developed based on the current EPBC Act Referral Guidelines for Three Threatened Black Cockatoo Species (DAWE, 2022).

4.4.1 Breeding Habitat

Breeding habitat was assessed by quantifying the number of trees that have the potential to form hollows (based on their diameter at breast height [DBH]), and those with potentially suitable hollows). Any hollow forming native eucalypts with a DBH > 500 mm was assessed, their location, species, and hollow presence were recorded.

Potential breeding trees are categorised as follows:

- Known nesting trees: Trees (live or dead but still standing) which contains a hollow where black cockatoo breeding has been recorded or which demonstrates evidence of breeding (i.e. showing evidence of use through scratches, chew marks or feathers).
- Suitable nesting trees: Trees with suitable nesting hollows present, although no evidence of use. Note that any species of tree may develop suitable hollows for breeding.
- Suitable nest hollow: Any hollow with dimensions suitable for use for nesting by black cockatoos. Characteristics of hollows used by each species is available in the SPRAT database. Suitable nest hollows are only found in live trees with a DBH of at least 500 mm. Usually this will be a natural hollow, but artificial hollows may also be suitable in some circumstances (for example, where the artificial hollow has been specifically designed for use by black cockatoos).
- Potential nesting trees: Trees that have a suitable DBH to develop a nest hollow, but do not currently have hollows. Trees suitable to develop a nest hollow in the future are 300-500 mm DBH. Note: that many species of eucalypt may develop suitable hollows for breeding.

Hollows are considered potentially suitable when the entrance hole is above a size of 10 cm in diameter and the hollow appears to continue inwards to reach a hollow with a base size greater than 30 cm. Tree hollow presence and suitability is assessed from ground level with the use of binoculars. Suitability and utilisation by black cockatoos cannot always be assessed adequately at ground level, and hence the Precautionary Principle is used where appropriate.

4.4.2 Roosting Habitat

An assessment of roosting habitat was conducted during the field surveys. This includes consideration of preferred roosting habitat and features such as water sources, tall trees, specific tree species as defined in the Referral Guidelines.

4.4.3 Foraging Habitat Potential

Two foraging habitat scoring methods were applied including the DAWE (2022) scoring tool and the more detailed BCE (2020) scoring tool. Both tools consider native vegetation, proximity of known breeding, roosting and foraging habitat, and field observations such as foraging evidence.

The DAWE (2022) Referral Guideline scoring tool defines one foraging score for an entire survey area. All areas of vegetation that support suitable foraging species (defined in Table 15), are automatically assigned a score of 10. Following this, several detractors are considered to inform the final score. Survey areas that do not support any of these, are considered to have no foraging value. Plant disease was assessed during the vegetation and flora assessment. All notable signs of disease were recorded, and the impact of the disease was assessed. If the disease impacts over 50% of the preferred food or plant species, deductions were taken from the foraging score.

Table 15 Black Cockatoo foraging quality tool from the Federal guidelines (DAWE, 2022)

Starting score		**Baudin's Cockatoo (*Zanda baudinii*)**		**Carnaby's Cockatoo (*Zanda latirostris*)**		**Forest Red-Tailed Black Cockatoo *(Calyptorhynchus banksii naso)***	
		Start at a score of 10 if your site is native eucalypt woodlands and forest, and proteaceous woodland and heath, particularly Marri, within the range of the species, including along roadsides and parkland cleared areas. Can include planted vegetation**. This tool only applies to sites equal to or larger than 1 hectare in size.**		**Start at a score of 10** if your site is native shrubland, kwongan heathland or woodland, dominated by proteaceous plant species such as *Banksia* spp. (including *Dryandra* spp.), *Hakea* spp. and *Grevillea* spp., as well as native eucalypt woodland and forest that contains foraging species, within the range of the species, including along roadsides and parkland cleared areas. Also includes planted native vegetation. **This tool only applies to sites equal to or larger than 1 hectare in size.**		**Start at a score of 10** if your site is Jarrah or Marri woodland and/or forest, or if it is on the edge of Karri Forest, or if Wandoo and Blackbutt occur on the site, within the range of the subspecies, including along roadsides and parkland cleared areas. **This tool only applies to sites equal to or larger than 1 hectare in size.**	
Attribute	Sub-tractions	Context adjustor (attributes reducing functionality of foraging habitat).					
Foraging potential	**-2**	**Subtract 2** from your score if there is no evidence of feeding debris on your site.	☒	**Subtract 2** from your score if there is no evidence of feeding debris on your site.	☐	**Subtract 2** from your score if there is no evidence of feeding debris on your site.	☐
Connectivity	**-2**	**Subtract 2** from your score if you have evidence to conclude that there is no other foraging habitat within 12 km of your site.	☐	**Subtract 2** from your score if you have evidence to conclude that there is no other foraging habitat within 12 km of your site.	☐	**Subtract 2** from your score if you have evidence to conclude that there is no other foraging habitat within 12 km of your site.	☐
Proximity to breeding	**-2**	**Subtract 2** if you have evidence to conclude that your site is more than 12 km from breeding habitat.	☐	**Subtract 2** if you have evidence to conclude that your site is more than 12 km from breeding habitat.	☐	**Subtract 2** if you have evidence to conclude that your site is more than 12 km from breeding habitat.	☐

Starting score		Baudin's Cockatoo (*Zanda baudinii*)		Carnaby's Cockatoo (*Zanda latirostris*)		Forest Red-Tailed Black Cockatoo (*Calyptorhynchus banksii naso*)	
Proximity to roosting	**-1**	**Subtract 1** if you have evidence to conclude that your site is more than 20 km from a known night roosting habitat.	☐	**Subtract 1** if you have evidence to conclude that your site is more than 20 km from a known night roosting habitat.	☐	**Subtract 1** if you have evidence to conclude that your site is more than 20 km from a known night roosting habitat.	☐
Impact from significant plant disease	**-1**	**Subtract 1** if your site has disease present (e.g. *Phytophthora* spp. or Marri canker) and the disease is affecting more than 50% of the preferred food plants present.	☐	**Subtract 1** if your site has disease present (e.g. *Phytophthora* spp. or Marri canker) and the disease is affecting more than 50% of the preferred food plants present.	☐	**Subtract 1** if your site has disease present (e.g. *Phytophthora* spp. or Marri canker) and the disease is affecting more than 50%of the preferred food plants present.	☐
		8		**10**		**10**	

The Bamford Consulting Ecologists (BCE, 2020) scoring tool considered the prevalence of suitable favoured foraging species, referred to as site condition, and site context and species stocking rate. This enables the differentiation between areas of vegetation that represent high quality foraging habitat based on potential actual use now and in the future.

Site condition is outlined in Table 17 and is the starting point. Any areas that score higher than '2' will then be further assessed for site context and species stocking rate. Site context is a function of site size, availability of nearby habitat and the availability of nearby breeding areas (Table 16). For this assessment, 'local area' is defined as within a 15 km radius of survey area. This is greater than the maximum distance of 12 km known to be flown by Carnaby's Black-Cockatoo when feeding chicks in the nest. For linear corridors this may over-value some areas.

Table 16 Site context weighting

Site Context Score	Percentage of the existing native vegetation within the 'local' area that the study site represents	
	'Local' breeding known/likely	'Local' breeding unlikely
3	>5%	>10%
2	1-5%	5-10%
1	0.1-1%	1-5%
0	<0.1%	<1%

Next, a species stocking rate score is applied. Species stocking rate is described as "the usage and/or density of a species at a particular site" in the offsets guide. Assignation of the species density score (0 or 1) is based on the Black-Cockatoo species being either abundant (score of 1) or not abundant (score of 0).

BCE tool scoring is transposed into one of the following categories:

- 0: None.
- 1: Negligible.
- 2: Low.
- 3: Low to Moderate.
- 4-6: Moderate.
- 7: Moderate to High.
- 8-10: High

Table 17 Site condition described by BCE.

Site Score	Description of Vegetation Values		
	Carnaby's Black Cockatoo	Baudin's Black Cockatoo	Forest Red-tailed Black Cockatoo
0	No foraging value. No Proteaceae, eucalypts or other potential sources of food. Examples: • Water bodies (e.g. salt lakes, dams, rivers); • Bare ground; • Developed sites devoid of vegetation (e.g. infrastructure, roads, gravel pits) or with vegetation of no food value, such as some suburban landscapes. • Mown grass	No foraging value. No eucalypts or other potential sources of food. Examples: • Water bodies (e.g. dams, rivers); • Bare ground; • Developed sites devoid of vegetation (e.g. infrastructure, roads, gravel pits).	No foraging value. No eucalypts or other potential sources of food. Examples: • Water bodies (e.g. dams, rivers); • Bare ground; • Developed sites devoid of vegetation (e.g. infrastructure, roads, gravel pits)
1	Negligible to low foraging value. Examples: • Scattered specimens of known food plants but projected foliage cover of these is < 2%. This could include urban areas with scattered foraging trees; • Paddocks that are lightly vegetated with melons or other known food-source weeds (e.g. Erodium spp.) that represent a short-term and/or seasonal food source; • Blue Gum plantations (foraging by Carnaby's Black-Cockatoos has been reported but appears to be unusual).	Negligible to low foraging value. Scattered specimens of known food plants but projected foliage cover of these < 1%. This could include urban areas with scattered foraging trees.	Negligible to low foraging value. Scattered specimens of known food plants but projected foliage cover of these < 1%. Could include urban areas with scattered foraging trees.
2	Low foraging value. Examples: • Shrubland in which species of foraging value, such as shrubby banksias, have <10% projected foliage cover; • Woodland with tree banksias 2-5% projected foliage cover; • Open eucalypt woodland/mallee of small-fruited species; • Paddocks that are densely vegetated with melons or other known food-source weeds (e.g. Erodium spp.) that represent a short-term and/or seasonal food source.	Low foraging value. Examples: • Woodland with scattered specimens of known food plants (e.g. Marri and Jarrah) 1-5% projected foliage cover; • Urban areas with scattered foraging trees.	Low foraging value. Examples: • Woodland with scattered specimens of known food plants (e.g. Marri, Jarrah or Sheoak) 1-5% projected foliage cover; • Urban areas with scattered food plants such as Cape Lilac, *Eucalyptus caesia* and *E. erythrocorys*.

Site Score	Description of Vegetation Values		
	Carnaby's Black Cockatoo	Baudin's Black Cockatoo	Forest Red-tailed Black Cockatoo
3	Low to Moderate foraging value. Examples: • Shrubland in which species of foraging value, such as shrubby banksias, have 10-20% projected foliage cover; • Woodland with tree banksias 5-20% projected foliage cover; • Eucalypt Woodland/Mallee of small-fruited species; • Eucalypt Woodland with Marri < 10% projected foliage cover	Low to Moderate foraging value. Examples: • Eucalypt Woodland with known food plants (especially Marri) 5-20% projected foliage cover; • Parkland-cleared Eucalypt Woodland/Forest with known food plants 10-40% projected foliage cover (poor long-term viability without management); • Younger areas of (managed) revegetation with known food plants 10-40% projected foliage cover (establishing food sources with good long-term viability).	Low to Moderate foraging value. Examples: • Eucalypt Woodland with known food plants (especially Marri and Jarrah) 5-20% projected foliage cover; • Parkland-cleared Eucalypt Woodland/Forest with known food plants 10-40% projected foliage cover (poor long-term viability without management); • Younger areas of (managed) revegetation with known food plants 10-40% projected foliage cover (establishing food sources with good long-term viability).
4	Moderate foraging value. Examples: • Woodland/low forest with tree banksias (of key species B. attenuata and B. menziesii) 20-40% projected foliage cover; • Kwongan/ Shrubland in which species of foraging value, such as shrubby banksias, have 20-40% projected foliage cover; • Eucalypt Woodland/Forest with Marri 20-40% projected foliage cover.	Moderate foraging value. Examples: • Marri-Jarrah Woodland/Forest with 20-40% projected foliage cover; • Marri-Jarrah Forest with 40-60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths. • Eucalypt Woodland/Forest with diverse, healthy understorey and known food trees (especially Marri) 10-20% projected foliage cover. • Orchards with highly desirable food sources (e.g. apples, pears, some stone fruits).	Moderate foraging value. Examples: • Marri-Jarrah Woodland/Forest with 20-40% projected foliage cover; • Marri-Jarrah Forest with 40-60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths; • Sheoak Forest with 40-60% projected foliage cover.

Site Score	Description of Vegetation Values		
	Carnaby's Black Cockatoo	Baudin's Black Cockatoo	Forest Red-tailed Black Cockatoo
5	Moderate to High foraging value. Examples: • Banksia Low Forest (of key species B. attenuata and B. menziesii) with 40-60% projected foliage cover; • Banksia Low Forest (of key species B. attenuata and B. menziesii) with > 60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths; • Pine plantations with trees more than 10 years old (but see pine note below in moderation section).	Moderate to High foraging value. Examples: • Marri-Jarrah Forest with 40-60% projected foliage cover; • Marri-Jarrah Forest with > 60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths.	Moderate to High foraging value. Examples: • Marri-Jarrah Forest with 40-60% projected foliage cover; • Marri-Jarrah Forest with > 60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths. • Sheoak Forest with > 60% projected foliage cover.
6	High foraging value. Example: Banksia Low Forest (of key species B. attenuata and B. menziesii) with > 60% projected foliage cover and vegetation condition good with low weed invasion and/or low tree deaths (indicating it is robust and unlikely to decline in the medium term).	High foraging value. Example: • Marri-Jarrah Forest with > 60% projected foliage cover and vegetation condition good with low weed invasion and/or low tree deaths (indicating it is robust and unlikely to decline in the medium term).	High foraging value. Example: • Marri-Jarrah Forest with > 60% projected foliage cover and vegetation condition good with low weed invasion and/or low tree deaths (indicating it is robust and unlikely to decline in the medium term).

Vegetation structural class terminology follows Keighery (1994).

4.5 Survey Limitations

Limitations of the survey are discussed in Table 18. No limitations were identified that would influence the outcome of the flora, vegetation and black cockatoo surveys.

Table 18 Limitations considered for the biological assessment.

Limitation	Flora and Vegetation	Fauna and Black Cockatoo
Availability of contextual information on the region	**Nil** Contextual information was derived from publicly available datasets for pre-European vegetation mapping, geology, landforms and climate. DBCA database searches were obtained to inform desktop studies. The Keighery (2012) and Gibson et al (1994) Swan Coastal Plain data was used for FCT analysis. Additional reports for the surrounding area were also used to inform the assessment, including: • AECOM, 2016. Ellenbrook Bus Rapid Transit Biological Assessment. Unpublished report prepared for Public Transport Authority of Western Australia. • AECOM, 2022a. Scar 4 – Flora, Vegetation and Black Cockatoo Assessment. Unpublished report prepared for Western Power. • AECOM, 2022b. North Region Energy Program - Flora, Vegetation and Fauna Assessment. Unpublished report prepared for Western Power. • RPS, 2020. Detailed flora and vegetation assessment – METRONET Morley-Ellenbrook Line. Unpublished report prepared for Public Transport Authority of Western Australia.	**Nil** Conservation significant fauna information was gathered utilising sufficient resources. Resources used to inform surveys included publicly available databases (PMST, Atlas of Living Australia), DBCA Priority and Threatened fauna data and black cockatoo known breeding and roosting locations (DBCA, 2019).
Competency/experience of consultant conducting survey	**Nil** The field surveys were led by ecologist Cassandra House who has more than 8 years' experience conducting surveys of similar scope.	**Nil** The survey was conducted by Zoologist Hannah Spanswick (3+ years' experience) and ecologist Cassandra House (8 years' experience).

Limitation	Flora and Vegetation	Fauna and Black Cockatoo
Proportion of flora/fauna identified, recorded and/or collected (based on sampling, timing and intensity)	**Nil** Floristic data was collected from 16 quadrats, 21 Relevés, and observation points. All species not recorded in quadrats were collected and recorded opportunistically. Some tracklogs were lost during the Program due to technical issues. The areas walked is therefore under-represented on Figure 8.	**Nil** The fauna survey search effort was distributed effectively to provide a representative assessment of fauna habitats across the survey area. The survey areas were traversed on foot covering the accessible locations of the polygon.
Completion (is further work needed)	**Minor** Survey effort focussed on areas of remnant native vegetation in 'Good' or better condition. Several vegetation communities are represented by less than three quadrats. These are largely Completely Degraded or Degraded vegetation including 'Trees', Pine Regrowth, and 'CcMpEr' (each more than 5 hectares). The lack of representation was justified in the absence of native understorey species. Further, some vegetation communities were better able to be represented using unbounded Relevés to accommodate "slivers" and smaller patches. Some patches of significant vegetation (TECs) are represented by one quadrat due to the relatively small size of the area present within the survey area.	**Nil** Fauna habitats were described based on 21 fauna habitat assessments. All areas were accessible or able to be assessed from the edge. All breeding habitat (i.e. trees with DBH >500 mm) was able to be recorded. Eight potentially suitable hollows were assessed from the ground only, with suitability dependent on the ability to see the hollow entrance. Further assessment of these hollows may be required to meet regulatory requirements.
Remoteness and/or access issues	**Nil** The entire survey area was not accessible on foot, several private properties were not accessible and the patch of Banksia woodland near Malaga-Ellenbrook Train station was not accessible. This had no serious implications for the flora survey as the private properties represented degraded vegetation while the patch of Banksia Woodland near the Train has been extensively surveyed as part of ongoing monitoring for the Malaga-Ellenbrook train (2021-2024).	**Moderate** The entire survey area was not accessible on foot. Access to areas of private residential lots and large-scale construction projects limited the access to the entire corridor. This may have limited the ability of the survey to capture black cockatoo breeding tree data within private properties.
Timing, weather, season, cycle	**Nil** The field survey was undertaken during the typical ideal survey season in accordance with EPA (2016) Flora Survey Technical Guide. Numerous orchids and annual species were confidently identified in the field or sampled and confirmed at the WA Herbarium.	**Nil** The survey occurred within the known active periods for all three of WA's Black Cockatoos. The survey timing is within range for basic fauna surveys based on the EPA Guidelines (2020).

Limitation	Flora and Vegetation	Fauna and Black Cockatoo
Disturbances (e.g. fire, flood, accidental human intervention) which affected results of the survey	**Minor** Native vegetation within the Neerabup survey area throughout Gnangara State Forest was burnt following the survey. Post-survey floristic composition will reflect natural succession rather than results presented here. The historical land use of the pine plantation within the Neerabup survey area made it difficult to differentiate vegetation communities. These areas were grouped together as one “vegetation community” although the composition of vegetation varied greatly.	**Nil** No disturbances were observed that would influence the outcome of the survey.

5.0 Desktop Assessment Results

5.1 Threatened and Priority Ecological Communities

Twenty-four significant communities were identified in the desktop assessment. This included 16 listed under the EPBC Act, 13 listed under the BC Act and 11 listed by DBCA. Note that at the State level numerous TECs and PECs can be representative of a single EPBC Act-listed community.

The comprehensive desktop study is presented in Appendix A The communities most pertinent to this Project are:

- Banksia Woodlands of the Swan Coastal Plain (Banksia Woodlands TEC) listed as Endangered under the EPBC Act and Priority 3 by DBCA; and
- Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain (Tuart Woodlands TEC) listed as Critically Endangered under the EPBC Act and Priority 3 by DBCA.

All other significant communities are associated with unique landforms, IBRA regions or hydrology that were not present within the survey area.

5.2 Significant Flora

A systematic review of significant flora records and their preferred habitat has determined the likelihood of Threatened and Priority flora species occurring within each survey area. These results are summarised in Table 19. The Priority 3 *Styphelia filifolia* is known in the Neerabup survey area. No other significant flora are known to occur within any of the survey areas.

Significant flora species which have a ‘high’ likelihood of occurrence are outlined in Table 20. The comprehensive desktop assessment is presented in Appendix B and results displayed in Figure 7.

Table 19 Desktop Assessment Result Summary – Flora

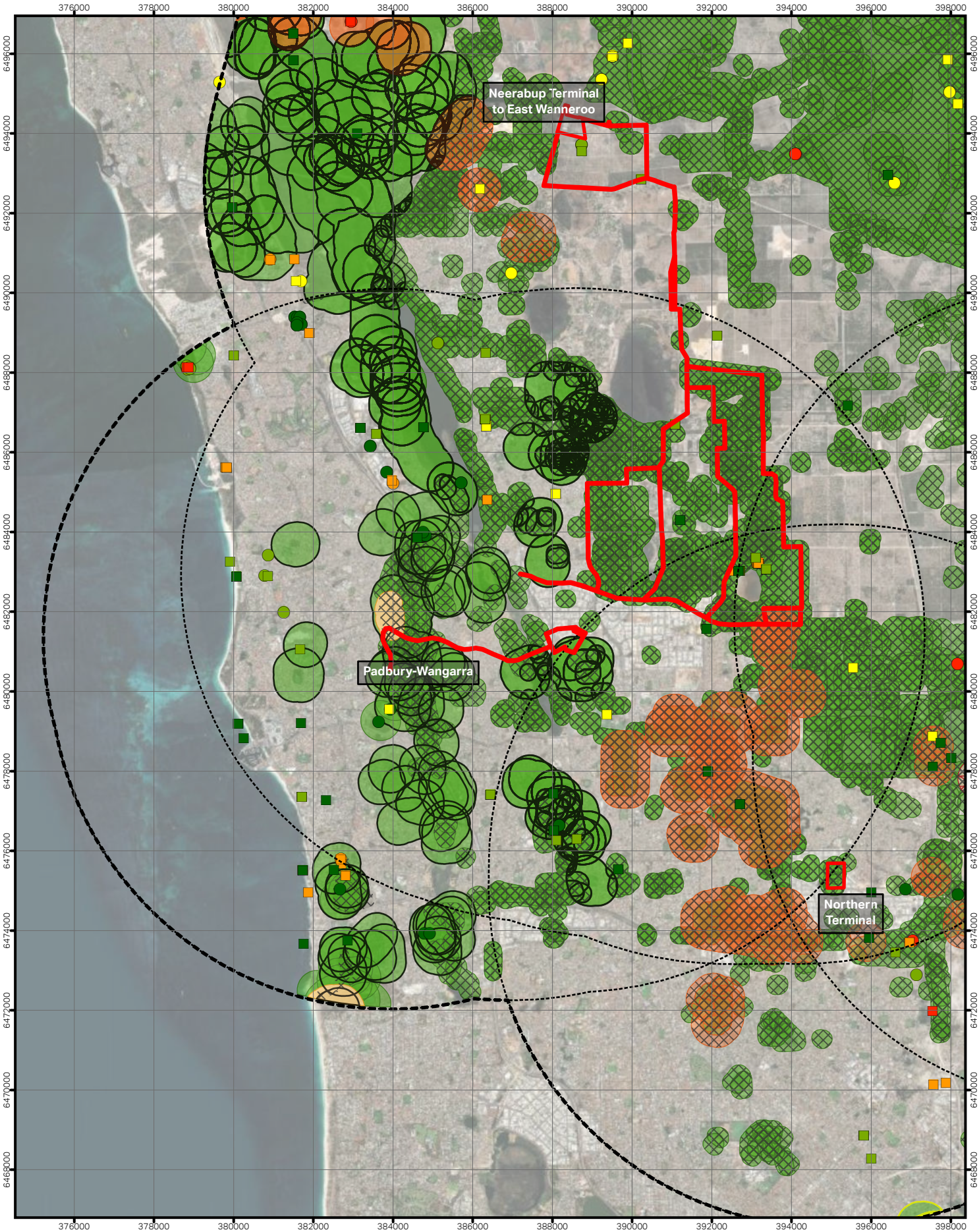
Survey Area	Number of Species Identified					
	Known	High Likelihood	Moderate Likelihood	Low Likelihood	Negligible Likelihood	Total
Neerabup Terminal and East Wanneroo	1	9	19	24	33	86
Padbury-Wangara	0	7	26	27	20	81
Northern Terminal	0	10	24	33	33	100
Pinjar Terminal	0	0	18	13	35	66
NT-NOR to HBK 132kV line	0	3	31	47	23	104

Table 20 Significant flora species that were considered likely to occur within the survey areas pre-survey.

Taxon	Cons. Code[1]		Habitat
	BC Act / DBCA	EPBC Act	
Neerabup Terminal and East Wanneroo			
Anigozanthos humilis subsp. *chrysanthus*	P4		Grey or yellow sand.
Baeckea sp. Limestone (N. Gibson & M.N. Lyons 1425)	P1		Known from North of Perth only within 100km of coast. Found in Banksia woodland on sand over limestone.
Calectasia elegans	P1		Between Pinjar and Bullsbrook on deep, grey, quartz sand in habitats that have experienced infrequent fires. Recorded growing in Banksia menziesii and B. attenuata woodland (Barrett, R and Barret, M, 2015).
Conostylis bracteata	P3		Sand, limestone. Consolidated sand dunes.
Cyathochaeta teretifolia	P3		Brown, grey sand. Sandy clay. Swamps, creek edges. Jarrah forest, SCP.
Dampiera triloba	P3		Loamy sand (WAH, 2024).
Jacksonia sericea	P4		Calcareous and sandy soils.
Poranthera moorokatta	P2		The species is known from two locations: Kings Park and Ellenbrook. In Kings Park it was recorded on white silica sand in open spaces between shrubs, not in shaded areas or in areas of high leaf litter cover (Barret, 2012). In Ellenbrook it was recorded in a shallow dampland on mixed grey-white sand with scattered leaf litter (Barret, 2012).
Stenanthemum sublineare	P2		Littered white sand. Coastal plain.
Styphelia filifolia	P3		Sandy soils of the coastal plain, usually in banksia or Jarrah woodland and low-lying situations (Hislop, M, Puente-Lelievre, C, 2017).
Verticordia lindleyi subsp. *lindleyi*	P4		Sand, sandy clay. Winter-wet depressions.
Padbury - Wangara			
Acacia benthamii	P2		Typically, on limestone breakaways.
Baeckea sp. Limestone (N. Gibson & M.N. Lyons 1425)	P1		Grey sand, yellow sand with limestone outcropping, hills.
Caladenia huegelii	CR	CE	Grey or brown sand, clay loam.

Taxon	Cons. Code[1]		Habitat
	BC Act / DBCA	EPBC Act	
Dampiera triloba	P3		Loamy sand (WA Herbarium, 2023).
Drosera patens	P1		Sandy soils. Margins of winter-wet depressions, swamps and lakes.
Jacksonia sericea	P4		Limestone/ limestone outcrops in heath and sandy soils in coastal areas. Sometimes on fixed dunes and slopes of hills (DCCEEW, 2023).
Styphelia filifolia	P4		Calcareous and sandy soils
Northern Terminal			
Caladenia huegelii	CR	CE	Grey or brown sand, clay loam.
Drosera patens	P3		Seasonally wet drainage lines and margins of permanent water sources, flat ground. Grey sand with clay, poor drainage (WA Herbarium 2023).
Drosera x *sidjamesii*	P1		Sandy soils. Margins of winter-wet depressions, swamps and lakes.
Jacksonia sericea	P1		Peaty sand. Along lake margins, close to winter high-water line.
Netrostylis sp. Chandala (G.J. Keighery 17055)	P4		Calcareous and sandy soils
Poranthera moorokatta	P2		Dampland with thick leaf litter over dark grey sand (WA Herbarium, 2023)
Stachystemon exilis	P2		Very gently inclined plain, white silica sand in open spaces between shrubs, not in shaded areas or in areas of high litter cover (WA Herbarium, 2023)
Stylidium longitubum	P1		On grey sand, seasonally damp (WA Herbarium, 2023)
Verticordia lindleyi subsp. *lindleyi*	P4		Sandy clay, clay, seasonal wetlands
NT-NOR to HBK 132kV			
Anigozanthos humilis subsp. *chrysanthus*	P4		Grey or yellow sand.
Hydrocotyle striata	P1		Open, low-lying Banksia woodland (Hislop, M & Davies, R, 2020).
Stylidium longitubum	P4		Sand, sandy clay. Winter-wet depressions.

