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ENVIRONMENT

HOLCIM (AUSTRALIA) PTY LTD

GOSNELLS QUARRY DETAILED FLORA, VEGETATION AND BLACK COCKATOO HABITAT ASSESSMENT

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EXECUTIVE SUMMARY

Holcim (Australia) Pty Ltd (Holcim) required flora and vegetation surveys to be conducted at Holcim's Gosnells quarry. The survey area covers 18.21 ha, including a previously cleared and rehabilitated area (Area A) and a second area (Area B) consisting mostly of undisturbed native vegetation. *ecologia* Environment (*ecologia*) was engaged by Holcim to undertake a detailed flora and vegetation survey and a black cockatoo habitat assessment. The survey was undertaken on the 18th and 25th September 2024.

Area A

Vegetation within Area A was described from four vegetation description sites and consisted of degraded vegetation with planted trees and an understorey of introduced grasses and herbs. Vegetation within Area A was not considered to be significant. Due to access constraints, a survey for significant species could not be undertaken in this area, but because the vegetation was degraded the likelihood that significant species occur here is low. Likewise, a black cockatoo habitat assessment could not be undertaken in this area.

Area B

Flora and Vegetation Assessment

A total of 105 vascular plant taxa representing 33 families and 67 genera were recorded within Area B. No *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) or *Biodiversity Conservation Act 2016* (BC Act) listed Threatened species were recorded with the survey area. Three Department of Biodiversity, Conservation and Attractions (DBCA) listed Priority taxa were recorded: *Beaufortia purpurea* (P3), *Acacia oncinophylla* subsp. *patulifolia* (P4), and *Darwinia pimelioides* (P4). Sixteen introduced plant species were recorded across both areas, two of which are listed as Declared Pests (*Gomphocarpus fruticosus* and *Moraea flaccida*).

Three vegetation types were described from 11 sampling sites within Area B, which consisted of one *Corymbia* mid open woodland, one *Corymbia* mid woodland, and one *Borya sphaerocephala* low herbland. Vegetation condition within Area B was mostly assessed as Very Good to Excellent.

No plant communities observed corresponded to any state (BC Act) or Commonwealth (EPBC Act) listed Threatened Ecological Community (TEC). One vegetation type (HaBs) was consistent with the state listed Priority Ecological Community (PEC): 'Central Northern Darling Scarp Granite Shrubland Community' Priority 4. HaBs accounted for 23.2% (3.5 ha) of Area B.

Black Cockatoo Habitat Assessment

An assessment was undertaken to investigate potential breeding habitat, night roosting habitat, and foraging habitat for the three black cockatoo species within the survey area. Four forest red-tailed black cockatoos were recorded overflying Area B during the field survey, two of which landed to forage. A total of 22 potentially suitable habitat trees (> 500 mm DBH) were recorded within the Area B. None of these trees had known or probable nesting hollows, 2 trees contained potentially suitable hollows (Category 3), and 1 tree contained a hollow that was not suitable of nesting (Category 4). The remaining 19 trees identified as habitat trees did not support hollows of a suitable size, height or angle to support black cockatoos.

Black cockatoo foraging habitat within the Area B was assessed as high quality. Given the appropriate timing of the survey, and the lack of confirmed breeding records recorded within the survey area, and that no trees had 'known' or 'probable' breeding hollows, it is unlikely that black cockatoos are currently utilising any of the trees identified as potential suitable breeding habitat or roost trees within the survey area.

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1 INTRODUCTION

1.1 PROJECT BACKGROUND

Holcim (Australia) Pty Ltd (Holcim) required flora and vegetation surveys to be conducted at Holcim's Gosnells quarry. The survey area covers 18.21 hectares (ha), including a previously cleared and rehabilitated stockpile/bund area (Area A) and a second area (Area B) consisting mostly of undisturbed native vegetation. *ecologia* Environmental (*ecologia*) was engaged by Holcim to undertake a detailed flora and vegetation survey and a black cockatoo habitat assessment at the Gosnells Quarry. The survey area is located approximately 20 kilometres (km) southeast of the Perth Central Business District (CBD) in Western Australia (WA) and is entirely in the Northern Jarrah Forest IBRA subregion of the Jarrah Forest IBRA region (Map 1).

1.2 SCOPE OF WORK

Holcim (Australia) requires a biological survey to delineate key flora, fauna, soil and surface water values (wetlands) and potential sensitivity to impact from the proposal. The following were therefore provided as part the biological assessment of the survey area:

- A desktop assessment to evaluate biological values of the survey area and surrounds, including a review of existing physical and biological values, significant species and communities, and other relevant available data.
- A single-phase detailed flora and vegetation survey in accordance with the *Technical Guidance* (EPA, 2016b).
- Targeted searches for significant plant species and communities within representative areas of suitable habitat.
- A plant species inventory, including all native and introduced species.
- An inventory of significant plant species, and an assessment of their local and regional distribution (if present).
- An inventory and a map of Weeds of National Significance (WONS) and Declared Pests (if present).
- Classification, characterisation, and mapping of vegetation types.
- Assessment and mapping of vegetation condition.
- An assessment of vegetation significance at a national, state, regional, and local level.
- Black cockatoo habitat assessment.

1.3 LEGISLATIVE AND REGULATORY FRAMEWORK

The Environmental Protection Authority's (EPA) environmental objectives for the factors *Flora and Vegetation* (EPA, 2016a) and *Terrestrial Fauna* (EPA, 2020) are to protect fauna, flora and vegetation so that biological diversity and ecological integrity are maintained. In this context, ecological integrity is the composition, structure, function and processes of ecosystems, and the natural range of variation of these elements. The primary objective of this flora, vegetation and fauna assessment was to provide sufficient information to assess the impact of any proposed development on the fauna, flora, and vegetation of the survey area, thereby ensuring that the EPA's objectives can be met.

The survey was designed and undertaken to comply with the following guidance documents:

- Environmental Factor Guideline: Flora and Vegetation (EPA, 2016a).
- Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (EPA, 2020).
- Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment (EPA, 2016b).

- Referral Guidelines for 3 WA Threatened Black Cockatoo Species: Carnaby's Cockatoo, Baudin's Cockatoo and the Forest Red-tailed Black-cockatoo (DAWE, 2022).

1.4 DEFINITIONS

1.4.1 Significant Flora

According to the *EPA Factor Guideline: Flora and Vegetation* (EPA, 2016a), plant taxa (or records) may be considered significant for reasons including, but not restricted to, the following:

- A taxon listed as Threatened under Western Australia's *Biodiversity Conservation Act 2016* (BC Act) or the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).
- A taxon on the Department of Biodiversity, Conservation and Attractions (DBCA) Priority Flora List.
- Locally endemic species or those associated with a restricted habitat type (e.g. surface water or groundwater dependent ecosystems).
- New species or those having anomalous features that indicate a potential new species.
- Being representative of the range of a species (particularly, at the extremes of range, recently discovered range extensions, or isolated outliers of the main range).
- Unusual species, including restricted subspecies, varieties or naturally occurring hybrids.
- Being representative of taxonomic groups that no longer occur widely in the broader landscape (relictual species/populations).

1.4.2 Significant Vegetation

According to *EPA Factor Guideline: Flora and Vegetation* (EPA, 2016a), vegetation may be considered significant for reasons including, but not restricted to, the following:

- Being listed as a Threatened Ecological Community (TEC) under the BC Act or the EPBC Act.
- Being listed as a Priority Ecological Community (PEC) by DBCA.
- Having a restricted distribution.
- The degree of historical impact from threatening processes.
- Playing a role as a refuge.
- Providing an important function required to maintain ecological integrity of a significant ecosystem.

1.4.3 Introduced Plants

Weeds of National Significance

Under the Australian Weeds Strategy there are 32 introduced plant species listed as Weeds of National Significance (WONS) that are "causing major economic, environmental and/or social impacts in a number of states or territories with strong potential for further spread" (DAWR, 2017). These species require "coordinated and strategic management along with shared stakeholder investment to develop and implement best practice to prevent, eradicate, contain and/or minimise impacts in different parts of the nation" (DAWR, 2017).

***Biosecurity and Agriculture Management Act* 2007**

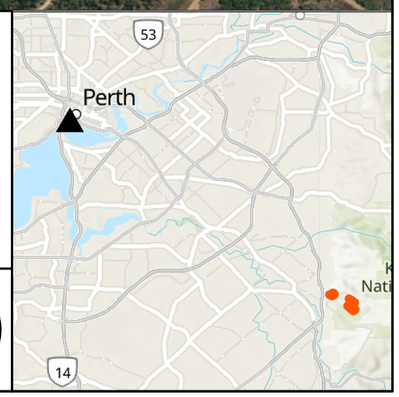
The purpose of Western Australia's *Biosecurity and Agriculture Management Act* 2007 (BAM Act) is to prevent serious animal and plant pests and diseases from entering Western Australia and becoming established, and to minimise the spread and impact of those that are already present. The Western Australian Organism List (WAOL) lists organisms that are categorised under the BAM Act into five legal categories: 'Declared Pest, Prohibited -s12', 'Declared Pest -s22(2)', 'Permitted -s11', 'Permitted, Requires Permit -r73', and 'Unlisted -s14'. A Declared Pest may be subject to control and keeping requirements once within Western Australia.

Regional Weed Prioritisation Process

At a regional level in Western Australia, introduced plant species are ranked using the Weed Prioritisation Process (DPaW, 2013b). The process is intended to "highlight the species that have the highest ecological impact, most extensive potential distribution, highest invasiveness, lowest current distribution and highest feasibility of control within a regional context based on the information available at the time" (DPaW, 2013b).



Survey area



ecologia ENVIRONMENT

Project No.: 2015
Author: AC
Created Date: 23 June 2025
Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Scale: 1:6,500 @A3

Map 1: Location of survey area.

0 100 200 400
Meters

Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community, Esri, CGIAR, Maxar

2 DESKTOP ASSESSMENT

2.1 DESKTOP METHODOLOGY

The methodology adopted for the desktop assessment was in accordance with the *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA, 2016b) and *Technical Guidance – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (EPA, 2020). A review of background environmental information for the survey area was undertaken, including, but not limited to, climate (Bureau of Meteorology, BOM), biogeography (IBRA 7) (DSEWPaC, 2012), soil-landscape systems (land systems) (DPIRD, 2016), the Surface Geology of Australia 1:1M spatial dataset (Geoscience Australia, 2012), the Atlas of Australian Soils (Northcote et al., 1960-1968), and pre-European native vegetation of Western Australia (Shepherd, Beeston, & Hopkins, 2002).

Searches of the databases listed in Table 1 were undertaken to determine the significant species and ecological communities previously recorded within 10 km of the survey area. The criteria listed in Table 2 were then applied to determine the likelihood of occurrence of these species and communities within the survey area. Habitat preferences were sourced, where available, from relevant taxonomic literature, FloraBase records (Western Australian Herbarium, 1998–), Threatened Species Profiles (SPRATs), or specimen data from the Australasian Virtual Herbarium (AVH) database (CHAH, 2017). The presence of potentially suitable habitat within the survey area was determined using broad landforms, soils, and vegetation associations in comparison to cited preferred habitat (if available) for each species.

Table 1: Databases queried for the desktop assessment.

Database	Search details
EPBC Act Protected Matters database	Records of matters of national significance under the EPBC Act within 10 km of the survey area
DBCA Threatened and Priority Ecological Communities Database	TECs and PECs within 5 km of the survey area (22-0125EC)
DBCA Threatened and Priority Flora (TPFL) and WAHERB database	Significant plant records within 10 km of the survey area (40-0924FL).
Atlas of Living Australia (ALA) Database	All flora records within 5 km of the survey area.

Table 2: Criteria used to assess the likelihood of occurrence of significant species and communities.

Rating	Criterion
Recorded	The species/community has been recorded within the survey area.
Likely	Suitable habitat is almost certainly present and there are records immediately adjacent to survey area.
Possible	Suitable habitat is likely to be present and there are records within 40 km of the survey area, or there is insufficient information available to exclude the possibility of occurrence.
Unlikely	Suitable habitat is not likely to be present and/or there are no records within 40 km of the survey area.
Does not occur	The community is an existing regionally mapped vegetation association (e.g. Shepherd et al. 2002) or land system (e.g. DPIRD 2016) which does not occur within the survey area; or The species is recognised as being locally extinct or extinct in the wild and does not occur within the survey area.

2.2 CLIMATE

Rainfall data from the nearest long-term Bureau of Meteorology (BOM) weather station (since 1964) were obtained from Roleystone (Station No. 9113), located 5.69 km to the southeast of the survey area. Rainfall at Roleystone over the 12 months prior to the survey was approximately 99% of mean annual rainfall (989.1 mm), but rainfall in September 2024 (just prior to the survey) was below average (Figure 1). Temperature data were obtained from Bickley (Station No. 9240) (BOM, 2024) which is located 12.15 km to the northeast of the survey area (Figure 1). Maximum daytime temperature at Bickley is frequently above 25°C between November and March and minimum temperatures can drop below 10°C between June and October.

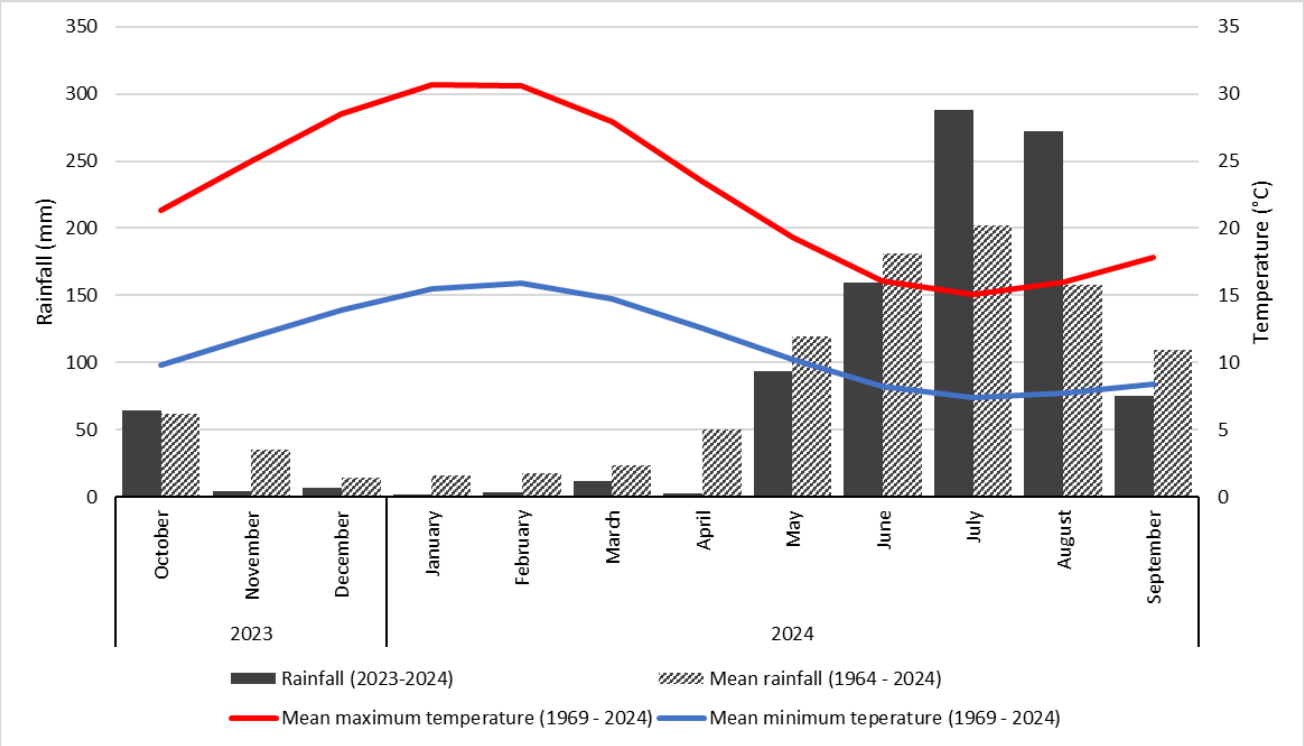


Figure 1: Monthly mean rainfall and temperature for Roleystone (rainfall) and Jandakot Aero (temperature).

2.3 INTERIM BIOGEOGRAPHIC REGIONALISATION FOR AUSTRALIA

The Interim Biogeographic Regionalisation for Australia (IBRA) classifies the Australian continent into bioregions based on similar geology, landform, vegetation, fauna and climate characteristics (DSEWPaC, 2012). The survey area is located within the Northern Jarrah Forest subregion of the Jarrah Forest region according to IBRA 7. The Northern Jarrah Forest subregion is the area east of the Darling escarpment, in which Jarrah-Marri Forest occur on lateritic gravels and Wandoo-Marri woodland occur on clayey soils (Williams & Mitchell, 2001). Eluvial and alluvial sediments support *Agonis* shrublands and heath is found widespread in the understorey throughout the forests and woodlands (Williams & Mitchell, 2001). The climate is Warm Mediterranean, with an average rainfall of 1300 mm on the escarpment to 700 mm in the east and north, and the subregional area is 2,255,905 ha (Kendrick, 2001).

2.4 SOIL-LANDSCAPE SYSTEMS, SURFACE GEOLOGY, AND SOILS

Geological features of the survey area were derived from three spatial datasets: Soil Landscape Mapping - Best Available (Version 05.01) (DPIRD-027) (DPIRD, 2022); Surface Geology of Australia 1:1 million scale dataset 2012 edition (Geoscience Australia, 2012); and the Atlas of Australian Soils (Northcote et al., 1960-1968). Eight soil-landscape systems (land systems) (Table 3, Map 2), one surface geology unit (Table 4, Map 3), and two soil units (Table 5, Map 4), were associated with the survey area.

2.5 DBCA MANAGED LANDS AND NATIONALLY IMPORTANT WETLANDS

Spatial datasets were queried for DWER Environmentally Sensitive Areas (ESAs) (DWER-046), Nationally Important Wetlands (DBCA-045), and DBCA managed lands and waters (DBCA-011), occurring in the vicinity of the survey area. No Nationally Important Wetlands occur near the survey area, one unnamed ESA occurs 40 meters (m) north of the proposed galleries upgrade area, and the proposed quarry extension area overlaps with Crown land (Map 5).

Table 3: Land systems associated with the survey area (DPIRD 2016).

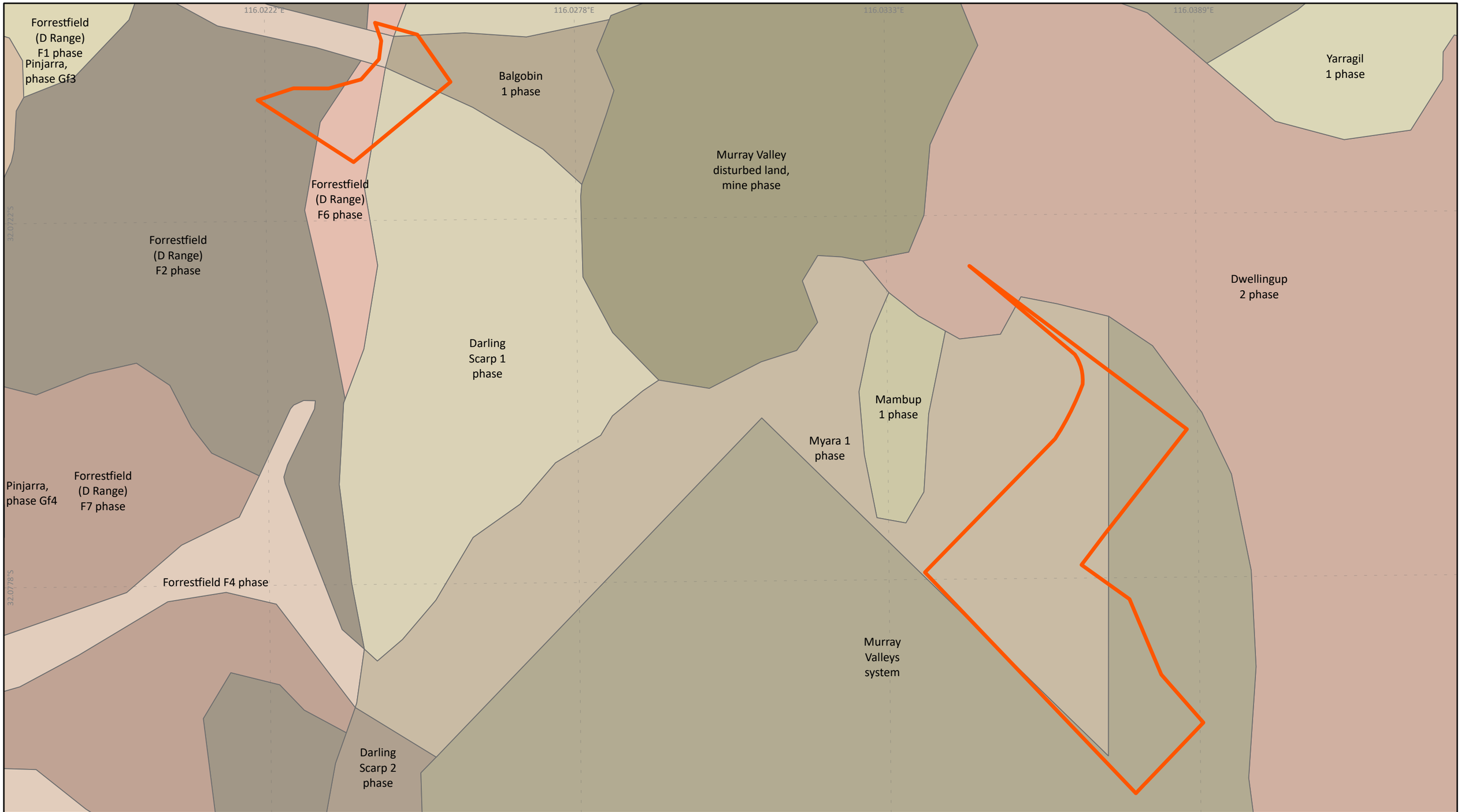
Land system	Description	Extent within survey area (ha)	Extent within survey area (%)
Balgobin 1 phase	Valleys within Darling Scarp with sideslopes <35%. Variable moderately well to well drained duplex and gradational soils. Common rock outcrop.	0.6	3.2
Darling Scarp 1 phase	Gentle to moderate upper slopes (5-30%). Variable moderately well to well drained duplex and gradational soils. Common rock outcrop.	0.7	3.7
Dwellingup 2 phase	Very gently to gently undulating terrain (<10%) with well drained, shallow to moderately deep gravelly brownish sands, pale brown sands and earthy sands overlying lateritic duricrust.	< 0.05	0.2
Forrestfield (D Range) F2 phase	Foot and low slopes < 10%. Well drained gravelly yellow or brown duplex soils with sandy topsoil. Woodland of *E.marginata, E. calophylla* and some *B.grandis*.	0.6	3.5
Forrestfield (D Range) F6 phase	Crests and knolls and upper slopes 3-15% with common lateritic outcrop. Soils are shallow moderately well drained gravelly brownish or earthy sands.	1.1	6.2
Forrestfield F4 phase	Incised stream channels within gentle slopes with deep acidic yellow duplex soils and sandy alluvial gradational brown earths.	0.1	0.5
Murray Valleys system	Western Darling Range from the Avon Valley to Harvey. Deeply incised valleys with Red loamy earths, shallow duplexes and rock outcrop and Jarrah-marri-wandoo forest and woodland with mixed shrubland.	4.9	27
Myara 1 phase	Gentle to steep valley sideslopes (5-35%) and narrow incised valley floors. Variable well drained duplex and gradational soils. Common rock outcrop. *E. wandoo, E.accedens* and *E.marginata* on sandy gravels and Acacia spp. On shallow soils.	10.2	55.7

Table 4: Surface geology associated with the survey area (Geoscience Australia 2012).

Map symbol	Surface geological unit	Description	Extent within survey area (ha)	Extent within survey area (%)
Ag	Felsic intrusives 74292	Undifferentiated felsic intrusive rocks, including monzogranite, granodiorite, granite, tonalite, quartz monzonite, syenogranite, diorite, monzodiorite, pegmatite. Locally metamorphosed, foliated, gneissic. Local abundant mafic and ultramafic inclusions	18.2	100

Table 5: Atlas of Australian Soil units associated with the survey area (Northcote *et al*. 1960-1968).

Map code	Description	Extent within survey area (ha)	Extent within survey area (%)
Sp2	Gently sloping bench or terrace--the Ridge Hill Shelf: chief soils are hard acidic yellow soils (Dy2.61) containing ironstone gravels. Associated are brown sands (Uc4.2) often containing ironstone gravels at depth and form- ing a western fringe to the bench; and some (Dy3.4) soils on dissected areas. As mapped, areas of units Wd6 and Gb16 may be included	3.1	17.1
Mw31	Deeply incised, steep scarp and valley side slopes of the Darling scarp and its more deeply incised tributary valleys: chief soils of the steep scarp and valley side slopes, on which massive rock outcrops are a feature, seem to be acid red earths (Gn2.14) on the colluvial slope deposits. Associated are (Dr2.21) and (Dy3.21) soils on moderate to steep upper slopes with some (Uc4.11) soils containing ironstone gravel on spurs and ridge tops	15.1	82.9



Survey area

Land systems

- Balgobin 1 phase
- Darling Scarp 1 phase
- Darling Scarp 2 phase
- Dwellingup 2 phase
- Forrestfield (D Range) F1 phase
- Forrestfield (D Range) F2 phase
- Forrestfield (D Range) F6 phase
- Forrestfield (D Range) F7 phase
- Forrestfield F4 phase
- Mambup 1 phase
- Murray Valley disturbed land, mine phase
- Murray Valleys system
- Myara 1 phase
- Pinjarra, phase Gf3
- Pinjarra, phase Gf4
- Yarragil 1 phase

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Project No.: 2015
Author: SN-W
Created Date: 12 February 2025
Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Scale: 1:6,000 @A3

Map 2: Land systems (DPIRD, 2016).

Maxar

0 50 100 200 300 400 500
Meters

116.0222°E
116.0278°E
116.0333°E
116.0389°E
32.07'22"S
32.07'78"S

colluvium
38491

felsic
intrusives
74292

Survey area

Surface geology

colluvium 38491

felsic intrusives 74292

Project No.: 2015
Author: SN-W
Created Date: 12 February 2025
Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Scale: 1:6,000 @A3

Map 3: Surface geology (1:1,000,000) of the survey area (Geoscience Australia, 2012).

Maxar

0 50 100 200 300 400 500
Meters

116.0222°E
116.0278°E
116.0333°E
116.0389°E
32.0722°S
32.0778°S

Sp2
Mw31
JZ1
Pb2

Survey area

Soil
- JZ1
- Mw31
- Pb2
- Sp2

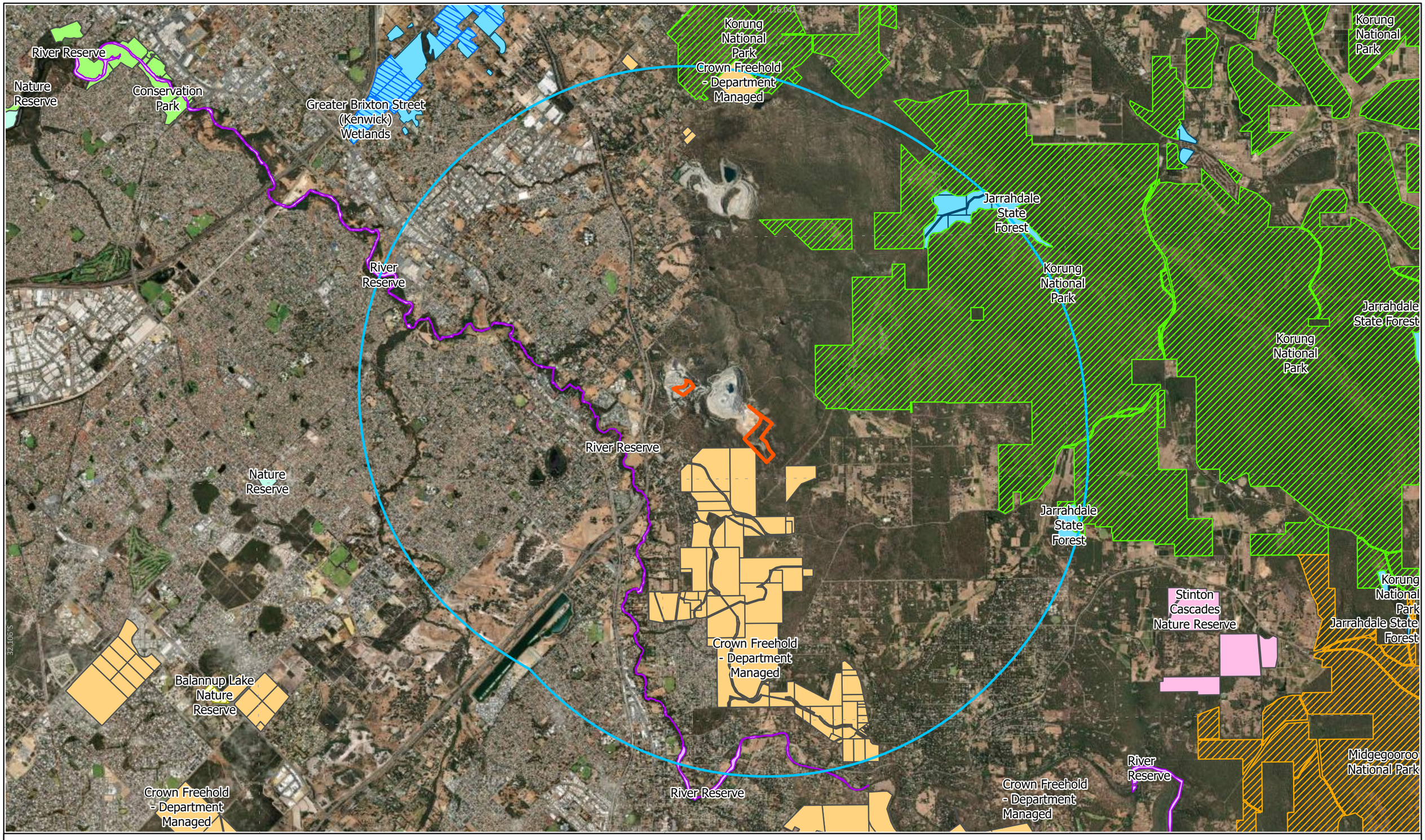
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Project No.: 2015
Author: SN-W
Created Date: 12 February 2025
Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Scale: 1:6,000 @A3

Map 4: Atlas of Australian Soils map units associated with the survey area (Northcote et al., 1960-1968).

