Proten Western Australia Pty Ltd

Flora and Fauna Survey

Hunter Road and Brand Highway Intersection

February 2024



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Flora and Fauna Survey
Hunter Road and Brand Highway Intersection

Proten Western Australia Pty Ltd

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Approved by:	Rob Harrison	07/02/2024	

WSP acknowledges that every project we work on takes place on First Peoples lands.
We recognise Aboriginal and Torres Strait Islander Peoples as the first scientists and engineers and pay our respects to Elders past and present.

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Executive summary

ProTen Western Australia Pty Ltd (ProTen) is proposing to undertake road works to improve the intersection of Hunter Road and Brand Highway in Regans Ford, approximately 105 km north of Perth in the Shire of Dandaragan, Western Australia (WA) (the Project).

ProTen engaged a suitably qualified ecologist to conduct a survey to assess the flora, vegetation, and fauna values within the survey area and to identify any significant flora, vegetation, and fauna populations. As part of the assessment a desktop review of relevant background information was completed, and a field survey was undertaken 6 September 2023. During the field survey an assessment was made on the type, condition, and values of vegetation across the survey area.

Three quadrats and one relevé were assessed within the survey area. The relevé was selected in areas of native vegetation representing the best condition within the survey area. This improved the robustness of the assessment by maximising the opportunity to detect any conservation significant flora and to evaluate the presence of threatened ecological communities (TECs).

Outcomes of the survey include the following:

- A total of 43 native and 8 non-native (weed) flora species were recorded within the survey area during the field survey, representing 24 families and 44 genera.
- No threatened flora species were recorded within the survey area.
- One priority flora taxon (*Hibbertia subvillosa* (P3)) was recorded within the survey area.
- The native vegetation within the survey area was mapped as single plant community (BpNfHvAh).
- The BpNfHvAh plant community aligns closely with floristic community type (FCT) "23c North-eastern *Banksia attenuata* – *Banksia menziesii* woodlands".
- Most of the survey area contains relatively intact native vegetation in 'excellent' (0.22 ha), 'very good' (0.03 ha), and 'good' (0.13 ha) condition. The remainder of the survey area is in 'degraded' or 'completely degraded' condition (0.1 ha).
- The native vegetation within the survey area (BpNfHvAh) is in "excellent to good" condition that meet the minimum condition and/or size threshold with some patches in poorer condition that do not meet the minimum condition and/or size threshold.
- Approximately 0.48 ha of the banksia woodland of the Swan Coastal Plain TEC/PEC, which meet the minimum condition and/or size threshold, is present within the survey area.
- Given the presence of additional areas of '*Banksia* woodland' vegetation directly adjacent to the survey area, the BpNfHvAh vegetation within the survey area forms part of a much larger contiguous patch of the TEC/PEC.

1 Introduction

1.1 Project background

ProTen Western Australia Pty Ltd (ProTen) is proposing to undertake road works to improve the intersection of Hunter Road and Brand Highway in Regans Ford, approximately 105 km north of Perth in the Shire of Dandaragan, Western Australia (WA) (the Project). The Project Area (area within which the proposed activities will occur) is shown on Figure 1.1. The Project area consists of four survey areas. ProTen has engaged WSP to assess the flora, vegetation, and fauna values within the survey area to support a Native Vegetation Clearing Permit (NVCP).

The Project aims to provide better and safer traffic flow for road users. ProTen was engaged by Main Roads Western Australia (MRWA) to plan and undertake the proposed road works at the intersection. ProTen is seeking approval to clear up to 0.48 hectares (ha) of native vegetation to support the Project. The proposed native vegetation clearing areas (NVCAs) (areas that are proposed to be cleared of native vegetation) within the Survey area are shown on Figure 1.1.

1.2 Purpose and scope of work

The purpose of the NVCP application is to seek approval to clear up to 0.48 ha of native vegetation within the proposed NVCAs (as shown on Figure 1.1), to allow ProTen to undertake the following road works at the intersection of the Hunter Road and Brand Highway:

- widening of Hunter Road and Brand Highway intersection to provide safer access
- improve turning and intersection lanes (including a dedicated turning lane)
- improve drainage.

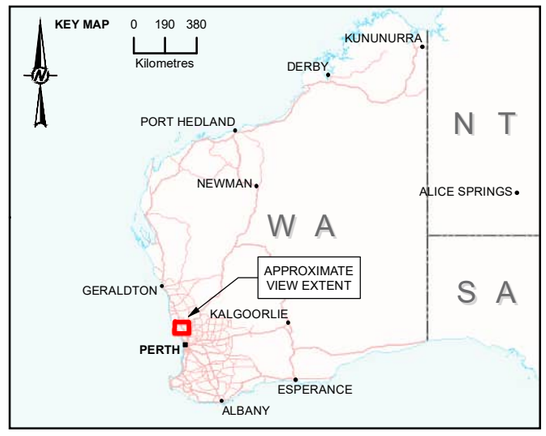
A suitably qualified ecologist has been engaged by ProTen to support the NVCP application by assessing the flora, vegetation, and fauna values within the survey area and to identify any significant flora, vegetation, and fauna populations. The scope of work included:

- Reconnaissance flora and vegetation survey compliant with the Environmental Protection Authority (EPA) (2016b) *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* and other relevant State and Federal guidelines and legislation. The flora and vegetation survey scope included the following:
  - a desktop study of the flora and vegetation of the survey area, with an emphasis on threatened and priority flora and conservation significant ecological communities
  - low intensity sampling to collect botanical data from quadrats or relevés in the survey area
  - recording visual observations on the fire regimes, grazing pressures, and overall health of the vegetation to allow for an assessment of the overall condition of the flora and vegetation communities
  - identifying and recording the locations of any declared pest organisms or weed species
  - providing advice on the local and regional significance of the vegetation communities.
- Basic fauna survey and a black cockatoo habitat assessment compliant with the EPA (2020) *Technical Guidance – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment*. The fauna survey scope included the following:
  - A desktop study to gather contextual information using the Department of Biodiversity, Conservation and Attractions' (DBCA's) threatened and priority fauna database, NatureMap, the Department of Climate Change, Energy, the Environment and Water (DCCEEW) Protected Matters Search Tool (PMST) and other publicly available literature and spatial data;
  - A day-time general fauna survey and habitat assessment to validate the findings from the desktop study, assess habitat types, hollows, scats, and condition and record opportunistic sightings of fauna species; and
- Documenting the results of the assessment including the preparation of relevant spatial data.



LEGEND

PROJECT AREA



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1:250,000 METRES

NOTE:
1. COORDINATE SYSTEM: GDA 1994 MGA ZONE 50

REFERENCES:
1. AERIAL IMAGE SOURCED FROM ESRI BASEMAP

CLIENT
PROTEN WESTERN AUSTRALIA PTY LTD

PROJECT
HUNTER ROAD NVCP

TITLE
SITE LOCATION

CONSULTANT

YYYY-MM-DD	2024-02-07
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PREPARED	JE
REVIEWED	RD
APPROVED	

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2 Environmental context

2.1 Physical environment

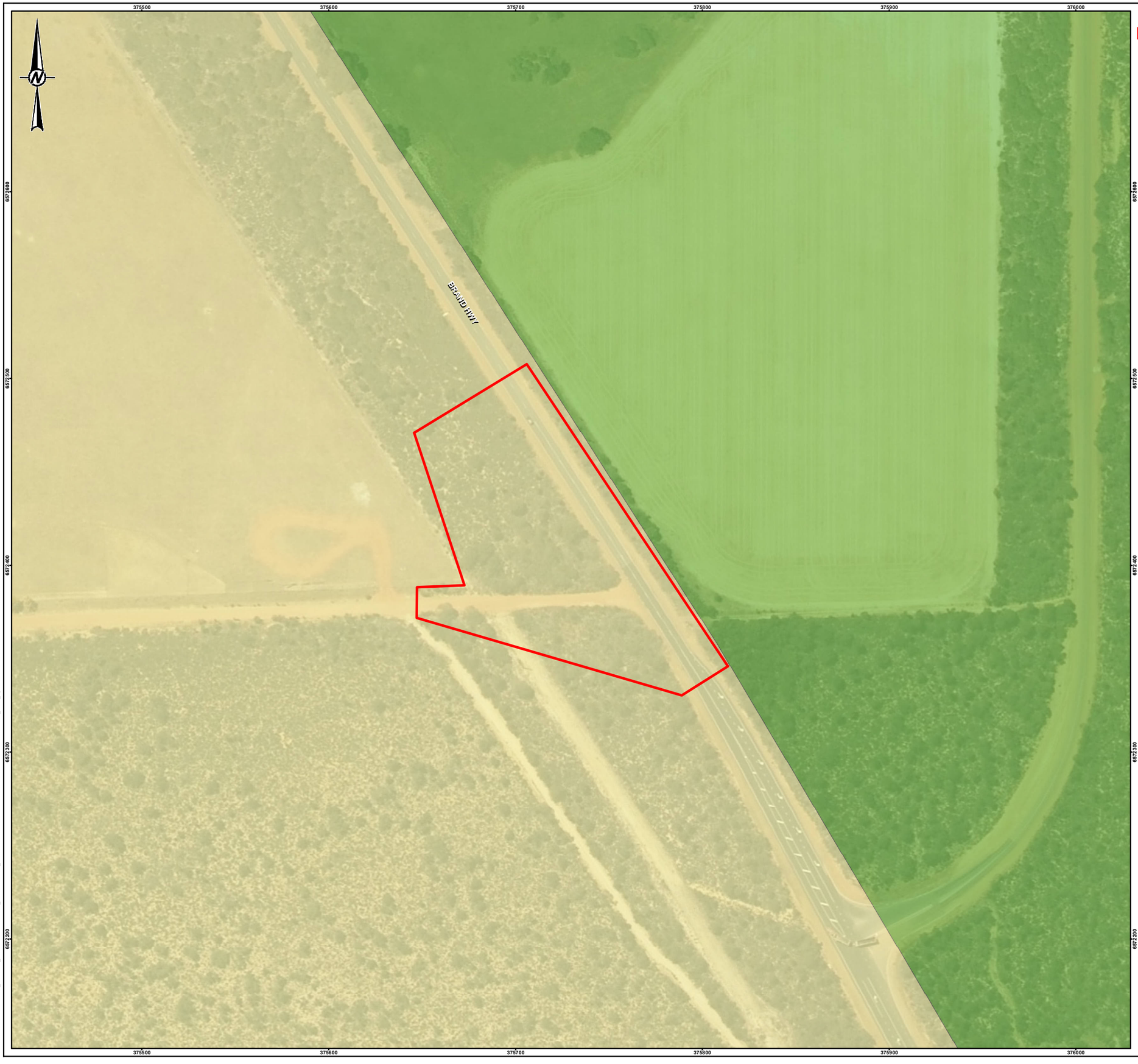
2.1.1 Geology, landforms, and soils

Landform and soils influence fauna habitat and species at regional and local scales. The Project area lies in the Swan Coastal Plain Interim Biogeographic Regionalisation of Australia (IBRA) region and the Dandaragan Plateau subregion.

The geology bedrock of the site forms part of the Warnbro Group of the Perth Basin and is described as interbedded sandstone, siltstone, and shale, with minor conglomerate (GHD 2016). The Department of Primary Industries and Regional Development (DPIRD) has compiled data from various surveys to produce a soil landscape mapping dataset for Western Australia.

Table 2.1 Extent of soil landscape from the land system mapping units close to the survey area

Land system	Description	State-wide current extent (HA)	Survey area	
			Area of intersection (HA)	Proportion of current extent (%)
212Mo – Moore River System	Alluvial flats; Swan Coastal Plain west of Gingin; wet soil, semi-wet soil, pale and yellow deep sands; Woodlands and heaths	10720.44	0.48	0.0045
222Mm – Moochamulla System	level to gently undulating plain being a relict flood plain, partially rejuvenated; sandy duplex, sandy earth, some sandy gravel; alluvium and weathered sandstone	Not intersecting within the survey area		



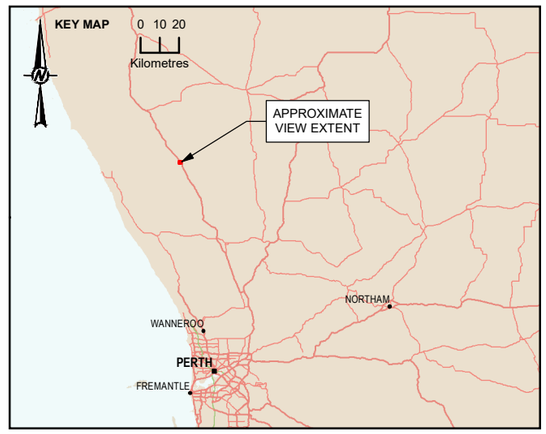
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PROJECT AREA

LAND SYSTEM

212Mo - Moore River System - Alluvial flats; Swan Coastal Plain west of Gingin; wet soil, semi-wet soil, pale and yellow deep sands; Woodlands and heaths

222Mm - Moochamulla System - level to gently undulating plain being a relict flood plain, partially rejuvenated; sandy duplex, sandy earth, some sandy gravel; alluvium and weathered sandstone



0 50 100

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REFERENCES:
1. AERIAL IMAGE SOURCED FROM LANDGATE

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PROJECT
HUNTER ROAD NVCP

TITLE
LAND SYSTEMS

CONSULTANT
wsp

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2.1.2 Hydrology and wetlands

Wetlands are areas of seasonally, intermittently, or permanently waterlogged land, such as poorly drained soils, ponds, billabongs, lakes, swamps, tidal flats, estuaries, rivers, and their tributaries (Wetlands Advisory Committee 1977).