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LEGEND

- Survey Area
- 8.5km Buffer Survey Area

WA Herbarium database (WAHERB)

- Threatened
- P1
- P2
- P3
- P4

Threatened and Priority Flora database (TPFL)

- Threatened
- P1
- P2
- P3
- P4

TEC / PEC (State Listed)

- Critically Endangered
- Endangered
- Vulnerable
- Priority 3

TEC / PEC (Federally Listed)

- Critically Endangered
- Endangered
- Vulnerable

Conservation Significant Flora and Communities Desktop Results: Padbury-Wangarra

WESTERN POWER

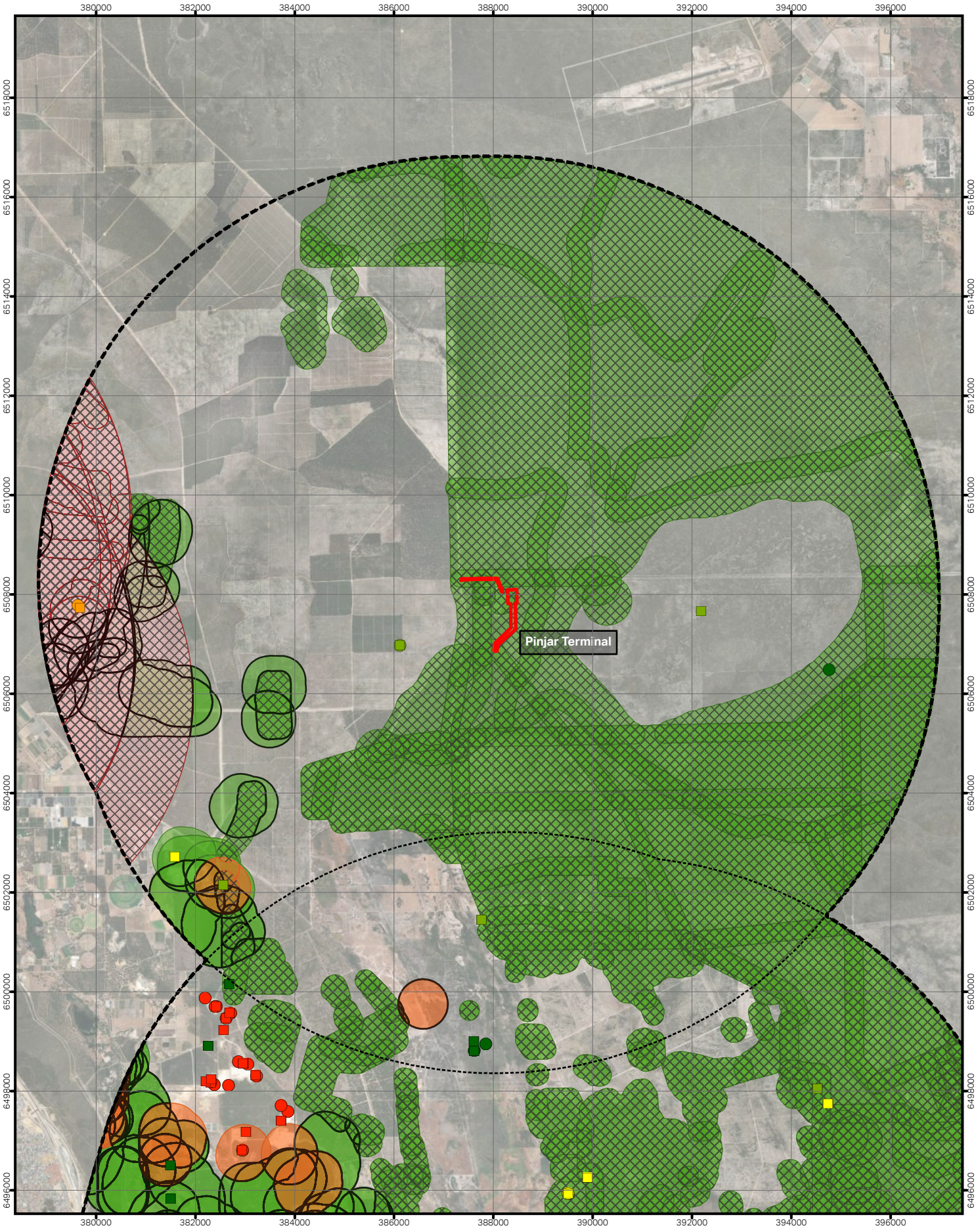
NREP SWAN COASTAL PLAIN FLORA, VEGETATION AND FAUNA ASSESSMENT

Figure 7a.1

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LEGEND

- Survey Area
- 8.5km Buffer Survey Area

WA Herbarium database (WAHERB)

- Threatened
- P1
- P2
- P3
- P4

Threatened and Priority Flora database (TPFL)

- Threatened
- P1
- P2
- P3
- P4

TEC / PEC (State Listed)

- Critically Endangered
- Endangered
- Priority 3

TEC / PEC (Federally Listed)

- Critically Endangered
- Endangered

Conservation Significant Flora and Communities Desktop Results: Pinjar Terminal

WESTERN POWER

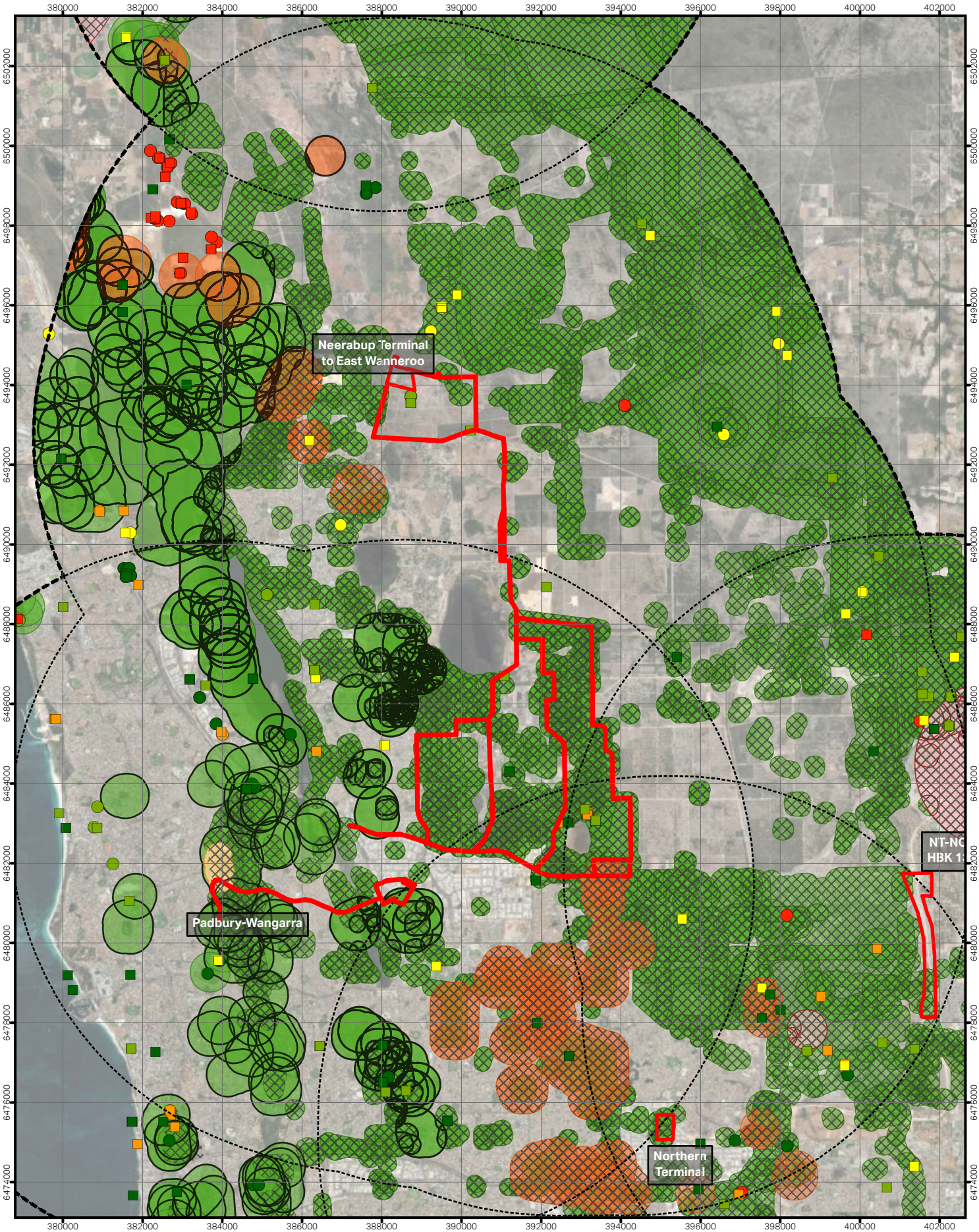
NREP SWAN COASTAL PLAIN FLORA, VEGETATION AND FAUNA ASSESSMENT

Figure 7a.2

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GDA2020 MGA ZONE 50

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Service Layer Credits: World Imagery: Earthstar Geographics,Hybrid Reference Layer: Esri, TomTom, Garmin, FAO, NOAA, USGS

LEGEND

- Survey Area
- 8.5km Buffer Survey Area

WA Herbarium database (WAHERB)
- Threatened
- P1
- P2
- P3
- P4

Threatened and Priority Flora database (TPFL)
- Threatened
- P1
- P2
- P3
- P4

TEC / PEC (State Listed)
- Critically Endangered
- Endangered
- Vulnerable
- Priority 3

TEC / PEC (Federally Listed)
- Critically Endangered
- Endangered

Conservation Significant Flora and Communities Desktop Results: Neerabup Terminal to East Wanneroo

WESTERN POWER

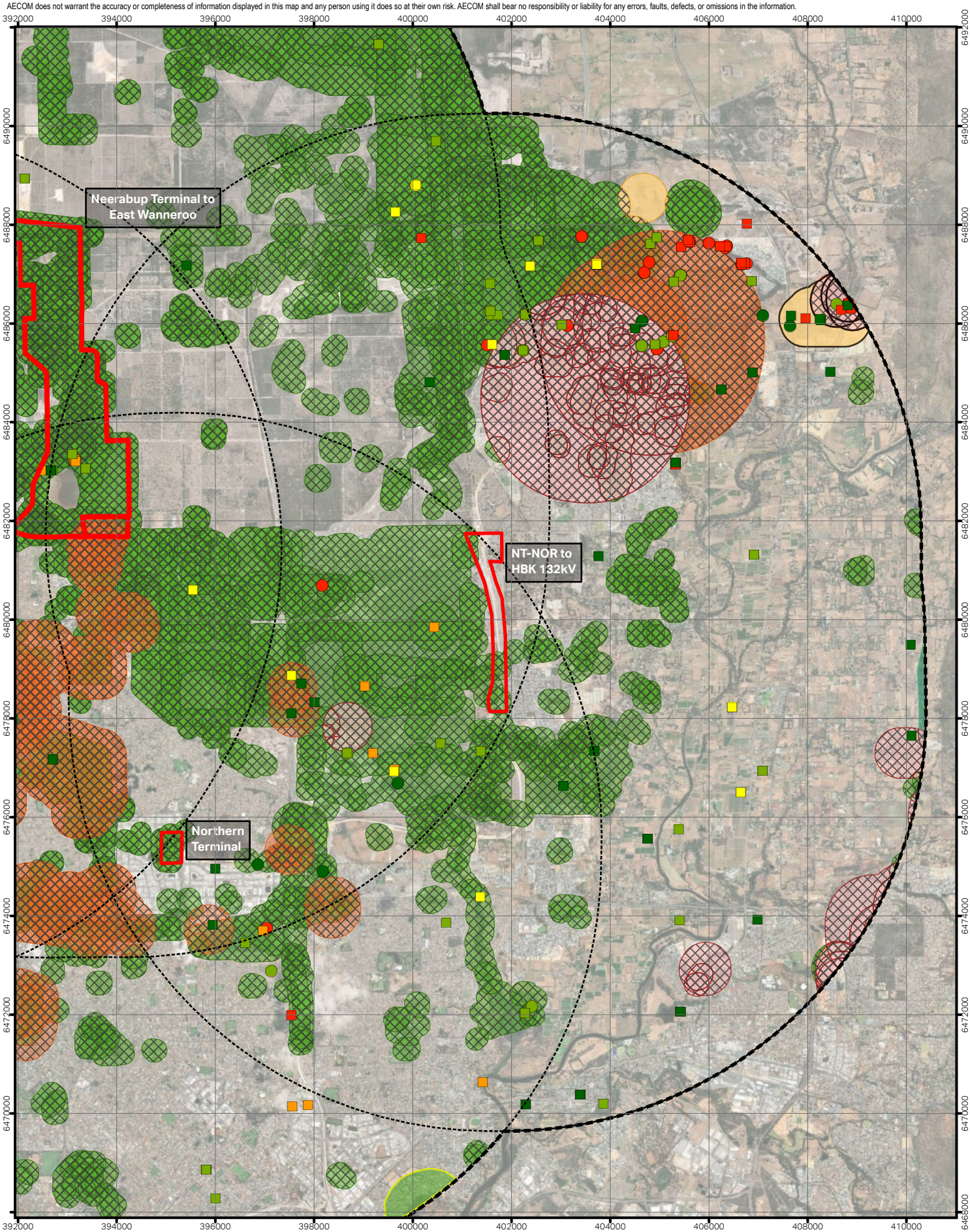
NREP SWAN COASTAL PLAIN FLORA, VEGETATION AND FAUNA ASSESSMENT

Figure 7a.3

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GDA2020 MGA ZONE 50

DATA SOURCES Base Data: (c) Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2010)
Service Layer Credits: World Imagery: Earthstar Geographics,Hybrid Reference Layer: Esri, TomTom, Garmin, FAO, NOAA, USGS

LEGEND

- Survey Area
- 8.5km Buffer Survey Area

WA Herbarium database (WAHERB)

- Threatened
- P1
- P2
- P3
- P4

Threatened and Priority Flora database (TPFL)

- Threatened
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- P3
- P4

TEC / PEC (State Listed)

- Critically Endangered
- Endangered
- Vulnerable
- Priority 3
- Priority 4

TEC / PEC (Federally Listed)

- Critically Endangered
- Endangered
- Vulnerable

Conservation Significant Flora and Communities Desktop Results: NT-NOR to HBK 132kV

WESTERN POWER

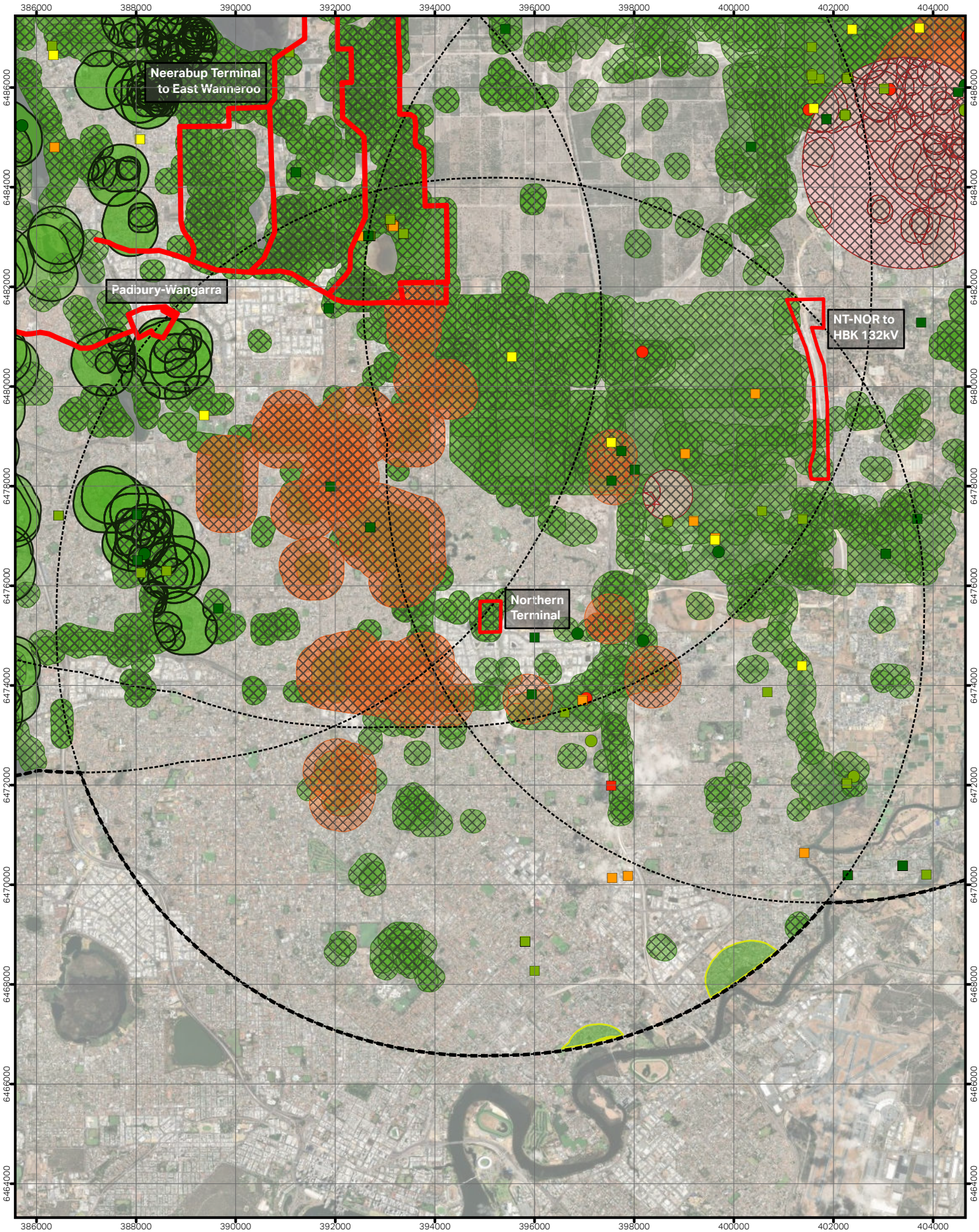
NREP SWAN COASTAL PLAIN FLORA, VEGETATION AND FAUNA ASSESSMENT

Figure 7a.4

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LEGEND

- Survey Area
- 8.5km Buffer Survey Area

WA Herbarium database (WAHERB)

- Threatened
- P1
- P2
- P3
- P4

Threatened and Priority Flora database (TPFL)

- Threatened
- P3
- P4

TEC / PEC (State Listed)

- Critically Endangered
- Endangered
- Priority 3

TEC / PEC (Federally Listed)

- Critically Endangered
- Endangered
- Vulnerable

Conservation Significant Flora and Communities Desktop Results: Northern Terminal

WESTERN POWER

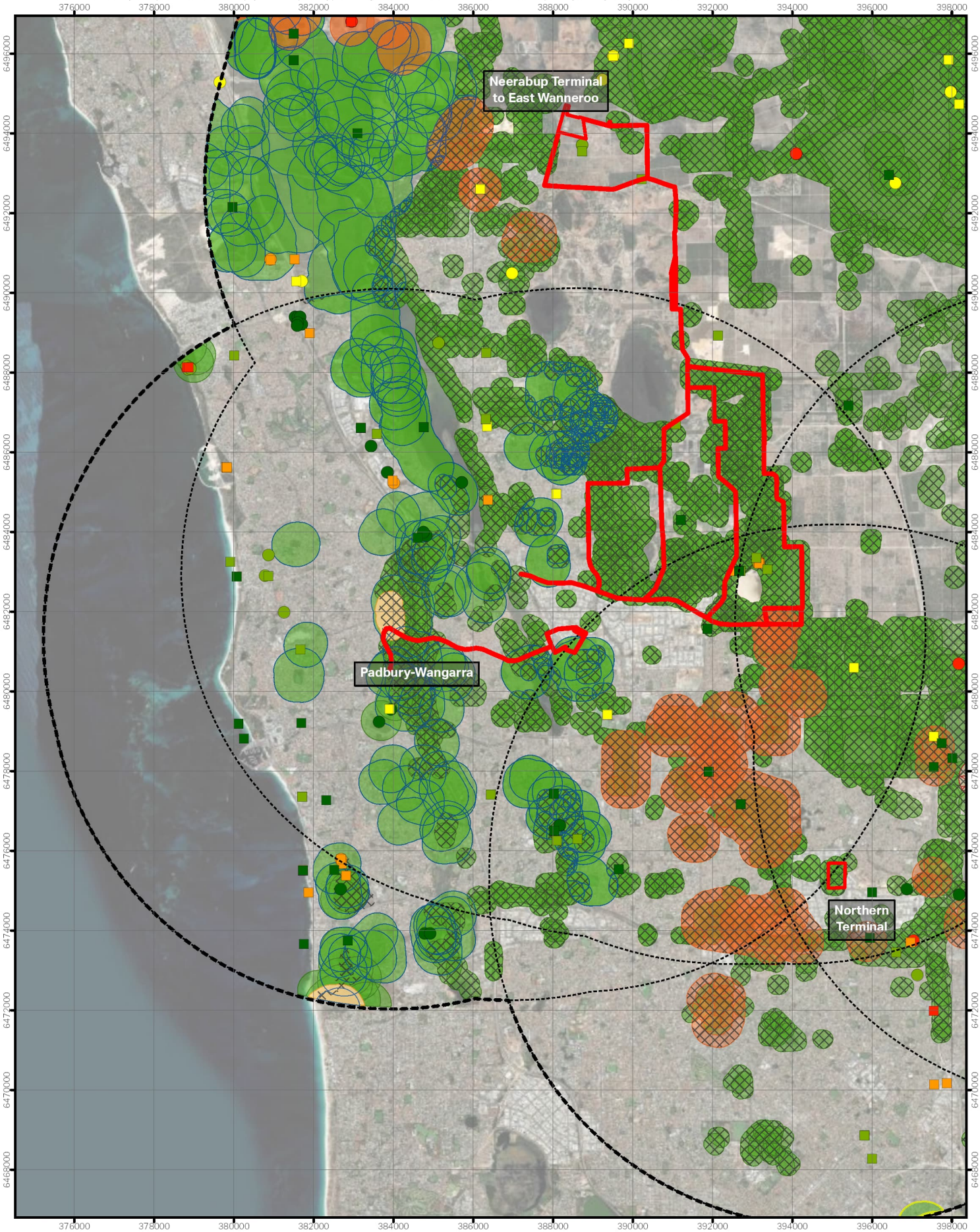
NREP SWAN COASTAL PLAIN FLORA, VEGETATION AND FAUNA ASSESSMENT

Figure 7a.5

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LEGEND

- Survey Area
- 8.5km Buffer Survey Area

WA Herbarium database (WAHERB)
- Threatened
- P1
- P2
- P3
- P4

Threatened and Priority Flora database (TPFL)
- Threatened
- P1
- P2
- P3
- P4

TEC / PEC (State Listed)
- Critically Endangered
- Endangered
- Vulnerable
- Priority 3

TEC / PEC (Federally Listed)
- Critically Endangered
- Endangered
- Vulnerable

Conservation Significant Flora and Communities Desktop Results: Padbury-Wangarra

WESTERN POWER

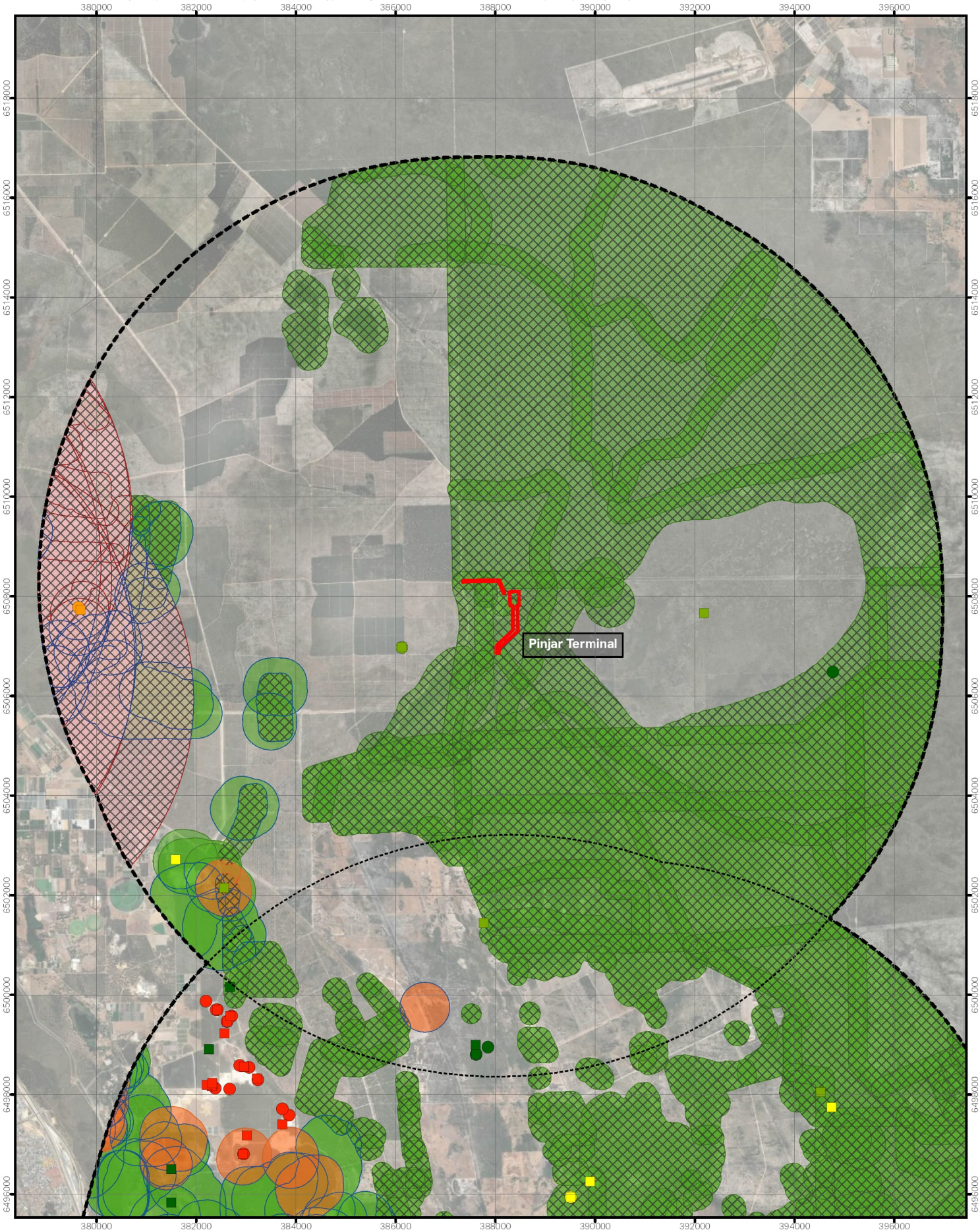
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Figure **7a.1**

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LEGEND

- Survey Area
- 8.5km Buffer Survey Area

WA Herbarium database (WAHERB)

- Threatened
- P1
- P2
- P3
- P4

Threatened and Priority Flora database (TPFL)

- Threatened
- P1
- P2
- P3
- P4

TEC / PEC (State Listed)

- Critically Endangered
- Endangered
- Priority 3

TEC / PEC (Federally Listed)