Maxar

0 50 100 200 300 400 500
Meters



Survey area
Study area (5 km buffer)

Important Wetlands (DBCA-045)
Brixton Street Swamps

Legislated Lands and Waters (DBCA-011)
Balannup Lake Nature Reserve
Conservation Park
Crown Freehold - Department Managed
Greater Brixton Street (Kenwick) Wetlands
Jarrahdale State Forest
Korung National Park
Midgegooroo National Park
Nature Reserve
River Reserve
Stinton Cascades Nature Reserve

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Project No.: 2015
Author: AS
Created Date: 13 February 2025
Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Scale: 1:55,000 @A3

Map 5: DBCA Legislated Lands and Nationally Important Wetlands near the survey area.

0 500 1,000 2,000 3,000 4,000 5,000
Meters

Earthstar Geographics, NIWA, GeosciencesAustralia, Esri, Garmin, NaturalVue

2.6 FLORA

2.6.1 Floristic Diversity

A search of the Atlas of Living Australia (ALA) database (ALA, 2025) identified a total of 1,392 native vascular plant taxa and 179 introduced vascular plant taxa (including species, infraspecific taxa, and phrase name taxa), representing 109 families and 397 genera, within 5 km of the survey area (Appendix A). The most diverse families were the Fabaceae (122 taxa), Orchidaceae (90 taxa), Myrtaceae (77 taxa), Proteaceae (73 taxa), Cyperaceae (58 taxa), and Poaceae (53 taxa). The most diverse genera were *Stylidium* (35 taxa), *Acacia* (28 taxa), *Drosera* (21 taxa), *Schoenus* (21 taxa), *Hibbertia* (20 taxa), and *Hakea* (19 taxa).

2.6.2 Significant Species

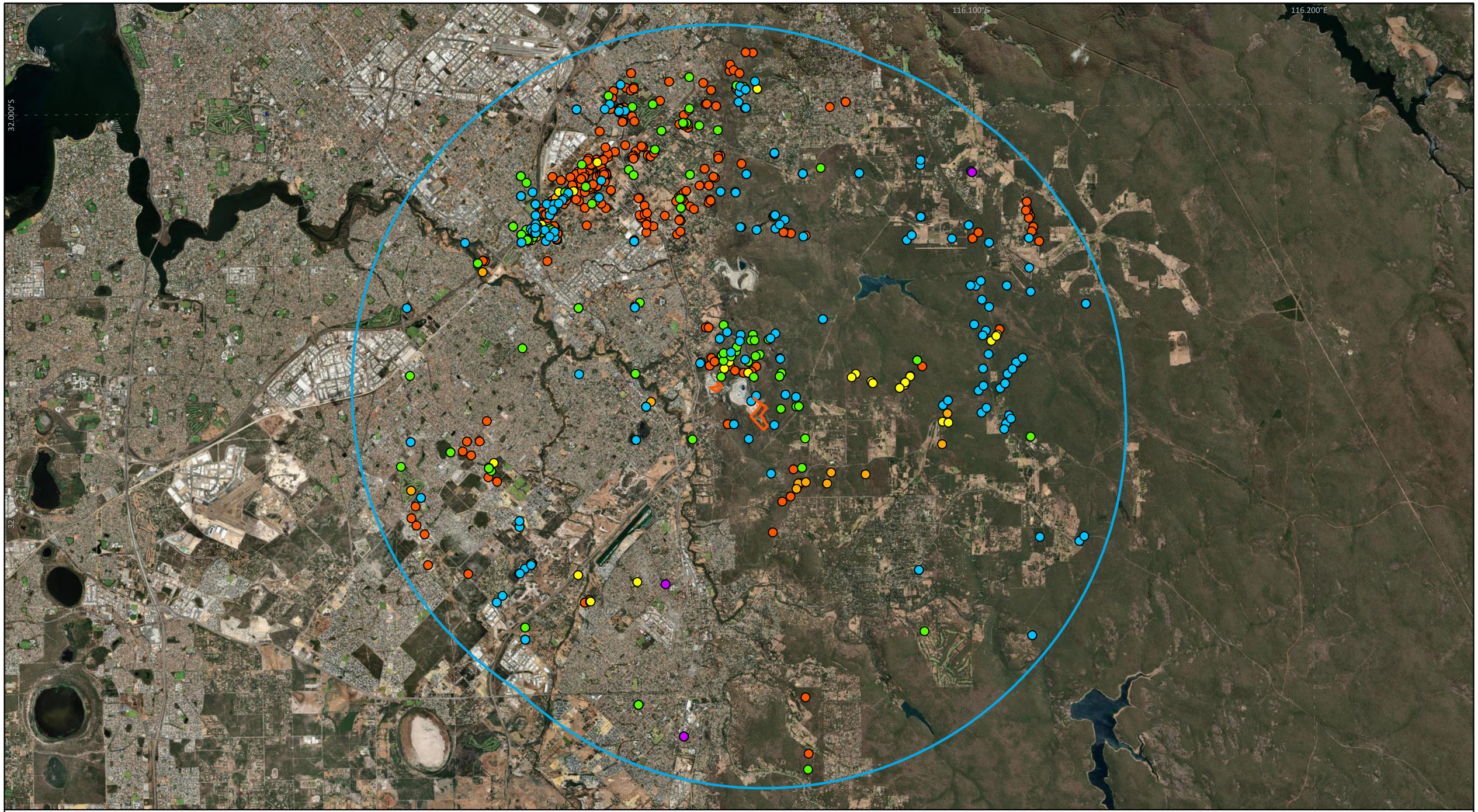
DBCA database searches identified 104 significant plant taxa within 10 km of the survey area, including 25 Threatened taxa, eight Priority 1 taxa, 15 Priority 2 taxa, 33 Priority 3 taxa, 21 Priority 4 taxa, and two taxa presumed to be extinct (Appendix B, Map 6). The PMST database search identified potentially suitable habitat for 34 EPBC Act listed (Threatened) species with 10 km of the survey area (PMST, Appendix A). The locations of EPBC Act and BC Act listed Threatened species have not been shown in accordance with DBCA's conditions of supply.

The likelihood for each taxon to occur within the survey area was assessed using the criteria outlined in section 2.1. Based on the proximity of previous records and the potential presence of suitable habitat, 30 taxa potentially occur within the survey area ('Likely' and 'Possible' ratings) (Appendix B). Seventy-one taxa were considered 'Unlikely' to occur due to the probable absence of suitable habitat within the survey area or because they are known to have very restricted distributions and have not been recorded in the vicinity of the survey area (Appendix B).

2.6.3 Introduced Species

A search of the Atlas of Living Australia database (ALA, 2023) identified 179 introduced plant species within 5 km of the survey area (Appendix C). Twelve species are classified as a Declared Pests according to the BAM Act and listed on the WAOL (DPIRD, 2007–): *Asparagus asparagoides, Chrysanthemoides monilifera* subsp. *monilifera, Echium plantagineum, Galium aparine, Gomphocarpus fruticosus, Lantana camara, Moraea flaccida, Opuntia ficus-indica, Rubus rugosus, Rubus ulmifolius, Solanum linnaeanum,* and *Zantedechia aethiopica*. Three species are classified as WONS: *Asparagus asparagoides, Lantana camara,* and *Opuntia ficus-indica*. Nineteen species have high ecological impact rating and rapid invasiveness rating according to the Weed Prioritisation Process for the region (Appendix C).

Map 6: Significant plant species recorded within 10 km of the survey area (40-9024FL).



Survey area

Study area (10 km buffer)

Conservation Status

- T
- P1
- P2
- P3
- P4
- X

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Project No.: 2015
Author: AS
Created Date: 16 January 2025
Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Scale: 1:100,000 @A3

Map 6: Significant plant species recorded within 10 km of the survey area (40-9024FL).

0 1.2 2.3 3.5 7
Kilometers

Earthstar Geographics, Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community, Esri, USGS

2.7 VEGETATION

2.7.1 Pre-European Vegetation

The Western Australian Land Use and Vegetation Data Project produced a 1:250,000 scale digital spatial dataset of the pre-European native vegetation of Western Australia, compiled from previous vegetation mapping exercises, primarily by J.S. Beard from 1964 to 1981, with updates reflecting the National Vegetation Information System (NVIS) standards (Shepherd et al., 2002). Two vegetation associations (3 and 4) are mapped within the survey area (Table 6, Map 7).

The National Objectives and Targets for Biodiversity Conservation 2001-2005 (DEH, 2001) recognise that the retention of 30% or more of the pre-clearing extent of an ecological community is necessary if Australia's biological diversity is to be protected, as this is the threshold below which species loss appears to accelerate exponentially (EPA, 2000). Based on the Statewide Vegetation Statistics dataset (Government of Western Australia, 2018), the current extent of both vegetation associations in the Northern Jarrah Forest subregion are above this threshold (Table 6). According to Principle (e) of the native vegetation clearing guidelines (DER, 2014), areas within constrained areas (i.e., Perth Metropolitan, Peel and Greater Bunbury Region Schemes) are recognised for their past land use planning decisions and hence have retention objectives to "at least 10%". Due to the survey area falling within the Perth Metropolitan region and the current percentage of vegetation 4 protected for conservation within the Jarrah Forest IBRA region being 27.09%, this vegetation association is not classified as 'Vulnerable'.

2.7.2 Threatened and Priority Ecological Communities

The desktop assessment identified three EPBC Act or BC Act listed TECs occurring within 10 km of the survey area: '*Banksia attenuata* and/or *Eucalyptus marginata* woodlands of the eastern side of the Swan Coastal Plain (floristic community type 20b as originally described in Gibson et al. 1994)', '*Banksia* Woodlands of the Swan Coastal Plain ecological community', and '*Corymbia calophylla — Eucalyptus marginata* woodlands on sandy clay soils of the southern Swan Coastal Plain (floristic community type 3b as originally described in Gibson et al. 1994)'. These TECs were assessed to be potentially occurring based on their descriptions of landforms, land systems, and floristic communities. The locations of TECs have not been shown on Map 8 in accordance with DBCA's data supply conditions.

DBCA database searches identified one PEC intersecting with the survey area: the 'Central Northern Darling Scarp Granite Shrubland Community' Priority 4 PEC (Table 7, Map 8).

Table 6: Pre-European vegetation associations mapped with the survey area (Shepherd et al., 2002).

Shepherd et al. (2002) vegetation association	Description	Pre-European extent within Jarrah Forest IBRA region (ha)	Percentage remaining within Jarrah Forest IBRA region	Current percentage protected for conservation within Jarrah Forest IBRA region	Extent within survey area (ha)
3	Medium forest; jarrah-marri	2,390,592	67.1%	16.11%	0.96 (5.23%)
4	Medium woodland; marri & wandoo	1,022,713	27.09%	4.36%	17.26 (94.73%)

Table 7: Threatened and Priority Ecological Communities within 40 km of the survey area.

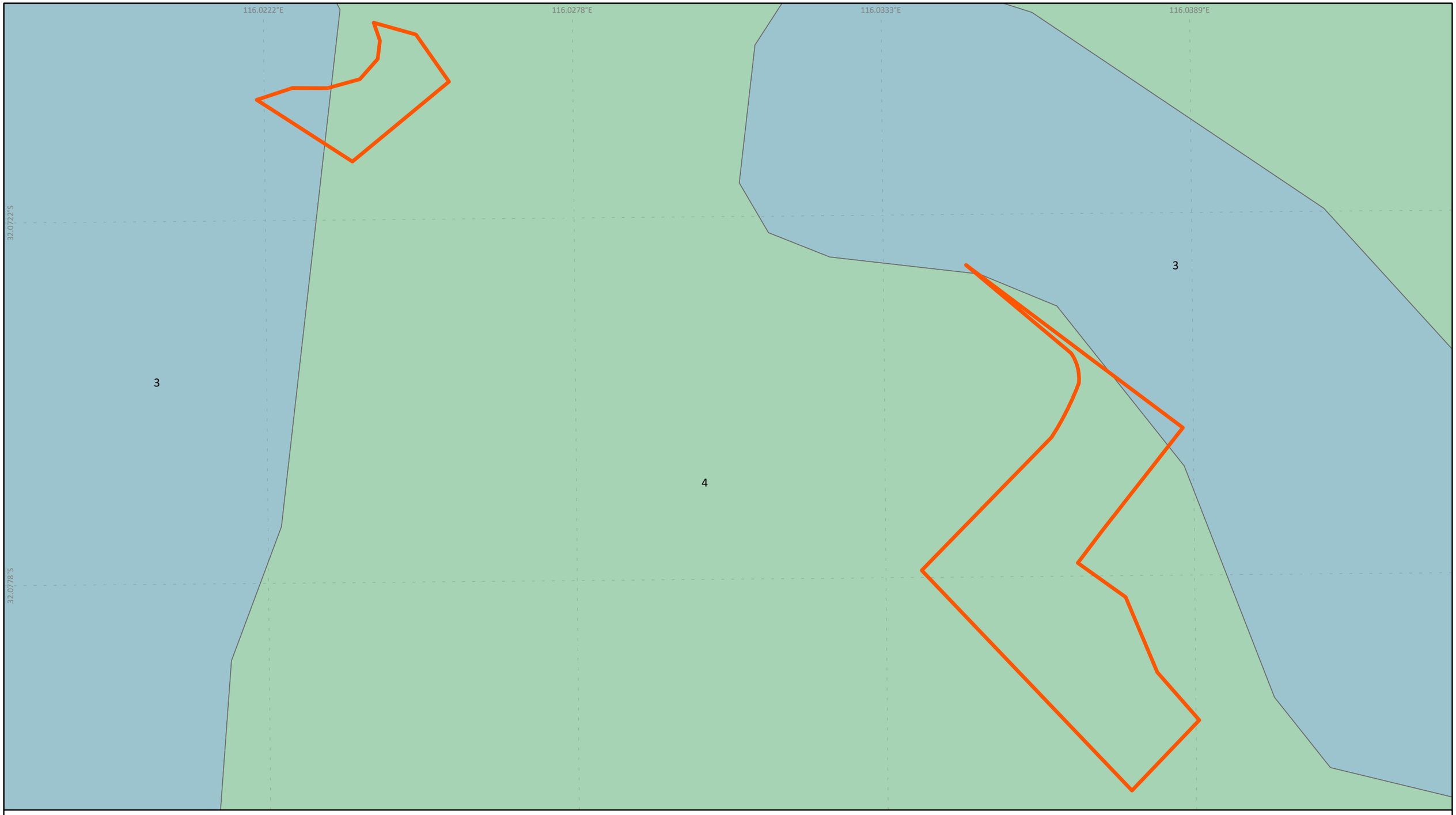
Community	Description	Likelihood of occurrence
Threatened		
Banksia attenuata and/or Eucalyptus marginata woodlands of the eastern side of the Swan Coastal Plain (floristic community type 20b as originally described in Gibson et al. 1994)	The community is found on a range of soil and landform units at the base of the Darling Scarp that are described in Churchward and McArthur (1978) *The landforms and soils of the Darling System* (Division of Land Resources Management, CSIRO, Perth, Western Australia). The community occurs largely on the Forrestfield unit (Ridge Hill Shelf), Guildford unit or at the confluence of Guildford with Forrestfield but also occurs on the Southern River unit. The community is generally very species rich. Most occurrences of this community type are *Eucalyptus marginata - Banksia attenuata* woodlands but *Banksia* woodlands and heaths are also found, with *Mesomelaena pseudostygia, Morelotia octandra, Banksia dallanneyi* (couch honeypot), *Desmocladus fasciculatus*, and *Chamaescilla corymbosa* (blue squill) being common in the understorey. The community is also known as 'floristic community type 20b' as orginally described in Gibson N., Keighery B.J., Keighery G.J., Burbuidge A.H. and Lyons M.N. (1994) *A floristic survey of the southern Swan Coastal Plain* (unpublished report for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and the Conversation Council of Western Australia (Inc.)).	Unlikely
Banksia attenuata woodlands over species rich dense shrublands (floristic community type 20a as originally described in Gibson et al. 1994)	The community has been recorded from sands near Koondoola and Banksia Grove, and at the base of the Darling Scarp between Wannamal and Maddington. This community is generally very species rich. It is usually dominated by *Banksia attenuata* (slender banksia), occasionally with *Eucalyptus marginata* (jarrah) with *Bossiaea eriocarpa* (common brown pea), *Conostephium pendulum* (pearl flower), *Hibbertia huegelii*, *Hibbertia hypericoides* (yellow buttercups), *Petrophile linearis* (pixie mops), *Scaevola repens*, *Stirlingia latifolia* (blueboy), *Mesomelaena pseudostygia* and *Alexgeorgea nitens* being common in the understorey. The community is also known as 'floristic community type 20a' as originally described in Gibson N., Keighery B.J., Keighery G.J., Burbidge A.H. and Lyons M.N. (1994) A floristic survey of the southern Swan Coastal Plain (unpublished report for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.)).	Unlikely

Community	Description	Likelihood of occurrence
Banksia Woodlands of the Swan Coastal Plain ecological community	Canopy is most commonly dominated or co-dominated by *Banksia attenuata* and/or *B. menziesii*. Other Banksia species that can dominate in the community are *B. prionotes* or *B. ilicifolia*. It typically occurs on well drained, low nutrient soils on sandplain landforms, particularly deep Bassendean and Spearwood sands and occasionally on Quindalup sands; it is also common on sandy colluvium and aeolian sands of the Ridge Hill Shelf, Whicher Scarp and Dandaragan Plateau and, in other less common scenarios. The description, area and condition thresholds that apply to the EPBC-listed TEC of the same name, also apply to this Priority ecological community.	Unlikely
Corymbia calophylla — Eucalyptus marginata woodlands on sandy clay soils of the southern Swan Coastal Plain (floristic community type 3b as originally described in Gibson et al. 1994)	The community is known from the eastern side of the Swan Coastal Plain largely between Wannamal and Dunsborough. Most occurrences of the community are dominated by both *Corymbia calophylla* (marri) and *Eucalyptus marginata* (jarrah) with additional common taxa comprising low shrubs, sedges, grasses and herbs. These include *Bossiaea eriocarpa* (common brown pea), *Conostylis juncea*, *Hibbertia hypericoides* (yellow buttercups), *Morelotia octandra*, *Chamaescilla corymbosa* (blue squill), *Desmocladus fasciculatus*, *Banksia dallanneyi* (couch honeypot), *Mesomelaena tetragona* (semaphore sedge), *Babingtonia camphorosmae* (camphor myrtle), *Lepidosperma squamatum*, *Neurachne alopecuroidea* (foxtail mulga grass), *Philotheca spicata* (pepper and salt), *Burchardia congesta* (milkmaids), *Caesia micrantha* (pale grass-lily), *Kingia australis* (kingia), *Drosera erythrorhiza* (red ink sundew), *Lomandra hermaphrodita* and *Caladenia flava* (cowslip orchid). The community is also known as 'floristic community type 3b' as originally described in Gibson N., Keighery B.J., Keighery G.J., Burbidge A.H. and Lyons M.N. (1994) *A floristic survey of the southern Swan Coastal Plain* (unpublished report for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.)).	Unlikely
Corymbia calophylla – Kingia australis woodlands on heavy soils (floristic community type 3a as originally described in Gibson et al. 1994)	The community has been recorded from heavy soils of the eastern side of the southern Swan Coastal Plain largely between Capel and Chittering. Typical native taxa in the community are the tree *Corymbia calophylla* (marri), the shrubs *Banksia dallanneyi* (couch honeypot), *Philotheca spicata* (pepper and salt), *Kingia australis* (kingia) and *Xanthorrhoea preissii* (balga), and the herbs, rushes and sedges *Cyathochaeta avenacea*, *Dampiera linearis* (common dampiera), *Haemodorum laxum*, *Desmocladus fasciculatus*, *Mesomelaena tetragona* (semaphore sedge) and *Morelotia octandra*. The community is also known as 'floristic community type 3a' as originally described in Gibson N., Keighery B.J., Keighery G.J., Burbidge A.H. and Lyons M.N. (1994) *A floristic survey of the southern Swan Coastal Plain* (unpublished report for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.)).	Unlikely
Corymbia calophylla — Xanthorrhoea preissii woodlands and shrublands, Swan Coastal Plain (floristic	The community occurs on heavy soils of the eastern side of the southern Swan Coastal Plain, generally between Bullsbrook and Stratham. The community is usually dominated by *Corymbia calophylla* (marri) and *Xanthorrhoea preissii* (balga). It also occasionally includes *Eucalyptus wandoo* (wandoo). The more common shrubs include *Gompholobium marginatum*, *Hypocalymma angustifolium* (white myrtle) and *Banksia dallanneyi*	Unlikely

Community	Description	Likelihood of occurrence
community type 3c as originally described in Gibson et al. 1994)	(couch honeypot), with herbs, grasses and sedges including *Burchardia congesta* (milkmaids), *Cyathochaeta avenacea*, *Neurachne alopecuroidea* (foxtail mulga grass), *Caesia micrantha* (pale grass-lily), *Mesomelaena tetragona* (semaphore sedge), *Morelotia octandra*, *Desmocladus flexuosus, Opercularia vaginata* (dog weed), *Sowerbaea laxiflora* (purple tassels), *Lepidosperma* spp. and *Drosera menziesii* (pink rainbow) also common. The community is also known as 'floristic community type 3c' as originally described in Gibson N., Keighery B.J., Keighery G.J., Burbidge A.H. and Lyons M.N. (1994) *A floristic survey of the southern Swan Coastal Plain* (unpublished report for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.)).	
Herb rich saline shrublands in clay pans (floristic community type 7 as originally described in Gibson et al. 1994)	The community is generally dominated by *Melaleuca viminea* (mohan), *Melaleuca osullivanii*, *Melaleuca cuticularis* (saltwater paperbark) or *Casuarina obesa* (swamp sheoak) or a mixture of these species. It has been recorded between Mogumber and Ambergate on heavy clay soils that are generally inundated from winter to mid-summer. The species *Melaleuca cuticularis* and *Casuarina obesa* may indicate some saline influence for at least part of the year. Herbs such as *Brachyscome bellidioides*, *Centrolepis polygyna* (wiry centrolepis), *Pogonolepis stricta* (stiff angianthus) and *Cotula coronopifolia* (waterbuttons; note: listed as alien in Florabase) are typical of this community. In addition, species such as *Angianthus drummondii* (priority 3), *Eryngium pinnatifidum* subsp. Palustre (priority 3) and *Blennospora drummondii* occur in the community at low frequency. A suite of annual flora is seen in the community as the season progresses. In early spring many of the occurrences of the community are covered by free water up to 30cm deep. *Cotula coronopifolia* sometimes forms yellow floating mats in some pools while others may be dominated by *Ornduffia submersa* (priority 4). Aquatic species are common in the community early in the growing season. As the wetland dries a succession of species such as *Centrolepis* spp. and annual *Stylidium* spp. successively germinate, grow and flower, resulting in an extended flowering period of over three months. The community is also known as 'floristic community type 7' as originally described in Gibson N., Keighery B.J., Keighery G.J., Burbidge A.H. and Lyons M.N. (1994) *A floristic survey of the southern Swan Coastal Plain* (unpublished report for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.)).	Unlikely
Herb rich shrublands in clay pans (floristic community type 8 as originally described in Gibson et al. 1994)	The community has been recorded between Bullsbrook and Ludlow and occurs in low-lying flats with a clay impeding layer that facilitates seasonal inundation. The vegetation can be dominated by *Viminaria juncea* (swishbush), *Melaleuca viminea* (mohan), *Melaleuca lateritia* (robin redbreast bush) or *Melaleuca osullivanii* (broombush) but also occasionally by *Eucalyptus wandoo* (wandoo). Commonly occurring flora include *Hypocalymma angustifolium* (white myrtle), *Acacia lasiocarpa* var. *bracteolata* (long peduncle form) and *Verticordia huegelii* (variegated featherflower), and aquatic annuals. The community is also known as 'floristic community type 8' as originally described in Gibson N., Keighery B.J., Keighery G.J., Burbidge A.H. and Lyons M.N. (1994) *A floristic survey of the southern Swan Coastal Plain* (unpublished report for the Australian Heritage	Unlikely

Community	Description	Likelihood of occurrence
	Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.)).	
Low lying Banksia attenuata woodlands or shrublands	(a component of the Endangered Banksia Woodlands of the Swan Coastal Plain EPBC listed TEC) This type occurs sporadically between Gingin and Bunbury, and is largely restricted to the Bassendean system. The type tends to occupy lower lying wetter sites and is variously dominated by *Melaleuca preissiana, Banksia attenuata, B. menziesii, Regelia ciliata, Eucalyptus marginata* or *Corymbia calophylla*. Structurally, this community type may be either a woodland or occasionally shrubland.	Unlikely
Seasonal rainfall filled wetlands with impeding substrate of the Swan Coastal Plain and Jarrah Forest in transitional rainfall zones	(previously 'Claypans of the Swan Coastal Plain'; synonymous with sub-types of the Claypans of the Swan Coastal Plain EPBC-listed TEC) This listing encompasses Claypan Group 1, 2 and 3 (as defined by Gibson *et. al.* 2005: Threatened plant communities of Western Australia. 2 The seasonal clay-based wetland communities of the South West. Pacific Conservation Biology 11:287-301) that are included under the EPBC-listed TEC and are not listed as a TEC at the state level (i.e., while floristic communit types 7, 8, 9, and 10a (as defined by Gibson *et. al.* 1994; A floristic survey of the southern Swan Coastal Plain) are also part of the synonymous EPBC-listed claypan TEC, those claypans have existing state TEC status: Group 1: Claypans of the Swan Coastal Plain and plateau with a damp terrestrial phase of the pool cycle. Common overstorey taxa include Casuarina obesa, Melaleuca viminea and Melaleuca cuticularis. Taxa of this group often reflect a higher salinity of the claypan substrate. Group 2: Seasonally inundated flats largely confined to the Swan Coastal Plain in high rainfall areas. Generally characterised by Hypocalymma angustifolium, Kunzea micrantha, Kunzea recurva and Viminaria juncea. Group 3: Predominantly claypans of deeper basins of the Swan Coastal Plain and Jarrah Forest Bioregion (plateau). Generally dominated by Melaleuca lateritia and characterised by aquatic and amphibious taxa (eg: Hydrocotyle lemnoides P4, Glossostigma diandrum, Liparophyllum capitatum, and Eleocharis keigheryi VU).	Unlikely
Shrublands and woodlands of the eastern side of the Swan Coastal Plain (floristic community type 20c as originally described in in Gibson et al. 1994)	The community occurs mainly on the transitional soils of the Ridge Hill Shelf, on the Swan Coastal Plain adjacent to the Darling Scarp but also extends marginally onto the alluvial clays deposited on the eastern fringe of the Swan Coastal Plain. It has been recorded between Stratton and Maddington. It generally comprises a shrubland or woodland of *Banksia attenuata* (slender banksia) and *Banksia menziesii* (firewood banksia), sometimes with *Allocasuarina fraseriana* (western sheoak), over a shrub layer that can include the species *Adenanthos cygnorum* (woolybush), *Hibbertia huegelii*, *Scaevola repens* var. *repens* (fan flower), *Allocasuarina humilis* (dwarf sheoak), *Bossiaea eriocarpa* (common brown pea), *Hibbertia hypericoides* (yellow buttercups) and *Stirlingia latifolia* (blueboy). A suite of herbs including *Conostylis aurea* (golden conostylis), *Trachymene pilosa* (native parsnip), *Lomandra hermaphrodita, Burchardia congesta* (milkmaids) and *Patersonia occidentalis* (purple flag), and the sedges *Mesomelaena pseudostygia* (semaphore sedge) and *Lyginia barbata* usually occur in the community. The community is also known as 'floristic community type 20c' as originally described in	Unlikely

Community	Description	Likelihood of occurrence
	Gibson N., Keighery B.J., Keighery G.J., Burbidge A.H. and Lyons M.N. (1994) *A floristic survey of the southern Swan Coastal Plain* (unpublished report for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.)).	
Shrublands and woodlands on Muchea Limestone of the Swan Coastal Plain	The community occurs on the heavy soils of the eastern side of the Swan Coastal Plain and has been recorded between Beermullah and Wokalup. Known patches include wetland and well-drained habitats, in a variety of landforms. It is defined on the basis of substrates with a limestone influence. Many of the species are commonly associated with the limestone soils that occur on the coast, and do not generally occur further inland. Typical and common native species in areas of best developed limestone are: the tree *Casuarina obesa* (swamp sheoak); the mallees *Eucalyptus decipiens* (redheart) and *Eucalyptus foecunda* (narrow-leaved red mallee); the shrubs *Melaleuca huegelii* (chenille honey-myrtle), *Alyogyne huegelii* (lilac hibiscus), *Grevillea curviloba* (endangered), *Grevillea evanescens* (priority 1) and *Melaleuca systena* (coastal honeymyrtle); and the herb *Thysanotus arenarius* (sand-dune fringed lily). Where the limestone substrate is less well developed and limestone may occur as nodules or chunks, the flora assemblages can be influenced by other characteristics of the substrate, such as clay content, with the presence of calcicoles such as *Thysanotus arenarius, Gahnia trifida* (coast saw-sedge), *Eremophila glabra* (tar bush) and *Melaleuca brevifolia* (mallee honey-myrtle) providing evidence of the limestone influence. *Melaleuca huegelii* shrublands, *Eucalyptus decipiens* mallee, *Casuarina obesa* woodlands and *Melaleuca brevifolia*, *Melaleuca systena* or *Melaleuca viminea* shrublands have been recorded on Muchea Limestone.	Unlikely
Shrublands on dry clay flats (floristic community type 10a as originally described in Gibson et al. 1994)	The community occurs on clay flats with thin skeletal soils and has been recorded largely between Wattle Grove and Sabina River. It comprises rapidly drying clay flats. Typical and common shrubs include *Hakea sulcata* (furrowed hakea), *Verticordia densiflora* (compacted featherflower), *Hakea varia* (variable-leaved hakea), *Pericalymma ellipticum* (swamp teatree) and *Viminaria juncea* (swishbush). *Aphelia cyperoides* (hairy aphelia), *Centrolepis aristata* (pointed centrolepis), *Drosera gigantea* (giant sundew) and *Drosera menziesii* (pink rainbow) also commonly occur. The community is also known as 'floristic community type 10a' as originally described in Gibson N., Keighery B.J., Keighery G.J., Burbidge A.H. and Lyons M.N. (1994) *A floristic survey of the southern Swan Coastal Plain* (unpublished report for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.)).	Unlikely
Priority 4		
Central Northern Darling Scarp Granite Shrubland Community	Shrublands and heath on deeper loams and red earths on fragmented granite/quartzite. Heath species typically consist of the taller shrubs *Xanthorrhoea acanthostachya* and *Allocasuarina humilis* over smaller proteaceous and myrtaceous shrubs, namely *Melaleuca* aff. *scabra, Baeckea camphorosmae* and to a lesser extent, the proteaceous shrubs *Dryandra armata*, *Hakea incrassata* and *Hakea undulata*. Located in central region of the Northern Darling Scarp near Perth.	Likely