Wetlands can be recognised by the presence of vegetation associated with waterlogging or the presence of hydric soils such as peat, peaty sand, or carbonate mud (Hill *et al*. 1996).

Wetlands of national or international significance may be afforded special protection under Commonwealth or international agreements. The following lists of important wetlands were checked as part of this assessment:

- Ramsar List of Wetlands of International Importance (DBCA 2017)
- A Directory of Important Wetlands in Australia (DBCA 2018).

The DBCA Swan Coastal Plain Geomorphic Wetlands Study identified four small geomorphic dampland and swamplands approximately 500 m to the north of the project area and the Moore River approximately 1 km south-east of the project area (DBCA 2019).

2.2 Biological environment

2.2.1 Interim Biogeographic Regionalisation of Australia

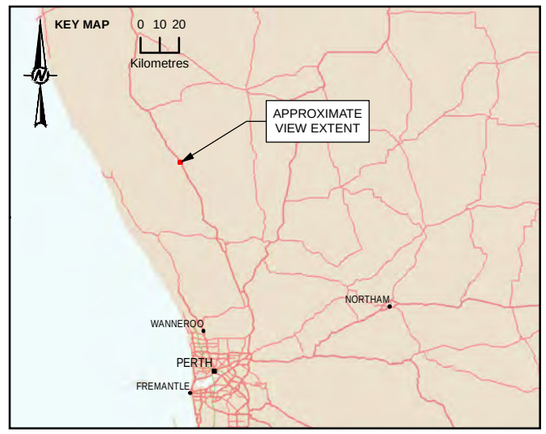
The Interim Biogeographic Regionalisation for Australia (IBRA version 7) divides the Australian continent into 89 bioregions and 419 subregions (Department of the Environment, 2015c). IBRA regions represent a landscape-based approach to classifying the land surface, including attributes of climate, geomorphology, landform, lithology, and characteristic flora and fauna. Specialist ecological knowledge, combined with appropriate regional and continental scale biophysical datasets were interpreted to define and describe these regions (Thackway and Cresswell 1995). Information about each subregion is used to help determine which ecosystems are adequately protected in the conservation estate.

The project area is contained within the Swan Coastal Plain IBRA region (Figure 2.2) and Dandaragan Plateau subregion (Figure 2.3). The Swan Coastal Plain is approximately 500 km long and 20 to 30 km wide and is roughly bound by the Indian Ocean to the west and the Darling Scarp to the east. Broadly the Swan Coastal Plain consists of two sedimentary belts of different origin. Its eastern side comprises the Pinjarra Plain which formed from the deposition of alluvial material washed down from the Darling Scarp, while its western side comprises three dune systems that run roughly parallel to the Indian Ocean coastline (Seddon 2004). The subregion plateau is described as ‘bordered by Derby and Dandaragan Faults. Cretaceous marine sediments are mantled by sands and laterites’ and is characterised by ‘Banksia low woodland, Jarrah-Marri woodland, Marri woodland, and by scrub-heaths on laterite pavement and on gravelly sandplains’ (Desmond 2001 and GHD 2016).



LEGEND

- PROJECT AREA
- SWAN COASTAL PLAIN IBRA REGION



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REFERENCES:
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INTERIM BIOGEOGRAPHIC REGIONALISATION FOR AUSTRALIA - IBRA REGIONS

CONSULTANT

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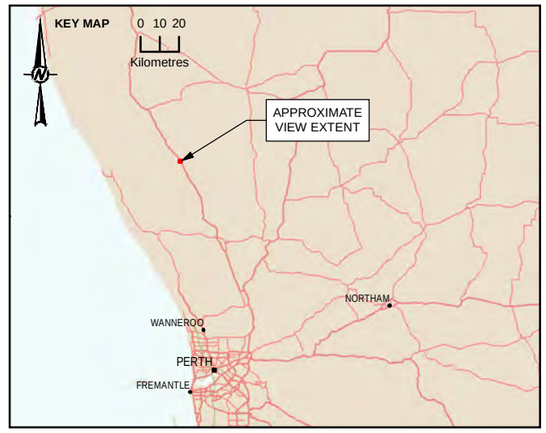
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- PROJECT AREA
- WAR01 - WARREN IBRA SUBREGION



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TITLE
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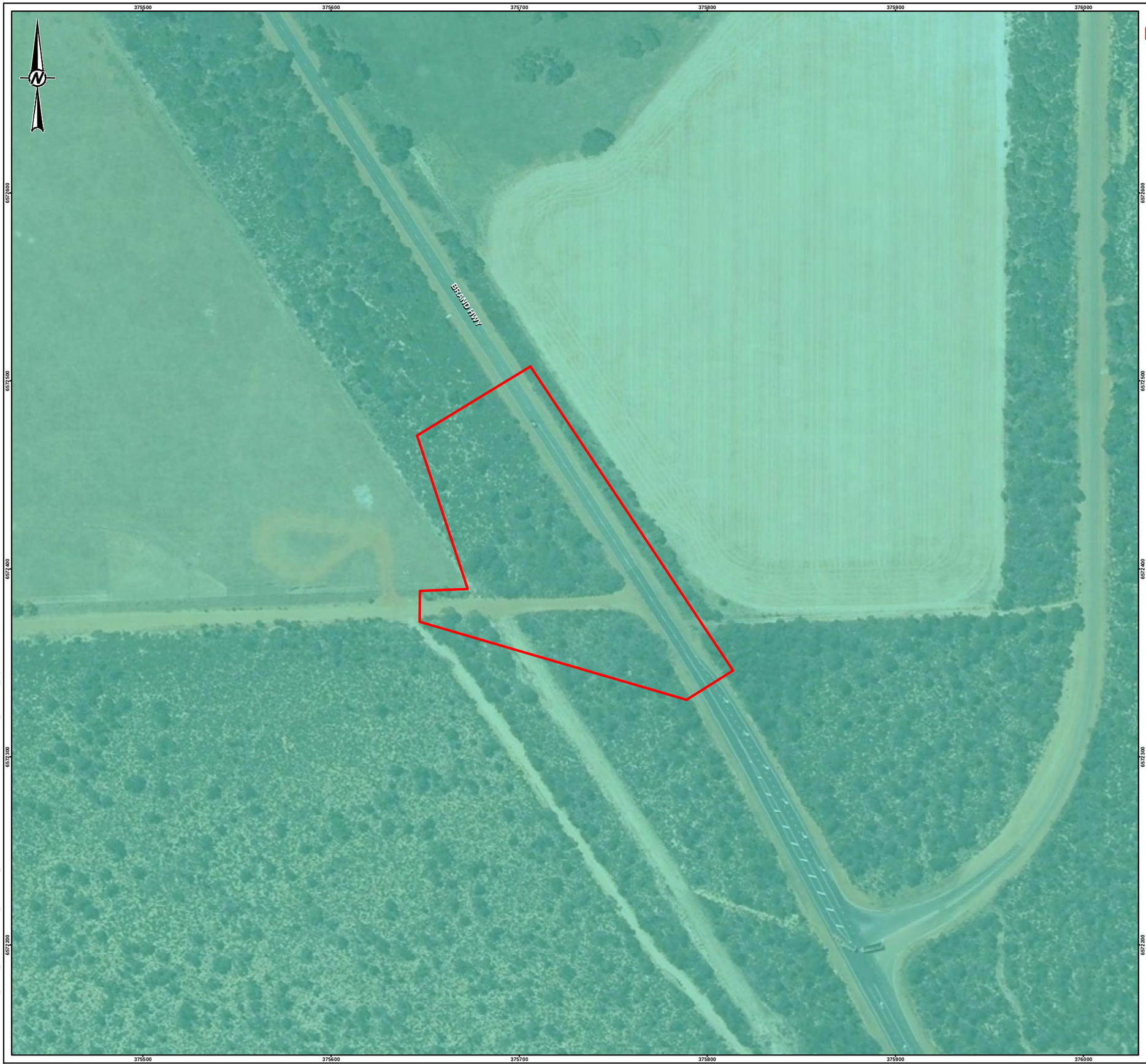
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2.2.2 Pre-European vegetation

The pre-European vegetation in the area was mapped by Beard (1976) on a broad scale (1:1,000,000). The identification of the original pre-European and current extent of each of the vegetation types assist in providing baselines for managing activities such as land clearing. The pre-European mapping for the area identified one Vegetation Association within the survey area as shown in Table 2.2 and Figure 2.4.

Table 2.2 Extent of pre-European vegetation associations close to the survey area

Vegetation system association code	Description	Extent remaining (%)		Survey area	
		State level	Bioregion	Area of intersection (ha)	Proportion of current extent (%)
Beard Vegetation Association 1030.2 – BASSENDEAN	Other *Acacia*, *Banksia*, peppermint, cypress pine, casuarina, York gum Acacia spp., *Banksia* spp., *Agonis flexuosa*, *Callitris* spp., *Allocasuarina* spp., *Eucalyptus loxophleba*.	111286.74	-	0.48	0.00043

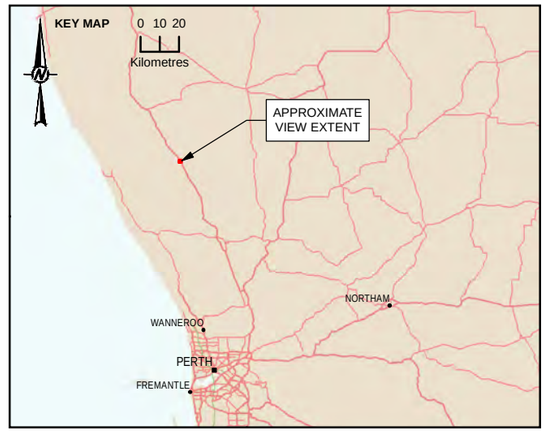


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PROJECT AREA

PRE-EUROPEAN VEGETATION

1030.2 - BASSENDEAN - Other acacia, banksia, peppermint, cypress pine, casuarina, York gum Acacia spp., Banksia spp., *Agonis flexuosa, Callitris spp., Allocasuarina spp., Eucalyptus loxophleba.*



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NOTE:
1. COORDINATE SYSTEM: GDA 1994 MGA ZONE 50

REFERENCES:
1. AERIAL IMAGE SOURCED FROM LANDGATE

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2.2.3 Threatened and Priority Ecological Communities

The search results indicated one threatened ecological community (TECs), or priority ecological community (PECs) are predicted to occur within the project area. The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC) and Protected Matters Search Tool (PMST) identified one TEC as likely to occur within the survey area. A larger search area (20 km radius from the project area) was used due to the low number of surveys undertaken within the immediate vicinity of the site to assist in revealing what has been modelled or mapped as occurring in the wider locality and of potential relevance to the survey area.

TECs are ecological communities recognised as rare or under threat and therefore warrant special protection. Selected TECs are afforded statutory protection at a Commonwealth level under Section 181 of the EPBC Act. Any action likely to have a significant impact on a community listed under the EPBC Act requires an EPBC Referral and determination from the commonwealth minister for the DCCEEW, as to whether the Project is a controlled action or not under the EPBC Act.

TECs are also listed within Western Australia under Sections 27(1) and 33 of the *Biodiversity Conservation Act 2016* (BC Act) and under the *Biodiversity Conservation Regulations* (BC Regulations). Their conservation significance is also acknowledged through other state environmental approval processes such as 'environmental impact assessment' pursuant to Part IV of the *Environmental Protection Act 1986* (EP Act) and the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*.

A plant community under consideration for listing as a TEC in Western Australia that does not yet meet survey criteria or has not been adequately defined may be listed as a priority ecological community (PEC). Listing as a PEC is similarly considered during State approval processes. PEC's and TECs identified by the EPBC PMST are described in Table 2.3 and shown in Figure 2.5.