- Critically Endangered
- Endangered

Conservation Significant Flora and Communities Desktop Results: Pinjar Terminal

WESTERN POWER

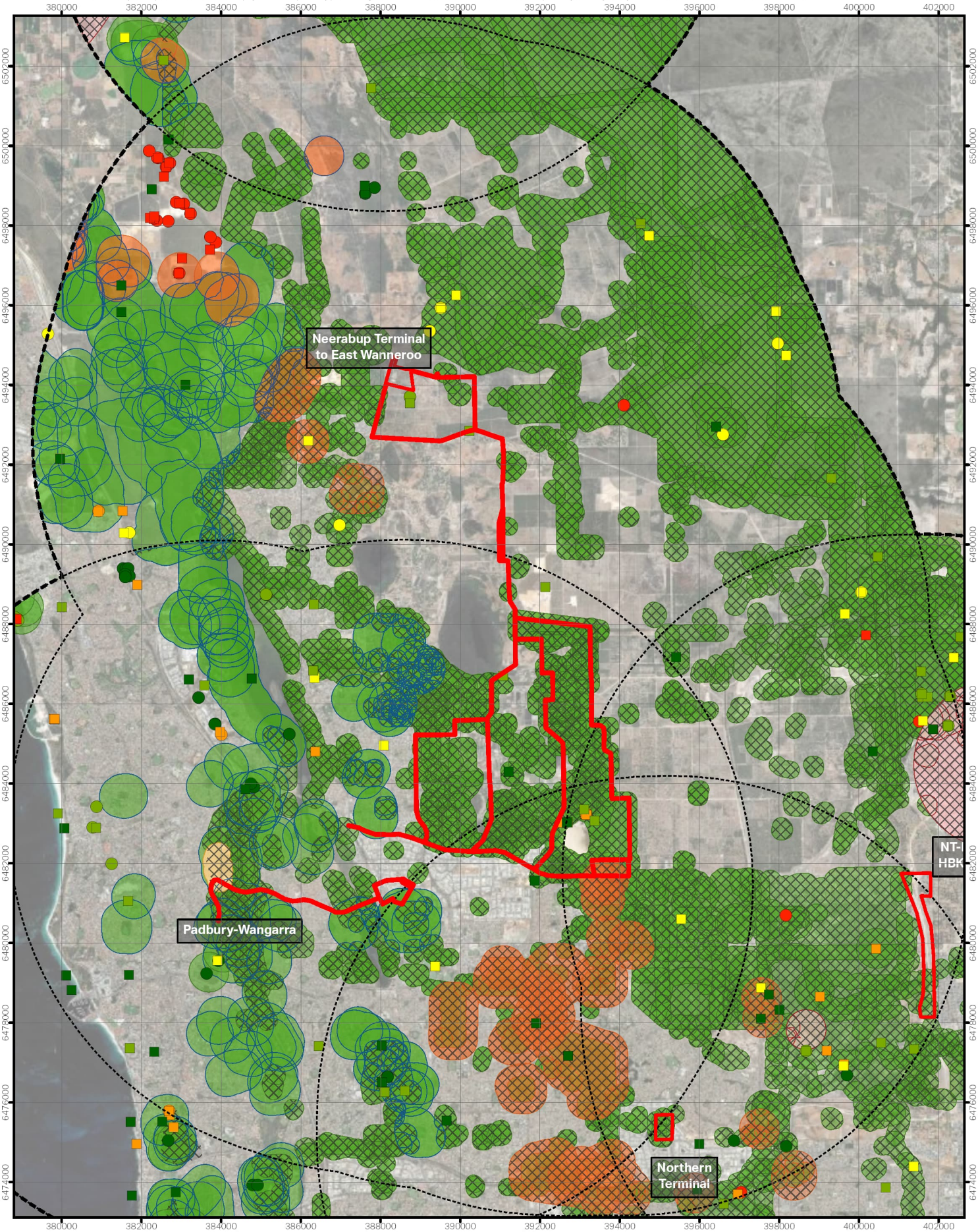
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Figure 7a.2

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LEGEND

- Survey Area
- 8.5km Buffer Survey Area

WA Herbarium database (WAHERB)
- Threatened
- P1
- P2
- P3
- P4

Threatened and Priority Flora database (TPFL)
- Threatened
- P1
- P2
- P3
- P4

TEC / PEC (State Listed)
- Critically Endangered
- Endangered
- Vulnerable
- Priority 3

TEC / PEC (Federally Listed)
- Critically Endangered
- Endangered

Conservation Significant Flora and Communities Desktop Results: Neerabup Terminal to East Wanneroo

WESTERN POWER

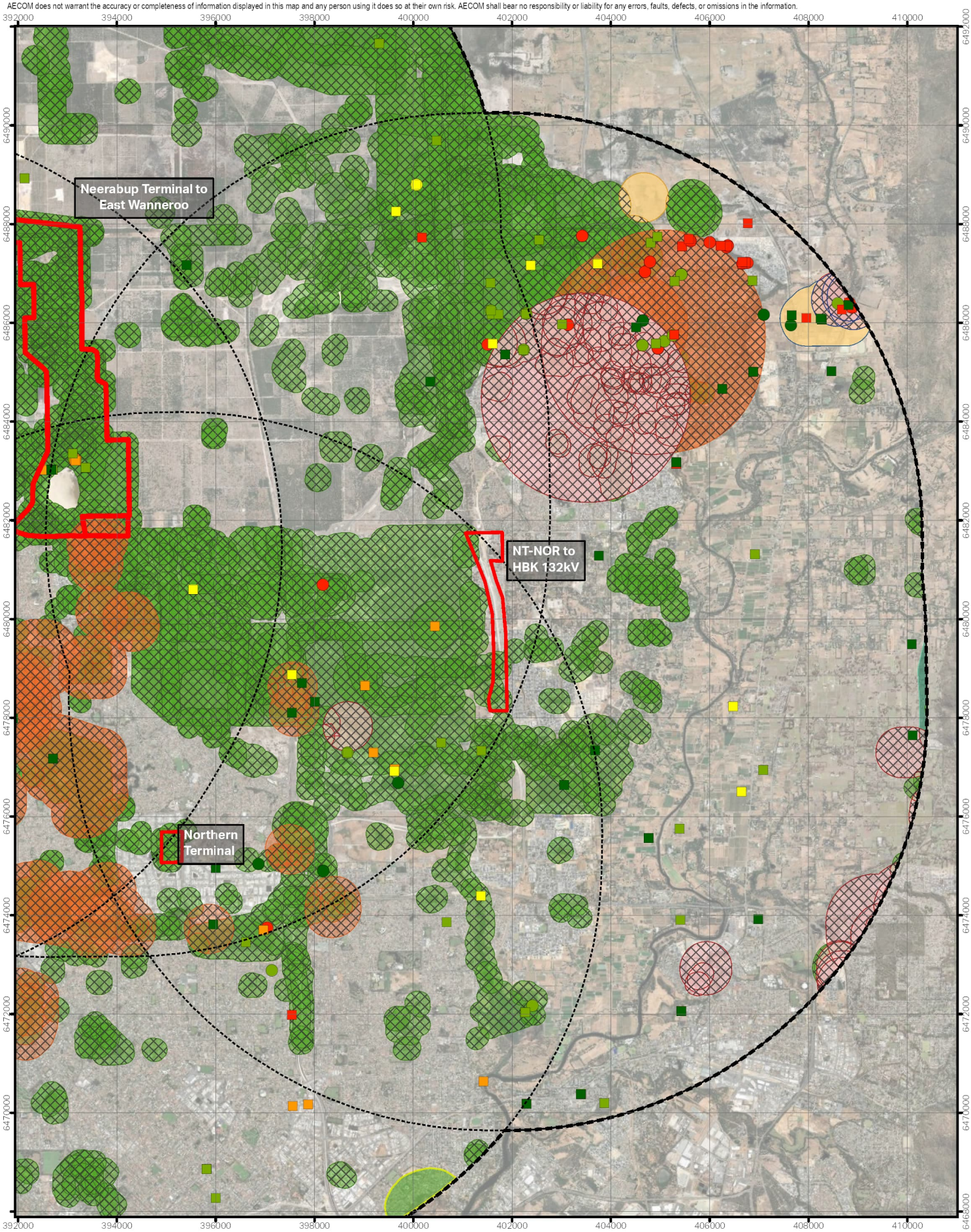
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Figure **7a.3**

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LEGEND

- Survey Area
- 8.5km Buffer Survey Area

WA Herbarium database (WAHERB)

- Threatened
- P1
- P2
- P3
- P4

Threatened and Priority Flora database (TPFL)

- Threatened
- P2
- P3
- P4

TEC / PEC (State Listed)

- Critically Endangered
- Endangered
- Vulnerable
- Priority 3
- Priority 4

TEC / PEC (Federally Listed)

- Critically Endangered
- Endangered
- Vulnerable

Conservation Significant Flora and Communities Desktop Results: NT-NOR to HBK 132kV

WESTERN POWER

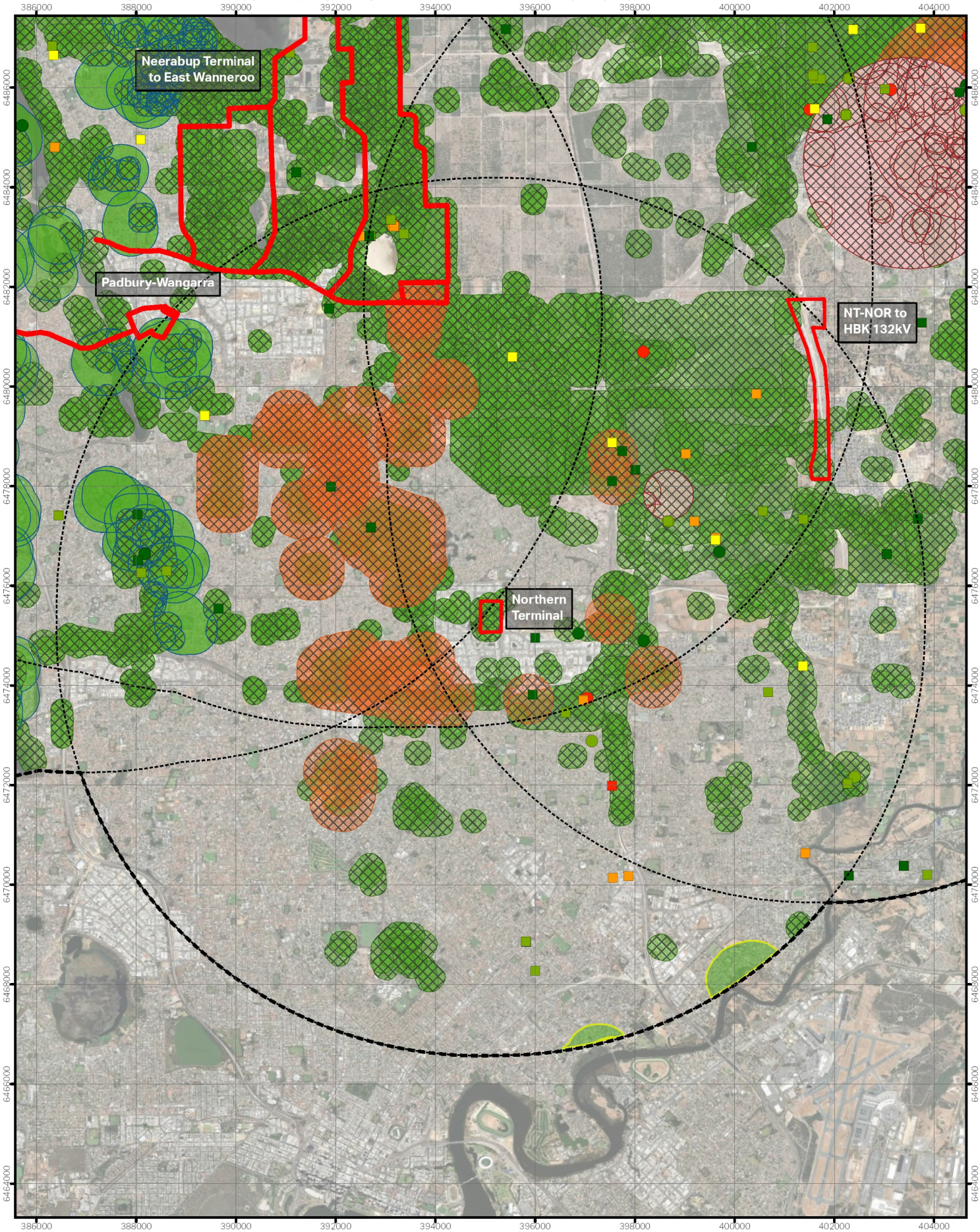
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Figure **7a.4**

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LEGEND

- Survey Area
- 8.5km Buffer Survey Area

WA Herbarium database (WAHERB)

- Threatened
- P1
- P2
- P3
- P4

Threatened and Priority Flora database (TPFL)

- Threatened
- P3
- P4

TEC / PEC (State Listed)

- Critically Endangered
- Endangered
- Priority 3

TEC / PEC (Federally Listed)

- Critically Endangered
- Endangered
- Vulnerable

Conservation Significant Flora and Communities Desktop Results: Northern Terminal

WESTERN POWER

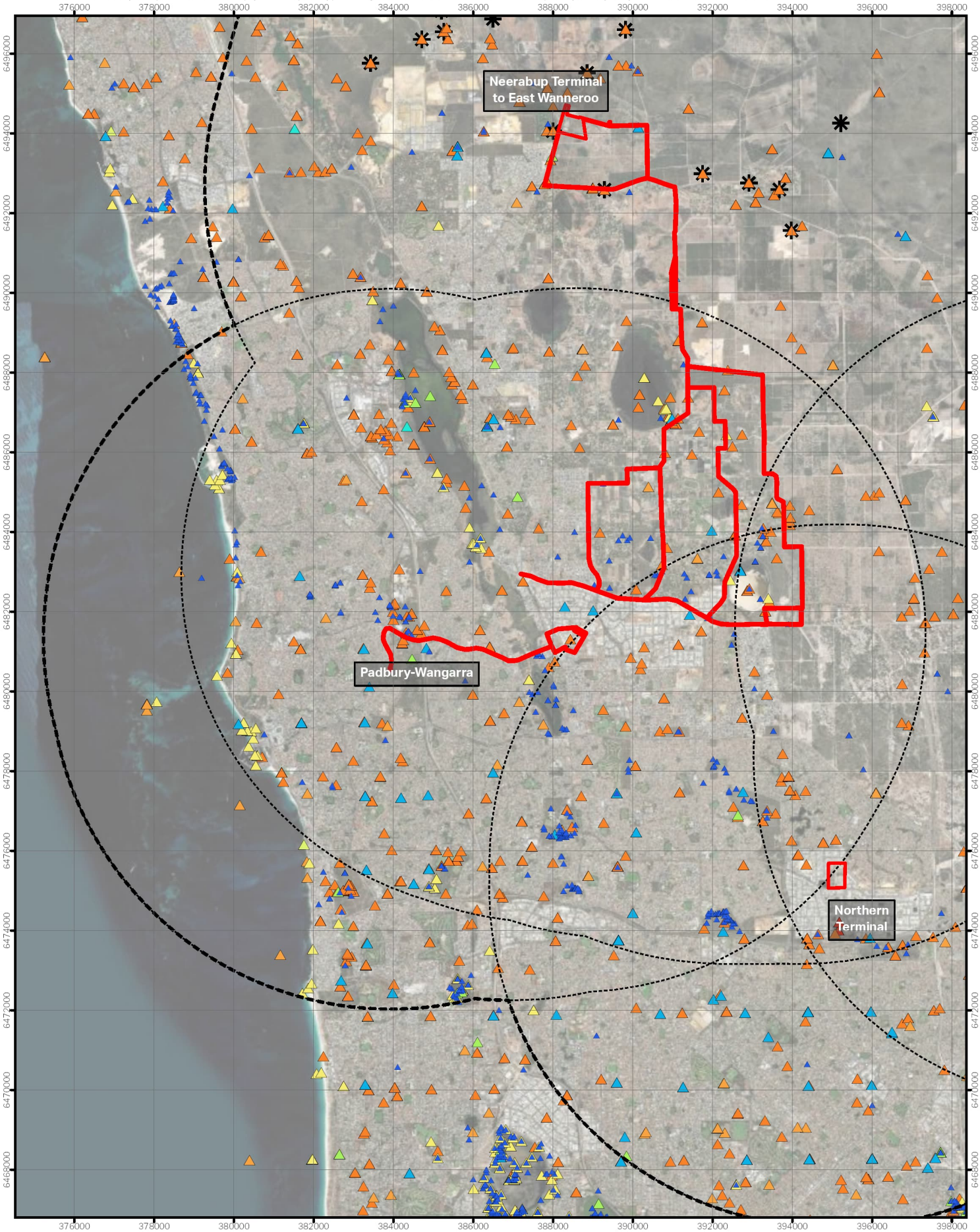
CLEAN ENERGY LINK SWAN COASTAL PLAIN FLORA, VEGETATION AND FAUNA ASSESSMENT

Figure **7a.5**

A4 size

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Service Layer Credits: World Imagery, Earthstar Geographics+Hybrid Reference Layer: Esri, TomTom, Garmin, FAO, NOAA, USGS

LEGEND

- Survey Area
- 8.5km Buffer Survey Area
- Black Cockatoo Roosting Sites

Threatened Fauna database (DBCA)

- Critically Endangered
- Endangered
- Vulnerable
- Migratory Species
- Conservation Dependant
- Specially Protected
- Priority 2
- Priority 3
- Priority 4

Conservation Significant Fauna Desktop Results: Padbury-Wangarra

WESTERN POWER

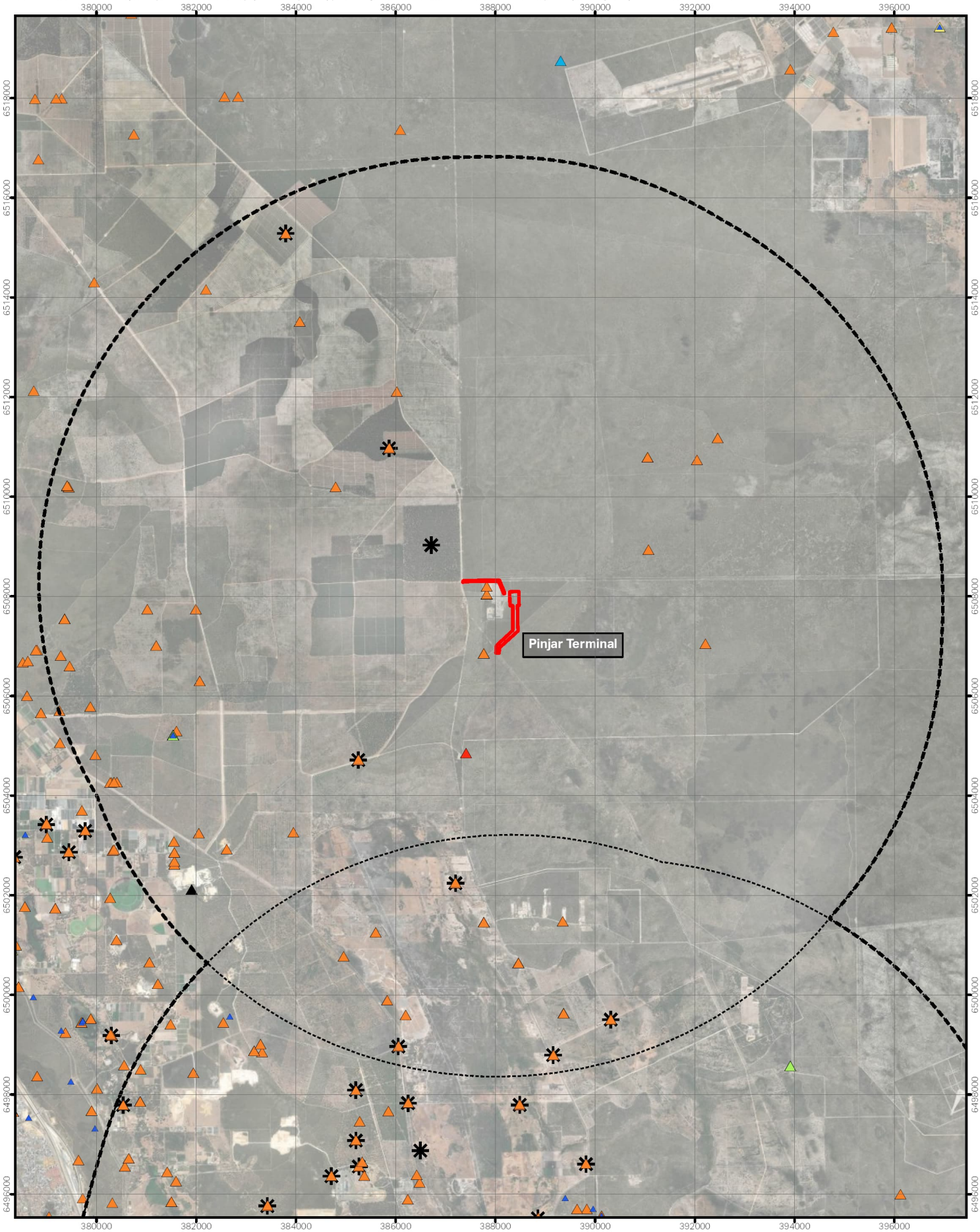
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Figure **7b.1**

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LEGEND

- Survey Area
- 8.5km Buffer Survey Area
- Black Cockatoo Roosting Sites

Threatened Fauna database (DBCA)

- Critically Endangered
- Endangered
- Vulnerable
- Migratory Species
- Specially Protected
- Priority 3
- Priority 4
- Extinct

Conservation Significant Fauna Desktop Results: Pinjar Terminal

WESTERN POWER

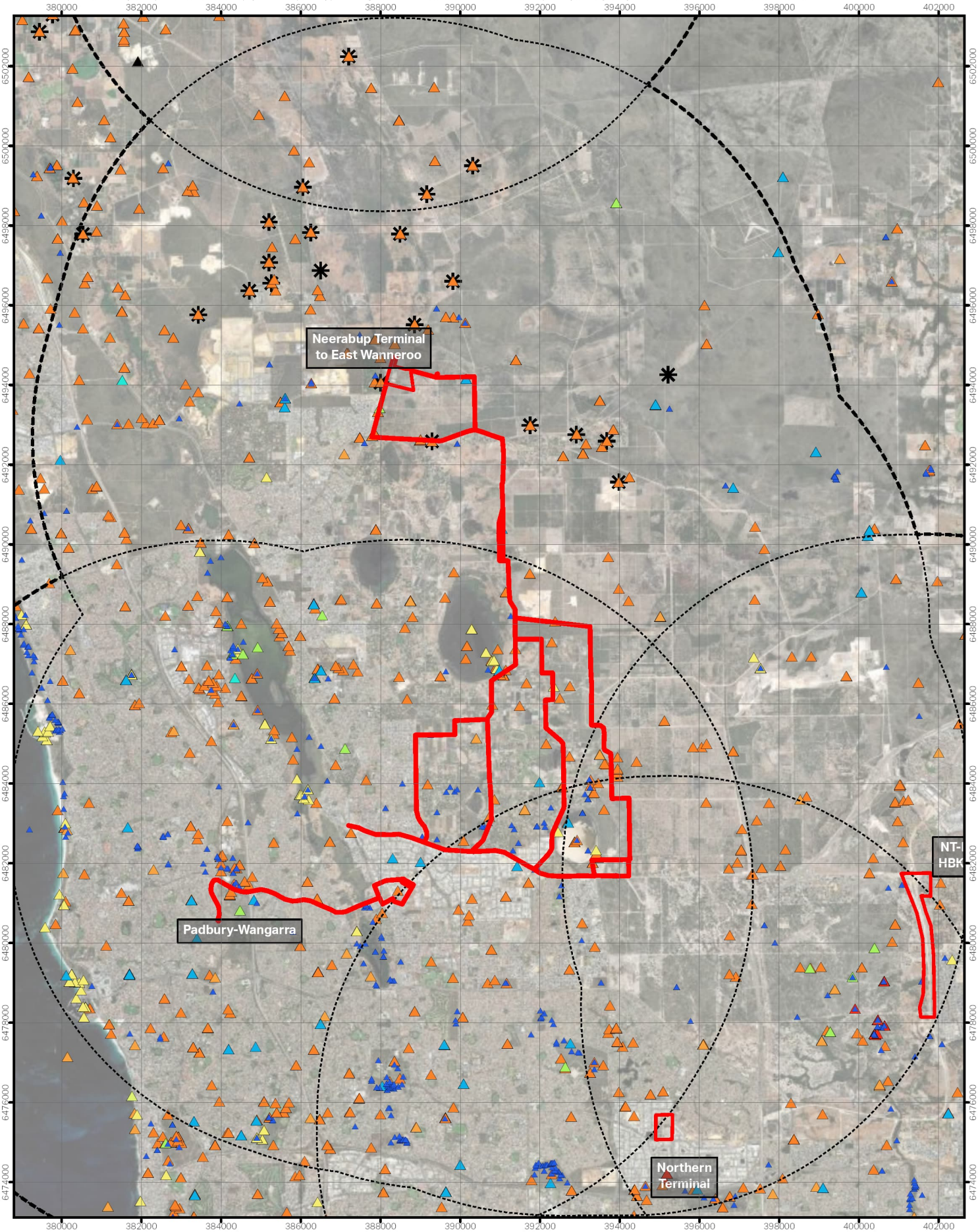
CLEAN ENERGY LINK SWAN COASTAL PLAIN FLORA, VEGETATION AND FAUNA ASSESSMENT

Figure **7b.2**

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GDA2020 MGA ZONE 50

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Service Layer Credits: World Imagery: Earthstar Geographics+Hybrid Reference Layer: Esri, TomTom, Garmin, FAO, NOAA, USGS

LEGEND

- Survey Area
- 8.5km Buffer Survey Area
- Black Cockatoo Roosting Sites

Threatened Fauna database (DBCA)

- Critically Endangered
- Endangered
- Vulnerable
- Migratory Species

- Conservation Dependant
- Specially Protected
- Priority 2
- Priority 3
- Priority 4
- Extinct