Survey area

Pre-European vegetation association

3,Medium forest; jarrah-marri

4,Medium woodland; marri & wandoo

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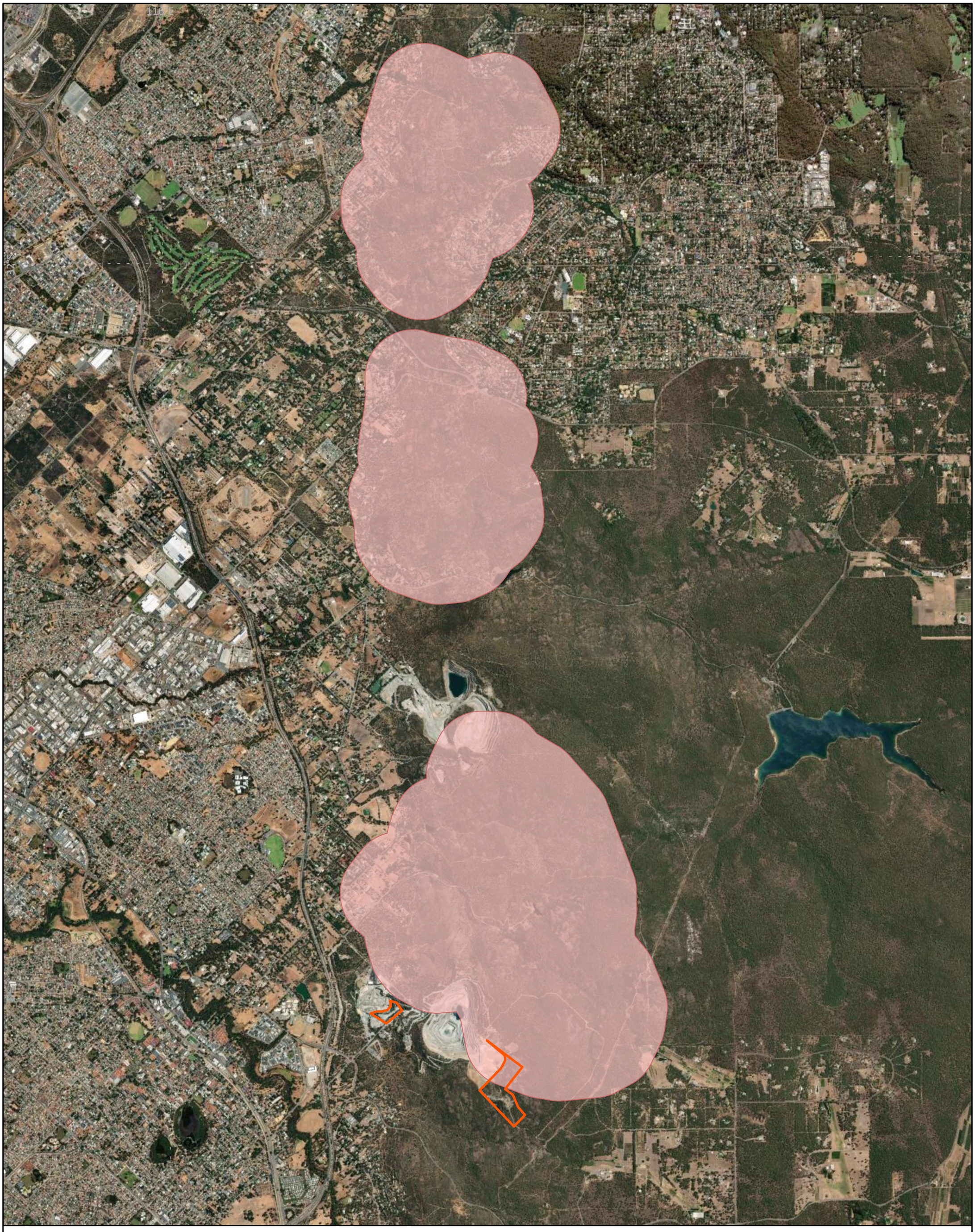
Project No.: 2015
Author: SN-W
Created Date: 12 February 2025
Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Scale: 1:6,000 @A3

Map 7: Pre-European vegetation associations (Shepherd et al., 2002).

Maxar

0 50 100 200 300 400 500

Meters



Survey area

Priority ecological community

Central Northern Darling Scarp Granite Shrubland Community

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Project No.: 2015
Author: SN-W
Created Date: 22 January 2025
Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Scale: 1:35,000 @A3

Map 8: Significant ecological communities within 10 km of the survey area (22-0125EC).

0 0.5 1 2
Kilometers

Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community, Esri, USGS, Maxar

2.8 BLACK COCKATOO HABITAT

The Department of Agriculture, Water and the Environment referral guidelines for three Threatened black cockatoo species (DAWE, 2022) provide the modelled distributions for Carnaby's black cockatoo, Baudin's black cockatoo and forest red-tailed black cockatoo in the southwest of Western Australia. The survey area (collectively both areas assessed during the field survey) occurs within the distribution of all three Threatened black cockatoo species.

2.8.1 Species habitat profiles

Carnaby's black cockatoo

Conservation status: EPBC & BC Act Endangered.

Distribution and habitat: The Carnaby's black-cockatoo, also known as the short-billed black-cockatoo, is a large, black cockatoo with white tail panels, white cheek patches and a short bill (Threatened Species Network). It is endemic to the south-west of Western Australia, ranging from the lower Murchison River in the north, throughout the south west corner, and east to Cape Arid (Ron E. Johnstone & Storr, 1998).

Ecology: They are usually seen in pairs, triples or small flocks. In the non-breeding season, they occur in large flocks of up to 10,000 birds that wander in search of food, particularly in banksia woodland and pine plantations on the northern Swan Coastal Plain (R. E. Johnstone, Johnstone, & Kirkby, 2007). The cockatoos breed mainly in the Wheatbelt, in large hollows usually high in eucalypt, Karri or Marri trees, and then move west following breeding to feed in coastal and near-coastal areas from late December to July (Morcombe, 2010; Shah, 2006). They forage mainly in shrubland or kwongan heath, eucalypt woodland and pine plantations, feeding on the seeds, nuts and flowers of a large variety of proteaceous species such as *Banksia*, *Dryandra*, *Grevillea* and *Hakea*, as well as *Eucalyptus*, *Pinus* and *Allocasuarina* (Ron E. Johnstone & Storr, 1998; Shah, 2006).

The life history of this cockatoo makes it extremely vulnerable to threats resulting from human activities and introduced competitors because pairs bond for life, require large tree hollows for breeding and only produce one chick per year (Shah, 2006). The number of Carnaby's black-cockatoos left in the wild is estimated at 8,000-10,000 individuals (Burnham, Barrett, Blythman, & Scott, 2010), with an estimated total population decline of over 50% in the past 45 years (Shah, 2006).

Factors contributing to their decline include:

- habitat fragmentation and clearing of semi-arid sandplains, particularly in the northern and eastern areas of the Wheatbelt. Most habitats suitable for breeding and feeding in the Wheatbelt have been cleared entirely.
- Clearing of heathland surrounding breeding sites has reduced the survival rate of fledglings by decreasing the available food sources for the young (DPaW, 2013a; D.A. Saunders, 1986).
- Poaching of eggs and young by collectors and animal dealers; breeding hollows become unsuitable for future breeding attempts through damage of hollows and trees when young and eggs are taken (DPaW, 2013a).
- The introduction and spread of invasive species such as the Galah (*Eolophus roseicapillus*) on the Swan Coastal Plain, corellas (*Cacatua sanguinea* and *C. tenuirostris*), and feral bee (*Apis mellifera*). These species compete with and exclude Carnaby's black-cockatoos from traditional nest hollows (D.A. Saunders, 1979; Shah, 2006).

Baudin's black cockatoo

Conservation status: EPBC & BC Act Endangered.

Distribution and habitat: Baudin's black-cockatoo is also known as the long-billed black-cockatoo (Higgins, 1999). It is a large, black cockatoo with white tail panels, white ear patches and a bill with a

long, fine tip to the upper mandible In appearance it is very similar to Carnaby's black-cockatoo, and was only recognised as separate species in 1974 (D.A. Saunders, 1974). The species is endemic to the south-west of Western Australia, where it is found in or near forested areas. Being a forest specialist, its range follows the distribution of its main food species, the Marri tree (*Corymbia calophylla*), a eucalypt native to the jarrah and karri forest.

Ecology: After breeding, birds congregate in large flocks that move north-east, searching for food (Ron E. Johnstone & Storr, 1998; D.A. Saunders, 1974). During this time, foraging flocks may enter commercial orchards where they feed on the seeds and juice of apples and pears (Chapman, 2007; Chapman & Massam, 2005; D.A. Saunders, 1974; D. A. Saunders, Rowley, & Smith, 1985). Because of this habit, many birds are shot illegally by orchardists, and this process is considered the principal threat to the species (Higgins, 1999; McKenzie, May, & McKenna, 2003; D.A. Saunders, 1974). On average, breeding pairs only produce one chick every 2 years; hence, it is unlikely that enough chicks are produced each year to offset the high adult mortality from shooting (Chapman, 2007; Ron E. Johnstone & Storr, 1998).

Threats: Destruction of habitat due to logging and clearing for agriculture has reduced this species' range by 25% while it has reduced in density over a further 25% (Garnett, Szabo, & Dutson, 2011). Baudin's black-cockatoo only breeds in densely forested areas in the Southern Jarrah Forest bioregion (JF2) (Higgins, 1999; McKenzie et al., 2003; D.A. Saunders, 1974), with the northern-most breeding events recorded near Serpentine, 40 km south of Perth (Ron E. Johnstone & Kirkby, 2008).

Forest red-tailed black cockatoo

Conservation status: EPBC & BC Act Vulnerable.

Distribution and habitat: The forest red-tailed black-cockatoo once occurred between Albany, Augusta and Perth, and north along the Swan Coastal Plain to Dandaragan (Ron E. Johnstone, 1997), but has declined by 25–30% in range and a further 14% in density as a result of clearing of the margins of the forests for agriculture in the early 1900s (Garnett et al., 2011; Mawson & Johnstone, 1997). The population was projected to decline by a further 30% or more between 2005 and 2015 (Department of Conservation and Land Management, 2006).

The forest red-tailed black-cockatoo inhabits the dense Jarrah (*Eucalyptus marginata)*, Karri (*E. diversicolor)* and Marri (*Corymbia calophylla)* forests receiving more than 600 mm average rainfall annually (D.A. Saunders & Ingram, 1995; D. A. Saunders et al., 1985). Although most records are in Jarrah-Marri forests, the forest red-tailed black-cockatoo has been observed in a range of other forest and woodland types, including blackbutt (*E. patens*), wandoo (*E. wandoo*), Tuart (*E. gomphocephala*), Albany Blackbutt, Yate (*E. cornuta*), and Flooded Gum (*E. rudis*) (Abbott, 1998).

Habitats in which the forest red-tailed black-cockatoo occurs often have an understorey of banksia (*Banksia* spp.), Snottygobble (*Persoonia longifolia)* and Sheoak (*Allocasuarina fraseriana)*, with scattered blackbutt and Wandoo (Ron E. Johnstone & Kirkby, 1999).

The forest red-tailed black-cockatoo occurs within the same habitat as Baudin's black-cockatoo (*Calyptorhynchus baudinii*), and as with Baudin's black-cockatoo, it nests in large hollows of Marri, Jarrah and Karri (Ron E. Johnstone & Kirkby, 1999). The subspecies has also been sighted nesting in wandoo and Bullich (*E. megacarpa*).

Ecology: The life span of forest red-tailed black-cockatoos is predicted to be 25-50 years. The cockatoos are thought to begin breeding when they are 4-6 years old, fledging only one chick (Ron E. Johnstone & Storr, 1998). It is probable that less than 10% of the population of Forest Red-tailed Black-Cockatoos are be capable of breeding in any one year and birds may only breed every 2-3 years, with low breeding success (Ron E. Johnstone & Kirkby, 2006).

Like all black cockatoos, the forest red-tailed black-cockatoo is monogamous and pairs probably from a lifetime bond (Higgins, 1999; Smith & Saunders, 1986). The breeding period spans from September to

April, with eggs typically laid in October/November (Ron E. Johnstone, 1997; Ron E. Johnstone & Storr, 1998), or March/April in years with good autumn rains. Nests are made in large tree hollows in Marri, Jarrah, wandoo and Bullich trees that are at least 500–600 mm in diameter at breast height and may be more than 130 years old (Ron E. Johnstone & Storr, 1998; Whitford, 2002; Whitford & Williams, 2002). Trees of less than 500 mm in diameter are considered to have the potential to develop hollows and are also important breeding resources for the species.

Around 90% of the subspecies' diet is made up of the seeds from Marri and Jarrah fruits (Ron E. Johnstone & Kirkby, 1999). Other species used for feeding include blackbutt, Forest Sheoak, Snottygobble and the non-indigenous native Spotted Gum (*E. maculata*) and Cape Lilac (Ron E. Johnstone & Kirkby, 1999; Ron E. Johnstone & Storr, 1998). Due to the slow and patchy flowering and seeding of Marri trees, Forest red-tailed Black-Cockatoo highlights the need for foraging habitat to consist of a mosaic of tree species and age classes.

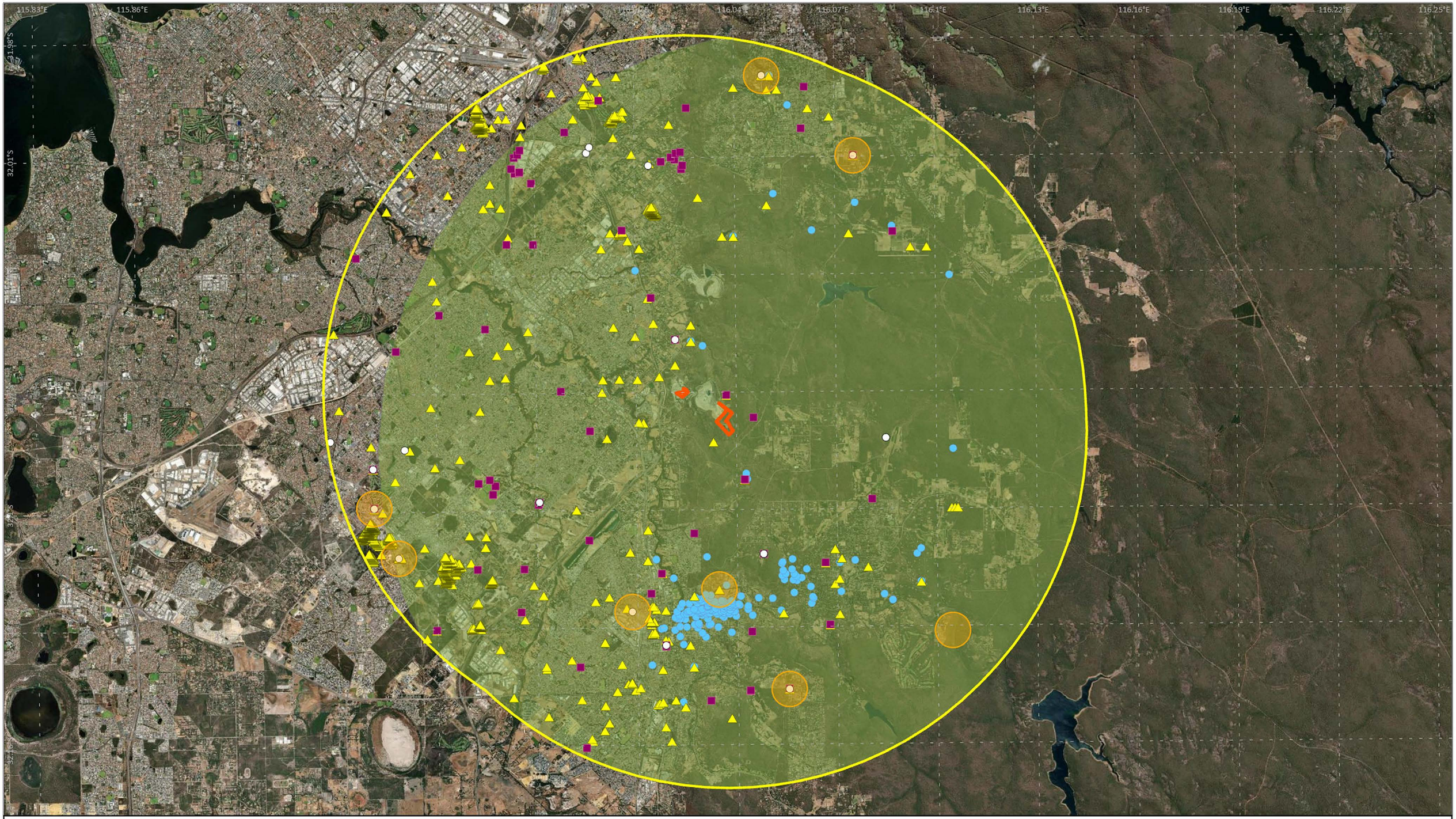
Flocks of up to 50 individuals (Abbott, 1998) spend the night roosting in trees and leave at sunrise, splitting into smaller family groups, of around 10 birds, and moving into adjacent forest. After a short period of preening and basking in the sunlight they feed for 10–12 hours before moving off to creeks or dams to drink. On dark, they return to their roosts (Ron E. Johnstone & Kirkby, 1999).

Threats: Key threats to the forest red-tailed black-cockatoo are habitat loss, nest hollow shortage and competition for available nest hollows from other species, and injury or death from the European Honeybee (*Apis mellifera*), illegal shooting and fire (Department of Conservation and Land Management, 2006). Climate change is an additional threat that is likely to exacerbate other threats as a result of changes to biodiversity and ecosystem function (Chambers, Hughes, & Weston, 2005).

2.8.2 Black cockatoo desktop results

The DBCA Threatened and Priority fauna database search identified 191 records of Baudin's black cockatoo, 1645 records of Carnaby's black cockatoo and 84 records of forest red-tailed black cockatoo, within 10 km of the survey area. A further 126 records were identified as white-tailed black cockatoo as the individual observed could not be identified as either Baudin's or Carnaby's (Map 9).

Additionally, DBCA black cockatoo databases were queried for breeding and roosting records within 10 km of the survey area. No forest-red tailed black cockatoo breeding or roosting records were identified. Eight Carnaby's black cockatoo roosts were identified within 10 km of the survey area, and the survey area occurs within 12 km of a Carnaby's black cockatoo breeding site (Map 9).



Survey area

Study area (10 km buffer)

DBCA black cockatoo records

- Baudin's cockatoo
- Carnaby's cockatoo
- Forest red-tailed black cockatoo
- White-tailed black cockatoo (Baudin's or Carnaby's)

Carnaby confirmed roosts (500 m buffer)

Carnaby's cockatoo breeding area (12 km buffer)

ecologia ENVIRONMENT

Project No.: 2015
Author: DS
Created Date: 12 February 2025
Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Scale: 1:100,000 @A3

Map 9: Black cockatoo records, roosts and breeding areas.

Earthstar Geographics

0 1 2 3 6 Kilometers

N

3 METHODOLOGY

3.1 FLORA AND VEGETATION ASSESSMENT

3.1.1 Field Survey

The detailed flora and vegetation assessment was conducted by two *ecologia* botanists over two days, on the 18th and 25th September 2024. The survey was conducted in accordance with the *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA, 2016b), primarily by sampling vascular plant species within quadrats. The Galleries upgrade area was not surveyed due to site access issues and in this case photographs were taken at four different points of the survey area.

3.1.2 Quadrat Sampling

Sampling site locations were selected using a combination of aerial photography, topographic features, land system mapping, pre-European vegetation mapping, and field observations, to represent the geomorphological and floristic variation found within the survey area. Where possible, at least three sites were selected to represent each potentially distinct plant community in accordance with EPA (2016b). However, as vegetation types are classified according to total floristic composition and cannot be determined until data analysis has been completed, final vegetation types may in some cases be represented by fewer than three sites. Sites were positioned to avoid obvious transition zones between plant communities and were preferentially placed in areas of intact mature vegetation and minimal disturbance.

Eleven quadrats were assessed within the survey area (Map 10). All quadrats were 10 m x 10 m in dimension or of an equivalent area, and in most cases had a north-south orientation. Quadrats were measured prior to assessment and the location of each corner was recorded.

The following attributes were recorded from each quadrat:

- Site code.
- GPS coordinate of all corners.
- Photograph from the north-west corner.
- A comprehensive species list (including introduced species) and the dominant height class (ESCAVI, 2017) and estimated percentage foliage cover (using a variant of the Domin scale) of each species (< 1%, 1-4%, 5-9%, 10-24%, 25-32%, 33-49%, 50-74%, 95-100%). If isolated tall shrub and tree species are present in the surrounding landscape and do not occur within a quadrat, then these species may be recorded as associated if they are considered important for characterising the community.
- Vegetation condition (Table 8) and description of disturbance.
- Additional information to assist vegetation characterisation, including landform, slope, soil type, surface geology, and fire history.

3.1.3 Significant Species

Targeted searches for significant plant species identified from the desktop assessment were made along traverses and within quadrats in areas of potential suitable habitat, and within representative areas of each of the major landforms and plant communities present within the survey area. Where significant species were observed the following parameters were recorded: location (for individual or localised plants) or population boundary (for more extensive populations, time permitting); number of plants (count, for individual or localised plants) or estimated number of plants for more extensive populations; reproductive state; plant community; and landform.

The initial likelihood of occurrence assessment for each species was reviewed following the field survey based on the level of survey effort, seasonal conditions, vegetation condition, and the presence of suitable habitat. This reassessment is presented with the desktop results in Appendix B.

3.1.4 Specimen Identification

Specimen identification was undertaken with reference to current taxonomic literature and herbarium reference specimens. Scientific names used in this report follow the species concepts currently adopted by the Western Australian Herbarium. Specimens that could not be adequately identified to genus or species level due to the absence of reproductive material required for positive identification were indicated with a query but were not considered to be otherwise anomalous.

3.1.5 Asymptotic Species Richness and Rarefaction

Estimators of asymptotic species richness use abundance or incidence data to estimating the number of undetected species in an assemblage (Gotelli & Colwell, 2012). Using species data from 11 sampling sites, asymptotic species richness was estimated for the survey area using the non-parametric sample-based estimator Chao 2 in EstimateS v9.1 with the default settings (Colwell, 2013) and 9,999 randomisations. To provide some indication of survey completeness, a sample-based rarefaction curve, which displays the rate at which new species are found within a sample in relation to increasing sampling effort, was also calculated in EstimateS and plotted against the Chao 2 species richness estimator and its 95% confidence intervals. Rarefaction curves and estimates of species richness may provide some measure of survey completeness relating specifically to the proportion of species recorded, at least for the season in which the survey was conducted. Should the curve reach an asymptote, few additional species would be expected to have been recorded should additional samples have been taken in similar areas during the same season.

3.1.6 Vegetation Classification

Vegetation classification using multivariate clustering methods is preferred for detailed surveys as it is repeatable, can be more readily placed into a regional context, and is more objective than 'expert-based' structural classification. Hierarchical agglomerative clustering was used with similarity profile analysis (SIMPROF) as a hypothesis testing-based approach for assessing multivariate group structure and to inform the classification of groups of floristically similar sites into vegetation types. All analyses were conducted in R 4.1.2 (R Core Team, 2021).

Percentage cover scores recorded using the Domin scale were converted to percentage cover using the 'Domin 2.6' transformation (Currall, 1987). Singletons (taxa recorded at only one site) were excluded. The final data set included 11 sites and 105 taxa (Appendix E). Pair-wise site dissimilarity was calculated from square root transformed percentage cover data using Bray-Curtis dissimilarity and subsequent hierarchical agglomerative clustering used the unweighted pair-groups method using arithmetic averages (UPGMA). The site dissimilarity matrix and dendrogram were generated using the 'simprof' function of *clustsig* (Whitaker & Christman, 2014) and statistically different clusters of sites were determined with 999 permuted similarity profiles and $\alpha = 0.001$ as suggested by Clarke, Somerfield, and Gorley (2008).

Within a dendrogram, SIMPROF detects groups of homogenous objects (sampling sites) with respect to a set of descriptors (species) and provides a means of stopping unwarranted over-interpretation of group substructure. When no significant group structure is detected by the test there is no justification for further interpretation of substructure, and sites at this point may be considered essentially homogenous (i.e., vegetation types). Some groups identified by SIMPROF can be too fine to meaningfully interpret in an ecological context and in such cases it is appropriate to define coarser groupings as vegetation types provided they are supersets of the SIMPROF groups (Clarke et al., 2008).

Non-metric multidimensional scaling (NMDS) ordination was used as an independent clustering method to assess relationships among clusters and to visually validate the SIMPROF classification by assessing cluster compactness and dissimilarity from neighbouring clusters. It was not our aim to define only highly discrete and compact groups as vegetation types as doing so would likely obscure much of the community diversity present within the survey area. Rather, groups classified here as vegetation types should at least form reasonably distinct clusters with minimal overlap with

neighbouring clusters. NMDS using Bray-Curtis dissimilarity was conducted using the 'MetaMDS' function of *vegan* (Oksanen et al., 2017). A stress value for the ordination was calculated to determine if the 2-dimentional configuration of points is a good representation of the actual similarity between sites, where stress <0.2 is considered acceptable.

Indicator species for each vegetation type were determined with the IndVal statistic (M De Cáceres & Legendre, 2009) using the 'multipatt' function of *indicspecies* (M. De Cáceres, Jansen, & Dell, 2017). Species with high indicator values (closer to 1.00) are those that occur in all (or most) sites within a group but also occur in no (or few) sites outside of that group and provide an additional means of cluster validation.

3.1.7 Vegetation Characterisation

The groups identified as vegetation types using the procedures described above were characterised by the constancy of shared species, shared dominant species, diagnostic (indicator) species, and other abiotic attributes (e.g., soil, landform).

Vegetation types were given descriptive names consistent with NVIS Level V – Association (ESCAVI, 2017), which include structural features and dominant or diagnostic species. Plant communities are naturally variable across wide geographic areas and vegetation types here are delineated based on the overall floristic similarity of sites. Species included in descriptive names are therefore those that are most characteristic of the vegetation type but were not necessarily present at all sites. Species that are dominant in some examples of a community but present in ≤50% of sites representing that community are indicated with '±' in the description.

3.1.8 Vegetation Mapping

Preliminary vegetation mapping of survey area was undertaken prior to the survey and in the field using aerial imagery and data from ground-truthed sites. Vegetation types were then determined post-survey using the floristic classification methods described above and applied to these ground-truthed areas. Vegetation type boundaries were refined using aerial imagery in ESRI ArcGIS Pro. Extrapolative mapping was undertaken in areas that could not be ground-truthed and was based on observed similarities in spectral and structural features between ground-truthed sites and unvisited areas.

Vegetation condition mapping was undertaken in a similar manner, with reference to the condition recorded at sampled sites using the EPA scale (EPA, 2016b) (Table 8), opportunistic observations, and aerial imagery. In some cases, small changes in vegetation condition over large areas could not be perceived from aerial imagery or feasibly mapped in the field; in such cases a range of vegetation conditions was given.

Table 8: Vegetation condition scale (adapted from Trudgen 1988).

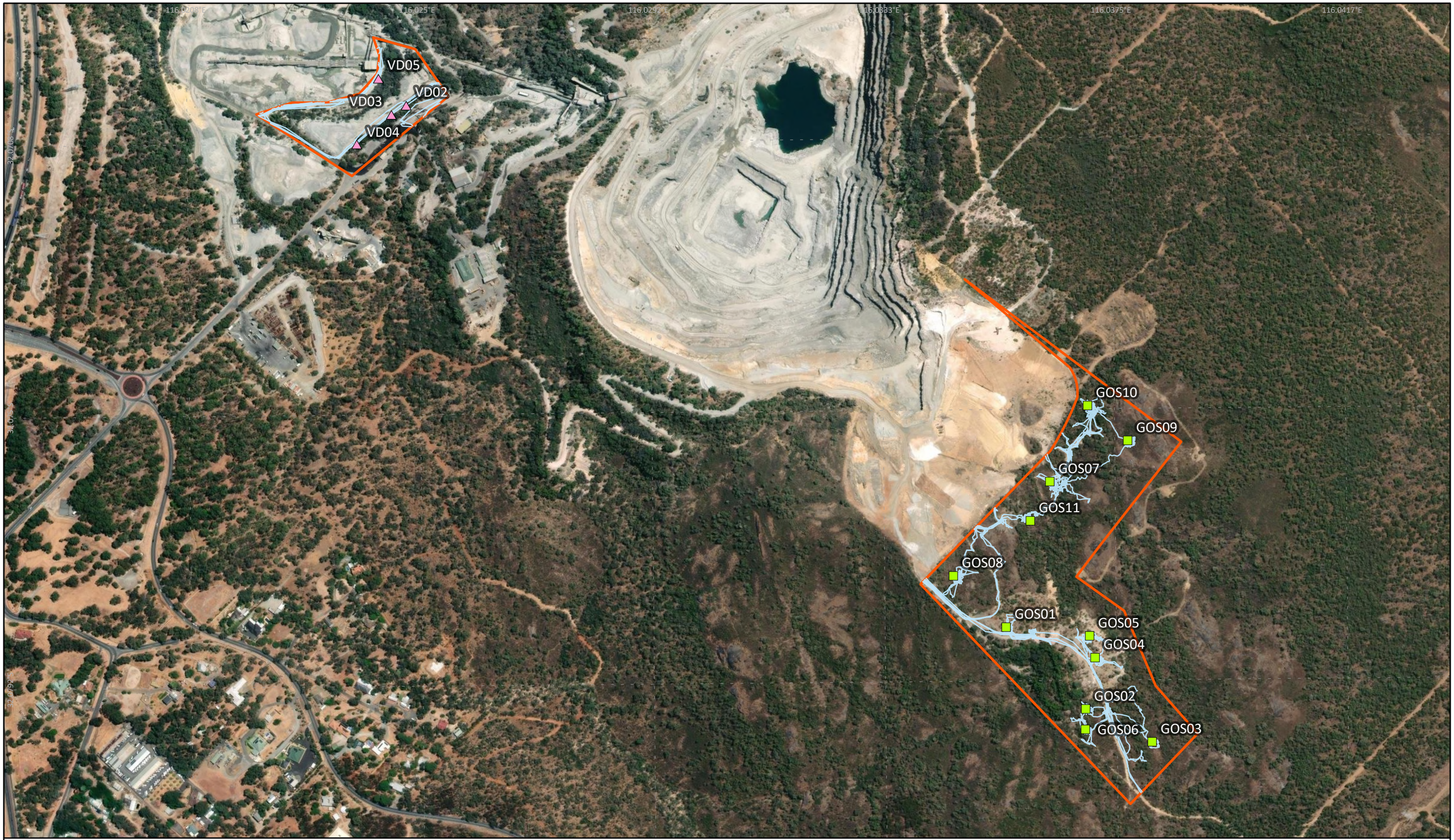
Vegetation condition	Criterion
Pristine	Pristine or nearly so, no obvious signs of disturbance or damage caused by human activities since European settlement.
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species. Damage to trees caused by fire, the presence of non-aggressive weeds and occasional vehicle tracks.
Very Good	Vegetation structure altered, obvious signs of disturbance. Disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds at high density, partial clearing, dieback and grazing.
Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees and shrubs.

