Native Vegetation Clearing Permit Supporting document

Neerabup Resource Recovery Precinct

Prepared for City of Wanneroo

25 March 2025

Project Number: TW25008

DOCUMENT CONTROL

Version	Description	Date	Author	Reviewer	Approver
0.1	First Draft	12/03/2025	DT/QK	LS	
2.0	Final release	25/03/2025	DT/QK	LS	LS

Approval for Release

Name	Position	File Reference
[redacted]	Team lead Mining and Industrial | Principal Environmental Scientist	TW25008_Wanneroo Neerabup_Native Vegetation Clearing Permit_Supporting Documentation_2.0
Signature	[redacted]	

Table of Contents

Tables

Figures

Appendices

1 Introduction

1.1 Background

Talis Consultants (Talis) have been commissioned by the City of Wanneroo (the City) to develop this Native Vegetation Clearing Permit (NVCP) for the clearing associated with the Neerabup Resource Recovery Precinct (NRRP) Master Plan (the Project) located on Lot 600, 570 Wattle Ave, Neerabup.

The Project is located approximately 31km north of Perth, Western Australia (Figure 1-1). The proposed facilities include a waste transfer building, a material recovery facility, a community recycling centre and supporting infrastructure for the southern portion of the NRRP. The NRRP is designed to provide infrastructure for recyclables, organics, and residual waste, including a Waste to Energy (WtE) facility, Material Recovery Facilities (MRF), Food Organics/Garden Organics (FOGO) processing and a Waste Transfer Station (WTS). The NRRP will help address the lack of waste infrastructure in northern Perth while increasing material recovery, generating local employment opportunities and reducing transportation costs and emissions.

Lot 600 covers an area of 47 Hectares (ha) however the buildable area is limited by gas, transport and power services and their easements and restriction zones which are in place across Lot 600. The phased development of the project will start with the facility contained within the boundary of both CPS 6359/3 and this proposed clearing application (Figure 1-2).

Under Section 51C of the *Environmental Protection Act 1986* (EP Act), the clearing of any native vegetation requires an approved clearing permit, unless an exemption applies. This NVCP is to clear 8.90 ha of native vegetation.

1.2 Purpose of Clearing Permit Application

The purpose of this NVCP supporting document is to present the results of an assessment of the clearing aspects of this proposal against the ten clearing principles as outlined in the (then) Departments of Environment Regulation (DER)'s *A guide to the assessment of applications to clear native vegetation* (2014) under Part V Division 2 of the EP Act. This report identifies the potential environmental impacts associated with the proposal based on the best available data. This report and accompanying NVCP Purpose Permit application form will be submitted to DEMIRS for assessment.

1.3 Proposed Timeframes

Clearing is proposed to commence in Q3 2025 with clearing for the facility likely to be completed by 2026.

1.4 Responsible Applicant

City of Wanneroo is responsible for the implementation of the clearing described within this report. Correspondence relating to this NVCP application should be addressed to:

Christopher Forde

Project Director – Strategic Projects

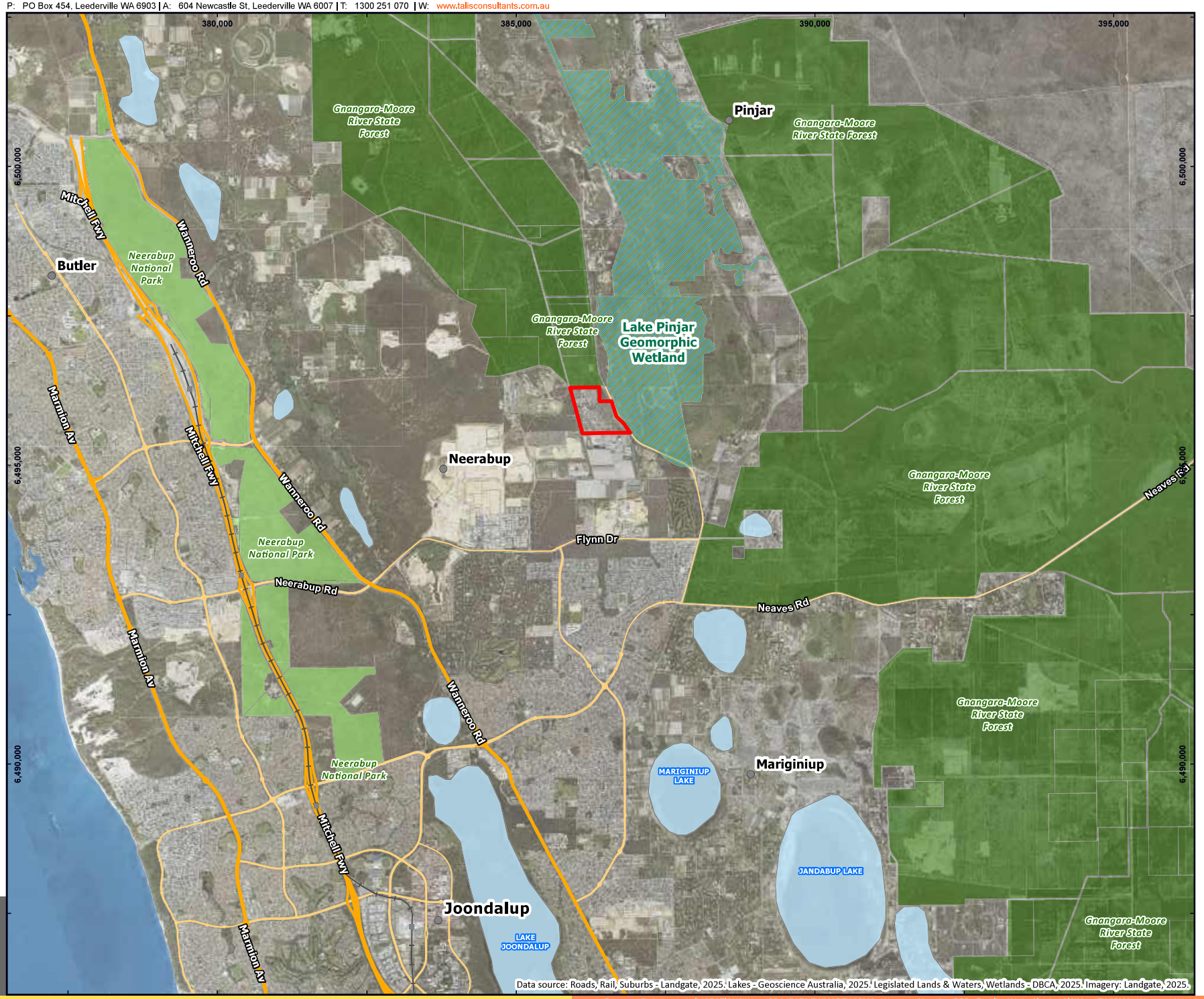
City of Wanneroo

Adress: Locked Bag 1, Wanneroo WA 6946

Phone: 9405 5951

Email: Christopher.forde@wanneroo.wa.gov.au

P: PO Box 454, Leederville WA 6903 | A: 604 Newcastle St, Leederville WA 6007 | T: 1300 251 070 | W: www.talisconsultants.com.au



Data source: Roads, Rail, Suburbs - Landgate, 2025. Lakes - Geoscience Australia, 2025. Legislated Lands & Waters, Wetlands - DBCA, 2025. Imagery: Landgate, 2025.

LEGEND

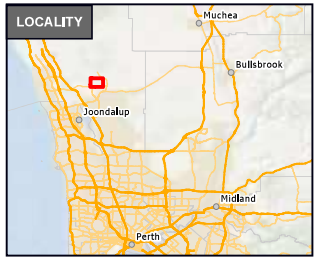
- Lot 600 on DP302260
- National Park
- State Forest
- Lakes
- Conservation Wetlands

Rail Network

- Railway Stations
- Railway Lines

Western Australian Roads

- Freeway / Highway
- Main Road



LOCALITY

Neerabup Resource Recovery Precinct

Native Vegetation Clearing Permit

City of Wanneroo

N
0 500 1,000 1,500 2,000 2,500 m

Coordinate System: GDA2020 MGA Zone 50
Scale @ A3: 1:60,000

Prepared:	E Jackson	Date:	10/03/2025
Reviewed:	D Tills	Revision:	A
Project:	TW25008		

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Figure 1-1

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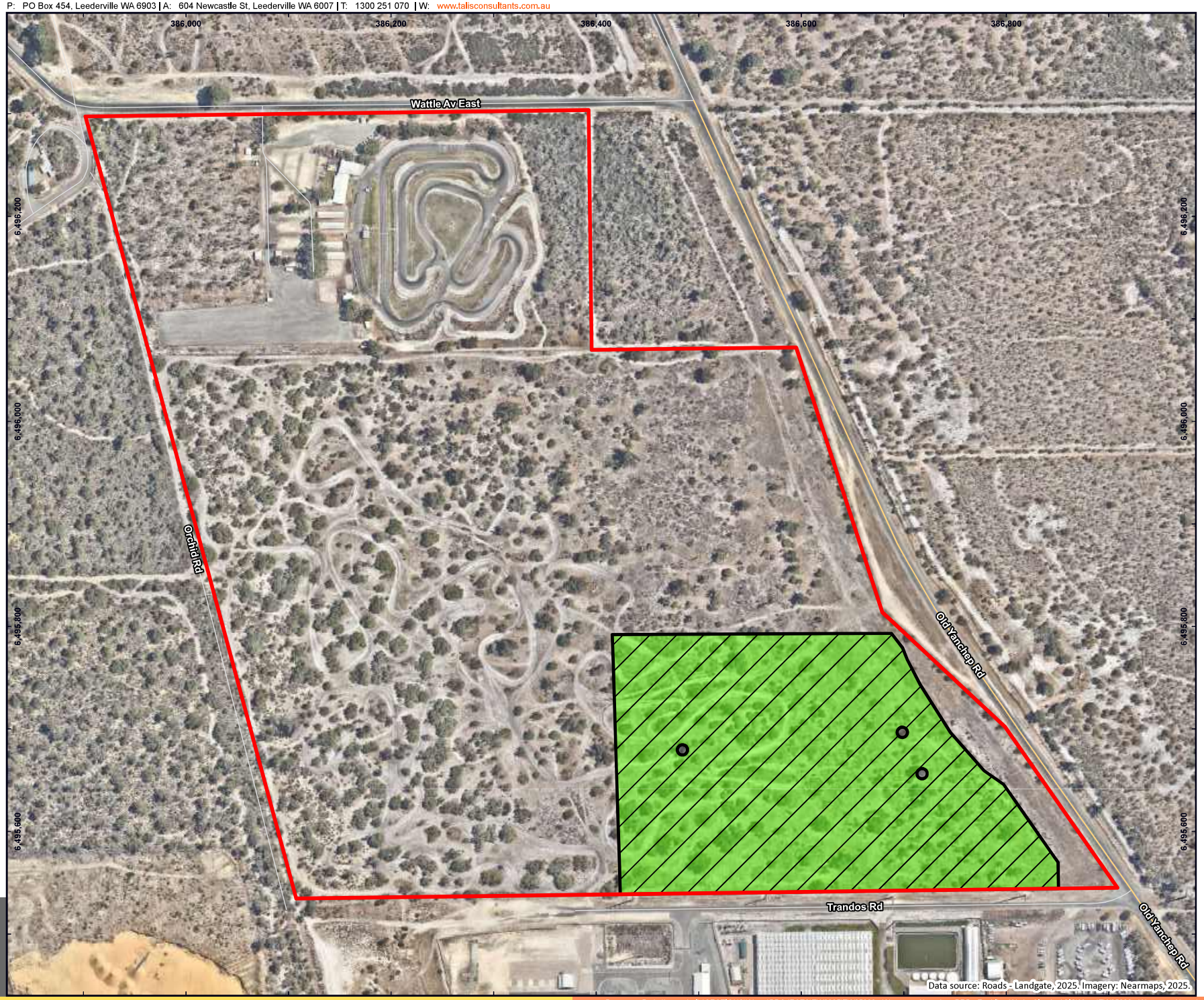
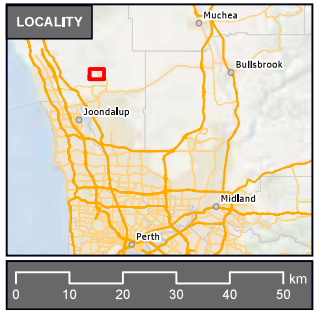


LEGEND

- Lot 600 on DP302260
- Proposed Clearing Area

Western Australian Roads

- Main Road
- Minor Road
- Other



PROPOSED CLEARING AREA

Neerabup Resource Recovery Precinct

Native Vegetation Clearing Permit

City of Wanneroo

N
0
50
100
150
m

Coordinate System: GDA2020 MGA Zone 50
Scale @ A3: 1:3,500

Prepared:	E Jackson	Date:	6/03/2025
Reviewed:	D Tills	Revision:	A
Project:	TW25008		

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Figure 1-2

Document Path: \\servertalis\SECTIONS\Waste\PROJECTS\TW2025\TW25008 - Wanneroo Neerabup RRP - Enabling Works Clearing\GIS\Maps\TW25008 - Wanneroo Neerabup RRP - NVCP\TW25008 - Wanneroo Neerabup RRP - NVCP.aprx

2 Site overview

2.1 Climate

The Project is located in the Western Australian Swan Coastal Plain, approximately 31 km North of Perth. Perth has Mediterranean climate characterised by hot, dry summers and mild, wet winters. The closest weather station is the Pearce RAAF (station id 009053) with is approximately 22 km northeast of the project area.

The mean max temperature peaks in January at 33.6° and the mean minimum drops to 8.3° in August. The annual mean rainfall is 671.8 mm with majority of the rainfall occurring from May to September, the remaining months of the year are relatively dry.

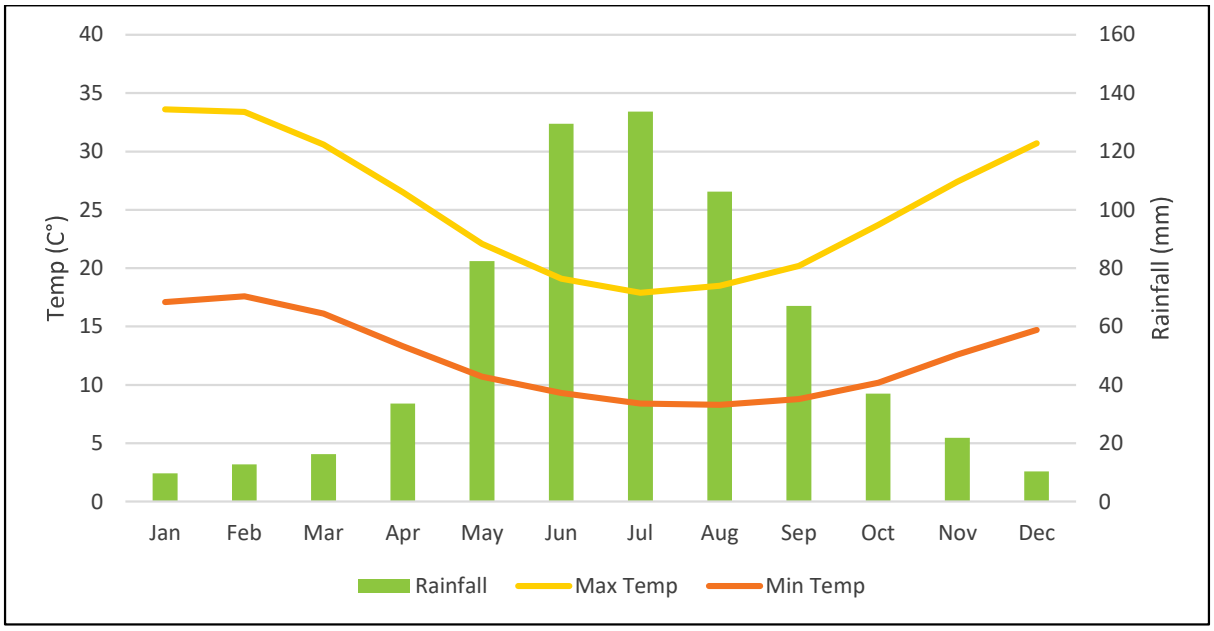

Figure 2-1: Long-term and Monthly total Rainfall, Maximum and Minimum Temperatures for Pearce RAAF 009053 (Bureau of Meteorology, 2025).

2.2 Topography

The topography across Lot 600 does not vary significantly, with elevations ranging from 56 metres Australian Height Datum (mAHD) in the south-western corner, to 44 mAHD on the eastern border of Lot 600. On average there is a 1.6% change in grade across Lot 600. In the Proposed Clearing area just 1 m of variation of topography across the area from 45 mAHD to 46 mAHD. The topography of the proposed clearing area is shown in Figure 2-2.

2.3 Soil Landscape Systems

Soil landscapes and land system mapping of WA describes broad soil and landscape characteristics from regional to local scales, and has been captured at scales ranging from 1:20,000 to 1:250,000 (DPIRD, 2020). The Project was mapped over one Soil Landscape System as shown in Table 2-1.

Table 2-1: Land Systems (DPIRD 2020)

Mapping Unit	Land system	Description	Extent (ha)	%
211Sp	Karrakatta Sand Yellow Phase	Low hilly to gently undulating terrain. Iron podzols. *Banksia spp* woodland with *E. todtiana* and depauperate *E. marginata;* dense shrub layer.	8.90	100

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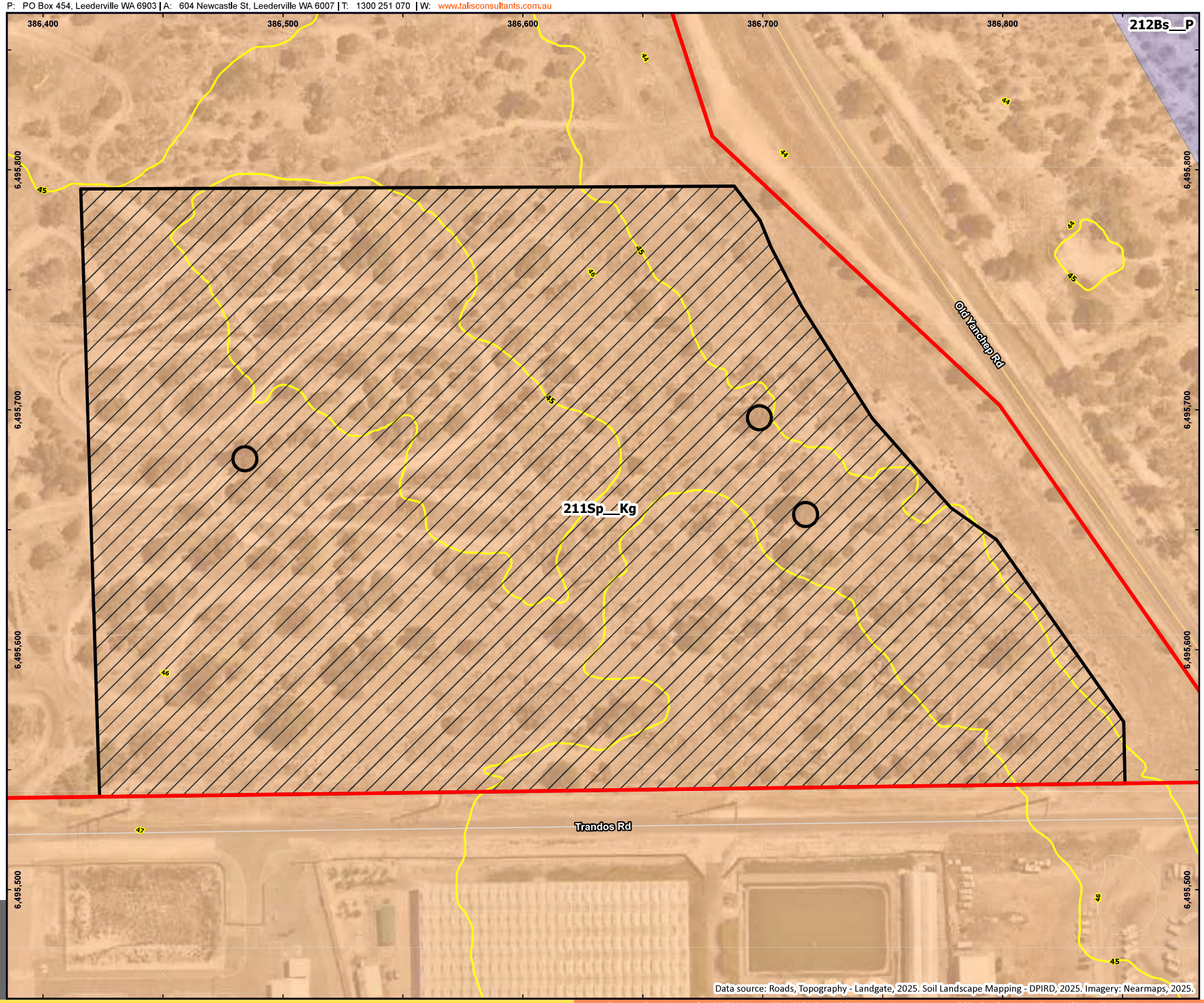


LEGEND

Lot 600 on DP302260

Proposed Clearing Area

Ground Surface Topography

Major Contour (m AHD)

Minor Contour (m AHD)

Soil Landscape Mapping

Bassendean, Pinjar phase - Bassendean System (212Bs__P): Extensively flat swampy areas. Sandy surface sometimes with diatomite over organic hardpan below. E. rudis, B. littoralis and M. preissiana around the edges; sedges and reeds with scattered M. teretifolius in centre; Jacksonia furcellata

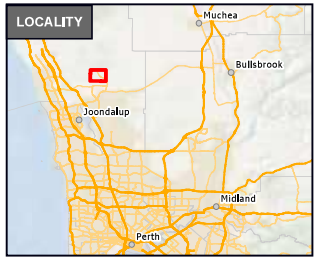
Karrakatta Sand Grey phase - Spearwood System (211Sp__Kg): Low hilly to gently undulating terrain. Iron podzols. Banksia spp woodland with E. todtiana and depauperate E. marginata; dense shrub layer

Western Australian Roads

Main Road

Minor Road

LOCALITY



0 10 20 30 40 50 km

SOIL LANDSCAPE SYSTEMS & TOPOGRAPHY

Neerabup Resource Recovery Precinct

Native Vegetation Clearing Permit

City of Wanneroo

N

0 20 40 60 m

Coordinate System: GDA2020 MGA Zone 50
Scale @ A3: 1:1,500

Prepared:	E Jackson	Date:	6/03/2025
Reviewed:	D Tills	Revision:	A
Project:	TW25008		

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Figure 2-2

Data source: Roads, Topography - Landgate, 2025. Soil Landscape Mapping - DPIRD, 2025. Imagery: Nearmaps, 2025.

2.4 Hydrology and Wetlands

Lot 600 is in the Swan Avon Lower Swan catchment and partially intersects the Lake Pinjar geomorphic wetland in the east. No drainage lines or other hydrological features intersect the survey area of Lot 600.

Lot 600 is part of the Neerabup Industrial Area (NIA) which is situated within the Gnangara Underground Water Pollution Control Area, specifically in the Wanneroo Proclaimed Groundwater Area and borders to the Gnangara Proclaimed Groundwater Area in the north.

3 Flora and Vegetation Assessment

Ecoscape Pty Ltd (Ecoscape) conducted a basic fauna and detailed flora and vegetation survey in October 2020 for the purpose of this NVCP. The survey area included the entire lot 600. The full survey can be found in Appendix A. Some of the results discussed herein refer to the portion of the survey area relating to the proposed clearing for this NVCP, This area is referred to as the project area, which is a subset of the survey area.

3.1 Flora Assessment

Ecoscape completed a flora and vegetation survey on the 29th and 30th of October 2020 for lot 600 and included the 8.90 ha proposed for the development of this NVCP for the Facility (the project area).

The flora and vegetation surveys found 113 flora species from 93 genera and 39 families from 15 floristic quadrats, opportunistic observations, and searches for conservation-listed flora. The proposed clearing area had just 20 species of flora recorded including 7 introduced species.

The desktop assessment was conducted using both the PMST search and DBCA database search with an 8 km buffer. Together these searches found three Threatened Flora, three Priority 1, four Priority 2, six Priority 3 and three Priority 4 taxa. Despite these findings through the desktop search; the field survey recorded no Threatened or Priority Flora. The likelihood of occurrence desktop survey considered 4 conservation listed species as possible to occur within the survey area which were all revised to unlikely, in the post-survey assessment.

3.2 Interim Biogeographic Regionalisation of Australia

The Interim Biogeographic regionalisation of Australia (IBRA) divides Australia into 89 bioregions based on major biological, geographical and geological attributes. These bioregions are subdivided into 419 subregions as part of a refinement of the IBRA framework (Department of Climate Change, Energy, the Environment and Water, 2023) The Project is located within IBRA Bioregion of the Swan Coastal Plain in the Perth Subregion (SWA2), which is generally characterised by low lying coastal plain mainly covered with Tuart or Banksia woodlands on sandy soils, *Casurina obesa* on outwash plains and paperbark swamp areas.

3.3 Pre-European vegetation Types

Mapping of pre-European vegetation within Western Australia was completed on a broad scale (1:1,000,000) by Beard (1990). One of Beard's pre-European vegetation associations are mapped within the survey area (Figure 3-1):

- Association 6 (Spearwood): Jarrah, marri, and wandoo *Eucalyptus marginata*, *Corymbia calophylla*, *Eucalyptus wandoo.*

The extent of the Beard vegetation unit within the survey area is less than 30 percent (%) for Vegetation association 6, however the extent for the IBRA biogeographic subregion of Perth within the Swan Coastal plain is, at 23.65% and well above the 10 % threshold for the Perth Metro area (DER,2014). Table 3-1 details the remaining proportion of the Vegetation Association 6 that lies within the proposed clearing footprint.

Table 3-1: Extents of vegetation associations mapped within the survey area

Vegetation Association	Scale	Pre European extent (ha)	Current extent (ha)	Remaining (%)	Hectares (ha) within the Proposed Clearing Area	% of current extent within the Proposed Clearing Area
6	State: WA	56,343.01	13,362.25	23.72	8.90	0.07
	IBRA biogeographic region (Swan Coastal plain)	56,343.01	13,362.25	23.72	8.90	0.07
	IBRA biogeographic Subregion: Perth	56,343.01	13,362.25	23.72	8.90	0.07
	LGA: City of Wanneroo	12,662.10	2,777.67	21.94	8.90	0.32

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LEGEND

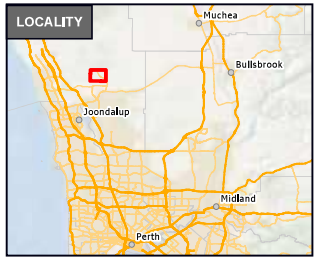
- Lot 600 on DP302260
- Proposed Clearing Area

Pre-European Vegetation Associations

- 6: Woodland southwest

Western Australian Roads

- Main Road
- Minor Road



PRE-EUROPEAN VEGETATION ASSOCIATIONS

Neerabup Resource Recovery Precinct

Native Vegetation Clearing Permit

City of Wanneroo

N
0 20 40 60 m

Coordinate System: GDA2020 MGA Zone 50
Scale @ A3: 1:1,500

Prepared:	E Jackson	Date:	6/03/2025
Reviewed:	D Tills	Revision:	A
Project:	TW25008		

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Figure 3-1

Data source: Roads - Landgate, 2025. Pre-European Vegetation - DPIRD, 2025. Imagery: Nearmaps, 2025.

3.4 Vegetation communities

The survey undertaken by Ecoscape identified 2 ecological communities within the proposed Project area (Table 3-2, Figure 3-2).

Table 3-2: Ecological Communities recorded at Lot 600, Neerabup

Ecological Community	Area (ha)
MpMW: *Melaleuca preissiana* and *Eucalyptus rudis* subsp. *rudis* mid woodland over **Ehrharta calycina*, **Carpobrotus edulis* and **Bromus diandrus* mid open tussock grassland/forbland with *Astartea scoparia* tall isolated shrubs	7.52
EtLMW: *Eucalyptus todtiana* and *Nuytsia floribunda* mid mallee woodland /low woodland over **Ehrharta calycina* mid open tussock grassland	0.26

3.5 Vegetation condition

The vegetation condition was degraded throughout roughly 87.5 % of the proposed clearing area and the remaining 12.5 % had no vegetation as it had been previously cleared, although there is some evidence of recolonisation, based on current aerial imagery. (Figure 3-3). The main factor affecting vegetation condition was disturbance from weeds and vehicles as evidenced by the number of vehicle tracks observed within the survey area and project area.