Table 2.3 TECs likely to occur within the region

Community name	**Conservation status**	
	EPBC Act TEC status	**State Act PEC status**
Banksia Woodlands of the Swan Coastal Plain ecological community	Endangered	Priority 3

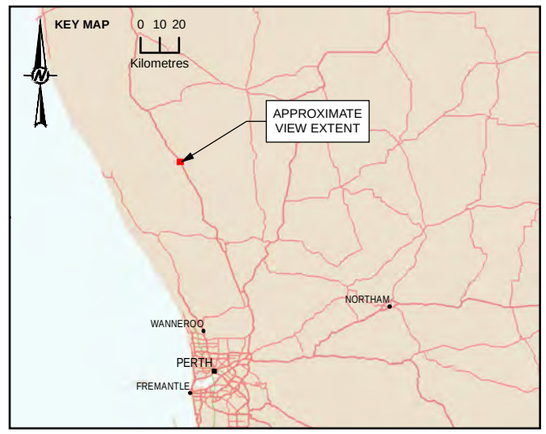


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PROJECT AREA

PEC / TEC

Banksia Woodlands of the Swan Coastal Plain ecological community



0 125 250

1:5,000 METRES

NOTE:
1. COORDINATE SYSTEM: GDA 1994 MGA ZONE 50

REFERENCES:
1. AERIAL IMAGE SOURCED FROM LANDGATE

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TITLE
ECOLOGICAL COMMUNITIES

CONSULTANT

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3 Methods

3.1 Flora desktop assessment

3.1.1 Database searches

State and Commonwealth database searches were conducted to identify listed significant flora within, and/or near, the survey area (Dandaragan). Results were interpreted to provide context to the potential values and threats associated with the survey area. Search details are summarised in Table 3.1, with the Australian Government PMST and the Department of Biodiversity, Conservation and Attractions (DBCA) database search conducted within the area of the shapefile provided by Ventia with an additional 20 km buffer survey area (dated August 2023).

Environmentally sensitive areas (ESA) are declared by the Minister for Environment under Section 51B of the EP Act to prevent incremental degradation of important environmental values such as declared rare (Threatened) flora, threatened ecological communities or significant wetlands. A search for ESAs in the vicinity of the survey area was conducted using Commonwealth and Western Australian government datasets (Department of the Environment and Energy 2008, 2018, Department of the Environment 2015, Department of Biodiversity, Conservation and Attractions 2017) as per Table 3.1 below.

Table 3.1 Database searches undertaken

Database	Date search results received	Search focus	Search parameter
Australian Government PMST (Department of Agriculture, Water and the Environment 2022)	August 2023	Matters of National Environmental Significance (MNES)	Orange Springs – 20 km buffer around a centre point of the survey area, defined by the coordinate: GDA94 50H 375684 E 6572367 N
NatureMap (Department of Biodiversity, Conservation and Attractions 2022a)	August 2023	Flora of significance	Orange Springs – 20 km buffer around a centre point of the survey area, defined by the coordinate: GDA94 50H 375684 E 6572367 N
Threatened and Priority Flora Database (TPFL) (Department of Biodiversity Conservation and Attractions 2022b)			
Western Australian Herbarium Flora Database (Department of Biodiversity, Conservation and Attractions 2022b)			
Commonwealth and Western Australian government datasets (Department of the Environment and Energy 2008, 2018, Department of the Environment 2015, Department of Biodiversity, Conservation and Attractions 2017)	August 2023	ESAs	Orange Springs – 20 km buffer around a centre point of the survey area, defined by the coordinate: GDA94 50H 375684 E 6572367 N

3.1.1.1 Likelihood of occurrence assessment – conservation significant flora

Prior to conducting the field survey, aerial imagery was interpreted to identify potential habitat types within and surrounding the survey area. Preferred habitat information for each significant flora species was also compiled using publicly available information from Flora Base (Western Australian Herbarium 2023) and Western Australian Herbarium (WA Herbarium) voucher information (obtained using Level 5 access on FloraBase).

The distance of the survey area to the nearest records of significant flora, was calculated using GIS software and the coordinates provided with database results. The significant flora species returned from the database searches (Appendix A) were then categorised according to the criteria in Table 3.2 for potential occurrence within the survey area.

Table 3.2 Likelihood of occurrence

Likelihood of occurrence	Criteria
Recorded	Species previously recorded within the survey area.
Likely	Species previously recorded within 10 km of the survey area and suitable habitat appears to be present in the survey area.
Potential	Species previously recorded within 10 km to 20 km of the survey area and/or suitable habitat appears to be present in the survey area.
Unlikely	No known occurrence within 20 km of the survey area, and/or suitable habitat appears to be absent in the survey area.

Following the field survey, the significant flora species identified during the desktop assessment were again assessed to determine their likelihood of occurrence within the survey area. Post-field survey likelihood was primarily based on validating the presence (and thorough inspection) of suitable habitats within the survey area, combined with life form, habitat and flowering information for each flora species and site conditions.

3.1.2 Field survey

The flora and vegetation field surveys were conducted by Associate Ecologist Roger Dharmarajan (Flora Permit FB62000412). Surveys were undertaken on 6 September 2023. The survey was undertaken in accordance with the requirements outlined in the agreed scope of work.

The survey area was traversed on foot and the composition and condition of vegetation was recorded. Photographs were taken throughout the field visit to present specific site conditions.

3.1.2.1 Reconnaissance flora and vegetation survey

Information acquired during the desktop assessment assisted in the design of the field survey. Pre-survey planning involved an examination of aerial imagery to identify potentially different landforms, habitat and vegetation throughout the survey area. The entire survey area was traversed on foot during the field survey, targeting all significant flora species with the potential to occur. Where potential flora of significance was identified, a minimum of a 10 m radius of the surrounding area was also searched. Where any potential flora of significance was identified, the following information was collected:

- Location – coordinates measured using a differential global positioning system unit with +/- 0.5 m accuracy (MGA50, GDA94).
- Recorder and date – personnel involved in sampling that location and the survey date.
- Species – representative samples of all suspected significant species were collected for confirmation at the WA Herbarium.
- Species abundance – a count of the number of individuals.
- Photographs –in-situ photographs were taken of each significant flora species.

3.1.2.2 Taxonomy and nomenclature

A specimen of each potential significant flora species recorded in the field was collected for confirmation identification. Specimens were initially identified by the ecologist in the field and subsequently taken to the WA Herbarium for confirmation. The assigned nomenclature is consistent with the current listing of scientific names recognised by the WA Herbarium.

3.1.2.3 Vegetation condition

Vegetation condition was assigned at each sample and changes in vegetation condition were also noted and mapped across the survey area. The condition of the vegetation was assessed using the Keighery (1994) scale (Table 3.3). Vegetation within the survey area containing *Banksia* spp., the condition scale provided in the conservation advice for the 'banksia woodlands of the Swan Coastal Plain TEC' (DoEE 2016a) was applied in addition to the Keighery scale, as shown in Table 3.3.

Table 3.3 Vegetation condition scale applied during the field assessment

Condition category	**Definition (Keighery 1994)**	**Indicator (DoEE 2016a)**	
		Typical native vegetation composition	**Typical weed cover**
Pristine:	Pristine or nearly so, no obvious signs of disturbance or damage caused by human activities since European settlement.	Native plant species diversity fully retained or almost so	
Excellent:	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.	High native plant species diversity	Less than 10%
Very Good:	Vegetation structure altered obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.	Moderate native plant species diversity	5-20%
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.	Low native plant species diversity	5-50%
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.	Very low native plant species diversity	20-70%
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 or shrubs.	Very low to no native species diversity	Greater than 70%

3.1.2.4 Plant community identification and description

The plant communities within the survey area were identified from the sample data collected during the field survey. The vegetation was described according to the dominant species present using the structural formation descriptions of the National Vegetation Inventory System (NVIS) (NVIS Technical Working Group 2017). The identified plant communities were mapped on aerial photography from the sample locations and boundaries were interpreted from aerial photography and notes taken in the field. Vegetation condition was mapped on aerial photography based on the samples and notes recorded during the field survey to define areas with differing condition.

3.1.2.5 Floristic community type assignment

The identified plant community was then compared to the regional 'floristic community type' (FCT) dataset 'A' floristic survey of the southern Swan Coastal Plain (Gibson et al. 1994). Each sample was compared to Gibson et al. (1994) separately to limit the influence of spatial correlation when assigning an FCT. FCT analysis was not undertaken for samples located within disturbed vegetation with low native species diversity and next to roadside as the vegetation was considered unlikely to currently represent an FCT.

3.1.2.6 Limitations

Following completion of the desktop assessment and field surveys, a review of any limitations that may have affected a complete assessment of the survey area was conducted. The limitations listed in Table 3.4 are based on those suggested as considerations in *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA, 2016b).

Table 3.4 Potential flora and vegetation survey limitations

Potential limitation	Limitation (none/minor/ requires consideration)	Statement regarding potential limitations
Availability of contextual information at a regional and local scale	None	Broad-scale contextual information is available and described in regional level and adequate to place the survey site and vegetation in context.
Scope (i.e., what life forms, etc., were sampled)	None	Vascular flora and weed species, the focus of the present survey, were thoroughly sampled and assessed.
Competency/ experience of the team carrying out the survey, including experience in the bioregion surveyed	None	The ecologist responsible for undertaking the field surveys has 13 years' experience in conducting flora and vegetation surveys throughout Western Australia, including the Swan Coastal plain, and is suitably qualified.
Proportion of flora/fauna recorded and/or collected, any identification issues	None	Adequate time was allowed for a thorough search of the survey area. All specimens collected were able to be identified to species level and confirmed by the WA Herbarium.
Was the appropriate area fully surveyed (effort and extent)	None	The survey area was adequately surveyed for the presence and abundance of significant flora species. Sufficient time was provided to allow a thorough search for the survey area. Survey area coverage was comprehensive (track logged).
Access restrictions within the survey area	None	The entirety of the survey area was able to be accessed by vehicle and traversed by foot.

Potential limitation	Limitation (none/minor/ requires consideration)	Statement regarding potential limitations
Proportion of flora collected and identified (based on sampling, timing, and intensity)	None	The survey was conducted during the recommended survey period (Spring) when the highest percentage of flora species are flowering and readily identifiable. The botanist is familiar with conservation significant taxa in the vegetation surrounding the survey area.
survey timing, rainfall, season of survey	None	The survey was conducted in September and October and thus within the main flowering season. Therefore, it is likely that many flora species would have been in flower and/or visible at the time of survey, including native geophytic flora species, such as orchids. The survey timing was considered adequate to allow the detection of flora species for which seasonal timing is critical.
Disturbance that may have affected the results of survey such as fire, flood or clearing	None	This disturbance did not limit the outcomes of the survey. There was no evidence of recent fire, floods or clearing in the survey area.

3.2 Fauna desktop assessment

Prior to the commencement of the fauna survey, a desktop assessment was undertaken to identify relevant environmental information pertaining to the survey area and to assist in survey design. The desktop assessment involved a review of:

- DBCA NatureMap database for fauna species previously recorded within the subject land (DBCA, 2022) (Appendix B).
- Review of DBCA threatened fauna database (Appendix C).
- DCCEEW Protected Matters Search Tool (PMST) to identify communities and species listed under the EPBC Act (DCCEEW, 2023) (Appendix C).
- Conservation code definitions are included in Appendix D.

3.2.1 Targeted survey

The EPBC, PMST, and the DBCA Threatened Fauna Database searches identified that three species of Black Cockatoo may occur within the survey area. Based on the desktop assessment and based upon the vegetation types/habitat within the survey area and the range of conservation significant fauna, a targeted survey for the following three species of Black Cockatoo was conducted:

- *Calyptorhynchus banksii naso* – Forest red-tailed black Cockatoo
- *Calyptorhynchus baudinii* – Baudin's Cockatoo
- *Calyptorhynchus latirostris* – Carnaby's Cockatoo.

3.2.2 Fauna field survey

3.2.2.1 Fauna habitat assessment

A fauna habitat assessment was undertaken to document the type, condition, and extent of habitats within the survey area. Vegetation, landform, and soil units present at the subject land were used to define broad fauna habitat types. The information below was recorded:

- Habitat structure, e.g., vegetation type, presence/absence of structural layers such as ground cover and mid-storey.
- Presence/absence of refuge including density of ground covers, fallen timber (coarse woody debris), hollow-bearing trees and stags and rocks/boulder piles, and the type and extent of each refuge.
- Presence/absence of waterways including type, extent and habitat quality within any waterway.
- Location of the habitat within the survey area in comparison to the habitat within the surrounding landscape.
- Habitat connectivity and identification of wildlife corridors within and immediately adjacent to the survey area.
- Current land use and disturbance history.
- Evaluation of key habitat features and types identified during the desktop assessment relevant to fauna of conservation significance.
- Evaluation of the likelihood of occurrence of conservation significant fauna within the habitat (based on presence of suitable habitat).
- Vegetation condition based on Keighery (1994).
- A representative photograph of each habitat type.

3.2.2.2 Black Cockatoo habitat assessment

Habitat used by the three Cockatoo species can be categorised as Breeding, Foraging and/or Night Roosting Habitat (Department of Agriculture, Water and the Environment, 2022) as presented in Table 3.5 and the following commentary.