3.1.9 Assessment of Potential Vegetation Significance

Vegetation types described for the survey area were assessed at National, state, regional, and local levels to assist the environmental impact assessment (EIA) process. There are 11 criteria against which vegetation is assessed, as summarised in Table 9.

Table 9: Criteria for assessment of potential vegetation significance.

Level	Criterion
National	1. Vegetation supporting populations of Threatened (EPBC listed) plant species. 2. Vegetation which corresponds to a nationally (EPBC) listed Threatened Ecological Community. 3. Vegetation which includes Ramsar wetlands and Nationally Important (DIWA) wetlands.
State	4. Vegetation supporting populations of Threatened (BC Act) plant species. 5. Vegetation which corresponds to a BC Act listed Threatened Ecological Community. 6. Vegetation corresponding to a state (DBCA) listed Priority Ecological Community. 7. Vegetation occurring within a state-managed conservation estate (areas protected under the *Conservation and Land Management Act 1984*) or areas that have been formally recommended by DBCA for inclusion in the state conservation estate.
Regional	8. Vegetation that is represented by less than 30% of its pre-European extent within the relevant bioregion. This criterion was assessed using the vegetation association mapping of Shepherd et al. (2002).
Local	9. Vegetation associated with significant watercourses or permanent or ephemeral wetlands. 10. Vegetation supporting potentially new plant species. 11. Vegetation represented by small, isolated communities or vegetation with a limited local extent.



Survey area

Traverses

Sampling sites

Quadrat

Vegetation description

ecologia ENVIRONMENT

Project No.: 2015
Author: SN-W
Created Date: 04 February 2025
Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Scale: 1:6,000 @A3

Maxar

Map 10: Locations of sampling sites and traverses within the survey area.

0 50 100 200 300 400 500

Meters

3.2 BLACK COCKATOO HABITAT ASSESSMENT

Three Threatened species of black cockatoo listed under both the EPBC Act and the BC Act occur within the south-west of Western Australia (Table 10). The Department of Agriculture, Water and the Environment (DAWE) *Referral Guideline for 3 WA Threatened Black Cockatoo Species* (DAWE, 2022) provide modelled distributions for the three species of black cockatoo, including breeding areas, with the survey area intersecting the modelled distribution of all three species.

Table 10: Status of black cockatoos occurring within the south-west.

Common name	Taxon	EPBC Act	BC Act
Forest red-tailed black cockatoo	*Calyptorhynchus banksii naso*	Vulnerable	Vulnerable
Baudin's cockatoo	*Zanda baudinii*	Endangered	Endangered
Carnaby's cockatoo	*Zanda latirostris*	Endangered	Endangered

The DAWE *Referral Guideline for 3 WA Threatened Black Cockatoo Species* (DAWE, 2022) recommend 'habitat assessments' as the primary method to inform decisions on the potential for significant impact for black cockatoos as short-term surveys for bird presence are unlikely to give a true representation of habitat use. Targeted black cockatoo habitat assessments should be undertaken in areas within the range focusing on key criteria such as foraging, roosting and breeding. Details on habitat types used by each black cockatoo species for breeding, foraging and night roosting are provided in Table 11. Known breeding and night roosting trees for black cockatoos are generally large with a diameter at breast height (DBH) of at least 500 mm, or 300 mm for salmon gum and wandoo (DAWE, 2022).

Table 11: Habitats used by black cockatoos (DAWE, 2022).

Habitat	Baudin's Cockatoo	Carnaby's Cockatoo	Forest Red-tailed Black Cockatoo
Breeding	Generally in woodland or forest, but may also breed in partially cleared woodland or forest, including isolated trees. Nest in hollows in live or dead trees (many eucalypt species may provide suitable hollows), particularly karri *(Eucalyptus diversicolor)*, karri, jarrah, wandoo, bullich *(E. megacarpa)* and tuart.	Generally in woodland or forest, but also breeds in partially cleared woodland or forest, including isolated trees. Nest in hollows in live or dead trees (many eucalypt species may provide suitable hollows), particularly salmon gum, wandoo, tuart, jarrah, flooded gum *(E. rudis)*, york gum, powderbark *(E. accedens)*, karri and marri.	Generally in woodland or forest, but may also breed in partially cleared woodland or forest, including isolated trees. Nest in hollows in live or dead trees (many eucalypt species may provide suitable hollows), particularly marri, karri, wandoo, bullich, blackbutt *(E. patens)*, tuart and jarrah.
Night roosting	Generally in or near riparian environments or other permanent water sources. Any tall trees may provide roosting habitat, but particularly jarrah, flooded gum, blackbutt, tuart and introduced eucalypts (blue gum *(E. globulus)*, lemon scented gum *(Corymbia citriodora)*.	Generally in or near riparian environments or natural and artificial permanent water sources. Any tall trees may provide roosting habitat, but particularly flat-topped yate *(E. occidentalis),* salmon gum, wandoo, marri, karri, blackbutt, tuart, introduced eucalypts and introduced pines.	Any tall trees may provide roosting habitat, but particularly tall jsarrah, marri, blackbutt, tuart and introduced eucalypt trees or large trees on the edges of forests.

Habitat	Baudin's Cockatoo	Carnaby's Cockatoo	Forest Red-tailed Black Cockatoo
Foraging and common food items	Primarily seeds of marri, rarely jarrah, in woodlands and forest, and seeds of native proteaceous plant species (for example, *Banksia* spp. (includes *Dryandra* spp.) and *Hakea* spp.). During the breeding season feed primarily on native vegetation, particularly marri (seeds, flowers, nectar and grubs). Also insects and insect larvae; pith of kangaroo paw (*Anigozanthos flavidus*); tips of *Pinus* spp.; *Macadamia* spp., almonds and pecans; seeds of apples and pears; and persimmons.	Native shrubland, kwongan heathland and woodland on seeds, flowers and nectar of native proteaceous plant species (*Banksia* spp., *Hakea* spp. and *Grevillea* spp.), as well as *Callistemon* spp. and marri. Also seeds of introduced species including *Pinus* spp., *Erodium* spp., wild radish, canola, almonds, macadamia and pecan nuts; insects and insect larvae; occasionally apples and persimmons; and liquidambar.	Primarily seeds of jarrah and marri in woodlands and forest, and edges of karri forests, including wandoo and blackbutt. Forages on *Allocasuarina* cones, fruits of Snottygobble (*Persoonia longifolia*) and mountain marri (*C. haematoxylon*). Other less important foods include blackbutt, Bullich, *Allocasuarina fraseriana*, *Hakea* spp., tuart, redheart moit (*E. decipiens*) and bushy yate (*E. lehmanni*). Also some introduced eucalypts such as river red gum (*E. camaldulensis*) and rose gum (*E. grandis*). On the Swan Coastal Plain, often feeds on introduced cape lilac (*Melia azedarach*), *E. caesia, E. erythrocorys, l*emon-scented gum and kaffir plum (*Harpephyllum caffrum*).

3.2.1 Breeding Habitat

DAWE *Referral Guideline for 3 WA Threatened Black Cockatoo Species* (DAWE, 2022) define breeding habitat as habitat that contains known, suitable or potential nesting trees, including:

- Known nesting trees: Trees (live or dead, but still standing) which contain a hollow/s where black cockatoo breeding has been recorded or which demonstrate evidence of breeding (i.e. showing evidence of use through scratches, chew marks or feathers).
- Suitable nesting trees: Trees with suitable nesting hollows present, although no evidence of use.
- Potential nesting trees: Trees that have a suitable DBH to develop a nest hollow, but do not currently have hollows. Trees suitable to develop a nest hollow in the future are 300-500mm DBH.

The DAWE referral guidelines define suitable nesting hollows as any hollow with dimensions suitable for use for nesting by black cockatoos (DAWE, 2022). Trees which contain deep, near vertical hollows with an entrance diameter of >100 mm and are >10 m high are classified as suitable for use by black cockatoos (Whitford, 2002; Whitford & Williams, 2002).

Suitability of each breeding habitat tree identified was assessed from ground level and breeding habitat trees were categorised using the definitions within Table 12. For trees with a suitable DBH which are functionally capable of supporting a nest hollow, the following information was recorded:

- Fauna habitat.
- Fauna species.
- Flora species.
- DBH.
- Hollow suitability category (as per Table 12).
- Location (using a Global Positioning System [GPS]).
- Photographs of any trees classified as category 1, 2 or 3.

Trees with DBH > 500 mm (>300 mm for wandoo and salmon gum) which were deemed functionally unable to support a nest hollow (e.g. trees that branch into multiple thin trunks with DBH <500 mm

within a metre of breast height or trees with completely hollowed out trunks), were excluded at the discretion of the recorder.

Table 12: Breeding habitat tree categories.

Tree Category	Description
Known nesting tree	**Tree with suitable DBH which contains hollows where breeding has been recorded or evidence of breeding (scratches, chew marks or feathers)**
Suitable nesting tree (confirmed)	**Trees with suitable DBH which contains suitable nesting hollows, although no evidence of use (confirmed). Internal characteristics assessed.**
Suitable nesting tree (unconfirmed)	**Trees with suitable DBH which contains suitable nesting hollows, although no evidence of use visible from ground level. Internal characteristics not assessed.**
Potential nesting tree	**Trees with suitable DBH containing unsuitable nest hollows or no visible hollows.** Note – multiple stemmed trees that branch above DBH may not be suitable.

3.2.2 Roosting Habitat

Black cockatoo flocks show strong fidelity to night roosts. Generally, these roost trees are close to high-quality foraging sites and important water sources. According to DAWE (2022) night roosting habitat is classified as habitat that contains one, or a group of, known or potential roosting trees, including:

- Known roosting tree: a tree (generally the tallest), native or introduced, known to be used for night roosting or which demonstrates evidence of roosting. Usually close to an important water source and within an area of high-quality foraging habitat
- Potential roosting tree: a tall tree of any species within close proximity to water.

3.2.3 Foraging Habitat

Black cockatoos rely on foraging resources to provide sufficient energy for their movements across their range and the availability of foraging habitat plays a critical role in the post-breeding period when individuals need to build condition after breeding, and teach juveniles where foraging resources are located (Commonwealth of Australia, 2017).

The DAWE referral guidelines define foraging habitat as any vegetation containing plant species known to support foraging (Table 11) within the range of each black cockatoo species (DAWE, 2022).

Habitat assessments and associated field observations must be sufficient to complete the scoring tool, provide justification for scores given to each attribute and support overall appraisal of foraging habitat quality (DAWE, 2022). This tool only applies to foraging areas >1 ha in size, as clearing of foraging habitat <1 ha in size is unlikely to require referral.

The survey area was traversed by foot and food sources known to be utilised by black cockatoos were identified and quantified in both the over-storey and under-storey in order to complete the DAWE foraging quality scoring tool. A concurrent flora and vegetation assessment of the survey area facilitated this assessment. Specific effort was made to document sightings of black cockatoos in addition to evidence of chew marks around hollows, or feeding debris (including characteristically chewed Banksia or pinecones and marri nuts). As feeding debris can remain on the ground for up to two years, foraging evidence can be assessed at any time of year (DAWE, 2022).

3.3 STUDY TEAM AND LICENCES

The personnel undertaking this assessment and project roles are listed in Table 13.

Table 13: Project staff and licences.

Project staff				
Name	**Qualification**	**Role**	Project role	Experience
Shaun Grein	B.App. Sc (Biol.); Grad. Dip. Nat. Resources; MBA	Managing Director/Senior Principal Scientist	Project management, QA	30+
Sandra Ng	B.Sc (MarineBiol., Cons. & WildlifeBiol.); Dip. Biomedical Sc.	Botanist	Field survey, GIS, reporting	2+
Amelia Shepherdson	B.Sc. (Botany)	Graduate Botanist	Field survey	1
Licences				
Sandra Ng	Flora Taking (Biological Assessment) Licence: FB62000543 (exp. 23/03/2026)			
Amelia Shepherdson	Flora Taking (Biological Assessment) Licence: FB62000723 (exp. 28/08/2025) Authorisation to Take or Disturb Threatened Species: TFL-2425-0045 (exp. 30/07/2027)			

3.4 LIMITATIONS AND CONSTRAINTS

An assessment of survey-specific issues and limitations is detailed in Table 14. There were minor limitations identified this survey but was unlikely to affect the results.

Table 14: Flora and vegetation survey limitations.

Aspect	Assessment	Constraint
Availability of contextual information at a regional and local scale	Broad vegetation, land system, soil, and geology mapping data were available for the survey area, in addition to DBCA Threatened and Priority Ecological Community spatial data. This information was adequate to provide appropriate contextual information for the survey.	Nil
Competency/experience of the team carrying out the survey, including experience in the bioregion surveyed	The personnel undertaking field work and specimen identification were suitably qualified and have conducted numerous botanical surveys within the Southwest botanical province. Key personnel leading the field survey and undertaking specimen identification, data analysis, vegetation mapping, and reporting have over 2 years' experience with flora and vegetation surveys in the Jarrah Forest region.	Nil
Proportion of flora recorded and/or collected, any identification issues	All species encountered during the survey were recorded within sampling sites or opportunistically. Representative specimens of all taxa recorded in the field were collected for confirmation. Forty-seven specimens (ca. 45%) could not be identified to species level due to a lack of required reproductive material; this is considered to have only minor impact on the survey as it does not affect the classification of plant communities at this scale. None of these specimens were believed to correspond to any significant species nor were any considered to be anomalous.	Minor
Was the appropriate area fully surveyed (effort and extent)	Four vegetation description sites were assessed in Area A. Eleven quadrats were assessed within Area B. The appropriate area was sufficiently surveyed. Parts of Area A could not be fully assessed due to site access and safety issues and therefore a comprehensive species list could not be tabulated.	Minor
Access restrictions within the survey area	Much of Area A could not be safely accessed.	Minor
Survey timing, rainfall, season of survey	The survey was conducted on the 18th and 25th September 2024 during the primary survey season for detailed flora and vegetation surveys in the Southwest botanical province. There was lower than average rainfall immediately preceding	Nil

Aspect	Assessment	Constraint
	the survey which may have impacted the identification of some specimens. However, seasonal conditions were considered adequate to characterise the vegetation present within the survey area.	
Disturbance that may have affected the results of survey such as fire, flood or clearing	No significant limitations identified. The survey area was not affected by any recent fire that might have affected the results of the survey.	Nil

4 RESULTS

4.1 FLORA

4.1.1 Floristic Diversity and Estimated Species Richness

A total of 105 vascular plant taxa (species, infraspecific taxa, and phrase names) representing 33 families and 67 genera were recorded during the survey within 11 quadrats (Appendix D). Of these species, 15 (ca. 14%) were annuals or short-lived perennials, and 16 (ca. 15%) were introduced. The most dominant families in terms of species richness were the Myrtaceae (17 taxa), Fabaceae (14), Proteaceae (12), Asteraceae (10), and Poaceae (7). The most dominant genera were *Acacia* (6 taxa), *Drosera* (4), *Hakea* (4), *Grevillea* (3), *Hypocalymma* (3), *Melaleuca* (3), and *Stylidium* (3) (Appendix D). Most genera (49) were represented by only one taxon. Forty-nine taxa were recorded from only a single sampling site (singletons), and eighteen taxa were recorded from only two sample sites (doubletons) (Table 15).

The estimated species richness for the survey area based on 11 sampling sites, using the Chao2 estimator, was 171 species (Table 15). Observed species richness (S) after sampling 11 sites was 105, indicating that approximately 62% of the total estimated species were detected during the survey. The rarefaction curve did not show accumulation of new species tending towards zero (asymptote) by 11 sites (Figure 2). Additional site-based survey effort would likely have resulted in an increased number of taxa recorded at sites.

4.1.2 Significant Species

Threatened and Priority listed species

Area A could not be sufficiently surveyed for significant plant species due to access. Representative areas of each of the major landforms and plant communities within Area B were traversed on foot to record significant plant species. No EPBC Act or BC Act listed Threatened species were recorded. There were three DBCA Priority taxa recorded within the Area B: *Beaufortia purpurea* (P3), *Acacia oncinophylla* subsp. *patulifolia* (P4), and *Darwinia ?pimelioides* (P4) (Figure 3, Table 16, Map 11). *Darwinia ?pimelioides* individuals were lacking the material needed for positive identification, but were presumed to belong to this species based on the available material. The number of individuals of each taxon recorded and associated landforms and vegetation types (section 4.2.1) are summarised below and in Table 16.

Atypical specimens

Several specimens collected were unable to be identified to species level due to a lack of reproductive material required for positive identification but were not considered to be otherwise anomalous.

Range extensions

Based on current Atlas of Living Australia records (including all Western Australia Herbarium records), there were no species records representing range extensions of greater than 100 km from the nearest known records. There were no new bioregional range extensions recorded (i.e., new records for the Jarrah Forest IBRA bioregion).

4.1.3 Introduced Species

Sixteen introduced plant species were recorded (Table 17). Thirteen are listed as 'Permitted - s11' on the WAOL (DPIRD, 2007–) and one was not listed. There were two specimens (*Gomphocarpus ?fruticosus* and *?Moraea flaccida*) that could not be confirmed due to a lack of material, but were assumed to be the Declared Pests (Declared Pests -s22(2)): *Gomphocarpus fruticosus* and *Moraea flaccida* respectively. Ecological impact and invasiveness ratings have been determined for introduced species in the South West region using the Weed Prioritisation Process (DPaW, 2013b), which are listed for these species in Appendix C.

Table 15: Species richness summary and estimates for the survey area.

N (number of reference samples)	11		
S (observed number of taxa within quadrats)	105		
No. of singletons	51		
No. of doubletons	18		
No. taxa not observed in quadrats	0		
Total taxa observed (including opportunistic records)	105		
Species richness estimator	*Estimated species richness±SD*[1]	*% of total taxa observed*	*% undetected*
Chao2	170.68 ± 25.37	61.5	38.5

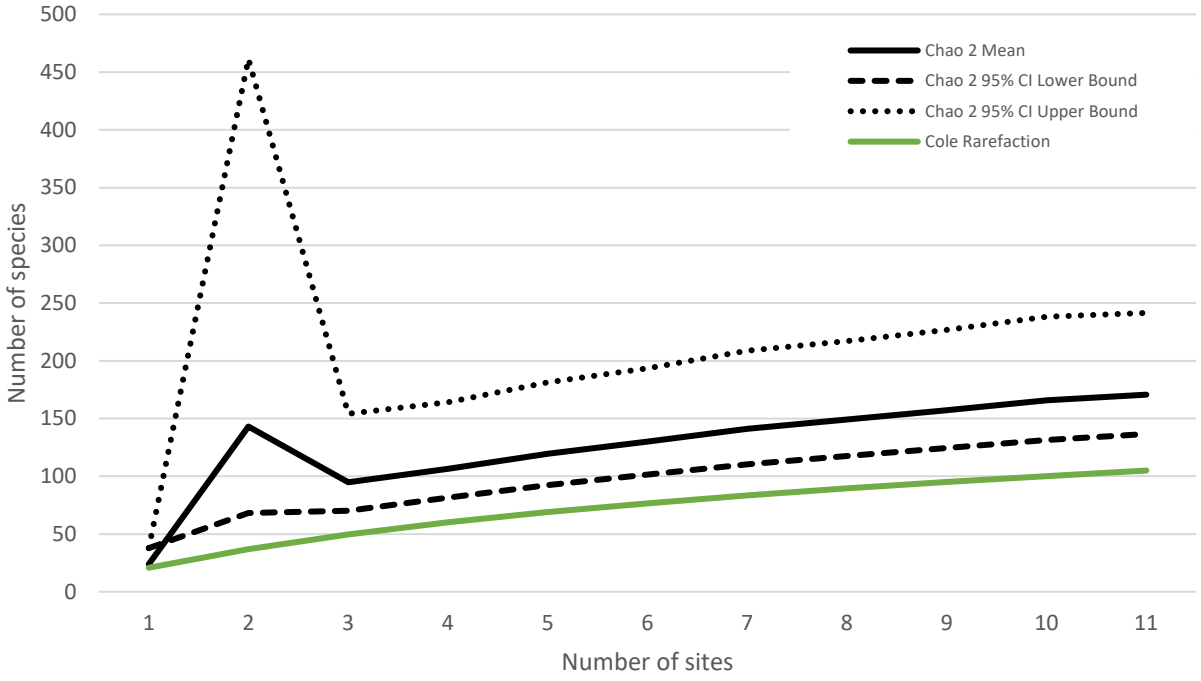


Figure 2: Asymptotic species richness estimated by the Chao2 non-parametric richness estimator and rarefaction curve (species observed) for the survey area after 11 sampling sites.



Survey area

Significant species

- *Darwinia ?pimeloides* (P4)
- *Beaufortia purpurea* (P3)
- *Acacia oncinophylla* subsp. *patulifolia* (P4)

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Project No.: 2015
Author: SN-W
Created Date: 04 February 2025
Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Scale: 1:6,000 @A3

Maxar

Map 11: Significant plant species recorded within the survey area.

0 50 100 200 300 400 500
Meters

Table 16: Summary of significant plant species recorded within the survey area.

Name	Land system	Landform	Total records within survey area[1]	Distribution within vegetation type (survey area)		
				CcAsLa	CcXpBd	HaBs
Priority 3						
Beaufortia purpurea	Myara phase 1	Gentle granite hills with light brown sand	2	–	2	–
Priority 4						
Acacia oncinophylla subsp. *patulifolia*	Murray Valleys system, Myara phase 1	Gentle to moderate granite hill-outcrop with light brown sand.	2	–	–	2
Darwinia ?pimelioides	Murray Valleys system, Myara phase 1	Gentle to moderate granite hill-outcrop with light brown sand.	4	–	1	3

[1]In cases where abundance data were not recorded, abundance was assumed to be 1.

Table 17: Summary of introduced species recorded within the survey area.

Species	Common name	Family	BAM Act status	Ecological impact*	Invasiveness*
?Moraea flaccida[1]	One-leaf cape tulip	Iridaceae	Declared Pest - s22(2)	High	Moderate
Acacia iteaphylla	Flinders range wattle	Fabaceae	Permitted - s11	Unknown	Rapid
Aira cupaniana	Hairgrass	Poaceae	Permitted - s11	Unknown	Rapid
Arctotheca calendula	Capeweed	Asteraceae	Permitted - s11	Moderate	Moderate
Briza minor	Shivery grass	Poaceae	Permitted - s11	Unknown	Rapid
Gomphocarpus ?fruticosus[2]	Narrowleaf cottonbush	Apocynaceae	Declared Pest - s22(2)	Unknown	Rapid
Hypochaeris ?radicata[3]	Flatweed, flat weed	Asteraceae	Permitted - s11	Moderate	Rapid
Lotus angustissimus	Slender birdsfoot trefoil, narrowleaf trefoil	Fabaceae	Permitted - s11	Unknown	Rapid
Lupinus angustifolius	Narrowleaf lupin	Fabaceae	Permitted - s11	Moderate	Unknown
Lysimachia arvensis	Scarlet pimpernel, blue pimpernel	Primulaceae	Permitted - s11	Unknown	Rapid
Melilotus indicus	Melilot	Fabaceae	Permitted - s11	Unknown	Moderate
Sonchus asper	Rough sowthistle	Asteraceae	Permitted - s11	Moderate	Rapid
Sonchus oleraceus	Common sowthistle	Asteraceae	Permitted - s11	Moderate	Rapid
Stachys arvensis	Stagger weed, staggerweed	Lamiaceae	Permitted - s11	Unknown	Rapid
Trifolium campestre	Hop trefoil	Fabaceae	Permitted - s11	Unknown	Unknown
Vulpia myuros forma myuros	Rat's tail fescue	Poaceae	Not listed	Unknown	Rapid

* Ratings based on the Western Australian Weed Prioritisation Process.
[1] Assumed to be *Moraea flaccida*.
[2] Assumed to be *Gomphocarpus fruticosus*.
[3] Assumed to be *Hypochaeris radicata*.



Figure 3: Priority plant species recorded within the survey area.

Top left to right: *Beaufortia purpurea* (P3), *Acacia oncinophylla* subsp. *patulifolia* (P4)
Bottom: *Darwinia ?pimelioides* (P4)

4.2 VEGETATION

4.2.1 Vegetation Type Classification and Characterisation

Vegetation within Area A, which is a historically disturbed rehabilitated area consisting primarily of mixed planted eucalypts, was described as a single vegetation type (EAb) from four vegetation description sites (Table 18). Hierarchical agglomerative clustering was conducted using floristic data from 11 quadrats within native vegetation in Area B (Figure 4). Two significantly different clusters, within which there is no meaningful sub-structure, were identified by SIMPROF. One cluster was further divided into two subgroups (CcXpBd and HaBs) which were not significantly different in overall floristic composition, but could be distinguished based on vegetation structure. Three vegetation types were described for Area B (Table 18). The vegetation types described from the hierarchical clustering were also resolved as distinct clusters of sites in the NMDS ordination (Figure 5). Overall there were no disagreements between the ordination and the hierarchical clustering, lending support to the validity of the groups identified as vegetation type, and each vegetation type was supported by two or more indicator species (IndVal > 0.85) (Table 18).

The floristic features used to characterise each vegetation type (dominant species, indicator species, and frequently occurring species) are summarised in Table 18 and other relevant attributes (landform, soils, vegetation condition, and species richness) are summarised in Table 18. The full species assemblage associated with each vegetation type is shown in a constancy-importance table in Appendix E, representative site photographs are shown in Figure 6. Vegetation type boundaries were mapped within the survey area by extrapolation from aerial imagery and ground-truthed sites (Map 12). Raw sampling site data are shown in Appendix G.

4.2.2 Vegetation Condition

Vegetation condition according to the EPA (2016) scale was recorded at each sampling site and was assessed periodically along traverses. Planted areas of vegetation within Area A were assessed as ‘Degraded’ with the remainder of area assessed as ‘cleared’. Vegetation condition within Area B, excluding vehicle tracks and other cleared areas, varied from ‘Degraded’ to ‘Excellent’, and vehicle tracks, roads and other cleared areas were mapped as ‘Cleared’. ‘Degraded’ vegetation was largely adjacent to vehicle tracks with obvious and extensive disturbance (e.g., the presence of many aggressive weed species) (Map 13). The most significant populations of introduced species was *Lotus angustissimus* (narrowleaf trefoil), which appeared in dense infestations in quadrats in the areas of ‘Degraded’ and ‘Very Good’ vegetation. Areas of ‘Excellent’ vegetation had minimal disturbance and weed presence. (Map 13).

4.2.3 Significant Vegetation

Threatened and Priority Ecological Communities

There were no plant communities recorded and analysed that corresponded to any state (DBCA) or Commonwealth (EPBC Act) listed Threatened Ecological Community (TEC).

The desktop assessment identified the Priority 4 PEC: ‘Central Northern Darling Scarp Granite Shrubland Community’ intersecting with the survey area. This PEC consists of taller shrubs like *Allocasuarina humilis* and *Xanthorrhoea acanthostachya,* over smaller proteaceous and myrtaceous shrubs like *Melaleuca* aff. *scabra*, *Baeckea comphorosmae, Dryandra armata* (=*Banksia armata*), *Hakea incrassata,* and *Hakea undulata* on fragmented granite/quartzite (Table 7).

Vegetation type HaBs within Area B supported three of the species listed in the description of the PEC (*Allocasuarina humilis*, *Banksia armata*, and *Hakea undulata*) with a variety of other proteaceous and myrtaceous shrubs. The granite outcrop habitat and vegetation structure were also consistent with the PEC description. Vegetation type HaBs is therefore broadly consistent with this PEC, and accounted for 3.49 ha (23.2%) of the Area B.

Other Potentially Significant Vegetation

Vegetation types were assessed for potential national, state, regional, and local significance according to the criteria described in Table 9. There were no vegetation types considered to have national, state, or regional significance based on the assessed criteria.