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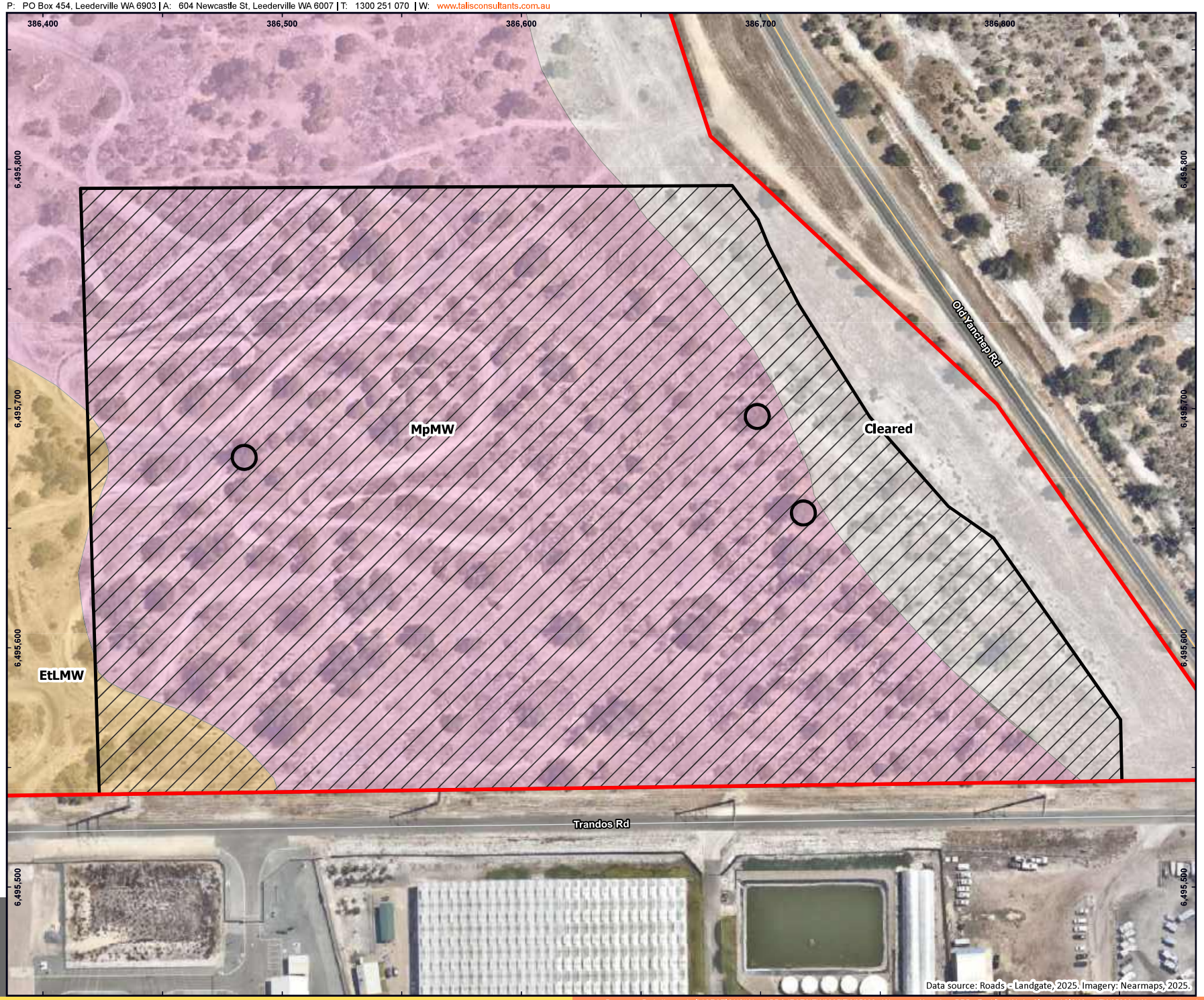


LEGEND

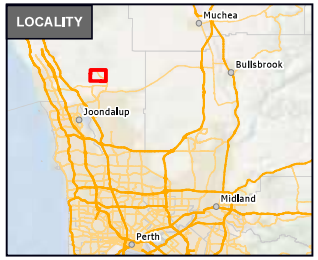
- Lot 600 on DP302260
- Proposed Clearing Area

Vegetation Units

- **EtLMW:** Eucalyptus todtiana and Nuytsia floribunda mid mallee woodland
- **MpMW:** Melaleuca preissiana and Eucalyptus rudis subsp. rudis mid woodland
- **Cleared:** No Vegetation

Western Australian Roads

- Main Road
- Minor Road



VEGETATION UNITS

Neerabup Resource Recovery Precinct

Native Vegetation Clearing Permit

City of Wanneroo

N
0 20 40 60 m

Coordinate System: GDA2020 MGA Zone 50
Scale @ A3: 1:1,500

Prepared:	E Jackson	Date:	6/03/2025
Reviewed:	D Tills	Revision:	A
Project:	TW25008		

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Figure 3-2

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LEGEND

- Lot 600 on DP302260
- Proposed Clearing Area

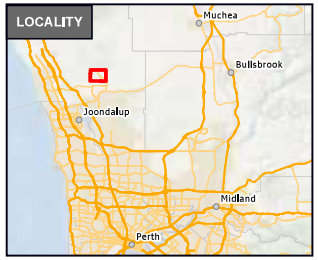
Vegetation Condition

- Degraded
- N/A (No Vegetation)

Western Australian Roads

- Main Road
- Minor Road

LOCALITY



VEGETATION CONDITION

Neerabup Resource Recovery Precinct

Native Vegetation Clearing Permit

City of Wanneroo

N
0 20 40 60 m

Coordinate System: GDA2020 MGA Zone 50
Scale @ A3: 1:1,500

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Project:	TW25008		

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Figure 3-3

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3.6 Groundwater Dependent Vegetation

The Groundwater Dependent Ecosystems Atlas (Australian Government & BoM 2020) indicated the survey area is considered as low and medium potential for terrestrial GDEs to occur.

3.7 Weeds

Twenty six introduced flora species (weeds) were recorded during the field survey, representing 23.01% of the overall flora inventory. **Ehrharta calycina* (Perennial Veldt Grass) was the most commonly recorded introduced species occurring in 13 of 15 quadrats and was a major contributor to vegetation condition assessment. Two of the introduced flora species have significance:

- **Asparagus asparagoides* – WoNS (Weeds of National Significance) and Declared Pest
- **Moraea miniata* - Declared Pest

3.8 Environmentally Sensitive areas

The eastern boundary of Lot 600 intersects an ESA, the Lake Pinjar conservation category geomorphic wetland. Lake Pinjar is a shallow surface expression of an unconfined aquifer and is roughly 24km long chain of wetlands. The project area will not intersect the ESA itself, however the facility will be utilising the area within the 50 m buffer (Figure 3-4). The vegetation survey described the buffer to have either degraded vegetation or no vegetation (cleared) in the buffer areas of the Lake Pinjar wetland.

3.9 Threatened ecological communities

The database searches (DBCA, 2020) completed by Ecoscape identified TEC's within the 8km buffer search to the proposed clearing area. The area search found that the Banksia Woodlands on the Swan Coastal Plain PEC/TEC, or its buffers, occurred within the survey area, however the field survey found that no banksia woodland vegetation occurs within the boundary of the proposed clearing area. No clearing of banksia woodland is occurring as a result of the clearing from this NVCP (Figure 3-5).

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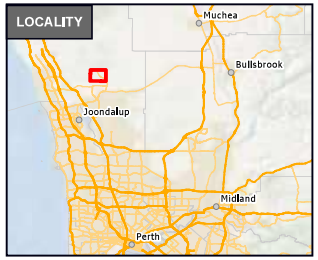
LEGEND

- Lot 600 on DP302260
- Proposed Clearing Area
- Conservation Wetlands
- Conservation Wetlands (50m Buffer)

Western Australian Roads

- Main Road
- Minor Road



CONSERVATION SIGNIFICANT FEATURES

Neerabup Resource Recovery Precinct

Native Vegetation Clearing Permit

City of Wanneroo

N
0 20 40 60 m

Coordinate System: GDA2020 MGA Zone 50
Scale @ A3: 1:1,500

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Project:	TW25008		

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Figure 3-4

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LEGEND

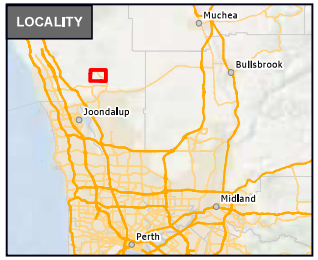
- Lot 600 on DP302260
- Proposed Clearing Area

Threatened Ecological Communities

- Banskia Dominated Woodlands of the Swan Coastal Plain IBRA Region

Western Australian Roads

- Main Road
- Minor Road



THREATENED ECOLOGICAL COMMUNITIES

Neerabup Resource Recovery Precinct

Native Vegetation Clearing Permit

City of Wanneroo

N
0 20 40 60 m

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Figure 3-5

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4 Fauna

A basic Fauna survey was conducted late October 2020 including targeted surveys on significant fauna and habitats at Lot 600, DP 302260 (Ecoscape, 2021).

Additionally, the survey identified the likelihood of species occurrence as part of the desktop study and was re-analysed post-survey with a remaining five conservation listed species having a medium, high or recorded (in the case of the rainbow bee-eater) likelihood of occurrence, post survey.

A total of 18 vertebrate fauna species were recorded during the survey, consisting of; three mammals (two introduced), 14 birds (one introduced) and one reptile. No fauna species were recorded in the proposed clearing area. Summarised in Table 4-1 are the species found during the survey along with their Conservation status and likelihood of occurrence.

The Rainbow Bee eater was the only significant species found during the survey listed as marine and protected under the EPBC act. The species has a broad habitat suitability and therefore the survey area is unlikely to be significant habitat for this species. Additionally, the recording was outside of the proposed clearing area.

Table 4-1: Likelihood of occurrence of fauna species

Species	Common name	Post Survey Likelihood of occurrence	Cwth EPBC Act status	Western Australian BC Act status
	Mammals			
**Canis familiaris familiaris*	Dog	recorded	-	-
**Oryctolagus cuniculus*	Rabbit	recorded	-	-
Macropus fuliginosus melanops	Western Grey Kangaroo	recorded	-	-
Isoodon fusciventer	Quenda	High		*P4*
Notamacropus irma	Western Brush Wallaby	Medium		*P4*
	Birds			
**Dacelo novaeguineae*	Laughing Kookaburra	recorded	-	-
Todiramphus sanctus	Sacred Kingfisher	recorded	-	-
Cacatua roseicapilla	Galah	recorded	-	-
Coracina novaehollandiae	Black-faced Cuckoo-shrike	recorded	-	-
Cracticus tibicen	Australian Magpie	recorded	-	-
Falco berigora	Brown Falcon	recorded	-	-

Species	Common name	Post Survey Likelihood of occurrence	Cwth EPBC Act status	Western Australian BC Act status
Lichmera indistincta	Brown Honeyeater	recorded	-	-
Phylidonyris novaehollandiae	New Holland Honeyeater	recorded	-	-
Merops ornatus	Rainbow Bee-eater	recorded	*MA*	
Petroica goodenovii	Red-capped Robin	recorded	-	-
Platycercus spurius	Red-capped Parrot	recorded	-	-
Platycercus zonarius	Australian Ringneck	recorded	-	-
Rhipidura leucophrys	Willie Wagtail	recorded	-	-
Threskiornis spinicollis	Straw-necked Ibis	recorded	-	-
Calyptorhynchus banksii naso	Forest Red-tailed Black Cockatoo	High	VU	VU
Calyptorhynchus latirostris	Carnaby's Cockatoo	High	EN	EN
	Reptiles			
Ctenophorus adelaidensis	Western Heath Dragon	recorded	-	-

4.1 Habitat Types

Degraded woodland was the only habitat type recorded in the proposed clearing area. The degraded open woodland comprised of Paperbark (*Melaleuca preissiana*), Flooded Gum (*Eucalyptus rudis*) and Coastal Blackbutt (*Eucalyptus todtiana*) over scattered shrubs and grasses on white sand, with patches of sedgeland on seasonally wet soil. This habitat is suitable for Woodland Birds, Western Grey Kangaroo, Rabbit and more significantly, foraging habitat for Black Cockatoo species. The cleared areas contained little to no native vegetation had little suitable habitat to support fauna species.

The habitat is of low value for most fauna species, particularly small ground dwelling species, but is still of moderate value to bird species. The remnant trees of the Degraded Woodland provide habitat structure and foraging opportunities for bird species such as Purple-crowned Lorikeets, Rainbow Bee-eaters, Sacred Kingfishers and Red-capped Robins. This area is also likely to provide foraging resources to Black Cockatoos. The seasonally wet sedgelands provide a water source throughout part of the year. The remnant trees in an otherwise degraded area may still provide nesting and breeding opportunities for suitable bird species. The habitat is also utilised by introduced predators such as Dogs, Foxes and Cats and grazing animals such as Rabbits and Western Grey Kangaroos.

4.1.1 Conservation Significant Habitat

Trees suitable for breeding by Black cockatoos were surveyed across the proposed clearing area. Each tree was assessed for the potential to provide breeding habitat for the Black Cockatoo species (Forest Red-tailed Black Cockatoo, Baudin's Cockatoo and Carnaby's Cockatoo) as per Commonwealth guidelines (DSEWPaC, 2012). The survey area was also assessed for quality of foraging habitat where the degraded woodland was assessed as may be utilised as roost sites and as foraging resources No evidence of Black Cockatoo presence was found during the survey.

Three potential breeding trees were located within the proposed development area (Figure 4-1). All three of the recorded *Eucalyptus rudis* trees were classified as class 5 when scored using the scale developed by Dr Mike Bamford (Bamford 2016). These Class 5 trees do not currently exhibit the characteristics necessary for Black Cockatoo use for nesting however, due to the trees being of a suitable size to potentially provide suitable nesting hollows in the future, they were recorded during the survey. These trees, including a 5 m buffer will be excluded from the clearing permit area. The area beneath the tree canopy will not be cleared if larger than the estimated 5 m buffer.

Section 5 describes the mitigation used to avoid any potential harm to the trees.

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LEGEND

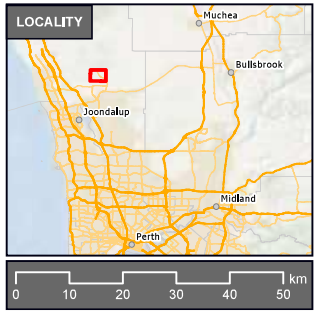
- Lot 600 on DP302260
- Proposed Clearing Area

Potential Black Cockatoo Habitat

- Eucalyptus rudis (Class 5)
- 5m Buffer

Western Australian Roads

- Main Road
- Minor Road



POTENTIAL BLACK COCKATOO HABITAT TREES

Neerabup Resource Recovery Precinct

Native Vegetation Clearing Permit

City of Wanneroo

N
0 20 40 60 m

Coordinate System: GDA2020 MGA Zone 50
Scale @ A3: 1:1,500

Prepared:	E Jackson	Date:	6/03/2025
Reviewed:	D Tills	Revision:	A
Project:	TW25008		

talis consultants

Figure 4-1

Document Path: \\servertalis\SECTIONS\Waste\PROJECTS\TW2025\TW25008 - Wanneroo Neerabup RRP - Enabling Works Clearing\GIS\Maps\TW25008 - Wanneroo Neerabup RRP - NVCP\TW25008 - Wanneroo Neerabup RRP - NVCP.aprx

5 Environmental Management Measures

5.1 Avoidance

To mitigate the clearing impact of the Project, The City will avoid any potential risk to conservation significant habitat, or environmentally sensitive areas by adhering to the demarcated areas.

The proposed clearing area includes 5 m buffers surrounding the three potential cockatoo habitat trees as the project will incorporate the trees into the design of the facility, hence avoiding any harm to the potentially habitable trees. If the area beneath the tree canopies is larger than 5 m in radius, that area will not be cleared to avoid any impact to the trees.

Lake Pinjar Geomorphic wetland will not be impacted by the project as the design of the facility has ensured no clearing will occur within the boundary of the ESA. The buffer of the wetland will however be incorporated into the design of the facility but no impact will occur as a result of the development of the facility, due to its current degraded and cleared status. Additionally, the surface of the facility ensures the water does not flow towards the ESA and captures all potential run off through the Surface Water Management System (SWMS).

5.2 Mitigation measures

5.2.1 Introduced species management

To reduce impact of introduced weed species to the proposed clearing area and surrounding environment, the site will carry out clearing with clean machinery and will clean equipment used after clearing to reduce the risk of spread of introduced species and specifically reduce potential to spread declared pest and WoNS species, *Asparagus asparagoides*

5.2.2 Impacts to Surface and Groundwater

Drainage channels will be used to effectively transport any surface water run-off to the storm water retention ponds for sedimentation or diversion. Each of the three facilities will have its own storm water retention pond all to prevent any adverse impacts to the surrounding environment and the Environmentally Sensitive Area (ESA).

Environmental risks associated with surface water within the overall Site boundary will be managed through the establishment of a best practice and operationally flexible SWMS. The design features incorporated to achieve this, are shown in Table 5-1.

Table 5-1: Objectives and Associated Design Features of the Surface Water Management System

Objective	Design Feature
Proactively Manage Surface Water	Develop hardstands that are graded to ensure the capture of all stormwater run-off within the Site's operational areas
	Ensure the surface water management system is appropriately sized to manage a 1-in-20-year Annual Exceedance Probability (AEP), 24-hour duration storm event
	Consideration of the environmentally sensitive area adjacent to the Site (i.e., the wetland conservation area)
	Establish controlled discharge points for surface water

All waste materials will be received in separate receptacles with appropriate containment measures, such as bunding. Additionally, all waste handling will take place within a fully contained space, minimising the risk of stormwater contact and leachate generation. This proactive approach reduces the potential for environmental impacts. This will reduce the risk of any leachate, if generated, being released from these areas into other parts of the Site or the environment.

All operational areas of the Site will have hardstands made of asphalt or concrete. Depending on the final design and grading of the hardstands, surface water run-off will be managed using either swales or pit and pipe drainage channels, with culverts used where necessary.

The swales and/or drainage channels will run throughout the Site, connecting to their respective stormwater retention pond. The ponds will be constructed to effectively retain sediment during small rainfall events and provide a safe discharge point during larger events. The ponds will be lined with Geosynthetic Liner (HDPE) to avoid the surface water infiltrating into the ground and groundwater levels and cause any contamination. Evaporation will be utilised as the preferred stormwater management technique on site. However, during large storm events exceeding the 1-in-20-year, 24-hour duration threshold, the lined stormwater retention ponds will overflow into either a single shared infiltration basin or multiple individual basins, to be constructed on-site. This will allow for highly diluted stormwater to be released in a control manner into the environment. The ponds and the infiltration basins will be located outside the wetland conservation area.

There will be a pipe connecting each lined pond to its infiltration basin. If a fire was to occur at the Site, this connection pipe would be closed ensuring that no fire wash water is released into the environment. This fire wash water can then be collected from a vacuum truck and tankered off site.

6 Assessment Against the Ten Clearing Principles

Table 6-1: Assessment of Project against the Ten Clearing Principles

Principle	Assessment	Outcome
Principle (a) Native vegetation should not be cleared if it comprises a high level of biological diversity.	The Remnant vegetation condition of the proposed clearing area is either degraded or has been previously cleared with a high proportion of introduced weed species, and disturbance due to dirt bike activity throughout Lot 600. Ecoscape's survey (Ecoscape, 2021) found the Proposed clearing area does not intersect the ESA, contain TECs or any threatened flora species.	**Not likely to be a variance to this Principle**
Principle (b) Native vegetation should not be cleared if it comprises the while or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.	The 3 Eucalyptus rudis trees located within the proposed clearing area were assessed as class 5 against the Bamford assessment tool (2016) The potential black cockatoo habitat trees located within the proposed clearing area will not be cleared as they have been excluded from the proposed clearing footprint.	**Not likely to be a variance to this Principle**
Principle (c) Native Vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora.	The survey conducted by Ecoscape (2021) found the Proposed Clearing area has no Priority or threatened flora species. The likelihood of occurrence desktop survey considered 4 conservation listed species as possible to occur within the survey area which were all revised to unlikely post-survey.	**Not likely to be a variance to this Principle**
Principle (d) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a threatened ecological community.	The survey conducted by Ecoscape (2021) found the Proposed Clearing area does not intersect the ESA, contain TECs or any Threatened flora species. The Banksia woodlands TEC buffer identified in the desktop survey, was not represented in the in-field survey. There is no presence of the Banksia woodland TEC within the boundary of the Proposed Clearing Area.	**Not likely to be a variance to this Principle**
Principle (e) Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.	Pre-European vegetation association mapping indicates that the vegetation type have greater than 23.72% of the IBRA biogeographic subregion of Perth (Ecoscape, 2021). The DER's (2014) guidance of constrained areas has a minimum threshold of retention of 10%, the vegetation type within the Perth metro area and the proposed clearing area is above this threshold. The remaining vegetation within the clearing area represents 0.07% of the remaining vegetation in	**Not likely to be a variance to this Principle**

Principle	Assessment	Outcome
	the IBRA biogeographic subregion of Perth within the Swan Coastal plain and 23.65% will be remaining after the clearing for this project.	
Principle (f) Native vegetation should not be cleared if it is growing in, or in association with a watercourse or wetland.	The Proposed clearing area is adjacent to the Lake Pinjar geomorphic wetland ESA. The Project will not intersect the ESA itself however the facility will be utilising the area within the 50 m buffer. The vegetation survey described the buffer to have either degraded vegetation or no vegetation (previously cleared). The design of the facility itself has taken topography and run off into consideration and has a closed cycle drainage system. No Surface water runoff will directly impact the wetland.	**Not likely to be a variance to this Principle**
Principle (g) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.	The Department of Environmental Regulation, 2014 (now DWER) has defined land degradation as: • The clearing of vegetation; • Decline in vegetation condition; • Soil erosion and soil acidity (caused by wind and water erosion due to vegetation clearing); • Salinity; or • Waterlogging/flooding The degraded condition of the existing vegetation in the proposed clearing footprint is due to pre-existing vehicle tracks and weed presence. Clearing vegetation within the proposed clearing area is unlikely to cause appreciable land degradation to the areas adjacent to the proposed clearing area. The works associated with the clearing are unlikely to cause appreciable land degradation that is different or more significant than what has already occurred within Lot 600 and the surrounding area to date.	**Not likely to be a variance to this Principle**
Principle (h) Native vegetation should not be cleared if the clearing of the vegetation is likely to have impact on the environmental values of any	The Proposed clearing area is adjacent to the Lake Pinjar geomorphic wetland ESA. The Project will not intersect the ESA itself however the facility will be utilising the area within the 50 m buffer. The vegetation survey described the buffer to have either degraded vegetation or no vegetation (previously cleared) in the areas in the 50 m buffer of the wetland. The design of the facility itself has taken topography and run off into consideration and has a closed cycle drainage system. No Surface water runoff will directly impact the wetland.	**Not likely to be a variance to this Principle**

Principle	Assessment	Outcome
adjacent of nearby conservation area.	The survey conducted by Ecoscape (2020) found the Proposed Clearing area does not intersect TECs, PECs or their buffers. The Banksia woodlands TEC buffer identified in the desktop survey, was not represented in the in-field survey. There is no presence of the Banksia woodland TEC within the boundary of the Proposed Clearing Area.	
Principle (i) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.	The wetland to the east of the project will not be impacted by surface water runoff as drainage channels will be used to effectively transport any surface water run-off to the storm water retention ponds for sedimentation or diversion. The Groundwater Dependent Ecosystems Atlas (Australian Government & BoM 2020) indicated the survey area is considered as low and medium potential for terrestrial GDEs to occur. Environmental risks associated with surface water and groundwater within the overall Site boundary will be managed through the establishment of a best practice and operationally flexible Surface Water Management	**Not likely to be a variance to this Principle**
Principle (j) Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence of flooding.	Diversion channels, bunds, handstands and lined retention ponds will be installed to maintain controlled surface water flow around the facility, to minimise risk of flooding and reduce risk of contamination events due to flood events. Evaporation will be utilised as the preferred stormwater management technique on site. However during large storm events exceeding the 1-in-20-year, 24-hour duration threshold, the lined stormwater retention ponds will overflow into a infiltration basin which will allow for highly diluted stormwater to be released in a control manner into the environment. The ponds and the infiltration basins will be located outside the wetland conservation area. Pipes connecting each lined pond to its infiltration basin would be closed during any potential fire or contamination event to ensure no fire wash water or contamination is released into the environment. This potential contamination can then be collected from a vacuum truck and tankered off site.	**Not likely to be a variance to this Principle**

7 Summary of Assessment

The assessment concludes that the clearing of 8.90 ha of native vegetation for the development of the Project is not at variance with the Ten Clearing Principles.

The Potential Black Cockatoo Habitat Trees are being avoided and will be retained for the Project. The ESA will not be impacted as a result of the Clearing associated with this Project. The Banksia woodlands TEC and its buffers identified in the desktop survey, was not represented in the in-field survey. There is no presence of the Banksia woodland TEC within the boundary of the proposed clearing area. No conservation significant flora or fauna is expected to be impacted by the project.

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APPENDIX A

Ecoscape (2021) Neerabup Industrial Ara Environmental Assessments

NEERABUP INDUSTRIAL AREA ENVIRONMENTAL ASSESSMENTS – PORTION 2

City of Wanneroo

ecoscape

Revision	Authors	QA Reviewer	Approved	Date
Draft Rev1	[redacted]			22/02/2021
Final				10/03/2021

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This document should be cited as 'Ecoscape (Australia) Pty Ltd (2020) *Neerabup Industrial Area Environmental Assessments – Portion 2,* prepared for the City of Wanneroo'

TABLE OF CONTENTS

FIGURES

TABLES

MAPS

SUMMARY

The City of Wanneroo (the City) has an approved Clearing Permit CPS 6359 for 10ha of Lot 600 Wattle Ave and this survey is required for the lodgement of a new clearing permit application for the remaining 37ha proposed for the development of a solar power energy generation facility. The City has requested a biological survey comprising a Basic Fauna survey and a Detailed Flora and Vegetation survey to support the clearing permit application for this site.

A desktop assessment was conducted prior to the field surveys and the results include the following significant findings:

- two known Threatened Ecological Communities and five Priority Ecological Communities occur within an 8 km buffer of the survey area. Based on information available in the desktop assessment, the *Banksia Woodlands of the Swan Coastal Plain* TEC/PEC was considered likely to occur within the survey area
- three Threatened flora, three Priority 1, four Priority 2, six Priority 3 and three Priority 4 flora occur within the search area buffer. Of these, four were considered 'Possible' to occur within the survey area based on a likelihood assessment: *Drosera patens* (P1), *Calectasia elegans* (P2), *Poranthera moorokatta* (P2) and *Stenanthemum sublineare* (P2)
- five conservation-listed vertebrate fauna were identified as having previously been recorded from within a buffer of 4 km (two mammals and three birds). Of these, one was previously recorded within the survey area (*Calyptorhynchus latirostris*) and three were assessed as having a 'High' likelihood of occurring (*Calyptorhynchus banksii naso, Notamacropus irma* and *Isoodon fusciventer*).

The flora and vegetation survey was conducted over two days from 29-30 October 2020 with the following significant findings:

- a total of 113 vascular flora were recorded from 93 genera and 39 families. Of these, 26 were weed species including two significant weeds (**Asparagus asparagoides* and **Moraea miniata*). No Threatened or Priority flora were recorded within the survey area
- four vegetation types were recorded within the survey area. Two of the vegetation types (**BaMW** and **BiMW**) had patches that met the criteria for inclusion in the *Banksia Woodlands of the Swan Coastal Plain* TEC/PEC
- most of the vegetation within the survey area was assessed as Degraded with better condition vegetation occurring in the northern section (west and east of the go kart track) in vegetation types **BaMW** and **BiMW**.

The fauna survey was conducted on 29 October 2020 with the following significant findings:

- a total of 18 vertebrate fauna species were recorded from within the survey area. No conservation-listed fauna other than the Rainbow Bee-eater (EPBC-listed as Marine) were recorded. However, the *Banksia* Woodland has suitable habitat for conservation-listed species to occur, such as Black Cockatoos and Quenda
- two fauna habitat types were recorded within the survey area: *Banksia* Woodland and Degraded Woodland (*Eucalyptus todtiana*, *Melaleuca preissiana*, *Eucalyptus rudis*)
- a total of 19 Black Cockatoo breeding habitat trees were recorded within the survey area consisting of *Eucalyptus marginata* (three) and *Eucalyptus rudis* (16). The survey area also contains foraging habitat for Black Cockatoos which was assessed as 'High' and 'Very High' quality for Carnaby's and Forest Red-tailed Cockatoos, respectively.

ACRONYMS AND ABBREVIATIONS

Table 1: Acronyms and abbreviations

Acronyms and abbreviations	
BAM Act	Western Australian *Biosecurity and Agriculture Management Act 2007*
BC Act	Western Australian *Biodiversity Conservation Act 2016*
BoM	Bureau of Meteorology
CD	Conservation Dependent (fauna; specially protected species under the Western Australian BC Act)
CR	Critically Endangered (listed under Commonwealth EPBC Act and/or Western Australian BC Act)
DAFWA	Department of Agriculture and Food, Western Australia (2006-2017, now DPIRD)
DAWE	Commonwealth Department of Agriculture, Water and Environment (2020-)
DBCA	Western Australian Department of Biodiversity, Conservation and Attractions
DBH	Diameter at Breast Height (1.3 m)
DEWHA	Department of Environment, Water, Heritage, and the Arts
DMIRS	Western Australian Department of Mines, Industry Regulation and Safety
DPaW	Western Australian Department of Parks and Wildlife (2013-2017, now DBCA)
DoE	Commonwealth Department of the Environment (2013-2016, now DAWE)
DotEE	Commonwealth Department of the Environment and Energy (2016-2020)
DPIRD	Western Australian Department of Primary Industries and Rural Development
DWER	Western Australian Department of Water and Environmental Regulation
EN	Endangered (listed under Commonwealth EPBC Act and/or Western Australian BC Act)
Ecoscape	Ecoscape (Australia) Pty Ltd
EP Act	Western Australian *Environmental Protection Act 1986*
EPA	Western Australian Environmental Protection Authority
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
GDA 94	Geographic Datum of Australia 1994
GIS	Geographic Information System
GPS	Global Positioning System
GWA	Government of Western Australia
ha	hectare/hectares
IBRA	Interim Biogeographic Regionalisation for Australia
IUCN	International Union for Conservation of Nature
km	kilometre/kilometres
m	metre/metres
MGA	Map Grid of Australia
MI	Migratory species (fauna; specially protected species under the Western Australian BC Act)
NVIS	National Vegetation Inventory System
MNES	Matters of National Environmental Significance
OEPA	Office of the Environmental Protection Authority
OS	Other specially protected species (fauna; specially protected species under the Western Australian BC Act)
P; P1, P2, P3, P4, P5	Priority Flora and Fauna species rankings (P1-P4) or Priority Ecological Communities (P1-P5)
PEC	Priority Ecological Community
PA	Potential Black Cockatoo breeding trees with available hollows
PF	Priority Flora
PMST	Protected Matters Search Tool (hosted by DAWE, used to search for MNES)
PN	Potential Black Cockatoo breeding trees without hollows

Acronyms and abbreviations	
PU	Potential Black Cockatoo breeding trees with unavailable hollows
sp.	Species (generally referring to an unidentified taxon or when a phrase name has been applied)
subsp.	Subspecies (infrataxon)
S1	Schedule 1 Fauna species listed under the BC Act
TEC	Threatened Ecological Community
T	Threatened Fauna species listing by DBCA
TF	Threatened Flora (formerly termed Declared Rare Flora, DRF, in Western Australia)
var.	Variety (infrataxon)
VU	Vulnerable (listed under Commonwealth EPBC Act and/or Western Australian BC Act)
WAH	Western Australian Herbarium
WAM	Western Australian Museum
WAOL	Western Australian Organism List
WONS	Weeds of National Significance
*****	Introduced flora species (i.e. weed)

1 INTRODUCTION

1.1 BACKGROUND

The City of Wanneroo (the City) has an approved Clearing Permit CPS 6359 for 10 ha of Lot 600 Wattle Ave and this survey is required for the lodgement of a new clearing permit application for the remaining 37 ha proposed for the development of a solar power energy generation facility. The City has requested a biological survey to support the clearing permit application for this site. The requirements of the survey are:

- a Basic Fauna survey including the following tasks as a minimum:
  - desktop assessment
  - field survey by suitably experienced and qualified personnel
  - submission of data in accordance with the EPA's IBSA (Index of Biodiversity Surveys for Assessments) requirements
  - a fauna report including maps and data in shapefile format.
- a single-phase Detailed Flora and Vegetation survey conducted in accordance with the following:
  - Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016)
  - Keighery vegetation condition scale (Keighery 1994)
  - the use of multiple quadrats at representative points throughout each preliminary vegetation type, opportunistic collections, systematic transects and targeted inspections of potential habitat.