Conservation Significant Fauna Desktop Results: Neerabup Terminal to East

WESTERN POWER

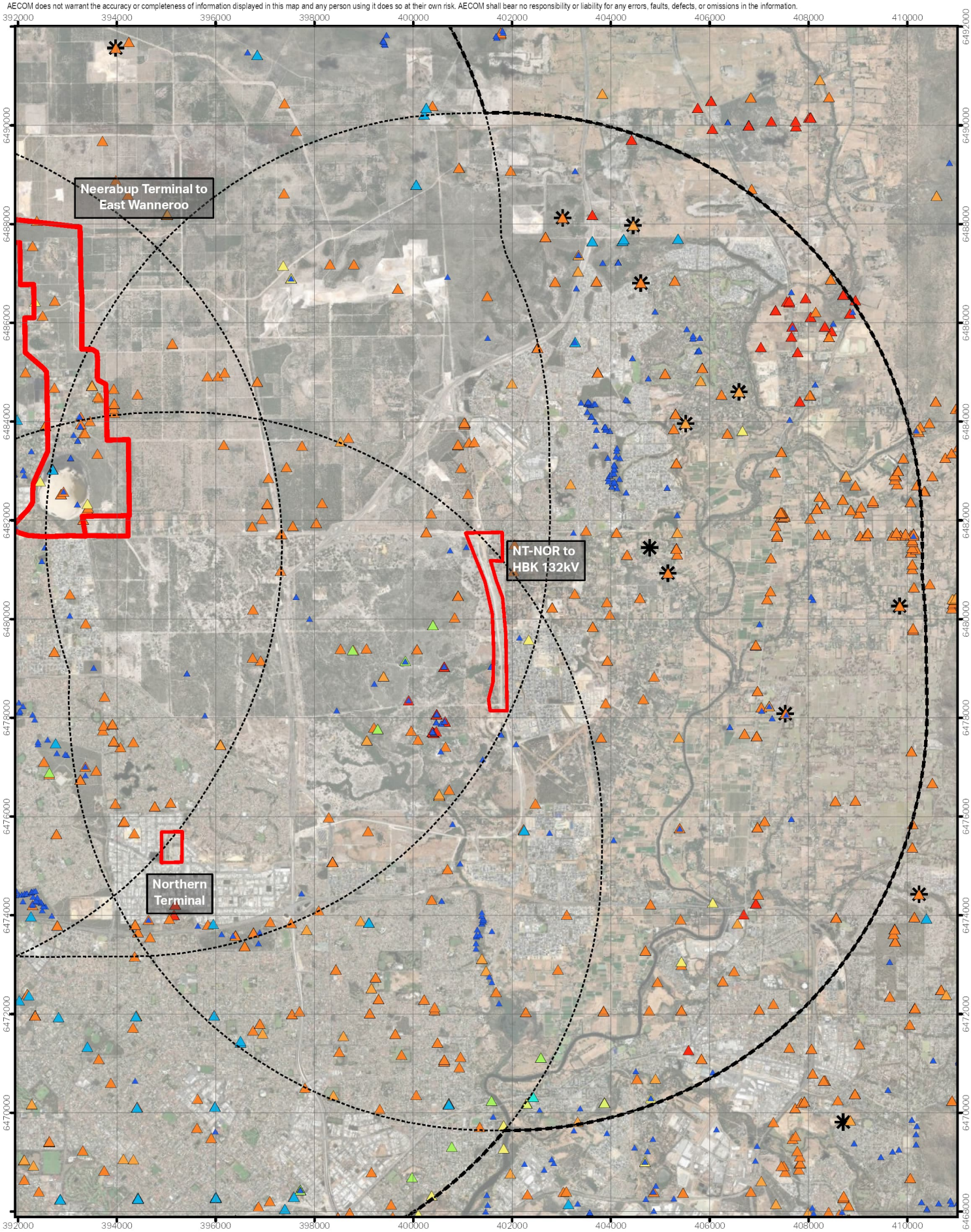
CLEAN ENERGY LINK SWAN COASTAL PLAIN FLORA, VEGETATION AND FAUNA ASSESSMENT

Figure **7b.3**

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GDA2020 MGA ZONE 50

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LEGEND

- Survey Area
- 8.5km Buffer Survey Area
- Black Cockatoo Roosting Sites

Threatened Fauna database (DBCA)

- Critically Endangered
- Endangered
- Vulnerable
- Migratory Species
- Conservation Dependant
- Specially Protected
- Priority 2
- Priority 3
- Priority 4

Conservation Significant Fauna Desktop Results: NT-NOR to HBK 132kV

WESTERN POWER

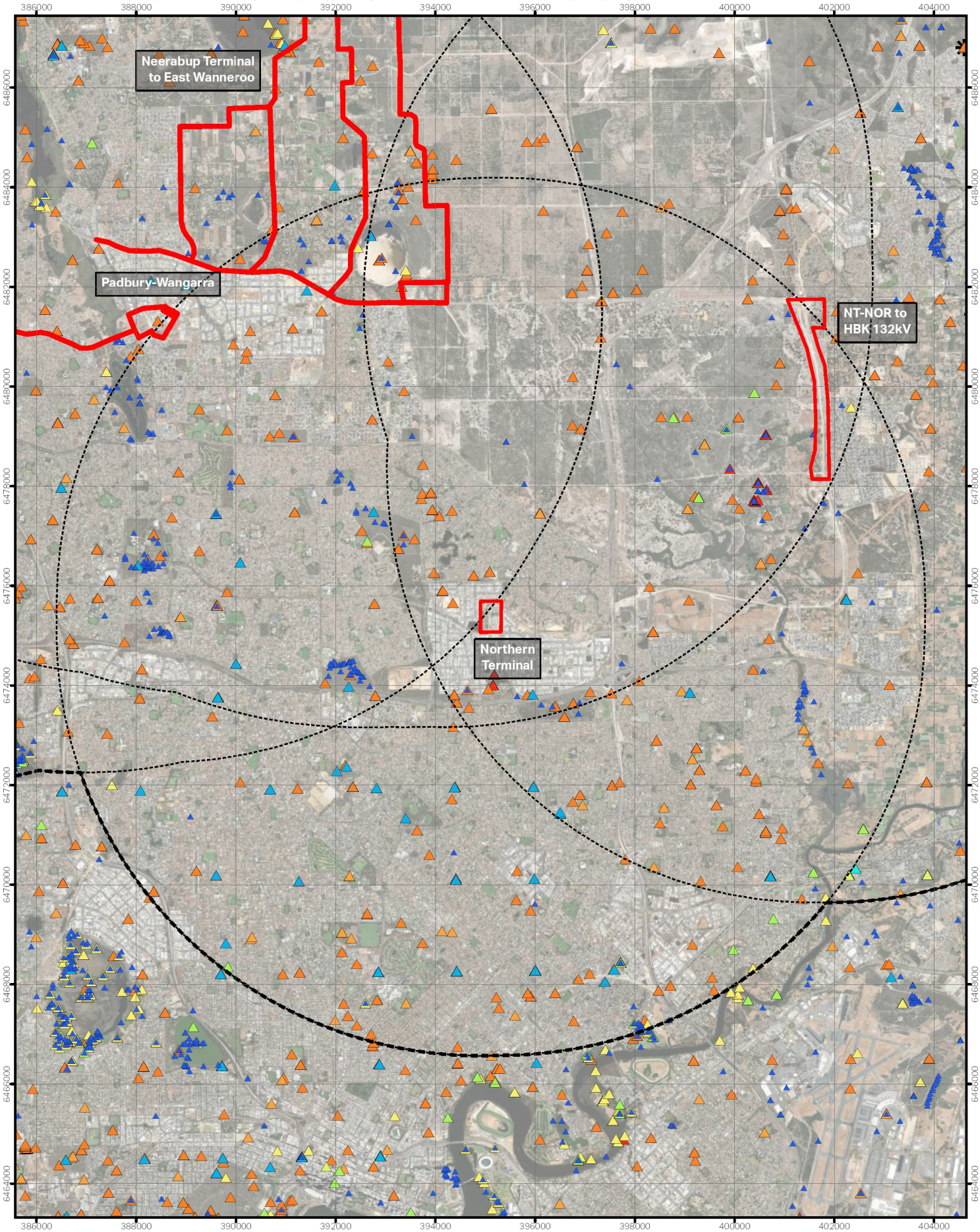
CLEAN ENERGY LINK SWAN COASTAL PLAIN FLORA, VEGETATION AND FAUNA ASSESSMENT

Figure **7b.4**

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GDA2020 MGA ZONE 50

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LEGEND

- Survey Area
- 8.5km Buffer Survey Area
- Black Cockatoo Roosting Sites

Threatened Fauna database (DBCA)

- Critically Endangered
- Endangered
- Vulnerable
- Migratory Species
- Conservation Dependant
- Specially Protected
- Priority 2
- Priority 3
- Priority 4

Conservation Significant Fauna Desktop Results: Northern Terminal

WESTERN POWER

CLEAN ENERGY LINK SWAN COASTAL PLAIN FLORA, VEGETATION AND FAUNA ASSESSMENT

Figure **7b.5**

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5.3 Significant Fauna

Between 71 to 79 significant fauna species were identified to potentially occur for the survey areas. Species identified in the desktop that are oceanic species, or strictly marine were excluded from the desktop assessment as the survey does not include marine waters. The results of the desktop assessments completed for the survey areas are included in Table 21. Species with a 'high' likelihood of occurrence are presented in Table 22. and the results are mapped in Figure 7. The comprehensive desktop results are presented in Appendix C and mapped in Figure 7.

Table 21 Significant fauna desktop assessment results summary

Survey Area	Likelihood of Each Species Identified					
	Known	High Likelihood	Moderate Likelihood	Low Likelihood	Negligible Likelihood	Total
Padbury - Wangara	0	6	12	39	22	**79**
Pinjar Terminal	0	6	8	32	30	**76**
Neerabup Terminal and East Wanneroo	0	4	3	22	42	**71**
NT-NOR to HBK 132kV Line	0	3	9	36	28	**76**
Northern Terminal	0	2	14	33	29	**78**

Table 22 Significant fauna species considered to have a 'high' likelihood of occurrence within the survey area.

Scientific Name	Common Name	Conservation status		Ecology	Padbury - Wangara	Pinjar Terminal	Neerabup Terminal and East Wanneroo	NT-NOR to HBK 132 JKv Line	Northern Terminal
		BC Act /DBCA[1]	EPBC Act[2]						
Calyptorhynchus banksii naso	Forest Red-tailed Black Cockatoo	VU	V	Inhabits dense *Eucalyptus marginata* (Jarrah), *E. diversicolor* (Karri) and *Corymbia calophylla* (Marri) forests (TSSC, 2009).	High	High	High	High	High
Idiosoma sigillatum	Swan Coastal Plain Shield-backed Trapdoor Spider	P3		Remnant habitats in Banksia woodland and heathland on sandy soils (Rix et al., 2018).	High	High	High		
Isoodon fusciventer	Quenda, Southern Brown Bandicoot	P4		Forest, woodland, heath and shrub communities, with sandy soils and dense heathy vegetation (Van Dyck & Strahan, 2008).	High	High	High		
Neelaps calonotos	Black-striped Snake	P3		Confined to the Swan Coastal Plain between Mandurah and Lancelin, sheltering in upper layers of loose soil beneath leaf litter in Eucalyptus/Banksia woodlands, typically at the base of trees and shrubs (Bush et al., 2010).	High	High	High		
Zanda baudinii	Baudin's Cockatoo	EN	E	Temperate forest and woodland dominated by *Eucalyptus marginata* (jarrah), *Corymbia calophylla* (marri) and *E. diversicolor* (karri) (TSSC, 2018).	High	High		High	
Zanda latirostris	Carnaby's Cockatoo	EN	E	Uncleared or remnant native eucalypt woodlands containing salmon gum and wandoo, and in shrubland or kwongan heathland dominated by hakea, dryandra, banksia and grevillea species. It also occurs in remnant patches of native vegetation on land otherwise cleared for agriculture. Forages seasonally in pine plantations (DCCEEW, 2023)	High	High	High	High	High

1. BC Conservation status codes: VU Vulnerable, EN Endangered P1-5 Priority Species, OS Other Specially Protected.
2. EPBC Conservation status codes: V Vulnerable, E Endangered.

6.0 Padbury-Wangara Results and Discussion

6.1 Flora

6.1.1 Vegetation Communities

Five native vegetation communities were defined and mapped including:

- Banksia Woodlands BaAbAb for (0.15 ha, 1%),
- Banksia Woodlands BaAlTe (0.58 ha, 2%),
- Tuart Woodlands EgHcPp (1.12 ha, 4%),
- Callitris Woodland CpMsLo (0.48 ha, 2%),
- Trees (0.61 ha, 0.6%).

Non-native communities included Paddock (2.26 ha) and Cleared (20.97 ha).

Vegetation community descriptions are presented in Table 23 and mapped on Figure 8.

Table 23 WGA vegetation community descriptions and photographs

Description	Additional Details	Photograph
Native Vegetation		
BaAbAb *Banksia attenuata* Woodland *Banksia attenuata* and *Callitris preissii* woodland over *Acacia blakelyi, Melaleuca huegelii, *Grevillea preissii* open shrubland over *Avena barbata, *Bromus diandrus* and *Austrostipa flavescens* grassland. Recorded on white-grey sand on a gentle slope.	Survey effort: CHR04 Native species richness: 5 Weed species richness: 9 Condition: Degraded Extent: 0.15 ha	
BaAlTe *Banksia attenuata* Woodland *Banksia attenuata* and *Banksia grandis* woodland over *Acacia lasiocarpa* var. *lasiocarpa, Xanthorrhoea preissii, Daviesia divaricata* subsp. *divaricate* open shrubland over *Tricoryne elatior, *Euphorbia terracina* and *Conostylis setigera* forbland. Recorded on white sand on a flat landform.	Survey effort: CHQ16 Native species richness: 8 Weed species richness: 8 Condition: Good Extent: 0.58 ha	

Description	Additional Details	Photograph
EgHcPp Tuart Woodland *Eucalyptus gomphocephala*, *Corymbia calophylla* and *Melaleuca huegelii* open woodlands over *Hibbertia cuneiformis* and *Acacia saligna* sparse shrubland over *Poa porphyroclados*, **Ehrharta calycina* and **Avena barbata* grassland. Represents the Tuart Woodlands TEC. Recorded on brown sandy loam soils on a gentle slope.	Survey effort: CHQ05 Native species richness: 7 Weed species richness: 12 Condition: Completely Degraded to Good Extent: 1.12 ha	
CpMsLo Callitris Woodland *Callitris preissii* low open woodland over *Melaleuca seriata, Acacia lasiocarpa var. sedifolia* and *Rhagodia baccata* sparse shrubland over **Lagurus ovatus, *Cynodon dactylon* and **Ehrharta calycina* open grassland. Recorded on white sand on a flat landform.	Survey effort: CHQ05 Native species richness: 8 Weed species richness: 9 Condition: Degraded to Good Extent: 0.48 ha	
Trees Scattered native species including but not limited to *Eucalyptus, Banksia, Acacia, Xanthorrhoea* and *Melaleuca* species. Recorded on a variety of soil types.	Survey effort: observations only Area: 0.61 ha	N/A
Non-native Communities		
Paddock Largely comprised of common pasture weeds, with occasional native species Recorded on a variety of soil types.	Survey effort: observations only Area: 2.26 ha	N/A

6.1.2 Conservation Significant Vegetation

6.1.2.1 Banksia Woodlands TEC Assessment

Two patches of Banksia Woodlands were assessed against the key diagnostic characteristics outlined in the DEE (2016) Conservation Advice.

Banksia Woodlands Patch 1 is mapped for 0.15 ha within the survey area and was considered Good, which does not meet the key diagnostic characteristics to be considered representative of the federally protected ecological community. The patch does not extend beyond the survey area, with the closest remnant native vegetation more than 30 m away. The patch assessment is presented in Table 24 below.

Table 24 Patch 1 Banksia Woodlands TEC Assessment

<table>
<tr><td>ID</td><td>Patch 1</td></tr>
<tr><td>Date</td><td>CHR04 scored on 17-Oct-23</td></tr>
<tr><td>Location</td><td>On the Swan Coastal Plain, on the Spearwood System.</td></tr>
<tr><td>Patch vegetation description</td><td>Represents BaAbAb, a Banksia woodland dominated by B. attenuata</td></tr>
<tr><td>Structure</td><td>Represents a low woodland.</td></tr>
<tr><td>Tree Data incl. height, canopy percent cover and dominance</td><td>
<table>
<tr><th rowspan="2">Species</th><th colspan="2">CHR04</th></tr>
<tr><th>Ht (cm)</th><th>Cover</th></tr>
<tr><td>B. attenuata</td><td>600</td><td>45</td></tr>
<tr><td>C. preissii</td><td>400</td><td>1</td></tr>
</table>
</td></tr>
<tr><td>Native understorey present (%) and diversity</td><td>Excludes trees.
<table>
<tr><th>Species</th><th>CHR04</th></tr>
<tr><td>Cover (%)</td><td>32.2</td></tr>
<tr><td>Diversity total</td><td>3</td></tr>
</table>
</td></tr>
<tr><td>Weed cover (%) and dominant weed species</td><td>
<table>
<tr><th>Species</th><th>CHR04</th></tr>
<tr><td>Cover (%)</td><td>7.4</td></tr>
<tr><td>Dominant species</td><td>*Avena barbata</td></tr>
</table>
</td></tr>
<tr><td>Soil type and colour</td><td>White-grey sand</td></tr>
<tr><td>Landform</td><td>Undulating sandy terrain</td></tr>
<tr><td>Size of patch</td><td>Within survey area: 0.15 ha. Does not extend beyond survey area.</td></tr>
<tr><td>Summary</td><td>The patch does not meet the condition and size thresholds to be considered representative of the Commonwealth listed TEC.</td></tr>
<tr><td>Photograph</td><td>  </td></tr>
</table>

Patch 2 does not meet the key characteristics, size and condition threshold to be considered representative of the federally protected ecological community. The Banksia Woodlands Patch 2 is mapped for 0.58 ha within the survey area and is in Good condition. Woodlands that are in Good condition require a minimum extent of 2 ha to be considered representative of the TEC. The patch is surrounded by Tuart Woodland and is disconnected (by more than 30 m) from patches of Banksia Woodland.

The patch assessment is presented in Table 25.

Table 25 Patch 2 Banksia Woodlands TEC Assessment

<table>
<tr><td>ID</td><td>Patch 2</td></tr>
<tr><td>Date</td><td>CHQ16 scored on 17-Oct-23</td></tr>
<tr><td>Location</td><td>On the Swan Coastal Plain, on the Spearwood System.</td></tr>
<tr><td>Patch vegetation description</td><td>Represents BaAlTe, a Banksia woodland dominated by B. attenuata and B. grandis</td></tr>
<tr><td>Structure</td><td>Represents a low woodland.</td></tr>
<tr><td>Tree Data incl. height, canopy percent cover and dominance</td><td>
<table>
<tr><th rowspan="2">Species</th><th colspan="2">CHQ16</th></tr>
<tr><th>Ht (cm)</th><th>Cover</th></tr>
<tr><td>B. attenuata</td><td>700</td><td>25</td></tr>
<tr><td>B. grandis</td><td>800</td><td>5</td></tr>
</table>
</td></tr>
<tr><td>Native understorey present (%) and diversity</td><td>Excludes trees.
<table>
<tr><th>Species</th><th>CHQ16</th></tr>
<tr><td>Cover (%)</td><td>16.7</td></tr>
<tr><td>Diversity</td><td>6</td></tr>
</table>
</td></tr>
<tr><td>Weed cover (%) and dominant weed species</td><td>
<table>
<tr><th>Species</th><th>CHQ16</th></tr>
<tr><td>Cover (%)</td><td>5.3</td></tr>
<tr><td>Dominant species</td><td>*Euphorbia terracina</td></tr>
</table>
</td></tr>
<tr><td>Soil type and colour</td><td>White-grey sand</td></tr>
<tr><td>Landform</td><td>Undulating sandy terrain</td></tr>
<tr><td>Size of patch</td><td>Within survey area: 0.58 ha</td></tr>
<tr><td>Summary</td><td>Native diversity is not comparable with the mean species richness for the closest matching FCT, with only eight recorded of the mean 55.2 native species (FCT 28). The patch does not meet the condition and size thresholds to be considered representative of the Commonwealth listed TEC.</td></tr>
<tr><td>Photograph</td><td>  </td></tr>
</table>

6.1.2.2 Tuart Woodlands TEC Assessment

There are two patches of Tuart Woodlands in the Padbury-Wangara survey area. One patch (Patch 2) meets the key diagnostic characteristics in accordance with the DEE (2019) Conservation Advice and is mapped for 0.78 ha. Both Patches are discussed below.

Patch 1 is located to the east of Mitchell Freeway and north of Whitfords Avenue and consists of minimal remnant vegetation (two native species) mixed with planted introduced Eucalyptus trees. The area is in Degraded condition and is 0.43 ha representing the edge of a larger patch that extends approximately 2 ha.

The minimum size threshold for Degraded vegetation is 5 ha, as such, the patch does not meet the key diagnostic characteristics for the federally protected ecological community. The assessment is presented in Table 26.

Table 26 Patch 1 Tuart Woodlands TEC assessment

Patch identification and location	The patch is located to the east of Mitchell Freeway, north of Whitfords Avenue and south of a residential area.
Key diagnostic characteristics	Yes • Occurs on Swan Coastal Plain. • Occurs on the Spearwood System. • Four mature (DBH >500 mm) *E. gomphocephala* trees were counted in the portion of the patch. • Patch 1 occurs as an open woodland. • Minimal native understorey was present, indicative of historical disturbance. • Planted introduced eucalyptus trees were also recorded within the patch.
Species richness	Two native understorey species were observed: *Melaleuca huegelii* and *Acacia saligna*
Condition	Poor condition (DEE, 2019). The vegetation condition is mapped as Degraded.
Size	0.43 ha
Variety within patch	The patch is small, segregated from other mature Tuart trees by more than 60 m, and has minimal variety within it. It consists of mature Tuart trees over two native shrub species and cleared / common pasture weeds.
Additional information	The patch is disconnected from other Tuart Woodland patches due to the large freeway and urban development.



Plate 1 Tuart Woodlands Patch 1

Patch 2

Patch 2 represents a large area of Tuart Forest that extends north and south of Whitfords Avenue, west of Mitchell Freeway, and west of Gibson Avenue. The total area of Patch 2 within the survey area is 0.54 ha, representing part of a larger patch more than 30 ha. The total patch size is greater than 5 ha, therefore condition thresholds are not applicable.

An assessment against the key diagnostic characteristics was undertaken, and condition was determined using a quadrat to further support the patch assessment. The patch meets the key diagnostic characteristics for the federally protected ecological community. The assessment is presented in Table 27 and Figure 8.

Table 27 Patch 2 Tuart Woodlands TEC assessment

<table>
<tr><td>Patch identification and location</td><td>Remnant native vegetation north and south of Whitfords Avenue and west of Mitchell Freeway, and west of Gibson Avenue. The patch is represented by CHQ05 scored on 17 October 2023.</td></tr>
<tr><td>Key diagnostic characteristics</td><td>Yes
Occurs on Swan Coastal Plain.
Occurs on both the Quindalup South system and the Spearwood System.
More than 32 mature (DBH >500 mm) E. gomphocephala trees were counted which represents a small portion of the larger patch continuing outside the survey area.
Patch 1 occurs as an open woodland.
Includes native understorey species that vary in density reflective of level of disturbance.</td></tr>
<tr><td>Species richness</td><td>Key indicators for the condition thresholds are outlined in the table below.<table><tr><th>Parameter</th><th>CHQ05</th></tr><tr><td>Proportion of understorey foliage that is native</td><td>23.7%</td></tr><tr><td>Native species richness</td><td>7</td></tr></table></td></tr>
<tr><td>Condition</td><td>Moderated condition (DEE, 2019).
Mapped as Good condition.</td></tr>
<tr><td>Size</td><td>Within survey area: 1.63 ha
Total: over 30 ha</td></tr>
<tr><td>Variety within patch</td><td>The patch is open woodland, with some minor variation in the density of understorey shrubs, particularly Acacia saligna, Hibbertia cuneiformis and Melaleuca huegelii. The variation is attributed to historical disturbance, with common introduced weeds displacing many smaller herbs and annual native species.
Vegetation condition was mapped as Good with weeds displacing native understorey species and the extensive clearing in the area has further limited biodiversity. Native understorey is entirely absent near the edge. The patch represents the southern edge of Tuart Woodlands protected in Bush Forever Site 303.</td></tr>
<tr><td>Additional information e.g. buffer, connectedness, land use history</td><td>Although intersected by Whitfords Avenue and residential developments, the patch is large and represents an important local refuge for native flora and fauna. The patch condition is anticipated to be in better condition further from the edge.</td></tr>
</table>



Plate 2 Tuart Woodlands Patch 2

6.1.2.3 State-Listed Ecological Communities

No state-listed TEC or PEC were confirmed to occur. One FCT was able to be confidently inferred, FCT 28 Spearwood *B. attenuata* or *B. attenuata-Eucalyptus* woodland. This FCT was confirmed for CHQ16 (see Table 28). The similarity was relatively low (28% using Keighery data), and the group clustering was ambiguous. This was attributed to the degradation of the vegetation.

FCT 28 is associated with the Banksia Woodlands TEC. As discussed in Section 6.1.3.1, the Banksia Woodlands patch was too small and too degraded to meet the size and conditions thresholds for the federally protected ecological community.

No FCT was confidently inferred for CHQ05. There was some correlation to FCT 25 Southern Swan Coastal Plain *Eucalyptus gomphocephala - Agonis flexuosa* woodlands which represents a PEC. Similarity was low and results from Gibson and Keighery data was ambiguous. The quadrat is missing a key indicator species for FCT 25 (*Agonis flexuosa*). The other FCT inferred was FCT 24 Scattered heath with Tuart. This seems unlikely due to the absence of key species such as *Calothamnus quadrifidus*, *Chaetospora curvifolia* (previously *Schoenus curvifolius*), and *Banksia sessilis*.

Table 28 Padbury-Wangara FCT analysis results

Quadrat	Gibson (1994)				Keighery (2012)				Final Determination
	% Similar	FCT	Site	Dendrogram	% Similar	FCT	Site	Dendrogram	
CHQ16	27	28	YAN-6	Broadly clustering with FCT 18 and 19.	30	24	cool 08	Broadly clustering with FCT 19 and 29a.	FCT28 Spearwood *B. attenuata* or *B. attenuata-Eucalyptus* woodland. Suits description and confirms similarity. Low similarity is likely due to the disturbed and isolated nature of the vegetation patch, which is located next to a road, cleared land and a pathway. Weeds are also abundant. Known to be associated with Banksia Woodlands TEC, however, does not represent a PEC or TEC as explained in Section 6.1.2.1.
	26	28	WOODV-2		30	25	much04		
	23	28b	WOODV-1		28	28	WOODV-2		
CHQ05	32	24	TRIG-6	Broadly clustering with FCTs 11 and 19.	37	s11	m6402	Broadly clustering with FCTs s11, s15, 30a2 and 29b	Indeterminate Does not represent FCT24 Scattered health with Tuart. Is missing key species such as *Calothamnus quadrifidus, Chaetospora curvifolia* (previously *Schoenus curvifolius*), and *Banksia sessilis*. Low similarity to all FCTs likely relates to high presence of weeds and low abundance of native understorey species due to historical disturbance.
	29	25	C71-4		34	24	xbeer01		
	28	24	NEER-1		34	24	star01		

6.1.3 Vegetation Condition

The survey area comprises 2.95 ha of native vegetation. The majority of this was in Completely Degraded condition. A high level of weed invasion was present which is expected in a highly developed area on the Swan Coastal Plain.

Cleared areas represent areas devoid of native vegetation and are not included in percentage calculations below. Vegetation condition is mapped on Figure 8 and extent of each category is presented in Table 29 below.

Table 29 Vegetation condition extent

Condition Rating	Extent (ha)	Percent of Total Area
Completely Degraded	0.65	22%
Degraded	0.63	21%
Good	1.67	57%
Total	**2.95**	**100%**
Cleared	26.12	

6.1.4 Conservation Significant Flora

No significant flora species were recorded in the Padbury-Wangara survey area.

6.1.5 Flora Inventory

A total of 69 flora species from 27 families were recorded. The total includes 39 (56.6%) locally native species and 30 (43.5%) introduced or naturalised weed species. No weed species listed as Weeds of National Significance (WONS) or listed as Declared Pests under the BAM Act were recorded.

Families with the highest representation are Myrtaceae (11 native taxa), Fabaceae (four native taxa), and Asparagaceae (four native taxa).

The comprehensive list of vascular flora species recorded, organised by site and the community they occur in is presented in Appendix D. Quantitative data recorded from individual samples sites is presented in Appendix E.

6.2 Fauna

6.2.1 Fauna Habitat Assessment

Four fauna habitats representing native vegetation were mapped, including Banksia Woodland, Eucalyptus Woodland, Mixed Shrubland and Trees Over Cleared. Trees Over Cleared (4.82 ha, 16.6% of the survey area) and Mixed Shrubland (1.41 ha, 4.8%) were the two most dominant habitat types. Fauna habitat types and suitability for significant fauna species is described below and mapped in Figure 9.