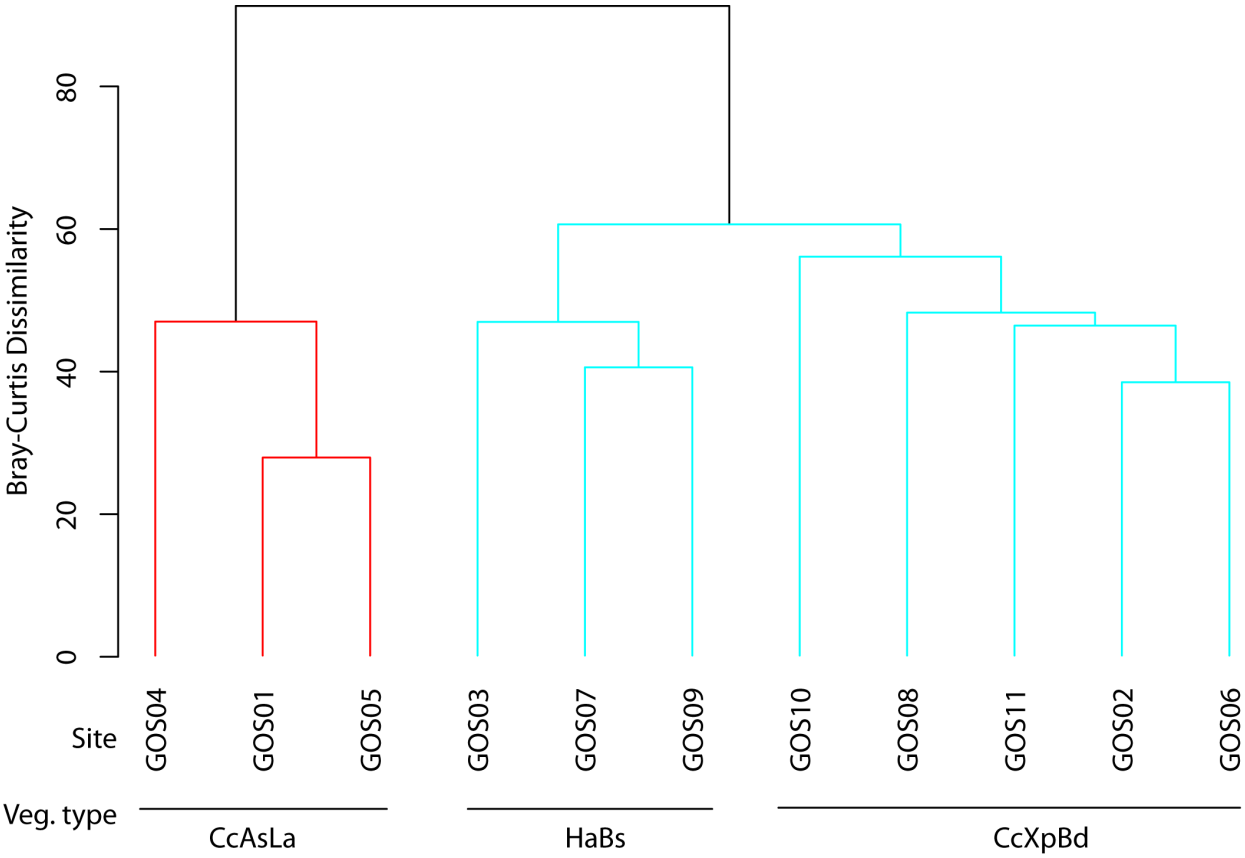


Figure 4: UPGMA hierarchical agglomerative clustering dendrogram summarising floristic relationships among sampling sites and vegetation types.

Same-coloured branches indicate significantly different groups identified by similarity profile analysis ($\alpha = 0.001$).

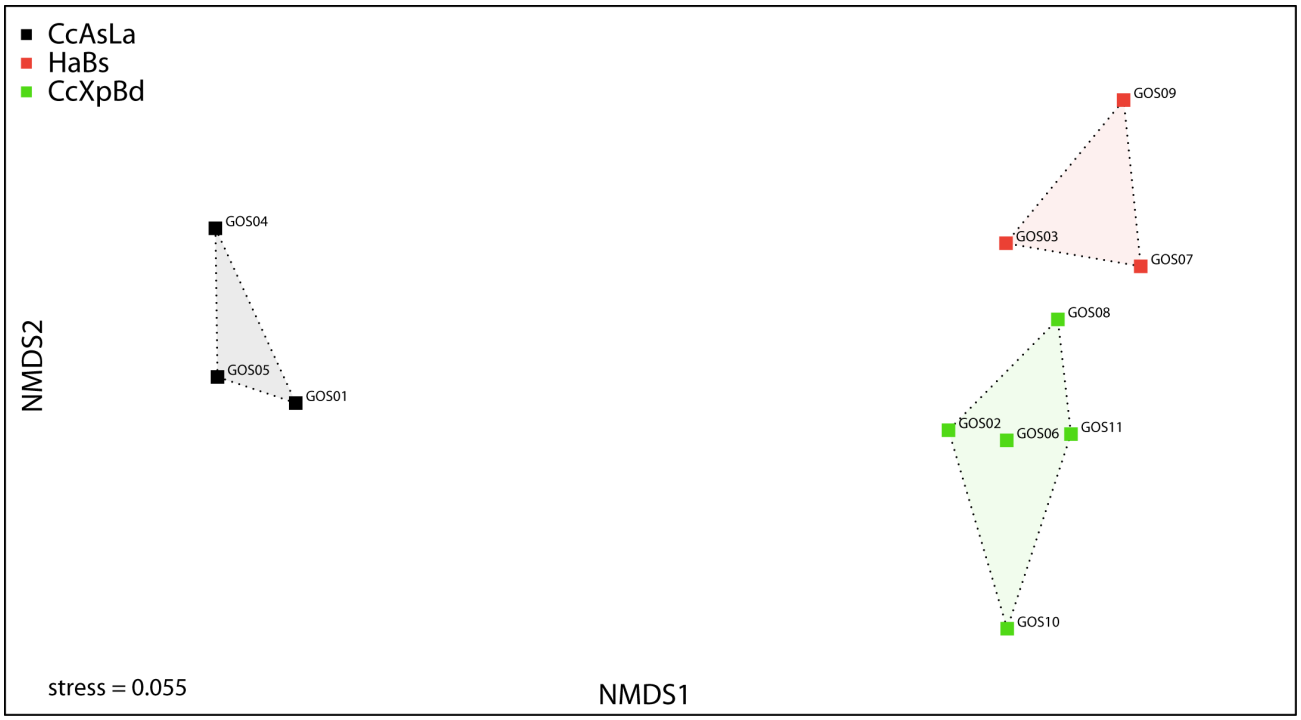


Figure 5: NMDS ordination plots summarising two-dimensional relationships among sites and vegetation types.

Table 18: Summary of vegetation types within the survey area.

Map code	Broad floristic formation (NVIS III)	Description	Frequently occurring species (occurrence in ≥ 50% of quadrats within vegetation type)1	Indicator species (IndVal > 0.70, p < 0.05)	Significant species	Landform and soils	Vegetation condition	Mean site species richness (range)	Environmental Significance (WA)	Extent within Area A (ha) (% of area)	Extent within Area B (ha) (% of area)	Sites
CcAsLa	*Corymbia* mid open woodland	*Corymbia calophylla* mid open woodland; *Acacia saligna* mid sparse shrubland; **Lotus angustissimus*, **Aira cupaniana*, *Calothamnus quadrifidus* low herbland/grassland/shrubland.	*Acacia saligna, Aira cupaniana, Calothamnus quadrifidus, Lotus angustissimus*	*Acacia saligna (1.00), Calothamnus quadrifidus (1.00), Lotus angustissimus (1.00), Aira cupaniana (0.99)*	—	Gentle hills, light brown sand over granite.	Very Good to Degraded	18 (17-19)	None	—	1.99 (13.2%)	GOS01, GOS04, GOS05
HaBs	*Borya sphaerocephala* low herbland	*Hypocalymma angustifolium, Hakea trifurcata, Verticordia densiflora* mid sparse shrubland; *Borya sphaerocephala* low herbland.	*Allocasuarina humilis, Borya sphaerocephala, Calytrix glutinosa, Darwinia ?pimelioides, Drosera ?erythrorhiza, Drosera ?glanduligera, Drosera drummondii, Hakea trifurcata, Hibbertia ?hypericoides, Hypocalymma angustifolium, Isopogon ?dubius, Lepidosperma squamatum, ?Moraea flaccida, ?Neurachne alopecuroidea, Petrophile biloba, Trymalium ledifolium* ?var. *rosmarinifolium, Verticordia densiflora, Xanthorrhoea preissii*	*Hakea trifurcata (1.00), Hibbertia ?hypericoides (1.00), Borya sphaerocephala (0.91), Darwinia ?pimelioides (0.90)*	*Acacia oncinophylla subsp. patulifolia* (P4), *Darwinia ?pimelioides* (P4)	Granite outcrops.	Excellent to Very Good	28 (18-34)	Priority 4 PEC: 'Central Northern Darling Scarp Granite Shrubland Community'	—	3.49 (23.2%)	GOS03, GOS07, GOS09
CcXpBd	*Corymbia* mid woodland	*Corymbia calophylla*, ±*Eucalyptus marginata*, ±*Eucalyptus wandoo* mid woodland; *Xanthorrhoea preissii, Hakea trifurcata* mid sparse shrubland; *Banksia dallanneyi subsp. sylvestris, Hibbertia ?hypericoides, Acacia pulchella var. pulchella low open shrubland.*	*Acacia pulchella var. pulchella, Banksia dallanneyi subsp. sylvestris, Burchardia congesta, Cassytha sp., Corymbia calophylla, Dampiera alata, Drosera ?macrantha, Hakea trifurcata, Hakea undulata, Hibbertia ?hypericoides, Hypocalymma angustifolium, Lepidosperma squamatum, Melaleuca sp. G11, Mesomelaena tetragona, ?Moraea flaccida, ?Neurachne alopecuroidea, Verticordia densiflora, Xanthorrhoea preissii*	*Hakea trifurcata (1.00), Hibbertia ?hypericoides (1.00), Banksia dallanneyi* subsp. *sylvestris (0.97), Acacia pulchella* var. *pulchella (0.93), Dampiera alata (0.89)*	*Beaufortia purpurea* (P3), *Darwinia ?pimelioides* (P4)	Gentle to moderately sloped hills, light brown sand over granite.	Excellent to Very Good	29 (25-34)	None	—	8.96 (59.4%)	GOS02, GOS06, GOS08, GOS10, GOS11
EwAb	*Eucalyptus* mid open woodland	*Eucalyptus* spp., *Allocasuarina* sp. mid open woodland; **Avena barbata*, **Oxalis pes-caprae*, **Lotus angustissimus* low tussock grassland/herbland.	—	—	—	Slopes with sand soils.	Degraded	—	None	1.22 (39.3%)	—	VD02, VD03, VD04, V05
Cleared	—	Cleared/unvegetated.	—	—	—	—	—	—	None	1.89 (60.7%)	0.63 (4.2%)	—

[1]Species that were dominant in some examples of the vegetation type but were recorded in <50% of sites representing that type are indicated with '±'.

[2] For a full list of species associated with each vegetation type see Appendix E (constancy-importance table).


VD05
VD02
VD03
VD04
GOS10
GOS09
GOS07
GOS11
GOS08
GOS01
GOS05
GOS04
GOS02
GOS06
GOS03
Maxar



Survey area

Vegetation Condition

- Excellent
- Very Good
- Degraded
- Cleared

Project No.: 2015
Author: SN-W
Created Date: 04 February 2025
Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Scale: 1:6,000 @A3

Map 13: Vegetation condition within the survey area.

Maxar

0 50 100 200 300 400 500

Meters



CcAsLa: *Corymbia calophylla* mid open woodland; *Acacia saligna* mid sparse shrubland; *Lotus angustissimus*, *Aira cupaniana*, *Calothamnus quadrifidus* low herbland/grassland/shrubland.



HaBs: *Hypocalymma angustifolium, Hakea trifurcata, Verticordia densiflora* mid sparse shrubland; *Borya sphaerocephala* low herbland.



CcXpBd: *Corymbia calophylla*, ±*Eucalyptus marginata*, ±*Eucalyptus wandoo* mid woodland; *Xanthorrhoea preissii, Hakea trifurcata* mid sparse shrubland; *Banksia dallanneyi subsp. sylvestris, Hibbertia ?hypericoides, Acacia pulchella var. pulchella low open shrubland.*



EAv: *Eucalyptus* spp., *Allocasuarina* sp. mid open woodland; *Avena barbata*, *Oxalis pes-caprae*, *Lotus angustissimus* low tussock grassland/herbland.

Figure 6: Representative photographs of vegetation types (CcAsLa, HaBs, and CcXpBd).

4.3 FAUNA

4.3.1 Black Cockatoo Habitat Assessment

4.3.1.1 Breeding Habitat

Three species of medium to large eucalypts were identified within the survey area that have the potential to provide breeding habitat for black cockatoo: *Eucalyptus wandoo* subsp. *wandoo* (wandoo), *Eucalyptus marginata* (jarrah) and *Corymbia calophylla* (marri). Wandoo trees with DBH of greater than 300 mm were recorded using a DGPS while the remaining trees with DBH >500 mm were similarly recorded. A total of two trees supporting one or more potentially suitable hollows at a suitable size, height and aspect for use by black cockatoos for breeding were recorded during the survey. Locations of habitat trees recorded during the survey with a suitable DBH are provided in Map 14.

Two potential breeding habitat trees were identified and recorded during the survey (Table 19). No trees were identified as supporting hollows and no trees with known or suitable nesting hollows were recorded.

Table 19: DBH trees recorded within the survey area.

Hollow category	Total
Active nest hollow (1)	**0**
Suitable nest hollow (2)	**0**
Potentially suitable hollow (3)	**2**
No suitable hollows (4)	**1**
No hollows (5)	**19**
Total	**22**

4.3.1.2 Roosting Habitat

Flocks of black cockatoos demonstrate a strong site fidelity to night roosts that are near high-quality foraging habitat (Saunders 1986). Roosting habitat is classified as a tree (or group of trees) where there are records or recent evidence of night roosting. Night roosts are usually located in the tallest trees within an area and in proximity (usually within 6 km) to both quality foraging habitat and an important water supply. Flocks will use different night roosts, often for weeks, or until the local food supply is exhausted. However, due to changing patterns of resource availability not all night-roosts are used every year.

Trees with a DBH greater than 500 mm may be tall enough to provide roosting habitat for Carnaby's black cockatoos (Department of Sustainability Environment Water Population and Communities, 2012). Black-cockatoos tend to have traditional roosting sites and these have been documented in the Great Cocky Count (Byrne, Barrett, Blythman, Finn, & Williams, 2015).

4.3.1.3 Foraging Habitat

Black cockatoos rely on foraging resources to provide sufficient energy for their movements across their range and availability of foraging habitat plays a critical role in the post-breeding period when individuals need to build condition after breeding and teach juveniles where these foraging resources are located (Commonwealth of Australia, 2017).

Majority of the survey area had high quality foraging material (Map 14), with most vegetation types dominated by marri (*Corymbia calophylla*), which is a known quality food source for black cockatoos. This foraging habitat accounted for 60.2% (10.92 ha) of the survey area.

4.3.1.4 Direct Observations

Primary evidence of forest red-tailed black cockatoos was recorded during the current survey (Map 14). On two occasions forest red-tailed black cockatoos were observed flying over the survey area totalling four individuals. Two of these cockatoos landed and foraged in the survey area while the survey was undertaken.



Survey area

Hollow category

- 3, Potentially suitable hollow
- 4, No suitable hollows
- 5, No Hollows

Primary observation

Foraging

- High quality

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Project No.: 2015
Author: SN-W
Created Date: 04 February 2025
Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Scale: 1:6,000 @A3

Map 14: Black cockatoo observations, foraging habitat, habitat trees recorded (DBH > 500 mm) and hollow category rating

Maxar

0 50 100 200 300 400 500
Meters

5 DISCUSSION

5.1 FLORA

5.1.1 Floristic Diversity

A total of 105 vascular plant taxa were recorded within the survey area, representing approximately 62% of the estimated species richness for the area at the time of the survey. The most dominant families were the Myrtaceae, Fabaceae, Proteaceae, Asteraceae, and Poaceae; the most dominant genera were *Acacia, Drosera, Hakea, Grevillea, Hypocalymma, Melaleuca,* and *Stylidium*. Species diversity and floristic composition of the survey area is typical of the landforms present and reflects the generally high quality of the vegetation present.

Rainfall immediately preceding the survey in September 2024 was below average. This may have caused the lack of flowering or fruiting material needed for a positive identification (ca. 44% of species recorded could not be identified to the species level).

Sixteen introduced species (two of which listed as Declared Pests (Declared Pests -s22(2)) recorded) were recorded and accounted for 15% of total taxa recorded. These introduced species were in high abundance at sampling sites GOS01 and GOS05 possibly due to the clearing and track running adjacent to these sites. These species are generally widely naturalised across the Jarrah Forest region, and their presence within the survey area is not considered unusual.

5.1.2 Significant Species

DBCA listed Priority species

Two DBCA listed Priority species were recorded within the Area B: *Beaufortia purpurea* (Priority 3) and *Acacia oncinophylla* subsp. *patulifolia* (Priority 4). One potential Priority 4 species, *Darwinia ?pimelioides*, which was in relatively poor condition at the time of the survey, was also recorded within Area B.

A summary of the local and regional distribution of the Priority species recorded is as follows:

- *Beaufortia purpurea* (P3) is known from 10 locations within the Jarrah Forest region, where it extends from Kelmscott to west of York, and is typically associated with lateritic or granitic soils on rocky slopes. This species was recorded at sites GOS06 (1 – 4% cover of quadrat) and GOS08 (10 – 24% cover of quadrat) within vegetation type CcXpBd.
- *Acacia oncinophylla* subsp. *patulifolia* (P4) is known from 22 locations within the Jarrah Forest region, occurring from east of Bridgetown to Avon Valley National Park. This species is typically associated with granitic soils and occasionally laterite. It was recorded at sites GOS07 and GOS09 within vegetation type HaBs. Cover percentages at both sites were 1 – 4%.
- *Darwinia pimelioides* (P4) is known from 16 locations within the Jarrah Forest region. Most occur north-east of Perth, with one outlier occurring south of Morgan State Forest. This species is typically associated with loam – sandy loam soils on granite outcrops, and was recorded at sites GOS03, GOS07, GOS09, and GOS11, primarily in vegetation type HaBs. Cover percentages at all of these sites was between1 – 4%, with the exception of GOS07 (5 – 9%).

The likelihood of occurrence of significant species was reassessed following the survey based on survey effort, the presence of suitable habitat, and vegetation condition. Seasonal conditions, particularly below average rainfall, were unsuitable for detecting the presence of most annual species, and the vegetation within the survey area was mostly in ‘Excellent’ to ‘Very Good’ condition. A total of 11 quadrats and 4 vegetation description sites were distributed across representative areas of all vegetation types and some additional targeted searches were undertaken along walked traverses.

Given the size of the survey area, this level of survey effort is reasonable for determining the likely presence of significant species.

In the desktop assessment, 30 Priority taxa were assessed potentially occurring within the survey area based on proximity to the survey area and the potential presence of suitable habitat. These included 13 species assessed as likely to occur, and 17 species possibly occurring. The likelihood of occurrence of these species was reassessed following the field survey based on survey effort, the presence of suitable habitat, and vegetation condition (Appendix B). Given the size of the survey area, this level of survey effort is reasonable for determining the likely presence of significant species, especially the more conspicuous perennial taxa.

Four taxa initially assessed as 'Likely', and five taxa initially assessed as 'Possible' were downgraded to or remained as 'Possible' (Appendix B) due to the presence of suitable habitat but lack of records during the survey, which could be a result of the below average rainfall.

Although Area A could not be sufficiently surveyed for significant species, the understorey was degraded and consisted mostly of introduced species, so it is considered unlikely that any significant species occur within this area.

5.2 VEGETATION

5.2.1 Vegetation Types and Condition

Vegetation within Area A consisted of planted trees (eucalyptus, allocasuarinas, and acacias) over a degraded understorey of introduced grasses and herbs, which accounted for 1.22 ha (39.3%) of the area. The remainder of Area A was cleared.

Vegetation within Area B consisted of three vegetation types, one of which (CcXpBd) accounted for over half of the area (8.96 ha, 59.4%). This vegetation type is dominated by *Corymbia* mid woodlands that occur on gentle to moderately sloped hills associated with the Myara 1 phase land system. This is consistent with the pre-European vegetation mapping of Shepherd *et al*. (2002) in which vegetation association 4 (Medium woodland; marri & wandoo) is mapped in over 90% of the survey area.

Vegetation condition within the survey area ranged from 'Degraded' to 'Excellent' according to the EPA (2016) vegetation condition scale. Area A was mostly cleared, but the vegetated rehabilitation areas were assessed as 'Degraded'. Area B consists of gentle to moderate hills, and vegetation in these areas were almost exclusively in 'Excellent' and 'Very Good' conditions, with either no obvious disturbance or only very minor weed invasion. Cleared areas adjacent to tracks were in 'Degraded' condition, owing to the high abundance of weed infestation.

5.2.2 Significant Vegetation

Vegetation may be considered significant for a range of reasons including, but not limited to: being listed as a Threatened Ecological Community under the BC Act or the EPBC Act; being classified as a Priority Ecological Community by DBCA; having a restricted distribution; the degree of historical impact from threatening processes; playing a role as a refuge for Threatened species; or providing an important function required to maintain ecological integrity of a significant ecosystem (EPA, 2016b). Other environmental features, such as significant watercourses or wetlands may also be considered significant under some circumstances (DER, 2014).

Vegetation type HaBs was consistent with the description of Priority 4 PEC: 'Central Northern Darling Scarp Granite Shrubland Community'. This vegetation type accounts for 23.2% (3.5 ha) of Area B. None of the remaining vegetation types within the survey area are considered significant for any other reason.

5.3 FAUNA

5.3.1 Black Cockatoo Habitat Assessment

The study area falls within the modelled distributions of the three black cockatoo species and DBCA database searches identified records of each species within the study area. An assessment was undertaken to investigate potential breeding habitat, night roosting habitat, and foraging habitat for the three species of black cockatoo within the survey area. Four forest red-tailed black cockatoos were recorded flying over the survey area during the field survey.

A total of 22 potentially suitable habitat trees (DBH >500 mm) were recorded within the survey area, none of which had known (Category 1) or probable (Category 2) nesting hollows:

- Two trees supporting potentially suitable hollows (Category 3) were recorded.
- One tree supporting hollows unsuitable for black cockatoos (Category 4) were recorded.
- Nineteen potential habitat trees of a suitable size supporting no hollows (Category 5) were recorded within the survey area.

The foraging habitat within the survey area was assessed as 'high quality'. Mature marri trees (*Corymbia calophylla*) were recorded which are known food source for all three species of black cockatoo.

The 22 suitably sized trees recorded within the survey area also represent potential roosting habitat; however, none of these trees were the largest trees in the surrounding area and it is unlikely any of these trees are used as a roost tree.

Given the appropriate timing of the survey, the lack of confirmed breeding records recorded within the survey area and the fact that no trees were recorded with 'probable' breeding hollows, it is unlikely that black cockatoos are currently utilising any of the trees within the survey area as breeding or roosting habitat.

6 CONCLUSIONS

The biological surveys were conducted on the 18th and 25th September 2024 and were conducted in accordance with *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA, 2016b)and *Technical Guidance – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (EPA, 2020). The key findings for the survey area were:

Area A:

- Vegetation consisted mostly of degraded areas with planted trees and a weedy understorey of introduced grasses and herbs.
- There were no significant species recorded within Area A, nor are any significant species considered likely to occur in this area.
- None of the vegetation within Area A is considered to be significant.
- A black cockatoo habitat assessment could not be undertaken in Area A.

Area B:

- A total of 105 vascular plant taxa were recorded, representing approximately 62% of the estimated species richness for the Area B.
- Sixteen introduced species were recorded, two of which were presumably Declared Pests but could not be positively identified due to lack of material: *?Moraea flaccida* and *Gomphocarpus ?fruticosus*.
- No EPBC Act or BC Act listed Threatened species were recorded
- Three DBCA listed Priority species, *Beaufortia purpurea* (P3), *Acacia oncinophylla* subsp. *patulifolia* (P4), and *Darwinia ?pimelioides* (P4), were recorded.
- Three vegetation types were recorded within Area B, one of which (HaBs) corresponded DBCA listed Priority 4 PEC 'Central Northern Darling Scarp Granite Shrubland Community'. This vegetation type accounts for 23.2% (3.49 ha) of Area B.
- A total of 22 potential future breeding habitat trees (DBH >500 mm) were recorded within Area B. Two of these contained potentially suitable hollows (Category 3), and one tree contained a hollow that was not suitable for nesting (Category 4).
- Four forest red-tailed black cockatoos were recorded overflying Area B.
- Foraging habitat within Area B was of high quality, with majority of the vegetation dominated by wandoo (*Corymbia calophylla*), a known food source for black cockatoos.

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8 APPENDICES

Appendix A Desktop assessment database search results.

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 15-Jan-2025

Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat
Acknowledgements

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance (Ramsar	1
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	5
Listed Threatened Species:	55
Listed Migratory Species:	10

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at https://www.dcceew.gov.au/parks-heritage/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	49
Commonwealth Heritage Places:	None
Listed Marine Species:	16
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	16
Regional Forest Agreements:	1
Nationally Important Wetlands:	2
EPBC Act Referrals:	50
Key Ecological Features (Marine):	None
Biologically Important Areas:	None
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar Wetlands) [Resource Information]

Ramsar Site Name	Proximity
Forrestdale and thomsons lakes	Within 10km of Ramsar site

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.
Status of Vulnerable, Disallowed and Ineligible are not MNES under the EPBC Act.

Community Name	Threatened Category	Presence Text
Banksia Woodlands of the Swan Coastal Plain ecological community	Endangered	Community likely to occur within area
Clay Pans of the Swan Coastal Plain	Critically Endangered	Community likely to occur within area
Corymbia calophylla - Kingia australis woodlands on heavy soils of the Swan Coastal Plain	Endangered	Community known to occur within area
Empodisma peatlands of southwestern Australia	Endangered	Community may occur within area
Tuart (Eucalyptus gomphocephala) Woodlands and Forests of the Swan Coastal Plain ecological community	Critically Endangered	Community likely to occur within area

Listed Threatened Species [Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text
BIRD		
Botaurus poiciloptilus		
Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area
Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo, Karrak [67034]	Vulnerable	Species or species habitat known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat may occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat likely to occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Species or species habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]	Endangered	Species or species habitat likely to occur within area
Zanda baudinii listed as Calyptorhynchus baudinii Baudin's Cockatoo, Baudin's Black-Cockatoo, Long-billed Black-cockatoo [87736]	Endangered	Roosting known to occur within area
Zanda latirostris listed as Calyptorhynchus latirostris Carnaby's Black Cockatoo, Short-billed Black-cockatoo [87737]	Endangered	Breeding known to occur within area
INSECT		

Scientific Name	Threatened Category	Presence Text
Leioproctus douglasiellus a short-tongued bee [66756]	Critically Endangered	Species or species habitat known to occur within area
Neopasiphae simplicior A native bee [66821]	Critically Endangered	Species or species habitat likely to occur within area
MAMMAL		
Bettongia penicillata ogilbyi Woylie [66844]	Endangered	Species or species habitat known to occur within area
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat known to occur within area
Myrmecobius fasciatus Numbat [294]	Endangered	Species or species habitat may occur within area
Pseudocheirus occidentalis Western Ringtail Possum, Ngwayir, Womp, Woder, Ngoor, Ngoolangit [25911]	Critically Endangered	Species or species habitat may occur within area
Setonix brachyurus Quokka [229]	Vulnerable	Species or species habitat known to occur within area
OTHER		
Westralunio carteri Carter's Freshwater Mussel, Freshwater Mussel [86266]	Vulnerable	Species or species habitat known to occur within area
PLANT		
Acacia anomala Grass Wattle, Chittering Grass Wattle [8153]	Vulnerable	Species or species habitat known to occur within area
Acacia aphylla Leafless Rock Wattle [13553]	Vulnerable	Species or species habitat known to occur within area
Andersonia gracilis Slender Andersonia [14470]	Endangered	Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Anthocercis gracilis Slender Tailflower [11103]	Vulnerable	Species or species habitat known to occur within area
Austrostipa bronweniae listed as Austrostipa bronwenae [92773]	Endangered	Species or species habitat known to occur within area
Austrostipa jacobsiana [87809]	Critically Endangered	Species or species habitat known to occur within area
Banksia mimica Summer Honeypot [82765]	Endangered	Species or species habitat known to occur within area
Caladenia huegelii King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid [7309]	Endangered	Species or species habitat known to occur within area
Calytrix breviseta subsp. breviseta Swamp Starflower [23879]	Endangered	Species or species habitat known to occur within area
Chamelaucium lullfitzii listed as Chamelaucium sp. Gingin (N.G.Marchant 6) Gingin Wax [92777]	Endangered (listed as Chamelaucium sp. Gingin	Species or species habitat may occur within area
Conospermum undulatum Wavy-leaved Smokebush [24435]	Vulnerable	Species or species habitat known to occur within area
Darwinia apiculata Scarp Darwinia [8763]	Endangered	Species or species habitat known to occur within area
Diplolaena andrewsii [6601]	Endangered	Species or species habitat likely to occur within area
Diuris drummondii Tall Donkey Orchid [4365]	Vulnerable	Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Diuris micrantha Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat likely to occur within area
Diuris purdiei Purdie's Donkey-orchid [12950]	Endangered	Species or species habitat known to occur within area
Drakaea elastica Glossy-leafed Hammer Orchid, Glossy-leaved Hammer Orchid, Warty Hammer Orchid [16753]	Endangered	Species or species habitat known to occur within area
Drakaea micrantha Dwarf Hammer-orchid [56755]	Vulnerable	Species or species habitat known to occur within area
Eleocharis keigheryi Keighery's Eleocharis [64893]	Vulnerable	Species or species habitat known to occur within area
Eremophila glabra subsp. chlorella [84927]	Endangered	Species or species habitat known to occur within area
Eucalyptus x balanites Cadda Road Mallee, Cadda Mallee [87816]	Endangered	Species or species habitat known to occur within area
Goodenia arthrotricha [12448]	Endangered	Species or species habitat known to occur within area
Grevillea curviloba subsp. incurva Narrow curved-leaf Grevillea [64909]	Endangered	Species or species habitat likely to occur within area
Grevillea flexuosa Zig Zag Grevillea [2957]	Vulnerable	Species or species habitat may occur within area
Grevillea thelemanniana Spider Net Grevillea [32835]	Critically Endangered	Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Lepidosperma rostratum Beaked Lepidosperma [14152]	Endangered	Species or species habitat known to occur within area
Macarthuria keigheryi Keighery's Macarthuria [64930]	Endangered	Species or species habitat known to occur within area
Morelotia australiensis listed as Tetraria australiensis Southern Tetraria [92784]	Vulnerable	Species or species habitat known to occur within area
Ptilotus pyramidatus Pyramid Mulla-mulla [18216]	Critically Endangered	Species or species habitat known to occur within area
Synaphea sp. Fairbridge Farm (D.Papenfus 696) Selena's Synaphea [82881]	Critically Endangered	Species or species habitat known to occur within area
Synaphea sp. Pinjarra Plain (A.S.George 17182) [86878]	Endangered	Species or species habitat may occur within area
Synaphea sp. Serpentine (G.R.Brand 103) [86879]	Critically Endangered	Species or species habitat likely to occur within area
Thelymitra dedmaniarum Cinnamon Sun Orchid [65105]	Endangered	Species or species habitat may occur within area
Thelymitra stellata Star Sun-orchid [7060]	Endangered	Species or species habitat known to occur within area