1.2 SURVEY AREA

The Lot 600 project area, known as the 'survey area' in this report, is located within the City of Wanneroo in the Swan Coastal Plain region approximately 31 km north of Perth (**Figure 1**). The survey area is approximately 47.30 ha in size and consists of a go kart track in the north and open forest and woodland vegetation.

Figure 1: Survey area location

1.3 COMPLIANCE

This biological assessment was conducted in accordance with Commonwealth and State legislation and guidelines:

- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
- Western Australian *Environmental Protection Act 1986* (EP Act)
- Western Australian *Biodiversity Conservation Act 2016* (BC Act)
- Western Australian *Biodiversity Conservation Regulations 2018*
- Western Australian *Animal Welfare Act 2002*
- Department of Environment, Water, Heritage and the Arts (DEWHA 2009) *Matters of National Environmental Significance. Significant impact guidelines 1.1 - Environment Protection and Biodiversity Conservation Act 1999*
- DSEWPaC (2012) *EPBC Act referral guidelines for three threatened black cockatoo species: Carnaby's cockatoo (endangered) Calyptorhynchus latirostris, Baudin's cockatoo (vulnerable) Calyptorhynchus baudinii, Forest red-tailed black cockatoo (vulnerable) Calyptorhynchus banksii naso, known in this document as the Black Cockatoo Referral Guidelines*
- Commonwealth of Australia (2017) *Revised draft referral guideline for three threatened black cockatoo species: Carnaby's Cockatoo, Baudin's Cockatoo and the Forest Red-tailed Black Cockatoo, known in this document as the Revised Draft Referral Guideline*
- Threatened Species Scientific Committee (TSSC 2016) *Approved conservation advice (incorporating listing advice) for the Banksia Woodlands of the Swan Coastal Plain ecological community*
- Department of the Environment and Energy (DotEE 2019) *Approved Conservation Advice (incorporating listing advice) for the Tuart (Eucalyptus gomphocephala) woodlands and forests of the Swan Coastal Plain ecological community*.

As well as those listed above, the assessment complied with Environmental Protection Authority (EPA) requirements for environmental survey and reporting in Western Australia, as outlined in:

- EPA (2020a) *Technical Guidance – Terrestrial vertebrate fauna surveys for environmental impact assessment*, known herein as the Fauna Technical Guidance
- EPA (2016) *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment*, known herein as the Flora and Vegetation Technical Guidance
- EPA (2020b) *Statement of Environmental Principles, Factors and Objectives*.

1.3.1 COMMONWEALTH ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999

The EPBC Act is a legal framework to protect and manage matters of national environmental significance (MNES) including important flora, fauna, ecological communities, and heritage areas listed under the Act. Threatened taxa (flora and fauna) are protected under the EPBC Act, which lists species and ecological communities that have been assessed as meeting the criteria to be listed as Critically Endangered, Endangered, Vulnerable, Conservation Dependant, Extinct, or Extinct in the Wild, as detailed in **Table 16** in **Appendix One**. Threatened Ecological Communities are categorised as Critically Endangered, Endangered or Vulnerable, also detailed in this table.

1.3.2 WESTERN AUSTRALIAN ENVIRONMENTAL PROTECTION ACT 1986

The Western Australian EP Act was created to provide for an Environmental Protection Authority (the EPA) that has the responsibility for:

- prevention, control and abatement of pollution and environmental harm
- conservation, preservation, protection, enhancement, and management of the environment
- matters incidental to or connected with the above.

The EPA is responsible for providing the guidance and policy under which environmental assessments are conducted. It conducts environmental impact assessments (based on the information provided by the proponent), initiates measures to protect the environment and provides advice to the Minister responsible for environmental matters.

1.3.3 WESTERN AUSTRALIAN BIODIVERSITY CONSERVATION ACT 2016

The Western Australian BC Act provides for the conservation, protection and ecologically sustainable use of biodiversity and biodiversity components in Western Australia.

Threatened species (both flora and fauna) and ecological communities that meet the categories listed within the BC Act are protected under this legislation and require authorisation by the Minister to take or disturb. These are known as Threatened Flora, Threatened Fauna and Threatened Ecological Communities. The conservation categories of Critically Endangered, Endangered and Vulnerable are detailed in **Table 17** of **Appendix One**. These categories align with those within the EPBC Act.

Flora and fauna species may be listed as being of special conservation interest if they have a naturally low population, have a restricted natural range, are subject to, or recovering from, a significant population decline or reduction of range or are of special interest, and the Minister considers that taking may result in depletion of the species. Migratory species and those subject to international agreement are also listed under the Act. These are known as specially protected species in the BC Act.

The most recent flora and fauna listings were published in the *Government Gazette* on 11 September 2018 (Government of Western Australia 2018a).

1.4 FLORA

1.4.1 THREATENED AND PRIORITY FLORA

Conservation significant flora species are those that are listed as TF (Threatened Flora) and (within Western Australia) as PF (Priority Flora). TF species are listed as Threatened by the Western Australian DBCA and protected under the provisions of the BC Act. Some State-listed TF are provided with additional protection as they are also listed under the Commonwealth EPBC Act (see **Table 16** in **Appendix One** for conservation status category descriptions).

Flora are listed as PF where populations are geographically restricted or threatened by local processes, or where there is insufficient information to formally assign them to TF categories. Whilst PF are not specifically listed in the BC Act, some may qualify as being of special conservation interest and thereby have a greater level of protection than unlisted species.

There are seven categories covering Western Australian-listed TF and PF species which are outlined in **Table 17** in **Appendix One**. PF for Western Australia are regularly reviewed by the DBCA whenever new information becomes available, with species status altered or removed from the list when data indicates that they no longer meet the requirements outlined in **Table 17**.

1.4.2 OTHER SIGNIFICANT FLORA

According to the Flora and Vegetation Technical Guidance (EPA 2016) other than being listed as Threatened or Priority Flora, a species can be considered as significant if it is considered to be:

- locally endemic or association with a restricted habitat type (e.g. Groundwater Dependent Ecosystems, Sheet Flow Dependent Vegetation)
- a new species or has anomalous features that indicate a potential new species
- at the extremes of range, recently discovered range extensions (generally considered greater than 100 km or in a different bioregion), or isolated outliers of the main range)
- unusual species, including restricted subspecies, varieties or naturally occurring hybrids
- relictual status, being representative of taxonomic groups that no longer occur widely in the broader landscape.

1.4.3 INTRODUCED FLORA

Introduced plant species, known as weeds, are plants that are not indigenous to an area and have been introduced either directly or indirectly (unintentionally) through human activity. Species are regarded as introduced if they are listed as 'alien' on *FloraBase* (Western Australian Herbarium [WAH] 1998-2020) and are designated with an asterisk (*) in this document.

1.4.3.1 Weeds of National Significance

At a national level there are 36 weed species listed as Weeds of National Significance (WoNS) (Weeds Australia & Centre for Invasive Species Solutions 2020). The Commonwealth *Australian Weeds Strategy 2017-2027* (Invasive Plants and Animals Committee 2016) describes broad goals and objectives to manage these species.

1.4.3.2 Declared Pest Plants

The Western Australian Organism List (WAOL) details organisms listed as Declared Pests under the *Biosecurity and Agriculture Management Act 2007* (BAM Act). Under the BAM Act, Declared Pests are listed as one of the three categories, or exempt:

- C1 (exclusion), that applies to pests not established in Western Australia; control measures are to be taken to prevent their entry and establishment
- C2 (eradication), that applies to pests that are present in Western Australia but in low numbers or in limited areas where eradication is still a possibility
- C3 (management), that applies to established pests where it is not feasible or desirable to manage them in order to limit their damage
- exempt (no category).

1.5 ECOLOGICAL COMMUNITIES/VEGETATION

Most, although not all, conservation-listed ecological communities are defined by vegetation, usually within the context of a defined landform or unique habitat. Although 'vegetation' and 'ecological communities' are not interchangeable terms, this assessment describes the vegetation of the survey area with conservation status taking into consideration the interactions of the vegetation with the biological and physical environment within which it occurs (i.e. the ecological community as a whole).

1.5.1 EPBC-LISTED THREATENED ECOLOGICAL COMMUNITIES

Ecological communities are naturally occurring biological assemblages associated with a particular type of habitat (DBCA 2020). At Commonwealth level, Threatened Ecological Communities (TECs) are protected under the Commonwealth EPBC Act. Ecological communities are categorised as Critically Endangered, Endangered and Vulnerable as described in **Table 16** in **Appendix One**.

1.5.2 WESTERN AUSTRALIAN THREATENED ECOLOGICAL COMMUNITIES

Western Australian TECs are protected under the BC Act. TECs are categorised much like those of the EPBC Act, shown in **Table 18** in **Appendix One**.

Currently described TECs are listed on the DBCA website, with the most recent list endorsed by the Minister for Environment in June in June 2018 (DBCA 2018).

1.5.3 WESTERN AUSTRALIAN PRIORITY ECOLOGICAL COMMUNITIES

DBCA maintains a list of Priority Ecological Communities (PECs). PECs include potential TECs that do not meet survey criteria, or that are not adequately defined. They are not protected under legislation but are taken into consideration as part of the environmental approvals process.

Currently described PECs are listed on the DBCA website, with the most recent list dated 5 May 2020 (Species and Communities Program; DBCA 2020).

1.5.4 OTHER SIGNIFICANT VEGETATION

According to the Flora and Vegetation Technical Guidance (EPA 2016), other than being listed as a TEC or PEC, vegetation can be considered as significant if it is considered to have:

- restricted distribution
- a degree of historical impact from threatening processes
- a role as a refuge
- provides an important function required to maintain ecological integrity of a significant ecosystem.

1.6 FAUNA

1.6.1 EPBC-LISTED THREATENED FAUNA

At a Commonwealth level, Threatened Fauna are protected under the EPBC Act, which lists species and ecological communities that are considered Critically Endangered, Endangered, Vulnerable, Conservation Dependant, Extinct, or Extinct in the Wild (detailed in **Table 16** in **Appendix One**).

Migratory species subject to international agreements are also protected under the EPBC Act. The definition of a migratory species under the Act follows that prescribed by the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention) (DotEE 2020):

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

Species listed by the following international agreements are currently protected under the EPBC Act:

- *Convention on the Conservation of Migratory Species of Wild Animals* (Bonn Convention)

- *China-Australia Migratory Bird Agreement* (CAMBA)
- *Japan-Australia Migratory Bird Agreement* (JAMBA)
- *Republic of Korea-Australia Migratory Bird Agreement* (ROKAMBA).

1.6.2 WESTERN AUSTRALIAN BC ACT-LISTED FAUNA

Threatened fauna that meet the categories listed within the BC Act are protected and require authorisation by the Minister to take or disturb. The conservation categories of Critically Endangered, Endangered and Vulnerable have been aligned with those detailed in the EPBC Act.

Fauna species may be listed as being of special conservation interest if they have a naturally low population, restricted natural range, are subject to or recovering from a significant population decline or reduction of range or are of special interest, and the Minister considers that taking may result in depletion of the species. These are known as Specially Protected Species in the BC Act.

The categories covering State-listed threatened fauna species are outlined in **Table 17** in **Appendix One**.

1.6.3 WESTERN AUSTRALIAN PRIORITY FAUNA

Conservation significant fauna species are listed by the DBCA as Priority Fauna where populations are geographically restricted or threatened by local processes, or where there is insufficient information to formally assign them to threatened fauna categories. Whilst Priority Fauna are not specifically listed in the BC Act, these have a greater level of significance than other native species. The categories covering Priority Fauna species are outlined in **Table 17** in **Appendix One**.

1.7 ENVIRONMENTALLY SENSITIVE AREAS

There are a number of areas around Western Australia identified as being of environmental significance within which the exemptions to the Native Vegetation Clearing Regulations do not apply. These are referred to as Environmentally Sensitive Areas (ESAs), and are declared under section 51B of the EP Act and described in the *Environmental Protection (Environmentally Sensitive Areas) Notice*.

1.8 CONSERVATION ESTATE

The National Reserve System is a network of protected areas managed for conservation under international guidelines. The objective of placing areas of bushland into the Conservation Estate is to achieve and maintain a comprehensive, adequate, and representative reserve system for Western Australia. The Conservation and Parks Commission is the vesting body for conservation lands, forest and marine reserves that are managed by DBCA (Government of Western Australia 2018b).

2 EXISTING ENVIRONMENT (DESKTOP ASSESSMENT)

2.1 PHYSICAL ENVIRONMENT

2.1.1 CLIMATE

The southwest of Western Australia is generally described as having a Mediterranean-type climate of mild, wet winters and warm to hot, dry summers. The climate of the region is strongly influenced by the position of a band of high pressure known as the sub-tropical ridge. For much of the year the ridge is located to the south allowing the east or south easterly winds to prevail. During the cooler months the ridge periodically moves to the north allowing cold fronts to pass over the west coast and deliver much of the annual rainfall (Beard 1990).

According to the Köppen-Geiger climate classification, the survey area has a temperate climate with hot, dry summers (Class Csa) (Peel, Finlayson & McMahon 2007). This classification is considered to represent a Mediterranean climate where average summer maximum temperatures exceed 22°C and the average coldest month maximum is between 18 and -3°C, and summer rainfall is less than one third of winter rainfall.

The closest Bureau of Meteorology (BoM) station with long term records for rainfall is Wanneroo (station 9105, operating since 1905) (BoM 2020) located approximately 7 km from the survey area. The mean annual rainfall is 793.60 mm, of which 70% falls in the winter months from May to August.

The closest BoM station with long term records for temperature is Perth Metro (station 9225) located approximately 19.9 km from the survey area. February is the hottest month with a mean maximum temperature of 31.6°C and minimum of 18.4°C. July is the coldest month with a mean maximum of 18.5°C and minimum of 7.9°C.

Figure 2 shows the average rainfall and temperatures of the survey area, with rainfall for the months preceding the field survey. The rainfall in the six months prior to the survey was below average (65% of the mean rainfall for this period).

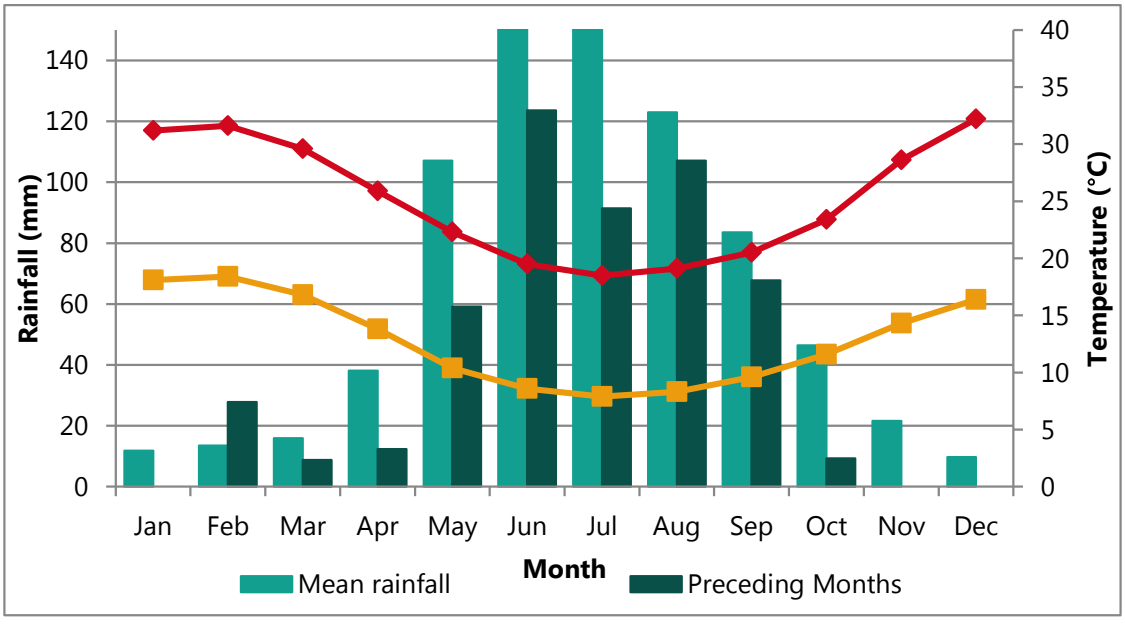

Figure 2: Rainfall and temperature data for the survey area

2.1.2 LAND SYSTEMS

According to Department of Primary Industries and Rural Development (DPIRD 2020) soil landscape mapping, the following land systems intersect the survey area (**Table 2** and **Map 1**).

Table 2: Land systems (DPIRD 2020)

Mapping unit	Land system	Description	Extent (ha)	%
211Sp	Karrakatta Sand Yellow Phase	Low hilly to gently undulating terrain. Yellow sand over limestone at 1-2 m. *Banksia* spp. woodland with scattered emergent *E. gomphocephala* and *E. marginata* and a dense shrub layer.	3.79	8.01
211Sp	Karrakatta Sand Grey Phase	Low hilly to gently undulating terrain. Iron podzols. *Banksia* spp woodland with *E. todtiana* and depauperate *E. marginata*; dense shrub layer.	43.51	91.99

2.1.3 GEOLOGY

The survey area corresponds with the Muchea map sheet of the 1:50,000 Geological series maps (DMIRS 2020). The geological units that intersect the survey area are shown in **Table 3**.

Table 3: Geology

Mapping unit	Description	Extent (ha)	%
S7	SAND - pale and olive-yellow medium to coarse-grained sub-angular quartz moderately sorted of residual origin modified by marine inundation	46.89	99.13
S4	SAND - greyish brown medium to coarse-grained quartz variable silt content moderately well sorted of lacustrine origin	0.41	0.87

2.1.4 WETLANDS AND DRAINAGE

The survey area is in the Swan Avon Lower Swan catchment and partially intersects the Lake Pinjar geomorphic wetland in the south east (**Map 1**). No drainage lines or other hydrological features intersect the survey area.

2.1.5 GROUNDWATER DEPENDENT ECOSYSTEMS

The Groundwater Dependent Ecosystems Atlas (Australian Government & BoM 2020) indicates that the survey area is considered as low and medium potential for terrestrial GDEs to occur, with an IDE likelihood of six, eight and 10.

2.1.6 ENVIRONMENTALLY SENSITIVE AREAS

The survey area intersects ESAs in the north and east, with the eastern section most likely associated with the Lake Pinjar geomorphic wetland. The ESA that intersects in the north corresponds with Bush Forever sites 428 and 382.

2.1.7 CONSERVATION LANDS

The survey area does not intersect any conservation lands but is immediately adjacent to the Gnangara-Moore Rive State Forest conservation estate in the north (**Map 2**).

2.2 BIOLOGICAL ENVIRONMENT

2.2.1 BIOGEOGRAPHIC REGION

Biogeographic regions are delineated on the basis of similar climate, geology, landforms, vegetation and fauna and are defined in the Interim Biogeographical Regionalisation for Australia (IBRA) (Department of Agriculture Water and the Environment 2020).

The survey area is located in the Swan Coastal Plain IBRA region in the Perth subregion (SWA2), described as:

> *a low lying coastal plain, mainly covered with woodlands. It is dominated by Banksia or Tuart on sandy soils, Casuarina obesa on outwash plains, and paperbark in swampy areas. In the east, the plain rises to duricrusted Mesozoic sediments dominated by Jarrah woodland. The climate is Warm Mediterranean. Three phases of marine sand dune development provide relief. The outwash plains, once dominated by C. obesa-marri woodlands and Melaleuca shrublands, are extensive only in the south. The Perth subregion is composed of colluvial and aeolian sands, alluvial river flats, coastal limestone. Heath and/or Tuart woodlands on limestone, Banksia, and Jarrah-Banksia woodlands on Quaternary marine dunes of various ages, Marri on colluvial and alluvials. Includes a complex series of seasonal wetlands and also includes Rottnest, Carnac, and Garden Islands etc. Rainfall ranges between 600 and 1000 mm annually and the climate is Mediterranean. The subregional area is 1, 333, 901 ha.*

2.2.2 PRE-EUROPEAN VEGETATION

During the 1970s, John Beard and associates conducted a systematic survey of native vegetation, describing the vegetation systems in Western Australia at a scale of 1:250 000 in the south-west and at a scale of 1:1 000 000 in less developed areas.

Beard's vegetation maps attempted to depict the native vegetation as it was presumed to be at the time of settlement and is known as the pre-European vegetation type and extent. Beard's vegetation maps have since been developed in digital form by Shepherd, Beeston & Hopkins (2002) and updated by DPIRD (2019). Extents are updated every two years by DBCA (2019a). This mapping indicates that the survey areas intersects one pre-European vegetation unit, Association 6 (Spearwood): Jarrah, marri, and wandoo *Eucalyptus marginata*, *Corymbia calophylla*, *E. wandoo*.

The pre-European vegetation association identified from the survey area (DPIRD 2019) and its pre-European and current extents are listed in **Table 4** (DBCA 2019a).

Table 4: Pre-European vegetation association representation (DBCA 2019a)

Region	Vegetation association	Original extent (ha)	Current extent (ha)	% remaining
Western Australia	6	56,343.01	13,362.25	23.72
IBRA biogeographic region (Swan Coastal Plain)	6	56,343.01	13,362.25	23.72
IBRA biogeographic sub-region (Perth)	6	56,343.01	13,362.25	23.72
LGA (City of Wanneroo)	6	12,662.10	2,777.67	21.94

2.2.3 HEDDLE VEGETATION COMPLEXES

Heddle *et al.* (1980) divided the Swan Coastal Plain into medium to large areas based on soil and landform units, with the vegetation within these areas defined in terms of floristic composition, growth-form dominance, species composition and stratal structure.

According to Heddle *et al.* (1980), two vegetation complexes correspond with the survey area (**Map 2**):

- Karrakatta Complex – Central and South (99.66% of survey area): Predominantly open forest of *Eucalyptus gomphocephala* (Tuart) - *Eucalyptus marginata* (Jarrah) - *Corymbia calophylla* (Marri) and woodland of *Eucalyptus marginata* (Jarrah) - *Banksia* species. *Agonis flexuosa* (Peppermint) is co-dominant south of the Capel River
- Pinjar Complex (0.34% of survey area): Vegetation ranges from woodland of *Eucalyptus marginata* (Jarrah) - *Banksia* species to a fringing woodland of *Eucalyptus rudis* (Flooded Gum) - *Melaleuca preissiana* (Moonah) and sedgelands.

2.2.4 THREATENED AND PRIORITY ECOLOGICAL COMMUNITIES

The Protected Matters Search Tool (PMST) search (Australian Government & DAWE 2020; search reference REUQ47) using a 8 km buffer around a point approximating the centre of the survey area, identified:

- two EPBC-listed TECs likely to occur:
  - *Banksia* Woodlands of the Swan Coastal Plain ecological community
  - Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain ecological community.

The DBCA database search (search reference 20145 clipped to an appropriate buffer of 8 km) identified the following TECs and PECs within the search area buffer:

- *Banksia attenuata woodland over species rich dense shrublands* (EPBC Act Endangered TEC, BC Act Endangered TEC)
- *Banksia ilicifolia woodlands* (EPBC Act Endangered TEC, Priority 3 PEC)
- *Banksia Woodlands of the Swan Coastal Plain* (EPBC Act Endangered TEC, Priority 3 PEC)
- *Melaleuca huegelii - Melaleuca systena shrublands on limestone ridges* (BC Act Endangered)
- *Northern Spearwood shrublands and woodlands* (Priority 3 PEC)
- *Southern Eucalyptus gomphocephala-Agonis flexuosa woodlands* (Priority 3 PEC)
- *Tuart (Eucalyptus gomphocephala) woodlands and forests of the Swan Coastal Plain* (EPBC Act Critically Endangered TEC, Priority 3 PEC).

Map 3 shows the locations of ecological communities identified by the DBCA database search.

Banksia Woodlands of the Swan Coastal Plain

Some TECs listed under the EPBC Act have detailed assessment methodologies to determine if vegetation is representative. The *Banksia Woodlands of the Swan Coastal Plain* TEC/PEC is likely to occur within the survey area and the following was referred to when making a determination for inclusion in the TEC:

- TSSC (2016) *Approved conservation advice (incorporating listing advice) for the Banksia Woodlands of the Swan Coastal Plain ecological community.*

Further information, including criteria and thresholds for inclusion are summarised in **Appendix Two**.

2.2.5 THREATENED AND PRIORITY FLORA

The PMST search (as above) identified two EPBC-listed Threatened Flora (TF) that are known to occur within the 8 km search buffer area, five as 'species or habitat likely to occur within area' and six as 'species or habitat that may occur within area'.

The requested DBCA database search (search reference 07-0720FL) was conducted using a buffer clipped to 8 km around the survey area. The results incorporate the TPFL List, taken from Threatened and Priority Flora Report Forms and DBCA surveys, and WA Herb, taken from vouchered specimens held in the Western Australian Herbarium.
Map 3 shows the locations of conservation-listed flora identified by the DBCA database search.

The combined database searches identified the species listed in **Table 25** in **Appendix Three**, consisting of three TF (two from records known to occur within the database search buffer), three P1, four P2, six P3 and three P4.

2.2.5.1 Threatened and Priority Flora Likelihood Assessment

Ecoscape conducted a likelihood assessment to identify TF and PF species that have potential to occur within the survey area. The likelihood of a species occurring is based on the following attributes, as listed on *FloraBase* (WAH 1998-2020, 2020, including specimen collection information), incorporating an assessment of habitats likely to be present in the survey area. The attributes taken into consideration were:

- broad soil type usually associated with the species
- broad landform usually associated with the species
- usual vegetation (characteristic species) with which the species is usually associated
- species having previously been recorded from within approximately 4 km of the survey area (considered as 'nearby') taking locational accuracy into account
- time since recorded (i.e. within the previous 25 years), taking into consideration land use changes since collection.

The likelihood rating is assigned using the categories listed in **Table 5** and the likelihood assessment is available in **Table 25** in **Appendix Three**. No flora were identified as having been recorded previously. One P1 and three P2 were identified as having a Possible likelihood of occurring based on the information available during the desktop assessment. These were considered the most likely to occur and were prioritised for field survey.

Following the field survey when actual survey area characteristics (vegetation types, vegetation condition, visibility for individual species) are better understood, and the level of survey effort was considered, the likelihood of occurrence was re-evaluated. The post-survey likelihood is also incorporated into this table and discussed further in **Section 5.1.1.2**.

Table 5: Categories for likelihood of occurrence of TF and PF

Likelihood	Category
Recorded	Species recorded within the survey area.
Possible	May occur within the survey area (but has not been recorded); broadly, 2-4 of the required attributes (but always including records from nearby) are present in the survey area.
Unlikely	Could occur but is not expected; 1-3 of the required attributes are present in the survey area but: • it is not known from nearby, or • it is known from nearby but has no other required attributes, or • it is known from nearby but has at least one well-defined attribute that does not occur in the survey area (e.g. it is associated with a specific landform or soil type that does not occur in the survey area), or • it is known from nearby but: o the record is old (>25 years), or o the locational data is highly likely to be inaccurate, or o the area has been significantly cleared at and around the location of the record and survey area and as such the habitat almost certainly no longer occurs within the survey area.
Highly unlikely	The species characteristics include only one or none of the required attributes of soil, landform, associated vegetation and having previously been recorded nearby, or a critical element (often landform) is not within the survey area and as such it almost certainly does not occur.

2.2.6 THREATENED AND PRIORITY FAUNA

Exclusively marine species (e.g. whales, sea turtles etc.) and invertebrates are not included in the Threatened and Priority Fauna lists as there is no marine habitat within with the survey area and this is a terrestrial vertebrate survey.

2.2.6.1 NatureMap

NatureMap (DBCA 2007-2020) is maintained collaboratively by the DBCA and the WAM. These records represent a combination of vouchered museum specimens and records obtained via the Fauna Survey Returns Database maintained by the DBCA.

The *NatureMap* search identified 100 fauna species previously recorded within the applied 4 km buffer area:

- seven mammals (four native; three introduced)
- 69 birds (66 native; three introduced)
- 21 reptiles
- three amphibians.

Of these, four (two mammals and two birds) are conservation-listed:

- *Isoodon fusciventer* (Quenda) –P4
- *Notamacropus irma* (Western Brush Wallaby) – P4
- *Calyptorhynchus latirostris* (Carnaby's Cockatoo) – EN EPBC Act, EN BC Act
- *Falco peregrinus* (Peregrine Falcon) – OS BC Act.

NatureMap results are incorporated into **Table 26** in **Appendix Three**.

2.2.6.2 DBCA Database Search

A search of the DBCA databases was conducted (search reference: Payne6384), reduced to a 4 km buffer around the survey area. Five conservation-listed vertebrate fauna were identified as having previously been recorded from within the search area buffer, consisting of:

- two mammals
- three birds.

The results incorporate the conservation-listed species identified from the *NatureMap* search (as above), with one additional species, *Neelaps calonotos* (Black-striped Snake, P3).

DBCA database search results are incorporated into **Table 26** in **Appendix Three** and shown on Map 4.

2.2.6.3 Protected Matters Search

The PMST search (Australian Government & DAWE 2020; search reference REUQ47), identified:

- one mammal: 'species or species habitat likely to occur within area'
- 27 birds: 13 'species or species habitat known to occur within area', five 'species or species habitat likely to occur within area', nine 'species or species habitat may occur within area'.

The PMST results are incorporated into **Table 26** in **Appendix Three**. Not all species identified by the PMST search have DBCA/Western Australian Museum (WAM) records (*NatureMap* and DBCA database searches).

2.2.6.4 Threatened and Priority Fauna Likelihood Assessment

The likelihood of occurrence of significant fauna species identified by the database and literature searches was assessed using the following criteria:

- suitability of habitat types present within the survey area
- distance between previous record of conservation-listed species and the survey area
- frequency and number of records in the region
- date of record of conservation-listed species (recent or historical).

The following were also taken into consideration during the assessment:

- sufficiency of information
- behavioural and ecological characteristics such as cryptic behaviours
- record certainty.

The categories of likelihood of occurrence, assessed using the above criteria, are shown in **Table 6**.

Table 6: Categories for likelihood of occurrence of conservation-listed fauna

Likelihood	Category
Recorded	Species recorded within the survey area within a reasonable timeframe (0-25 years)
High	Species recorded in close proximity to the survey area (<1 km) within the past 25 years; and suitable habitat occurs within the survey area
Medium	Species historically recorded in close proximity (<2 km) to the survey area, more than 25 years ago; and suitable habitat may exist within the survey area
Low	Species not recorded in the proximity of the survey area or rarely recorded within 4 km of the survey area; and suitable habitat unlikely to occur within the survey area
Very Low	Species not recorded by multiple surveys/databases within 4 km of the survey area and suitable habitat does not occur within the survey area, however, species or suitable habitat is listed as potentially occurring in the wider region

The likelihood of species occurring within the survey area are indicated in **Table 26** in **Appendix Three**. Five species were assessed as having a High likelihood of occurring within the survey area:

- *Calyptorhynchus latirostris* (Carnaby's Cockatoo)
- *Calyptorhynchus banksii naso* (Forest Red-tailed Black Cockatoo)
- *Isoodon fusciventer* (Quenda)
- *Notamacropus irma* (Western Brush Wallaby).