Cleared represents 23.23 ha and is devoid of vegetation.

6.2.1.1 Banksia Woodland

The Banksia Woodland habitat is mapped for 0.74 ha (3% of the survey area) occurs as isolated occurrences in two locations along Whitfords Avenue. It is characterised by an overstorey of *Banksia attenuata, Banksia grandis*, and *Callitris preissii* over mixed shrublands and grasslands of variable density. Shrub species included *Acacia lasiocarpa var. lasiocarpa, Daviesia divaricata subsp. divaricata, Hibbertia hypericoides* and *Melaleuca huegelii*. A grassy understorey was common throughout.

Microhabitat features such as logs and rocks are limited in their abundance, attributed to the restricted size. Coarse litter is abundant, whilst fine leaf litter is sparse and bare ground is common throughout.



Plate 3 Banksia Woodland Habitat

6.2.1.2 Eucalyptus Woodland

The Eucalyptus Woodland habitat extends for 1.12 ha (4% of the survey area) and represents the edge of a larger area of remnant native vegetation. Areas of larger remnant native vegetation provides an important refuge for fauna species within the surrounding developed area. The Eucalyptus Woodland habitat consists of large mature trees, primarily Tuart *Eucalyptus gomphocephala* and Marri *Corymbia calophylla* over a variable understorey species.

Coarse leaf litter is abundant through the habitat, providing excellent shelter and foraging habitat which may be utilised by species such as the Quenda *Isoodon fusciventer* and the Black-striped Snake *Neelaps calonotos.* Large logs (>30cm) were infrequent while small logs were abundant.

The Eucalyptus Woodland habitat represents suitable roosting, foraging and breeding habitat for Black Cockatoo species due to the presence of mature tall trees and proximity of a water source.

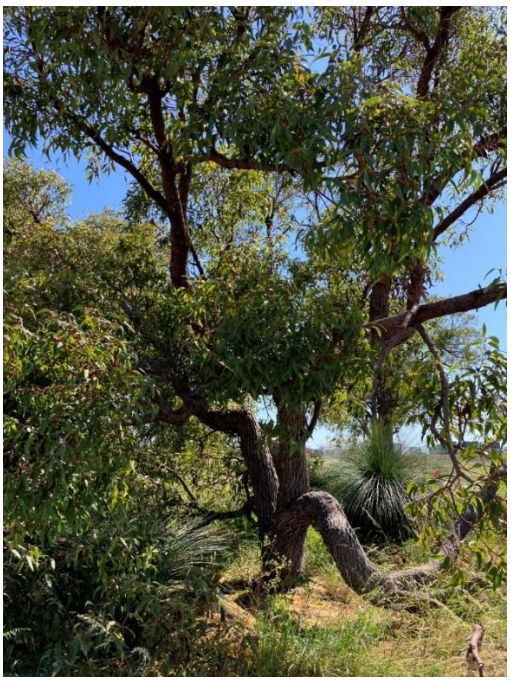


Plate 4 Eucalyptus Woodland Habitat

6.2.1.3 Mixed Shrubland

The Mixed Shrubland habitat extends for 1.84 ha (5% of the survey area), occurring sporadically throughout the survey area and varying in size. Composition alters, but it provides a unique ecological niche within the survey area for smaller animals such as birds and reptiles due to a higher plant density generally observed compared to more open habitats such as a Eucalyptus Woodland. Densely branched shrubs provide greater protection from predation when foraging and nesting. The habitat includes isolated planted shrubs, as well as remnant native vegetation shrublands. Species included *Acacia saligna, Calothamnus quadrifidus, Callistemon phoenicus* and various *Melaleuca* species.

Smaller logs occur throughout the habitat type, but large logs and rocks were rarely observed. Grasses were abundant, with coarse leaf litter occurring occasionally.



Plate 5 Mixed Shrubland Habitat

6.2.1.4 Trees Over Cleared

The Trees Over Cleared habitat type is the most abundant habitat type. It extends for 2.13 ha (7% of the survey area) and consists of planted street trees along with isolated native trees over grasses and weeds. There is minimal variation and limited microhabitats throughout the habitat type. Leaf litter is infrequent, with minimal logs and fallen branches present. The habitat would primarily be used by invertebrates and flighted species such as birds and microbats that shelter, breed and forage in the mature trees.



Plate 6 Trees Over Cleared Habitat

6.2.2 Fauna Inventory

A total of 15 vertebrate fauna species were recorded during the field survey. This comprised of 11 bird, three mammal and one reptile species. A complete inventory of fauna species recorded within the survey area is provided in Table 30.

One introduced species was recorded, the European Rabbit *Oryctolagus cuniculus*, listed as a Declared Pest (s22(2)) under the BAM Act. The species is common throughout Western Australia.

Table 30 Fauna observations within the Padbury-Wangara survey area

Class	Scientific Name	Common Name	Method
Mammal	*Isoodon fusciventer*	Quenda	Foraging evidence
Mammal	*Macropus fuliginosus melanops*	Western Grey Kangaroo	Seen. Scats observed
Mammal	*Oryctolagus cuniculus*	European Rabbit	Seen
Bird	*Rhipidura leucophrys*	Willie Wagtail	Seen and heard
Bird	*Eolophus roseicapilla*	Galah	Seen and heard
Bird	*Calyptorhynchus banksii naso*	Forest Red-tailed Black Cockatoo	Foraging evidence
Bird	*Zanda latirostris*	Carnaby's Cockatoo	Seen and heard. Foraging evidence
Bird	*Falco cenchroides*	Nankeen Kestrel	Seen
Bird	*Phylidonyris longirostris*	New Holland Honeyeater	Seen and heard
Bird	*Spilopelia senegalensis*	Laughing Dove	Seen and heard

Class	Scientific Name	Common Name	Method
Bird	*Threskiornis molucca*	Australian White Ibis	Seen
Bird	*Anthochaera carunculata*	Red Wattlebird	Seen and heard
Bird	*Trichoglossus moluccanus*	Rainbow Lorikeet	Seen and heard
Bird	*Cacatua sanguinea*	Little Corella	Seen and heard
Reptile	*Tiliqua rugosa rugosa*	Bobtail/Shingleback Lizard	Seen

6.2.3 Conservation Significant Fauna

Three conservation significant fauna species were recorded including two bird species and one mammal species:

- Carnaby's Cockatoo (*Zanda latirostris)* listed as Endangered under the EPBC Act and BC Act
- Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso)* listed as Vulnerable under the EPBC Act and BC Act
- Quenda (*Isoodon fusciventer)* listed as Priority 4 by DBCA.

Carnaby's Cockatoos were seen and heard during the survey. Foraging evidence was recorded for the Forest Red-tailed Black Cockatoo. Quenda presence was recorded via distinct foraging evidence (Plate 7). Evidence of conservation significant species is mapped in Figure 9.

Fauna habitat is considered suitable for another four conservation significant fauna species, assessed as moderately likely to occur post-survey:

- Baudin's Cockatoo (*Zanda baudinii*) listed as Endangered under the EPBC Act and BC Act
- Peregrine Falcon (*Falco peregrinus*) listed as Other Specially Protected Fauna under the BC Act
- Black-striped Snake (*Neelaps calonotos*) listed as Priority 3 by DBCA
- Swan Coastal Plain Shield-backed Trapdoor Spider (*Idiosoma sigillatum*) listed as Priority 3 by DBCA

Habitat descriptions and conservation significant species likely to utilise this habitat is defined in Table 31.



Plate 7 Typical conical-shaped Quenda digging - foraging evidence

Table 31 Area (ha) of suitable habitat for significant fauna species within the survey area

Species	Area of Suitable Habitat (ha)				Total (ha)
	Eucalyptus Woodland	Banksia Woodland	Trees Over Cleared	Mixed Shrubland	
Carnaby's Cockatoo (*Zanda latirostris*)	1.12	0.74	2.13		6.68
Baudin's Cockatoo (*Zanda baudinii)*	1.12		2.13		5.94
Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*)	1.12		2.13		5.94
Peregrine Falcon (*Falco peregrinus*)	1.12	0.74	2.13	1.84	8.09
Quenda (*Isoodon fusciventer*)	1.12	0.74		1.84	3.27
Black-striped Snake (*Neelaps calonotos*)	1.12	0.74		1.84	3.27
Swan Coastal Plain Shield-backed Trapdoor Spider (*Idiosoma sigillatum*)		0.74			0.74

6.3 Targeted Black Cockatoo Survey

6.3.1 Foraging

The survey area has been assessed as a score of 10 ‘High-quality foraging habitat’ for both the Carnaby’s Cockatoo and Forest Red-tailed Black Cockatoo in accordance with the Commonwealth Black Cockatoo Referral Guidelines foraging tool (DAWE, 2022) (Table 32). No subtractions were made for these two species. The survey area has been assessed as a score of 8 for Baudin’s Cockatoo due to an absence of foraging evidence during the survey.

The survey area contains mature Banksia Woodlands and Eucalyptus Woodlands, with suitable foraging species including multiple proteaceous species, Marri *Corymbia calophylla* and Tuart *Eucalyptus gomphocephala* trees.

Table 32 Black Cockatoo Foraging Habitat Assessment (DAWE, 2022)

Starting score		**Baudin's Cockatoo (*Zanda baudinii*)**		**Carnaby's Cockatoo (*Zanda latirostris*)**		**Forest Red-Tailed Black Cockatoo *(Calyptorhynchus banksii naso)***	
		Start at a score of 10 if your site is native eucalypt woodlands and forest, and proteaceous woodland and heath, particularly Marri, within the range of the species, including along roadsides and parkland cleared areas. Can include planted vegetation**. This tool only applies to sites equal to or larger than 1 hectare in size.**		**Start at a score of 10** if your site is native shrubland, kwongan heathland or woodland, dominated by proteaceous plant species such as *Banksia* spp. (including *Dryandra* spp.), *Hakea* spp. and *Grevillea* spp., as well as native eucalypt woodland and forest that contains foraging species, within the range of the species, including along roadsides and parkland cleared areas. Also includes planted native vegetation. **This tool only applies to sites equal to or larger than 1 hectare in size.**		**Start at a score of 10** if your site is Jarrah or Marri woodland and/or forest, or if it is on the edge of Karri Forest, or if Wandoo and Blackbutt occur on the site, within the range of the subspecies, including along roadsides and parkland cleared areas. **This tool only applies to sites equal to or larger than 1 hectare in size.**	
Attribute	Sub-tractions	Context adjustor (attributes reducing functionality of foraging habitat).					
Foraging potential	**-2**	**Subtract 2** from your score if there is no evidence of feeding debris on your site.	☒	**Subtract 2** from your score if there is no evidence of feeding debris on your site.	☐	**Subtract 2** from your score if there is no evidence of feeding debris on your site.	☐
Connectivity	**-2**	**Subtract 2** from your score if you have evidence to conclude that there is no other foraging habitat within 12 km of your site.	☐	**Subtract 2** from your score if you have evidence to conclude that there is no other foraging habitat within 12 km of your site.	☐	**Subtract 2** from your score if you have evidence to conclude that there is no other foraging habitat within 12 km of your site.	☐
Proximity to breeding	**-2**	**Subtract 2** if you have evidence to conclude that your site is more than 12 km from breeding habitat.	☐	**Subtract 2** if you have evidence to conclude that your site is more than 12 km from breeding habitat.	☐	**Subtract 2** if you have evidence to conclude that your site is more than 12 km from breeding habitat.	☐

Starting score		Baudin's Cockatoo (*Zanda baudinii)*		Carnaby's Cockatoo (*Zanda latirostris)*		Forest Red-Tailed Black Cockatoo *(Calyptorhynchus banksii naso)*	
Proximity to roosting	**-1**	**Subtract 1** if you have evidence to conclude that your site is more than 20 km from a known night roosting habitat.	☐	**Subtract 1** if you have evidence to conclude that your site is more than 20 km from a known night roosting habitat.	☐	**Subtract 1** if you have evidence to conclude that your site is more than 20 km from a known night roosting habitat.	☐
Impact from significant plant disease	**-1**	**Subtract 1** if your site has disease present (e.g. *Phytophthora* spp. or Marri canker) and the disease is affecting more than 50% of the preferred food plants present.	☐	**Subtract 1** if your site has disease present (e.g. *Phytophthora* spp. or Marri canker) and the disease is affecting more than 50% of the preferred food plants present.	☐	**Subtract 1** if your site has disease present (e.g. *Phytophthora* spp. or Marri canker) and the disease is affecting more than 50%of the preferred food plants present.	☐
		8		**10**		**10**	

The refined foraging habitat value using the BCE (2020) method considered known breeding and roosting sites, and the characteristics associated with each fauna habitat type. The following factors influenced the results:

- There is a confirmed white-tailed Black Cockatoo (Baudin's or Carnaby's) roosting site less than 200 m south of the survey area (DBCA, 2023c).
- The survey area is less than 2 km from the buffer zone of a confirmed breeding site (DBCA, 2023c).
- There is 13,250 ha of native vegetation within 15 km of the survey area. Native vegetation within the survey area (2.95 ha) represents 0.01% of the available foraging habitat therefore species context is rated as 0.
- Carnaby's Cockatoos were observed resting and foraging in *Banksia grandis* within the survey area, as well as flying over (Plate 8).
- Foraging evidence was identified for Forest Red-Tailed Black Cockatoos within the survey area, with individuals also heard calling.



Plate 8 Carnaby's Cockatoos seen foraging on a *Banksia grandis* in the survey area.

The Banksia Woodland represents 'Moderate to High' Carnaby's Cockatoo foraging habitat. This represents a site condition score of 6 and a stocking score of 1 attributed to the presence of favourable foraging species and foraging evidence. This same fauna habitat represents 'Low' foraging habitat for Baudin's Cockatoo and Forest Red-tailed Black Cockatoo due to the lack of preferred foraging species such as *Eucalyptus marginata*, *Eucalyptus todtiana* or *Corymbia calophylla*.

The Eucalyptus Woodland fauna habitat represented 'Moderate' quality for the three Cockatoos with site scores of 3 and 4 and stocking rate of 1 for Carnaby's and Forest Red-tailed Black Cockatoos. The score was influenced by the abundance of suitable foraging species such as *Corymbia calophylla*, *Eucalyptus gomphocephala* and *Banksia grandis* and presence of foraging evidence.

The Mixed Shrubland habitat scored a 1 and 2 for the three Cockatoos, representing 'Negligible' and 'Low' quality lacking suitable foraging species.

The Trees over Cleared represented 'Low' quality for Carnaby's representing open woodland of small-fruited Eucalypt species. It was considered 'Low to Moderate' for Baudin's and Forest Red-tailed Black Cockatoo with a total score of 3 for Baudin's and 4 for Forest Red-tailed Black Cockatoos due to foraging evidence being present.

The low values reflect the absence or low abundance of foraging species present resulting in lower site condition scores and lower site context scores.

Foraging habitat scores for each habitat type are shown in Table 33 and mapped in Figure 10.

Table 33 Padbury-Wangara refined foraging score calculation (Bamford, 2020)

Habitat Type	Carnaby's Cockatoo	Baudin's Cockatoo	Forest Red-tailed Black Cockatoo	Extent (ha)
Mixed Shrubland	2	1	1	1.84
Banksia Woodlands	7	2	2	0.73
Eucalyptus Woodland	4	4	5	1.12
Trees Over Cleared	2	3	4	2.13

Table 34 Padbury-Wangara foraging habitat extent

Foraging Habitat Quality	Carnaby's Cockatoo (ha)	Baudin's Cockatoo (ha)	Forest Red-tailed Black Cockatoo (ha)
1: Negligible	0	1.84	1.84
2: Low	3.97	0.74	0.74
4-6: Moderate	1.86	3.25	3.25
7: Moderate to High	0	0	0
8-10: High.	0	0	0
Total	5.83	5.83	5.83

6.3.2 Breeding

A total of 103 potential nesting trees with a suitable DBH (>500 mm) were recorded within and adjacent to the survey area (Table 35, Figure 10). The majority were Tuart (*Eucalyptus gomphocephala*) and Marri (*Corymbia calophylla*) trees.

Two suitable nesting trees (Tuart) were identified supporting five potentially suitable nest hollows (Plate 9, Plate 10). One of these hollows is currently occupied by Little Corellas and one may be too small to be suitable, however this is unable to be determined from ground-level observations. This assessment is limited to observations made from the ground.

Table 35 Potential nesting trees

Tree Species	Total Trees with DBH >500 mm
Tuart (*Eucalyptus gomphocephala*)	47
Marri (*Corymbia calophylla*)	29
Jarrah (*Eucalyptus marginata*)	5
Other	6
Introduced	16
Total	**103**

Table 36 Suitable nesting tree details including species and hollow dimensions.

ID	Species	Hollow Entrance (Depth x Width)	Height Above Ground (m)	Hollow Angle	Facing	Hollow Type	Evidence of Use
54	Tuart (*Eucalyptus gomphocephala*)	15 x 15 cm	12	Vertical	North-west	Trunk	Chew Marks
		10 x 10 cm	8	Vertical	South-west	Branch	None
		20 x 20 cm	18	Vertical	North-west	Trunk	Chew Marks
		10 x 10 cm	8	Vertical	South	Trunk	Chew Marks
84	Tuart (*Eucalyptus gomphocephala*)	15 x 15 cm	8	Vertical	North-west	Trunk	Chew Marks



Plate 9 Hollow on potentially suitable nesting tree ID84 Tuart (*Eucalyptus gomphocephala*)



Plate 10 Hollows recorded on potentially suitable nesting tree ID54 Tuart (*Eucalyptus gomphocephala*)

6.3.3 Roosting

Sixty-nine confirmed white-tailed Black Cockatoo and Forest Red-tailed Black Cockatoo roosting sites occur within 15 km of the survey area. Seven of these occur within 5 km and one within 1 km of the survey area (DBCA, 2023c).

No roosting sites were observed within the survey area. There is a water source within 2 km of the survey area, foraging habitat is present in the local area and there are mature Eucalypt trees present. The Eucalyptus Woodland fauna habitat would therefore provide suitable roosting habitat. There is a known roosting site within Pinnaroo Valley Memorial Park, adjacent to the survey area.

6.4 Discussion

6.4.1 Flora and Vegetation

Native vegetation was mapped for 2.95ha of the survey area, representing 10% of the total area. The survey area intersects with Bush Forever Sites 299 and 303. Site 299 Yellagonga Regional Park represents Tamala Limestone and holocene swamp deposits on Spearwood and Quindalup dune systems (Govt. of WA, 2000). It comprises mostly Banksia and Jarrah woodlands, Marri woodlands and Tuart woodlands and is part of a recognised Greenway (Govt. of WA, 2000). Site 303 Whitfords Avenue Bushland represents Spearwood and Quindalup dunes and includes limestone ridges and vegetated uplands. It comprises Tuart woodlands and Banksia woodlands with emergent Jarrah trees (Govt. of WA, 2000).

Four native vegetation communities and three modified communities were mapped two Banksia Woodlands communities BaAbAb (0.15 ha, 0.5%) and BaAlTe (0.58 ha, 2%), one Tuart Woodland EgHcPp (1.12 ha, 3.9%) and one Callitris Woodland CpMsLo (0.48 ha, 1.6%). patch met the requirements presented in the Conservation Advice. Each patch represents isolated occurrences that are less than 2 ha, supported low native diversity, and therefore did not meet the condition and size thresholds.

Tuart Woodlands TEC was anticipated to occur, as a known occurrence is mapped within this area. One patch of Tuart Woodlands TEC was confirmed. It extends for 0.50 ha within the survey area, representing the edge of a larger patch estimated at more than 30 ha. This patch represents Bush Forever Site 303 which is mapped as more than 75% Very Good to Good and 25% Degraded (Govt of WA, 2000). The vegetation within the survey area is part of the 25% of mapped Degraded vegetation. It is adjacent to native vegetation for 50% of the edge (north) and a major road (Whitfords Avenue). The vegetation continues on the south side of Whitfords Avenue. The patch is within the highly developed and cleared urban area of Perth and provides an important refuge for native flora and fauna species.

All native vegetation was close to roads and urban development. Historical impacts from these including clearing and introduction and spread of weeds have resulted in a reduction in flora diversity and absence of suitable habitat for significant flora species. Flora diversity equally represented native and weed species (39 native compared to 30 weed species). A biological survey completed nearby along Mitchell Freeway found 217 flora species (145 native compared to 72 weed species) within 42.2 ha (Astron, 2020). Flora diversity is comparable given the smaller size of the survey area.

No significant flora species were recorded. This was expected, as the desktop assessment did not identify any species considered to have a high likelihood of occurrence, and large parts of the survey area were historically disturbed.

All areas of native vegetation were traversed on foot during the ideal detection period for target significant species. Further, all species that were not recorded in sample sites were sampled opportunistically. No suitable habitat was identified for most species given the degradation of the area and proximity to development. As such, all species considered to have a moderate likelihood of occurrence were downgraded to a low likelihood post-survey. Table 37 provides a summary of pre-survey and post-survey likelihood of occurrence for species identified as potentially occurring within the survey area.

Table 37 Summary of Padbury-Wangara likelihood of occurrence pre-survey and post-survey

Likelihood	Number of Species Identified					
	Known	High Likelihood	Moderate Likelihood	Low Likelihood	Negligible Likelihood	Total
Pre-survey	0	0	34	27	21	82
Post-survey	0	0	0	34	48	82

6.4.2 Fauna

Fifteen fauna species were recorded during the field survey. This included eleven birds, three mammals and one reptile. Three significant fauna species were recorded including two bird species and one mammal species:

- Carnaby's Cockatoo (*Zanda latirostris)* listed as Endangered under the EPBC Act and BC Act
- Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso)* listed as Vulnerable under the EPBC Act and BC Act
- Quenda (*Isoodon fusciventer)* listed as Priority 4 by DBCA.

Following the survey, a post-survey likelihood desktop assessment was completed. Details of all the conservation significant species considered to have a high or known post-survey likelihood and their associated habitats is presented in Table 38. Those which have been downgraded from a high likelihood due to the post-survey assessment are also discussed.

Four native fauna habitats were defined and mapped for the survey area based on the results of the field assessment. These habitats include Banksia Woodland, Eucalyptus Woodland, Trees Over Cleared and Mixed Shrubland.

The significant fauna species are most likely to utilise Eucalyptus Woodland and Banksia Woodland areas where native understorey density was higher, generally associated with vegetation condition of 'Good' or better.

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Table 38 Fauna species which are known or moderately likely to utilise associated fauna habitat within the Padbury-Wangara survey area.

Species	Conservation code (EPBC/State WA)	Habitat	Number of DBCA Records and Distance	Pre survey likelihood of occurrence	Post survey likelihood of occurrence	Discussion
Carnaby's Cockatoo (*Zanda latirostris*)	E (EPBC Act) EN (BC Act)	Uncleared or remnant native Eucalypt woodlands containing Salmon gum and Wandoo, and in shrubland or Kwongan heathland dominated by Hakea, Dryandra, Banksia and Grevillea species. It also occurs in remnant patches of native vegetation on land otherwise cleared for agriculture. Forages seasonally in pine plantations (DCCEEW, 2023)	There are 9264 records on the DBCA database, the closest record is 0.08 km away from the survey area and was most recently sighted in 2020.	High	Known	This species was observed foraging in Banksia trees within the survey area. It is likely to use the Eucalyptus Woodland, Banksia Woodland and Trees Over Cleared habitat types for foraging and roosting within the survey area. These habitats are found outside of and directly adjacent to the survey area.
Baudin's Cockatoo (*Zanda baudinii*)	E (EPBC Act) EN (BC Act)	Temperate forest and woodland dominated by *Eucalyptus marginata* (Jarrah), *Corymbia calophylla* (Marri) and *E. diversicolor* (Karri) (TSSC, 2018).	There are 136 records on the DBCA database, the closest record is 7.51 km away from the survey area and was most recently sighted in 2015.	High	Moderate	This species may use the Eucalyptus Woodland, Banksia Woodland and Trees Over Cleared habitat types within the survey area. This habitat is found outside of and directly adjacent to the survey area.
Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*)	V (EPBC Act) VU (BC Act)	Inhabits dense *Eucalyptus marginata* (Jarrah), *E. diversicolor* (Karri) and *Corymbia calophylla* (Marri) forests (TSSC, 2009).	There are 363 records on the DBCA database, the closest record is 1.2 km away from the survey area and was most recently sighted in 2020.	High	Known	This species is likely to use the Eucalyptus Woodland, Banksia Woodland and Trees Over Cleared habitat types within the survey area. Foraging evidence for the Forest Red-tailed Black Cockatoo was also recorded within the survey area. These habitats are found outside of and directly adjacent to the survey area.
Quenda (*Isoodon fusciventer*)	P4	Forest, woodland, heath, and shrub communities, with sandy soils and dense heathy vegetation (Van Dyck & Strahan, 2008). The presence of accumulated coarse leaf litter is suitable foraging habitat for the Quenda.	There are over 1588 records within 10 km of the survey area, with the closest record occurring at 0.04 km. The most recent of these was recorded in 2021.	High	High	This species is likely to use Eucalyptus Woodland, Mixed Shrubland and Banksia Woodland habitats within the survey area. These habitats are found outside of and directly adjacent to the survey area.

Species	Conservation code (EPBC/State WA)	Habitat	Number of DBCA Records and Distance	Pre survey likelihood of occurrence	Post survey likelihood of occurrence	Discussion
		Quenda foraging activity was observed throughout these habitat types.				
Black-striped Snake *(Neelaps calonotos)* listed as Priority 3 by DBCA	P3	Restricted to sandy coastal strip near Perth, WA between Mandurah and Cataby, with isolated populations north, near Eneabba and Dongara. Dunes and vegetated sand plains with heaths and Eucalyptus/Banksia woodlands are preferred habitats (Wilson and Swan 2023).	There are 97 records on the DBCA database, the closest record is 0.61 km away from the survey area. The most recent record is in 2017.	High	Moderate	Dense leaf litter which is known to occur in sandy Banksia Woodlands of the survey area (Bush et al., 2010) is the preferred habitat type of this species. This species may utilise areas where native understorey density in Banksia Woodlands and Eucalyptus Woodlands was higher, generally associated with vegetation condition of 'Good' or better. These habitats are found outside of and directly adjacent to the survey area.
Swan Coastal Plain Shield-backed Trapdoor Spider (*Idiosoma sigillatum*)	P3	Remnant habitats in Banksia woodland and heathland on sandy soils (Rix et al., 2018).	There are 124 records on the DBCA database, the closest record is 0.24 km away from the survey area. The most recent record is in 2019.	High	Moderate	This species may utilise areas where native understorey density in Banksia Woodlands was higher, generally associated with vegetation condition of 'Good' or better. This habitat is found outside of and directly adjacent to the survey area.
Peregrine Falcon (*Falco peregrinus*)	OS	Utilises most habitat types, from forests to urban areas. The greatest influence on presence is the abundance of prey and secure nest sites (Birdlife Australia, 2024).	There are 109 records on the DBCA database, with the closest record 0.54 km away from the survey area. The most recent record is 2014.	Moderate	Moderate	The species may utilise the area for hunting, particularly the Eucalyptus Woodland and Banksia Woodland habitats. Breeding is unlikely, as suitably high buildings are not present within the survey area. The suitable habitat types are not limited to the survey area.