Listed Migratory Species		[Resource Information]
Scientific Name	Threatened Category	Presence Text
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		

Scientific Name	Threatened Category	Presence Text
Motacilla cinerea		
Grey Wagtail [642]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat known to occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat known to occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat likely to occur within area
Charadrius leschenaultii		
Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat may occur within area
Numenius madagascariensis		
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus		
Osprey [952]		Breeding known to occur within area
Tringa nebularia		
Common Greenshank, Greenshank [832]	Endangered	Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Lands	[Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Commonwealth Land Name	State
Defence	

Commonwealth Land Name	State
Defence - AIRTC CANNINGTON [50230]	WA
Defence - AIRTC CANNINGTON [50233]	WA
Defence - AIRTC CANNINGTON [50232]	WA
Defence - AIRTC CANNINGTON [50229]	WA
Defence - AIRTC CANNINGTON [50231]	WA
Unknown	
Commonwealth Land - [50836]	WA
Commonwealth Land - [50835]	WA
Commonwealth Land - [50838]	WA
Commonwealth Land - [51928]	WA
Commonwealth Land - [51528]	WA
Commonwealth Land - [51525]	WA
Commonwealth Land - [50844]	WA
Commonwealth Land - [51348]	WA
Commonwealth Land - [50843]	WA
Commonwealth Land - [50848]	WA
Commonwealth Land - [51349]	WA
Commonwealth Land - [51347]	WA
Commonwealth Land - [51986]	WA
Commonwealth Land - [50953]	WA
Commonwealth Land - [51526]	WA
Commonwealth Land - [50882]	WA
Commonwealth Land - [51427]	WA
Commonwealth Land - [51356]	WA
Commonwealth Land - [51354]	WA
Commonwealth Land - [51387]	WA
Commonwealth Land - [50949]	WA

Commonwealth Land Name	State
Commonwealth Land - [50870]	WA
Commonwealth Land - [51242]	WA
Commonwealth Land - [50883]	WA
Commonwealth Land - [51382]	WA
Commonwealth Land - [51357]	WA
Commonwealth Land - [50833]	WA
Commonwealth Land - [50837]	WA
Commonwealth Land - [51927]	WA
Commonwealth Land - [50873]	WA
Commonwealth Land - [51266]	WA
Commonwealth Land - [51518]	WA
Commonwealth Land - [50867]	WA
Commonwealth Land - [50872]	WA
Commonwealth Land - [50874]	WA
Commonwealth Land - [50864]	WA
Commonwealth Land - [51350]	WA
Commonwealth Land - [50866]	WA
Commonwealth Land - [50865]	WA
Commonwealth Land - [50881]	WA
Commonwealth Land - [51287]	WA
Commonwealth Land - [51376]	WA
Commonwealth Land - [51160]	WA
Commonwealth Land - [51163]	WA

Listed Marine Species		[Resource Information]
Scientific Name	Threatened Category	Presence Text
Bird		

Scientific Name	Threatened Category	Presence Text
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area
Bubulcus ibis as Ardea ibis Cattle Egret [66521]		Species or species habitat may occur within area overfly marine area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area overfly marine area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat likely to occur within area overfly marine area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area overfly marine area

Scientific Name	Threatened Category	Presence Text
Numenius madagascariensis		
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pachyptila turtur		
Fairy Prion [1066]		Species or species habitat likely to occur within area
Pandion haliaetus		
Osprey [952]		Breeding known to occur within area
Rostratula australis as Rostratula benghalensis (sensu lato)		
Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area overfly marine area
Thinornis cucullatus as Thinornis rubricollis		
Hooded Plover, Hooded Dotterel [87735]		Species or species habitat likely to occur within area overfly marine area
Tringa nebularia		
Common Greenshank, Greenshank [832]	Endangered	Species or species habitat likely to occur within area overfly marine area

Extra Information

State and Territory Reserves		[Resource Information]
Protected Area Name	Reserve Type	State
Balannup Lake	Nature Reserve	WA
Canning River	Management Area	WA
Dundas Road	Nature Reserve	WA
Kenwick Wetlands	Nature Reserve	WA
Korung	National Park	WA
Lesmurdie Falls	National Park	WA
Midgegooroo	National Park	WA
Stinton Cascades	Nature Reserve	WA
Unnamed WA21569	5(1)(g) Reserve	WA

Protected Area Name	Reserve Type	State
Unnamed WA23076	Nature Reserve	WA
Unnamed WA24657	Conservation Park	WA
Unnamed WA29815	5(1)(h) Reserve	WA
Unnamed WA37997	Nature Reserve	WA
Unnamed WA49299	Nature Reserve	WA
Unnamed WA49363	Conservation Park	WA
Unnamed WA53649	Nature Reserve	WA

Regional Forest Agreements [Resource Information]

Note that all areas with completed RFAs have been included. Please see the associated resource information for specific caveats and use limitations associated with RFA boundary information.

RFA Name	State
South West WA RFA	Western Australia

Nationally Important Wetlands [Resource Information]

Wetland Name	State
Brixton Street Swamps	WA
Gibbs Road Swamp System	WA

EPBC Act Referrals [Resource Information]

Title of referral	Reference	Referral Outcome	Assessment Status
Fruit Orchard Expansion Project	2022/09315		Completed
Industrial Development MKSEA Precinct 1	2023/09760		Completed
Residential Development of Lot 200 Skeet Road	2024/09950		Referral Decision
Residential subdivision of Lot 126 Lawnbrook Road, Walliston	2021/9105		Completed
Southern Link Road Stage 3 City of Canning	2020/8809		Assessment
Tree removal for Nerrigen Brook culvert repair, Armadale.	2023/09464		Completed
Tree removal for road widening - Eighth Road, Armadale, WA	2023/09563		Completed

Title of referral	Reference	Referral Outcome	Assessment Status
Vinci Quarry, Gravel Quarry Expansion	2022/9142		Assessment
Controlled action			
Airport & Freight Access Gateway	2010/5384	Controlled Action	Post-Approval
Byford Rail Extension, Byford, WA	2020/8764	Controlled Action	Post-Approval
Clearing for orchard expansion, Lot 400 Canning Road, Carmel, WA	2016/7647	Controlled Action	Completed
Construction of Residential Dwelling, Ozone Terrace, Kalamunda	2006/3147	Controlled Action	Post-Approval
Development of an Integrated Aged Care Facility, Kalumunda, WA	2013/6990	Controlled Action	Completed
Garden Street road extension, Huntingdale, city of Gosnells, WA	2016/7735	Controlled Action	Post-Approval
Keane Road Strategic Link, proposed construction central portion of Keane Road	2009/5035	Controlled Action	Completed
Native vegetation clearing of Lot 21 Webster Road for Industrial Development	2011/6186	Controlled Action	Post-Approval
Natural Gas Pipeline Expansion	2006/2813	Controlled Action	Post-Approval
Residential development and bushfire protection within part Lot 9006 Reilly Road, Harrisdale, WA	2016/7846	Controlled Action	Post-Approval
Residential Estate at Lot 1580 Warton Road, Southern River	2004/1471	Controlled Action	Post-Approval
Thornlie-Cockburn Link Project, WA	2018/8188	Controlled Action	Post-Approval
Tonkin Highway Grade Separated Interchanges	2019/8529	Controlled Action	Post-Approval
Not controlled action			
Berkshire Road and Roe Highway Interchange, Forrestfield, East Perth, WA	2014/7243	Not Controlled Action	Completed
Burslem Drive Bridge Duplication Over Canning River, Maddington, WA	2014/7115	Not Controlled Action	Completed

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action			
Canning Mills Road Improvement Project, Martin, WA	2015/7426	Not Controlled Action	Completed
Clearing of Lot 400 Canning Road, Carmel, WA	2017/7979	Not Controlled Action	Completed
Commercial development of Lot 106 Wright Road, Forrestdale WA	2003/1255	Not Controlled Action	Completed
Construction of international rowing course and commercial/residential areas	2003/1034	Not Controlled Action	Completed
Denny Avenue Level Crossing Removal, Kelmscott WA	2018/8377	Not Controlled Action	Completed
Eighth Road and Forrest Road Upgrade, Armadale, WA	2019/8538	Not Controlled Action	Completed
Eradication of the European House Borer, Perth metropolitan area, WA	2009/5027	Not Controlled Action	Completed
Grazing of stock and associated works on Lot 1790 Passmore Street, Southern River Western Australia	2018/8176	Not Controlled Action	Completed
Hartfield Park Sporting Field Extension	2013/7008	Not Controlled Action	Completed
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed
INDIGO Central Submarine Telecommunications Cable	2017/8127	Not Controlled Action	Completed
Industrial Development (multiple lots) Edward Street, Kenwick, WA	2018/8231	Not Controlled Action	Completed
Residential Development, Hilbert	2020/8675	Not Controlled Action	Completed
Residential development of Lots 302, 308, 320 and part of Lot 9502, Hawtin Rd, Forrestfield, WA	2016/7770	Not Controlled Action	Completed
Road widening - Eighth Road Armadale between Gribble Avenue and Armadale Road	2021/8964	Not Controlled Action	Completed
Southern River Mixed Business Precinct F, City of Gosnells, WA	2013/6813	Not Controlled Action	Completed
Southern River Precinct 3E	2017/7900	Not Controlled Action	Completed

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action			
To develop a residential development at Glyde Road, Lesmurdie, WA	2013/7096	Not Controlled Action	Completed
Tonkin Highway Extension	2001/470	Not Controlled Action	Completed
Translocation of orchids (Caladenia huegelii) from Roe Hway Reserve	2002/781	Not Controlled Action	Completed
Wungong Transfer Mains Project	2007/3532	Not Controlled Action	Completed
Yule Brook Main Drain Flood Mitigation Works	2019/8572	Not Controlled Action	Completed
Not controlled action (particular manner)			
City of Cockburn Sporting Facilties	2005/2139	Not Controlled Action (Particular Manner)	Post-Approval
INDIGO Marine Cable Route Survey (INDIGO)	2017/7996	Not Controlled Action (Particular Manner)	Post-Approval
South West Metropolitan Railway Project	2003/1175	Not Controlled Action (Particular Manner)	Post-Approval
State Football Centre	2020/8824	Not Controlled Action (Particular Manner)	Post-Approval
Referral decision			
Commercial development of Lot 414 Grove Road, Kenwick	2021/9022	Referral Decision	Referral Publication

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data is available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance on the contents of this report.

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions when time permits.

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded breeding sites; and
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact us page.

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Appendix B Significant plant species recorded within 10 km of the survey area and likelihood of occurrence assessment.

Taxon	WA Status	WA Rank	Habitat	Known flowering period	Distance to nearest record (km)	Possibility of suitable habitat?	Post-field assessment	Post-survey likelihood of occurrence
Pre-survey likelihood: Likely								
Acacia horridula	P3		Gravelly soils over granite, sand. Rocky hillsides.	May to August	0.6 km	Yes	Suitable habitat is present.	Possible
Acacia oncinophylla subsp. *patulifolia*	P4		Granitic soils, occasionally on laterite.	August to December	0.2 km	Yes	Species was recorded.	Recorded
Andersonia sp. Blepharifolia (F. & J. Hort 1919)	P2		Laterite. Hilltops.	September to November	0.4 km	Possible	Suitable habitat is unlikely to be present.	Unlikely
Asteridea gracilis	P3		Sand, clay, gravelly soils.	September to December	0.6 km	Possible	Suitable habitat is unlikely to be present.	Unlikely
Beaufortia purpurea	P3		Lateritic or granitic soils. Rocky slopes.	October to December or January to February	0.4 km	Yes	Species was recorded.	Recorded
Calothamnus graniticus subsp. *leptophyllus*	P4		Clay over granite, lateritic soils. Hillsides.	June to August	0.1 km	Yes	Suitable habitat is unlikely to be present.	Unlikely
Conospermum undulatum	T	VU	Grey or yellow-orange clayey sand.	May to October	1.6 km	Likely	Suitable habitat is unlikely to be present.	Unlikely
Cyanothamnus tenuis	P4		Gritty brown sandy clay over granite. Creeks, slopes.	August to November	1.5 km	Yes	Suitable habitat may be present, not recorded possibly due to lack of rainfall.	Possible
Goodenia arthrotricha	T	EN	Gravel. Granite rocks, slopes.	October to November	0.7 km	Yes	Suitable habitat may be present, not recorded possibly due to lack of rainfall.	Possible
Halgania corymbosa	P3		Gravelly soils, soils over granite.	August to November	1.0 km	Yes	Suitable habitat is unlikely to be present.	Unlikely
Lasiopetalum glutinosum subsp. *glutinosum*	P3		Granite outcrops and creeks.	September to December	0.2 km	Yes	Suitable habitat may be present, not recorded possibly due to lack of rainfall.	Possible
Stackhousia sp. Red-blotched corolla (A. Markey 911)	P3		Light grey gritty clay, with surface granitic cobbles, on a gentle southern upper slope.	June to September	0.9 km	Yes	Suitable habitat is unlikely to be present.	Unlikely
Thelymitra magnifica	T	CR	Stony ridges.	October to November	0.6 km	Yes	Suitable habitat may be present, not recorded possibly due to lack of rainfall.	Possible
Pre-survey likelihood: Possible								
Acacia aphylla	T	VU	Sand, loam, clay loam. Granite outcrops, hills.	August to October	4.5 km	Yes	Suitable habitat was present, but yielded no records.	Unlikely
Allocasuarina grevilleoides	P3		Sand over laterite, gravel.	—	0.9 km	Possible	Suitable habitat is unlikely to be present.	Unlikely
Anthocercis gracilis	T	VU	Sandy or loamy soils. Granite outcrops.	September to October	4.4 km	Yes	Suitable habitat was present, but yielded no records.	Unlikely
Banksia kippistiana var. *paenepeccata*	P3		Lateritic gravelly soils.	October to November	0.8 km	Possible	Suitable habitat is unlikely to be present.	Unlikely
Banksia mimica	T	VU	White or grey sand over laterite, sandy loam.	December to January	2.1 km	Possible	Suitable habitat is unlikely to be present.	Unlikely
Bossiaea modesta	P2		Soils derived from granite. Damp areas close to streams.	October to December	6.5 km	Yes	Suitable habitat is unlikely to be present.	Unlikely

Taxon	WA Status	WA Rank	Habitat	Known flowering period	Distance to nearest record (km)	Possibility of suitable habitat?	Post-field assessment	Post-survey likelihood of occurrence
Calectasia grandiflora	P2		White, grey or yellow sand, sandy clay, gravel, laterite, granite. Swampy areas, rock outcrops, flats, slopes, ridges.	June to November	6.5 km	Yes	Suitable habitat was present, but yielded no records.	Unlikely
Calothamnus accedens	P4		Sandy soils over laterite. Road verge.	September to January	0.5 km	Unlikely	Suitable habitat is unlikely to be present.	Unlikely
Darwinia apiculata	T	EN	Lateritic soils.	October	0.5 km	Unlikely	Suitable habitat is unlikely to be present.	Unlikely
Grevillea pimeleoides	P4		Gravelly soils over granite. Valleys, hillsides.	May to November	5.9 km	Yes	Suitable habitat was present, but yielded no records.	Unlikely
Isopogon autumnalis	P3		Occurs in sandy soils, often in banksia woodlands.	—	4.6 km	Possible	Suitable habitat is unlikely to be present.	Unlikely
Lasiopetalum bracteatum	P4		Sandy clay, clay, lateritic gravel. Along drainage lines, creeks, gullies, granite outcrops.	August to November	6.3 km	Yes	Suitable habitat was present, but yielded no records. Possibly due to lack of appropriate seasonal conditions.	Possible
Paracaleana ferricola	P2		Open gravel with sandy patches. Disturbed areas.	November to December	2.5 km	Possible	Suitable habitat was present, but yielded no records. Possibly due to lack of appropriate seasonal conditions.	Possible
Pithocarpa corymbulosa	P3		Gravely or sandy loam. Granite outcrops.	January to April	6.3 km	Yes	Suitable habitat was present, but yielded no records.	Unlikely
Senecio leucoglossus	P4		Gravelly lateritic or granitic soils. Granite outcrops, slopes.	August to December	6.6 km	Yes	Suitable habitat was present, but yielded no records. Possibly due to lack of appropriate seasonal conditions.	Possible
Thelymitra stellata	T	EN	Sand, gravel, lateritic loam.	October to November	1.4 km	Unlikely	Suitable habitat was present, but yielded no records. Possibly due to lack of appropriate seasonal conditions.	Possible
Thysanotus cymosus	P3		Clay, granitic or lateritic sand.	September to October	6.7 km	Yes	Suitable habitat was present, but yielded no records. Possibly due to lack of appropriate seasonal conditions.	Possible
Pre-survey likelihood: Unlikely								
Acacia anomala	T	VU	Lateritic soils. Slopes.	August to September	7.4 km	Unlikely	Suitable habitat unlikely to be present.	Unlikely
Acacia benthamii	P2		Sand. Typically on limestone breakaways.	August to September	6.5 km	Possible	Suitable habitat unlikely to be present.	Unlikely
Acacia lasiocarpa var. bracteolata long peduncle variant (G.J. Keighery 5026)	P1		Grey or black sand over clay. Swampy areas, winter wet lowlands.	May or August	1.7 km	No	Suitable habitat unlikely to be present.	Unlikely
Andersonia gracilis	T	VU	White/grey sand, sandy clay, gravelly loam. Winter-wet areas, near swamps.	September to November	6.4 km	Unlikely	Suitable habitat unlikely to be present.	Unlikely
Aponogeton hexatepalus	P4		Mud. Freshwater ponds, rivers, claypans.	August to September	2.5 km	No	Suitable habitat unlikely to be present.	Unlikely
Austrostipa bronweniae	T	EN	Road verges. Yellow brown sand and brown loam. Swamps, seasonal wetlands.	October to November	6.6 km	No	Suitable habitat unlikely to be present.	Unlikely
Austrostipa jacobsiana	T	CR	Plain. Grey clay/loam. Seasonally wet flats.	October to November	7.4 km	No	Suitable habitat unlikely to be present.	Unlikely

Taxon	WA Status	WA Rank	Habitat	Known flowering period	Distance to nearest record (km)	Possibility of suitable habitat?	Post-field assessment	Post-survey likelihood of occurrence
Babingtonia urbana	P3		Upper slope, grey sand. Seasonally wet depressions and drainage lines.	December to March	6.1 km	No	Suitable habitat unlikely to be present.	Unlikely
Banksia pteridifolia subsp. *vernalis*	P3		White/grey sand over laterite. Grows in sandy loam over gravel in low kwongan, and in sand in banksia low open woodland.	September to October	7.7 km	Possible	Suitable habitat unlikely to be present.	Unlikely
Bolboschoenus fluviatilis	P1		Littoral zone. In standing water or wet mud. Wet dark brown silt, grey sand.	November	7.1 km	No	Suitable habitat unlikely to be present.	Unlikely
Borya subulata	P4		Sandstone	June	6.4 km	Unlikely	Suitable habitat unlikely to be present.	Unlikely
Byblis gigantea	P3		Sandy-peat swamps.	September to January	4.6 km	No	Suitable habitat unlikely to be present.	Unlikely
Caladenia huegelii	T	CR	Grey or brown sand, clay loam.	August to October	6.3 km	Unlikely	Suitable habitat unlikely to be present.	Unlikely
Calandrinia uncinella	P1		Wet flats, seasonal swamps. White-grey sandy loam. Clay based wetlands.	August to September	6.6 km	No	Suitable habitat unlikely to be present.	Unlikely
Calytrix breviseta subsp. *breviseta*	T		Sandy clay. Swampy flats.	October to November	6.4 km	No	Suitable habitat unlikely to be present.	Unlikely
Calytrix simplex subsp. *simplex*	P1		Ecology unknown; subsp. *oppositifolia* occurs in heath associations on grey sands with lateritic gravel, in closed heath on dark red-brown sandy loam over clay and massive laterite, and with *Eucalyptus tetragona* on sand plain.	October to November	8.5 km	Unlikely	Suitable habitat unlikely to be present.	Unlikely
Carex tereticaulis	P3		Black peaty sand.	September to October	7.4 km	No	Suitable habitat unlikely to be present.	Unlikely
Chamaescilla gibsonii	P3		Clay to sandy clay. Winter-wet flats, shallow water-filled claypans.	September	6.6 km	No	Suitable habitat unlikely to be present.	Unlikely
Comesperma griffinii	P2		Yellow or grey sand. Plains.	October	6.6 km	Unlikely	Suitable habitat unlikely to be present.	Unlikely
Comesperma rhadinocarpum	P3		Sandy soils.	October to November	6.7 km	Likely	Suitable habitat unlikely to be present.	Unlikely
Commersonia sp. Lesmurdie (A.A. Mitchell 11429)	P2		Cracking clay over basalt sill. Melaleuca woodland.	November to December	8.2 km	No	Suitable habitat unlikely to be present.	Unlikely
Cyanicula ixioides subsp. *ixioides*	P4		Laterite, gravel.	August to October	6.9 km	Unlikely	Suitable habitat unlikely to be present.	Unlikely
Diuris brevis	P2		Flat coastal plain. Grey sand, black peaty soil.	August	6.6 km	No	Suitable habitat unlikely to be present.	Unlikely
Diuris drummondii	T	EN	Low-lying depressions, swamps.	November to December	6.9 km	No	Suitable habitat unlikely to be present.	Unlikely
Diuris purdiei	T	EN	Grey-black sand, moist. Winter-wet swamps.	September to October	9.1 km	No	Suitable habitat unlikely to be present.	Unlikely
Drakaea elastica	T	CR	White or grey sand. Low-lying situations adjoining winter-wet swamps.	October to November	7.0 km	No	Suitable habitat unlikely to be present.	Unlikely
Drosera occidentalis	P4		White-yellow sand, clayey soils. Swamps, seasonally wet depressions and slopes.	October to January	4.6 km	No	Suitable habitat unlikely to be present.	Unlikely
Drosera oreopodion	T	CR	Clayey sand sometimes mixed with lateritic pebbles.	September to October	8.9 km	Unlikely	Suitable habitat unlikely to be present.	Unlikely

Taxon	WA Status	WA Rank	Habitat	Known flowering period	Distance to nearest record (km)	Possibility of suitable habitat?	Post-field assessment	Post-survey likelihood of occurrence
Drosera patens	P1		Sandy soils. Margins of winter-wet depressions, swamps and lakes.	December to February	8.9 km	No	Suitable habitat unlikely to be present.	Unlikely
Eleocharis keigheryi	T	VU	Clay, sandy loam. Emergent in freshwater: creeks, claypans. In seasonally filled clay pans and drainage lines, in water about 15 cm deep, in clayey soils.	—	1.9 km	No	Suitable habitat unlikely to be present.	Unlikely
Eremophila glabra subsp. *chlorella*	T	EN	Sandy clay. Winter-wet depressions.	July to November	6.8 km	No	Suitable habitat unlikely to be present.	Unlikely
Eriochilus glareosus	P1		Gravel scrapings. Sandy lateritic gravel.	June	1.8 km	Unlikely	Suitable habitat unlikely to be present.	Unlikely
Eryngium pinnatifidum subsp. Palustre (G.J. Keighery 13459)	P3		Seasonally wet depressions and clay flats. Black sand.	September to November	6.5 km	No	Suitable habitat unlikely to be present.	Unlikely
Eryngium sp. Subdecumbens (G.J. Keighery 5390)	P3		Seasonally inundated claypan. Grey to grey-white clay.	—	6.4 km	No	Suitable habitat unlikely to be present.	Unlikely
Grevillea thelemanniana	T	CR	Sand, sandy clay. Winter-wet low-lying flats.	May to November	5.7 km	Unlikely	Suitable habitat unlikely to be present.	Unlikely
Haemodorum loratum	P3		Grey or yellow sand, gravel.	November	7.2 km	Unlikely	Suitable habitat unlikely to be present.	Unlikely
Haloragis aculeolata	P2		Black sand or clay over limestone. Winter-wet areas.	December	7.0 km	No	Suitable habitat unlikely to be present.	Unlikely
Hydrocotyle lemnoides	P4		Swamps.	August to October	6.3 km	No	Suitable habitat unlikely to be present.	Unlikely
Isotropis cuneifolia subsp. *glabra*	P3		Sand, clay loam. Winter-wet flats.	September	6.6 km	No	Suitable habitat unlikely to be present.	Unlikely
Jacksonia gracillima	P3		Drainage areas and floodplains, sandplains. Grey sand, brown loam.	October to November	6.7 km	No	Suitable habitat unlikely to be present.	Unlikely
Johnsonia pubescens subsp. *cygnorum*	P2		Grey-white-yellow sand. Flats, seasonally-wet sites.	September	5.6 km	No	Suitable habitat unlikely to be present.	Unlikely
Lepidosperma rostratum	T	EN	Peaty sand, clay.	—	6.1 km	Unlikely	Suitable habitat unlikely to be present.	Unlikely
Lepyrodia curvescens	P2		Wetlands and swamps.	September to November	6.6 km	No	Suitable habitat unlikely to be present.	Unlikely
Leucopogon sp. Busselton (D. Cooper 243)	P2		Flats, seasonally damp wetlands. Brown clayey sand, grey sand.	August to September	6.9 km	No	Suitable habitat unlikely to be present.	Unlikely
Meionectes tenuifolia	P3		Sand or clay. Wetlands and swamps.	September to December	4.3 km	No	Suitable habitat unlikely to be present.	Unlikely
Microtis quadrata	P4		Drainage lines, swamps, seasonally wet flats. Laterite. Brown loam, grey sand.	October to December	2.8 km	Unlikely	Suitable habitat unlikely to be present.	Unlikely
Morelotia australiensis	T	VU	Flat. Light brown sand clay loam.	December	6.9 km	Unlikely	Suitable habitat unlikely to be present.	Unlikely
Myriophyllum echinatum	P3		Clay. Winter-wet flats.	October to November	6.5 km	No	Suitable habitat unlikely to be present.	Unlikely
Ornduffia submersa	P4		Pools, lakes, swamps, winter-wet depressions.	September to October	6.1 km	No	Suitable habitat unlikely to be present.	Unlikely
Pimelea rara	P4		Lateritic soils.	December or January	1.7 km	Unlikely	Suitable habitat unlikely to be present.	Unlikely

Taxon	WA Status	WA Rank	Habitat	Known flowering period	Distance to nearest record (km)	Possibility of suitable habitat?	Post-field assessment	Post-survey likelihood of occurrence
Ptilotus pyramidatus	T	CR	Fringing saline wetlands. Seasonally inundated floodplains. Grey to grey-white sandy clay, sandy mud.	October to December	6.7 km	No	Suitable habitat unlikely to be present.	Unlikely
Ptilotus sericostachyus subsp. *roseus*	X	EX	—	—	5.1 km	Unknown	Suitable habitat unlikely to be present.	Unlikely
Rytidosperma racemosum var. *racemosum*	P2		Road verges. Brown loam. Laterite.	June	6.7 km	Unlikely	Suitable habitat unlikely to be present.	Unlikely
Schoenus benthamii	P3		White, grey sand, sandy clay. Winter-wet flats, swamps.	October to November	2.6 km	No	Suitable habitat unlikely to be present.	Unlikely
Schoenus capillifolius	P3		Brown mud. Claypans.	September to November	6.2 km	No	Suitable habitat unlikely to be present.	Unlikely
Schoenus loliaceus	P2		Sandy soils. Winter-wet depressions.	October to November	6.5 km	No	Suitable habitat unlikely to be present.	Unlikely
Schoenus natans	P4		Winter-wet depressions.	August to November	6.6 km	No	Suitable habitat unlikely to be present.	Unlikely
Schoenus pennisetis	P3		Grey or peaty sand, sandy clay. Swamps, winter-wet depressions.	August to September	3.0 km	No	Suitable habitat unlikely to be present.	Unlikely
Schoenus sp. Beaufort (G.J. Keighery 6291)	P1		Mud. Winter-wet claypans.	—	6.5 km	No	Suitable habitat unlikely to be present.	Unlikely
Schoenus sp. Waroona (G.J. Keighery 12235)	P3		Clay or sandy clay. Winter-wet flats.	October to November	7.5 km	No	Suitable habitat unlikely to be present.	Unlikely
Scholtzia sp. Bickley (W.H. Loaring s.n. PERTH 06165184)	X	EX	—	—	8.7 km	Unknown	Suitable habitat unlikely to be present.	Unlikely
Stenanthemum sublineare	P2		Littered white sand. Coastal plain.	October to December	6.5 km	Unlikely	Suitable habitat unlikely to be present.	Unlikely
Stylidium aceratum	P3		Sandy soils. Swamp heathland.	October to November	6.6 km	Unlikely	Suitable habitat unlikely to be present.	Unlikely
Stylidium longitubum	P4		Seasonal wetlands.	November	6.7 km	No	Suitable habitat unlikely to be present.	Unlikely
Stylidium striatum	P4		Brown clay loam over laterite. Hillslopes. Jarrah/marri forest, wandoo woodland.	October to November	7.8 km	Unlikely	Suitable habitat unlikely to be present.	Unlikely
Styphelia filifolia	P3		Sandplains. Yellow sand.	March to May	6.6 km	Unlikely	Suitable habitat unlikely to be present.	Unlikely
Synaphea sp. Fairbridge Farm (D. Papenfus 696)	T	CR	Sandy with lateritic pebbles. Near winter-wet flats, in low woodland with weedy grasses.	October	6.9 km	Unlikely	Suitable habitat unlikely to be present.	Unlikely
Thysanotus anceps	P3		White or grey sand, lateritic gravel, laterite.	October to December	1.6 km	Unlikely	Suitable habitat unlikely to be present.	Unlikely
Thysanotus glaucus	P4		White, grey or yellow sand, sandy gravel.	November to February	6.8 km	Likely	Suitable habitat unlikely to be present.	Unlikely
Tripterococcus sp. Brachylobus (A.S. George 14234)	P4		Grey, black or peaty sand. Winter-wet flats.	October to November	8.6 km	No	Suitable habitat unlikely to be present.	Unlikely
Verticordia lindleyi subsp. *lindleyi*	P4		Sand, sandy clay. Winter-wet depressions.	November to January	3.1 km	No	Suitable habitat unlikely to be present.	Unlikely

Appendix C Introduced plant species recorded within 5 km of the survey area including BAM Act status and Weed Prioritisation Process rating.