Following the field survey when actual survey area characteristics are better understood, and the level of survey effort was considered, the likelihood of occurrence was re-evaluated. The post-survey likelihood is also incorporated into this table and discussed further in Sections **4.5.3** and **5.3.3.1**.

2.3 LITERATURE REVIEW

One survey is known to have been previously conducted partly within the survey area (in the southwest corner):

- *Targeted Flora and Fauna Assessment – Lot 4 Flynn Drive Neerabup* (Eco Logical Australia Pty Ltd 2013a). The survey included a targeted flora and vegetation community assessment, and an ecological assessment for Carnaby's Black Cockatoo. The report also presents the results of other flora and fauna surveys conducted previously within the area, including the portion intersecting the survey area in the southwest. Of particular significance are the results of the ATA Environmental survey conducted in 2007 which provides vegetation types for comparison in this survey.

The following documents were identified as having relevance to the survey area:

- *Flynn Drive Biological Survey* (Ecoscape 2020a)
- *Conservation Area Management Plan - Mather Reserve (53163) and Lot 24 Mart Street, Wanneroo* (City of Wanneroo 2020)
- *Flynn Drive and Mather Drive Industrial Development, Neerabup – Environmental Review* (Eco Logical Australia Pty Ltd 2013b)
- *Ground Truthing of Environmental Values for Lot 4 Flynn Drive, Neerabup* (Eco Logical Australia Pty Ltd 2012)
- *Spring Flora and Vegetation Survey - Flynn Drive Re-alignment, Neerabup* (Coffey Environments 2008)
- Vegetation Assessment, Mather Reserve Neerabup and Lot 24 Mary Street Wanneroo (Ecoscape 2020b)
- Black Cockatoo Habitat Survey (Neerabup Industrial Area (Ecoscape 2019)
- Flora, Vegetation and Fauna Survey, IWSS Neerabup GW Expansion (Ecoscape 2017).

3 METHODS

3.1 FLORA AND VEGETATION FIELD SURVEY

3.1.1 GUIDING PRINCIPLES

The flora and vegetation survey was conducted as a detailed survey according to the Flora and Vegetation Technical Guidance (EPA 2016). The EPA considers that a detailed survey requires:

- a comprehensive survey design, including giving consideration to the survey timing that should be conducted during the primary season of survey for the bioregion and disturbance events, and the potential requirement for supplementary surveys
- a minimum of three quadrats (in proportion to the extent of the vegetation unit), located throughout each preliminary vegetation types sampled throughout its geographic range, with additional quadrats and rescoring during supplementary surveys to clarify vegetation unit boundaries
- regional surveys if there is insufficient information available (identified during the desktop assessment) to provide local and regional context
- the survey may include a number of sampling techniques including quadrats, relevés, transects and traverses, as well as opportunistic observations
- the flora inventory should be comprised of data collected from quadrats and relevés, supplemented by opportunistic observations, systematic surveys, and targeted inspections of various habitat areas
- it may be appropriate to increase survey effort in areas of unusual habitat
- sampling sites that are placed at representative locations throughout the survey area considering landform, geology, elevation, slope, aspect, surface or groundwater expression and soil type, as well as vegetation structure, composition, and condition.

Targeted searches were also conducted in areas of habitat suitable for TF and PF identified during the desktop assessment and previous surveys as having potential to occur.

3.1.2 FIELD SURVEY METHODS

The methods utilised during the field survey followed those outlined in the Flora and Vegetation Technical Guidance (EPA 2016), conducted as a single phase survey.

Conservation criteria used in this assessment are included in **Table 16**, **Table 17** and **Table 18** in **Appendix One**.

Survey method details are outlined below.

3.1.2.1 Floristic Quadrats

Floristic quadrat ('quadrat') locations were selected using aerial photography, environmental values, and field observations to represent the vegetation values existing at the site. The unmarked quadrats were 10 m x 10 m in dimension, as required according to the Flora and Vegetation Technical Guidance (EPA 2016).

The following information was collected from within each quadrat:

- observer
- date
- quadrat/site number
- GPS location (GDA94) of the northwest corner

- digital photograph (spatially referenced with a reference number), taken from the northwest corner, looking diagonally across the quadrat
- broad soil type and colour
- topography
- list of flora species recorded with the average height and total cover within the quadrat for each species
- vegetation description (as per below)
- vegetation condition.

At least three quadrats per vegetation type were recorded for the detailed survey where there was sufficient extent. All quadrat locations are displayed on **Map 5.**

3.1.2.2 Targeted Searches

Threatened and Priority Flora identified during the desktop analysis and previous surveys as known or having potential to occur were targeted for searches in areas of potential habitat. Due to the small extent of the survey area (47.30 ha), the entire area was extensively searched.

The locations of all targeted taxa collected were recorded using a handheld GPS with the following data recorded:

- observer, date, and time
- reproductive status and other features such as health of plants, percentage flowering and fruiting
- local abundance/population size and/or population boundary, including outside the development envelopes where possible
- landform
- brief vegetation community description
- representative photos of each species and habitat
- collection of representative specimens.

3.1.2.3 Introduced Species

Introduced species (weeds) were recorded during the collection of the overall flora inventory.

3.1.2.4 Vegetation Description and Classification

Vegetation was described from each of the quadrats using the height and estimated cover of dominant and characteristic species of each stratum based on the National Vegetation Information System, recorded at Level V (NVIS Technical Working Group & DotEE 2017) (**Table 19** and **Table 20** in **Appendix One**). Up to three species per stratum from each stratum (upper, mid, and ground) were used to formulate vegetation descriptions for each quadrat and each vegetation type.

Vegetation type descriptions were created by combining quadrat descriptions and modifying, where necessary, based on the wider vegetation. Vegetation codes for these were formulated using the characteristic species of the highest stratum within the vegetation type that had >2% cover (i.e. not scattered) if present, with the first series of letter codes referring to the component species (upper case first letter referring to the genus, lower case one or two letters referring to the species), with the upper case letters at the end referring to the stratum structure e.g. **BiMW** refers to ***B**anksia **i**licifolia* mid woodland.

3.1.2.5 Vegetation Condition Assessment

Vegetation condition was assessed broadly and continuously throughout the survey area and at each quadrat using the Keighery vegetation condition scale (Keighery 1994) (

Table 21 in **Appendix One**). As quadrats are located in the best condition parts of a vegetation type, the condition rating of the quadrat may not match that of the broader vegetation type due to the scale of mapping.

3.1.2.6 Field Survey Timing

The field survey was conducted during 29-30 October 2020 which is within the optimal period for a primary survey within the bioregion according to the Flora and Vegetation Technical Guidance (EPA 2016).

3.1.3 STATISTICAL ANALYSIS

3.1.3.1 Post-survey Likelihood Assessment

Following the field survey, a post-survey likelihood assessment was conducted to identify conservation-listed species that have potential to occur on site. This assessment was based on survey effort and habitat known to occur in the survey area.

3.1.3.2 Floristic Analysis

PATN© software (Belbin & Collins 2006) was used to undertake statistical analysis to generate floristic groups using the data collected from the quadrats and relevés, in order to better understand local significance of floristic units. PATN analysis has been used for several local floristic analyses including Gibson *et al.* (1994) for the Swan Coastal Plain.

PATN is a multivariate analysis tool that generates estimates of association (resemblance, affinity, distance) between sets of objects described by a suite of variables (attributes) and classifies the objects into groups and condenses the information and displays the patterns in the data graphically. It offers a choice of data transformations prior to multivariate analysis.

Floristic groups, identified using a dendrogram output of the analysis, are used as a tool to inform vegetation type groups at various levels and scales.

For this project, a variety of analyses were run. The most informative analysis used the Bray Curtis similarity coefficient for rows (species) and columns (sites) as this provides a good estimation of association for ecological applications (Belbin & Collins 2006). For this analysis we used presence/absence values for each species.

Interpretation of these purely floristic groups into recognisable and mappable on-ground units is a tool used to identify broad vegetation types. Generally, quadrats that are closely floristically related on the dendrogram form identifiable vegetation units, however, interpretation is frequently required for imperfect results. Vegetation types are therefore determined as a combination of floristic analysis and on-ground interpretation using dominant and characteristic species.

3.1.3.3 Adequacy of Sampling

In order to demonstrate adequacy of sampling, a species accumulation curve was generated by the software Species Diversity and Richness IV (Pisces Conservation Ltd 2010) using five random selections of sample order, using quadrat data only.

3.2 FAUNA FIELD SURVEY

3.2.1 GUIDING PRINCIPLES

The fauna and fauna habitat survey was conducted as a basic survey according to the Fauna Technical Guidance (EPA 2020a). The EPA recommends a basic survey should:

- be conducted as a low intensity survey to gather broad fauna and habitat information
- verify the adequacy of the desktop assessment
- map, describe and photograph habitats
- record opportunistic fauna observations
- identify possible future survey site locations, access, and logistics
- determine if a detailed survey is required.

Targeted surveys were also conducted to gather information on significant fauna and/or habitats.

3.2.2 FIELD SURVEY METHODS

The methods utilised during the field survey followed those outlined in the Fauna Technical Guidance (EPA 2020a), conducted as a basic survey.

Conservation criteria used in this assessment are included in **Table 16** and **Table 17** in **Appendix One**.

Survey method details are outlined below.

3.2.2.1 Vertebrate Fauna Survey

The basic fauna survey incorporated a number of survey techniques as per the Terrestrial Fauna Technical Guidance (EPA 2020a) including habitat assessment, active searches (day time), raking of spoil heaps and leaf litter, searches for secondary evidence such as scats and tracks, as well as opportunistic searches.

Terrestrial vertebrate fauna were the main targets of the field survey. Survey techniques included:

- opportunistic bird observations while moving through the survey area
- turning of surface debris (rocks, logs, vegetation spoil heaps) that reptiles and mammals may shelter beneath
- raking of litter beds to locate fossorial reptile species
- tree hollow inspection to detect arboreal fauna.

Fauna species were identified opportunistically based on sightings, calls, remains, diggings, and other signs. Potential habitats for conservation significant species were identified and evaluated and their likelihood of occurrence assessed.

Based on the desktop assessment, the following were considered to have a High likelihood of occurring in the survey area and they, and habitat suitable to support them, were targeted during the field survey:

- Carnaby's Cockatoo
- Forest Red-tailed Black Cockatoo
- Quenda
- Western Brush Wallaby.

3.2.2.2 Fauna Habitat Assessment

The fauna habitats present within the survey area were identified and mapped. Fauna habitats were described as an area which is distinguishable from its surrounding area by its landform, vegetation and fauna assemblage occupying the area. In addition, its likelihood to harbour specialised fauna species which are not found in adjacent areas was taken into consideration.

The following information was used to identify and map all fauna habitats within the survey area:

- previous fauna habitat mapping
- land systems
- vegetation type and condition mapping
- aerial imagery
- landforms
- soil characteristics
- fauna assemblage information.

The composition and characteristics of each fauna habitat type was recorded, including noting suitability for various fauna suites or conservation-listed species. Habitat types were delineated in the field and digitised upon return from the field survey.

3.2.2.3 Targeted Survey Methods

Black Cockatoo Assessment (Carnaby's Cockatoo; Baudin's Cockatoo, Forest Red-tailed Black-cockatoo)

Potential and active (actual) Black Cockatoo breeding trees were assessed as per Commonwealth guidance (DSEWPaC 2012). Relevant aspects of the recent draft referral guidelines (Commonwealth of Australia 2017) were also incorporated into the survey as this allows data to be gathered that could potentially be used when the updated referral guidelines are finalised.

Potential and actual Black Cockatoo habitat trees are:

- listed tree species as provided in the Commonwealth guidance (DSEWPaC 2012)
- minimum size of 500 mm diameter at breast height (DBH) for most species, or 300 mm DBH for Salmon Gum and Wandoo.

The following were recorded for each potential and actual habitat tree:

- location, recorded using a handheld GPS device with an accuracy of approximately 5 m
- species and DBH
- identifying if tree hollows of suitable size [and orientation] are present, and recording evidence of use by cockatoos such as chewing at the hollow entrance
- habitat value according to the scoring system developed by Dr Mike Bamford (2016); this score reflects the existing value of the tree characteristics with respect to its potential to be used as a nesting tree (as per
- **Table** 22 in **Appendix One**)
- photograph of each tree, showing hollows, if possible
- known nesting trees as per DBCA data.

The suitability of the survey area for breeding (additional to the specific tree survey) and as foraging habitat (as per the Commonwealth (2017) scoring tool; **Table 23** in **Appendix One**) was also assessed and mapped, taking into consideration:

- the presence of species favoured for foraging (as listed in the Commonwealth guidance, including Proteaceous species, Eucalypt species, *Pinus* species etc.)
- evidence of foraging e.g. chewed Eucalypt nuts
- location of known nesting or night roosting trees
- surrounding vegetation, up to at least 12 km from the survey area and taking into consideration the proximity to any known breeding habitat and watering points
- presence of disease, such as *Phytophthora cinnamomi* or Marri Canker (*Quambalaria coyrecup*).

3.2.2.4 Field Survey Timing

The survey was conducted over one day during October 2020. October is within the optimal timing for fauna survey for the majority of fauna groups likely to inhabit the survey area (EPA 2020a).

3.2.2.5 Data Management

Data gathered through the desktop review, field survey habitat assessments and observations will be collated to provide locations of significant fauna species records and maps of fauna habitat types. Fauna habitat quality is assessed at each sampling point to provide an overall habitat quality of the survey area as this may vary across habitats of different type.

4 FIELD SURVEY RESULTS

4.1 FLORA AND VEGETATION SURVEY

The flora and vegetation survey was conducted by James Tsakalos (Senior Environmental Scientist, Flora Collecting Permit FB62000163; Threatened Flora Collecting Permit TFL 58-1920) on during 29-30 October 2020.

4.2 FLORA

4.2.1 FLORA INVENTORY

A total of 113 vascular flora were recorded from 93 genera and 39 families from 15 floristic quadrats, opportunistic observations, and searches for conservation-listed flora. Of these, 26 were introduced (23.01%) and three (2.30%) could not be identified to species level due to insufficient diagnostic reproductive material.

The most commonly represented families were Poaceae (13 taxa, nine introduced), Myrtaceae (12) and Fabaceae (11). The most commonly represented genera were *Stylidium* with five taxa, *Eucalyptus* (three) and *Banksia* (three).

The number of species per quadrat ranged from 50 in quadrat NQ01 to eight in quadrat NQ14, with an average species diversity per quadrat of 20.87. The most commonly recorded species were **Ehrharta calycina* recorded from 13 quadrats, **Gladiolus caryophyllaceus* (10 quadrats), **Ursinia anthemoides* subsp. *anthemoides* and **Briza maxima* (nine quadrats each).

The combined flora inventory is presented in **Table 27** in **Appendix Four**. Quadrat data is presented in **Appendix Five**.

4.2.2 CONSERVATION-LISTED FLORA

Threatened Flora

No Commonwealth EPBC Act or Western Australian BC Act-listed Threatened Flora were recorded during the field survey.

Priority Flora

No Priority-listed flora were recorded during the field survey.

4.2.3 OTHER SIGNIFICANT FLORA

No flora taxa having other significance according to the Flora and Vegetation Technical Guidance (EPA 2016) were recorded during the field survey.

4.2.4 FLORA OF TAXONOMIC INTEREST

No flora of taxonomic interest were recorded during the field survey.

4.2.5 INTRODUCED FLORA

Twenty six introduced flora species (weeds) were recorded during the field survey, representing 23.01% of the overall flora inventory. **Ehrharta calycina* (Perennial Veldt Grass) was the most commonly recorded introduced species occurring in 13 of 15 quadrats and was a major contributor to vegetation condition assessment.

Of the introduced flora, two species have significance:

- **Asparagus asparagoides* - WoNS and Declared Pest
- **Moraea miniata* - Declared Pest.

4.3 VEGETATION

4.3.1 VEGETATION TYPES

Four vegetation types were recorded from within the survey area (**Table 7**, **Map 5**) based on a combination of structural vegetation type as identified in the field, floristic analysis (see **Section 4.3.4**) and subsequent desktop review.

Table 7: Vegetation types

Landform	Mapping unit	Vegetation type	Floristic quadrats	Representative photograph	Other characteristic species	Area (ha) and extent (%)
Sandplain	**BaMW**	*Banksia attenuata* and *B. menziesii* mid woodland over *Allocasuarina humilis* tall sparse shrubland over *Hibbertia hypericoides* subsp. *hypericoides* and **Ehrharta calycina* low open shrubland/tussock grassland	NQ01 NQ02 **NQ03**		*Beaufortia elegans, Gompholobium tomentosum, Xanthorrhoea preissii, Tetraria octandra, Jacksonia sternbergiana, Styphelia conostephioides*	2.65 ha 5.60%
Sandplain	**BiMW**	*Banksia ilicifolia* mid woodland over *Kunzea glabrescens* and *Adenanthos cygnorum* subsp. *cygnorum* tall shrubland over *Lyginia imberbis*, *Brachyloma preissii* and *Hibbertia racemosa* mid open rushland/low open shrubland	**NQ04** NQ05 NQ06		*Banksia menziesii, Jacksonia furcellata*	1.28 ha 2.71%

Landform	Mapping unit	Vegetation type	Floristic quadrats	Representative photograph	Other characteristic species	Area (ha) and extent (%)
Sandplain	**EtLMW**	*Eucalyptus todtiana* and *Nuytsia floribunda* mid mallee woodland/low woodland over **Ehrharta calycina* mid open tussock grassland	**NQ09** NQ10 NQ11		*Jacksonia sternbergiana, Stirlingia latifolia, Aira caryophyllea, Eremaea pauciflora, Hibbertia hypericoides subsp. hypericoides*	12.88 ha 27.23%
Sandplain	**MpMW**	*Melaleuca preissiana* and *Eucalyptus rudis* subsp. *rudis* mid woodland over **Ehrharta calycina*, **Carpobrotus edulis* and **Bromus diandrus* mid open tussock grassland/forbland with *Astartea scoparia* tall isolated shrubs	NQ07 NQ08 **NQ12** NQ13 NQ14 NQ15		*Nuytsia floribunda, Dianella revoluta var. divaricata, Adenanthos cygnorum subsp. cygnorum, Corynotheca micrantha, Aira caryophyllea, Jacksonia furcellata*	19.67 ha 41.60%
		Not native vegetation (cleared)			10.81 ha	22.86%
		TOTAL EXTENT			**47.30 ha**	**100%**

4.3.2 VEGETATION SIGNIFICANCE

TECs and PECs

Database searches (**Section 2.2.4**) identified the *Banksia Woodlands on the Swan Coastal Plain* PEC/TEC as occurring within the survey area. Two vegetation types observed during the field survey (**BaMW** and **BiMW**) are consistent with the criteria defined for this TEC (shown on **Map 5**), specifically:

- a distinct upper stratum of trees dominated by *Banksia attenuata, B. menziesii* and *B. ilicifolia*
- vegetation assessed in Good to Very Good condition and greater than 1 hectare patch side (also taking into consideration the extrapolation of vegetation within the same patch outside the survey area)
- species-rich understorey with key species present *(Adenanthos cygnorum* subsp. *cygnorum, Allocasuarina humilis, Gompholobium tomentosum, Hibbertia hypericoides* subsp. *hypericoides, Kunzea glabrescens, Xanthorrhoea preissii, Lyginia imberbis, Jacksonia furcellata).*

4.3.3 OTHER SIGNIFICANT VEGETATION

No vegetation having other significance according to the Flora and Vegetation Technical Guidance (EPA 2016) was recorded during the field survey.

4.3.4 FLORISTIC ANALYSIS

The floristic analysis dendrogram (**Figure 3**) indicates four distinct floristic groups based on the quadrats recorded. The grouping of quadrats mostly aligns with the vegetation units observed in the field. The Very Good condition quadrats within vegetation types **BaMW** and **BiMW** in the northern end of the survey area formed the most discrete groupings and these quadrats were also located adjacent to areas of native vegetation. Vegetation type **MpMW** is less clearly defined floristically (likely due to Degraded condition) and was defined based on on-ground interpretation using species dominance and vegetation structure.

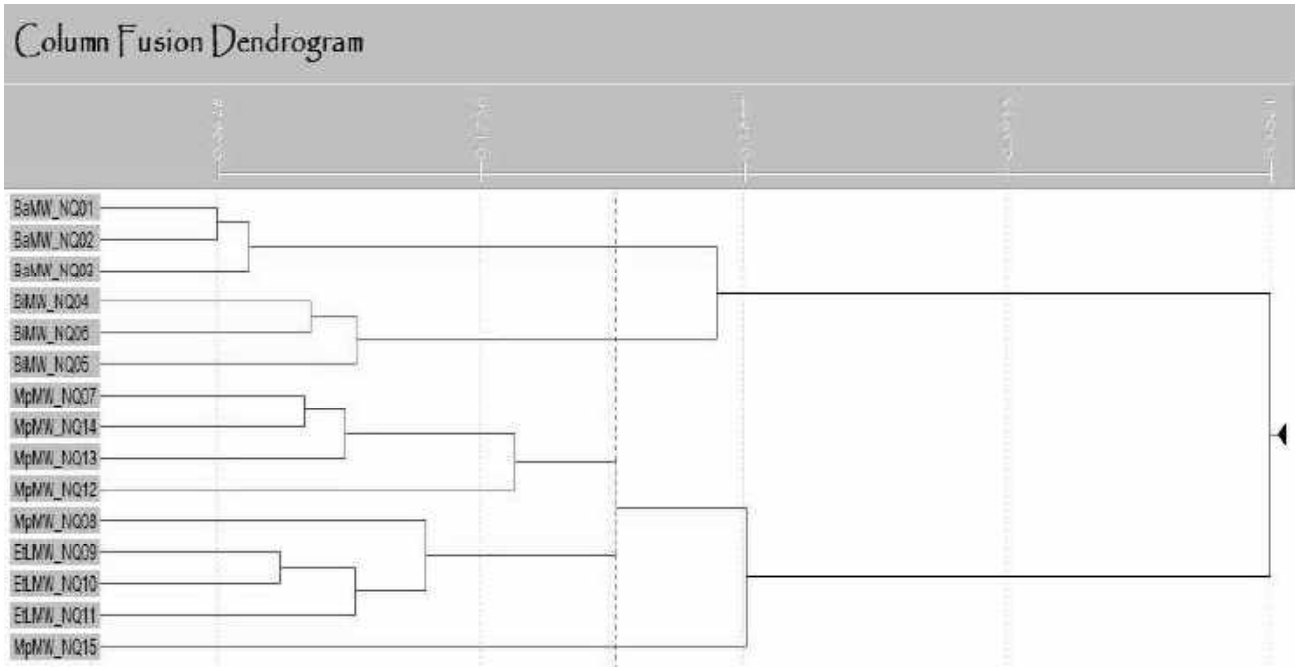

Figure 3: Floristic analysis dendrogram

4.3.5 VEGETATION CONDITION

The vegetation condition within the survey area ranged from Degraded to Very Good condition, with the majority in Degraded condition (**Table 8**, **Map 6**). The main factor affecting vegetation condition was disturbance from weeds and vehicles as evidenced by the number of vehicle tracks observed within the survey area.

Table 8: Vegetation condition

Vegetation condition	Extent (ha)	Proportion (%)
Pristine	0	0
Excellent	0	0
Very Good	2.11	4.45
Good	0.66	1.39
Degraded	33.72	71.30
Completely Degraded	0	0
Cleared/Not vegetated	10.81	22.86

4.3.6 ADEQUACY OF SURVEY

Adequacy of survey can be demonstrated using a species accumulation curve; if the curve has reached (or almost reached) an asymptote it is considered that most species are likely to have been recorded from the survey area.

A species accumulation curve was generated using quadrat data (**Figure 4**). Opportunistic observations, which increase the number of species recorded, are not included in the analysis.

The species accumulation curve suggests that the majority of species present within the survey area have been recorded. The Bootstrap estimate of species richness is 123.9 which, when taking opportunistic records into account, is slightly higher than the 113 species recorded during the survey. This indicates that 91.20% of the flora taxa have likely been recorded.

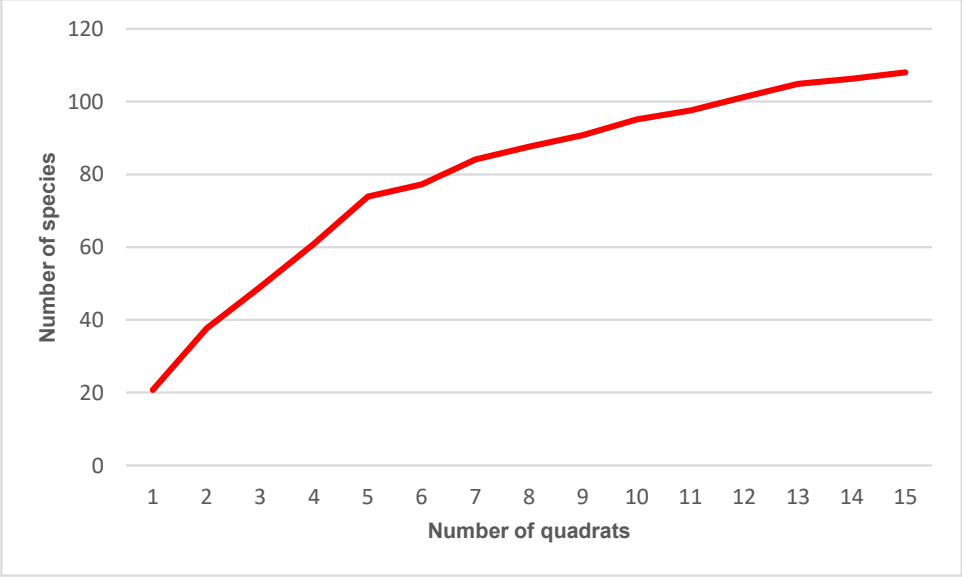

Figure 4: Species accumulation curve

4.4 BOTANICAL LIMITATIONS

Survey design: Single phase, quadrat-based flora and vegetation survey with extensive traverses searching for conservation-listed flora. Results from previous surveys were considered as part of survey design and the desktop assessment.

Survey type: Detailed flora and vegetation survey with extensive searches for significant flora searches conducted over a single phase. All areas were adequately surveyed through the use of floristic quadrats to sample vegetation types, and targeted searches for conservation significant flora.

Type of vegetation classification system: Vegetation classified at NVIS Level V (NVIS Technical Working Group & DotEE 2017) using largely structural vegetation types defined using dominant and characteristic species and vegetation structure as recorded during the field surveys. Floristic analysis was used to identify major floristic groups and outlier groups of floristic interest.

Survey timing was optimal for the bioregion, however, rainfall in the six months prior to the survey was 65% of the mean rainfall for that same period. The lower-than-average rainfall may be a constraint for the number of annual and ephemeral species recorded.

A full summary of botanical limitations is presented in **Table 9**.

Table 9: Botanical limitations

Possible limitations	Constraints (yes/no): Significant, moderate, or negligible	Comment
Availability of contextual information at a regional and local scale	No	One survey was previously conducted partially within the survey area and several surveys have been conducted in the general vicinity, as identified in Section 2.3. The vegetation of the Swan Coastal Plain is well studied.
Competence/experience of the team conducting the survey, including experience in the bioregion surveyed	No	The botanist conducting the field survey has six years of experience flora and vegetation surveys throughout Western Australia, including the Swan Coastal Plain.
Proportion of the flora recorded and/or collected, and any identification issues	Negligible	113 vascular flora taxa were recorded during the field survey of which 2.30% could not be identified with certainty to species level due to the lack of diagnostic reproductive material. This is considered a relatively low level of unidentified taxa. None of the unidentified taxa are considered likely to represent any conservation-listed flora from the region.
Was the appropriate area fully surveyed (effort and extent)	No	The survey area was covered sufficiently to develop a thorough understanding of the flora and vegetation.
Access restrictions within the survey area	No	The entire survey area was easily accessible on foot.
Survey timing, rainfall, season of survey	Moderate	The field survey was conducted during October which coincides with the optimal period for botanical survey in the bioregion. However, the rainfall in the six months prior to the survey was 65% of the average rainfall for that same period (see **Figure 5**). This may represent a

Possible limitations	Constraints (yes/no): Significant, moderate, or negligible	Comment
		moderate constraint for the number of annual and ephemeral species recorded.
Disturbance that may have affected the results of the survey e.g. fire, flood, clearing	No	There were no recent disturbances that would have affected the results of the survey. None of the survey area had been recently burnt.

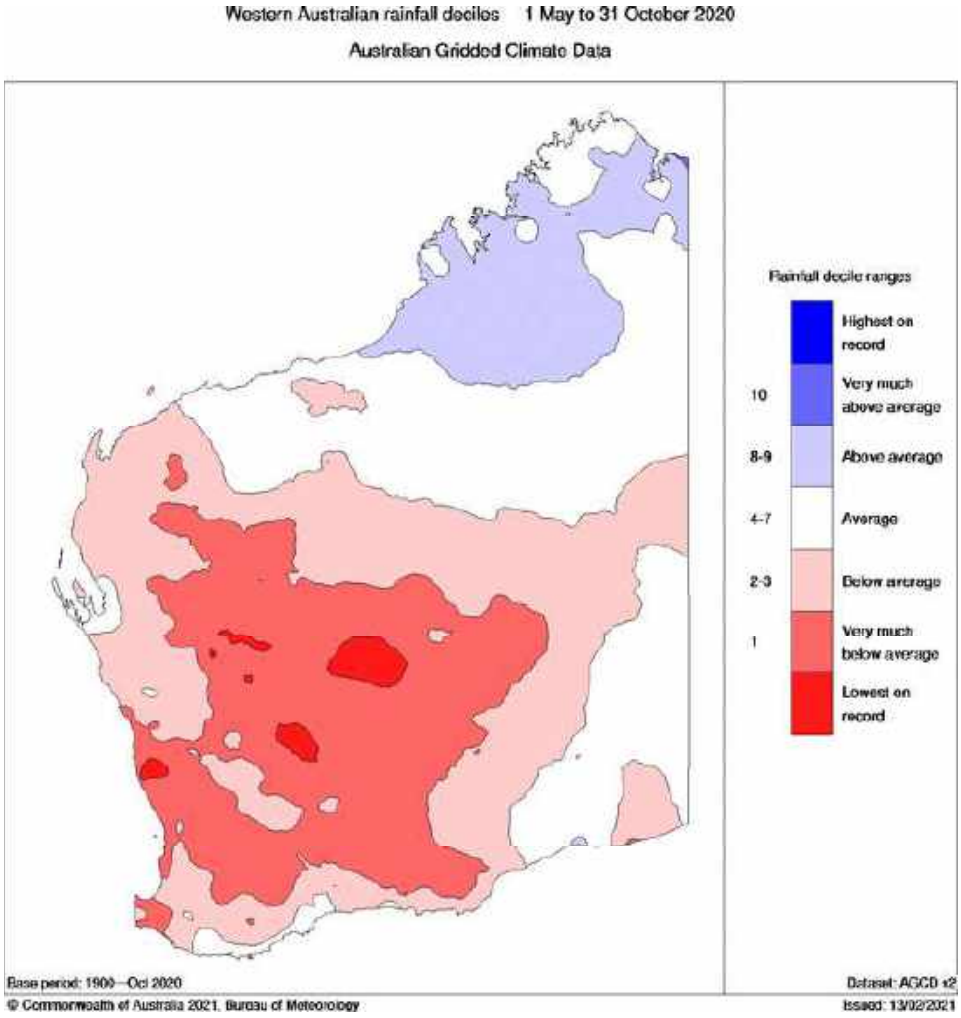

Figure 5: Rainfall deciles for the six months prior to the field survey

4.5 VERTEBRATE FAUNA SURVEY

The fauna survey was conducted by Hugh Osborn (Zoologist) during 29 October 2020. The survey was conducted in accordance with the requirements outlined in the Fauna Technical Guidance (EPA 2020a).