6.4.3 Targeted Black Cockatoo

The survey area is within the known range for the three threatened Black Cockatoo species. Both the Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksia naso*) and Carnaby's Cockatoo (*Zanda latirostris*) were observed foraging and resting within the survey area. There were 103 potential nesting trees with a suitable DBH (>500 mm) identified with the survey area. Two potentially suitable nesting trees were identified, which have multiple hollows with a potentially suitable entrance size for black cockatoos. Presently, this survey area is not within the known breeding range of any of the black cockatoo species.

The survey area scored a foraging habitat score of 10 for both the Carnaby's Cockatoo and Forest Red-tailed Black Cockatoo in accordance with the DAWE 2022 guidelines. The survey area has been assessed as a score of 8 for Baudin's Cockatoo, due to an absence of foraging evidence during the survey. The BCE (2020) scoring method defined the area as supporting Negligible to High foraging quality. This quality is primarily associated with the Banksia Woodland and Eucalyptus Woodland habitat types, which includes suitable foraging species such as *Banksia attenuata*, *Banksia menziesii, Eucalyptus gomphocephala* and *Eucalyptus todtiana*. A permanent water source presence nearby, confirmed sighting during the survey, and extent of suitable foraging habitat in the vicinity all contributed to the foraging score. The small size and reduced quality of the foraging habitat within the survey area limited the overall quality score for Forest Red-tailed Black Cockatoos, with higher quality foraging habitat occurring outside the survey area. The small patch of Banksia Woodlands was observed to be well utilised by Carnaby's Cockatoos, with a small flock observed foraging on *Banksia grandis* during the survey. This patch was rated as High quality for the species.

The trees within the survey area are unlikely to be utilised as a roosting site. The entire survey area corridor incorporates busy metropolitan roads and crosses a Freeway. Alternative roosting sites would be present further from infrastructure and potentially light pollution further from the survey area. A large roosting site for black cockatoos is known to occur in the Tuart Woodland within Pinnaroo Valley Memorial Park, which is directly adjacent to the survey area.

The local area supports both urban and conservation land use. It is situated on the edge of a significant corridor of native vegetation which includes Craigie Bushland. The native vegetation in the vicinity is in better condition, protected in Bush Forever Sites 299 and 303 that support favoured foraging species in higher abundance compared to that found in the survey area.

7.0 Pinjar Terminal Results and Discussion

7.1 Flora

7.1.1 Vegetation Communities

One native Banksia Woodland community, BaAcCc was defined and mapped for 14.75 ha (89%). The remaining 1.82 ha represents cleared areas devoid of vegetation. Vegetation community descriptions are presented in Table 39 and mapped on Figure 8.

Table 39 Pinjar vegetation community descriptions and photographs

Description	Additional Details	Photograph
Native Vegetation		
BaAcCc *Banksia attenuata* Woodland *Banksia attenuata and Banksia menziesii* woodland over *Adenanthos cygnorum* subsp. *cygnorum, Xanthorrhoea preissii, Kunzea glabrescens* open shrubland over *Conostylis candicans, Patersonia occidentalis* and *Lomandra sericea* forbland. Represents the Banksia Woodlands TEC. It was located on white sandy soil on gently undulating terrain.	Survey effort: NSR05, CHQ06, CHQ07 supplemented by AECOM (2022b) Q12 situated 200 m from survey area. Species richness: 55 species Condition: Very Good to Excellent Extent: 14.75 ha	

7.1.2 Conservation Significant Vegetation

One TEC listed under the EPBC Act was verified to occur. No communities listed under the BC Act were identified in the survey area.

One patch of Banksia Woodland TEC (Patch 3) was assessed against the key diagnostic characteristics outlined in the DEE (2016) Conservation Advice. The patch met the key characteristics, size and condition threshold to be considered representative of the federally protected ecological community. The Banksia Woodlands TEC is mapped for 14.75 ha in the survey area.

One Priority 3 PEC was also identified through FCT analysis, FCT 23b Swan Coastal Plain *B. attenuata-B. menziesii* woodlands. This FCT represent a component of the Banksia Woodlands TEC. Similarity was high when comparing against Gibson and Keighery data varying between 43-47% across CHQ06 and CHQ07 (Table 41). Clustering further supported the inferred FCT23b. FCT23b is inferred for all Banksia Woodlands within the survey area and represents the federally listed Banksia Woodlands TEC.

The patch assessment is presented in Table 40 below.

Table 40 Pinjar Banksia TEC patch assessment

<table>
<tr><td>ID</td><td>Patch 3</td></tr>
<tr><td>Date</td><td>CH06, CHQ07, NSR05 scored on 18-Oct-23</td></tr>
<tr><td>Location</td><td>On the Swan Coastal Plain, on the Bassendean System.</td></tr>
<tr><td>Patch vegetation description</td><td>Represents BaAcCc, a Banksia woodland dominated by B. attenuata and B. menziesii.</td></tr>
<tr><td>Structure</td><td>Represents a low woodland.</td></tr>
<tr><td>Tree Data incl. height, canopy percent cover and dominance</td><td>
<table>
<tr><th rowspan="2">Species</th><th colspan="2">CHQ06</th><th colspan="2">CHQ07</th><th colspan="2">NSR05</th></tr>
<tr><th>Ht (cm)</th><th>Cover</th><th>Ht (cm)</th><th>Cover</th><th>Ht (cm)</th><th>Cover</th></tr>
<tr><td>B. attenuata</td><td>1000</td><td>40</td><td>700</td><td>30</td><td>350</td><td>7</td></tr>
<tr><td>B. menziesii</td><td>850</td><td>10</td><td>500</td><td>4</td><td>-</td><td>-</td></tr>
<tr><td>Allocasuarina humilis</td><td>160</td><td>8</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
</table>
</td></tr>
<tr><td>Native understorey present (%) and diversity</td><td>Excludes trees.
<table>
<tr><th>Species</th><th>CHQ06</th><th>CHQ07</th><th>NSR05</th></tr>
<tr><td>Cover (%)</td><td>76.8</td><td>58.6</td><td>57.2</td></tr>
<tr><td>Diversity total</td><td>36</td><td>36</td><td>17</td></tr>
</table>
</td></tr>
<tr><td>Weed cover (%) and dominant weed species</td><td>
<table>
<tr><th>Species</th><th>CHQ06</th><th>CHQ07</th><th>NSR05</th></tr>
<tr><td>Cover (%)</td><td>0.1</td><td>0.1</td><td>0.2</td></tr>
<tr><td>Dominant species</td><td>*Gladiolus caryophyllaceus</td><td>*Gladiolus caryophyllaceus</td><td>No clear dominant</td></tr>
</table>
</td></tr>
<tr><td>Soil type and colour</td><td>White-grey sand</td></tr>
<tr><td>Landform</td><td>Undulating sandy terrain</td></tr>
<tr><td>Size of patch</td><td>Within survey area: 14.75 ha
Estimated total extent: >1,000 ha</td></tr>
<tr><td>Summary</td><td>The patch meets the condition and size thresholds to be considered representative of the Commonwealth listed TEC.</td></tr>
</table>

Photograph	



Table 41 Pinjar floristic community type analysis results

Quadrat	Gibson (1994)				Keighery (2012)			Final Determination	
	% Similar	FCT	Site	Dendrogram	% Similar	FCT	Site	Dendrogram	
CHQ06	43	23b	YAN-19	Broadly clustering with FCT 23a and 23b (super group 3).	44	12	MP04	Broadly clustering with FCT 23b and 23c (super group 3).	**FCT 23b** • Correct landform: Bassendean system • Soils: white-grey sand • Key species: 13 of 19 typical species present
	42	21a	NINE-2		43	23b	YAN-19		
	39	23b	MILT-3		43	21c	ELE25		
CHQ07	49	21a	NINE-2	Broadly clustering with FCT 23a and 23b (super group 3).	52	21a	NINE-2	Broadly clustering with FCT 23b S (super group 3).	**FCT 23b** • Correct landform: Bassendean system • Soils: white-grey sand • Key species: 10 of 19 typical species present
	45	23b	ELDO-1		47	23b	ELE28		
	43	23b	YAN-19		46	23b	ELE08		

7.1.3 Vegetation Condition

Areas of native vegetation were mostly in Excellent condition (12.48 ha, 85%). Minor weed invasion was present which is expected on the Swan Coastal Plain, particularly where parcels of vegetation have been dissected by tracks. Areas where rubbish, or more aggressive weeds were present were mapped as Very Good. No areas of Pristine vegetation were encountered since the survey area generally followed existing powerlines and associated access tracks.

Cleared areas represent areas devoid of vegetation and are not included in percentage calculations below. Vegetation condition is mapped on Figure 8 and extent of each category is presented in Table 42 below.

Table 42 Vegetation condition extent

Condition Rating	Extent (ha)	Percent of Total Area
Excellent	12.48	85%
Very Good	2.27	15%
Total	**14.75**	**100%**
Cleared	1.82	

7.1.4 Conservation Significant Flora

No significant flora species were recorded in the Pinjar survey area.

7.1.5 Flora Inventory

A total of 55 flora species from 27 families were recorded. The total includes 53 (96%) locally native species and two (4%) introduced or naturalised weed species. No weed species listed as Weeds of National Significance (WONS) or listed as Declared Pests under the BAM Act were recorded.

Families with the highest representation are Myrtaceae (6 native taxa), Proteaceae (six native taxa), and Goodeniaceae (four native taxa).

The comprehensive list of vascular flora species recorded, organised by family and the community they occur in is presented in Appendix D. Quantitative data recorded from individual samples sites is presented in Appendix E.

7.2 Fauna

7.2.1 Fauna Habitat Assessment

One fauna habitat was mapped, described below and mapped in Figure 9. Cleared areas are mapped for occurs over 1.82 ha and comprising 11% of the survey area. Tracks and scats were sporadically observed along the cleared tracks that provides connectivity between areas of native vegetation. Predatory species such as foxes, hawks or falcons may take advantage of these spaces for hunting smaller species.

Banksia Woodland was mapped for 14.75 ha, comprising 89% of the survey area. It is characterised by an overstorey of *Banksia attenuata*, *Banksia menziesii, Nuytsia floribunda* and *Eucalyptus todtiana* over predominantly Proteaceous and Myrtaceous shrubs of variable density and height.

This habitat type contains occasional large logs (>30cm in diameter) and abundant small logs (<10cm). Vines are not present. Small hollows were observed in mature trees. Rocks occur sporadically on the deep grey sands typical of the Swan Coastal Plain. Coarse and fine leaf litter was abundant, fine leaf litter is common and areas of bare ground was rare.





Plate 11 Banksia Woodland Habitat

7.2.2 Fauna Inventory

A total of 13 vertebrate fauna species were recorded during the field survey. This comprised of seven bird, three mammal and three reptile species. A complete inventory of fauna species recorded within the survey area is provided in Table 43.

One introduced species was recorded, the European Rabbit *Oryctolagus cuniculus*, which is listed as a Declared Pest (s22(2)) under the BAM Act.

Table 43 Fauna observations within the Pinjar Terminal survey area

Class	Scientific Name	Common Name	Observation Method
Mammal	*Isoodon fusciventer*	Quenda	Foraging evidence
Mammal	*Macropus fuliginosus melanops*	Western Grey Kangaroo	Seen, tracks and scats recorded
Mammal	*Vulpes vulpes*	Red Fox	Seen
Bird	*Phylidonyris longirostris*	New Holland Honeyeater	Seen
Bird	*Colluricincla harmonica*	Grey Shrike-thrush	Seen and heard
Bird	*Phylidonyris niger*	White-cheeked Honeyeater	Seen and heard
Bird	*Lichmera indistincta*	Brown Honeyeater	Seen and heard
Bird	*Acanthiza uropygialis*	Chestnut-rumped Thornbill	Seen
Bird	*Malurus splendens*	Splendid Fairy-wren	Seen and heard
Bird	*Accipiter fasciatus*	Brown Goshawk	Seen and heard
Reptile	*Pseudonaja affinis*	Dugite	Seen
Reptile	*Tiliqua occipitalis*	Blue tongue	Seen
Reptile	*Tiliqua rugosa rugosa*	Bobtail/Shingleback Lizard	Seen

7.2.3 Conservation Significant Fauna

One conservation significant fauna species was recorded during the survey, Quenda (*Isoodon fusciventer)* listed as Priority 4 by DBCA. Distinct foraging evidence was observed (Plate 12), mapped in Figure 9.

An additional three species are considered to have a high potential to occur within the survey area due to the presence of suitable habitat and recent records within the surrounding area. These include:

- Carnaby's Cockatoo (*Zanda latirostris*) listed as Endangered under the EPBC Act and BC Act
- Black-striped Snake (*Neelaps calonotos*) listed as Priority 3 by DBCA
- Swan Coastal Plain Shield-backed Trapdoor Spider (*Idiosoma sigillatum*) listed as Priority 3 by DBCA



Plate 12 Typical Conical-Shaped Quenda Digging - Foraging Evidence

7.3 Targeted Black Cockatoo Survey

7.3.1 Foraging

The survey area has been assessed as a score of 8 ‘High-quality foraging habitat’ for Carnaby’s Cockatoo in accordance with the Commonwealth Black Cockatoo Referral Guidelines foraging tool (DAWE, 2022) (Table 44). The survey area contains mature Banksia Woodlands, with suitable foraging species including multiple proteaceous species and one subtraction was relevant due to a lack of foraging evidence.

No evidence of any of the three Threatened Black Cockatoo species were observed during the survey. No suitable breeding trees, foraging evidence or hollows were recorded.

Table 44 Black Cockatoo Foraging Habitat Assessment (DAWE, 2022)

Starting score		Carnaby's Cockatoo (*Zanda latirostris*)	
		Start at a score of 10 if your site is native eucalypt woodlands and forest, and proteaceous woodland and heath, particularly Marri, within the range of the species, including along roadsides and parkland cleared areas. Can include planted vegetation**. This tool only applies to sites equal to or larger than 1 hectare in size.**	
Attribute	Sub-tractions	Context adjustor (attributes reducing functionality of foraging habitat).	
Foraging potential	**-2**	**Subtract 2** from your score if there is no evidence of feeding debris on your site.	☒
Connectivity	**-2**	**Subtract 2** from your score if you have evidence to conclude that there is no other foraging habitat within 12 km of your site.	☐
Proximity to breeding	**-2**	**Subtract 2** if you have evidence to conclude that your site is more than 12 km from breeding habitat.	☐
Proximity to roosting	**-1**	**Subtract 1** if you have evidence to conclude that your site is more than 20 km from a known night roosting habitat.	☐
Impact from significant plant disease	**-1**	**Subtract 1** if your site has disease present (e.g. *Phytophthora* spp. or Marri canker) and the disease is affecting more than 50% of the preferred food plants present.	☐
		8	

Table 45 Pinjar Terminal refined foraging score calculation (Bamford, 2020)

Habitat Type	Carnaby's Cockatoo	Extent (ha)
Banksia Woodlands	6	14.75

Table 46 Pinjar Terminal foraging habitat extent

Foraging Habitat Quality	Carnaby's Cockatoo (ha)
1: Negligible	0
2: Low	0
4-6: Moderate	14.75
7: Moderate to High	0
Total	14.75

The refined foraging habitat value considered known breeding and roosting sites, and the characteristics associated with each fauna habitat type. The following factors influenced the results:

- There is a confirmed white-tailed Black Cockatoo roosting site less than 400 m west of the survey area (DBCA, 2023c).
- The survey area is 15 km from the buffer zone of a confirmed breeding area (DBCA, 2023c).
- There is suitable foraging habitat adjacent to the survey area. Native vegetation within the survey area represents <0.1% of the available foraging habitat within a 15 km radius. Site context is therefore 0.
- No evidence of foraging, or potential nesting trees were observed. Stocking rate was therefore 0.

The Banksia Woodland fauna habitat areas scored 6 for Carnaby's Cockatoo according to the BCE (2020) scoring tool representing 'Moderate' Quality. This is attributed to the condition of the vegetation and the number of Proteaceous foraging species present.

No score was given for Baudin's Cockatoo or Forest Red-tailed Black Cockatoo as the survey area falls outside their known range. Foraging habitat is mapped in Figure 10.

7.3.2 Breeding

No breeding habitat was observed within the survey area.

7.3.3 Roosting

No roosting sites were observed within the survey area. There are no tall trees or riparian vegetation within 2 km of the survey area, therefore roosting is unlikely. There are 32 confirmed roosting sites for white-tailed Black Cockatoos and Forest Red-tailed Black Cockatoos within 15 km from the survey area.

7.4 Discussion

7.4.1 Flora and Vegetation

The survey area is situated within Gnangara State Forest and Bush Forever Site 280. This Site is characterised by a mixture of *Eucalyptus* and *Banksia* woodlands. The survey area is intersected by a powerline and associated access track.

The vegetation was mapped as Banksia Woodland, extending 14.75

One Priority 3 PEC listed by the DBCA (2023) was confirmed, supported by FCT analysis. FCT23b northern *Banksia attenuata – B. menziesii* woodlands was considered likely to occur. This FCT represents Banksia woodlands generally restricted to the Bassendean system, with subgroup b having lower species richness than the other subgroups and a significantly lower mean weed frequency, reflecting the more extensive intact *Banksia* woodlands that occur north of Perth (Gibson et al. 1993).

Flora diversity was considered average with 53 species recorded. The diversity is typical of FCT23b (54.8 species per 10x10 m quadrat). Diversity is comparable to a nearby biological survey undertaken for the SCAR 4 Project (AECOM, 2022a) recorded 145 flora species from a long linear corridor encompassing eight vegetation communities. No significant flora species were recorded. Approximately 25% of the survey area has been subjected to targeted flora searches previously (AECOM, 2022a) and no significant flora species were recorded at that time within or near the survey

area. Following the two survey events, 17 of the 18 species with a moderate likelihood have been reduced to low or negligible (Table 47). These all represent perennial species that would have been detectable at the time of the surveys.

One species, *Poranthera moorokatta* (P2), was investigated further to determine its post-survey likelihood. *P. moorokatta* is an inconspicuous annual herb that may have been overlooked. The species was described in 2012 at which time it was known from two locations: Kings Park and Ellenbrook. In Kings Park it was recorded on white silica sand in open spaces between shrubs, not in shaded areas or in areas of high leaf litter cover (Barret, 2012). In Ellenbrook it was recorded in a shallow dampland on mixed grey-white sand with scattered leaf litter (Barret, 2012).

The Banksia Woodlands in the survey area supports 'open spaces between shrubs' and therefore represents suitable habitat. This annual species is 16-47 mm tall, flowers late September to early November and is often confused with the common *P. microphylla* (Barret, 2012). The Ellenbrook population is 17 km from the survey area situated low in the landscape. The Pinjar survey area is on a sand dune, more than 15 km from a known location and has been surveyed twice (partially). The species was therefore reduced to having a 'Low' likelihood.

Table 47 Summary of Pinjar likelihood of occurrence pre-survey and post-survey

Likelihood	Number of Species Identified					
	Known	High Likelihood	Moderate Likelihood	Low Likelihood	Negligible Likelihood	Total
Pre-survey	0	0	18	13	35	66
Post-survey	0	0	0	18	48	66

7.4.2 Fauna

Thirteen vertebrate fauna species were recorded during the field survey. This included seven birds, three mammals and three reptile species. Foraging evidence of the Priority 4 Quenda (*Isoodon fusciventer*) was recorded at three locations within the survey area. This species was considered likely to occur in the desktop study, with 1588 DBCA records known from the vicinity and the habitat present is typical Quenda habitat as described below.

All native vegetation was mapped as Banksia Woodland fauna habitat. This habitat represented an overstorey of Banksia species over a diverse native sclerophyllous understorey over herbs and scattered grasses. This habitat provides ideal refuge and foraging habitat for common fauna species. It is highly connected, with 90% of the perimeter buffered by intact native vegetation. This high connectivity supports fauna movement into and through the survey area.

Following the survey, a post-survey likelihood desktop assessment was completed. Details of all the conservation significant species considered to have a high or known post-survey likelihood and their associated habitats is presented in Table 48. Those which have been downgraded from a high likelihood due to the post-survey assessment are also discussed.

The Banksia Woodlands habitat is considered suitable habitat for Quenda (*Isoodon fusciventer*), Carnaby's Cockatoos (*Zanda latirostris*), the Swan Coastal Plain Shield-backed Trapdoor Spider (*Idiosoma sigillatum*), and Black-striped Snake (*Neelaps calonotos*).

The accumulated coarse leaf litter provides shelter for lizards to dig small burrows, suitable hunting habitat for many birds of prey, and shelter and foraging habitat for small mammals like Priority listed Quenda and Black-striped Snake (*Neelaps calonotos*). The Black-striped Snake is known to prefer sheltering and foraging within leaf litter in Banksia Woodlands in sandy soil (Bush et al., 2010). The sandy soil and presence of leaf litter are also a key habitat component for the Swan Coastal Plain Shield-backed Trapdoor Spider (*Idiosoma sigillatum*).

The larger trees present within the Banksia Woodlands provide nesting, perching and roosting locations for various bird species. These trees are also suitable foraging species for Carnaby's Cockatoo which was observed foraging in *Banksia* trees within the survey area.

Table 48 Fauna species and associated fauna habitat within the Pinjar Terminal survey area

Species	Conservation code (EPBC/State WA)	Habitat	Number of DBCA Records and Distance	Pre survey likelihood of occurrence	Post survey likelihood of occurrence	Discussion
Fauna species likely to utilise fauna habitat within the Pinjar Terminal survey area						
Carnaby's Cockatoo (*Zanda latirostris*)	E (EPBC Act) EN (BC Act)	Uncleared or remnant native Eucalypt woodlands containing Salmon gum and Wandoo, and in shrubland or Kwongan heathland dominated by Hakea, Dryandra, Banksia, and Grevillea species. It also occurs in remnant patches of native vegetation on land otherwise cleared for agriculture. Forages seasonally in Pine plantations (DCCEEW, 2023)	There are 9264 records on the DBCA database, the closest record is 0.12 km away from the survey area. The most recent record is in 2020.	High	High	This species is likely to use the Banksia Woodland habitats within the survey area. This habitat can also be found outside, and surrounding, the survey area.
Quenda (*Isoodon fusciventer*)	P4	Forest, woodland, heath, and shrub communities, with sandy soils and dense heathy vegetation (Van Dyck & Strahan, 2008). The presence of accumulated coarse leaf litter is suitable foraging habitat for the Quenda. Quenda foraging activity was observed throughout these habitat types.	There are 1588 records on the DBCA database, the closest record is 9.09 km away from the survey. The most recent record is in 2021.	High	Known	This species is likely to use the Banksia Woodland habitats within the survey area. This habitat can also be found outside, and surrounding, the survey area.
Black-striped Snake (*Neelaps calonotos*) listed as Priority 3 by DBCA	P3	Restricted to sandy coastal strip near Perth, WA between Mandurah and Cataby, with isolated populations north, near Eneabba and Dongara. Dunes and vegetated sand plains with heaths and Eucalyptus/Banksia woodlands are preferred habitats (Wilson and Swan 2023).	There are 97 records on the DBCA database, the closest record is 12.37 km away from the survey area. The most recent record is in 2017.	High	High	Dense leaf litter which is known to occur in Banksia Woodlands of the survey area (Bush et al., 2010) is also the preferred habitat type of this species. This species may utilise areas where native understorey density in Banksia Woodlands was higher, generally associated with vegetation condition of 'Good' or better. Banksia woodland habitat is also found outside, the survey area.

Species	Conservation code (EPBC/State WA)	Habitat	Number of DBCA Records and Distance	Pre survey likelihood of occurrence	Post survey likelihood of occurrence	Discussion
Swan Coastal Plain Shield-backed Trapdoor Spider (*Idiosoma sigillatum*)	P3	Remnant habitats in Banksia woodland and heathland on sandy soils (Rix et al., 2018).	There are 124 records on the DBCA database, the closest record is 14.46 km away from the survey area. The most recent record is in 2019.	High	High	This species is likely to use the Banksia Woodland habitats within the survey area. This habitat can also be found outside, and surrounding, the survey area.
Fauna species unlikely to utilise fauna habitat within the Pinjar Terminal survey area						
Baudin's Cockatoo (*Zanda baudinii*)	E (EPBC Act) EN (BC Act)	Temperate forest and woodland dominated by *Eucalyptus marginata* (Jarrah), *Corymbia calophylla* (Marri) *and E. diversicolor* (Karri) (TSSC, 2018).	There are 136 records on the DBCA database, the closest record is 20.79 km away from the survey area. The most recent record is in 2015.	High	Low	This species is unlikely to use the Banksia Woodland habitats within the survey area. This habitat can also be found outside, and surrounding, the survey area.
Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*)	V (EPBC Act) VU (BC Act)	Inhabits dense *Eucalyptus marginata* (Jarrah), *E. diversicolor* (Karri) and *Corymbia calophylla* (Marri) forests (TSSC, 2009).	There are 363 records on the DBCA database, the closest record is 16.93 km away from the survey area. The most recent record is in 2020.	High	Low	This species is unlikely to use Banksia Woodland habitats within the survey area. This habitat can also be found outside, and surrounding, the survey area.

7.4.3 Targeted Black Cockatoo

The survey area is within the known range for Carnaby's Cockatoo and Forest Red-tailed Black Cockatoo species. No foraging evidence or breeding habitat was recorded, and no Cockatoos were observed flying or heard 'calling' during the field survey.

The survey area has a DAWE (2022) foraging habitat score of 8 for Carnaby's Cockatoo. One detractor was relevant, a lack of foraging evidence, and the survey area represents intact vegetation. There was no evidence of Dieback observed during the survey. These observations are limited to assessing Banksia condition which was noted to be healthy.

The BCE (2020) score for Banksia Woodlands is considered 'Moderate' quality (score of 6) for Carnaby's Cockatoo. This is associated with the presence of suitable foraging species such as *Banksia attenuata*, *Banksia menziesii,* and *Eucalyptus todtiana*. The known occurrence of multiple roosting sites within 15 km of the survey area, and extent of suitable foraging habitat in the vicinity all contributed to the foraging score.

Black Cockatoo species prefer to roost in tall trees high in the landscape. No such trees were present in the survey area therefore roosting is considered unlikely.

8.0 Neerabup Terminal and East Wanneroo Results and Discussion

8.1 Flora

8.1.1 Vegetation Communities

Native vegetation was mapped for 77.09 ha represented by 12 vegetation communities. Non-native vegetation represented Planted vegetation (Pine and street trees), mapped for 15.07 ha and Cleared mapped for 109.50 ha. The vegetation is summarised below and presented in detail in Table 49 and mapped in Figure 8:

- five Banksia Woodlands
  - BaAcDf: low-lying *Banksia attenuata* woodland, represents the federal TEC and a Priority 3 PEC (FCT 21c)
  - BaAhDf: high diversity *Banksia attenuata* woodland recorded in Wanneroo adjacent to Lake Gnangara, represents the federal TEC
  - BaRcGt: a low-diversity *Banksia attenuata-Banksia menziesii* woodland isolated to Neerabup Terminal, represents the federal TEC
  - BmAcPo: remnant *Banksia menziesii* woodland occurring in an isolated location in Gnangara State Forest, represents the federal TEC.
  - BmEpLi: remnant *Banksia menziesii* woodland occurring in an isolated location in Gnangara State Forest, with a denser understorey than BmAcPo and also epresenting the federal TEC.
- two Eucalypt Woodlands
  - CcXpDf: diverse Marri woodland adjacent to Banksia Woodland and pine plantation throughout Gnangara State Forest
  - EgGlCe: a Tuart Woodland limited to Neerabup Terminal
- three Melaleuca Woodlands representing riparian vegetation
  - MpHaDb: isolated remnant wetland community.
  - MpHaEc: diverse *Melaleuca preissiana* woodlands community.
  - MpXpDb: disturbed wetland community, surrounded by development and historically disturbed.
- disturbed native vegetation
  - PpAcCe: Pine plantation regrowth with variable native understorey component.
  - Trees: parkland cleared with stands or isolated native trees and/or shrubs.