Table 3.5 Habitats used by Black Cockatoos

Habitat	Baudin's	Carnaby's	Forest red-tailed
Breeding	Generally, in woodland or forest, but may also breed in former woodland or forest now present as isolated trees. Nest in hollows in live or dead trees of Karri (*Eucalyptus diversicolor*), Marri (*Corymbia calophylla*), Wandoo (*E. wandoo*) and Tuart (*E. gomphocephala*).	Generally, in woodland or forest, but also breeds in former woodland or forest now present as isolated trees. Nest in hollows in live or dead trees of Salmon Gum (*E. salmonophloia*), Wandoo, Tuart, Jarrah (*E. marginata*), Flooded Gum (*E. rudis)*, York Gum (*E. loxophleba* subsp. *loxophleba*), Powderbark (*E. accedens*), Karri and Marri.	Generally, in woodland or forest, but may also breed in former woodland or forest now present as isolated trees. Nest in hollows in live or dead trees of Marri, Karri, Wandoo, Bullich (*E. megacarpa*), Blackbutt (*E. patens*), Tuart and Jarrah.

Habitat	Baudin's	Carnaby's	Forest red-tailed
Night roosting	Generally, in or near riparian environments or other permanent water sources. Tall trees that may provide roosting habitat, particularly, Jarrah, Marri, Flooded Gum, Blackbutt (*E. patens*), Tuart, and introduced eucalypts including Blue Gum (*E. globulus*) and Lemon Scented Gum (*Corymbia citriodora*).	Generally, in or near riparian environments or natural and artificial permanent water sources. Tall trees that may provide roosting habitat, particularly Flat-topped Yate (*E. occidentalis*), Salmon Gum, Wandoo, Marri, Karri, Blackbutt, Tuart, introduced *Eucalyptus* species (for example Blue Gum) and introduced Pines.	Tall trees that may provide roosting habitat, particularly Jarrah, Marri, Blackbutt, Tuart and introduced Eucalypt trees within or on the edges of forests.
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*, Lemon-scented Gum and Kaffir Plum (*Harpephyllum caffrum*).

Source: Department of Agriculture, Water and the Environment (2022).

Foraging habitat is scored according to its ability to provide suitable food, its context in the landscape and the likelihood of Cockatoos using the area. The foraging quality will be scored using the criteria outlined in Table 3.6. To support the assessed habitat score, an overall appraisal of the habitat on the impact site including a 20 km buffer is required to clearly explain and justify the score. This appraisal must include a discussion on the foraging habitat's proximity to other resources frequency of use of proximate sites, the degree of evidence, and description of vegetation type and condition.

Table 3.6 Foraging quality scoring tool template

Starting score		Budin's cockatoo	Carnaby cockatoo	Forest red-tailed black-cockatoo
10		Start at a score of 10 if your survey area is native eucalypt woodlands and forest, and proteaceous woodland and heath, particularly, within the range of the species, including along roadsides and parkland cleared areas. Can include planted vegetation. This tool only applies to the survey area equal to or larger than 1 hectare in size	Start at a score of 10 if your survey area is native shrubland, kwongan heathland or woodland, dominated by proteaceous plant species such as Banksia spp. (including *Dryandra* spp.), *Hakea* spp. and *Grevillea* spp., as well as native eucalypt woodland and forest that contains foraging species, within the range of the species, including along roadsides and parkland cleared areas. Also includes planted native vegetation. This tool only applies to sites equal to or larger than 1 hectare in size	Start at a score of 10 if your survey area is Jarrah or Marri woodland and/or forest, or if it is on the edge of Karri Forest, or if Wandoo and Blackbutt occur on the survey area, within the range of the subspecies, including along roadsides and parkland cleared areas. This tool only applies to the survey area equal to or larger than 1 hectare in size
Attribute	**Sub-tractions**	**Context adjuster**		
Foraging	-2	Subtract 2 from your score if there is no evidence of feeding debris within the project area..	Subtract 2 from your score if there is no evidence of feeding debris within the project area.	Subtract 2 from your score if there is no evidence of feeding debris within the project area.
Connectivity	-2	Subtract 2 from your score if you have evidence to conclude that there is no other foraging habitat within 12 km of your project area.	Subtract 2 from your score if you have evidence to conclude that there is no other foraging habitat within 12 km of your project area.	Subtract 2 from your score if you have evidence to conclude that there is no other foraging habitat within 12 km of your project area.
Proximity to breeding	-2	Subtract 2 if you have evidence to conclude that your project area is more than 12 km from breeding habitat	Subtract 2 if you have evidence to conclude that your project area is more than 12 km from breeding habitat	Subtract 2 if you have evidence to conclude that your project area is more than 12 km from breeding habitat
Proximity to roosting	-1	Subtract 1 if you have evidence to conclude that your project area is more than 20 km from a known night roosting habitat	Subtract 1 if you have evidence to conclude that your project area is more than 20 km from a known night roosting habitat	Subtract 1 if you have evidence to conclude that your project area is more than 20 km from a known night roosting habitat
Impact from significant plant disease	-1	Subtract 1 if your project area has disease present (e.g., *Phytophthora* spp. or Marri canker) and the disease is affecting more than 50% of the preferred food plants present	Subtract 1 if your project area has disease present (e.g., *Phytophthora* spp. or Marri canker) and the disease is affecting more than 50% of the preferred food plants present.	Subtract 1 if your project area has disease present (e.g., *Phytophthora* spp. or Marri canker) and the disease is affecting more than 50% of the preferred food plants present.

Source: Department of Agriculture, Water and the Environment (2022).

3.2.2.3 Black Cockatoo breeding habitat

Assessment of Cockatoo breeding habitat involves the identification of all suitable breeding tree species within the survey area with a diameter at breast height (DBH) of over 50 cm. Species such as Wandoo and Salmon Gums are considered potential habitat trees if the DBH is greater than 30 cm. If potential breeding trees are present, the DBH of each tree is measured using a pre-made gauge.

The location of each potential breeding tree identified is recorded with a GPS and details of the tree species and the number and size of hollows (if any), also recorded. Target tree species include Marri, Jarrah and Karri or any other endemic *Corymbia*/*Eucalyptus* species of a suitable size that are present. Peppermint, *Banksia*, Sheoak and *Melaleuca* tree species (for example) are not assessed, as they do not develop hollows used by Cockatoos.

For the purposes of this survey, a tree containing a potential cockatoo nest hollow is defined as:

> *Any tree which is alive or dead that contains one or more visible hollows (cavities within the trunk or branches) suitable for occupation by black cockatoo for the purpose of nesting/breeding. Hollows that had an entrance greater than about 12cm in diameter and would allow the entry of a black cockatoo into a suitably orientated and sized branch/trunk, will be recorded as a 'potential nest hollow'. Identified hollows are examined using binoculars for evidence of actual use by black cockatoos (e.g., chewing around hollow entrance, scarring and scratch marks on trunks and branches). The calls of chicks were also listened for, if a suitable hollow is present.*

3.2.2.4 Black Cockatoo surveys

Cockatoo surveys are to be conducted during the time of year when they are most likely to be active as it increases the possibility of observing the species. The three species of Cockatoo utilise various habitats throughout the year. Table 3.7 outlines the suggested times of year to conduct targeted Cockatoo surveys. Surveys for feeding debris can be conducted year-round, as the foraging debris will remain for up to two years.

Table 3.7 Timing for surveys for black cockatoos

Region	Baudin's cockatoo	Carnaby's cockatoo	Forest red-tailed black cockatoo
Swan Coastal Plain	**Foraging habitat** – March to September **Breeding habitat** – may occur in southern Swan Coastal Plain *Note: unlikely to occur in the region.*	**Foraging habitat and night roosts** –January to July **Breeding habitat** –July to December *Note: some individuals inhabit year-round*	**Foraging habitat and night roosts** – any time of the year **Breeding habitat** – may occur in some locations containing suitable breeding tree species
Wheatbelt	**Breeding habitat and foraging habitat** in proximity – October to March *Note: possible on western margins*	**Breeding habitat and foraging habitat** in proximity – July to December *Note: some individuals occur year-round*	**Breeding habitat and foraging habitat** in proximity – year-round *Note: possible presence on margins*
Jarrah Forest	**Foraging habitat** – February/ March to September **Breeding habitat and foraging habitat** in proximity – August to January	**Breeding habitat and foraging habitat** in proximity – July to December	**Breeding habitat and foraging habitat** in proximity –April to June and August to October *Note: individual occur year-round*

Region	Baudin's cockatoo	Carnaby's cockatoo	Forest red-tailed black cockatoo
South Coast	**Foraging habitat** – March to September **Breeding habitat and foraging habitat** in proximity – August to January	**Foraging habitat and night roosts** – January to July **Breeding habitat** – breeding activity is July through December	Breeding habitat and foraging habitat in proximity – at any time of the year in the forested areas of the region, with peaks in April to June and August to October

Source: Department of Agriculture, Water and the Environment (2022).

The survey area associated with the project are in the Swan Coastal Plain region within the breeding range of the Baudin's and Carnaby's Black Cockatoos. The distribution of the Forest Red-tailed Black Cockatoo is outside of the project. The survey was conducted on 6 September 2023, which falls within the suggested timing (July to December) to conduct targeted surveys for the Carnaby Cockatoo.

4 Results and discussion

4.1 Flora and vegetation

4.1.1 Desktop assessment

Database search results identified 102 significant flora species as potentially occurring within a 20 km radius of the survey area (DCCEEW 2023, DBCA 2023a, 2023b). This included:

- 19 threatened taxa
- 8 Priority 1 (P1) taxa
- 16 Priority 2 (P2) taxa
- 36 Priority 3 (P3) taxa
- 23 Priority 4 (P4) taxa.

Most of the significant flora were considered less potential to occur in the survey area due to the absence of suitable habitat and proximity of known locations to the survey area; however, 12 of these were considered ‘likely’ to occur (Appendix A).

4.1.2 Field survey

Three quadrats and one relevé were assessed within the survey area. This improved the robustness of the assessment by maximising the opportunity to detect conservation significant flora and to evaluate the presence of threatened ecological communities (TECs) (Figure 2.5).

4.1.2.1 Seasonal conditions

Daily weather observations recorded at Dandaragan weather station (Bureau of Meteorology (BOM) station 009014), located approximately 1.4 km west of the survey area was used to describe local rainfall and temperatures preceding the field survey.

Long term average rainfall and temperature data, together with monthly rainfall data for the period September 2022 to September 2023 are shown in Figure 4.1 (BOM 2023).

A total of 331.1 mm of rainfall was recorded at the Dandaragan weather station in the 12 months preceding the field survey; 256.3 mm below the long-term average (1951–2023). Maximum temperatures prior to the field survey ranged between 17.6°C and 34.6°C (BOM 2023) (Figure 4.1).

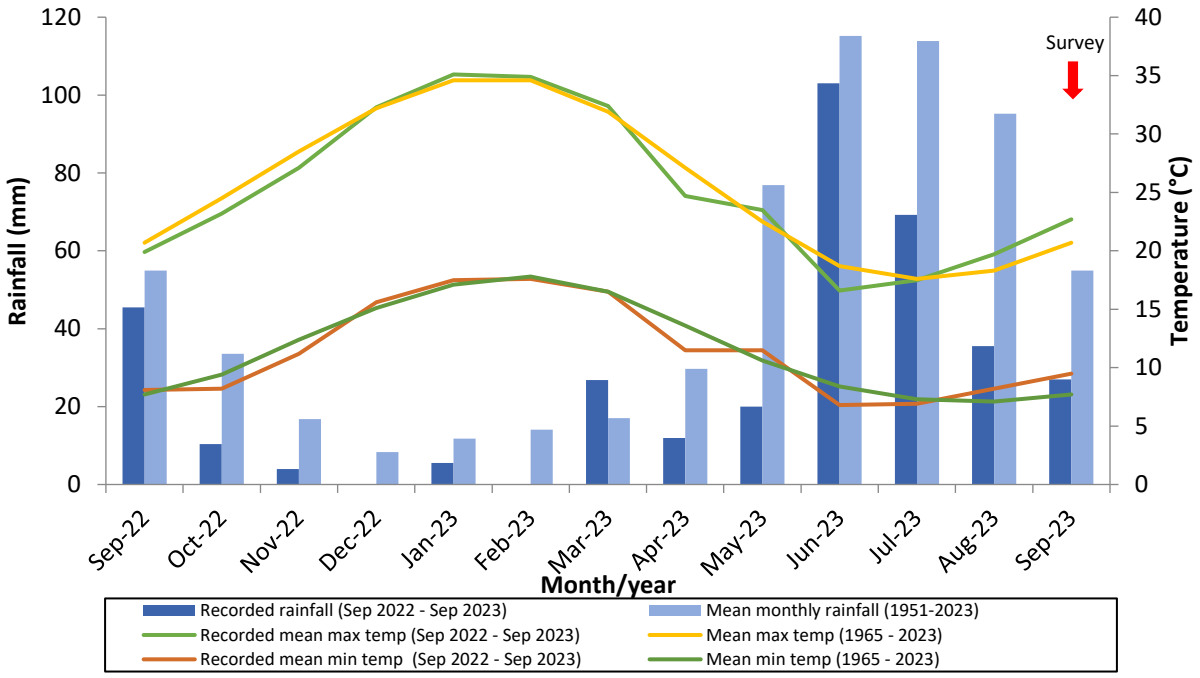


Figure 4.1 Rainfall and temperature data for Dandaragan West WA (BOM Station 009014)

4.1.2.2 Flora summary

A total of 43 native and 8 non-native (weed) species were recorded within the survey area during the field survey, representing 24 families and 44 genera. The dominant families containing native taxa were Proteaceae (9 taxa), Poaceae, Asteraceae, and Fabaceae (four taxa each). A complete species list is provided in Appendix E.