The entire site was traversed on foot and all habitats were assessed for quality and capability of supporting both locally common and significant fauna species.

4.5.1 FAUNA ASSEMBLAGE

A total of 18 vertebrate fauna species were recorded during the survey (**Table 10**), consisting of:

- three mammals (two introduced)
- 14 birds (one introduced)
- one reptile.

Survey sites are listed in **Table 28** in **Appendix Four**.

Table 10: Recorded fauna species

Species	Common name	EPBC Act status	Western Australian status
Mammals			
***Canis familiaris familiaris**	Dog	-	-
***Oryctolagus cuniculus**	Rabbit	-	-
***Macropus fuliginosus melanops**	Western Grey Kangaroo	-	-
Birds			
***Dacelo novaeguineae**	Laughing Kookaburra	-	-
***Todiramphus sanctus**	Sacred Kingfisher	-	-
***Cacatua roseicapilla**	Galah	-	-
***Coracina novaehollandiae**	Black-faced Cuckoo-shrike	-	-
***Cracticus tibicen**	Australian Magpie	-	-
***Falco berigora**	Brown Falcon	-	-
***Lichmera indistincta**	Brown Honeyeater	-	-
***Phylidonyris novaehollandiae**	New Holland Honeyeater	-	-
***Merops ornatus**	Rainbow Bee-eater	MA	
***Petroica goodenovii**	Red-capped Robin	-	-
***Platycercus spurius**	Red-capped Parrot	-	-
***Platycercus zonarius**	Australian Ringneck	-	-
***Rhipidura leucophrys**	Willie Wagtail	-	-
***Threskiornis spinicollis**	Straw-necked Ibis	-	-
Reptiles			
***Ctenophorus adelaidensis**	Western Heath Dragon	-	-

* denotes introduced species

4.5.2 FAUNA HABITAT

Two fauna habitat types were recorded within the survey area (**Table 11**):

- *Banksia* Woodland
- Degraded Woodland (*Eucalyptus todtiana*, *Melaleuca preissiana*, *Eucalyptus rudis*).

Table 11: Fauna habitat types

Habitat type	Description	Photograph
***Banksia* Woodland**	**Description:** *Banksia* dominated woodland over mixed shrubs Habitat is suitable for expected suite of small reptiles, mammals, and woodland birds. Breeding, foraging and roosting habitat for Black Cockatoo species. **Extent**: 3.66 ha; 7.74%	
Degraded Woodland (*Eucalyptus todtiana*, *Melaleuca preissiana*, *Eucalyptus rudis*)	**Description:** Degraded open woodland of Paperbark (*Melaleuca preissiana*), Flooded Gum (*Eucalyptus rudis*) and Coastal Blackbutt (*Eucalyptus todtiana*) over scattered shrubs and grasses on white sand, with patches of sedgeland on seasonally wet soil. Habitat is suitable for Woodland Birds, Western Grey Kangaroo and Rabbit. Foraging habitat for Black Cockatoo species. **Extent**: 32.55 ha; 68.82%	
No habitat	**Description:** Cleared areas containing little to no native vegetation This habitat is unsuitable to support fauna species. **Extent**: 11.08 ha; 23.43%	

The survey area is separated by a well-maintained fence line running east to west through the entire northern portion of the area which also encloses this portion. This fence line effectively divides the area into two parts, likely preventing larger ground-dwelling animals from passing through. On the north of this divide are the areas of *Banksia* Woodland fauna habitat and in the south are the areas of Degraded Woodland.

The quality of each habitat type was based on the field surveyor's experience and takes into consideration the level of disturbance to habitats from weeds, the amount of native vegetation, vegetation cover (density) and the context of the habitat with the surrounding landscape. Twelve habitat assessment sampling points were recorded to represent the habitat types present, recording the values of habitat characteristics that currently

exist within the survey area (**Table 28** in **Appendix Four**). Images representing each sampling point are displayed in **Table 29** in **Appendix Four**.

4.5.3 SIGNIFICANT FAUNA AND ASSOCIATED HABITAT

The significant fauna species observed during the field survey are discussed below with respect to each species' habitat requirements, taking into consideration the findings of the field survey and survey effort.

4.5.3.1 Rainbow Bee-eater (*Merops ornatus*) – MA EPBC status

The Rainbow Bee-eater is listed as Marine and protected under the EPBC Act. It inhabits a range of habitats including most vegetation types, open country, sand dunes and banks (Simpson & Day 2004). The species was seen utilising trees within the Degraded Woodland fauna habitat to perch and hunt.

The habitat within the survey area may be used by this species for foraging as part of the greater surrounds. The species has a broad habitat suitability and therefore the survey area is unlikely to be significant habitat for this species.

4.5.4 BLACK COCKATOO BREEDING HABITAT

Trees suitable or potentially suitable to be used for breeding by Black Cockatoos were surveyed throughout the survey area. A list of trees is provided in (**Table 31**). Each tree was assessed for the potential to provide breeding habitat for the Black Cockatoo species (Forest Red-tailed Black Cockatoo, Baudin's Cockatoo and Carnaby's Cockatoo) as per Commonwealth guidelines (DSEWPaC 2012).

A total of 19 trees were recorded as having potential to be used for breeding by Black Cockatoos, consisting of three Jarrah (*Eucalyptus marginata*) and 16 Flooded Gum (*Eucalyptus rudis*) (**Table 30**). The recorded trees were all scored using the scale developed by Dr Mike Bamford (Bamford 2016) () to further refine nesting value to the Black Cockatoo species and the results summarised in **Table 12**.

Table 12: Potential breeding tree species by class

Tree species	Class 4	Class 5	Species total
Jarrah *(Eucalyptus marginata)*	1	2	3
Flooded Gum (*Eucalyptus rudis*)	2	14	16
Total	**3**	**16**	**19**

No trees were recorded of Class 3 or above. A total of three trees of Class 4 and 16 trees of Class 5 were recorded. These trees do not currently exhibit the characteristics necessary for Black Cockatoo use for nesting. Due to the trees being of a suitable size (DBH > 500mm) to potentially provide suitable nesting hollows in the future, they have been recorded (DSEWPaC 2012).

The survey area is unlikely to currently provide breeding habitat for Black Cockatoo species as it does not contain suitable sized hollows for Black Cockatoo nesting (Class 3 trees and above).

4.5.5 BLACK COCKATOO FORAGING HABITAT

Based on the Revised Draft Referral Guidelines for the three Black Cockatoo species (Commonwealth of Australia 2017), the survey area was assessed for quality of existing suitable foraging habitat (**Table 23**). The survey area contains *Banksia* Woodland fauna habitat, containing a diversity of species including proteaceous shrubs and trees, which is foraging habitat for all three Black Cockatoo species. The Degraded Woodland contains large trees such as Coastal Blackbutt (*Eucalyptus todtiana*) and Flooded Gum (*Eucalyptus rudis*) which

may be utilised as roost sites by Black Cockatoo and as foraging resources, along with scattered proteaceous shrubs. No evidence of Black Cockatoo presence was found during the survey.

The habitat quality scores as below were tabulated using the guidelines' example. Foraging habitat quality for Carnaby's Cockatoo and Forest Red-tailed Black Cockatoo were assessed and scored as detailed in **Table 13** and **Table 14**. The modelled distribution for Baudin's Cockatoo does not extend to the survey area and this species is not likely to occur, therefore, a scoring assessment has not been included.

Table 13: Foraging habitat scoring tool – Carnaby's Cockatoo

Habitat Summary for Carnaby's Cockatoo Foraging Habitat	Score
Starting Score:	
Survey area has a section of *Banksia* Woodland i.e. Woodland dominated by proteaceous plant species	+7
Attributes improving functionality of foraging habitat:	
Impact area is within the Swan Coastal Plain (important foraging habitat)	+3
Impact area contains trees with potential to be used for breeding (DBH ≥500 mm	+2
Attributes reducing functionality of foraging habitat:	
No clear evidence of feeding debris	-2
FINAL SCORE	**10**

The final score is **10** (of a maximum score of 21). According to the guidelines (Commonwealth of Australia 2017) this indicates **very high quality** foraging habitat for Carnaby's Cockatoo.

Table 14: Foraging habitat scoring tool – Forest Red-tailed Black Cockatoo

Habitat Summary for Forest Red-tailed Black Cockatoo Foraging Habitat	Score
Starting Score:	
Survey area contains some Jarrah and *Allocasuarina* cones which provide foraging resources	+7
Attributes improving functionality of foraging habitat:	
Impact area contains trees with potential to be used for breeding (DBH ≥500 mm)	+2
Attributes reducing functionality of foraging habitat:	
No clear evidence of feeding debris	-2
FINAL SCORE	**7**

The final score is **7** (out of a maximum score of 21). According to the guidelines this indicates **high quality** foraging habitat for Forest Red-tailed Black Cockatoo.

4.6 FAUNA SURVEY LIMITATIONS

The limitations of the basic fauna survey are summarised in **Table 15** below. There were no constraints in relation to survey adequacy.

Table 15: Fauna survey limitations

Possible limitations	Constraints (yes/no): Significant, moderate, or negligible	Comment
Competency/experience of the consultant conducting the survey	No	The fauna field surveyor was experienced with the fauna survey methods used and with the identification of fauna taxa.
Scope (what faunal groups were sampled and were some sampling methods not able to be employed because of constraints such as weather conditions).	No	The survey was conducted as a Basic fauna assessment. Sufficient time was allocated to the fauna survey, which included active diurnal searches to adequately describe the fauna assemblage present in the survey area.
Proportion of fauna identified, recorded and/or collected.	No	All fauna species opportunistically observed were identified in the field.
Sources of information (previously available information as distinct from new data).	No	Many sources referencing field surveys in the vicinity were available. No constraints were associated with this previous data.
The proportion of the task achieved and further work which might be needed.	No	The survey area was adequately searched.
Timing/weather/season/cycle.	No	The timing of the field survey was within a period suitable to identify most components of the expected fauna assemblage if they were present on site. The seasonal conditions were suitable for fauna survey with warm daytime temperatures and fine weather during the survey period.
Disturbances which affected results of the survey (e.g., fire, flood, accidental human intervention).	No	No disturbance to the survey was detected.
Intensity (in retrospect was the intensity adequate).	No	The survey was considered suitable to determine the presence or potential presence of conservation significant fauna.
Completeness (e.g., was relevant area fully surveyed), remoteness and/or access problems	No	The entire survey area was adequately searched and was entirely accessible.
Resources (e.g., degree of expertise available in animal identification to taxon level).	No	Field staff has over 10 years' experience identifying fauna. All terrestrial vertebrate fauna was identified to species level.
Availability of contextual (e.g., biogeographic) information on the region).	Negligible	Few fauna surveys appear to have been conducted in the general region. However, there is 1990s literature available describing the suite of species present at that time, giving context to the discussion in this report.
Efficacy of sampling methods (i.e., any groups not sampled by survey methods).	No	The survey was conducted as a Basic fauna assessment. All fauna species opportunistically observed were identified in the field. The survey did not include marine, subterranean, nor invertebrate species.

5 DISCUSSION

5.1 FLORA SIGNIFICANCE

Ecoscape recorded a total of 113 vascular flora from within the survey area including three that could not be identified with certainty due to insufficient diagnostic reproductive material. The species accumulation curve generated using quadrat data indicates that additional taxa would have been recorded with additional survey effort. However, the Bootstrap estimate of species richness shows that 91.20% of the flora taxa have been recorded which represents most species likely present. Ecoscape considers that if seasonal conditions were optimal with average or above-average rainfall in the months preceding the survey, additional annual and ephemeral species would occur.

5.1.1 LOCAL AND REGIONAL ASSESSMENT OF FLORA SIGNIFICANCE

5.1.1.1 Conservation-listed Flora

Threatened and Priority Flora

Three TF and 16 PF were identified in the database searches as occurring within the search area however no TP or PF were recorded from within the survey area. The targeted flora survey conducted by Eco Logical Australia (ELA) (2013a) which partially intersects the survey area in the southwest, also did not record any TF or PF.

5.1.1.2 Post-survey Likelihood Assessment

Four conservation-listed flora were considered as 'Possible' to occur within the survey area based on information available prior to the survey i.e. the desktop assessment. The likelihood of conservation-listed flora occurring in the survey area was revised following the field survey. The likelihood for these four species was revised to 'Unlikely', taking into account vegetation condition, grazing, weeds, other disturbances, actual habitat availability and search effort. There revised likelihood assessment is included in **Table 25** in **Appendix Three**.

5.1.1.3 Other Significant Flora

No flora taxa having other significance according to the Flora and Vegetation Technical Guidance (EPA 2016) were recorded during the field survey.

5.1.1.4 Introduced Flora

Ecoscape recorded 26 introduced flora species (weeds) within the survey area, representing 23.01% of the overall flora inventory. Two of the weed species recorded are significant weeds: *Asparagus asparagoides* is a Weed of National Significance and Declared Pest, and *Moraea miniata* is a Declared Pest. Most of the other weed species are commonly recorded weeds and have no specific significance.

5.2 VEGETATION SIGNIFICANCE

Four vegetation types were recorded from within the survey area with the floristic analysis confirming the floristic groups. The vegetation types correspond with one broad landform unit: gently undulating sandplains. The vegetation types recorded were:

- **BaMW**: *Banksia attenuata* and *B. menziesii* mid woodland over *Allocasuarina humilis* tall sparse shrubland over *Hibbertia hypericoides* subsp. *hypericoides* and **Ehrharta calycina* low open shrubland/tussock grassland
- **BiMW**: *Banksia ilicifolia* mid woodland over *Kunzea glabrescens* and *Adenanthos cygnorum* subsp. *cygnorum* tall shrubland over *Lyginia imberbis*, *Brachyloma preissii* and *Hibbertia racemosa* mid open rushland/low open shrubland
- **EtLMW**: *Eucalyptus todtiana* and *Nuytsia floribunda* mid mallee woodland/low woodland over **Ehrharta calycina* mid open tussock grassland
- **MpMW**: *Melaleuca preissiana* and *Eucalyptus rudis* subsp. *rudis* mid woodland over **Ehrharta calycina*, **Carpobrotus edulis* and **Bromus diandrus* mid open tussock grassland/forbland with *Astartea scoparia* tall isolated shrubs.

Minor differences in vegetation types **EtLMW** and **MpMW** occur between this survey and the survey results of ATA Environmental (cited in Eco Logical Australia (2013a)) which intersects the southwest corner of the survey area. However, this is largely the result of differences in survey design and effort, and naming conventions used to determine vegetation type codes and descriptions.

5.2.1 LOCAL AND REGIONAL ASSESSMENT OF VEGETATION SIGNIFICANCE

Vegetation of the **BaMW** and **BiMW** vegetation types in the northern section of the survey area is considered to represent the *Banksia Woodlands on the Swan Coastal Plain* TEC and PEC (**Map 5**). The proportion of vegetation assessed as a TEC/PEC within the vegetation types **BaMW** and **BiMW** is 79.54% and 50.98% respectively. The vegetation was assessed against the criteria detailed in the Approved Conservation Advice for the *Banksia Woodlands on the Swan Coastal Plain TEC* (TSSC 2016) **Appendix Two**.

5.2.2 VEGETATION CONDITION

No vegetation was assessed as being in Pristine or Excellent condition. The majority of vegetation to the east and west of the go kart track (corresponding with the *Banksia Woodlands on the Swan Coastal Plain* TEC/PEC and vegetation types **BaMW** and **BiMW**) was assessed as Good to Very Good, representing 5.84% of the survey area. These areas of better vegetation condition were located further from the go kart track and adjacent cleared areas. The area to the south of the go kart track was assessed as mostly Degraded, representing 71.30% of the survey area. Similarly, the vegetation condition mapping by Eco Logical Australia (2013a) for the intersecting area in the southwest recorded the vegetation in mostly Degraded condition with a smaller portion assessed as Good. The minor differences in vegetation condition between this survey and the ELA survey are not considered significant and could be indicative of degradation that has occurred since 2013.

Weed cover and disturbance from vehicles (as evidenced by a number of tracks) were the major factors affecting vegetation condition in the survey area.

5.3 FAUNA SIGNIFICANCE

5.3.1 FAUNA HABITAT TYPES

Two fauna habitat types were recorded within the survey area: *Banksia* Woodland and Degraded Woodland (*Eucalyptus todtiana*, *Melaleuca preissiana*, *Eucalyptus rudis*). Each of these habitat types supports a common suite of birds, mammals, and reptiles, some of which have specific requirements unique to a particular habitat

such as passerine woodland bird species and small fossorial reptiles. The survey area is divided by a fence line running east to west along the northern portion of the area, separating the areas of *Banksia* Woodland and Degraded Woodland.

The *Banksia* Woodland habitat contains a diversity of trees and shrubs which provide both foraging resources and habitat structure for fauna. This habitat provides refuge areas and resources in the leaf litter and dense shrub understorey for fossorial reptiles, birds, and small mammals such as Quenda. This habitat also provides foraging opportunities for Black Cockatoo species.

The Degraded Woodland fauna habitat is of low value for most fauna species, particularly small ground-dwelling species, but is still of moderate value to bird species. The remnant trees of the Degraded Woodland (2013a)provide habitat structure and foraging opportunities for bird species such as Purple-crowned Lorikeets, Rainbow Bee-eaters, Sacred Kingfishers and Red-capped Robins. This area is also likely to provide foraging resources to Black Cockatoos. The seasonally wet sedgelands provide a water source throughout part of the year. The remnant trees in an otherwise degraded area may still provide nesting and breeding opportunities for suitable bird species. The habitat is also utilised by introduced predators such as Dogs, Foxes and Cats and grazing animals such as Rabbits and Western Grey Kangaroos.

5.3.2 FAUNA ASSEMBLAGE

The fauna survey identified an expected suite of species for the existing habitats. The eighteen species detected during the basic survey included a variety of birds, three mammals (including two introduced) and one reptile. Bird species were seen throughout the entire survey area and were diverse in the open areas of the Degraded Woodland.

5.3.3 CONSERVATION-LISTED SPECIES

No conservation listed species other than the Rainbow Bee-eater (EPBC-listed as Marine) were recorded during the field survey. A species listed as Marine is protected under the EPBC Act, even if not listed as Threatened (e.g. Endangered, Vulnerable etc.). The *Banksia* Woodland habitat within the survey area is suitable for conservation-listed species Carnaby's Cockatoo, Forest Red-tailed Black Cockatoo and Quenda.

The two Black Cockatoo species are known to utilise the woodland habitats for foraging and roosting with the potential for use as breeding habitat (Ecoscape 2019). The Quenda and Western Brush Wallaby are common residents making use of large extents of bushland and connections to nearby wetlands.

5.3.3.1 Post-survey Likelihood Assessment

The remaining conservation-listed fauna species identified during the desktop assessment as having a High likelihood of occurring are discussed below with respect to each species' habitat requirements, taking into consideration the findings of the field survey and survey effort. The post-survey likelihood assessment is incorporated into **Table 26** in **Appendix Three**.

Carnaby's Cockatoo (*Calyptorhynchus latirostris*) – EN EPBC status; EN BC status/DBCA status

Carnaby's Cockatoo is a large species of cockatoo endemic to south-western Western Australia which has predominantly black plumage with white cheek patches and tail feather panels. The known distribution for the species runs roughly south-west of a line between Kalbarri and Esperance, extending along the south coast to Cape Arid National Park (Commonwealth of Australia 2017), with birds foraging in Proteaceous woodlands and shrublands in coastal areas from January to July, then moving inland to woodlands with suitable nesting hollows during the breeding season of late July to December (Saunders 1980). Carnaby's Cockatoo occurs in

uncleared or remnant native eucalypt woodlands and shrubland or kwongan heathland dominated by Hakea, Banksia, and Grevillea species. It is a seasonal visitor to plantations of exotic Pines (*Pinus* spp.), and sometimes occurs in forests.

The survey area falls within the species' range with the *Banksia* Woodlands of the survey area providing very high quality foraging habitat for this species. Ecoscape considers that Carnaby's Cockatoo has a high likelihood of occurring within the survey area.

Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) – VU EPBC status; VU BC status/DBCA status

Forest Red-tailed Black Cockatoo was formerly common but is now rare to uncommon and patchily distributed over a range which has become markedly reduced (DSEWPaC 2012). This taxon usually occurs in pairs or small flocks, seldom large flocks (up to 200) and has declined due to destruction of forests and woodlands and competition for nest hollows with native and exotic species, and the impact of fire.

Its Commonwealth mapped distribution includes the survey area and the desktop assessment identified that it has been recorded nearby. The *Banksia* Woodland habitat within the survey area contains high quality foraging habitat for this species. Ecoscape considers that Forest Red-tailed Black Cockatoo has a high likelihood of occurring within the survey area.

Western Brush Wallaby (*Notamacropus irma*) – P4 DBCA status

The Western Brush Wallaby's optimum habitat is open forest or woodland, particularly favouring open, seasonally wet flats with low grasses and open scrubby thickets. It is also found in some areas of mallee and heathland and is uncommon in Karri forest (DCE 2010).

The species has recently been recorded in the adjacent Mather Reserve (Ecoscape 2018). However, due to the small and isolated extents of habitat which are mostly fenced off from surrounding areas, and the presence of predators, it is less likely to be present in the survey area. Ecoscape considers that the Western Brush Wallaby has a medium likelihood of occurring within the survey area.

Quenda (*Isoodon fusciventer*) – P4 DBCA status

Quenda are widely distributed from near the coast from Guilderton (north of Perth) to the east of Esperance. They also have a patchy distribution through the Jarrah and Karri forest, the Swan Coastal Plain, and inland as far as Hyden. Quenda have been recorded in swampy vegetation with dense cover up to 1 m high, often feeding in adjacent forest and woodland that is burnt on a regular basis, and in areas of pasture and cropland lying close to dense cover. Populations inhabiting Jarrah and Wandoo forests are usually associated with watercourses. Quenda will thrive in more open habitat subject to introduced predator control. On the Swan Coastal Plain, Quenda are often associated with wetlands (DEC 2012).

There is only moderate suitable habitat for Quenda in the survey area, habitat quality is reduced due to fragmentation and predator presence.

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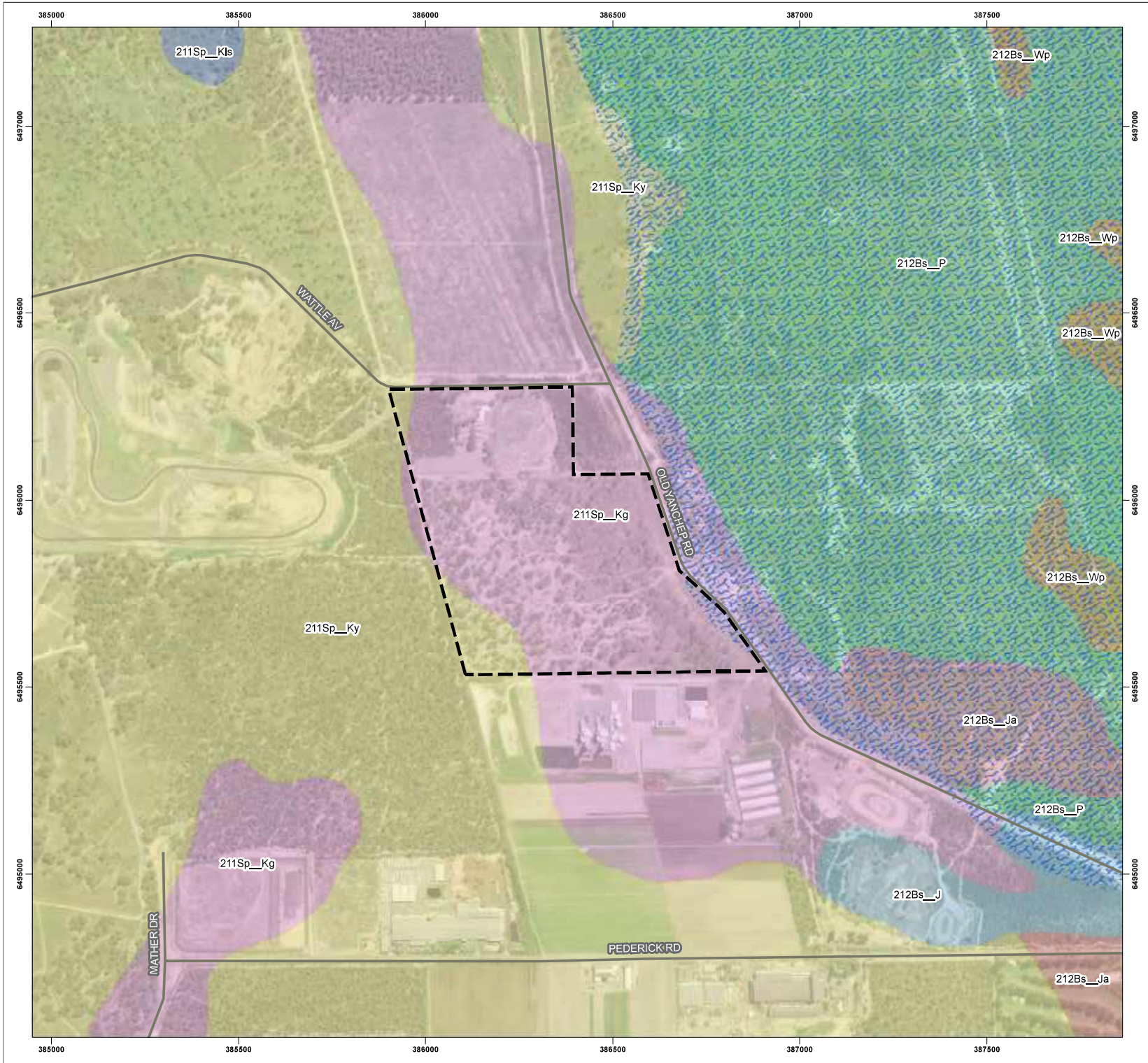
MAPS



LEGEND

- Survey Area
- Roads
- Lake Pinjar Geomorphic Wetland (Sumpland, Conservation)

Soil Land Systems

- 211Sp__Kg: Low hilly to gently undulating terrain. Iron podzols. *Banksia* spp woodland with *E. todtiana* and depauperate *E. marginata*; dense shrub layer
- 211Sp__Kls: Low hills and ridges. Bare limestone or shallow siliceous or calcareous sand over limestone. Dense low shrub dominated by *Dryandra sessilis, Melaleuca huegellii* and species of *Grevillea*
- 211Sp__Ky: Low hilly to gently undulating terrain. Yellow sand over limestone at 1-2 m. *Banksia* spp. woodland with scattered emergent *E. gomphocephala* and *E. marginata* and a dense shrub layer
- 212Bs__J: Poorly drained depressions. Humus podzols. Scattered *M. preissiana, E. rudis* and *Banksia ilicifolia* with a dense shrub layer
- 212Bs__Ja: Jandakot low dunes. Slopes less than 10% and generally more than 5m relief. Grey sand over pale yellow sands generally underlain by humic and iron podsols; *Banksia* spp. low open woodland with a dense shrub layer
- 212Bs__P: Extensively flat swampy areas. Sandy surface sometimes with diatomite over organic hardpan below. *E. rudis, B. littoralis* and *M. preissiana* around the edges; sedges and reeds with scattered *M. teretifolius* in centre; *Jacksonia furcellata*
- 212Bs__Wp: Depressions. Humus podzols and peats around the edges often with some diatomite zoned vegetation with heath on upper slopes. *Melaleuca* spp. and *E. rudis* at waters edge. Reeds and sedges in shallow water

DATA SOURCES
SOURCE DATA: SOIL-LANDSCAPE MAPPING WESTERN AUSTRALIA - BEST AVAILABLE SOILS (2019); TRANSPORT ROAD CENTRELINES (MRWA 2012); GEOMORPHIC WETLANDS, SWAN COASTAL PLAIN (DBCA-019)
AERIAL: ESRI BASEMAP (2019)
SERVICE LAYERS: SOURCE: ESRI, MAXAR, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY

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SOIL LANDSCAPE MAPPING

NEERABUP INDUSTRIAL AREA
ENVIRONMENTAL ASSESSMENTS - PORTION 2

City of Wanneroo

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

N

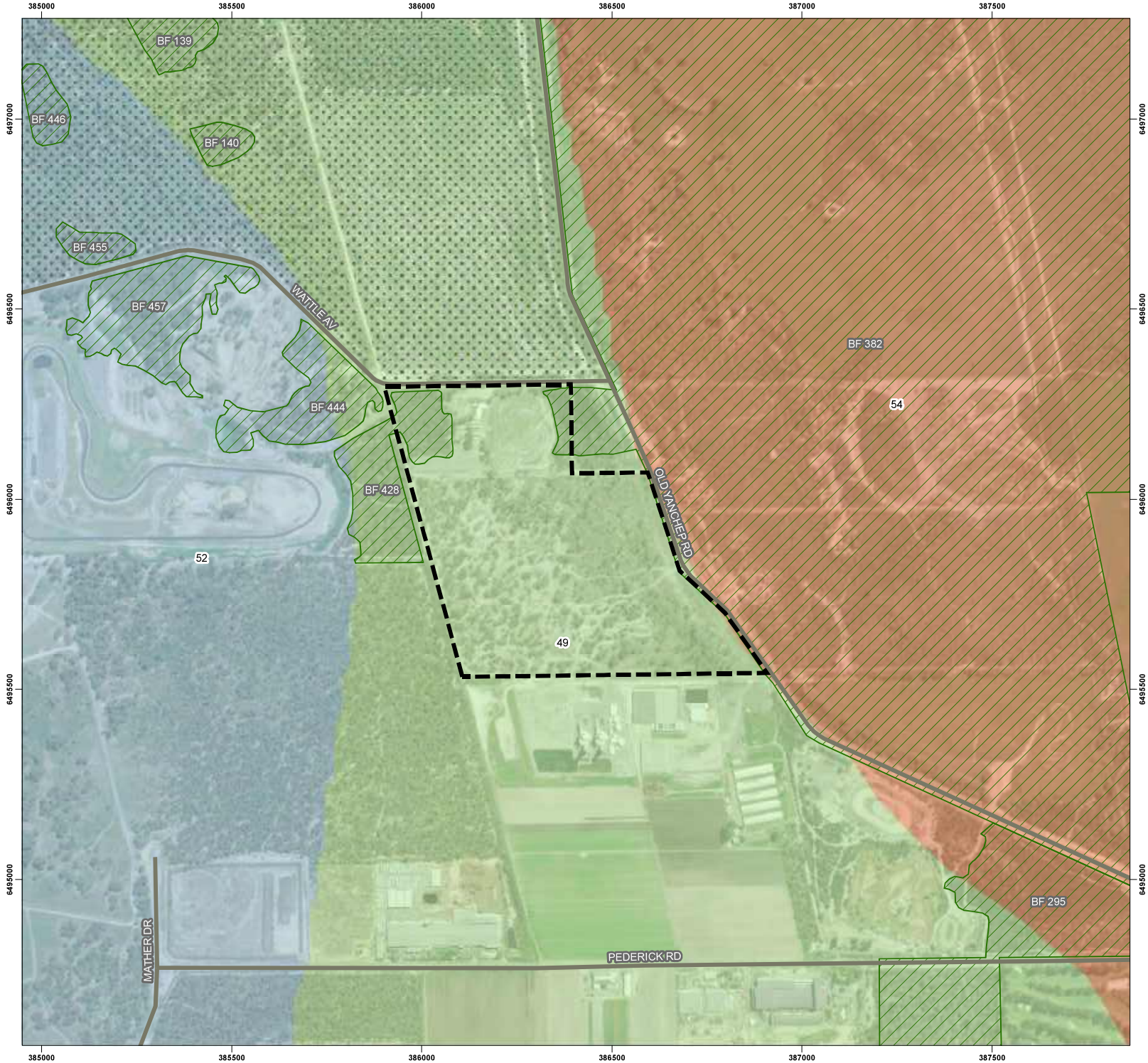
SCALE: 1:10,000 @ A3

0 80 160 240 320 400 m

PROJECT NO: 4591-20

REV	AUTHOR	APPROVED	DATE
0	KP	SB	22/02/2021

MAP 1



LEGEND

- Survey Area
- Roads
- Bush Forever Sites
- Gnangara-Moore River State Forest

Vegetation Complexes

- 52: Cottesloe Complex-Central and South - Woodland and open forest and closed heath
- 49: Karrakatta Complex-Central and South - Open forest and woodland
- 54: Pinjar Complex - Woodland to fringing woodland

DATA SOURCES

SOURCE DATA: VEGETATION COMPLEXES - SWAN COASTAL PLAIN (DBCA-046); TRANSPORT ROAD CENTRELINES (MRWA 2012); BUSH FOREVER AREAS 2000 (DPLH-019); DBCA - LEGISLATED LANDS AND WATERS (DBCA-011)
AERIAL: ESRI BASEMAP (2019)
SERVICE LAYERS: SOURCE: ESRI, MAXAR, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY

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VEGETATION COMPLEXES

NEERABUP INDUSTRIAL AREA ENVIRONMENTAL ASSESSMENTS – PORTION 2

City of Wanneroo

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

N

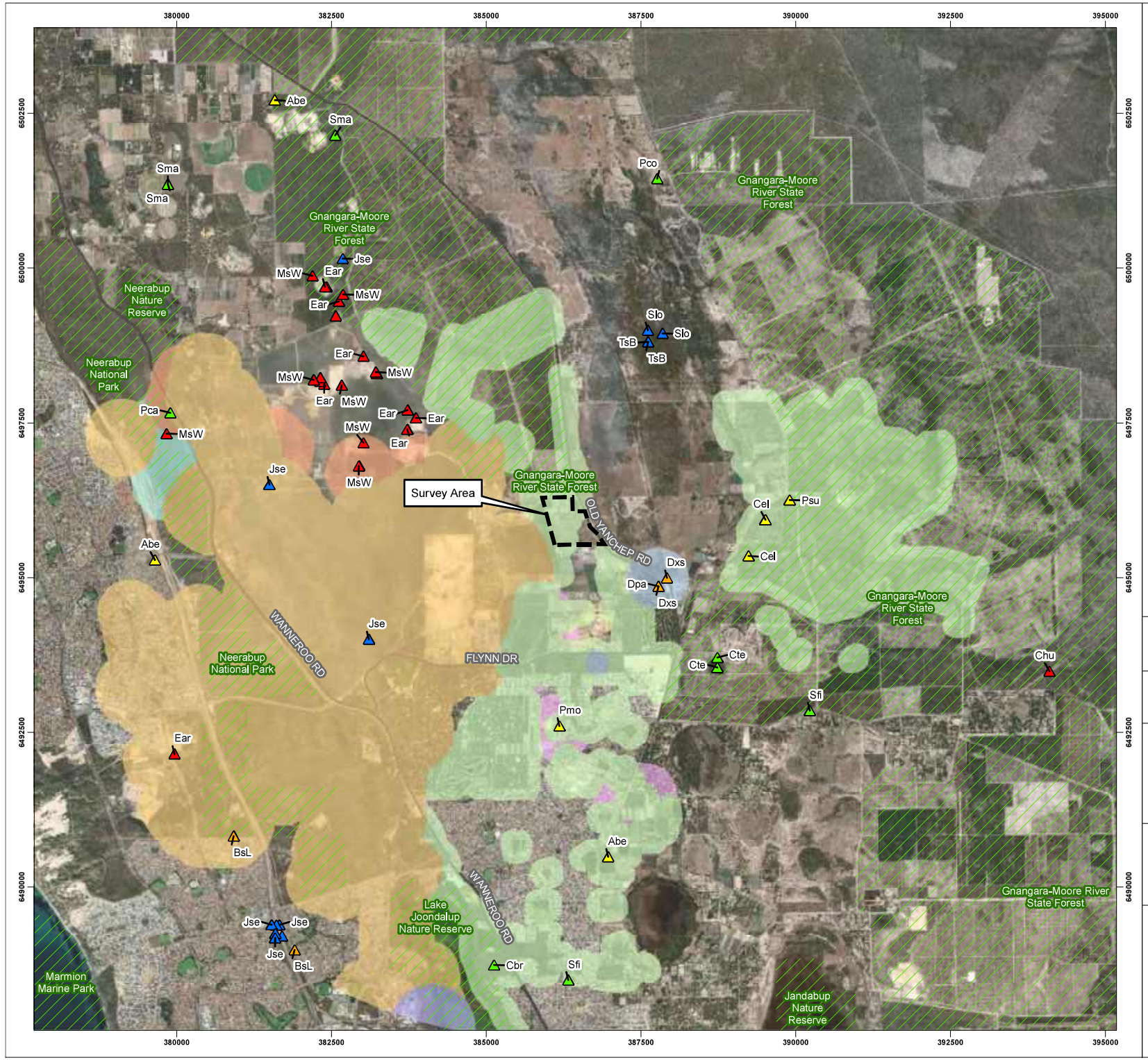
SCALE: 1:10,000 @ A3

0 80 160 240 320 400 m

PROJECT NO: 4591-20

REV	AUTHOR	APPROVED	DATE
1	KP	SB	22/02/2021

MAP 2



LEGEND

- Survey Area
- Roads
- DBCA Reserves

Conservation-listed Flora (DBCA 2020)

- Threatened
- Priority 1
- Priority 2
- Priority 3
- Priority 4

TEC/PEC (DBCA 2020)

- *Banksia* Dominated Woodlands of the Swan Coastal Plain IBRA Region
- *Banksia attenuata* woodlands over species rich dense shrublands
- *Banksia ilicifolia* woodlands
- *Melaleuca huegelii - Melaleuca systena* shrublands on limestone ridges
- Northern Spearwood shrublands and woodlands
- Southern *Eucalyptus gomphocephala-Agonis flexuosa* woodlands
- Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain

Code	Taxon	Status
Abe	*Acacia benthamii*	2
BsL	*Baeckea* sp. Limestone (N. Gibson & M.N. Lyons 1425)	1
Chu	*Caladenia huegelii*	T
Cel	*Calectasia elegans*	2
Cbr	*Conostylis bracteata*	3
Cte	*Cyathochaeta teretifolia*	3
Dpa	*Drosera patens*	1
Dxs	*Drosera x sidjamesii*	1
Ear	*Eucalyptus argutifolia*	T
Fha	*Fabronia hampeana*	2
Jse	*Jacksonia sericea*	4
MsW	*Melaleuca* sp. Wanneroo (G.J. Keighery 16705)	T
Pca	*Pimelea calcicola*	3
Pco	*Pithocarpa corymbulosa*	3
Pmo	*Poranthera moorokatta*	2
Psu	*Stenanthemum sublineare*	2
Slo	*Stylidium longitubum*	4
Sma	*Stylidium maritimum*	3
Sfi	*Styphelia filifolia*	3
TsB	*Tripterococcus* sp. Brachylobus (A.S. George 14234)	4

DATA SOURCES

SOURCE DATA: FLORA AND TEC/PEC DATA (DBCA 2020); TRANSPORT ROAD CENTRELINES (MRWA 2012); DBCA LEGISLATED LANDS AND WATERS (DBCA-011)
AERIAL: ESRI BASEMAP (2019)
SERVICE LAYERS: SOURCE: ESRI, MAXAR, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY

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FLORA AND COMMUNITIES DATABASE SEARCH RESULTS

NEERABUP INDUSTRIAL AREA ENVIRONMENTAL ASSESSMENTS - PORTION 2

City of Wanneroo

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

N

SCALE: 1:60,000 @ A3

0 0.5 1 1.5 2 km

PROJECT NO: 4591-20

REV	AUTHOR	APPROVED	DATE
1	KP	SB	22/02/2021

MAP 3

LEGEND

- Survey Area
- Roads
- DBCA Reserves

Conservation-listed Fauna (DBCA 2020)

- Endangered
- Vulnerable
- Migratory
- Other Specially Protected
- Priority 4

Code	Taxon	Status
Apa	*Apus pacificus*	MI
Cbn	*Calyptorhynchus banksii naso*	VU
Cla	*Calyptorhynchus latirostris*	EN
CsW	*Calyptorhynchus* sp. 'white-tailed black cockatoo'	EN
Fpe	*Falco peregrinus*	OS
Ifu	*Isoodon fusciventer*	P4
Nir	*Notamacropus irma*	P4

DATA SOURCES:
SOURCE DATA: FAUNA DATA (DBCA 2020); TRANSPORT ROAD CENTRELINES (MRWA 2012); DBCA LEGISLATED LANDS AND WATERS (DBCA-011)
AERIAL: ESRI BASEMAP (2019)
SERVICE LAYERS: SOURCE: ESRI, MAXAR, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY

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FAUNA DATABASE SEARCH RESULTS

NEERABUP INDUSTRIAL AREA ENVIRONMENTAL ASSESSMENTS - PORTION 2

City of Wanneroo

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

N

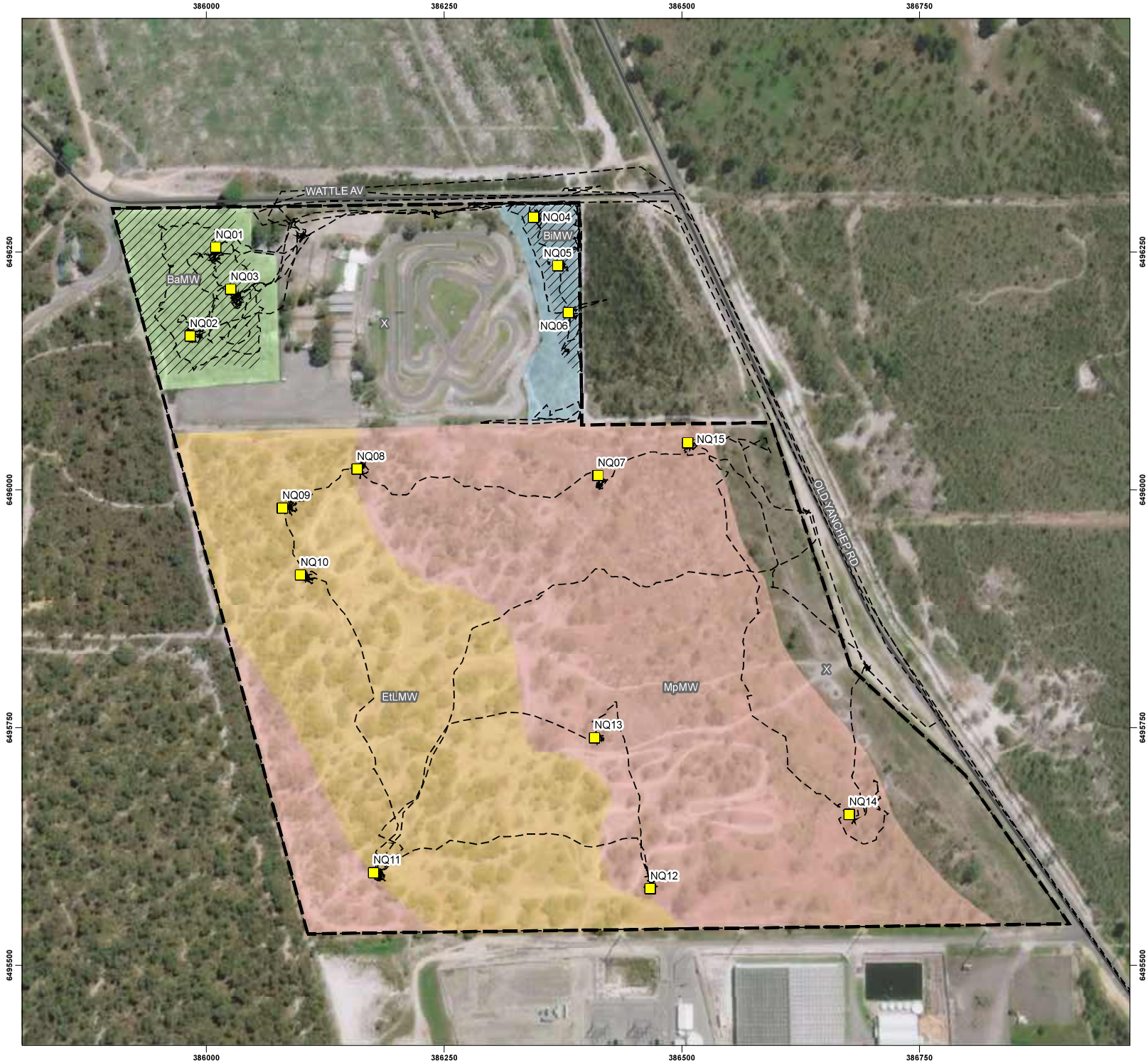
SCALE: 1:30,000 @ A3

0 0.2 0.4 0.6 0.8 1 km

PROJECT NO: 4591-20

REV	AUTHOR	APPROVED	DATE
1	KP	SB	22/02/2021

MAP 4



LEGEND

- Survey Area
- Survey Tracks
- Roads
- Quadrats

TEC/PEC

- *Banksia* dominated woodlands of the Swan Coastal Plain TEC/PEC

Vegetation Types

- BaMW: *Banksia attenuata* and *B.menziesii* mid woodland
- BiMW: *Banksia ilicifolia* mid woodland
- EtLMW: *Eucalyptus todtiana* and *Nuytsia floribunda* mid mallee woodland
- MpMW: *Melaleuca preissiana* and *Eucalyptus rudis* subsp. *rudis* mid woodland
- X: No vegetation (cleared)

DATASOURCES
SOURCE DATA: FLORA DATA (ECOSCAPE 2020); TRANSPORT ROAD CENTRELINES (MRWA 2012)
AERIAL: ESRI BASEMAP (2019)
SERVICE LAYERS: SOURCE: ESRI, MAXAR, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY

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VEGETATION TYPES AND QUADRAT LOCATIONS

NEERABUP INDUSTRIAL AREA ENVIRONMENTAL ASSESSMENTS - PORTION 2

City of Wanneroo

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

N

SCALE: 1:4,000 @ A3

0 30 60 90 120 150 m

PROJECT NO: 4591-20

REV	AUTHOR	APPROVED	DATE
0	KP	SB	22/02/2021

MAP 5

LEGEND

- Survey Area
- Roads

Vegetation Condition

- Very Good
- Good
- Degraded
- N/A

Quadrat Condition

- Very Good
- Degraded

Significant Weeds

- **Asparagus asparagoides*
- **Moraea miniata*

DATA SOURCES
SOURCE DATA: FLORA DATA (ECOSCAPE 2020); TRANSPORT ROAD CENTRELINES (MRWA 2012)
AERIAL: ESRI BASEMAP (2019)
SERVICE LAYERS: SOURCE: ESRI, MAXAR, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY

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VEGETATION CONDITION & SIGNIFICANT WEEDS

NEERABUP INDUSTRIAL AREA ENVIRONMENTAL ASSESSMENTS - PORTION 2

City of Wanneroo

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

N

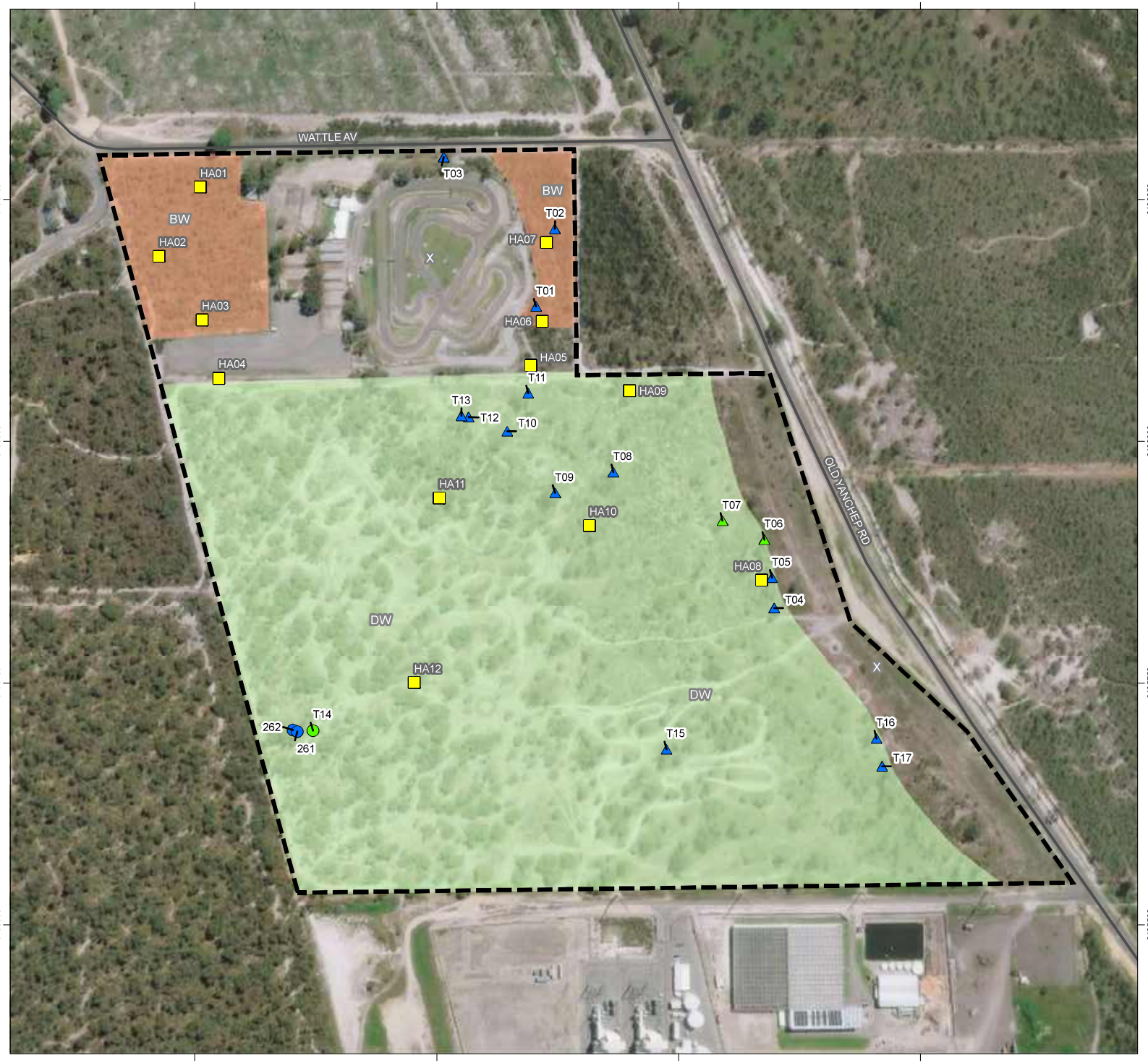
SCALE: 1:4,000 @ A3

0 30 60 90 120 150 m

PROJECT NO: 4591-20

REV	AUTHOR	APPROVED	DATE
0	KP	SB	22/02/2021

MAP 6



LEGEND

- Survey Area
- Roads
- Fauna Assessment Points

Fauna Habitat

- BW: *Banksia* Woodland
- DW: Degraded Woodland (*Eucalyptus todtiana*, *Melaleuca preissiana*, *Eucalyptus rudis*)
- X: No habitat

Habitat Trees

Eucalyptus marginata

- Class 4
- Class 5

Eucalyptus rudis

- Class 4
- Class 5

DATA SOURCES
SOURCE DATA: FAUNA DATA (ECOSCAPE 2020); TRANSPORT ROAD CENTRELINES (MRWA 2012)
AERIAL: ESRI BASEMAP (2019)
SERVICE LAYERS: SOURCE: ESRI, MAXAR, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY

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FAUNA SITES AND HABITAT

NEERABUP INDUSTRIAL AREA ENVIRONMENTAL ASSESSMENTS - PORTION 2

City of Wanneroo

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

N

SCALE: 1:4,000 @ A3

0 30 60 90 120 150 m

PROJECT NO: 4591-20

REV	AUTHOR	APPROVED	DATE
0	KP	SB	22/02/2021

MAP 7

APPENDIX ONE DEFINITIONS AND CRITERIA

Table 16: EPBC Act categories for flora, fauna, and ecological communities

Category	Threatened species	Threatened Ecological Communities
Extinct	A native species is eligible to be included in the extinct category at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.	n/a
Extinct in the wild	A native species is eligible to be included in the extinct in the wild category at a particular time if, at that time: (a) it is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or (b) it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.	n/a
Critically Endangered (CE)	A native species is eligible to be included in the *critically endangered* category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.	An ecological community is eligible to be included in the *critically endangered* category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria
Endangered (EN)	A native species is eligible to be included in the *endangered* category at a particular time if, at that time: (a) it is not critically endangered; and (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.	An ecological community is eligible to be included in the *endangered* category at a particular time if, at that time: (a) it is not critically endangered; and (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
Vulnerable (VU)	A native species is eligible to be included in the *vulnerable* category at a particular time if, at that time: (a) it is not critically endangered or endangered; and (b) it is facing a high risk of extinction in the wild in the medium term future, as determined in accordance with the prescribed criteria.	An ecological community is eligible to be included in the *vulnerable* category at a particular time if, at that time: (a) it is not critically endangered or endangered; and (b) it is facing a high risk of extinction in the wild in the medium term future, as determined in accordance with the prescribed criteria.
Conservation Dependent	A native species is eligible to be included in the conservation dependent category at a particular time if, at that time: (a) the species is the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered, or critically endangered; or (b) the following subparagraphs are satisfied: (i) the species is a species of fish. (ii) the species is the focus of a plan of management that provides for management actions necessary to stop the decline of, and support the recovery of, the species so that its chances of long-term survival in nature are maximised. (iii) the plan of management is in force under a law of the Commonwealth or of a State or Territory. (iv) cessation of the plan of management would adversely affect the conservation status of the species.	n/a

Table 17: Conservation codes for Western Australian flora and fauna (DBCA 2019b)

Conservation Codes for Western Australian Flora and Fauna	
Threatened, Extinct and Specially Protected fauna or flora[1] **are species[2] which have been adequately searched for and are deemed to be, in the wild, threatened, extinct or in need of special protection, and have been gazetted as such.** **The *Wildlife Conservation (Specially Protected Fauna) Notice 2018* and the *Wildlife Conservation (Rare Flora) Notice 2018* have been transitioned under regulations 170, 171 and 172 of the *Biodiversity Conservation Regulations 2018* to be the lists of Threatened, Extinct and Specially Protected species under Part 2 of the *Biodiversity Conservation Act 2016*.** **Categories of Threatened, Extinct and Specially Protected fauna and flora are:**	
T	**Threatened species** Listed by order of the Minister as Threatened in the category of critically endangered, endangered, or vulnerable under section 19(1), or is a rediscovered species to be regarded as threatened species under section 26(2) of the *Biodiversity Conservation Act 2016* (BC Act). Threatened fauna is that subset of 'Specially Protected Fauna' listed under schedules 1 to 3of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for Threatened Fauna. Threatened flora is that subset of 'Rare Flora' listed under schedules 1 to 3of the *Wildlife Conservation (Rare Flora) Notice 2018* for Threatened Flora. The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria as detailed below.
CR	**Critically endangered species** 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 undersection 19(1)(a) of the BC Act in accordance with the criteria set out in section 20 and the ministerial guidelines. Published under schedule 1 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for critically endangered fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for critically endangered flora.
EN	**Endangered species** 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 21 and the ministerial guidelines. Published under schedule 2 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for endangered fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for endangered flora.
VU	**Vulnerable species** 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 undersection 19(1)(c) of the BC Act in accordance with the criteria set out in section 22 and the ministerial guidelines. Published under schedule 3of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for vulnerable fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for vulnerable flora.
Extinct species **Listed by order of the Minister as extinct under section 23(1) of the BC Act as extinct or extinct in the wild.**	
EX	**Extinct species** Species where "*there is no reasonable doubt that the last member of the species has died*", and listing is otherwise in accordance with the ministerial guidelines (section 24 of the BC Act). Published as presumed extinct under schedule 4of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for extinct fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for extinct flora.
EW	Extinct in the wild species Species that "*is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; and it has not been recorded in its known habitat or expected habitat, at appropriate seasons, anywhere in its past range, despite surveys over a time frame appropriate to its life cycle and form*", and listing is otherwise in accordance with the ministerial guidelines (section 25of the BC Act). Currently there are no threatened fauna or threatened flora species listed as extinct in the wild. If listing of a species as extinct in the wild occurs, then a schedule will be added to the applicable notice.
Specially protected species **Listed by order of the Minister as specially protected under section 13(1) of the BC Act. Meeting one or more of the following categories: species of special conservation interest; migratory species; cetaceans; species subject to international agreement; or species otherwise in need of special protection.** **Species that are listed as threatened species (critically endangered, endangered, or vulnerable) or extinct species under the BC Act cannot also be listed as Specially Protected species.**	

Conservation Codes for Western Australian Flora and Fauna	
MI	**Migratory species** 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 15of 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. Published as migratory birds protected under an international agreement under schedule 5 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018.
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 14of the BC Act). Published as conservation dependent fauna under schedule 6 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018.*
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 18of the BC Act). Published as other specially protected fauna under schedule 7of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018.*
P	**Priority species** Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened fauna or flora. 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 placed in Priority 4. These species require regular monitoring. Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.
1	**Priority 1: 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.
2	**Priority 2: 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.
3	**Priority 3: 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.

Conservation Codes for Western Australian Flora and Fauna	
4	**Priority 4: Rare, Near Threatened and other species in need of monitoring** (a) 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. (b) 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. (c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.
[1] The definition of flora includes algae, fungi, and lichens. **[2] Species includes all taxa (plural of taxon - a classificatory group of any taxonomic rank, e.g. a family, genus, species or any infraspecific category i.e. subspecies or variety, or a distinct population).**	

Table 18: DBCA definitions and criteria for TECs and PECs (DEC 2013)

Criteria	Definition
Threatened Ecological Communities	
Presumed Totally Destroyed (PD)	An ecological community that has been adequately searched for but for which no representative occurrences have been located. The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future. An ecological community will be listed as presumed totally destroyed if there are no recent records of the community being extant and either of the following applies (A or B): A. Records within the last 50 years have not been confirmed despite thorough searches of known or likely habitats or B. All occurrences recorded within the last 50 years have since been destroyed
Critically Endangered (CR)	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated. An ecological community will be listed as Critically Endangered when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future. This will be determined on the basis of the best available information, by it meeting any one or more of the following criteria (A, B or C): A. The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 90% and either or both of the following apply (i or ii): i. geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is imminent (within approximately 10 years). ii. modification throughout its range is continuing such that in the immediate future (within approximately 10 years) the community is unlikely to be capable of being substantially rehabilitated. B. Current distribution is limited, and one or more of the following apply (i, ii or iii): i. geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the immediate future (within approximately 10 years). ii. there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes. iii. there may be many occurrences, but total area is very small, and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes. C. The ecological community exists only as highly modified occurrences that may be capable of being rehabilitated if such work begins in the immediate future (within approximately 10 years).

Criteria	Definition
Endangered (EN)	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future. An ecological community will be listed as Endangered when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria (A, B, or C): A. The geographic range, and/or total area occupied, and/or number of discrete occurrences have been reduced by at least 70% since European settlement and either or both of the following apply (i or ii): i. the estimated geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is likely in the short term future (within approximately 20 years). ii. modification throughout its range is continuing such that in the short term future (within approximately 20 years) the community is unlikely to be capable of being substantially restored or rehabilitated. B. Current distribution is limited, and one or more of the following apply (i, ii or iii): i. geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the short term future (within approximately 20 years). ii. there are few occurrences, each of which is small and/or isolated and all or most occurrences are very vulnerable to known threatening processes. iii. there may be many occurrences, but total area is small and all or most occurrences are small and/or isolated and very vulnerable to known threatening processes. The ecological community exists only as very modified occurrences that may be capable of being substantially restored or rehabilitated if such work begins in the short-term future (within approximately 20 years).
Vulnerable (VU)	An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range. An ecological community will be listed as Vulnerable when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction or significant modification in the medium to long-term future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria (A, B or C): A. The ecological community exists largely as modified occurrences that are likely to be capable of being substantially restored or rehabilitated. B. The ecological community may already be modified and would be vulnerable to threatening processes, is restricted in area and/or range and/or is only found at a few locations. C. The ecological community may be still widespread but is believed likely to move into a category of higher threat in the medium to long term future because of existing or impending threatening processes.
Priority ecological communities	
Priority One	*Poorly known ecological communities* Ecological communities with apparently few, small occurrences, all or most not actively managed for conservation (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) and for which current threats exist. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.
Priority Two	*Poorly known ecological communities* Communities that are known from few small occurrences, all, or most of which are actively managed for conservation (e.g. within national parks, conservation parks, nature reserves, state forest, unallocated Crown land, water reserves, etc.) and not under imminent threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities, but do not meet adequacy of survey requirements, and / or are not well defined, and appear to be under threat from known threatening processes.