Two non-native areas:

- Planted: **Pinus pinaster* plantations and planted street trees/shrubs
- Cleared: devoid of any species

Table 49 Vegetation community descriptions and photographs

Description	Additional Detail	Photograph
Banksia Woodlands		
BaAcDf *Banksia attenuata, Banksia menziesii* and *Nuytsia floribunda* low open woodland over *Adenanthos cygnorum, Macrozamia fraseri* and *Gompholobium tomentosum* mid open shrubland over *Desmocladus flexuosus, Patersonia occidentalis* and *Corynotheca micrantha* low forbland. Represents Banksia Woodland TEC and FCT 21C PEC. Associated with surface water hydrology, adjacent to Jandabup Lake and provides important ecological functions including erosion control and prevention of sedimentation for the Lake. It was located on grey-white sandy soil on gently sloping terrain.	Survey effort: CHQ10 Native species richness: 28 Weed species richness: 4 Area: 0.85 ha, represents 1% of vegetation Condition: Very Good to Excellent	
BaAhDf *Banksia attenuata, B. menziesii* and *Eucalyptus todtiana* low open woodland over *Allocasuarina humilis, Calytrix flavescens* and *Eremaea pauciflora* var*. pauciflora* low shrubland over *Desmocladus flexuosus, Patersonia occidentalis* and **Ursinia anthemoides* low open forbland. Represents Banksia Woodland TEC. It was located on white sandy soil on flat terrain.	Survey effort: CHQ14, CHQ15 Native species richness: 48 Weed species richness: 10 Area: 2.27 ha, represents 3% of vegetation Condition: Degraded to Excellent	

Description	Additional Detail	Photograph
BaRcGt *Banksia attenuata, B. menziesii* and *Eucalyptus rudis* open woodland over *Regelia ciliata, Kunzea glabrescens* and *Gompholobium tomentosum* shrubland over *Ficinia nodosa* and *Lyginia imerbis* sedgeland Represents Banksia Woodlands TEC. It was located on white sandy soil on undulating terrain. Relevé completed in the 0.6 ha of Excellent vegetation.	Survey effort: CHR07 Native species richness: 14 Weed species richness: 3 Area: 3.03 ha, represents 4% of vegetation Condition: Good to Excellent	
BmAcPo *Banksia menziesii* and *Banksia attenuata* low open woodland over *Adenanthos cygnorum* subsp*. cygnorum, Regelia ciliata* and *Acacia pulchella* open shrubland over *Patersonia occidentalis, *Carpobrotus edulis* and *Dampiera linearis* forbland*.* Represents Banksia Woodland TEC. It was located on white-grey sandy soil on flat terrain.	Survey effort: NSR08 Native species richness: 19 Weed species richness: 7 Area: 0.1 ha, represents <1% of vegetation Condition: Very Good	

Description	Additional Detail	Photograph
BmEpLi *Banksia menziesii, Banksia attenuata, Allocasuarina fraseriana* low open woodland over *Eremaea purpurea, Hibbertia hypercoides* and *Macrozamia fraseri* open shrubland over *Lyginia imerbis, Lepidosperma leptostachyum* and *Mesomelaena pseudostygia* sedgeland. Represents Banksia Woodland TEC. It was located on white sandy soil on gently undulating terrain.	Survey effort: CHQ11, CHQ12 and CHQ13 Native species richness: 68 Weed species richness: 7 Area: 8.88 ha, represents 11% of vegetation Condition: Excellent	
Eucalypt Woodlands		
CcXpDf *Corymbia calophylla, Eucalyptus marginata* and *Banksia attenuata* open woodland over *Xanthorrhoea preissii, Jacksonia floribunda* and *Leucopogon pulchellus* shrubland over *Desmocladus flexuosus, Lomandra micrantha* and *Dasypogon bromeliifolius* forbland. It was located on grey sandy soil on flat terrain. Under-represented with only one relevé completed.	Survey effort: CHR10 Native species richness: 20 Weed species richness: 4 Area: 3.30 ha, represents 4% of vegetation Condition: Very Good to Excellent	

Description	Additional Detail	Photograph
EgGlCe *Eucalyptus gomphocephala, Eucalyptus rudis* and *Banksia grandis* open woodland over *Gastrolobium linearifolium, Kunzea glabrescens* and *Xanthorrhoea preissii* over **Carpobrotus edulis, *Disa bracteata* and **Euphorbia terracina* sparse forbland. It was located on grey sandy soil on flat terrain.	Survey effort: CHQ08, NSR06, CHR06 Native species richness: 28 Weed species richness: 14 Area: 1.37 ha, represents 2% of vegetation Condition: Degraded and Very Good	
Wetland		
MpHaDb *Melaleuca preissiana* and **Pinus pinaster* woodlands over *Hypocalymma angustifolium, Kunzea glabrescens* and **Acacia longifolia* subsp. *longifolia* shrubland over *Dasypogon bromeliifolius, Dianella revoluta* and **Carpobrotus edulis* forbland. Represents a degraded isolated wetland. Could be representative of other wetlands mapped in survey area but difficult to tell due to degradation. Represents riparian vegetation. It was located on white-grey sandy soil on sloped terrain.	Survey effort: NSR09 Native species richness: 8 Weed species richness: 8 Area: 0.58 ha, represents 1% of vegetation Condition: Good	

Description	Additional Detail	Photograph
MpHaEc *Melaleuca preissiana* woodlands over *Hypocalymma angustifolium, Kunzea glabrescens* and *Jacksonia furcellata* shrubland over **Ehrharta calycina* and *Microlaena stipoides* grassland. Represents riparian vegetation situated on the edge of a basin that is likely to be winter-wet. Has an association with surface and/or groundwater hydrology. It was located on grey sandy soil on sloped terrain.	Survey effort: CHQ09 Native species richness: 10 Weed species richness: 6 Area: 0.12 ha, represents <1% of vegetation Condition: Very Good	
MpXpDb *Melaleuca preissiana open woodland* over *Xanthorrhoea preissii, Banksia dallanneyi* and *Beaufortia elegans* open shrubland over *Dasypogon bromeliifolius, Desmocladus fasciculatus* and *Patersonia occidentalis* closed forbland. Likely represents remnant native vegetation in an ephemeral wetland, although it is not mapped as a known geomorphic wetland. It was located on grey sandy soil on low flat terrain.	Survey effort: CHR09 Native species richness: 12 Weed species richness: 3 Area: 0.38 ha, represents <1% of vegetation Condition: Excellent	
Disturbed Native Vegetation		
Trees	Survey effort: observations only	

Description	Additional Detail	Photograph
Scattered native species including but not limited to *Eucalyptus, Banksia, Acacia, Xanthorrhoea* and *Melaleuca* species. Soil type and terrain varied throughout the survey area.	Area: 8.13 ha, represents 11% of vegetation Condition: Completely Degraded	
PpAcCe Pine regrowth **Pinus pinaster* tall, isolated trees over *Adenanthos cygnorum* var. *cygnorum*, *Xanthorrhoea preissii* and *Macrozamia fraseri* tall to mid sparse shrubland over **Carpobrotus edulis, *Pelargonium capitatum* and **Ornithopus pinnatus* low sparse forbland. Includes isolated occurrences of common native species *E. todtiana, E. marginata, Acacia pulchella, Hemiandra pungens, Lechenaultia floribunda, Jacksonia furcellata.* Located on grey-white sandy soil with terrain varying throughout the survey area.	Survey effort: CHR08, NSR07 Native species richness: 22 Weed species richness: 15 Area: 48.08 ha, represents 62% of vegetation Condition: Completely Degraded and Degraded	
Non-Native Vegetation		
Planted Dominated by **Pinus pinaster* or planted street trees/shrubs. Soil type and terrain varied throughout the survey area.	Survey effort: observations only Area: 15.07 ha	N/A

8.1.2 Conservation Significant Vegetation

Eight patches of Banksia Woodland TEC were assessed against the key diagnostic characteristics outlined in the DEE (2016) Conservation Advice. All eight patches met the key characteristics, size and condition threshold to be considered representative of the federally protected ecological community. The Banksia Woodlands TEC is mapped for 15.13 ha, shown in Figure 8. Detailed assessments are provided below.

Three patches of Tuart Woodlands TEC were assessed against the key diagnostic characteristics outlined in the DEE (2019) Conservation Advice. One of these represents the federally protected ecological community, mapped for 1.71 ha. Detailed assessments are provided below.

8.1.2.1 Banksia Woodlands TEC Assessments

Patch 4 (Table 50) represents Banksia Woodlands located on Hawkins Road, on the edge of Jandabup Nature Reserve. The patch is 0.60 ha within the survey area and is part of a larger patch greater than 4 ha. It is in Excellent condition, represents the federal TEC and FCT 21c – a Priority 3 PEC.

Patch 5 (Table 51) represents Banksia Woodlands located in Gnangara State Forest east of Lake Gnangara. The patch is 2.26 ha as part of a larger patch approximately 100 ha. It is in Good to Excellent condition, represents the federal TEC and FCT 23a.

Patch 6 (Table 52) represents Banksia Woodlands within Neerabup Terminal in Wanneroo. The patch is 3.03 ha within the survey area and is not part of a larger patch. It is in Good to Excellent condition. No FCT was inferred for this patch. It represents the federal TEC.

Patch 7 (Table 53) represents regenerated native vegetation in Gnangara State Forest. The patch is 0.10 ha within the survey area and is part of a larger patch greater than 10 ha. It is in Very Good condition. No FCT was inferred for this patch. It represents the federal TEC.

Patch 8 (Table 54) represents Banksia Woodlands within Gnangara State Forest south of Neaves Road. The patch extends for 0.72 ha within the survey area and is part of a larger patch greater than 17 ha. It is in Excellent condition and represents FCT 23a. It represents the federal TEC.

Patch 9 (Table 55) represents Banksia Woodland within Gnangara State Forest, north of Gnangara Road. The patch extends 8.16 ha and is part of a larger, greater than 200 ha patch. It is in Excellent condition and represents FCT 23a. It represents the federal TEC.

Patch 10 (Table 56) and Patch 11 (Table 57) represent Banksia Woodlands that extend from the road verge within the survey area (largely Degraded) into private property. Patch assessments are based on observations made from the edge as any accessible areas were Degraded and not representative of the values of the patch observed within the property. In both cases, the Banksia Woodland outside the survey area was considered in Very Good condition. The patches represent areas of 0.17 ha and 0.09 ha within the survey area respectively and are part of larger patches more than 5 ha. This assumes that inaccessible vegetation is in similar condition and of similar diversity. These patches represent the federal TEC.

Table 50 Patch 4 Banksia TEC Assessment

<table>
<tr><td>ID</td><td>Patch 4</td></tr>
<tr><td>Date</td><td>CHQ10, scored on 20-Oct-23</td></tr>
<tr><td>Location</td><td>On Hawkins Road, on the edge of Jandabup Nature Reserve.</td></tr>
<tr><td>Patch vegetation description</td><td>Represents BaAcDf, described in Section 8.1.1</td></tr>
<tr><td>Structure</td><td>Low open woodland</td></tr>
<tr><td>Tree Data incl. height, canopy percent cover and dominance</td><td>
<table>
<tr><th rowspan="2">Species</th><th colspan="2">CHQ10</th></tr>
<tr><th>Ht</th><th>Cover</th></tr>
<tr><td>B. attenuata</td><td>800</td><td>40</td></tr>
<tr><td>B. menziesii</td><td>700</td><td>15</td></tr>
</table>
</td></tr>
<tr><td>Native understorey present (%) and diversity</td><td>Excludes trees.
<table>
<tr><th>Species</th><th>CHQ10</th></tr>
<tr><td>Cover (%)</td><td>86.7</td></tr>
<tr><td>Diversity total</td><td>25</td></tr>
</table>
</td></tr>
<tr><td>Weed cover (%) and dominant weed species</td><td>
<table>
<tr><th>Species</th><th>CHQ10</th></tr>
<tr><td>Cover (%)</td><td>6.3</td></tr>
<tr><td>Dominant species</td><td>*Briza maxima</td></tr>
</table>
</td></tr>
<tr><td>Soil type and colour</td><td>Grey sand</td></tr>
<tr><td>Landform</td><td>Undulating terrain</td></tr>
<tr><td>Size of patch</td><td>Within survey area: 0.60 ha
Estimated total extent: 4.08 ha</td></tr>
<tr><td>Summary</td><td>This patch connects to other native vegetation, is mapped as Excellent condition and extends beyond the survey area boundary for over 4 ha. The patch meets the condition and size thresholds to be considered representative of the Commonwealth listed TEC.
It represents FCT 21c, a Priority 3 Ecological Community.</td></tr>
<tr><td>Photograph</td><td>  </td></tr>
</table>

Table 51 Patch 5 Banksia TEC Assessment

<table>
<tr><td>ID</td><td>Patch 5</td></tr>
<tr><td>Date</td><td>Quadrats CHQ14 scored on 6-Nov-23, CHQ15 scored on 8-Nov-23</td></tr>
<tr><td>Location</td><td>Gnangara State Forest, to the east of Lake Gnangara.</td></tr>
<tr><td>Patch vegetation description</td><td>Represents BaAhDf, described in Section 8.1.1</td></tr>
<tr><td>Structure</td><td>Low open woodland</td></tr>
<tr><td>Tree Data incl. height, canopy percent cover and dominance</td><td>Low Banksia cover in CHQ15 is attributed to Quadrat placement rather than a reflection of Banksia absence.
<table>
<tr><th rowspan="2">Species</th><th colspan="2">CHQ14</th><th colspan="2">CHQ15</th></tr>
<tr><th>Ht</th><th>Cover</th><th>Ht</th><th>Cover</th></tr>
<tr><td>B. attenuata</td><td>600</td><td>4</td><td>800</td><td>15</td></tr>
<tr><td>B. menziesii</td><td>500</td><td>3.5</td><td>-</td><td>-</td></tr>
<tr><td>E. todtiana</td><td>250</td><td>2</td><td>-</td><td>-</td></tr>
</table></td></tr>
<tr><td>Native understorey present (%) and diversity</td><td>Excludes trees.
<table>
<tr><th>Species</th><th>CHQ14</th><th>CHQ15</th></tr>
<tr><td>Cover (%)</td><td>89.3</td><td>107.9</td></tr>
<tr><td>Diversity total</td><td>30</td><td>27</td></tr>
</table></td></tr>
<tr><td>Weed cover (%) and dominant weed species</td><td>
<table>
<tr><th>Species</th><th>CHQ14</th><th>CHQ15</th></tr>
<tr><td>Cover (%)</td><td>11.2</td><td>10.9</td></tr>
<tr><td>Dominant species</td><td>*Pentameris airoides</td><td>*Ursinia anthemoides</td></tr>
</table></td></tr>
<tr><td>Soil type and colour</td><td>White sand</td></tr>
<tr><td>Landform</td><td>Undulating terrain</td></tr>
<tr><td>Size of patch</td><td>Within survey area: 2.26 ha
Estimated total extent: >100 ha</td></tr>
<tr><td>Summary</td><td>The patch within the survey area represents the edge of a patch in Excellent condition. Within the survey area vegetation is mapped as Degraded, Good and Very Good with a small area along the northern edge mapped as Excellent. Adjacent vegetation outside the survey area is in Excellent condition and part of a large, connected area of native vegetation surrounding Lake Gnangara.</td></tr>
<tr><td>Photograph</td><td>  </td></tr>
</table>

Table 52 Patch 6 Banksia TEC Assessment

<table>
<tr><td>ID</td><td>Patch 6</td></tr>
<tr><td>Date</td><td>Relevé CHR07 scored on 19-Oct-23</td></tr>
<tr><td>Location</td><td>Inside the fenced area within Neerabup Terminal.</td></tr>
<tr><td>Patch vegetation description</td><td>Represents BaRcGt – described in Section 8.1.1</td></tr>
<tr><td>Structure</td><td>Low open woodland</td></tr>
<tr><td>Tree Data incl. height, canopy percent cover and dominance</td><td>
<table>
<tr><th rowspan="2">Species</th><th colspan="2">CHR07</th></tr>
<tr><th>Ht</th><th>Cover</th></tr>
<tr><td>B. attenuata</td><td>500</td><td>7</td></tr>
<tr><td>B. menziesii</td><td>400</td><td>5</td></tr>
<tr><td>E. rudis</td><td>800</td><td>3</td></tr>
</table>
</td></tr>
<tr><td>Native understorey present (%) and diversity</td><td>Excludes trees.
<table>
<tr><th>Species</th><th>CHR07</th></tr>
<tr><td>Cover (%)</td><td>36.7</td></tr>
<tr><td>Diversity total</td><td>11</td></tr>
</table>
</td></tr>
<tr><td>Weed cover (%) and dominant weed species</td><td>
<table>
<tr><th>Species</th><th>CHR07</th></tr>
<tr><td>Cover (%)</td><td>0.7</td></tr>
<tr><td>Dominant species</td><td>*Carpobrotus edulis</td></tr>
</table>
</td></tr>
<tr><td>Soil type and colour</td><td>White sand</td></tr>
<tr><td>Landform</td><td>Gently undulating terrain</td></tr>
<tr><td>Size of patch</td><td>Within survey area: 3.03 ha</td></tr>
<tr><td>Summary</td><td>Banksia Woodland is isolated to within the Neerabup Terminal, disconnected from other areas of native vegetation by industrial development and internal roads.
Vegetation condition varied from Good to Excellent representing historical disturbance and partial clearing.
Patch meets size and condition thresholds.
Represents natural regeneration, as Landgate aerial imagery shows the vegetation was absent in 2010 (Plate 15).
.</td></tr>
<tr><td>Photograph</td><td>  </td></tr>
</table>

Table 53 Patch 7 Banksia TEC Assessment

<table>
<tr><td>ID</td><td>Patch 7</td></tr>
<tr><td>Date</td><td>NSR08 scored on 20-Oct-23</td></tr>
<tr><td>Location</td><td>South of Neaves Road, west of Buloke Road in Gnangara State Forest</td></tr>
<tr><td>Patch vegetation description</td><td>BmAcPo – described in Section 8.1.1</td></tr>
<tr><td>Structure</td><td>Low open woodland</td></tr>
<tr><td>Tree Data incl. height, canopy percent cover and dominance</td><td>
<table>
<tr><th rowspan="2">Species</th><th colspan="2">NSR08</th></tr>
<tr><th>Ht</th><th>Cover</th></tr>
<tr><td>B. attenuata</td><td>600</td><td>4</td></tr>
<tr><td>B. menziesii</td><td>400</td><td>5</td></tr>
</table>
</td></tr>
<tr><td>Native understorey present (%) and diversity</td><td>Excludes trees.
<table>
<tr><th>Species</th><th>NSR08</th></tr>
<tr><td>Cover (%)</td><td>24.7</td></tr>
<tr><td>Diversity total</td><td>17</td></tr>
</table>
</td></tr>
<tr><td>Weed cover (%) and dominant weed species</td><td>
<table>
<tr><th>Species</th><th>NSR08</th></tr>
<tr><td>Cover (%)</td><td>0.9</td></tr>
<tr><td>Dominant species</td><td>No dominant</td></tr>
</table>
</td></tr>
<tr><td>Soil type and colour</td><td>Grey sand</td></tr>
<tr><td>Landform</td><td>Undulating terrain</td></tr>
<tr><td>Size of patch</td><td>Within survey area: 0.10 ha
Estimated total extent: >10 ha</td></tr>
<tr><td>Summary</td><td>Banksia Woodlands mapped as Very Good condition. Represents part of a larger patch that is connected to native vegetation. Intersected by various tracks and fence lines.
Patch meets size and condition thresholds.</td></tr>
<tr><td>Photograph</td><td>  </td></tr>
</table>

Table 54 Patch 8 Banksia TEC Assessment

<table>
<tr><td>ID</td><td>Patch 8</td></tr>
<tr><td>Date</td><td>Quadrat CHQ11 scored on 20-Oct-23</td></tr>
<tr><td>Location</td><td>Gnangara State Forest, south of Neaves Road.</td></tr>
<tr><td>Patch vegetation description</td><td>BmEpLi – described in Section 8.1.1</td></tr>
<tr><td>Structure</td><td>Low open woodland</td></tr>
<tr><td>Tree Data incl. height, canopy percent cover and dominance</td><td>
<table>
<tr><th rowspan="2">Species</th><th colspan="2">CHQ11</th></tr>
<tr><th>Ht</th><th>Cover</th></tr>
<tr><td>B. attenuata</td><td>650</td><td>3</td></tr>
<tr><td>B. menziesii</td><td>750</td><td>12</td></tr>
<tr><td>Allocasuarina fraseriana</td><td>800</td><td>5</td></tr>
</table>
</td></tr>
<tr><td>Native understorey present (%) and diversity</td><td>Excludes trees.
<table>
<tr><th>Species</th><th>CHQ11</th></tr>
<tr><td>Cover (%)</td><td>20.8</td></tr>
<tr><td>Diversity total</td><td>21</td></tr>
</table>
</td></tr>
<tr><td>Weed cover (%) and dominant weed species</td><td>
<table>
<tr><th>Species</th><th>CHQ11</th></tr>
<tr><td>Cover (%)</td><td>2.4</td></tr>
<tr><td>Dominant species</td><td>* Pentameris airoides</td></tr>
</table>
</td></tr>
<tr><td>Soil type and colour</td><td>Grey sand</td></tr>
<tr><td>Landform</td><td>Flat</td></tr>
<tr><td>Size of patch</td><td>Within survey area: 0.72 ha
Estimated total extent: >17 ha</td></tr>
<tr><td>Summary</td><td>Banksia Woodland in Excellent condition with high connectivity to areas of native vegetation. Patch represents FCT 23a. Some weeds were present. Patch meets size and condition thresholds.</td></tr>
<tr><td>Photograph</td><td>  </td></tr>
</table>

Table 55 Patch 9 Banksia TEC Assessment

<table>
<tr><td>ID</td><td>Patch 9</td></tr>
<tr><td>Date</td><td>Quadrats CHQ12 on 20-Oct-23, CHQ13 on 6-Nov-23</td></tr>
<tr><td>Location</td><td>Gnangara State Forest, north of Gnangara Road.</td></tr>
<tr><td>Patch vegetation description</td><td>BmEpLi – described in Section 8.1.1</td></tr>
<tr><td>Structure</td><td>Low open woodland</td></tr>
<tr><td>Tree Data incl. height, canopy percent cover and dominance</td><td>
<table>
<tr><th rowspan="2">Species</th><th colspan="2">CHQ12</th><th colspan="2">CHQ13</th></tr>
<tr><th>Ht</th><th>Cover</th><th>Ht</th><th>Cover</th></tr>
<tr><td>B. attenuata</td><td>700</td><td>10</td><td>800</td><td>6</td></tr>
<tr><td>B. menziesii</td><td>500</td><td>5</td><td>700</td><td>3</td></tr>
</table>
</td></tr>
<tr><td>Native understorey present (%) and diversity</td><td>Excludes trees.
<table>
<tr><th>Species</th><th>CHQ12</th><th>CHQ13</th></tr>
<tr><td>Cover (%)</td><td>50.8</td><td>61.4</td></tr>
<tr><td>Diversity total</td><td>46</td><td>38</td></tr>
</table>
</td></tr>
<tr><td>Weed cover (%) and dominant weed species</td><td>
<table>
<tr><th>Species</th><th>CHQ12</th><th>CHQ13</th></tr>
<tr><td>Cover (%)</td><td>1.5</td><td>1.2</td></tr>
<tr><td>Dominant species</td><td>No dominant</td><td>*Ursinia anthemoides</td></tr>
</table>
</td></tr>
<tr><td>Soil type and colour</td><td>White-grey sand</td></tr>
<tr><td>Landform</td><td>Gentle slopes, undulating terrain.</td></tr>
<tr><td>Size of patch</td><td>Within survey area: 8.16 ha
Estimated total extent: >200 ha</td></tr>
<tr><td>Summary</td><td>Patch meets size and condition thresholds.
This patch is part of a large area of Banksia Woodland in Gnangara State Forest in Excellent condition. Diversity was high. Patch represents FCT 23a.</td></tr>
<tr><td>Photograph</td><td>  </td></tr>
</table>

Table 56 Patch 10 Banksia TEC Assessment

<table>
<tr><td>ID</td><td>Patch 10</td></tr>
<tr><td>Date</td><td>No sample site, patch observed from the edge.</td></tr>
<tr><td>Location</td><td>Located on Badgerup Road, south of Ashby Street and north of Jambanis Road.</td></tr>
<tr><td>Patch vegetation description</td><td>BaAcDf</td></tr>
<tr><td>Structure</td><td>Low open woodland</td></tr>
<tr><td>Tree Data incl. height, canopy percent cover and dominance</td><td>
<table>
<tr><th rowspan="2">Species</th><th colspan="2">Opportunistic Estimate</th></tr>
<tr><th>Ht</th><th>Cover</th></tr>
<tr><td>B. attenuata</td><td>600</td><td>10</td></tr>
<tr><td>B. menziesii</td><td>500</td><td>5</td></tr>
<tr><td>E. marginata</td><td>300</td><td>5</td></tr>
</table>
</td></tr>
<tr><td>Native understorey present (%) and diversity</td><td>Unable to be verified by quadrat data.</td></tr>
<tr><td>Weed cover (%) and dominant weed species</td><td>Unable to be verified by quadrat data.</td></tr>
<tr><td>Soil type and colour</td><td>White/grey sand</td></tr>
<tr><td>Landform</td><td>Flat</td></tr>
<tr><td>Size of patch</td><td>Within survey area: 0.17 ha
Estimated total extent: >5 ha</td></tr>
<tr><td>Summary</td><td>The assessment relied on observations made from the edge. Visual observation determined a condition rating of ‘Very Good’ is applicable. The patch represents part of a larger area greater than 2 ha. As such, the patch is considered representative of the federally listed TEC.</td></tr>
<tr><td>Photograph</td><td>  </td></tr>
</table>

Table 57 Patch 11 Banksia TEC Assessment

<table>
<tr><td>ID</td><td>Patch 11</td></tr>
<tr><td>Date</td><td>No sample site, patch observed from the edge.</td></tr>
<tr><td>Location</td><td>Located on the corner of Lenore Road and Mary Street, Wanneroo, WA.</td></tr>
<tr><td>Patch vegetation description</td><td>BaAcDf</td></tr>
<tr><td>Structure</td><td>Low open woodland</td></tr>
<tr><td>Tree Data incl. height, canopy percent cover and dominance</td><td>
<table>
<tr><th rowspan="2">Species</th><th colspan="2">Opportunistic Estimate</th></tr>
<tr><th>Ht</th><th>Cover</th></tr>
<tr><td>B. attenuata</td><td>500</td><td>20</td></tr>
<tr><td>B. menziesii</td><td>400</td><td>15</td></tr>
</table>
</td></tr>
<tr><td>Native understorey present (%) and diversity</td><td>Unable to be verified by quadrat data.</td></tr>
<tr><td>Weed cover (%) and dominant weed species</td><td>Unable to be verified by quadrat data.</td></tr>
<tr><td>Soil type and colour</td><td>White-grey sand</td></tr>
<tr><td>Landform</td><td>Flat</td></tr>
<tr><td>Size of patch</td><td>Within survey area: 0.09 ha
Estimated total extent: >5 ha</td></tr>
<tr><td>Summary</td><td>The assessment relied on observations made from the edge. Visual observation determined a condition rating of ‘Good’ or potentially higher is applicable. The patch represents part of a larger area greater than 2 ha. As such, the patch is considered representative of the federally listed TEC.</td></tr>
<tr><td>Photograph</td><td>  </td></tr>
</table>

8.1.2.2 Tuart Woodlands TEC Assessment

The three Tuart Woodland patches, including two verified as the Tuart Woodland TEC (Patch 4 and 5) are described below.