4.1.2.3 Conservation significant flora

No threatened flora species were recorded within the survey area.

One priority flora taxon was recorded within the survey area. A brief description of this taxon is provided below:

***Hibbertia subvillosa* (P3) – Dilleniaceae –** Erect to spreading shrubs 0.3–0.75 m high, single-stemmed at base, leaves widely spreading, scattered, linear to narrowly linear-obovate. Flowers yellow in October to December or January. Often grows on graded road-verges, where it sometimes recruits abundantly. It is particularly common on roadsides around Wongan Hills. *Hibbertia subvillosa* is widespread, occurs in a number of nature reserves, and is not considered to be under threat. However, field work indicates that many populations are relatively small and weed-invaded (Australian Journal of Taxonomy 8:2 (2022)). This species was recorded at two locations within the survey area.

Table 4.1 Priority species recorded within the survey area

Quadrat	Population	Location (GDA94, zone 50)	
		Easting (ME)	Northing (MN)
Site 2	3	375684	6572367
Site 3	2	375727	6572366

4.1.2.4 Introduced flora

There are eight weed species recorded during the survey within the survey area:

- * *Arctotheca calendula* (Cape Weed)
- * *Eragrostis curvula* (African Lovegrass)
- * *Hypochaeris glabra* (Smooth Cats-ear)

- * *Romulea rosea* (Guildford Grass)
- * *Solanum nigrum* (Black Berry Nightshade)
- * *Sonchus oleraceus* (Common Sowthistle)
- * *Ursinia anthemoides* (Ursinia)
- * *Zantedeschia aethiopica* (Arum Lily) (Appendix E).

None of the weed species recorded are listed as Weeds of National Significance (WoNS) (Australian Weeds Committee 2012) or as a Declared pest plant in Western Australia (Department of Agriculture and Food Western Australia, 2016).

4.1.2.5 Vegetation communities

One plant community was identified within the survey area: BpNfHvAh and extends over most of the site (90%). This vegetation contains multiple native shrub species which occur as a mosaic of differing proportions and heights due to differences in landform and aspect (Figure 4.2).

The remainder of the survey area was mapped as cleared as it comprises tracks and bare soil with scattered non-native plants.

A description, area of plant community and representative photographs are provided in Table 4.2. Raw sample data is provided in Appendix E.

Table 4.2 Vegetation association described in the survey area

Plant community	Description	Area (ha)	Representative photograph
BpNfHvAh	*Banksia prionotes* and *Nuytsia floribunda* open woodland over *Jacksonia sternbergiana* open tall shurbland over *Hakea varia, Adenanthos cygnorum* and *Stirlingia latifolia* open shrubland over *Allocasuarina humilis* and *Calothamnus sanguineus* open shrubland over *Hibbertia hypericoides* subsp. *hypericoides, Eremaea pauciflora* var. *pauciflora* and *Hakea ruscifolia* sparse shrubland on a sandy loam flats.		 Plate 4.1 Vegetation representing BpNfHvAh – facing Northwest from GPS coordinates 50H 375684 mE and 6572367 N (MGA Zone 50H)



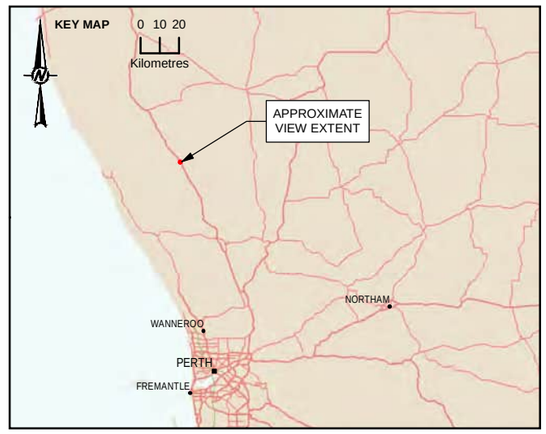
LEGEND

PROJECT AREA

VEGETATION MAPPING

Banksia prionotes and *Nuytsia floribunda* open woodland over *Jacksonia sternbergiana* open tall shurbland over *Hakea varia, Adenanthos cygnorum* and *Stirlingia latifolia* open shrubland over *Allocasuarina humilis* and *Calothamnus sanguineus* open shrubland over *Hibbertia hypericoides* subsp. *hypericoides*, *Eremaea pauciflora* var. *pauciflora* and *Hakea ruscifolia* sparse shrubland on a sandy loam flats.

CLEARED



0 10 20

1:750 METRES

NOTE:
1. COORDINATE SYSTEM: GDA 1994 MGA ZONE 50

REFERENCES:
1. AERIAL IMAGE SOURCED FROM LANDGATE

CLIENT
PROTEN WESTERN AUSTRALIA PTY LTD

PROJECT
HUNTER ROAD NVCP

TITLE
VEGETATION MAPPING

CONSULTANT

YYYY-MM-DD	2024-02-07
DESIGNED	JE
PREPARED	JE
REVIEWED	RD
APPROVED	

PROJECT NO.	CONTROL	REV.	FIGURE
PS206560	001-R	B	4.2

PATH: B:\Proten\Hunter Road_NVCP\99_PROJECTS\PS206560_HunterRoad\02_PRODUCTION\MXD\001-R\RevA\PS206560-001-R-RevA-F007_VegetationMapping.mxd PRINTED ON: 2023-11-09 AT: 12:33:37 PM

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ISO A3

25mm

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4.1.2.6 Vegetation condition

Most of the plant community BpNfHvAh was mapped as being in ‘excellent to good’ condition as it contains native species diversity. Small areas of BpNfHvAh vegetation comprised lower native species diversity and/or cover and were mapped as ‘degraded’ condition depending on cover and species present (see Figure 4.3).

The vegetation mapped as being in ‘excellent’ condition retains the structure expected of a banksia woodland community and has high native species diversity and less than 10% weed cover.

The portion of the plant community mapped as being in “very good” condition due to the vegetation structure being altered through repeated past disturbance which was evident through a very sparse tree canopy cover and a larger proportion of bare ground in combination with moderate native plant diversity and higher weed cover (10–20%).

The portion of the plant community mapped as being in “good” condition exhibited higher weed cover (20–50%) but still retained moderate native plant species diversity.

The plant community along the eastern side of the brand highway was mapped as being in “degraded condition” due to very low native species diversity and high weed cover. The remaining area is in ‘completely degraded’ condition and predominantly comprises bare ground associated with fire breaks and non-native species such as pasture grasses and weeds.

Table 4.3 Extent of vegetation condition categories within survey area

Description	Area (ha)
Pristine	0
Excellent	0.22
Very good	0.03
Good	0.13
Degraded	0.09
Completely degraded	0.01

4.1.2.7 Floristic community types

Plant community BpNfHvAh was determined to represent FCT 23c ‘North-eastern *Banksia attenuata* – *Banksia menziesii* woodlands”. This FCT is listed as ‘well reserved’ and ‘low risk’ by Gibson et al. (1994). FCT 23c were common among the bioregion and the survey area recorded around 53% similarity of all the Gibson et al. (1994) sites.

FCT 23c are dominated by *Banksia* woodlands, as having a canopy that is most dominated or co-dominated by *Banksia attenuata* and/or *Banksia menziesii*. Other *Banksia* species that can dominate in the community type are *Banksia prionotes*, which predominately occurs in the survey area. The PEC differs from the EPBC Act listed Banksia woodlands of the Swan Coastal Plain TEC in that it has no minimum condition and patch size thresholds.

Plant community BpNfHvAh, *Banksia* low woodland is considered representative of the *Banksia* dominated woodlands of the Swan coastal Plain (SCP) IBRA region (PEC). It is not considered representative of the commonwealth-listed *Banksia* TEC as it does not meet the minimum condition thresholds.

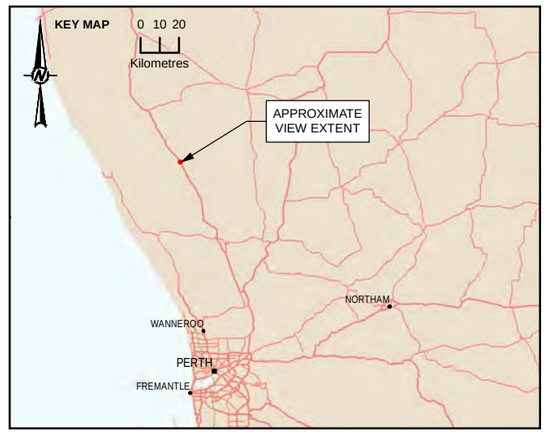


LEGEND

PROJECT AREA

CONDITION

- EXCELLENT
- VERY GOOD
- GOOD
- DEGRADED
- COMPLETELY DEGRADED



0 10 20

1:750 METRES

NOTE:
1. COORDINATE SYSTEM: GDA 1994 MGA ZONE 50

REFERENCES:
1. AERIAL IMAGE SOURCED FROM LANDGATE

CLIENT
PROTEN WESTERN AUSTRALIA PTY LTD

PROJECT
HUNTER ROAD NVCP

TITLE
VEGETATION CONDITION MAPPING

CONSULTANT

YYYY-MM-DD	2024-02-07
DESIGNED	JE
PREPARED	JE
REVIEWED	RD
APPROVED	

PROJECT NO.	CONTROL	REV.	FIGURE
PS206560	001-R	B	4.3

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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ISO A3
25mm
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4.1.2.8 Threatened and Priority Ecological Communities

The structure, composition, and patch size of plant community BpNfHvAh indicates that it is not fully representative of Commonwealth listed "*Banksia* woodland of the Swan Coastal Plain" TEC as outlined in Table 4.4.

Table 4.4 Criteria for determining presence of Banksia Woodlands of the Swan Coastal Plain TEC adapted from DCCEEW (DoEE, 2016)

Criteria	Requirements for meeting criteria	Survey area implications
Must meet key diagnostic characteristics	A variety of factors relating to: — location — soils — structure — composition	— Survey area meets location and soils criteria. — The BpNfHvAh vegetation structure and composition does not includes the key diagnostic feature of a tree layer of *Banksia attenuata*, *Banksia menziesii* and *Banksia ilicifolia*.
Must meet condition thresholds	Patch should at least meet the 'good' condition category	— The BpNfHvAh vegetation present in 'excellent', 'very good – good' condition individually meet this criterion. However, the 'degraded' condition does not individually meet this criterion. — However, the conservation advice indicates that a single patch may include areas of variable condition, meaning parts of the BpNfHvAh vegetation in 'degraded' condition may still be considered the TEC/PEC.
Must meet minimum patch size	Minimum size of patch: — pristine=no minimum size — excellent=0.5 ha — very good=1 ha — good=2 ha	— The BpNfHvAh vegetation in 'excellent" (0.22 ha) 'very good' (0.03 ha) and 'good' (0.13 ha) condition — Does not meet the criterion for any vegetation condition class.
Must incorporate surrounding context	— Breaks (e.g., tracks) < 30 m do not separate vegetation into separate patches — Buffer zones may apply (20–50 m recommended from patch edge) — The survey area should be thoroughly sampled — Survey timing should be appropriate. — Surrounding environment should be considered (e.g., connectivity, conservation values, fauna habitat)	— Small scale tracks (<30 m wide) exist within the survey area. — Land surrounding the patch is a combination of Roads, intersection and native vegetation. — The survey was conducted in September lies within the spring main flowering period.
Result	The survey area supports 0.38 ha of vegetation (excellent to good condition)	

4.2 Fauna

4.2.1 Desktop assessment

4.2.1.1 NatureMap

The NatureMap database search identified 19 species within 20 km of the survey area including: 4 mammals, 6 birds, 7 invertebrates, and 2 reptiles. The species list is included in Appendix C.

4.2.1.2 Conservation significant fauna

The EPBC Act PMST and the DBCA Threatened Fauna Database (20 km buffer for survey area; Appendix B) was used to compile a list identifying the potential presence of habitat, or the potential presence of conservation significant fauna species (Appendix C). The list excludes those species that are exclusively marine or migratory. Consideration was given to the likelihood of the species being present based on their mapped distribution, specimens formerly identified or presence of suitable habitat present.