Criteria	Definition
Priority Three	*Poorly known ecological communities* i. Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or. ii. Communities known from a few widespread occurrences, which are either large or within significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or. iii. Communities made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes. Communities may be included if they are comparatively well known from several localities, but do not meet adequacy of survey requirements and / or are not well defined, and known threatening processes exist that could affect them.
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. These communities require regular monitoring. i. Rare. Ecological communities known from few occurrences 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 communities are usually represented on conservation lands. ii. Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. iii. Ecological communities that have been removed from the list of threatened communities during the past five years.
Priority Five	*Conservation Dependent Ecological Communities* Ecological Communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

Table 19: NVIS structural formation terminology, terrestrial vegetation (NVIS Technical Working Group; DotEE 2017)

	Cover characteristics							
	Foliage cover *	70-100	30-70	10-30	<10	» 0 (scattered)	0-5 (clumped)	unknown
	Cover code	d	c	i	r	bi	bc	unknown
Growth Form	**Height Ranges (m)**	**Structural Formation Classes**						
tree, palm	<10,10-30, >30	closed forest	open forest	woodland	open woodland	isolated trees	isolated clumps of trees	tree, palm
tree mallee	<3, <10, 10-30	closed mallee forest	open mallee forest	mallee woodland	open mallee woodland	isolated mallee trees	isolated clumps of mallee trees	tree mallee
shrub, cycad, grass-tree, tree-fern	<1,1-2,>2	closed shrubland	shrubland	open shrubland	sparse shrubland	isolated shrubs	isolated clumps of shrubs	shrub, cycad, grass-tree, tree-fern
mallee shrub	<3, <10, 10-30	closed mallee shrubland	mallee shrubland	open mallee shrubland	sparse mallee shrubland	isolated mallee shrubs	isolated clumps of mallee shrubs	mallee shrub
heath shrub	<1,1-2,>2	closed heathland	heathland	open heathland	sparse heathland	isolated heath shrubs	isolated clumps of heath shrubs	heath shrub
chenopod shrub	<1,1-2,>2	closed chenopod shrubland	chenopod shrubland	open chenopod shrubland	sparse chenopod shrubland	isolated chenopod shrubs	isolated clumps of chenopod shrubs	chenopod shrub
samphire shrub	<0.5,>0.5	closed samphire shrubland	samphire shrubland	open samphire shrubland	sparse samphire shrubland	isolated samphire shrubs	isolated clumps of samphire shrubs	samphire shrub
hummock grass	<2,>2	closed hummock grassland	hummock grassland	open hummock grassland	sparse hummock grassland	isolated hummock grasses	isolated clumps of hummock grasses	hummock grass
tussock grass	<0.5,>0.5	closed tussock grassland	tussock grassland	open tussock grassland	sparse tussock grassland	isolated tussock grasses	isolated clumps of tussock grasses	tussock grass
other grass	<0.5,>0.5	closed grassland	grassland	open grassland	sparse grassland	isolated grasses	isolated clumps of grasses	other grass
sedge	<0.5,>0.5	closed sedgeland	sedgeland	open sedgeland	sparse sedgeland	isolated sedges	isolated clumps of sedges	sedge
rush	<0.5,>0.5	closed rushland	rushland	open rushland	sparse rushland	isolated rushes	isolated clumps of rushes	rush
herb	<0.5,>0.5	closed herbland	herbland	open herbland	sparse herbland	isolated herbs	isolated clumps of herbs	herb
fern	<1,1-2,>2	closed fernland	fernland	open fernland	sparse fernland	isolated ferns	isolated clumps of ferns	fern
bryophyte	<0.5	closed bryophyte-land	bryophyte-land	open bryophyteland	sparse bryophyteland	isolated bryophytes	isolated clumps of bryophytes	bryophyte
lichen	<0.5	closed lichenland	lichenland	open lichenland	sparse lichenland	isolated lichens	isolated clumps of lichens	lichen
vine	<10,10-30, >30	closed vineland	vineland	open vineland	sparse vineland	isolated vines	isolated clumps of vines	vine

Table 20: NVIS height classes (NVIS Technical Working Group; DotEE 2017)

Height		Growth form				
Height Class	**Height Range (m)**	**Tree, vine (M & U), palm (single-stemmed)**	**Shrub, heath shrub, chenopod shrub, ferns, samphire shrub, cycad, tree-fern, grass-tree, palm (multi-stemmed)**	**Tree mallee, mallee shrub**	**Tussock grass, hummock grass, other grass, sedge, rush, forbs, vine (G)**	**Bryophyte, lichen, seagrass, aquatic**
8	>30	tall	NA	NA	NA	NA
7	10-30	mid	NA	tall	NA	NA
6	<10	low	NA	mid	NA	NA
5	<3	NA	NA	low	NA	NA
4	>2	NA	tall	NA	tall	NA
3	1-2	NA	mid	NA	tall	NA
2	0.5-1	NA	low	NA	mid	tall
1	<0.5	NA	low	NA	low	low
Source: (based on Walker & Hopkins 1990)						

Table 21: Vegetation condition scale (Keighery 1994)

Condition rating	Description
Pristine	No obvious signs of disturbance
Excellent	Vegetation structure intact, disturbance only affecting individual species and weeds are non-aggressive species
Very Good	Vegetation structure altered, obvious signs of disturbance e.g.: repeated fires, aggressive weeds, dieback, logging, and grazing
Good	Vegetation structure altered, obvious signs of disturbance. Retains basic vegetation structure or ability to regenerate it. The presence of very aggressive weeds at high density, partial clearing, dieback, logging, and grazing
Degraded	Basic vegetation structure severely impacted by disturbance. Requires intensive management. The presence of very aggressive weeds at high density, partial clearing, dieback, logging, and grazing
Completely Degraded	Vegetation structure is no longer intact, and the area is completely or almost completely without native flora. 'Parkland Cleared'

Table 22: Grading system for the assessment of potential nest trees for Black Cockatoos (Bamford M 2016)

Class	Description of tree and hollows/activity
1	Active nest observed; adult (or immature) bird seen entering or emerging from hollow.
2	Hollow of suitable size and angle (i.e. near-vertical) visible with chew marks around entrance.
3	Potentially suitable hollow visible but no chew marks present; or potentially suitable hollow present (as suggested by structure of tree, such as large, vertical trunk broken off at a height of >10m).
4	Tree with large hollows or broken branches that might contain large hollows, but hollows or potential hollows are not vertical or near-vertical; thus a tree with or likely to have hollows of sufficient size but not to have hollows of the angle preferred by Black Cockatoos.
5	Tree lacking large hollows or broken branches that might have large hollows; a tree with more or less intact branches and a spreading crown.

Table 23: Commonwealth Black Cockatoo foraging quality scoring tool (Commonwealth of Australia 2017)

Starting Score	Foraging habitat for Carnaby's Cockatoo	Foraging habitat for Baudin's Cockatoo	Foraging habitat for Forest Red-tailed Black cockatoo
10 (Very high quality)	Foraging habitat that is being managed for black cockatoos such as habitat that is the focus of successful rehabilitation, and/or has some level of protection from clearing, and/or is quality habitat described below with attributes contributing to meet a sore of ≥10	Foraging habitat that is being managed for black cockatoos such as habitat that is the focus of successful rehabilitation, and/or has some level of protection from clearing, and/or is quality habitat described below with attributes contributing to meet a sore of ≥10	Foraging habitat that is being managed for black cockatoos such as habitat that is the focus of successful rehabilitation, and/or has some level of protection from clearing, and/or is quality habitat described below with attributes contributing to meet a sore of ≥10
7 (High quality)	Native shrubland, kwongan heathland and 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, including along roadsides. Does not include orchards, canola, or areas under an RFA	Native eucalypt woodlands and forest, and proteaceous woodland and heath, particularly marri, including along roadsides. Does not include orchards or areas under an RFA	Jarrah and marri woodlands and forest, and edges of karri forests, including wandoo and blackbutt, within the range of the subspecies, including along roadsides. Does not include areas under an RFA
5 (Quality)	Pine plantation or introduced eucalypts	Pine plantation or introduced eucalypts	Pine plantation or introduced eucalypts
1 (Low quality)	Individual foraging plants or small stand of foraging plants	Individual foraging plants or small stand of foraging plants	Individual foraging plants or small stand of foraging plants
Additions	**Context adjustor - attributes improving functionality of foraging habitat**	**Context adjustor - attributes improving functionality of foraging habitat**	**Context adjustor - attributes improving functionality of foraging habitat**
+3	Is within the Swan Coastal Plain (important foraging area).	Is within the known foraging area (see map).	Jarrah and/or marri show good recruitment (i.e. evidence of young trees).
+3	Contains trees with suitable nest hollows	Contains trees with suitable nest hollows	Contains trees with suitable nest hollows
+2	Primarily contains marri	Primarily contains marri	Primarily contains marri and/or jarrah
+2	Contains trees with potential to be used for breeding (dbh ≥ 500 mm or ≥ 300 mm dbh for salmon gum and wandoo)	Contains trees with potential to be used for breeding (dbh ≥ 500 mm or ≥ 300 mm dbh for salmon gum and wandoo)	Contains trees with potential to be used for breeding (dbh ≥ 500 mm or ≥ 300 mm dbh for salmon gum and wandoo)
+1	Is known to be a roosting site	Is known to be a roosting site	Is known to be a roosting site

Starting Score Subtractions	Foraging habitat for Carnaby's Cockatoo Context adjustor - attributes reducing functionality of foraging habitat	Foraging habitat for Baudin's Cockatoo Context adjustor - attributes reducing functionality of foraging habitat	Foraging habitat for Forest Red-tailed Black cockatoo Context adjustor - attributes reducing functionality of foraging habitat
-2	No clear evidence of feeding debris	No clear evidence of feeding debris	No clear evidence of feeding debris
-2	No other foraging habitat within 6 km	No other foraging habitat within 6 km	No other foraging habitat within 6 km
-1	Is > 12 km from a known breeding location	Is > 12 km from a known breeding location	Is > 12 km from a known breeding location
-1	Is > 12 km from a known roosting site	Is > 12 km from a known roosting site	Is > 12 km from a known roosting site
-1	Is > 2 km from a watering point	Is > 2 km from a watering point	Is > 2 km from a watering point
-1	Disease present (e.g. *Phytophthora cinnamomi* or marri canker	Disease present (e.g. *Phytophthora cinnamomi* or marri canker)	Disease present (e.g. *Phytophthora cinnamomi* or marri canker)

APPENDIX TWO TEC ASSESSMENT CRITERIA

BANKSIA WOODLANDS TEC

The criteria outlined in the Approved Conservation Advice for the *Banksia Woodlands of the Swan Coastal Plain* TEC (TSSC 2016) was used to determine if the TEC occurs, as below.

The key characteristics for vegetation to be included in this TEC are that:

- it occurs on the Swan Coastal Plain IBRA region, including the Dandaragan Plateau and adjacent to the Jarrah Forest IBRA region on the lower parts of the Darling and Whicher escarpments
- it generally occurs on low-nutrient sandy substrates, including sandy colluvium and aeolean sands although may occur occasionally on other substrates (usually on the Bassendean and Spearwood sands)
- the structure is typically low woodland or forest with a distinct upper stratum of low trees dominated or co-dominated by one or more of four characteristic Banksia species (Banksia attenuata, B. menziesii, B. prionotes, B. ilicifolia) although emergent trees are sometimes present but cannot be the dominant stratum
- the understorey is typically a highly diverse shrub and herb layer
- it meets the thresholds in the table that follows (with vegetation type mapping extrapolated outside the survey area to be included in the extent calculations).

Table 24: Condition categories and thresholds for inclusion in the *Banksia* Woodlands TEC (TSSC 2016)

Condition Threshold	Indicative Condition Measures (Typical)		Minimum Patch Size
	Native Vegetation Composition[1]	Weed Cover	
Pristine	Native plant species diversity	Native plant species diversity	No minimum
Excellent	High native plant species	High native plant species	0.5 ha / 5,000 m^2
Very Good	Moderate native plant species	Moderate native plant species	1 ha / 10,000 m^2
Good	Low native plant species	Low native plant species	2 ha / 20,000 m^2
Degraded	Very low native plant species	Very low native plant species	Not representative
Completely Degraded	Very low to no native species	Very low to no native species	Not representative

[1] Relative to expected natural range of diversity for that vegetation (e.g. Floristic Community Type; FCT), where comparative data exists.

Whilst FCTs, as defined in Gibson *et al.* (1994) can be used as a guide they do not necessarily define all vegetation that may be included in the TEC. Vegetation defined by Gibson *et al.* FCTs may be listed as TECs in Western Australia or as Priority Ecological Communities (PECs) by DBCA (combined into the EPBC-listed *Banksia Woodlands of the Swan Coastal Plain* TEC). Some Banksia woodlands on the eastern side of the Swan Coastal Plain (FCT 20 group) are not included in this TEC and have different conservation listings; these Banksia woodland types are not subject to the same thresholds as above to be considered representative of the relevant TEC or PEC.

APPENDIX THREE DESKTOP ASSESSMENT RESULTS AND LIKELIHOOD ASSESSMENTS

Table 25: Flora database search results, habitat, and likelihood assessment

Blue shading indicates high likelihood

DBCA*	PMST**	Species name	Habitat from: • *FloraBase* (WAH 1998-2020) • (for *Acacia* species) *World Wide Wattle* (WAH *et al.* 2019)	Flowering	Likelihood of occurrence	
					Desktop	Post-survey
		Threatened Flora* **				
WAH, TP	likely	*Caladenia huegelii* (EPBC Act - EN; BC Act – T)	Grey or brown sand. Clay loam.	Sep-Oct	Unlikely	Unlikely
WAH, TP	known	*Eucalyptus argutifolia* (EPBC Act - VU; BC Act – T)	Shallow soils over limestone. On slopes or in gullies of limestone ridges, outcrops	Mar-Apr	Unlikely	Unlikely
WAH, TP	known	*Melaleuca* sp. Wanneroo (G.J. Keighery 16705) (EPBC Act - EN; BC Act – T)	Limestone hills, slopes, and flats. Shallow soils over limestone, with outcropping limestone	Oct-Jan	Unlikely	Unlikely
		DBCA Priority 1				
WAH	-	*Baeckea* sp. Limestone (N. Gibson & M.N. Lyons 1425)	Slopes, hills, and flats. Yellow-grey sandy soils over limestone, with outcropping limestone	Sep-Dec	Unlikely	Unlikely
WAH	-	*Drosera patens*	Sandy soils. Margins of winter-wet depressions, swamps, and lakes	Dec or Feb	Possible	Unlikely
WAH	-	*Drosera x sidjamesii*	Peaty sand. Along lake margins, close to winter high-water line	Nov-Mar	Unlikely	Unlikely
		DBCA Priority 2				
WAH, TP	-	*Acacia benthamii*	On limestone breakaways	Aug-Sep	Unlikely	Unlikely
WAH, TP	-	*Calectasia elegans*	Flats and gentle slopes. Sandy soil	Sep-Nov	Possible	Unlikely
WAH	-	*Poranthera moorokatta*	Gently undulating plains, slopes, and crests of dunes. Sandy soil	Oct-Nov	Possible	Unlikely
WAH, TP	-	*Stenanthemum sublineare*	Coastal plains. Sandy soil	Oct-Dec	Possible	Unlikely
		DBCA Priority 3				
WAH, TP	-	*Conostylis bracteata*	Sand dunes. Sandy soil over limestone	Aug-Sep	Unlikely	Unlikely
WAH, TP	-	*Cyathochaeta teretifolia*	Wetlands, creek edges. Sandy loam or peaty soil	Jan	Unlikely	Unlikely
WAH	-	*Pimelea calcicola*	Coastal limestone ridges. Sandy soil	Sep-Nov	Highly unlikely	Highly unlikely
WAH	-	*Pithocarpa corymbulosa*	Amongst granite outcrops. Gravelly or sandy loam	Jan-Apr	Highly unlikely	Highly unlikely
WAH	-	*Stylidium maritimum*	Dune slopes and flats. Sandy soil over limestone	Sep-Nov	Unlikely	Unlikely
WAH	-	*Styphelia filifolia*	Flats, slopes. Yellow-brown sandy soil	Feb-Apr	Unlikely	Unlikely
		DBCA Priority 4				
WAH, TP	-	*Jacksonia sericea*	Plains, gentle slopes. Sandy soil, with outcropping limestone	Dec-Feb	Unlikely	Unlikely
WAH, TP	-	*Stylidium longitubum*	Seasonal wetlands. Sandy clay or clay soil	Oct-Dec	Unlikely	Unlikely
WAH, TP	-	*Tripterococcus* sp. Brachylobus (A.S. George 14234)	Plains, wetlands and on gentle slopes. Sandy soil	Jan-Mar and Oct-Dec	Unlikely	Unlikely

* WAH = herbarium record (vouchered specimen)
TP = Threatened and Priority Flora Report Form record; may be unconfirmed i.e. without vouchered specimen
** PMST likelihood of occurrence or likelihood of habitat occurring
*** Commonwealth EPBC Act and Western Australian BC Act conservation status

Table 26: Fauna database results and likelihood assessments

Blue shading indicates high likelihood; darker blue indicates species is known (recorded) from the survey area

Species	Common name	Conservation status		Database			Likelihood of occurrence	
		EPBC Act	Western Australian	PMST*	DBCA	*NatureMap*	Desktop	Post-survey
Mammals								
Dasyurus geoffroii	Chuditch	VU	VU	Likely			Very low	Very low
Isoodon fusciventer	Quenda		P4		X	X	High	High
Notamacropus irma	Western Brush Wallaby		P4		X	X	High	Medium
Birds								
Actitis hypoleucos	Common Sandpiper	MI	MI	Known			Very low	Very low
Apus pacificus	Fork-tailed Swift	MI	MI	Likely	X		Low	Low
Ardea alba	Great Egret		MI	Known			Very low	Very low
Ardea ibis	Cattle Egret		MI	May			Very low	Very low
Botaurus poiciloptilus	Australasian Bittern	EN	EN	May			Very low	Very low
Calidris acuminata	Sharp-tailed Sandpiper	MI	MI	Known			Very low	Very low
Calidris canutus	Red Knot	EN & MI	EN	May			Very low	Very low
Calidris ferruginea	Curlew Sandpiper	CR & MI	CR	Known			Very low	Very low
Calidris melanotos	Pectoral Sandpiper	MI	MI	May			Very low	Very low
Calidris ruficollis	Red-necked Stint	MI	MI	Known			Very low	Very low
Calidris subminuta	Long-toed Stint	MI	MI	Known			Very low	Very low
Charadrius ruficapillus	Red-capped Plover	MA		Known			Very low	Very low
Calyptorhynchus banksii naso	Forest Red-tailed Black Cockatoo	VU	VU	Likely	X		High	High
Calyptorhynchus latirostris	Carnaby's Cockatoo	EN	EN	Known	X	X	Recorded	High
Falco peregrinus	Peregrine Falcon		OS		X	X	Medium	Low
Haliaeetus leucogaster	White-bellied Sea Eagle		MI	Known			Very low	Very low

Species	Common name	Conservation status		Database			Likelihood of occurrence	
		EPBC Act	Western Australian	PMST*	DBCA	*NatureMap*	Desktop	Post-survey
Himantopus himantopus	Black-winged Stilt	MA		Known			Very low	Very low
Leipoa ocellata	Malleefowl	VU	VU	Likely			Very low	Very low
Merops ornatus	Rainbow Bee-eater	MA		May			Medium	Recorded
Motacilla cinerea	Grey Wagtail	MI	MI	May			Very low	Very low
Numenius madagascariensis	Eastern Curlew	CR	CR & MI	May			Very low	Very low
Pandion haliaetus	Osprey	MA & MI		Known			Very low	Very low
Recurvirostra novaehollandiae	Red-necked Avocet	MA		Likely			Very low	Very low
Rostratula australis	Australian Painted Snipe	EN	EN	Likely			Very low	Very low
Sternula nereis nereis	Australian Fairy Tern	VU	VU	May			Very low	Very low
Thinornis rubricollis	Hooded Plover		P4	May			Very low	Very low
Tringa glareola	Wood Sandpiper	MI	MI	Known			Very low	Very low
Tringa nebularia	Common Greenshank	MI	MI	Known			Very low	Very low
Reptiles								
Neelaps calonotos	Black-striped Snake		P3		X		Medium	Low

* PMST likelihood of occurrence or likelihood of habitat occurring

APPENDIX FOUR FIELD SURVEY RESULTS

Table 27: Flora inventory (site x species)

Family	Species	Naturalised	NQ01	NQ02	NQ03	NQ04	NQ05	NQ06	NQ07	NQ08	NQ09	NQ10	NQ11	NQ12	NQ13	NQ14	NQ15	Opportunistic
Aizoaceae	*Carpobrotus edulis*	*			x				x						x	x	x	x
Anarthriaceae	*Lyginia barbata*		x	x	x													
	Lyginia imberbis					x	x	x										
Apiaceae	*Xanthosia huegelii*			x	x													
Araliaceae	*Trachymene pilosa*		x	x	x	x	x											
Asparagaceae	*Asparagus asparagoides*	*												x				
	Thysanotus sp.				x			x										
Asteraceae	*Hypochaeris glabra*	*	x		x	x		x		x	x							
	Podotheca gnaphalioides									x	x	x	x					
	Siloxerus humifusus					x												
	Sonchus oleraceus	*														x		
	Urospermum picroides	*								x	x	x	x					
	Ursinia anthemoides subsp. *anthemoides*	*	x	x			x	x			x	x	x		x	x		
Campanulaceae	*Wahlenbergia capensis*	*	x							x			x					
	Wahlenbergia preissii				x	2												
Casuarinaceae	*Allocasuarina humilis*		x	x	x													
Centrolepidaceae	*Centrolepis drummondiana*					x		x										
Colchicaceae	*Burchardia congesta*		x	x														
Crassulaceae	*Crassula colorata*				x	x			x	x			x		x	x		
Cyperaceae	*Chaetospora curvifolia*																	x
	Lepidosperma apricola		x															
	Lepidosperma sp.																x	
	Tetraria octandra		x	x	x				x									

Family	Species	Naturalised	NQ01	NQ02	NQ03	NQ04	NQ05	NQ06	NQ07	NQ08	NQ09	NQ10	NQ11	NQ12	NQ13	NQ14	NQ15	Opportunistic
Dilleniaceae	*Hibbertia hypericoides* subsp. *hypericoides*		x	x	x					x		x	x		x			
	Hibbertia racemosa		x	x		x	x	x										
Droseraceae	*Drosera erythrorhiza*		x	x	x													
	Drosera menziesii			x														
Ericaceae	*Brachyloma preissii*					x	x	x				x						
	Conostephium pendulum		x	x	x	x												
	Leucopogon polymorphus		x	x	x													
	Styphelia conostephioides		x	x	x													
Euphorbiaceae	*Euphorbia terracina*	*										x	x					
Fabaceae	*Acacia huegelii*		x	x	x													
	Acacia pulchella		x	2	x													
	Bossiaea eriocarpa		x	x	x													
	Daviesia triflora		x															
	Gompholobium tomentosum		x	x	x													
	Hardenbergia comptoniana		x															
	Jacksonia furcellata					x		x									x	
	Jacksonia sternbergiana				x						x							
	Lotus subbiflorus	*														x		
	Ornithopus compressus	*										x	x					
	Trifolium dubium	*										x						
Geraniaceae	*Pelargonium capitatum*	*											x					
Goodeniaceae	*Dampiera linearis*					x		x										
Haemodoraceae	*Anigozanthos humilis*		x															
	Conostylis aculeata subsp. *aculeata*		x	x	x	x	x	x										
	Conostylis juncea			x	x													
	Phlebocarya ciliata		x	x	x													

Family	Species	Naturalised	NQ01	NQ02	NQ03	NQ04	NQ05	NQ06	NQ07	NQ08	NQ09	NQ10	NQ11	NQ12	NQ13	NQ14	NQ15	Opportunistic
Haloragaceae	*Gonocarpus pithyoides*		x	x	x													
Hemerocallidaceae	*Corynotheca micrantha*				x			x			x	x		x				
	Dianella revoluta var. *divaricata*					x	x	x	x								x	
	Tricoryne elatior			x														
Iridaceae	*Gladiolus caryophyllaceus*	*	x	x	x		x	x	x		x	x	x		x			
	Moraea miniata	*							x									
	Patersonia occidentalis			x	x													
Lamiaceae	*Hemiandra pungens*																	
Lauraceae	*Cassytha flava*		x	x														
Loganiaceae	*Phyllangium divergens*							x										
Loranthaceae	*Nuytsia floribunda*			x	x					x	x	x	x	x				
Montiaceae	*Calandrinia liniflora*		x															
Myrtaceae	*Astartea scoparia*								x							x		
	Beaufortia elegans		x		x							x						
	Calothamnus sanguineus		x															
	Calytrix fraseri		x															
	Eremaea pauciflora			x									x					
	Eucalyptus marginata																	x
	Eucalyptus rudis subsp. *rudis*									x				x			x	
	Eucalyptus todtiana										x	x	x					
	Hypocalymma angustifolium			x	x			x										
	Kunzea glabrescens					x	x	x										
	Melaleuca preissiana								x					x	x	x		
	Melaleuca seriata			x	x								x					
Orchidaceae	*Caladenia arenicola*		x															
	Disa bracteata	*															x	

Family	Species	Naturalised	NQ01	NQ02	NQ03	NQ04	NQ05	NQ06	NQ07	NQ08	NQ09	NQ10	NQ11	NQ12	NQ13	NQ14	NQ15	Opportunistic
	Diuris corymbosa										x							
	Microtis alba												x					
	Pterostylis sanguinea		x															
Poaceae	*Aira caryophyllea*	*							x	x	x	x	x		x	x		
	Austrostipa compressa		x	x	x		x											
	Briza maxima	*	x	x	x	x	x			x	x	x				x		
	Bromus diandrus	*								x			x	x	x	x		
	Ehrharta calycina	*	x	x	x	x			x	x	x	x	x	x	x	x	x	
	Ehrharta longiflora	*	x															
	Lachnagrostis plebeia		x															
	Lolium rigidum	*							x	x		x	x	x	x		x	
	Neurachne sp.		x															
	Pentameris airoides	*	x		x													
	Rytidosperma caespitosum				x													
	Vulpia muralis	*	x	x	x													
	Vulpia myuros	*							x									
Primulaceae	*Lysimachia arvensis*	*			x										x			
Proteaceae	*Adenanthos cygnorum* subsp. *cygnorum*					x	x	x		x								
	Banksia attenuata		x	x	x													
	Banksia ilicifolia						x	x										
	Banksia menziesii		x	x	x	x		x										
	Persoonia saccata						x											
	Petrophile linearis			x	x								x					x
	Stirlingia latifolia		x									x						
Restionaceae	*Alexgeorgea nitens*		x	x	x													
	Desmocladus flexuosus		x	x	x							x	x					

Family	Species	Naturalised	NQ01	NQ02	NQ03	NQ04	NQ05	NQ06	NQ07	NQ08	NQ09	NQ10	NQ11	NQ12	NQ13	NQ14	NQ15	Opportunistic
	Hypolaena exsulca														x			
Rutaceae	*Philotheca spicata*			x														
Stylidiaceae	*Levenhookia stipitata*					x		x										
	Stylidium araeophyllum																	
	Stylidium calcaratum		x		x													
	Stylidium crossocephalum			x														x
	Stylidium piliferum																	
	Stylidium repens		x		x	x												
Thymelaeaceae	*Pimelea floribunda*							x										
Xanthorrhoeaceae	*Xanthorrhoea preissii*		x	x														
Zamiaceae	*Macrozamia fraseri*		x															
	Macrozamia riedlei			x								x						

Table 28: Fauna sites (GDA94, Zone 50)

Site Name	Site Type	Habitat Unit	Habitat Description	Easting	Northing
HA01	Fauna: Habitat Assessment	Woodland (Open/Closed)	Banksia/Jarrah/shrubs	386005.504	6496262.99
HA02	Fauna: Habitat Assessment	Woodland (Open/Closed)	Banksia/Jarrah/shrubs	385962.769	6496191.568
HA03	Fauna: Habitat Assessment	Woodland (Open/Closed)	Jarrah/Wild Oats, edge	386007.303	6496125.542
HA04	Fauna: Habitat Assessment	Woodland (Open/Closed)	Coastal Blackbutt/Christmas Tree/grasses	386024.465	6496065.312
HA05	Fauna: Habitat Assessment	Cleared or Developed	Cleared/Degraded/some shrubs	386347.267	6496078.841
HA06	Fauna: Habitat Assessment	Woodland (Open/Closed)	Melaleuca/Banksia/grasses	386358.716	6496124.198
HA07	Fauna: Habitat Assessment	Woodland (Open/Closed)	Banksia/*Adenanthos*/*Kunzea*/*Jacksonia*	386363.0355	6496205.729
HA08	Fauna: Habitat Assessment	Woodland (Open/Closed)	Flooded Gum/Paperbark/grasses	386585.611	6495856.52
HA09	Fauna: Habitat Assessment	Woodland (Open/Closed)	Flooded Gum/Paperbark/grasses	386449.109	6496052.244
HA10	Fauna: Habitat Assessment	Woodland (Open/Closed)	Flooded Gum/Paperbark/*Banksia ilicifolia*/sedges/grasses	386407.781	6495912.882
HA11	Fauna: Habitat Assessment	Woodland (Open/Closed)	Flooded Gum/*Adenanthos*	386252.253	6495941.438
HA12	Fauna: Habitat Assessment	Woodland (Open/Closed)	Coastal Blackbutt/Christmas Tree/grasses	386226.666	6495750.475

Table 29: Representative assessment sampling point images

Point No.	Image
HA01 **Banksia/ Jarrah/ shrubs**	
HA04 **Coastal Blackbutt/ *Nuytsia floribunda*/ grasses**	