Species	Common name	BAM Act status and WONS	Ecological impact	Invasiveness
Acacia decurrens	Black wattle	Permitted - s11	Low	Slow
Acacia iteaphylla	Flinders range wattle	Permitted - s11	Unknown	Rapid
Acacia longifolia	Sydney golden wattle	Permitted - s11	Unknown	Moderate
Acacia podalyriifolia	Queensland silver wattle	Permitted - s11	Low	Slow
Acacia pycnantha	Golden wattle	Permitted - s11	Low	Slow
Agave americana	Century plant	Permitted - s11	Low	Slow
Aira caryophyllea	Silvery hairgrass	Permitted - s11	Unknown	Rapid
Aira cupaniana	Hairgrass	Permitted - s11	Unknown	Rapid
Alisma lanceolatum	Water plantain	Permitted - s11	Unknown	Unknown
Amaryllis belladonna	Easter lily, belladonna lily	Permitted - s11	Low	Slow
Anredera cordifolia	Madeira vine	Permitted - s11	High	Rapid
Arctotheca calendula	Capeweed, cape weed	Permitted - s11	Moderate	Moderate
Arundo donax	Giant reed	Permitted - s11	Unknown	Slow
Asparagus asparagoides	Bridal creeper	Declared Pest - s22(2) (WONS)	High	Rapid
Atriplex prostrata	Hastate orache	Permitted - s11	Unknown	Rapid
Avena barbata	Bearded oat	Permitted - s11	High	Rapid
Babiana angustifolia	Baboonflower	Permitted - s11	High	Moderate
Bellardia trixago	Bartsia	Permitted - s11	Unknown	Rapid
Brachypodium distachyon	False brome	Permitted - s11	Unknown	Unknown
Briza maxima	Blowfly grass	Permitted - s11	Unknown	Rapid
Briza minor	Shivery grass	Permitted - s11	Unknown	Rapid
Bromus hordeaceus	Soft brome	Permitted - s11	High	Rapid
Callitriche stagnalis	Common starwort	Permitted - s11	Unknown	Rapid

Calothamnus quadrifidus	Freeway calothamnus	Permitted - s11	High	Unknown
Calothamnus rupestris	Mouse ears	Permitted - s11	Unknown	Rapid
Cenchrus clandestinus	Kikuyu, kikuyu grass	Permitted - s11	High	Rapid
Cenchrus macrourus	African feathergrass, African feather grass	Permitted - s11	High	Moderate
Centaurium erythraea	Centaury, common centaury	Permitted - s11	Unknown	Rapid
Centaurium tenuiflorum	Slender centaury	Permitted - s11	Unknown	Rapid
Chamaecytisus palmensis	Tree lucerne, tagasaste	Permitted - s11	High	Rapid
Chamelaucium uncinatum	Geraldton wax	Permitted - s11	Unknown	Unknown
Chrysanthemoides monilifera subsp. *monilifera*	African boneseed	Declared Pest, Prohibited - s12	Unlisted	Unlisted
Corrigiola litoralis	Strapwort	Permitted - s11	Unknown	Unknown
Cortaderia selloana	Pampas grass	Permitted - s11	High	Rapid
Cotula coronopifolia	Waterbuttons	Permitted - s11	Unknown	Rapid
Cotula turbinata	Funnel weed	Permitted - s11	Unknown	Rapid
Cynodon dactylon	Couch	Permitted - s11	High	Rapid
Cyperus brevifolius	Mullumbimby couch, kyllinga weed	Not listed	High	Moderate
Cyperus congestus	Dense flat sedge, dense flat-sedge	Permitted - s11	Unknown	Moderate
Cyperus eragrostis	Umbrella sedge	Permitted - s11	Unknown	Moderate
Cyperus involucratus	Cyperus	Not listed	High	Rapid
Cyperus polystachyos	Bunchy sedge	Permitted - s11	Unknown	Moderate
Cyperus tenuiflorus	Scaly sedge	Permitted - s11	Unknown	Unknown
Osteospermum ecklonis	African daisy	Permitted - s11	Low	Slow
Dipogon lignosus	Dolichos pea	Permitted - s11	High	Moderate
Disa bracteata	South African orchid	Not listed	Unknown	Rapid
Dittrichia graveolens	Stinkwort	Permitted - s11	Unknown	Rapid
Echinochloa crus-pavonis	South american barnyard grass	Permitted - s11	Unknown	Rapid
Echium plantagineum	Paterson's curse	Declared Pest - s22(2)	Low	Moderate
Ehrharta calycina	Perennial veldtgrass, perennial veldt grass	Permitted - s11	Unknown	Moderate
Ehrharta longiflora	Annual veldtgrass, annual veldt grass	Permitted - s11	Unknown	Rapid

Eleusine indica	Crowsfoot grass	Permitted - s11	Unknown	Unknown
Eragrostis curvula	African lovegrass	Permitted - s11	High	Rapid
Erodium botrys	Long storksbill	Permitted - s11	Unknown	Moderate
Euphorbia terracina	Geraldton carnation weed	Permitted - s11	High	Rapid
Ficus carica	Edible fig, common fig	Permitted - s11	High	Slow
Fumaria capreolata	Climbing fumitory, whiteflower fumitory	Permitted - s11	Moderate	Unknown
Fumaria muralis subsp. *muralis*	Wall fumitory	Permitted - s11	Unknown	Unknown
Galium aparine	Cleavers	Declared Pest - s22(2)	Unknown	Unknown
Galium divaricatum	Slender goosegrass	Permitted - s11	Low	Unknown
Galium murale	Bedstraw, small goosegrass	Permitted - s11	Low	Unknown
Genista linifolia	Flaxleaf broom	Permitted - s11	Unknown	Rapid
Gladiolus caryophyllaceus	Pink gladiolus	Permitted - s11	Unknown	Unknown
Gladiolus undulatus	Wavy gladiolus, wild gladiolus	Permitted - s11	High	Moderate
Glyceria declinata	Sweetgrass	Permitted - s11	Moderate	Rapid
Gomphocarpus fruticosus	Swan plant, narrowleaf cottonbush	Declared Pest - s22(2)	Unknown	Rapid
Gomphocarpus physocarpus	Balloon cottonbush	Permitted - s11	Unknown	Rapid
Hyparrhenia hirta	Tambookie grass	Permitted - s11	High	Rapid
Hypochaeris glabra	Flatweed, smooth catsear	Permitted - s11	Moderate	Rapid
Hypochaeris radicata	Flatweed, flat weed	Permitted - s11	Moderate	Rapid
Ipomoea cairica	Mile-a-minute, coast morning glory	Permitted - s11	High	Slow
Isolepis marginata	Coarse clubrush, coarse club-rush	Permitted - s11	Low	Rapid
Isolepis prolifera	Budding clubrush, budding club-rush	Permitted - s11	Unknown	Rapid
Ixia maculata	Yellow ixia	Permitted - s11	Low	Moderate
Ixia polystachya	Variable ixia	Permitted - s11	Low	Moderate
Jacaranda mimosifolia	Blue jacaranda	Permitted - s11	Unknown	Unknown
Juncus acutus	Sharp rush	Permitted - s11	High	Rapid
Juncus acutus subsp. *acutus*	Sharp rush	Permitted - s11	High	Rapid
Juncus articulatus	Jointed rush	Permitted - s11	Unknown	Unknown
Juncus bufonius	Toadrush, toad rush	Permitted - s11	Low	Rapid

Juncus capitatus	Capitate rush	Permitted - s11	Low	Rapid
Juncus microcephalus	Weedy rush	Permitted - s11	Low	Rapid
Kickxia spuria	Fluellen, roundleaf toadflax	Permitted - s11	Low	Rapid
Lactuca serriola	Prickly lettuce	Permitted - s11	Low	Rapid
Lagurus ovatus	Hare's tail grass	Permitted - s11	Unknown	Moderate
Lantana camara	Common lantana	Declared Pest (WONS), Prohibited - s12	Unlisted	Unlisted
Lavandula stoechas	Topped lavender	Permitted - s11	Low	Moderate
Linum trigynum	French flax	Permitted - s11	Low	Unknown
Lolium rigidum	Ryegrass	Permitted - s11	Moderate	Rapid
Lonicera japonica	Japanese honeysuckle	Permitted - s11	Unknown	Slow
Lotus angustissimus	Slender birdsfoot trefoil, narrowleaf trefoil	Permitted - s11	Unknown	Rapid
Lotus subbiflorus	Hairy birdsfoot trefoil	Permitted - s11	Unknown	Rapid
Lupinus angustifolius	Narrowleaf lupin	Permitted - s11	Moderate	Unknown
Lupinus cosentinii	Sandplain lupin	Permitted - s11	Moderate	Moderate
Lupinus luteus	Yellow lupin	Permitted - s11	Moderate	Unknown
Lysimachia arvensis	Scarlet pimpernel, blue pimpernel	Permitted - s11	Unknown	Rapid
Lythrum hyssopifolia	Lesser loosestrife	Permitted - s11	Unknown	Rapid
Malva parviflora	Small-flowered mallow, marshmallow	Permitted - s11	Unknown	Unknown
Melaleuca armillaris	Bracelet honey-myrtle	Permitted - s11	Moderate	Moderate
Melaleuca nesophila	Freeway melaleuca, mindiyed	Permitted - s11	Low	Slow
Monopsis debilis	Monopsis	Permitted - s11	Low	Rapid
Monopsis debilis var. *depressa*	Pansy lobelia	Permitted - s11	Low	Rapid
Moraea flaccida	One-leaf cape tulip	Declared Pest - s22(2)	High	Moderate
Moraea lewisiae	Moraea	Permitted - s11	Unknown	Unknown
Moraea setifolia	Thread iris	Permitted - s11	Unknown	Unknown
Nemesia strumosa	Cape jewels	Permitted - s11	Unlisted	Unlisted
Nothoscordum gracile	False onion weed	Permitted - s11	Unknown	Unknown
Oenothera drummondii	Coastal evening primrose, beach evening primrose	Permitted - s11	Low	Unknown

Oenothera glazioviana	Tall evening primrose, evening primrose	Permitted - s11	Low	Rapid
Oenothera jamesii	Evening primrose	Permitted - s11	Low	Slow
Oenothera stricta	Common evening primrose	Permitted - s11	Low	Rapid
Olea europaea subsp. *europaea*	Olive	Permitted - s11	High	Moderate
Opuntia ficus-indica	Prickly pear	Declared Pest - s22(2) (WONS)	Unlisted	Unlisted
Orobanche minor	Broom rape, lesser broomrape	Permitted - s11	Unknown	Rapid
Oxalis caprina	Small white oxalis	Permitted - s11	Unknown	Unknown
Oxalis glabra	Fingerleaf oxalis	Permitted - s11	Moderate	Moderate
Oxalis hirta	Hairy wood-sorrel	Permitted - s11	Unlisted	Unlisted
Oxalis pes-caprae	Soursob	Permitted - s11	High	Slow
Oxalis purpurea	Purple oxalis, largeflower wood sorrel	Permitted - s11	High	Slow
Parentucellia latifolia	Red bartsia, common bartsia	Permitted - s11	Unknown	Rapid
Paspalum dilatatum	Paspalum	Permitted - s11	High	Rapid
Paspalum distichum	Water couch	Permitted - s11	High	Unknown
Paspalum urvillei	Vasey grass	Permitted - s11	Unknown	Unknown
Pelargonium capitatum	Rose pelargonium	Permitted - s11	High	Rapid
Pentameris airoides	False hairgrass	Permitted - s11	Unknown	Unknown
Petrorhagia dubia	Velvet pink	Permitted - s11	Unknown	Rapid
Phalaris angusta	Phalaris	Permitted - s11	Unknown	Unknown
Phalaris arundinacea	Reed canary grass	Permitted - s11	Unknown	Unknown
Phytolacca octandra	Inkweed, red ink plant	Permitted - s11	Unknown	Moderate
Plantago lanceolata	Ribwort plantain	Permitted - s11	High	Unknown
Podalyria sericea	Cape satin bush	Permitted - s11	Unknown	Unknown
Polygala myrtifolia	Myrtleleaf milkwort	Permitted - s11	Moderate	Moderate
Polypogon monspeliensis	Annual barbgrass, annual beardgrass	Permitted - s11	Moderate	Unknown
Portulaca oleracea	Pigweed, purslane	Permitted - s11	Low	Unknown
Puccinellia ciliata	Puccinellia	Permitted - s11	High	Moderate
Raphanus raphanistrum	Wild radish	Permitted - s11	Unknown	Rapid
Ricinus communis	Castor oil plant	Permitted - s11	Unknown	Unknown

Romulea flava var. *minor*	Guildford grass	Permitted - s11	High	Unknown
Romulea rosea	Guildford grass	Permitted - s11	High	Unknown
Romulea rosea var. *australis*	Guildford grass	Permitted - s11	High	Unknown
Rorippa nasturtium-aquaticum	Watercress	Permitted - s11	High	Rapid
Rubus rugosus	Wild raspberry	Declared Pest - s22(2)	High	Moderate
Rubus ulmifolius	Blackberry	Declared Pest - s22(2)	High	Moderate
Rumex conglomeratus	Clustered dock	Permitted - s11	Unknown	Unknown
Rumex crispus	Curled dock	Permitted - s11	Unknown	Unknown
Rumex vesicarius	Ruby dock	Permitted - s11	High	Rapid
Setaria parviflora	Slender pigeon grass	Permitted - s11	Low	Moderate
Solanum linnaeanum	Apple of sodom	Declared Pest - s22(2)	Moderate	Moderate
Solanum nigrum	Black berry nightshade	Permitted - s11	Unknown	Moderate
Sonchus asper	Rough sowthistle	Permitted - s11	Moderate	Rapid
Sonchus oleraceus	Common sowthistle	Permitted - s11	Moderate	Rapid
Sparaxis bulbifera	Sparaxis	Permitted - s11	High	Rapid
Spergula arvensis	Corn spurrey, corn spurry	Permitted - s11	Unknown	Unknown
Stachys arvensis	Stagger weed, staggerweed	Permitted - s11	Unknown	Rapid
Stenotaphrum secundatum	Buffalo grass	Permitted - s11	High	Moderate
Tolpis barbata	Tolpis, yellow hawkweed	Permitted - s11	Unknown	Rapid
Tribolium uniolae	Haas grass, tribolium	Permitted - s11	High	Moderate
Trifolium angustifolium var. *angustifolium*	Narrowleaf clover	Permitted - s11	Unknown	Unknown
Trifolium arvense var. *arvense*	Haresfoot clover	Permitted - s11	Unknown	Unknown
Trifolium campestre	Hop trefoil	Permitted - s11	Unknown	Unknown
Trifolium campestre var. *campestre*	Hop clover	Permitted - s11	Unknown	Unknown
Trifolium dubium	Suckling clover	Permitted - s11	Unknown	Unknown
Trifolium resupinatum var. *majus*	Shaftal clover	Permitted - s11	Unknown	Unknown
Trifolium striatum	Knotted clover	Permitted - s11	Unknown	Unknown
Tritonia gladiolaris	Tritonia, lined tritonia	Permitted - s11	Unknown	Unknown
Tropaeolum majus	Nasturtium, garden nasturtium	Permitted - s11	Low	Slow

Ursinia anthemoides	Ursinia	Permitted - s11	Unknown	Rapid
Vallisneria australis	Ribbon weed	Permitted - s11	Unknown	Unknown
Vellereophyton dealbatum	White cudweed	Permitted - s11	Moderate	Rapid
Verbascum virgatum	Green mullein, twiggy mullein	Permitted - s11	Low	Moderate
Verbesina encelioides	Crownbeard	Permitted - s11	Unlisted	Unlisted
Vicia sativa	Common vetch	Permitted - s11	Unknown	Slow
Vinca major	Blue periwinkle	Permitted - s11	High	Slow
Vulpia myuros	Rat's-tail fescure	Permitted - s11	Unknown	Rapid
Wahlenbergia capensis	Cape bluebell	Permitted - s11	Unknown	Rapid
Watsonia knysnana	Watsonia	Permitted - s11	High	Moderate
Watsonia marginata	Watsonia (pink)	Permitted - s11	High	Moderate
Watsonia meriana	Bubil watsonia	Permitted - s11	High	Moderate
Zantedeschia aethiopica	Arum lily	Declared Pest - s22(2)	High	Moderate

Appendix D Plant species recorded within the survey area.

Family	Taxon	WAConStat	Naturalised	WAOL	Ecological Impact	Invasiveness
Amaranthaceae	*?Ptilotus* sp. G02		NA	NA		
Apiaceae	*Platysace ?filiformis*		Native	Permitted - s11		
Apocynaceae	*Gomphocarpus ?fruticosus*		Introduced	Declared Pest - s22(2)		
Araliaceae	*Hydrocotyle intertexta*		Native	Not listed		
Asparagaceae	*Thysanotus ?patersonii*		Native	Permitted - s11		
Asteraceae	?Asteraceae sp. G02		NA	NA		
Asteraceae	?Asteraceae sp. G03		NA	NA		
Asteraceae	?Asteraceae sp. G07		NA	NA		
Asteraceae	*?Hypochaeris* sp. G05		NA	NA		
Asteraceae	*?Pterochaeta paniculata*		Native	Permitted - s11		
Asteraceae	*Arctotheca calendula*		Introduced	Permitted - s11	Moderate	Moderate
Asteraceae	*Hypochaeris ?radicata*		Introduced	Permitted - s11		
Asteraceae	*Millotia tenuifolia*		Native	Permitted - s11		
Asteraceae	*Sonchus asper*		Introduced	Permitted - s11	Moderate	Rapid
Asteraceae	*Sonchus oleraceus*		Introduced	Permitted - s11	Moderate	Rapid
Boryaceae	*Borya sphaerocephala*		Native	Permitted - s11		
Casuarinaceae	*Allocasuarina humilis*		Native	Permitted - s11		
Colchicaceae	*Burchardia congesta*		Native	Permitted - s11		
Cyperaceae	*Lepidosperma asperatum*		Native	Permitted - s11		
Cyperaceae	*Lepidosperma squamatum*		Native	Permitted - s11		
Cyperaceae	*Mesomelaena tetragona*		Native	Permitted - s11		
Dilleniaceae	*Hibbertia ?hypericoides*		Native	Permitted - s11		
Dilleniaceae	*Hibbertia ?polystachya*		Native	Permitted - s11		
Droseraceae	*Drosera ?erythrorhiza*		Native	Permitted - s11		
Droseraceae	*Drosera ?glanduligera*		Native	Permitted - s11		
Droseraceae	*Drosera ?macrantha*		Native	Permitted - s11		
Droseraceae	*Drosera drummondii*		Native	Not listed		
Ericaceae	?Ericaceae sp.		NA	NA		
Ericaceae	*Leucopogon ?polymorphus*		Native	Permitted - s11		
Ericaceae	*Styphelia discolor*		Native	Not listed		

Fabaceae	*?Hovea* sp. T3Q2		NA	NA		
Fabaceae	*Acacia ?obovata*		Native	Permitted - s11		
Fabaceae	*Acacia iteaphylla*		Introduced	Permitted - s11	Unknown	Rapid
Fabaceae	*Acacia oncinophylla* subsp. *patulifolia*	Priority 4 (DBCA)	Native	Not listed		
Fabaceae	*Acacia preissiana*		Native	Permitted - s11		
Fabaceae	*Acacia pulchella* var. *pulchella*		Native	Not listed		
Fabaceae	*Acacia saligna*		Native	Permitted - s11		
Fabaceae	*Fabaceae* sp. G10		NA	NA		
Fabaceae	*Gompholobium marginatum*		Native	Permitted - s11		
Fabaceae	*Lotus angustissimus*		Introduced	Permitted - s11	Unknown	Rapid
Fabaceae	*Lupinus angustifolius*		Introduced	Permitted - s11	Moderate	Unknown
Fabaceae	*Melilotus indicus*		Introduced	Permitted - s11		
Fabaceae	*Mirbelia spinosa*		Native	Permitted - s11		
Fabaceae	*Trifolium campestre*		Introduced	Permitted - s11	Unknown	Unknown
Goodeniaceae	*Dampiera alata*		Native	Permitted - s11		
Goodeniaceae	*Lechenaultia biloba*		Native	Permitted - s11		
Haemodoraceae	*Conostylis ?setigera* subsp. *setigera*		Native	Not listed		
Haemodoraceae	*Conostylis androstemma*		Native	Permitted - s11		
Hemerocallidaceae	*Tricoryne ?tenella*		Native	Permitted - s11		
Hemerocallidaceae	*Tricoryne elatior*		Native	Permitted - s11		
Iridaceae	*?Moraea flaccida*		Introduced	Declared Pest - s22(2)		
Iridaceae	*Patersonia occidentalis*		Native	Permitted - s11		
Lamiaceae	*Hemigenia incana*		Native	Permitted - s11		
Lamiaceae	*Stachys arvensis*		Introduced	Permitted - s11	Unknown	Rapid
Lauraceae	*Cassytha sp.*		NA	NA		
Malvaceae	*?Lasiopetalum* sp. G10		NA	NA		
Myrtaceae	*?Hypocalymma* sp.		NA	NA		
Myrtaceae	*Beaufortia purpurea*	Priority 3 (DBCA)	Native	Permitted - s11		
Myrtaceae	*Calothamnus quadrifidus*		Native	Permitted - s11	High	Unknown
Myrtaceae	*Calytrix glutinosa*		Native	Permitted - s11		
Myrtaceae	*Corymbia calophylla*		Native	Permitted - s11		
Myrtaceae	*Darwinia ?pimelioides*	Priority 4 (DBCA)	Native	Not listed		
Myrtaceae	*Eucalyptus marginata* subsp. *marginata*		Native	Not listed		

Myrtaceae	*Eucalyptus wandoo* subsp. *wandoo*		Native	Not listed		
Myrtaceae	*Hypocalymma angustifolium*		Native	Permitted - s11		
Myrtaceae	*Hypocalymma robustum*		Native	Permitted - s11		
Myrtaceae	*Melaleuca ?teretifolia*		Native	Permitted - s11		
Myrtaceae	*Melaleuca* sp. G07		NA	NA		
Myrtaceae	*Melaleuca* sp. G11		NA	NA		
Myrtaceae	*Myrtaceae* sp. G03		NA	NA		
Myrtaceae	*Myrtaceae* sp. G09		NA	NA		
Myrtaceae	*Verticordia ?plumosa*		Native	Permitted - s11		
Myrtaceae	*Verticordia densiflora*		Native	Permitted - s11		
Orchidaceae	*Cyanicula ?gemmata*		Native	Not listed		
Poaceae	*?Austrostipa* sp. G07		NA	NA		
Poaceae	*?Neurachne alopecuroidea*		Native	Permitted - s11		
Poaceae	*?Themeda triandra*		Native	Permitted - s11		
Poaceae	*Aira cupaniana*		Introduced	Permitted - s11	Unknown	Rapid
Poaceae	*Briza minor*		Introduced	Permitted - s11	Unknown	Rapid
Poaceae	*Neurachne alopecuroidea*		Native	Permitted - s11		
Poaceae	*Vulpia myuros forma myuros*		Introduced	Not listed		
Primulaceae	*Lysimachia arvensis*		Introduced	Permitted - s11	Unknown	Rapid
Proteaceae	*?Grevillea* sp. G02		NA	NA		
Proteaceae	*?Grevillea* sp. T1Q3		NA	NA		
Proteaceae	*Banksia armata* var. *?armata*		Native	Not listed		
Proteaceae	*Banksia dallanneyi* subsp. *sylvestris*		Native	Not listed		
Proteaceae	*Grevillea ?pilulifera*		Native	Permitted - s11		
Proteaceae	*Hakea lissocarpha*		Native	Permitted - s11		
Proteaceae	*Hakea* sp. G02		NA	NA		
Proteaceae	*Hakea trifurcata*		Native	Permitted - s11		
Proteaceae	*Hakea undulata*		Native	Permitted - s11		
Proteaceae	*Isopogon ?dubius*		Native	Permitted - s11		
Proteaceae	*Petrophile biloba*		Native	Permitted - s11		
Proteaceae	*Synaphea gracillima*		Native	Permitted - s11		
Pteridaceae	*Cheilanthes sieberi* subsp. *sieberi*		Native	Not listed		
Rhamnaceae	*Trymalium ledifolium* ?var. *rosmarinifolium*		Native	Not listed		
Rutaceae	*?Boronia crenulata*		Native	Permitted - s11		

Rutaceae	*?Boronia* sp.		NA	NA		
Rutaceae	*Philotheca spicata*		Native	Permitted - s11		
Solanaceae	*?Solanaceae* sp.G05		NA	NA		
Stylidiaceae	*?Stylidium* sp. G02		NA	NA		
Stylidiaceae	*Stylidium schoenoides*		Native	Permitted - s11		
Stylidiaceae	*Stylidium* sp. G03		NA	NA		
Xanthorrhoeaceae	*Xanthorrhoea preissii*		Native	Permitted - s11		
Zamiaceae	*Macrozamia ?riedlei*		Native	Permitted - s11		

Appendix E Site by species matrix and species constancy within vegetation types.

Constancy-importance table

Family	Taxon	CcAsLa	HaBs, CcXpBd
Ericaceae	?*Ericaceae* sp.	–	0.25 (1.5%)
Fabaceae	?*Hovea* sp. T3Q2	0.33 (1.5%)	0.25 (1.5%)
Iridaceae	?*Moraea flaccida*	–	0.75 (1.5%)
Poaceae	?*Neurachne alopecuroidea*	0.67 (9.2%)	0.75 (1.5%)
Amaranthaceae	?*Ptilotus* sp. G02	0.67 (2.9%)	–
Fabaceae	*Acacia* ?*obovata*	–	0.25 (1.5%)
Fabaceae	*Acacia iteaphylla*	0.67 (1.5%)	0.12 (9.2%)
Fabaceae	*Acacia oncinophylla* subsp. *patulifolia*	–	0.25 (4.3%)
Fabaceae	*Acacia pulchella* var. *pulchella*	–	0.75 (5.47%)
Fabaceae	*Acacia saligna*	1 (17.33%)	–
Poaceae	*Aira cupaniana*	1 (25%)	0.12 (1.5%)
Casuarinaceae	*Allocasuarina humilis*	–	0.5 (6.62%)
Asteraceae	*Arctotheca calendula*	0.67 (1.5%)	0.25 (1.5%)
Proteaceae	*Banksia dallanneyi* subsp. *sylvestris*	–	0.75 (4.53%)
Myrtaceae	*Beaufortia purpurea*	–	0.25 (10.35%)
Boryaceae	*Borya sphaerocephala*	–	0.62 (34.44%)
Poaceae	*Briza minor*	0.67 (12.8%)	–
Colchicaceae	*Burchardia congesta*	–	0.5 (1.5%)
Myrtaceae	*Calothamnus quadrifidus*	1 (2.43%)	–
Myrtaceae	*Calytrix glutinosa*	0.33 (4.3%)	0.38 (5.93%)
Lauraceae	*Cassytha* sp.	–	0.62 (1.5%)
Pteridaceae	*Cheilanthes sieberi* subsp. *sieberi*	–	0.25 (1.5%)
Haemodoraceae	*Conostylis androstemma*	–	0.25 (2.9%)
Myrtaceae	*Corymbia calophylla*	0.67 (9.2%)	0.62 (23.38%)
Goodeniaceae	*Dampiera alata*	–	0.5 (2.2%)
Myrtaceae	*Darwinia* ?*pimelioides*	–	0.5 (5.52%)
Droseraceae	*Drosera* ?*erythrorhiza*	–	0.38 (1.5%)
Droseraceae	*Drosera* ?*glanduligera*	–	0.38 (2.43%)
Droseraceae	*Drosera* ?*macrantha*	–	0.62 (1.5%)
Droseraceae	*Drosera drummondii*	–	0.38 (1.5%)
Apocynaceae	*Gomphocarpus* ?*fruticosus*	0.67 (1.5%)	–

Proteaceae	*Hakea trifurcata*	–	1 (9.42%)
Proteaceae	*Hakea undulata*	0.67 (2.9%)	0.75 (4.07%)
Dilleniaceae	*Hibbertia ?hypericoides*	–	1 (6.62%)
Myrtaceae	*Hypocalymma angustifolium*	0.33 (1.5%)	0.75 (9.53%)
Myrtaceae	*Hypocalymma robustum*	–	0.25 (5.35%)
Proteaceae	*Isopogon ?dubius*	–	0.5 (4.82%)
Cyperaceae	*Lepidosperma squamatum*	–	0.75 (5.38%)
Fabaceae	*Lotus angustissimus*	1 (44.83%)	–
Zamiaceae	*Macrozamia ?riedlei*	–	0.25 (1.5%)
Myrtaceae	*Melaleuca* sp. G07	–	0.38 (4.07%)
Myrtaceae	*Melaleuca* sp. G11	–	0.62 (10.12%)
Cyperaceae	*Mesomelaena tetragona*	0.33 (1.5%)	0.38 (6.47%)
Myrtaceae	*Myrtaceae* sp. G03	–	0.25 (4.3%)
Proteaceae	*Petrophile biloba*	–	0.5 (5.35%)
Asteraceae	*Sonchus oleraceus*	0.67 (6.75%)	–
Stylidiaceae	*Stylidium schoenoides*	–	0.25 (1.5%)
Ericaceae	*Styphelia discolor*	–	0.25 (4.3%)
Hemerocallidaceae	*Tricoryne elatior*	–	0.25 (1.5%)
Fabaceae	*Trifolium campestre*	0.67 (5.35%)	–
Rhamnaceae	*Trymalium ledifolium* ?var. *rosmarinifolium*	–	0.5 (3.6%)
Myrtaceae	*Verticordia densiflora*	–	0.88 (7.03%)
Poaceae	*Vulpia myuros forma myuros*	0.67 (41.05%)	–
Xanthorrhoeaceae	*Xanthorrhoea preissii*	–	0.88 (6%)

Appendix F Black cockatoo tree data.