Nineteen conservation significant fauna were identified as possibly occurring in the survey area (Appendix C). Of these, the following four species were assessed as potentially occurring:

- *Calyptorhynchus baudinii* (Baudin's Cockatoo) Endangered: Likely to occur as foraging habitat is present in the survey area.
- *Calyptorhynchus latirostris* (Carnaby's Cockatoo) Endangered*:* Likely to occur as foraging habitat is present in the survey area.
- *Calyptorhynchus banksii naso* (Forest Red-tailed Black Cockatoo, Karrak) Vulnerable*:* Likely to occur as foraging habitat is present in the survey area.

4.2.1.3 Limitations

The EPBC Act PMST is based on bioclimatic modelling for the potential presence of species. As such, the DCCEEW mapping does not represent actual records of the species in the area. The records from the DBCA searches of threatened fauna provide more accurate information for the general area. However, some records of collections, sightings or trappings cannot be dated and often misrepresent the current range of threatened species.

4.2.2 Field survey

A summary of the fauna habitat types recorded within the survey area is included in Table 4.5.

Table 4.5 Fauna habitat summary

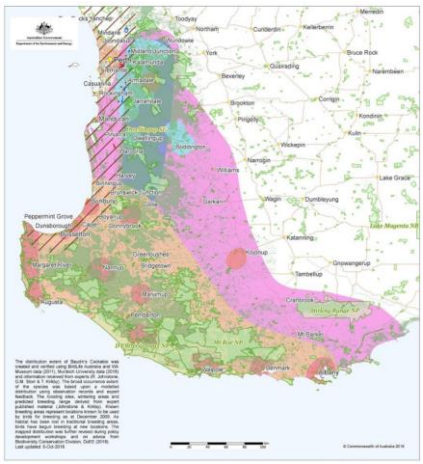
Description	Survey area
Habitat Structure	*Banksia prionotes* and *Nuytsia floribunda* open woodland over *Jacksonia sternbergiana* open tall shurbland over *Hakea varia*, *Adenanthos cygnorum* and *Stirlingia latifolia* open shrubland over *Allocasuarina humilis* and *Calothamnus sanguineus* open shrubland over *Hibbertia hypericoides* subsp. *hypericoides*, *Eremaea pauciflora* var. *pauciflora* and *Hakea ruscifolia* sparse shrubland on a sandy loam flat.
Presence or absence of refugia	Semi-closed woodland and medium shrubland vegetation with native understorey density
Presence of absence of wetlands/waterways	No natural waterways or wetlands near the survey area
Habitat connectivity	High connectivity

Description	Survey area
Current land use and disturbance	Surrounding areas with low *Banksia* woodlands in Excellent to good condition
Evaluation of likelihood of occurrence of conservation significant fauna	Refer to Appendix C
Vegetation/ habitat condition	Good quality habitat (depending on species)
Photograph of habitat	
The habitat type (low *Banksia* woodland) is similar to habitats found in low-lying areas and along road verges in the area. Ground foraging birds and larger reptiles are likely to utilise this habitat on occasion. 	

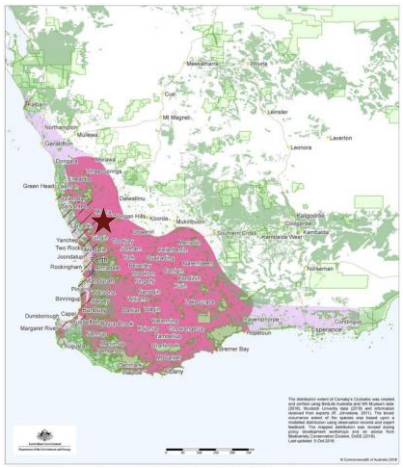
4.2.2.1 Targeted survey for Black Cockatoos

Of the three species of Black Cockatoos, only one, the Carnaby Cockatoo, has a distribution area that overlaps the survey area (Table 4.6). Since the project area is unlikely to be inhabited by the Baudin's Cockatoo and Forest Red-tailed Black-Cockatoo, the field assessment primarily focused on the Carnaby Cockatoo therefore, the foraging scores outlined in Table 4.7 was based on the preferential habitat of the Carnaby Cockatoo.

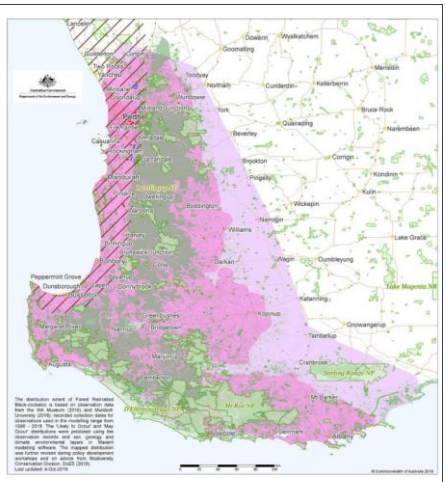
Table 4.6 Black Cockatoos distribution



Baudin's Cockatoo



Carnaby Cockatoo



Forest Red-tailed Black-Cockatoo

★ Project area

Source: Department of Agriculture, Water and the Environment (2022).

The vegetation within the survey area is dominated with *Banksia prionotes* open low woodland over *Jacksonia sternbergiana*, *Hakea varia*, *Adenanthos cygnorum*, and *Stirlingia latifolia* over *Allocasuarina humilis* and *Calothamnus sanguineus* over *Hibbertia hypericoides* subsp. *hypericoides*, *Eremaea pauciflora* var. *pauciflora* and *Hakea ruscifolia* sparse shrubland on a sandy loam flat. This vegetation community is suitable foraging habitat for Carnaby's Cockatoo as it contains Banksia species.

Foraging value scores for black cockatoos are shown in Table 4.7.

Table 4.7 Foraging value scores

Foraging attribute	Site score	Justification
Forage potential	10 – 0 = 10	Due to the presence of *Banksia* species, there is high foraging potential
Connectivity	10 – 0 = 10	Foraging area is located within 1 km of the site, the site was deemed to be highly connected to the surrounding habitat
Proximity to breeding	10 – 0 = 10	There is a lack of suitable trees available for breeding purposes onsite. The field and desktop assessments conclude the site is greater than 10 km from any known breeding habitats
Proximity to roosting	10 – 0 = 10	There is a lack of suitable trees available for roosting purposes onsite. The field and desktop assessments conclude the site is greater than 10 km from any known roosting sites.
Impact from significant plant disease	10 – 1 = 9	There might be some potential dieback disease evidence was observed within the site.
Final Score	9	Habitat is critical

Source: Department of Agriculture, Water and the Environment (2022).

The final foraging value for the site is 9. A score of 9 suggests the site does provide significant foraging value and is critical to the survival of any of the species. The habitat associated with the site is either known to be used for foraging only and not considerable for breeding or roosting areas. Habitat is critical for foraging attribute, but does not meet the size criterion.

4.2.2.2 Habitat trees

No habitat trees were recorded in the survey area. Carnaby Cockatoo (*Calyptorhynchus latirostris*) are likely to use the project area for foraging purposes only, but due to the relatively small size of trees and no habitat trees within the survey area, the likelihood has been revised to Low.

Small native mammals are unlikely to be present due to the small and fragmented nature of the available habitat. Whilst no evidence of feral cats was observed during the field survey, it should be noted that a daytime survey was conducted only.

4.2.2.3 Other conservation significant species

No evidence of other conservation significant species was identified in the survey area. Likewise, no wetland habitats are present within the survey area, therefore potential impacts on the listed birds associated with water bodies (sandpipers, Australasian Bittern, Australian Painted Snipe and Common Greenshank) are also minimal.

4.2.2.4 Other species

Other species which were observed during the survey are included in Table 4.8.

Table 4.8 Fauna species observed during survey

Species	Common name
Barnardius zonarius	Australian Ringneck (inc. race *semitorquatus*, 'Twenty-eight Parrot')
Gymnorhina tibicen	Australian Magpie
Rhipidura leucophrys	Willie Wagtail
Grallina cyanoleuca	Magpie-lark
Corvus coronoides	Australian Raven
Hirundo neoxena	Welcome Swallow
Tiliqua rugosa	Blue-tongue Lizard

4.2.2.5 Limitations

Seasonal sampling has not been carried out as part of this fauna assessment. The conclusions presented are based on information from Western Australian and Commonwealth databases, field data, and the field survey carried out over a limited period. Therefore, the data and interpreted outcomes are considered indicative of the environmental conditions on the survey area at the time of the field assessment. It is recognised survey area conditions may change over time.

The EPA (2020) Technical Guidance *Terrestrial vertebrate fauna surveys for environmental impact assessment* requires fauna assessment reports contain a section describing the limitations of the survey methods used. The limitations and constraints associated with this field survey are discussed in Table 4.9. The survey effort has not been subject to any constraints which may affect the thoroughness of the assessment, and the conclusions that have been provided.

Table 4.9 Limitations

Aspect	Limitation	Comment
Sources of information and availability of contextual information	Nil	Adequate information is available for the survey area, this includes broad scale (1:250,000) mapping by Beard (1979) and digitised by Shepherd *et al*., (2002) and other information (DBCA database, NatureMap, ALA).
Scope (what life forms were sampled etc.)	Nil	Following desktop review, reconnaissance and field surveys targeted conservation significant fauna unlikely to be present within the survey area.

Aspect	Limitation	Comment
Proportion of fauna identified, recorded and/or collected	Nil	Following desktop review, the fauna assessment was aimed at identifying habitat types and conservation significant terrestrial vertebrate fauna unlikely to be utilising the survey area.
Completeness and further work which might be needed (e.g., was the relevant area fully surveyed)	Nil	Adequate coverage of the survey area was undertaken.
Mapping reliability	Nil	The vegetation was mapped using high-resolution ESRI aerial imagery obtained from Landgate, topographical features, previous broad scale mapping (Beard, 1979) and field data and more detailed vegetation mapping, where available. Data was recorded in the field using hand-held GPS tools. Certain atmospheric factors and other sources of error can affect the accuracy of GPS receivers. The GPS units used for this survey was a hand-held GPS, which is accurate to within ±4 metres on average. Therefore, the data points consisting of coordinates recorded from the GPS may contain slight inaccuracies.
Timing/weather/season/cycle	Nil	The survey was undertaken in spring and the weather was fine.
Disturbances (e.g., fire, flood, accidental human intervention)	Nil	The survey area was partially disturbed but also contained vegetation in relatively intact condition.
Intensity (in retrospect, was the intensity adequate)	Nil	The survey area was sufficiently covered by foot during the survey.
Resources	Nil	Adequate resources were employed during the field survey.
Access restrictions	Nil	The survey area was accessed on foot.

5 Discussion

5.1 Flora and vegetation

Flora, including native vegetation occurs across most of the sites. The vegetation shows no evidence of alteration from fire, but this is not considered to be a sign of degradation. The vegetation recorded within the survey area were consistent with the historical mapping of Beard (1972 and 1990).

5.1.1 Threatened and priority flora

Based on background information, 102 significant flora species potentially occurring within a 20 km radius of the survey area (DCCEEW 2023, DBCA 2023a, 2023b) were assessed as potentially occurring within the survey area. The field survey was undertaken in September 2023 and was considered sufficient to determine that these species are identified to species and sub species level. One priority flora taxon was recorded within the survey area. *Hibbertia subvillosa* (P3) occurs in two locations within BpNfHvAh vegetation community.

5.1.2 Plant communities

The survey identified BpNfHvAh as the dominant community. BpNfHvAh – *Banksia prionotes* and *Nuytsia floribunda* open woodland over *Jacksonia sternbergiana* open tall shrubland over *Hakea varia, Adenanthos cygnorum* and *Stirlingia latifolia* open shrubland over *Allocasuarina humilis* and *Calothamnus sanguineus* open shrubland over *Hibbertia hypericoides* subsp. *hypericoides, Eremaea pauciflora* var. *pauciflora*, and *Hakea ruscifolia* sparse shrubland on a sandy loam flat.

During sampling and traverses within the vegetation it was evident a few species are consistently dominant across the site and considering the size, the whole survey area was mapped as one plant community.

5.1.3 Vegetation condition

The BpNfHvAh vegetation generally comprises high cover of native species and low cover of weeds. Assigning condition using a categorical scale is always most difficult when vegetation qualities are close to the road verge boundaries. The method applied to assess vegetation condition was robust, as it combined the standard qualitative, categorical scheme of Keighery (1994). The majority of BpNfHvAh vegetation was mapped as being in ‘excellent to very good’ condition as it has very low weed cover and high native species diversity.

5.1.4 Floristic community type assignment

All the quadrats within the one plant community BpNfHvAh showed similarity to sites comprising FCT 20d and FCT 23c. These two FCT are Banksia dominated woodlands as they have a canopy that is mostly dominated or co-dominated by *Banksia attenuata* and/or *Banksia menziesii*. Other *Banksia* species that can dominate in the community are *Banksia prionotes*, which predominately occurs in the survey area. A record of this FCT was anticipated given that the closest Gibson et al. (1994) site to the survey area represents these two FCT’s.