Point No.	Image
HA07 **Banksia/ Adenanthos/ Kunzea/ Jacksonia**	
HA08 **Flooded Gum/ Paperbark/ grasses**	

Point No.	Image
HA10 **Flooded Gum/ Paperbark/ *Banksia ilicifolia*/ sedges/ grasses**	
HA12 **Coastal Blackbutt/ *Nuytsia floribunda*/ grasses**	

Table 30: Potential Black Cockatoo Breeding Trees

Potential Breeding Trees				
				
T01 *Eucalyptus rudis*	T02 *Eucalyptus rudis*	T03 *Eucalyptus rudis*	T04 *Eucalyptus rudis*	T05 *Eucalyptus rudis*
				
T06 *Eucalyptus rudis*	T07 *Eucalyptus rudis*	T08 *Eucalyptus rudis*	T09 *Eucalyptus rudis*	T10 *Eucalyptus rudis*

Potential Breeding Trees				
				
T11 *Eucalyptus rudis*	T12 *Eucalyptus rudis*	T13 *Eucalyptus rudis*	T14 *Eucalyptus marginata*	T15 *Eucalyptus rudis*
				
T16 *Eucalyptus rudis*	T17 *Eucalyptus rudis*	Tag 261 *Eucalyptus marginata*	Tag 262 *Eucalyptus marginata*	

Table 31: Potential Black Cockatoo Breeding Trees (GDA94, Zone 50)

Tree Number	DBH (mm)	Tree Species	Tree Class (Bamford Scale)	Bees present	Easting	Northing
T01	580	*Eucalyptus rudis*	5: no hollows	no	386352.5	6496140
T02	630	*Eucalyptus rudis*	5: no hollows	no	386372.1	6496220
T03	930	*Eucalyptus rudis*	5: no hollows	no	386257.1	6496294
T04	530	*Eucalyptus rudis*	5: no hollows	no	386598.8	6495828
T05	560	*Eucalyptus rudis*	5: no hollows	no	386596.4	6495859
T06	1160	*Eucalyptus rudis*	4: hollows not suitable	yes	386588.8	6495899
T07	1010	*Eucalyptus rudis*	4: hollows not suitable	no	386545.3	6495918
T08	670	*Eucalyptus rudis*	5: no hollows	no	386432.6	6495968
T09	700	*Eucalyptus rudis*	5: no hollows	no	386372.2	6495947
T10	530	*Eucalyptus rudis*	5: no hollows	no	386322.7	6496010
T11	580	*Eucalyptus rudis*	5: no hollows	no	386344.6	6496050
T12	560	*Eucalyptus rudis*	5: no hollows	no	386282.7	6496025
T13	600	*Eucalyptus rudis*	5: no hollows	no	386275.5	6496026
T14	570	*Eucalyptus marginata*	4: hollows not suitable	no	386121.8	6495701
T15	800	*Eucalyptus rudis*	5: no hollows	no	386487.6	6495682
T16	500	*Eucalyptus rudis*	5: no hollows	no	386704.5	6495693
T17	<Null>	*Eucalyptus rudis*	5: no hollows	no	386710.3	6495664
262 *	677	*Eucalyptus marginata*	5: no hollows	no	386101.5	6495702
261 *	960	*Eucalyptus marginata*	5: no hollows	no	386105.6	6495700

*Trees were recorded in 2019 Neerabup Cockatoo Survey by Ecoscape

APPENDIX FIVE FLORISTIC QUADRAT DATA

NQ01

Staff JLT **Date** 29/10/2020 **Season** A

Revisit

Type Q 10 m x 10 m

Location

MGA Zone 50 386009 **mE** 6496255 **mN** **Lat.** -31.6633 **Long.** 115.7976

Habitat Sandplain

Aspect N/A **Slope** N/A

Soil Type White basso sand

Rock Type

Loose Rock 0 % cover **Litter** 70 % cover ; 1-2 cm in depth

Bare ground 35 % cover **Weeds** 2 % cover

Vegetation U+ ^*Banksia attenuata*,^*Banksia menziesii*\^tree\6\i;M ^*Beaufortia elegans*,^*Allocasuarina humilis*\^shrub\4\r;G ^^*Hibbertia hypericoides* subsp. *hypericoides*,*Gompholobium tomentosum*, *Ehrharta calycina*\^shrub,tussock grass\1\i

Veg. Condition Excellent

Disturbance

Fire Age >5 years

Notes Rabbit burrows nearby

Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia huegelii		.4	<1	
Acacia pulchella		.5	1.5	
Alexgeorgea nitens		.15	<1	
Allocasuarina humilis		1.6	1	

Anigozanthos humilis	.25	<1
Austrostipa compressa	.45	<1
Banksia attenuata	5.5	15
Banksia menziesii	5	11
Beaufortia elegans	.6	8
Bossiaea eriocarpa		<1
**Briza maxima*	.15	<1
Burchardia congesta	.25	<1
Caladenia arenicola	.3	<1
Calandrinia liniflora	.05	<1
Calothamnus sanguineus	.6	.5
Calytrix fraseri	.4	<1
Cassytha flava		<1
Conostephium pendulum		<1
Conostylis aculeata subsp. *aculeata*	.15	1
Daviesia triflora	.25	.5
Desmocladus flexuosus	.15	<1
Drosera erythrorhiza	.05	<1
**Ehrharta calycina*	.6	1.5
**Ehrharta longiflora*	.25	<1
**Gladiolus caryophyllaceus*	.6	.25
Gompholobium tomentosum	.35	2.5
Gonocarpus pithyoides	.35	<1
Hardenbergia comptoniana	.4	<1
Hibbertia hypericoides subsp. *hypericoides*	.45	3
Hibbertia racemosa	.45	.2
**Hypochaeris glabra*	.05	<1
Lachnagrostis plebeia	.15	<1
Lepidosperma apricola	.5	<1
Leucopogon polymorphus	.45	<1
Lyginia barbata	.35	<1
Macrozamia fraseri	.5	<1
Neurachne sp.	.3	<1
**Pentameris airoides*	.15	<1
Phlebocarya ciliata	.4	1.5
Pterostylis sanguinea	.15	<1
Stirlingia latifolia	.35	.5
Stylidium calcaratum	.05	<1

Stylidium repens	.05	<1
Styphelia conostephioides	.6	<1
Tetraria octandra	.3	.5
Trachymene pilosa	.05	<1
**Ursinia anthemoides* subsp. *anthemoides*	.15	<1
**Vulpia muralis*	.2	<1
**Wahlenbergia capensis*	.15	<1
Xanthorrhoea preissii	.5	.5

NQ02

Staff JLT **Date** 29/10/2020 **Season** A

Revisit

Type Q 10 m x 10 m

Location

MGA Zone 50 385982 **mE** 6496162 **mN** **Lat.** -31.6641 **Long.** 115.7973

Habitat Sandplain

Aspect N/A **Slope** N/A

Soil Type White sand

Rock Type

Loose Rock 0 % cover **Litter** 40 % cover ; 1-2 cm in depth

Bare ground 40 % cover **Weeds** 5 % cover

Vegetation U+ ^^*Banksia attenuata*,*Banksia menziesii*,*Nuytsia floribunda*\^tree\6\i;M ^*Allocasuarina humilis*, ^*Xanthorrhoea preissii*\^shrub,tree\4\bi;G ^^*Hibbertia hypericoides* subsp. *hypericoides*,*Tetraria octandra*,*Ehrharta calycina*\^shrub,sedge,tussock grass\\

Veg. Condition Very Good

Disturbance

Fire Age >5 years

Notes Rabbit burrows nearby

Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia huegelii		.3	.5	
Acacia pulchella		.4	<1	
Acacia pulchella		.5	<1	
Alexgeorgea nitens		.15	<1	

Allocasuarina humilis	1.3	2
Austrostipa compressa	.4	<1
Banksia attenuata	5	15
Banksia menziesii	4.5	8
Bossiaea eriocarpa	.2	<1
**Briza maxima*	.3	<1
Burchardia congesta	.3	<1
Cassytha flava	.5	<1
Conostephium pendulum	.35	<1
Conostylis aculeata subsp. *aculeata*	.25	<1
Conostylis juncea	.2	<1
Desmocladus flexuosus	.3	<1
Drosera erythrorhiza	.05	<1
Drosera menziesii	.5	<1
**Ehrharta calycina*	.4	1
Eremaea pauciflora		1
**Gladiolus caryophyllaceus*	.4	<1
Gompholobium tomentosum	.3	<1
Gonocarpus pithyoides	.4	<1
Hibbertia hypericoides subsp. *hypericoides*	.5	3
Hibbertia racemosa	.35	1
Hypocalymma angustifolium	.35	<1
Leucopogon polymorphus	.35	<1
Lyginia barbata	.4	<1
Macrozamia riedlei	.6	<1
Melaleuca leuropoma	.4	<1
Nuytsia floribunda	4	1
Patersonia occidentalis	.4	<1
Petrophile linearis		<1
Philotheca spicata		<1
Phlebocarya ciliata	.35	2
Stylidium crossocephalum	.1	<1
Styphelia conostephioides	.5	<1
Tetraria octandra	.4	1.5
Trachymene pilosa	.1	<1
Tricoryne elatior	.2	<1
**Ursinia anthemoides* subsp. *anthemoides*	.25	<1
**Vulpia muralis*	.1	<1

Xanthorrhoea preissii	.5	1
Xanthosia huegelii	.25	<1

NQ03

Staff JLT **Date** 29/10/2020 **Season** A

Revisit

Type Q 10 m x 10 m

Location

MGA Zone 50 386025 **mE** 6496211 **mN** **Lat.** -31.6637 **Long.** 115.7978

Habitat Sandplain

Aspect N/A **Slope** N/A

Soil Type White sand

Rock Type

Loose Rock 0 % cover **Litter** 40 % cover ; 1-2 cm in depth

Bare ground 40 % cover **Weeds** 5 % cover

Vegetation U+ ^^*Banksia attenuata*,*Banksia menziesii*,*Nuytsia floribunda*\^tree\7\i;M ^*Allocasuarina humilis*, ^*Jacksonia sternbergiana*\^shrub\4\r;G ^*Hibbertia hypericoides* subsp. *hypericoides*,*Beaufortia elegans*,*Styphelia conostephioides*\^shrub\1\r

Veg. Condition Excellent

Disturbance

Fire Age >5 years

Notes Rabbit burrows nearby

Species	WA Cons.	Height (m)	Cover (%)	Count
Acacia huegelii		.4	<1	
Acacia pulchella		2	<1	
Alexgeorgea nitens		.15	<1	
Allocasuarina humilis		1.4	2	

Austrostipa compressa	.25	<1
Banksia attenuata	5.5	10
Banksia menziesii	5	4
Beaufortia elegans	1.5	4
Bossiaea eriocarpa	.4	.5
**Briza maxima*	.3	<1
**Carpobrotus edulis*	.35	<1
Conostephium pendulum	.5	<1
Conostylis aculeata subsp. *aculeata*	.2	1
Conostylis juncea	.15	<1
Corynotheca micrantha	.45	<1
Crassula colorata	.03	<1
Desmocladus flexuosus	.15	<1
Drosera erythrorhiza	.05	<1
**Ehrharta calycina*	.45	<1
**Gladiolus caryophyllaceus*	.45	<1
Gompholobium tomentosum	.4	<1
Gonocarpus pithyoides	.35	<1
Hibbertia hypericoides subsp. *hypericoides*	.5	5
Hypocalymma angustifolium	.35	.5
**Hypochaeris glabra*	.1	<1
Jacksonia sternbergiana	1.8	1
Leucopogon polymorphus	.4	<1
Lyginia barbata	.35	<1
**Lysimachia arvensis*	.15	<1
Melaleuca leuropoma	.45	<1
Nuytsia floribunda	2	1
Patersonia occidentalis	.35	<1
**Pentameris airoides*	.15	<1
Petrophile linearis	.35	<1
Phlebocarya ciliata	.45	<1
Rytidosperma caespitosum	.2	<1
Stylidium calcaratum	.1	<1
Stylidium repens	.05	<1
Styphelia conostephioides	.35	2
Tetraria octandra	.5	<1
Thysanotus sp.	.5	<1
Trachymene pilosa	.35	<1

**Vulpia muralis*	.15	<1
Wahlenbergia preissii	.2	<1
Xanthosia huegelii	.15	<1

NQ04

Staff JLT **Date** 29/10/2020 **Season** A

Revisit

Type Q 10 m x 10 m

Location

MGA Zone 50 386344 **mE** 6496287 **mN** **Lat.** -31.6631 **Long.** 115.8011

Habitat Sandplain

Aspect N/A **Slope** N/A

Soil Type White sand

Rock Type

Loose Rock 0 % cover **Litter** 65 % cover ; 1-2 cm in depth

Bare ground 30 % cover **Weeds** 5 % cover

Vegetation U+ ^*Jacksonia furcellata*\^tree\6\r;M ^*Adenanthos cygnorum* subsp. *cygnorum*,^*Kunzea glabrescens*\^shrub\4\c;G ^^*Lyginia imberbis*,*Brachyloma preissii*,*Hibbertia racemosa*\^sedge, shrub\2\i

Veg. Condition Excellent

Disturbance

Fire Age >10 years

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
Adenanthos cygnorum subsp. *cygnorum*		2.5	18	
Banksia menziesii		1.6	.5	
Brachyloma preissii		.45	5	
**Briza maxima*		.25	<1	

Centrolepis drummondiana	.08	<1
Conostephium pendulum	.4	<1
Conostylis aculeata subsp. *aculeata*	.25	<1
Crassula colorata	.05	<1
Dampiera linearis	.25	<1
Dianella revoluta var. *divaricata*	.4	.5
**Ehrharta calycina*	.3	<1
Hibbertia racemosa	.35	2
**Hypochaeris glabra*	.05	<1
Jacksonia furcellata	4	2
Kunzea glabrescens	3	14
Levenhookia stipitata	.05	<1
Lyginia imberbis	.5	8
Siloxerus humifusus	.02	<1
Stylidium repens	.05	<1
Trachymene pilosa	.05	<1
Wahlenbergia preissii	.25	<1
Wahlenbergia preissii	.05	<1

NQ05

Staff JLT **Date** 29/10/2020 **Season** A

Revisit

Type Q 10 m x 10 m

Location

MGA Zone 50 386370 **mE** 6496236 **mN** **Lat.** -31.6635 **Long.** 115.8014

Habitat Sandplain

Aspect N/A **Slope** N/A

Soil Type Grey sand

Rock Type

Loose Rock 0 % cover **Litter** 60 % cover ; 2-3 cm in depth

Bare ground 45 % cover **Weeds** 1 % cover

Vegetation U+ ^*Banksia ilicifolia*\^tree\6\i;M ^*Kunzea glabrescens*,^*Adenanthos cygnorum* subsp. *cygnorum*\^shrub\4\c;G ^^*Lyginia imberbis*,*Brachyloma preissii*,*Hibbertia racemosa*\^rush, shrub\2\i

Veg. Condition Excellent

Disturbance

Fire Age >10 years

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
Adenanthos cygnorum subsp. *cygnorum*		2	5	
Austrostipa compressa		.45	<1	
Banksia ilicifolia		6	10	
Brachyloma preissii		.35	2	

**Briza maxima*	.3	<1
Conostylis aculeata subsp. *aculeata*	.25	<1
Dianella revoluta var. *divaricata*	.6	<1
**Gladiolus caryophyllaceus*	.6	<1
Hibbertia racemosa	4	1
Kunzea glabrescens	2.3	35
Lyginia imberbis	.5	12
Persoonia saccata	.5	<1
Trachymene pilosa	.15	<1
**Ursinia anthemoides* subsp. *anthemoides*	.15	<1

NQ06

Staff JLT **Date** 29/10/2020 **Season** A

Revisit

Type Q 10 m x 10 m

Location

MGA Zone 50 386380 **mE** 6496187 **mN** **Lat.** -31.6640 **Long.** 115.8015

Habitat Sandplain

Aspect N/A **Slope** N/A

Soil Type White sand

Rock Type

Loose Rock 0 % cover **Litter** 65 % cover ; 2-3 cm in depth

Bare ground 20 % cover **Weeds** 1 % cover

Vegetation U+ ^*Banksia ilicifolia*,^*Banksia menziesii*\^tree\6\i;M ^^*Kunzea glabrescens*,*Adenanthos cygnorum* subsp. *cygnorum*,*Jacksonia furcellata*\^shrub\4\c;G ^*Lyginia imberbis*,^*Brachyloma preissii*\^rush,shrub\2\i

Veg. Condition Excellent

Disturbance

Fire Age >10 years

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
Adenanthos cygnorum subsp. *cygnorum*		2	5	
Banksia ilicifolia		6	8	
Banksia menziesii		5	5	
Brachyloma preissii		.4	2	

Centrolepis drummondiana	.05	<1
Conostylis aculeata subsp. *aculeata*	.25	<1
Corynotheca micrantha	.35	<1
Dampiera linearis	.15	<1
Dianella revoluta var. *divaricata*	.45	<1
**Gladiolus caryophyllaceus*	.6	<1
Hibbertia racemosa	.35	<1
Hypocalymma angustifolium	.7	1
**Hypochaeris glabra*	.15	<1
Jacksonia furcellata	2	3
Kunzea glabrescens	2.5	45
Levenhookia stipitata	.05	<1
Lyginia imberbis	.5	8
Phyllangium divergens	.05	<1
Pimelea floribunda	.3	<1
Thysanotus sp.	.25	<1
**Ursinia anthemoides* subsp. *anthemoides*	.15	<1

NQ07

Staff JLT **Date** 30/10/2020 **Season** A

Revisit

Type Q 10 m x 10 m

Location

MGA Zone 50 386411 **mE** 6496015 **mN** **Lat.** -31.6655 **Long.** 115.8018

Habitat Sandplain

Aspect N/A **Slope** N/A

Soil Type White sand

Rock Type

Loose Rock 0 % cover **Litter** 20 % cover ; 1-2 cm in depth

Bare ground 70 % cover **Weeds** 30 % cover

Vegetation U+ ^*Melaleuca preissiana*\^tree\7\i;G ^^*Ehrharta calycina*,*Carpobrotus edulis*,*Dianella revoluta* var. *divaricata*\^tussock grass,forb,sedge\2\i

Veg. Condition Degraded

Disturbance

Fire Age >10 years

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
**Aira caryophyllea*		.1	1	
Astartea scoparia		.8	.5	
**Carpobrotus edulis*		.05	5	
Crassula colorata		.05	<1	
Dianella revoluta var. *divaricata*		.5	1	

**Ehrharta calycina*	.5	25
**Gladiolus caryophyllaceus*	.4	<1
**Lolium rigidum*	.25	<1
Melaleuca preissiana	10	20
**Moraea miniata*	.25	<1
Tetraria octandra	.3	<1
**Vulpia myuros*	.2	<1

NQ08

Staff JLT **Date** 30/10/2020 **Season** A

Revisit

Type Q 10 m x 10 m

Location

MGA Zone 50 386158 **mE** 6496022 **mN** **Lat.** -31.6654 **Long.** 115.7991

Habitat Sandplain

Aspect N/A **Slope** N/A

Soil Type White sand

Rock Type

Loose Rock 0 % cover **Litter** 30 % cover ; 1-2 cm in depth

Bare ground 60 % cover **Weeds** 40 % cover

Vegetation U+ ^*Eucalyptus rudis* subsp. *rudis*,^*Nuytsia floribunda*\^tree\7\i;M ^*Adenanthos cygnorum* subsp. *cygnorum*\^shrub\4\bi;G ^*Ehrharta calycina*,^*Bromus diandrus*\^tussock grass\\

Veg. Condition Degraded

Disturbance

Fire Age >10 years

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
Adenanthos cygnorum subsp. *cygnorum*		.4	1	
**Aira caryophyllea*		.15	<1	
**Briza maxima*		.15	<1	
**Bromus diandrus*		.35	5	
Crassula colorata		.05	<1	

**Ehrharta calycina*	.5	18
Eucalyptus rudis subsp. *rudis*	8	12
Hibbertia hypericoides subsp. *hypericoides*	.5	<1
**Hypochaeris glabra*	.08	<1
**Lolium rigidum*	.25	<1
Nuytsia floribunda	4	3
Podotheca gnaphalioides	.1	<1
**Urospermum picroides*	.15	<1
**Wahlenbergia capensis*	.2	<1

NQ09

Staff JLT **Date** 30/10/2020 **Season** A

Revisit

Type Q 10 m x 10 m

Location

MGA Zone 50 386080 **mE** 6495981 **mN** **Lat.** -31.6658 **Long.** 115.7983

Habitat Sandplain

Aspect N/A **Slope** N/A

Soil Type White sand

Rock Type

Loose Rock 0 % cover **Litter** 35 % cover ; 1-2 cm in depth

Bare ground 40 % cover **Weeds** 20 % cover

Vegetation U+ ^*Eucalyptus todtiana*,^*Nuytsia floribunda*\^tree mallee,tree\6\i;M ^*Jacksonia sternbergiana*\^shrub\4\bi;G ^*Ehrharta calycina*\^tussock grass\2\i

Veg. Condition Degraded

Disturbance

Fire Age >10 years

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
**Aira caryophyllea*		.10	<1	
**Briza maxima*		.15	<1	
Corynotheca micrantha		.25	<1	
Diuris corymbosa		0.4	<1	
**Ehrharta calycina*		.5	12	

Eucalyptus todtiana	5	10
**Gladiolus caryophyllaceus*	.4	<1
**Hypochaeris glabra*	.05	<1
Jacksonia sternbergiana	2	2
Nuytsia floribunda	4	15
Podotheca gnaphalioides	.14	.5
**Urospermum picroides*	.15	<1
**Ursinia anthemoides* subsp. *anthemoides*	.15	<1

NQ10

Staff JLT **Date** 30/10/2020 **Season** A

Revisit

Type Q 10 m x 10 m

Location

MGA Zone 50 386099 **mE** 6495911 **mN** **Lat.** -31.6664 **Long.** 115.7985

Habitat Sandplain

Aspect N/A **Slope** N/A

Soil Type White sand

Rock Type

Loose Rock 0 % cover **Litter** 30 % cover ; 1-2 cm in depth

Bare ground 40 % cover **Weeds** 20 % cover

Vegetation U+ ^*Eucalyptus todtiana*,^*Nuytsia floribunda*\^tree mallee,tree\6\i;M ^*Stirlingia latifolia*\^shrub\3\bi; G ^*Ehrharta calycina*,^*Aira caryophyllea*\^tussock grass\2\i

Veg. Condition Degraded

Disturbance

Fire Age >10 years

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
**Aira caryophyllea*		.1	1	
Beaufortia elegans		.5	<1	
Brachyloma preissii		.5	<1	
**Briza maxima*		.3	<1	
Corynotheca micrantha		.4	<1	

Desmocladus flexuosus	.15	<1
**Ehrharta calycina*	.5	12
Eucalyptus todtiana	5	12
**Euphorbia terracina*	.4	<1
**Gladiolus caryophyllaceus*	.4	<1
Hibbertia hypericoides subsp. *hypericoides*	.4	.5
**Lolium rigidum*	.2	<1
Macrozamia riedlei	.4	<1
Nuytsia floribunda	4	3
**Ornithopus compressus*	.15	<1
Podotheca gnaphalioides	.15	<1
Stirlingia latifolia	1	1.1
**Trifolium dubium*	.1	<1
**Urospermum picroides*	.2	<1
**Ursinia anthemoides* subsp. *anthemoides*	.15	<1

NQ11

Staff JLT **Date** 30/10/2020 **Season** A

Revisit

Type Q 10 m x 10 m

Location

MGA Zone 50 386176 **mE** 6495598 **mN** **Lat.** -31.6693 **Long.** 115.7993

Habitat Sandplain

Aspect N/A **Slope** N/A

Soil Type White sand

Rock Type

Loose Rock 0 % cover **Litter** 40 % cover ; 1-2 cm in depth

Bare ground 40 % cover **Weeds** 20 % cover

Vegetation U+ ^*Eucalyptus todtiana*,^*Nuytsia floribunda*\^tree mallee,tree\6\i;G ^^*Ehrharta calycina*,*Eremaea pauciflora*,*Hibbertia hypericoides* subsp. *hypericoides*\^tussock grass,shrub\2\i

Veg. Condition Degraded

Disturbance

Fire Age >10 years

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
**Aira caryophyllea*		.15	.3	
**Bromus diandrus*		.35	<1	
Crassula colorata		.05	<1	
Desmocladus flexuosus		.2	<1	
**Ehrharta calycina*		.5	10	

Eremaea pauciflora	.25	2
Eucalyptus todtiana	5	18
**Euphorbia terracina*	.5	<1
**Gladiolus caryophyllaceus*	.4	<1
Hibbertia hypericoides subsp. *hypericoides*	.4	1
**Lolium rigidum*	.2	<1
Melaleuca seriata	.45	<1
Microtis alba	.4	<1
Nuytsia floribunda	5	5
**Ornithopus compressus*	.10	<1
**Pelargonium capitatum*	.45	<1
Petrophile linearis	.4	<1
Podotheca gnaphalioides	.15	<1
**Urospermum picroides*	.25	<1
**Ursinia anthemoides* subsp. *anthemoides*	.25	<1
**Wahlenbergia capensis*	.25	<1

NQ12

Staff JLT **Date** 30/10/2020 **Season** A

Revisit

Type Q 10 m x 10 m

Location

MGA Zone 50 386467 **mE** 6495581 **mN** **Lat.** -31.6694 **Long.** 115.8023

Habitat Sandplain

Aspect N/A **Slope** N/A

Soil Type Grey sand

Rock Type

Loose Rock 0 % cover **Litter** 60 % cover ; 2-3 cm in depth

Bare ground 10 % cover **Weeds** 70 % cover

Vegetation U+ ^*Eucalyptus rudis* subsp. *rudis*,^*Nuytsia floribunda*\^tree\7\i;M ^*Melaleuca preissiana*\^tree\4\r; G ^^*Ehrharta calycina*,*Corynotheca micrantha*,*Bromus diandrus*\^tussock grass,shrub\2\c

Veg. Condition Degraded

Disturbance

Fire Age >10 years

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
**Asparagus asparagoides*		.3	1	
**Bromus diandrus*		.3	3	
Corynotheca micrantha		.5	5	
**Ehrharta calycina*		.5	40	
Eucalyptus rudis subsp. *rudis*		18	20	

**Lolium rigidum*	.35	<1
Melaleuca preissiana	3	4
Nuytsia floribunda	10	5

NQ13

Staff JLT **Date** 30/10/2020 **Season** A

Revisit

Type Q 10 m x 10 m

Location

MGA Zone 50 386408 **mE** 6495739 **mN** **Lat.** -31.6680 **Long.** 115.8017

Habitat Sandplain

Aspect N/A **Slope** N/A

Soil Type White sand

Rock Type

Loose Rock 0 % cover **Litter** 30 % cover ; 1-2 cm in depth

Bare ground 50 % cover **Weeds** 50 % cover

Vegetation U+ ^*Melaleuca preissiana*\^tree\7\i;G ^^*Ehrharta calycina*,*Carpobrotus edulis*,*Aira caryophyllea*\^tussock grass,forb\2\i

Veg. Condition Degraded

Disturbance Adjacent to four wheel drive track

Fire Age >10 years

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
**Aira caryophyllea*		.1	2	
**Bromus diandrus*		.35	<1	
**Carpobrotus edulis*		.15	5	
Crassula colorata		.05	<1	
**Ehrharta calycina*		.6	28	

**Gladiolus caryophyllaceus*	.4	<1
Hibbertia hypericoides subsp. *hypericoides*	.4	<1
Hypolaena exsulca	.45	<1
**Lolium rigidum*	.45	<1
**Lysimachia arvensis*	.15	<1
Melaleuca preissiana	15	30
**Ursinia anthemoides* subsp. *anthemoides*	.15	<1

NQ14

Staff JLT **Date** 30/10/2020 **Season** A

Revisit

Type Q 10 m x 10 m

Location

MGA Zone 50 386676 **mE** 6495659 **mN** **Lat.** -31.6688 **Long.** 115.8046

Habitat Sandplain

Aspect N/A **Slope** N/A

Soil Type White sand

Rock Type

Loose Rock 0 % cover **Litter** 20 % cover ; 1-2 cm in depth

Bare ground 25 % cover **Weeds** 15 % cover

Vegetation U+ ^*Melaleuca preissiana*\^tree\7\i;M ^*Astartea scoparia*\^shrub\4\bi;G ^*Ehrharta calycina*, ^*Carpobrotus edulis*\^tussock grass,chenopod shrub\2\i

Veg. Condition Degraded

Disturbance

Fire Age >10 years

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
**Aira caryophyllea*		.15	.5	
Astartea scoparia		1.8	2	
**Briza maxima*		.2	<1	
**Bromus diandrus*		.2	<1	
**Carpobrotus edulis*		.1	10	

Crassula colorata	.05	<1
**Ehrharta calycina*	.6	12
**Lotus subbiflorus*	.05	<1
Melaleuca preissiana	8	18
**Sonchus oleraceus*	.2	<1
**Ursinia anthemoides* subsp. *anthemoides*	.25	<1

NQ15

Staff JLT **Date** 30/10/2020 **Season** A

Revisit

Type Q 10 m x 10 m

Location

MGA Zone 50 386506 **mE** 6496049 **mN** **Lat.** -31.6652 **Long.** 115.8028

Habitat Sandplain

Aspect N/A **Slope** N/A

Soil Type White sand

Rock Type

Loose Rock 0 % cover **Litter** 10 % cover ; 1-2 cm in depth

Bare ground 30 % cover **Weeds** 15 % cover

Vegetation U+ ^*Eucalyptus rudis* subsp. *rudis*\^tree\7\i;M ^*Jacksonia furcellata*\^shrub\4\bi;G ^*Ehrharta calycina*,^*Carpobrotus edulis*\^tussock grass,chenopod shrub\2\i

Veg. Condition Degraded

Disturbance

Fire Age >10 years

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
**Carpobrotus edulis*		.15	5	
Dianella revoluta var. *divaricata*		.25	<1	
**Disa bracteata*		.3	<1	
**Ehrharta calycina*		.7	10	
Eucalyptus rudis subsp. *rudis*		20	18	

Jacksonia furcellata	1.2	1
Lepidosperma sp.	.25	<1
**Lolium rigidum*	.2	<1

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Staff JLT **Date** 29/10/2020 **Season** A

Revisit

Type Q

Location

MGA Zone **mE** **mN** **Lat.** **Long.**

Habitat

Aspect **Slope**

Soil Type

Rock Type

Loose Rock **Litter**

Bare ground **Weeds**

Vegetation

Veg. Condition

Disturbance

Fire Age

Notes

Species	WA Cons.	Height (m)	Cover (%)	Count
Chaetospora curvifolia		.35	<1	
Petrophile linearis		.35	<1	
Stylidium crossocephalum		.25	<1	

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