TreeID	Species	DBH	No. of hollows	Hollow size	Comments
T01	*Marri*	999			
T02	*Marri*	947			
T03	*Eucalyptus sp.*	907			
T04	*Marri*	888			
T05	*Eucalyptus sp.*	879	1	150 mm	Internal characteristics no assessed, about 10 m
T06	*Eucalyptus sp.*	844	1	> 100 mm	Internal characteristics no assessed, about 5 m
T07	*Marri*	840			
T08	*Marri*	831			
T09	*Marri*	812			
T10	*Marri*	758			
T11	*Marri*	758			
T12	*Eucalyptus sp.*	745			
T13	*Marri*	723			
T14	*Marri*	675			
T15	*Marri*	675			
T16	*Marri*	672			
T17	*Marri*	668			
T18	*Marri*	646			
T19	*Eucalyptus sp.*	627			
T20	*Marri*	621			
T21	*Marri*	595			
T22	*Marri*	581			

Appendix G Flora and vegetation sampling site data.

GOS01

Date	25/9/2024	**Site type**	10 m x 10 m quadrat	**Botanist**	AS
Northwest corner	50H 408974.7 mE 6450473.73 mN				
Landform	Hill	**Slope**	Gentle		
Soil colour	Light brown	**Soil texture**	Sand		
Rock type	Granite	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Degraded	**Disturbance**			
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
?*Neurachne alopecuroidea*	Tussock Grass (<0.5 m)	5 – 9
?*Ptilotus* sp. G02	Herb (<0.5 m)	1 – 4
Acacia ?iteaphylla	Shrub (0.5-1 m)	< 1
Acacia saligna	Shrub (1-2 m)	5 – 9
Aira cupaniana	Tussock Grass (<0.5 m)	25 – 32
Calothamnus quadrifidus	Shrub (1-2 m)	< 1
Corymbia calophylla	Tree (<10 m)	5 – 9
Gomphocarpus ?fruticosus	Herb (0.5-1 m)	< 1
Hakea undulata	Shrub (1-2 m)	1 – 4
Hypocalymma angustifolium	Shrub (0.5-1 m)	< 1
Lotus angustissimus	Herb (<0.5 m)	33 – 49
Lysimachia arvensis	Herb (<0.5 m)	10 – 24
Melilotus indicus	Herb (<0.5 m)	< 1
Mesomelaena tetragona	Sedge (0.5-1 m)	< 1
Vulpia myuros forma myuros	Tussock Grass (<0.5 m)	50 – 74

GOS02

Date	25/9/2024	**Site type**	10 m x 10 m quadrat	**Botanist**	AS
Northwest corner	50H 409110.16 mE 6450334.59 mN				
Landform	Hill	**Slope**	Moderate		
Soil colour	Light brown	**Soil texture**	Sand		
Rock type	Granite	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	< 10%
Vegetation condition	Very Good	**Disturbance**			
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
?*Grevillea* sp. G02	Shrub (0.5-1 m)	1 – 4
?*Hovea* sp. T3Q2	Shrub (<0.5 m)	< 1
?*Moraea flaccida*	Herb (<0.5 m)	< 1
?*Neurachne alopecuroidea*	Tussock Grass (<0.5 m)	< 1
Acacia iteaphylla	Shrub (0.5-1 m)	5 – 9
Acacia pulchella var. *pulchella*	Shrub (0.5-1 m)	5 – 9
Allocasuarina humilis	Shrub (0.5-1 m)	1 – 4
Banksia dallanneyi subsp. *sylvestris*	Shrub (<0.5 m)	5 – 9
Cassytha sp. G10	Herb (<0.5 m)	< 1
Conostylis androstemma	Tussock Grass (<0.5 m)	1 – 4
Corymbia calophylla	Tree (<10 m)	25 – 32
Drosera ?*macrantha*	Herb (<0.5 m)	< 1
Hakea ?*trifurcata*	Shrub (1-2 m)	10 – 24
Hakea sp. G02	Shrub (<0.5 m)	< 1
Hakea undulata	Shrub (0.5-1 m)	< 1
Hibbertia ?*hypericoides*	Shrub (0.5-1 m)	< 1
Hypocalymma ?*angustifolium*	Shrub (0.5-1 m)	1 – 4
Isopogon ?*dubius*	Shrub (0.5-1 m)	1 – 4
Lepidosperma squamatum	Sedge (0.5-1 m)	1 – 4
Macrozamia ?*riedlei*	Shrub (0.5-1 m)	Assoc.
Melaleuca sp. G11	Shrub (0.5-1 m)	1 – 4
Mesomelaena tetragona	Sedge (0.5-1 m)	< 1
Petrophile biloba	Shrub (1-2 m)	5 – 9
Verticordia densiflora	Shrub (0.5-1 m)	1 – 4
Xanthorrhoea preissii	Shrub (0.5-1 m)	1 – 4

GOS03

Date	25/9/2024	**Site type**	10 m x 10 m quadrat	**Botanist**	AS
Northwest corner	50H 409223.07 mE 6450278.72 mN				
Landform	Hill	**Slope**	Gentle		
Soil colour	Light brown	**Soil texture**	Sand		
Rock type	Granite	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	10 – 30%
Vegetation condition	Excellent	**Disturbance**	Weed		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
?*Boronia crenulata*	Shrub (<0.5 m)	1 – 4
?*Hypocalymma* sp. (seedling)	Shrub (<0.5 m)	< 1
?*Moraea flaccida*	Herb (<0.5 m)	< 1
?*Neurachne alopecuroidea*	Tussock Grass (<0.5 m)	< 1
?*Stylidium schoenoides*	Herb (<0.5 m)	< 1
Aira cupaniana	Tussock Grass (<0.5 m)	< 1
Allocasuarina humilis	Shrub (0.5-1 m)	1 – 4
Arctotheca calendula	Herb (<0.5 m)	< 1
Banksia dallanneyi subsp. *sylvestris*	Shrub (<0.5 m)	< 1
Borya sphaerocephala	Herb (<0.5 m)	25 – 32
Calytrix glutinosa	Shrub (<0.5 m)	1 – 4
Darwinia ?pimelioides	Shrub (<0.5 m)	1 – 4
Drosera ?erythrorhiza	Herb (<0.5 m)	< 1
Drosera ?glanduligera	Herb (<0.5 m)	< 1
Drosera drummondii	Herb (<0.5 m)	< 1
Hakea ?trifurcata	Shrub (<0.5 m)	5 – 9
Hakea undulata	Shrub (<0.5 m)	< 1
Hemigenia incana	Shrub (0.5-1 m)	< 1
Hibbertia ?hypericoides	Shrub (<0.5 m)	Assoc.
Hypocalymma ?angustifolium	Shrub (0.5-1 m)	1 – 4
Isopogon ?dubius	Shrub (<0.5 m)	1 – 4
Lepidosperma squamatum	Sedge (<0.5 m)	1 – 4
Melaleuca sp. G11	Shrub (<0.5 m)	5 – 9
Millotia tenuifolia	Herb (<0.5 m)	< 1

Myrtaceae sp. G03	Shrub (<0.5 m)	1 – 4
Petrophile biloba	Shrub (0.5-1 m)	5 – 9
Stachys arvensis	Herb (<0.5 m)	< 1
Stylidium sp. G03	Herb (<0.5 m)	< 1
Thysanotus ?patersonii	Herb (<0.5 m)	< 1
Tricoryne elatior	Herb (<0.5 m)	< 1
Verticordia densiflora	Shrub (0.5-1 m)	10 – 24
Xanthorrhoea preissii	Shrub (1-2 m)	5 – 9

GOS04

Date	25/9/2024	**Site type**	10 m x 10 m quadrat	**Botanist**	AS
Northwest corner	50H 409126 mE 6450421.98 mN				
Landform	Hill	**Slope**	Gentle		
Soil colour	Light brown	**Soil texture**	Sand		
Rock type	Granite	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	30 – 70%
Vegetation condition	Very Good	**Disturbance**	several weed sp		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
?*Asteraceae* sp. G02	Herb (<0.5 m)	5 – 9
?*Hovea* sp. T3Q2	Shrub (0.5-1 m)	< 1
?*Ptilotus* sp. G02	Herb (<0.5 m)	< 1
?*Stylidium* sp. G02	Herb (<0.5 m)	5 – 9
Acacia saligna	Shrub (1-2 m)	10 – 24
Aira cupaniana	Tussock Grass (<0.5 m)	5 – 9
Arctotheca calendula	Herb (<0.5 m)	< 1
Briza minor	Tussock Grass (<0.5 m)	5 – 9
Calothamnus quadrifidus	Shrub (0.5-1 m)	1 – 4
Calytrix glutinosa	Shrub (<0.5 m)	1 – 4
Hakea lissocarpha	Shrub (<0.5 m)	1 – 4
Hakea undulata	Shrub (0.5-1 m)	Assoc.
Hypochaeris ?radicata	Herb (<0.5 m)	5 – 9
Lotus angustissimus	Herb (<0.5 m)	50 – 74
Sonchus asper	Herb (0.5-1 m)	< 1
Sonchus oleraceus	Herb (<0.5 m)	5 – 9
Trifolium campestre	Herb (<0.5 m)	< 1

GOS05

Date	25/9/2024	**Site type**	10 m x 10 m quadrat	**Botanist**	AS
Northwest corner	50H 409116.8 mE 6450458.92 mN				
Landform	Hill	**Slope**	Gentle		
Soil colour	Light brown	**Soil texture**	Sand		
Rock type	Granite	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	30 – 70%
Vegetation condition	Degraded	**Disturbance**	several weed sp		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
?*Asteraceae* sp. G03	Herb (<0.5 m)	5 – 9
?*Corymbia calophylla*	Tree (<10 m)	5 – 9
?*Hypochaeris* sp. G05	Herb (<0.5 m)	< 1
?*Neurachne alopecuroidea*	Tussock Grass (<0.5 m)	5 – 9
?*Solanaceae* sp.G05	Herb (<0.5 m)	1 – 4
Acacia ?iteaphylla	Shrub (<0.5 m)	< 1
Acacia saligna	Shrub (1-2 m)	25 – 32
Aira cupaniana	Tussock Grass (<0.5 m)	33 – 49
Arctotheca calendula	Herb (<0.5 m)	< 1
Briza minor	Tussock Grass (<0.5 m)	10 – 24
Calothamnus quadrifidus	Shrub (<0.5 m)	< 1
Gomphocarpus ?fruticosus	Herb (0.5-1 m)	< 1
Lotus angustissimus	Herb (<0.5 m)	33 – 49
Lupinus angustifolius	Herb (0.5-1 m)	Assoc.
Sonchus oleraceus	Herb (<0.5 m)	1 – 4
Trifolium campestre	Herb (<0.5 m)	5 – 9
Vulpia myuros forma myuros	Tussock Grass (<0.5 m)	25 – 32

GOS06

Date	25/9/2024	**Site type**	10 m x 10 m quadrat	**Botanist**	AS
Northwest corner	50H 409109.53 mE 6450299.89 mN				
Landform	Hill	**Slope**	Gentle		
Soil colour	Light brown	**Soil texture**	Sand		
Rock type	Granite	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	< 10%
Vegetation condition	Excellent	**Disturbance**			
Time since fire	Long (> 3 yrs)				

Name	Stratum	Percent cover (%)
?*Grevillea* sp. T1Q3	Shrub (0.5-1 m)	1 – 4
?*Hovea* sp. T3Q2	Shrub (0.5-1 m)	< 1
?*Moraea flaccida*	Herb (<0.5 m)	< 1
?*Neurachne alopecuroidea*	Tussock Grass (<0.5 m)	< 1
?*Themeda triandra*	Tussock Grass (0.5-1 m)	< 1
Acacia pulchella var. *pulchella*	Shrub (<0.5 m)	1 – 4
Arctotheca calendula	Herb (<0.5 m)	< 1
Banksia dallanneyi subsp. *sylvestris*	Shrub (0.5-1 m)	5 – 9
Beaufortia purpurea	Shrub (0.5-1 m)	1 – 4
Borya sphaerocephala	Herb (<0.5 m)	1 – 4
Burchardia congesta	Herb (<0.5 m)	< 1
Cassytha sp. G10	Herb (0.5-1 m)	< 1
Conostylis androstemma	Tussock Grass (<0.5 m)	< 1
Corymbia calophylla	Tree (<10 m)	50 – 74
Dampiera alata	Herb (<0.5 m)	< 1
Drosera ?*macrantha*	Herb (<0.5 m)	< 1
Hakea trifurcata	Shrub (1-2 m)	10 – 24
Hakea undulata	Shrub (0.5-1 m)	< 1
Hibbertia ?*hypericoides*	Shrub (0.5-1 m)	10 – 24
Hypocalymma ?*angustifolium*	Shrub (0.5-1 m)	1 – 4
Hypocalymma robustum	Shrub (<0.5 m)	5 – 9
Lechenaultia biloba	Herb (<0.5 m)	< 1
Lepidosperma squamatum	Sedge (0.5-1 m)	10 – 24
Melaleuca sp. G07	Shrub (0.5-1 m)	5 – 9
Melaleuca sp. G11	Shrub (<0.5 m)	1 – 4
Mesomelaena tetragona	Sedge (0.5-1 m)	10 – 24
Myrtaceae sp. G03	Shrub (0.5-1 m)	1 – 4
Synaphea gracillima	Shrub (<0.5 m)	< 1
Tricoryne elatior	Herb (0.5-1 m)	< 1
Trymalium ledifolium ?var. *rosmarinifolium*	Shrub (0.5-1 m)	1 – 4
Verticordia densiflora	Shrub (0.5-1 m)	5 – 9
Xanthorrhoea preissii	Shrub (1-2 m)	5 – 9

GOS07

Date	18/9/2024	**Site type**	10 m x 10 m quadrat	**Botanist**	AS
Northwest corner	50H 409049.13 mE 6450721.39 mN				
Landform	Hill	**Slope**	Gentle		
Soil colour	Light brown	**Soil texture**	Sand		
Rock type	Granite	**Rock size**	Mixed	**Rock cover**	> 70%
Vegetation condition	Very Good	**Disturbance**	Weed		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
?*Asteraceae* sp. G07	Herb (<0.5 m)	< 1
?*Austrostipa* sp. G07	Tussock Grass (<0.5 m)	< 1
?*Boronia* sp.	Shrub (1-2 m)	1 – 4
?*Moraea flaccida*	Herb (0.5-1 m)	< 1
?*Neurachne alopecuroidea*	Tussock Grass (<0.5 m)	< 1
?*Pterochaeta paniculata*	Herb (<0.5 m)	< 1
Acacia oncinophylla subsp. *patulifolia*	Shrub (> 2 m)	1 – 4
Acacia pulchella var. *pulchella*	Shrub (1-2 m)	1 – 4
Borya sphaerocephala	Herb (<0.5 m)	33 – 49
Burchardia congesta	Herb (<0.5 m)	< 1
Calytrix glutinosa	Shrub (1-2 m)	5 – 9
Cheilanthes sieberi subsp. *sieberi*	Herb (<0.5 m)	< 1
Cyanicula ?gemmata	Herb (<0.5 m)	< 1
Darwinia ?pimelioides	Shrub (0.5-1 m)	5 – 9
Drosera ?erythrorhiza	Herb (<0.5 m)	< 1
Drosera ?macrantha	Herb (<0.5 m)	< 1
Hakea trifurcata	Shrub (1-2 m)	1 – 4
Hibbertia ?hypericoides	Shrub (0.5-1 m)	1 – 4
Hibbertia ?polystachya	Shrub (0.5-1 m)	< 1
Hypocalymma ?angustifolium	Shrub (1-2 m)	10 – 24
Isopogon ?dubius	Shrub (0.5-1 m)	< 1
Lepidosperma squamatum	Sedge (0.5-1 m)	< 1
Melaleuca sp. G07	Shrub (<0.5 m)	< 1
Petrophile biloba	Shrub (1-2 m)	< 1

Platysace ?*filiformis*	Herb (<0.5 m)	< 1
Styphelia discolor	Shrub (0.5-1 m)	1 – 4
Trymalium ledifolium ?var. *rosmarinifolium*	Shrub (<0.5 m)	1 – 4
Verticordia densiflora	Shrub (0.5-1 m)	< 1
Xanthorrhoea preissii	Shrub (1-2 m)	1 – 4

GOS08

Date	18/9/2024	**Site type**	10 m x 10 m quadrat	**Botanist**	AS
Northwest corner	50H 408885.01 mE 6450560.95 mN				
Landform	Hill	**Slope**	Gentle		
Soil colour	Light brown	**Soil texture**	Sand		
Rock type	Granite	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	< 10%
Vegetation condition	Excellent	**Disturbance**			
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
?*Neurachne alopecuroidea*	Tussock Grass (<0.5 m)	< 1
Acacia pulchella var. *pulchella*	Shrub (1-2 m)	1 – 4
Banksia dallanneyi subsp. *sylvestris*	Shrub (<0.5 m)	Assoc.
Beaufortia purpurea	Shrub (0.5-1 m)	10 – 24
Borya sphaerocephala	Herb (<0.5 m)	25 – 32
Cassytha sp. G10	Herb (<0.5 m)	< 1
Corymbia calophylla	Tree (<10 m)	5 – 9
Dampiera alata	Herb (<0.5 m)	1 – 4
Drosera ?*glanduligera*	Herb (<0.5 m)	1 – 4
Drosera ?*macrantha*	Vine (<0.5 m)	< 1
Drosera drummondii	Herb (<0.5 m)	< 1
Eucalyptus wandoo subsp. *wandoo*	Tree (<10 m)	5 – 9
Hakea trifurcata	Shrub (1-2 m)	5 – 9
Hakea undulata	Shrub (1-2 m)	5 – 9
Hibbertia ?*hypericoides*	Shrub (0.5-1 m)	10 – 24
Hypocalymma ?*angustifolium*	Shrub (<0.5 m)	< 1
Melaleuca sp. G07	Shrub (<0.5 m)	< 1
Melaleuca sp. G11	Shrub (0.5-1 m)	10 – 24
Patersonia occidentalis	Herb (0.5-1 m)	1 – 4
Philotheca spicata	Shrub (0.5-1 m)	1 – 4
Stylidium schoenoides	Herb (<0.5 m)	< 1
Verticordia ?*plumosa*	Shrub (0.5-1 m)	1 – 4
Verticordia densiflora	Shrub (1-2 m)	5 – 9
Xanthorrhoea preissii	Shrub (1-2 m)	< 1

GOS09

Date	18/9/2024	**Site type**	10 m x 10 m quadrat	**Botanist**	AS
Northwest corner	50H 409181.41 mE 6450791.41 mN				
Landform	Hill	**Slope**	Moderate		
Soil colour	Light brown	**Soil texture**	Sand		
Rock type	Granite	**Rock size**	Mixed	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**			
Time since fire	Long (> 3 yrs)				

Name	Stratum	Percent cover (%)
Acacia oncinophylla subsp. *patulifolia*	Shrub (1-2 m)	1 – 4
Allocasuarina humilis	Shrub (0.5-1 m)	< 1
Banksia armata var. *?armata*	Shrub (1-2 m)	1 – 4
Borya sphaerocephala	Herb (<0.5 m)	75 – 94
Cassytha sp. G10	Herb (0.5-1 m)	< 1
Darwinia ?pimelioides	Shrub (0.5-1 m)	1 – 4
Drosera ?glanduligera	Herb (<0.5 m)	< 1
Drosera drummondii	Herb (<0.5 m)	< 1
Hakea trifurcata	Shrub (1-2 m)	5 – 9
Hibbertia ?hypericoides	Shrub (<0.5 m)	1 – 4
Hypocalymma ?angustifolium	Shrub (1-2 m)	25 – 32
Lepidosperma squamatum	Sedge (0.5-1 m)	1 – 4
Mirbelia spinosa	Shrub (<0.5 m)	< 1
Myrtaceae sp. G09	Shrub (<0.5 m)	5 – 9
Petrophile biloba	Shrub (1-2 m)	< 1
Trymalium ledifolium ?var. *rosmarinifolium*	Shrub (0.5-1 m)	< 1
Verticordia densiflora	Shrub (0.5-1 m)	1 – 4

GOS10

Date	18/9/2024	**Site type**	10 m x 10 m quadrat	**Botanist**	AS
Northwest corner	50H 409113.14 mE 6450850.77 mN				
Landform	Hill	**Slope**	Gentle		
Soil colour	Light brown	**Soil texture**	Sand		
Rock type	Granite	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	30 – 70%
Vegetation condition	Very Good	**Disturbance**	Weed		
Time since fire	Long (> 3 yrs)				

Name	Stratum	Percent cover (%)
?*Ericaceae* sp.	Herb (<0.5 m)	< 1
?*Lasiopetalum* sp. G10	Shrub (<0.5 m)	< 1
?*Moraea flaccida*	Herb (0.5-1 m)	< 1
Acacia ?*obovata*	Shrub (<0.5 m)	< 1
Acacia preissiana	Herb (<0.5 m)	< 1
Acacia pulchella var. *pulchella*	Shrub (<0.5 m)	< 1
Banksia dallanneyi subsp. *sylvestris*	Shrub (<0.5 m)	< 1
Burchardia congesta	Herb (0.5-1 m)	< 1
Cassytha sp. G10	Herb (<0.5 m)	< 1
Conostylis ?*setigera* subsp. *setigera*	Herb (<0.5 m)	< 1
Corymbia calophylla	Tree (<10 m)	10 – 24
Dampiera alata	Herb (<0.5 m)	< 1
Drosera ?*erythrorhiza*	Herb (<0.5 m)	< 1
Eucalyptus ?*marginata* subsp. *marginata*	Tree (10-30 m)	10 – 24
Fabaceae sp. G10	Herb (<0.5 m)	< 1
Gompholobium marginatum	Herb (<0.5 m)	< 1
Grevillea ?*pilulifera*	Shrub (0.5-1 m)	< 1
Hakea trifurcata	Shrub (0.5-1 m)	< 1
Hakea undulata	Shrub (0.5-1 m)	< 1
Hibbertia ?*hypericoides*	Shrub (0.5-1 m)	1 – 4
Hydrocotyle intertexta	Herb (<0.5 m)	< 1
Hypocalymma robustum	Shrub (0.5-1 m)	< 1
Lepidosperma squamatum	Sedge (0.5-1 m)	< 1
Leucopogon ?*polymorphus*	Shrub (<0.5 m)	< 1
Macrozamia ?*riedlei*	Shrub (0.5-1 m)	< 1
Melaleuca ?*teretifolia*	Shrub (0.5-1 m)	1 – 4
Neurachne alopecuroidea	Tussock Grass (<0.5 m)	< 1
Tricoryne ?*tenella*	Herb (0.5-1 m)	< 1
Xanthorrhoea preissii	Shrub (1-2 m)	5 – 9

GOS11

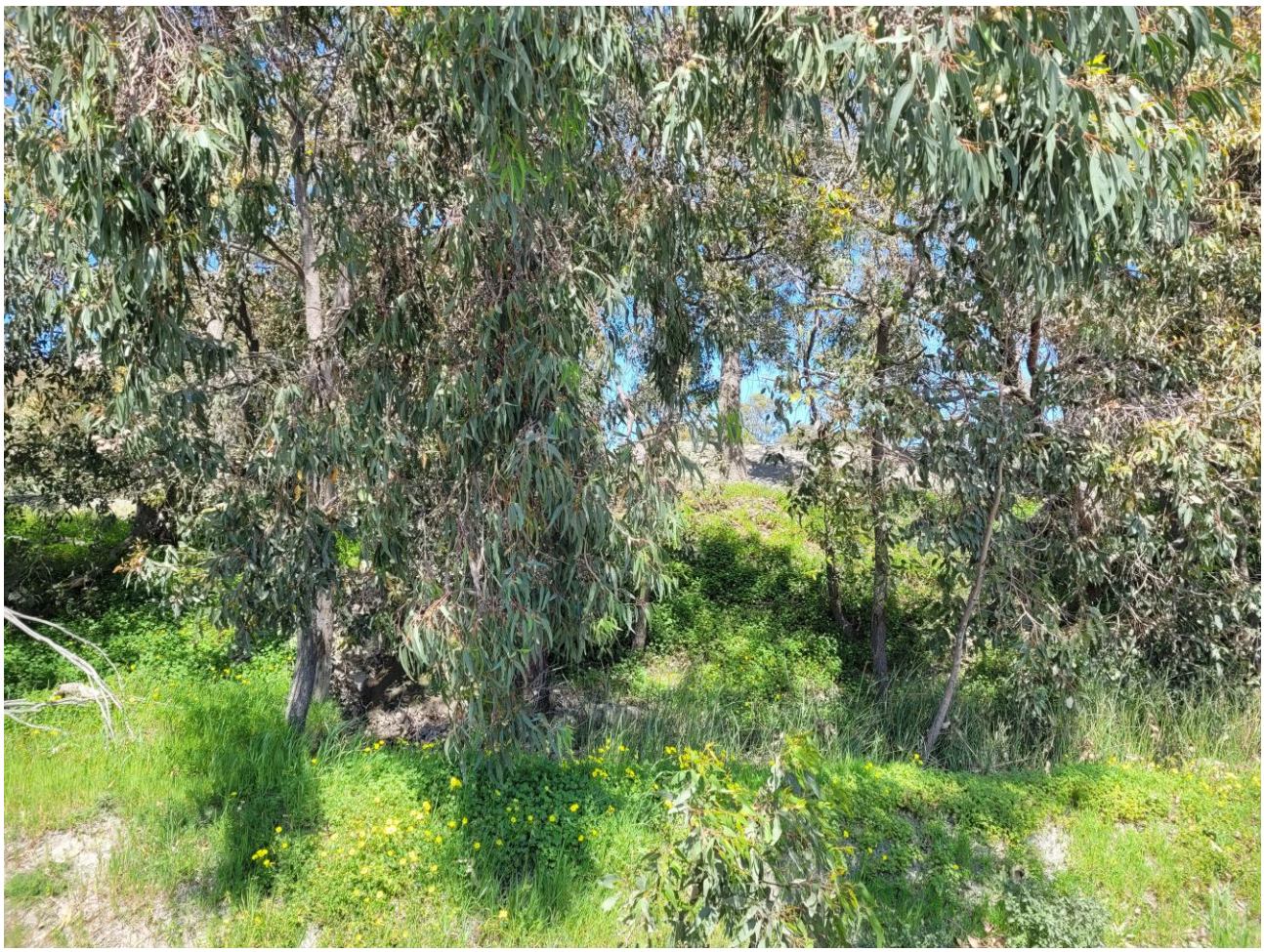
Date	18/9/2024	**Site type**	10 m x 10 m quadrat	**Botanist**	AS
Northwest corner	50H 409015.93 mE 6450654.65 mN				
Landform	Hill	**Slope**	Moderate		
Soil colour	Light brown	**Soil texture**	Sand		
Rock type	Granite	**Rock size**	Mixed	**Rock cover**	10 – 30%
Vegetation condition	Very Good	**Disturbance**	Weed		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
?*Ericaceae* sp.	Herb (<0.5 m)	< 1
?*Moraea flaccida*	Herb (<0.5 m)	< 1
?*Neurachne alopecuroidea*	Tussock Grass (<0.5 m)	< 1
Acacia ?*obovata*	Shrub (<0.5 m)	< 1
Acacia pulchella var. *pulchella*	Shrub (1-2 m)	5 – 9
Allocasuarina humilis	Shrub (1-2 m)	10 – 24
Banksia dallanneyi subsp. *sylvestris*	Shrub (<0.5 m)	1 – 4
Burchardia congesta	Herb (<0.5 m)	< 1
Calytrix glutinosa	Shrub (0.5-1 m)	1 – 4
Cheilanthes sieberi subsp. *sieberi*	Herb (<0.5 m)	< 1
Corymbia calophylla	Tree (<10 m)	5 – 9
Dampiera alata	Herb (<0.5 m)	< 1
Darwinia ?*pimelioides*	Shrub (1-2 m)	1 – 4
Drosera ?*macrantha*	Herb (<0.5 m)	< 1
Hakea trifurcata	Shrub (1-2 m)	5 – 9
Hakea undulata	Shrub (1-2 m)	5 – 9
Hibbertia ?*hypericoides*	Shrub (0.5-1 m)	1 – 4
Isopogon ?*dubius*	Shrub (0.5-1 m)	5 – 9
Lepidosperma asperatum	Sedge (0.5-1 m)	< 1
Melaleuca sp. G11	Shrub (1-2 m)	10 – 24
Mesomelaena tetragona	Sedge (0.5-1 m)	< 1
Styphelia discolor	Shrub (0.5-1 m)	1 – 4
Trymalium ledifolium ?var. *rosmarinifolium*	Shrub (0.5-1 m)	1 – 4
Verticordia densiflora	Shrub (0.5-1 m)	1 – 4
Xanthorrhoea preissii	Shrub (0.5-1 m)	1 – 4

VD02

Date	25/9/2024	**Site type**	Veg desc.	**Botanist**	SN
Northwest corner	50H 407954.26 mE 6451361.85 mN				
Landform	Footslope	**Slope**	Steep		
Soil colour	Light brown	**Soil texture**	Sand		
Rock type	Granite	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	< 10%
Vegetation condition	Degraded	**Disturbance**	Weed		
Time since fire	No evidence				



VD03

Date	25/9/2024	**Site type**	Veg desc.	**Botanist**	SN
Northwest corner	50H 407929.11 mE 6451346.22 mN				
Landform	Footslope	**Slope**	Steep		
Soil colour	Light brown	**Soil texture**	Sand		
Rock type	Granite	**Rock size**	Mixed	**Rock cover**	< 10%
Vegetation condition	Degraded	**Disturbance**	Weed		
Time since fire	No evidence				



VD04

Date	25/9/2024	**Site type**	Veg desc.	**Botanist**	SN
Northwest corner	50H 407870.28 mE 6451295.91 mN				
Landform	Footslope	**Slope**	Steep		
Soil colour	Light brown	**Soil texture**	Sand		
Rock type	Granite	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	< 10%
Vegetation condition	Degraded	**Disturbance**	Weed		
Time since fire	No evidence				



VD05

Date	25/9/2024	**Site type**	Veg desc.	**Botanist**	SN
Northwest corner	50H 407907.02 mE 6451407.65 mN				
Landform	Footslope	**Slope**	Steep		
Soil colour	Light brown	**Soil texture**	Sand		
Rock type	Granite	**Rock size**	Mixed	**Rock cover**	< 10%
Vegetation condition	Degraded	**Disturbance**	Weed		
Time since fire	No evidence				