5.1.5 Threatened and Priority Ecological Communities

The BpNfHvAh vegetation comprises of *Banksia prionotes* and *Nuytsia floribunda* open woodland over *Jacksonia sternbergiana* open tall shrubland over *Hakea varia, Adenanthos cygnorum* and *Stirlingia latifolia* open shrubland over *Allocasuarina humilis* and *Calothamnus sanguineus* open shrubland over *Hibbertia hypericoides* subsp. *hypericoides*, *Eremaea pauciflora* var. *pauciflora*, and *Hakea ruscifolia.* However, to constitute the banksia woodland TEC, a patch of banksia vegetation must also meet thresholds for condition and minimum patch size (refer to Table 4.3). Some patches of the BpNfHvAh plant community is in excellent to good condition and some are in poorer condition which therefore does not meet the minimum condition and/or size threshold.

5.2 Fauna

5.2.1 Fauna habitat types

The desktop investigation indicated that 19 species have been previously recorded within 20 km of the survey area including 4 mammals, 6 bird, 7 invertebrates, and 2 reptiles. No conservation significant fauna species were recorded, nor is the habitat suitable for any previously recorded in the locality. No trees suitable for roosting and breeding are present within the survey area, thus the area is unlikely to be suitable for Carnaby's Cockatoo.

The survey area contains no natural waterways or wetlands. No evidence of other conservation significant species was identified in the survey area. Likewise, no wetland habitats occur within the survey area, therefore potential impacts on the listed birds associated with wetlands are also minimal.

5.2.2 Conservation significant fauna

No conservation significant fauna species were recorded within the survey area. None are considered to have a high likelihood of occurring and does not have habitat that has any particular significance to any species of conservation or other significance (broken by roads and infrastructure) within the survey area.

6 Conclusions

Approximately 0.48 ha of vegetation is likely to be cleared within the survey area. The findings of the flora and fauna assessment are summarised as follows:

- The majority of the survey area contains relatively intact native vegetation in excellent (0.22 ha), very good (0.03 ha) and good (0.13 ha) condition. The remainder of the survey area is in degraded or completely degraded condition (0.1 ha).
- No threatened flora species were recorded within the survey area and none are considered likely to occur due to the lack of suitable habitat.
- One Priority 3 flora was recorded within the survey area in two different locations.
- The native vegetation within the survey area was mapped as a single plant community (BpNfHvAh) which aligns closely with floristic community type (FCT) '23a – Central *Banksia attenuata – Banksia menziesii* woodlands. Approximately 0.48 ha of the banksia woodlands of the Swan Coastal Plain TEC/PEC may be present within the survey area.
- Vegetation within the survey area may provide habitat for conservation significant fauna. In particular, it provides a foraging resource for threatened species of Carnaby's Cockatoo.

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Appendix A

Likelihood of occurrence of conservation significant flora species within survey area

Taxon	Status BC Act	Status EPBC Act	Habitat
Acacia cummingiana	Priority 3		Halfway up a laterite breakaway in grey sand.
Acacia denticulosa			Red, brown sandy loam.
Acacia drummondii subsp. affinis	Priority 3		
Acacia forrestiana			Breakaway. Hillside. Ridge. Dry, red-brown soil. Burnt 2001.
Allocasuarina grevilleoides	Priority 3		
Andersonia gracilis		Vulnerable	Claypan with rusty brown sand/loam/clay or near wetland, grey-brown sandy loam.
Andersonia sp. Mysosma (E.A. Griffin 2213)	Priority 2		Open depression, on slope, grey sand/clay soil with poor drainage.
Angianthus micropodioides	Priority 3		Winter-wet flat, brown heavy clay.
Anigozanthos humilis subsp. Badgingarra (S.D. Hopper 7114)	Priority 2		Yellow white sand. Burnt 5-10 years ago.
Anigozanthos humilis subsp. chrysanthus	Priority 4		Pale yellow dry sand upper slope NW aspect or white/grey sand with clay slope E and W aspect. Disturbed existing cleared track with open depression, seasonally inundated.
Anigozanthos viridis subsp. terraspectans		Vulnerable	Grey sand/clay loam flat area burnt in Nov/Dec 2010. Farmland.
Asterolasia drummondii	Priority 4		Red loam/grey sand with lateritic pebbles/rocks on gentle lateritic hill.
Babingtonia delicata	Priority 1		Dry to moist, low lying seasonal lake with flat lake edge moist to dry yellow-white-grey firm organic rich sandy clay with good drainage. Dense tall heath to open low heath.
Babingtonia urbana	Priority 3		
Banksia chamaephyton	Priority 4		Sand over laterite.
Banksia dallanneyi subsp. pollosta	Priority 3		Seasonally wet flat area, light grey sand over yellow sand/clay on dune top. Open low woodland, heath dominant. Fire history not known > 5 years.
Banksia fuscobractea		Critically Endangered	Laterite knoll/hilltop with dry brown loam and grey sand over lateritic gravel. Farmland – bush block.
Banksia kippistiana var. paenepeccata	Priority 3		A rehabilitated excavation on slope, dry grey and white-yellow sand/gravel over laterite.

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Taxon	Status BC Act	Status EPBC Act	Habitat
Banksia mimica		Vulnerable	Dune ridge with gentle slope, dry yellow-grey-white sand over white sand and lateritic, well drained.
Banksia prionophylla		Critically Endangered	Lateritic rise with dry grey sand/brown sandy loam and laterite with surface boulders.
Banksia pteridifolia subsp. vernalis	Priority 3		Laterite hilltop with flat slope, dry brown-grey-white sand-gravel over laterite.
Beaufortia eriocephala	Priority 3		Rocky lateritic slopes, dry orange-brown-yellow gravel sandy loam over lateritic pebbles/boulders with good drainage.
Caladenia multiplex	Priority 2		Slope to winter wet depression, brown loam.
Calectasia elegans	Priority 2		Gentle mid-slope to north, grey/cream moist sand. Open Woodland over Open Shrubland.
Calothamnus accedens	Priority 4		
Calothamnus brevifolius	Priority 4		Winter-wet flat, brown light clay.
Calothamnus pachystachyus	Priority 4		
Calytrix ecalycata subsp. brevis	Priority 3		Private land low rise above winter-wet clay flats with yellow-white-grey sand.
Chamelaucium sp. Cataby (G.J. Keighery 11009)		Vulnerable	Low plain slope below top of breakaway on laterite boulders/rocky gravel with yellow and grey sand/brown sandy loam.
Chordifex reseminans	Priority 2		Edge of winter-wet flat, brown sandy clay.
Comesperma rhadinocarpum	Priority 3		Valley slope. Grey lateritic sand over laterite.
Conostephium magnum	Priority 4		Light grey sand.
Dampiera tephrea	Priority 3		Riverbank near reserve with pale white-grey sand and orange-brown sand-loam.
Darwinia acerosa			
Darwinia carnea			
Desmocladus biformis	Priority 3		Hillside with dry yellow gravelly/loamy sand over lateritic pebbles.
Desmocladus microcarpus	Priority 2		Gentle slope with grey moist sandy soils.
Desmocladus nodatus	Priority 3		Edge of significant wetland area winter-wet flat, white-grey clay and grey-brown sandy loam.
Dillwynia dillwynioides	Priority 3		Flat valley with damp organic dark grey loamy sand/sand with poor drainage.
Dodonaea hackettiana	Priority 4		Next to old limestone quarry with grey-black sand over limestone.
Drakaea elastica		Critically Endangered	Gradual slope, moist grey sand. Open *Banskia* woodland.
Drosera prophylla	Priority 3		Laterite boulder with slope, dry brown/grey sand/gravel.

Taxon	Status BC Act	Status EPBC Act	Habitat
Eleocharis keigheryi		Vulnerable	Shrubland to Heath.
Eucalyptus abdita	Priority 2		Below on slope of lateritic breakaway facing West.
Eucalyptus annuliformis	Priority 1		On broad laterite hill in shallow gully rocky lateritic gravel loam over laterite.
Eucalyptus macrocarpa subsp. elachantha	Priority 4		Gradual slope with grey-white lateritic sand over laterite. Mallee over heath.
Goodenia xanthotricha	Priority 2		Sandy clay. Slopes.
Grevillea drummondii	Priority 4		Ironstone lateritic hill.
Grevillea evanescens	Priority 1		Swamp.
Grevillea florida	Priority 3		
Grevillea olivacea	Priority 4		In clacareis saxosis.
Grevillea rudis	Priority 4		
Grevillea thelemanniana			Winter-wet flat, brown light clay.
Grevillea thyrsoides subsp. thyrsoides	Priority 3		Laterite/boulder slope. Dry, yellow/grey gravel/sand.
Guichenotia alba	Priority 3		Lower slope surrounding depression. Grey loamy sand and gravel.
Gyrostemon sp. Mogumber (T.J. Hawkeswood 250)	Priority 1		
Haemodorum loratum	Priority 3		Hillslope and flat plain with pale yellow sand.
Hensmania stoniella	Priority 3		Low lying black peaty sand over clay.
Hypocalymma lateriticola	Priority 1		Bare plain with moist yellow sand.
Hypocalymma quadrangulare	Priority 3		Dry ridge top in yellow Spearwood sand ridge.
Hypocalymma serrulatum	Priority 2		In sand.
Hypocalymma tetrapterum	Priority 3		
Hypocalymma x proliferum	Priority 1		
Hypolaena robusta	Priority 4		Low-rise flat area with white-grey sand over laterite. No signs of fire.
Isopogon autumnalis	Priority 3		Just below creas of hill, yellow/grey dry sand with laterite gravel and boulders.
Isotropis cuneifolia subsp. glabra	Priority 3		Flat. Grey sandy clay.
Jacksonia carduacea	Priority 3		Edge of winter-wet flat, brown-grey sandy clay over laterite.
Lepidobolus densus	Priority 4		Gentle W facing slope near edge of Swan Coastal Plain with yellow sand. Burnt greater than 7 years ago.
Lepidobolus quadratus	Priority 3		On light grey sandy over lateritic hillside. Slope, dry.

Taxon	Status BC Act	Status EPBC Act	Habitat
Lepidosperma rostratum		Endangered	Swamp, claypan. Grey clay, moist with areas of inundation. Long unburnt.
Lepyrodia curvescens	Priority 2		Depression, intermittently wet on laterite, peaty sand.
Leucopogon foliosus	Priority 3		Ridge, west facing slope. Brown loam and lateritic gravel and dry grey/yellow sand and laterite.
Leucopogon squarrosus subsp. trigynus	Priority 2		White sand hills.
Macarthuria keigheryi		Endangered	Private Land. Low rise above winter-wet clay flats and midslopes with dry white-grey and brown sand. Recently burnt. Very open woodland over low scrub over open herbs.
Paracaleana dixonii		Vulnerable	Low woodland B.
Persoonia rudis	Priority 3		Flat. Grey sand. Unburnt. In sandy loam.
Petrophile biternata	Priority 3		
Philotheca wonganensis			Steep sides of gullies, variable aspect. Soil: Rocky red/brown sandy loam.
Phlebocarya pilosissima subsp. pilosissima	Priority 3		Grey sand.
Platysace ramosissima	Priority 3		Nature Reserve, undulating plain with brown – yellow and white/grey sand. Fire history not known.
Ptychosema pusillum		Vulnerable	Low lying plain, moist grey sand.
Rumex drummondii	Priority 4		Dry brown clayey loam.
Schoenus griffinianus	Priority 4		Mid-slope gentle to flat near small creek grey sandy soils. Burnt four years earlier. Within low regenerated native vegetation on consolidated edges of firebreaks and fence line.
Schoenus pennisetis	Priority 3		Wetland, orange-grey sandy loam.
Scholtzia laciniata	Priority 2		On yellow sand.
Stylidium aceratum	Priority 3		Edge of significant wetland area. Plants occurring on existing cleared track. White/grey sand with clay.
Stylidium aeonioides	Priority 4		Hill top with dry yellow sandy and red-brown clayey-sand lateritic over laterite.
Stylidium milleri	Priority 2		On sandplain, lateritic gravel and duricrust, grey sandy matrix upland.
Stylidium nonscandens	Priority 3		Dune on E lake side, lower slope on grey-brown sand.
Stylidium sp. Moora (J.A. Wege 713)	Priority 2		
Stylidium striatum	Priority 4		Growing in sand.
Stylidium vinosum	Priority 1		Hillslope; white-grey sand over laterite.
Styphelia allittii	Priority 3		Lateritic hillside. Dry, bare yellow, gravelly sandy loam.