Patch 3

Patch 3 is located adjacent to Old Yanchep Road and the Neerabup Terminal and consists of minimal remnant vegetation with a limited understorey. The area is in Degraded condition, with only one native understorey species present. As the size of Patch 3 is greater than 0.5 ha but less than 5 ha in total, patch size condition thresholds apply. The patch does not meet the key diagnostic characteristics for the federally protected ecological community due to its small size and lack of a native understorey. The assessment is presented Table 58.

Table 58 Patch 3 Tuart Woodlands TEC assessment

<table>
<tr><td>Patch identification and location</td><td>The patch is located to the east of Old Yanchep Road, and west of Neerabup Terminal.</td></tr>
<tr><td>Key diagnostic characteristics</td><td>Yes
Occurs on Swan Coastal Plain.
Occurs on the Bassendean System.
Six mature (DBH >500 mm) E. gomphocephala trees were counted.
Patch 3 occurs as an open woodland.
Minimal native understorey was present, indicative of disturbance.</td></tr>
<tr><td>Species richness</td><td>Key indicators for the condition thresholds are outlined in the table below.<table><tr><th>Parameter</th><th>CHR06</th></tr><tr><td>Proportion of understorey foliage that is native</td><td>22.2%</td></tr><tr><td>Native species richness</td><td>2</td></tr></table></td></tr>
<tr><td>Condition</td><td>Poor condition (DEE, 2019) and Degraded (Keighery, 1994).</td></tr>
<tr><td>Size</td><td>0.68 ha</td></tr>
<tr><td>Variety within patch</td><td>The patch is small and has minimal variety within it. It consists of mature Tuart trees over one native shrub species and cleared / common pasture weeds.</td></tr>
<tr><td>Additional information e.g. buffer, connectedness, land use history</td><td>The patch is disconnected from other Tuart Woodland patches due to historical clearing. One native understorey species was observed: Xanthorrhoea preissii</td></tr>
</table>



Plate 13 Tuart Woodlands Patch 3

Patch 4

Patch 4 represents an area of Tuart Woodland east of Neerabup Terminal. The total area of Patch 4 is 1.71 ha and is restricted to the survey area. Condition thresholds are applicable. An assessment against the key diagnostic characteristics was undertaken, and condition was determined using quadrat data. The quadrat data indicates that the patch is somewhere between Very high and high condition with 12 native understorey species, but not more than 80% of the understorey is represented by native species.

In accordance with the condition and size thresholds, the patch would have to represent high condition understorey and either have an important landscape role, a habitat role, or show regeneration. This particular patch supports two mature Tuart trees with a DBH greater than 50 cm. As such, it meets the key diagnostic characteristics for the federally protected ecological community. The assessment is presented in Table 59 and mapped in Figure 8.

Table 59 Patch 5 Tuart Woodlands TEC assessment

<table>
<tr><td>Patch identification and location</td><td>Located to the east of Neerabup Terminal. The patch is represented by CHQ08.</td></tr>
<tr><td>Key diagnostic characteristics</td><td>Yes
Occurs on Swan Coastal Plain.
Occurs on the Bassendean System.
More than 37 mature (DBH >500 mm) E. gomphocephala trees were counted within the survey area.
Patch 4 occurs as an open woodland.
Includes native understorey species that vary in density reflective of level of disturbance.</td></tr>
<tr><td>Species richness</td><td>Key indicators for the condition thresholds are outlined in the table below.<table><tr><th>Parameter</th><th>CHQ08</th></tr><tr><td>Proportion of understorey foliage that is native</td><td>63.2%</td></tr><tr><td>Native species richness</td><td>12</td></tr></table></td></tr>
<tr><td>Condition</td><td>High condition (DEE, 2019).
Mapped as Very Good condition.</td></tr>
<tr><td>Size</td><td>Within survey area: 1.71 ha excluding non-native vegetation.
Does not extend beyond the survey area.</td></tr>
<tr><td>Variety within patch</td><td>The patch is open woodland, with minor variation in the density of understorey shrubs attributed to historical disturbance. Common introduced weeds have displaced native herbs.</td></tr>
<tr><td>Additional information e.g. buffer, connectedness, land use history</td><td>The patch represents rehabilitated land. Landgate aerial imagery shows the vegetation was absent in 2010 (Plate 15). It is disconnected from other patches of Tuart Woodland.</td></tr>
</table>



Plate 14 Tuart Woodlands Patch 4



Plate 15 Historically cleared areas within Neerabup Terminal: 2010 to current

Patch 5

Patch 5 represents Tuart Woodland east of Ziatas Road, west of Neerabup Terminal. The total area of Patch 5 (excluding non-native vegetation mapped as Cleared or Planted) is 1.63 ha and it does not extend beyond the survey area. Condition thresholds are applicable.

An assessment against the key diagnostic characteristics was undertaken, and condition was determined using a quadrat and additional observational points. Patches that are <2ha representing 'High' condition will have to have:

- an important landscape role <100 m from native vegetation
- OR have a habitat role with more than 2 large trees per 0.5 ha
- OR show regeneration with more than 15 seedlings or saplings per 0.5 ha.

Patch 5 represents an isolated linear occurrence of a stand of *Eucalyptus gomphocephala* trees surrounded by Pine, the power station, and cleared areas. It does not have an important landscape role, or a habitat role. The area supports a suite of trees that are all similar age, between a sapling and adult tree with DBH approximately 15- 20 cm. No new recruits were recorded. The southern half of the Tuart TEC is mapped as Degraded, reflecting the lack of native understorey and regular pruning under powerlines.

Based on the above, this patch is not considered representative of the Tuart Woodlands TEC.

The assessment is presented in Table 27 and Figure 8.

Table 60 Patch 4 Tuart Woodlands TEC assessment

<table>
<tr><td>Patch identification and location</td><td>The patch is located to the east of Ziatas Road, and west of Neerabup Terminal. The patch is represented by NSR06, scored on 19-Oct-2023.</td></tr>
<tr><td>Key diagnostic characteristics</td><td>Yes
Occurs on Swan Coastal Plain.
Occurs on the Bassendean System.
Patch 5 occurs as an open woodland.
Includes native understorey species in the top half of the Tuart TEC.</td></tr>
<tr><td>Species richness</td><td>Key indicators for the condition thresholds are outlined in the table below.<table><tr><th>Parameter</th><th>NSR06</th></tr><tr><td>Proportion of understorey foliage that is native</td><td>66.7%</td></tr><tr><td>Native species richness</td><td>17</td></tr></table></td></tr>
<tr><td>Condition</td><td>More than 60% is native and there are 17 native species. The condition is considered 'High' (DEE, 2019) and Very Good (Keighery, 1994). The southern end of the Patch is mapped as Degraded.</td></tr>
<tr><td>Size</td><td>Within survey area: 1.63 ha.
Does not extend outside the survey area.</td></tr>
<tr><td>Variety within patch</td><td>The patch is open woodland, with understorey varying in response to historical disturbance. Common introduced weeds displacing many smaller herbs and annual native species.</td></tr>
<tr><td>Additional information e.g. buffer, connectedness, land use history</td><td>The patch represents rehabilitated vegetation following clearing in 2010 (Plate 15).
It is disconnected from other areas of native vegetation by roads, clearing for plantations and industrial development.</td></tr>
</table>



Plate 16 Tuart Woodlands Patch 5

8.1.2.3 State-Listed Ecological Communities

Three PECs are confirmed within the survey area including:

- FCT 21c Low lying Banksia attenuata woodlands or shrublands (Priority 3) mapped as Patch 4 Banksia Woodland TEC for 0.60 ha.
- Banksia Dominated Woodlands of the Swan Coastal Plain (Priority 3), synonymous with the Banksia Woodlands TEC where no other listed TEC or PEC associated with an FCT is inferred. This PEC is mapped for 15.13 ha.
- Tuart Woodlands and Forests of the Swan Coastal Plain (Priority 3), synonymous with the Tuart Woodlands TEC where no other listed TEC or PEC associated with an FCT is inferred. This PEC is mapped for 1.71 ha.

Analysis results confidently inferred three FCTs for seven of the eight quadrats analysed. One quadrat was inconclusive. A brief description of each is presented below. The comprehensive results for each quadrat, including similarity percentage, cluster dendrogram results and justification for the inferred FCT, is presented in Table 61.

FCT 21c Low lying *Banksia attenuata* Woodlands or Shrublands

This FCT was inferred for quadrat CHQ10. This quadrat is situated in a low-lying area, potentially winter-wet, and includes an overstorey of *M. preissiana* outside of the quadrat. Species richness is comparable, with an average of 32 spp. compared to 40 spp. in Gibson data. Similarity to FCT 21c was moderate, with 41%. It is likely that this would improve with more scoring events as the FCT is associated with water availability. Edge effects from the road may have also influenced diversity. The quadrat was in Excellent condition vegetation.

FCT 21c represents a Priority 3 Ecological Community.

FCT 23a Central *Banksia attenuata – B. menziesii* Woodlands

Five quadrats represent FCT 23a (11, 12, 13, 14 and 15). These quadrats are situated in various patches of Banksia Woodland along the edge of Gnangara State Forest in Wanneroo. Species richness was comparable (30-53 spp. compared to 52 spp. in the Gibson data). The variation in species richness is a reflection of the degradation of the vegetation associated with proximity to development and weed incursion. Numerous key species were present, and similarity was relatively high (40% to 49%).

FCT23a is not listed as a PEC or TEC and is therefore representative of the Priority 3 Banksia Dominated Woodlands of the Swan Coastal Plain.

FCT 5 *M. preissiana* Damplands

This FCT was inferred for quadrat CHQ09. This quadrat is in a wetland basin with an overstorey of *M. preissiana* as part of an open woodland to forest community. The area is disturbed caused by weed invasion typical of many wetland communities on the Swan Coastal Plain. Wetlands often require multiple scoring events to capture all species present and can be particularly driven by rainfall events. This contributed to low similarity (23%) to the Keighery data and incomparable species richness (10 native spp. compared to average 38.4 spp. in SCP dataset).

FCT 5 does not represent a TEC or PEC but does represent riparian vegetation.

Table 61 Neerabup Terminal and NBT Group floristic community type analysis results

Quadrat	Gibson (1994)				Keighery (2012)				Final Determination
	% Similar	FCT	Site	Dendrogram	% Similar	FCT	Site	Dendrogram	
CHQ08	23	6	card11	Clustering with FCT 6.	24	6	card11	Clustering with FCT 6.	Indeterminate. Low similarity to FCT 6, which is described in Gibson et al. (1994) as 'Weed dominated wetlands on heavy soils. This is not a suitable match, as the community is not a wetland and does not contain *Hypocalymma angustifolium.* The match is likely suggested due to a high presence of weeds and reduced condition.
	22	6	card4		22	6	card4		
	21	6	TWIN-1		22	6	TWIN-1		
CHQ09	23	5	AUSTB-4	Broadly clustering with FCTs 10b, 15 and 14.	28	11	hymus01	Clustering with FCT 14, s07 and s17.	FCT 5, low similarity. The Gibson et al (1994) community description of *Melaleuca preissiana* dominated wetlands with an open understorey is suitable. The mapped community has a sparse understorey below *Melaleuca preissiana*, with a high abundance of weeds likely resulting in the low similarity.
	22	11	hymus01		24	4	perth10		
	21	28	TRIG-4		24	21c	MODO-2		
CHQ10	41	21c	FL-5	Clustered with FCT 21a. Outlier of group with FCT 21c and 20c.	41	21a	Cavs10	Outlier of a group including FCTs 23c and 25	FCT 21c, confidently inferred, moderate similarity. Gibson et al (1994) description states that this community is dominated by *Banksia attenuata* and *B. menziesii* and often occurs in wetter areas. This site within the survey area was present next to a wetland and included species characteristic of the community.
	40	21c	FL-6		40	21c	FL-5		
	37	23a	WIRR-2		39	23a	WIRR-2		
CHQ11	37	23a	hurst03	Outlier, broadly clustering with FCTs 22 and 3b.	41	23b	SF01	Outlier of FCT 23c group	FCT 23a, confidently inferred, moderate similarity. Described as *Banksia attenuata-B. menziesii* woodlands (Gibson et al. 1994). The community description, landform and location are a suitable match.
	36	23a	WARB-3		40	23a	WHITE-1		
	36	23a	WHITE-1		38	23b	BNR03		
CHQ12	54	28	BULL-11	Clustered with FCT 28.	50	28	BULL-11	Clustered with FCT 23c	FCT 23a, confidently inferred, moderate similarity.

Quadrat	Gibson (1994)				Keighery (2012)				Final Determination
	% Similar	FCT	Site	Dendrogram	% Similar	FCT	Site	Dendrogram	
	46	23a	BULL-3		49	23a	perth04		Described as *Banksia attenuata-B. menziesii* woodlands (Gibson et al. 1994). The community description, landform and location are a suitable match.
	45	23b	SINT-1		48	23a	perth08		
CHQ13	48	28	BULL-11	Clustered with FCT 20a.	49	23a	perth08	Outlier of a group including FCTs 23b and s09	FCT 23a, confidently inferred, moderate similarity. Described as *Banksia attenuata-B. menziesii* woodlands (Gibson et al. 1994). The community description, landform and location are a suitable match.
	46	23a	WIRR-1		46	23a	Tele01		
	45	20a	KOON-1		46	20a	KOON-1		
CHQ14	40	20a	KOON-1	Clustered with FCTs 28, 21c and 20c.	51	23b	ELE24	Clustered with FCT 23a.	FCT 23a is suitable, confidently inferred, moderate similarity. Described as *Banksia attenuata-B. menziesii* woodlands (Gibson et al. 1994). The community description, landform and location are a suitable match.
	40	24	THOM-2		43	23a	perth04		
	40	23a	hurst03		43	23a	Tele01		
CHQ15	37	28	KING-2	Outlier. Broadly clustering with FCTs 3b and 22.	44	23a	gnan03	Clustered with FCT 23c and outlier of a group containing 28.	FCT 23a, confidently inferred, moderate similarity. Described as *Banksia attenuata-B. menziesii* woodlands (Gibson et al. 1994). The community description, landform and location are a suitable match.
	35	24	THOM-2		38	23a	Tele01		
	34	21c	FL-5		38	28	KING-2		

8.1.3 Vegetation Condition

Native vegetation was largely Degraded condition (44.60 ha the Swan Coastal Plain. The majority of the survey area follows existing road, track and powerline corridors, with some deviations into areas of intact native vegetation i.e. near Jandabup Lake and in Gnangara State Forest.

Vegetation in Excellent condition was mapped along the edge of intact native vegetation protected as part of Bush Forever Site 326, represented by quadrats CHQ12 and CHQ13, and in isolated occurrences throughout Gnangara State Forest.

Cleared areas represent areas devoid of vegetation (buildings, firebreaks, roads) and are not included in percentage calculations below. Vegetation condition is mapped on Figure 8 and extent of each category is presented in Table 62.

Table 62 Vegetation condition extent

Condition Rating	Extent (ha)	Percent of Total Area
Excellent	13.85	18
Very Good	2.25	3
Good	4.19	5
Degraded	44.60	58
Completely Degraded	12.20	16
Total	**77.09**	**100**
Cleared	124.56	

8.1.4 Conservation Significant Flora

A Priority 4 species *Jacksonia sericea* was collected (CH231108-168) in CHQ15. The sample was submitted to the WAH for formal identification (M. Hislop ACC/10546/E). Mike confirmed the identification and advised the following:

> "*Jacksonia sericea and J. calcicola intergrade to a significant extent in the N Perth suburbs and in its vegetative parts a case could be made for either species in this case. The bright orange standard however is better for the former species*."

Jacksonia sericea was recorded at two locations including in CHQ15 outside the survey area and opportunistically along Gnangara Road within the survey area, shown on Figure 8.

An unknown species, *Calectasia* sp. was collected in the survey area (CH231106-156). The sample was submitted to the WAH for formal identification (M. Hislop ACC/10690/E). Mike has advised whilst this specimen is more likely to be *C. narragarra*, photographs of the root system are needed to verify whether the specimen represents the Priority 2 species *C. elegans*.

This species was recorded within a quadrat (CHQ14) at one location within Banksia Woodland north of Gnangara Road. The location is outside the survey area, mapped on Figure 8.

8.1.5 Flora Inventory

A total of 178 flora species were recorded including and 144 native and 34 weed species. Native species were best represented by Myrtaceae (31 species) and Fabaceae (12 species), followed by Asparagaceae (nine species), and Proteaceae (nine species). One weed listed as a Declared Pest under the BAM Act was recorded, **Asparagus asparagoides*. It was identified within a relevé (NSR08), within a Banksia Woodland community. No species listed as a Weed of National Significance (WONS) were recorded.

A comprehensive species list, organised by family and the community they occur in, is presented in Appendix D. The flora quadrat data is presented in Appendix E.

8.2 Fauna

8.2.1 Fauna Habitat Assessment

Seven fauna habitats representing native vegetation were mapped, including Banksia Woodland, Adenanthos/Plantation, Pine Plantation, Eucalyptus Woodland, Melaleuca Woodland, Trees Over Cleared and Mixed Shrubland. Adenanthos/Plantation (56.61 ha, 27.6%) and Trees Over Cleared (34.65 ha, 16.9%) were the two most dominant habitat types. Fauna habitat types and suitability for significant fauna species is described below and mapped in Figure 9.

8.2.1.1 Banksia Woodland

The Banksia Woodland habitat is abundant throughout the survey area, primarily occurring through the Gnangara State Forest and totalling 15.14 ha (7.5% of the survey area). Overstorey plant species within the community include *Banksia attenuata, Banksia menziesii*, *Eucalyptus todtiana, Eucalyptus rudis, Allocasuarina fraseriana* and *Nuytsia floribunda*. Shrub species included *Acacia pulchella, Acacia sessilis, Adenanthos cygnorum* subsp. *cygnorum, Hibbertia hypericoides, Eremaea purpurea* and *Gompholobium tomentosum* among many others. The density and composition of these shrubs vary throughout the habitat type, with areas in better condition and further from disturbance likely to have greater diversity and foliage cover.

Large logs (>30cm in diameter) are found throughout the Banksia Woodlands habitat type, with small logs (<10cm) occurring more frequently. Bare ground is common, with coarse leaf litter also abundant. The sandy soil in combination with the abundant coarse leaf litter provide suitable habitat for the Swan Coastal Plain Shield-backed Trapdoor Spider *Idiosoma sigillatum* (listed as Priority 3 by DBCA). The Black-striped Snake *Neelaps calonotos* (listed as Priority 3 by DBCA) and the Quenda *Isoodon fusciventer* (listed as Priority 4 by DBCA) would utilise denser areas of understorey for shelter.

Within the Banksia Woodlands habitat type, numerous plant species provide suitable foraging habitat for the three black cockatoo species. Sporadic Eucalyptus trees within the habitat type have the potential to contain hollows which may be suitable for breeding, however these are limited in number.



Plate 17 Banksia Woodland Habitat

8.2.1.2 Adenanthos/Plantation

The Adenanthos/Plantation habitat type is the most abundant throughout the survey area (48.08 ha, 23.8% of the survey area). It consists of isolated pine trees (*Pinus pinaster*) over native regrowth. Regrowth species include Woollybush (*Adenanthos cygnorum var. cygnorum*), Grasstree (*Xanthorrhoea preissii*) and *Macrozamia fraseri*. The habitat type varies in shrub density, with minimal leaf litter present throughout. As the habitat is primarily open, it provides little variety in terms of microhabitats for conservation significant fauna species.



Plate 18 Adenanthos/Plantation

8.2.1.3 Pine Plantation

The Pine (*Pinus pinaster*) plantation habitat is found throughout Gnangara State Forest, with a total of 2.97 ha (1.5% of the survey area). Fine leaf litter occurs consistently throughout, with coarse leaf litter sparse. No understorey is present and large logs are common. The Pine trees provide suitable foraging habitat for Carnaby's Cockatoo but are otherwise limited in their suitability of use for both common and conservation significant fauna species.



Plate 19 Pine Plantation Habitat

8.2.1.4 Eucalyptus Woodland

The Eucalyptus Woodland habitat extends for 4.67 ha (2.3%) within the survey area, extending beyond the survey area boundary. The Eucalyptus Woodland habitat consists of large mature trees, primarily Marri *Corymbia calophylla* and Jarrah *Eucalyptus marginata.*

The habitat has a variable understorey of herbs, sedges, shrubs and grasses, influenced by past disturbances. The ground is covered with thick leaf litter, which offers shelter and food for animals like the Quenda *Isoodon fusciventer* and the Black-striped Snake *Neelaps calonotos*. There are few large logs present, but many small logs and branches are present throughout. The tall trees are used by various birds for foraging, roosting and breeding, including the three threatened species: Carnaby's Cockatoo, Forest Red-tailed Black Cockatoos and Baudin's Cockatoo. Roosting habitat is confirmed within and near the survey area (Black Cockatoo Roosting Sites - Buffered [DBCA-064]).



Plate 20 Eucalyptus Woodland Habitat

8.2.1.5 Melaleuca Woodland

The Melaleuca Woodland habitat consists of remnant native vegetation, dominated by *Melaleuca preissiana* with a variable understorey. The shrub species included within this habitat type include tall shrubs such as *Kunzea glabrescens*, *Jacksonia furcellata* and *Xanthorrhoea preissii*. Ground cover, herb and sedge species vary in their density, including *Dianella revoluta*, *Patersonia occidentalis* and *Dasypogon bromeliifolius*. These low plants, particularly in high density, provide suitable habitat for Quenda to forage and shelter in. Other habitat features include sporadic small logs and occasional coarse leaf litter. The overall habitat type extends for 1.08 ha (0.5% of the survey area), limited to small, isolated pockets spread throughout the survey area.



Plate 21 Melaleuca Woodland Habitat

8.2.1.6 Trees Over Cleared

This is the third-most dominant habitat in the survey area, occurring over 11.66 ha and comprising 5.8% of the survey area. The understorey is comprised mostly of weedy grasses and herbs, with sporadic native shrubs occurring. Plant species which occur within the Trees Over Cleared habitat include isolated trees of *Eucalyptus* and *Banksia* species. Shrubs present primarily include sporadic clusters of *Acacia* and *Adenanthos.*

This habitat consists of sparse bushes and solitary large trees that often serve as a refuge within the surrounding cleared areas for animals such as birds and kangaroos. Hollows and large logs are sparse, with small logs more common throughout. Coarse leaf litter is present under bushes or trees, with grasses covering most of the area. The grasses and the leaf litter offer foraging and shelter opportunities for Quenda, whilst suitable foraging species may be utilised by the three black cockatoo species.

8.2.1.7 Mixed Shrubland

The Mixed Shrubland habitat is restricted in size but provides an ecological niche for smaller animals such as birds and reptiles. It consists of isolated native shrubs as well as planted shrubs in gardens or along the roadside and extends for 8.58 ha (4.3% of the survey area).

Scattered small logs are present, whilst coarse leaf litter and grasses are abundant throughout. The grass and coarse leaf litter provide excellent foraging and shelter for the Quenda *Isoodon fusciventer*.



Plate 22 Mixed Shrubland Habitat

8.2.2 Fauna Inventory

A total of 37 vertebrate fauna species were recorded during the field survey. This comprised of 28 bird, four mammal and five reptile species. A complete inventory of fauna species recorded within the survey area is provided in Table 63.

Two introduced species were recorded, both of which are listed under the BAM Act:

- Feral Cat *Felis catus* (Declared Pest - s22(2)
- European Rabbit *Oryctolagus cuniculus* (Declared Pest - s22(2)).

Table 63 Fauna observations within the Neerabup Terminal and NBT Group survey area

Class	Scientific Name	Common Name	Method
Mammal	*Felis catus*	Feral Cat	Tracks
Mammal	*Isoodon fusciventer*	Quenda	Foraging evidence
Mammal	*Macropus fuliginosus melanops*	Western Grey Kangaroo	Seen
Mammal	*Oryctolagus cuniculus*	European Rabbit	Scats
Mammal	*Equus caballus*	Horse	Seen
Mammal	*Canis lupus familiaris*	Dog	Seen
Bird	*Dacelo novaeguineae*	Laughing Kookaburra	Seen and heard
Bird	*Lichmera indistincta*	Brown Honeyeater	Seen and heard
Bird	*Barnardius zonarius*	Australian Ringneck	Seen and heard
Bird	*Anthochaera carunculata*	Red Wattlebird	Seen and heard
Bird	*Malurus splendens*	Splendid Fairywren	Seen and heard
Bird	*Phylidonyris novaehollandiae*	New Holland Honeyeater	Seen and heard
Bird	*Smicrornis brevirostris*	Weebil	Seen and heard
Bird	*Falco longipennis*	Australian Hobby	Seen and heard
Bird	*Pachycephala rufiventris*	Rufous Whistler	Seen and heard
Bird	*Sericornis maculatus*	Spotted Scrubwren	Seen and heard
Bird	*Rhipidura albiscapa*	Grey Fantail	Seen and heard
Bird	*Colluricincla harmonica*	Grey Shrikethrush	Seen and heard
Bird	*Gymnorhina tibicen*	Australian Magpie	Seen and heard
Bird	*Zosterops lateralis*	Silvereye	Seen and heard
Bird	*Artamus cyanopterus*	Dusky Woodswallow	Seen
Bird	*Rhipidura leucophrys*	Willie Wagtail	Seen and heard
Bird	*Falco cenchroides*	Nankeen Kestrel	Seen
Bird	*Geophaps plumifera*	Spinifex Pigeon	Seen and heard
Bird	*Sericornis maculatus*	Spotted Scrubwren	Seen and heard
Bird	*Artamus cinereus*	Black-faced Woodswallow	Seen and heard
Bird	*Eolophus roseicapilla*	Galah	Seen and heard
Bird	*Falco berigora*	Brown Falcon	Seen
Bird	*Corvus coronoides*	Australian Raven	Seen and heard

Class	Scientific Name	Common Name	Method
Bird	*Cracticus torquatus*	Grey Butcherbird	Seen and heard
Bird	*Trichoglossus moluccanus*	Rainbow Lorikeet	Seen and heard
Bird	*Dromaius novaehollandiae*	Emu	Seen
Bird	*Calyptorhynchus banksia naso*	Forest Red-tailed Black Cockatoo	Seen and heard. Foraging evidence
Bird	*Zanda latirostris*	Carnaby's Cockatoo	Seen and heard. Foraging evidence
Reptile	*Varanus gouldii*	Gould's Monitor	Seen
Reptile	*Pseudonaja affinis*	Dugite	Seen. Tracks also observed
Reptile	*Notechis scutatus*	Tiger Snake	Seen
Reptile	*Tiliqua rugosa rugosa*	Bobtail/Shingleback Lizard	Seen
Reptile	*Ctenotus fallens*	West Coast Laterite Ctenotus	Seen

8.2.3 Conservation Significant Fauna

Three conservation significant fauna species were recorded during the survey:

- Quenda (*Isoodon fusciventer*) listed as Priority 4 by DBCA.
- Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksia naso*) listed as Vulnerable under the EPBC Act and BC Act.
- Carnaby's Cockatoo (*Zanda latirostris*) listed as Endangered under the EPBC Act and BC Act.

Quenda were recorded via distinct foraging evidence (Plate 12). Evidence of conservation significant species is mapped in Figure 9.

An additional six species are considered to have the potential to occur within the survey area due to the presence of suitable habitat and recent records within the surrounding area. The total area (ha) of suitable habitat for these species which occurs within the survey area is included in Table 64 below.