Taxon	Status BC Act	Status EPBC Act	Habitat
Synaphea panhesya	Priority 1		Sandy and gravel.
Synaphea sparsiflora	Priority 2		Slope, lateritic ridge. Pale brown sand – loam.
Tetratheca hirsuta subsp. boonanarring	Priority 2		Upper slope of landscape, dry white-grey sand merging with laterite and dark brown gravelly loam over massive laterite. No evidence >10 years. Site heavily shaded with a thick layer of leaf litter.
Thelymitra apiculata	Priority 4		Top of a low hill, grey-brown laterite and sandy gravel. Sandy-gravelly. Low heathland. No sign of fire.
Thelymitra stellata		Endangered	Low scrub regrowth on a site previously mined for gravel. No signs of fire. – Hakea regrowth.
Thysanotus glaucus	Priority 4		Growing in heath. Area burnt previous summer. In sand over laterite.
Tripterococcus sp. Brachylobus (A.S. George 14234)	Priority 4		Winter wet flats. Grey sand. Clay.
Verticordia lindleyi subsp. lindleyi	Priority 4		Flat. White sand. No signs of fire. On ploughed firebreaks (disturbed white sand). Drainage line, sandy soils with relatively high silt content.
Verticordia paludosa	Priority 4		Flat aspect, near depression. Dry white/grey sand. Swampy low lying area. No signs of fire.

Appendix B

Fauna species list

CLASS	Scientific name	Common name	Count of taxon
BIRD	*Calyptorhynchus banksii naso*	forest red-tailed black cockatoo	1
	Calyptorhynchus latirostris	Carnaby's cockatoo	44878
	Calyptorhynchus sp. 'white-tailed black cockatoo'	white-tailed black cockatoo	3303
	Falco peregrinus	peregrine falcon	1
	Leipoa ocellata	malleefowl	4
	Thinornis rubricollis	hooded plover, hooded dotterel	2
INVERTEBRATE	*Hylaeus globuliferus*	woolybush bee	1
	Idiosoma mcclementsorum	Julimar shield-backed trapdoor spider	2
	Idiosoma sigillatum	Swan Coastal Plain shield-backed trapdoor spider	1
	Leioproctus contrarius	a short-tongued bee	4
	Synemon gratiosa	graceful sunmoth	20
	Throscodectes xederoides	Mogumber bush cricket, Northern Throsco	1
	Westralunio carteri	Carter's freshwater mussel	241
MAMMAL	*Dasyurus geoffroii*	chuditch, western quoll	3
	Hydromys chrysogaster	water-rat, rakali	1
	Macrotis lagotis	bilby, dalgyte, ninu	1
	Notamacropus irma	western brush wallaby	16
REPTILE	*Neelaps calonotos*	black-striped snake, black-striped burrowing snake	5
	Pseudemydura umbrina	western swamp tortoise	86

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Appendix C

Likelihood of occurrence of conservation significant fauna within survey area

Species	Status WA	Status EPBC Act	Habitat	Likelihood to occur
Calyptorhynchus banksii naso (Forest Red-tailed Black- Cockatoo, Karrak)	Vulnerable	Vulnerable	Forest Red-tailed Black Cockatoos frequent the humid to sub-humid south-west of Western Australia from Gingin in the north, to Albany in the south and west to Cape Leeuwin and Bunbury (DSEWPaC, 2012). It nests in tree hollows with a depth of 1-5 m, that are predominately Marri (*Corymbia calophylla*), Jarrah (*Eucalyptus marginata*) and Karri (*E. diversicolor*) and it feeds primarily on the seeds of Marri.	Likely – feeding habitat present in the survey area.
Calyptorhynchus sp. (white-tailed black cockatoo)	Endangered	Endangered	This Cockatoo is found only in the south-west of Western Australia and generally bounded by the 750 mm rainfall isohyet (Albany, Gidgegannup and up to Mundaring and inland to the Stirling Ranges and Boyup Brook). Breeding has been recorded between Nornalup, northward to near Bridgetown, Lowden and Harvey (Department of the Environment, 2021a). Habitat comprises heavily forested areas dominated by Marri and other Eucalyptus species (particularly Karri and Jarrah). The distribution of the species comprises 40,000km2 http://www.environment.gov.au/cgi- bin/sprat/public/publicspecies.pl?taxon_id=769).	Likely – however, foraging habitat not present within the project area.
Calyptorhynchus latirostris (Carnaby's Cockatoo)	Endangered	Endangered	Carnaby's Cockatoo is found in the south-west of Australia from Kalbarri through to Ravensthorpe. It prefers feeding on the seeds of *Banksia, Dryandra, Hakea, Eucalyptus, Grevillea, Pinus* and Allocasuarina spp. It is nomadic often moving toward the coast after breeding. The birds breed in tree hollows that are 2.5 – 12m above the ground and have an entrance 23-30cm with a depth of 1-2.5m. Nesting mostly occurs in smooth-barked trees (e.g., Salmon Gum, Wandoo, Red Morrell) (DSEWPaC, 2012).	Likely – but foraging habitat present on the subject land.
Falco peregrinus (Peregrine Falcon)	Other specially protected fauna		The Peregrine Falcon is found in a variety of habitats but nests on high cliff ledges or artificial structures. It feeds primarily on small-medium sized birds, but occasionally taking insects, such as moths, cicadas and locusts (Birdlife, 2012).	Unlikely – may fly over but unlikely rely on the survey area.

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Species	Status WA	Status EPBC Act	Habitat	Likelihood to occur
Leipoa ocellata (Malleefowl)	Vulnerable	Vulnerable	The Malleefowl occurs in scrubland and woodland dominated by mallee and wattle species (Department of the Environment, http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=934).	Highly unlikely – Not suitable habitat in the survey area.
Thinornis rubricollis (Hooded Plover)	Priority 4	Not listed	The hooded plover (eastern) is a small Australian beach nesting bird. It mainly occurs on wide beaches backed by dunes with large amounts of seaweed and jetsam, creek mouths and inlet entrances (https://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=66726#).	Unlikely. The survey area does not contain habitat suitable for this species.
Dasyurus geoffroii (Chuditch, Western Quoll)	Endangered	Vulnerable	It is now largely restricted to the south-west of Western Australia, with small numbers in the Midwest, Wheatbelt and South Coast Regions. Historically, chuditch inhabited a wide range of habitats, but today it survives mostly in Jarrah Eucalyptus marginata forests and woodlands, mallee shrublands and heathlands (https://www.dpaw.wa.gov.au/images/documents/plants-animals/animals/animal_profiles/chuditch_fauna_profile.pdf).	Highly Unlikely - There have not been any records of Chuditch in the Survey area
Notamacropus Irma (Western Brush Wallaby)	Priority 4	Not listed	Preferred habitat is open forest or woodlands with seasonally wet sites and low vegetation. This species is often found in dry schlerophyll forests, such as jarrah, and areas of mallee and heathland scrub. It is rarely found in wet schlerophyll forests and is not found in ecosystems characterized by a thick understory, such as karri forests.	Highly Unlikely as the area of vegetation is relatively isolated in a highly cleared landscape.

Species	Status WA	Status EPBC Act	Habitat	Likelihood to occur
Pseudomys occidentalis (Western Mouse)	Priority 4	Not listed	The distribution range once extended across Southwest Australia and into the arid interior, this became restricted to a few areas near the Ravensthorpe Range, at Fitzgerald River National Park, and several isolated populations in the southern wheatbelt. This mouse lives in loamy soils in areas that have not been burnt recently, and not known at any location that has been subjected to fire in the preceding 30 to 50 years. The terrain has climax vegetation, especially the desert quandong Santalum acuminatum and sedge-like plants. The substrate of the ecological communities in which they are known to remain is sandy or sandy-clay soil that is often intermixed with gravel. Plant genera associated with their remnant sites are *Eucalyptus*, *Acacia*, *Isopogon*, *Allocasuarina* and *Melaleuca*, and the vegetation of their habitat is highly variable, including open woodlands, low and tall shrubland, mallee and heath in open to dense arrangements of plants	Highly unlikely as the area lacking understory and is relatively isolated in a highly cleared landscape.
Phascogale tapoatafa wambenger (south-western brush-tailed phascogale, wambenger)	Species of special conservation interest (Conservation dependent)	Critically Endangered	This subspecies has been observed in dry sclerophyll forests and open woodlands that contain hollow-bearing trees but a sparse ground cover. It has a highly fragmented distribution across the southwest of WA (https://en.wikipedia.org/wiki/Brush-tailed_phascogale).	Unlikely to persist within the Survey area

Appendix D

Conservation code definitions

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

THREATENED AND PRIORITY FLORA INFORMATION

Conditions with Respect to the Supply of Information

- The data supplied may not be provided to any other organisations, nor be used for any purpose other than for the project for which it has been originally provided for; without the prior consent of the Executive Director, Department of Biodiversity, Conservation and Attractions.
- Specific locality information for threatened flora is regarded as confidential, and should be treated as such by receiving organisations. Specific locality information for threatened flora may not be used in reports without the written permission of the Executive Director, Department of Biodiversity, Conservation and Attractions. Reports may only show generalised locations at a low resolution or, where necessary, show specific locations without identifying species. Species and Communities Branch is to be contacted for guidance on the presentation of threatened flora information.
- The Department of Biodiversity, Conservation and Attractions respects the privacy of private landowners who may have threatened and priority flora on their property. Threatened and priority flora locations identified in the data as being on private property should be treated in confidence, and contact with property owners must only be made through the Department of Biodiversity, Conservation and Attractions.
- The development of the Perth Herbarium database was not originally intended for electronic mapping (eg. GIS ArcView). The latitude and longitude coordinates for each entry are not verified prior to being data based. It is only in recent times that collections have been submitted with GPS coordinates. Therefore, be aware when using this data in GIS software that some records may not plot to the locality description given with each collection.
- Acknowledgment of the Department Biodiversity, Conservation and Attractions as the source of data is to be made in any published material and cited as Biodiversity, Conservation and Attractions (2018) Threatened and Priority Flora Database Search for [search area] accessed on the [date of search]. Prepared by the Species and Communities program for [Requesters name and company] for [purpose of search].
- Copies of all such publications are to be forwarded to the Department of Biodiversity, Conservation and Attractions, Attention; the Manager, Species and Communities program.

Disclaimers with Respect to the Supply of Information

- Receiving organisations should note that while every effort has been made to prevent errors and omissions in the data, they may be present. The Department of Biodiversity, Conservation and Attractions accepts no responsibility for this.
- Receiving organisations must also recognise that the database is subject to continual updating and amendment, and such considerations should be taken into account by the user.
- It should be noted that the supplied data does not necessarily represent a comprehensive listing of the threatened flora of the area in question. Its comprehensiveness is dependent on the amount of surveys carried out within a specified area. The receiving organisation should consider engaging a botanist, if required, to undertake a survey of the area under consideration.

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

ABBREVIATIONS USED IN THREATENED AND PRIORITY FLORA DATABASE

VESTING

AAP	Aboriginal Planning Authority
AGR	Chief Executive, Dep. of Agriculture
ALT	Aboriginal Land Trust
APB	Agricultural Protection Board of WA
BGP	Botanical Gardens & Parks Authority
BSA	Boy Scouts Association
CC	Conservation Commission – NPNCA - LFC
CGT	Crown Grant in Trust
COM	Commonwealth of Australia
CRO	Crown Freehold-Govt Ownership
CRW	Crown
DAG	Dep. of Agriculture
DOW	Dep. of Water
DPI	Dep. of Planning
EXD	Exec Direc CALM
FES	Fire and Emergency Services Aust.
HOW	Dep. of Housing/State Housing Commission
ILD	Industrial Lands Develop. Auth
LAC	LandCorp
LGA	Shire/LGA
MAG	Minister for Agriculture
MCB	Metropolitan Cemeteries Board
MED	Ministry of Education
MHE	Minister for Health
MIN	Minister for Mines
MPL	Ministry for Planning
MPR	Minister for Prisons
MRD	Main Roads WA
MTR	Minister for Transport
MWA	Minister for Water Resources
MWO	Minister for Works
NAT	Natural Trust of Australia WA
NON	Not Vested
PLB	Pastoral Lands Board
PRI	Private/Freehold
RAI	Public Transport Authority
REL	Religious Organisation
SPC	State Planning Commission
SYN	Synergy (ex Western Power)
SWA	State of Western Australia
TEL	Telstra
UNK	Unknown
WAT	Water Corporation
WEL	Minister Community Welfare
WRC	Water & Rivers Commission
XPL	Ex-Pastoral Lease

PURPOSES

ABR	Aboriginal Reserve
ACC	Access Track
AER	Aerodrome
AIR	Airport
ARS	Agricultural Research Station
BAP	Baptist Union of WA
CAM	Camping
CAR	Caravan park
CEM	Cemetery
CFA	Conservation of Fauna
CFF	Conservation Of Flora & Fauna
CFL	Conservation of Flora
CHU	Church
CMN	Communications
COM	Common
CON	Conservation Park
CPK	Car Park
CRM	Conservation & Resource Management
DEF	Defence
DRA	Drain
EDE	Educational Endowment
EDU	Educational purposes
UWA	
ENE	Enjoyment of Natural Environ.
EPL	Ex-pastoral Lease (Sect 33(2) CALM Act)
EPS	Explosives
EXC	Excepted from sale
EXL	Exploration Lease
EXP	Experimental Farm
FIR	Firing Range
FOR	State Forest
FP	Foreshore Purposes
GE	General Lease
GHA	Grain Handling
GOL	Golf
GRA	Gravel Pit
GVT	Government Requirements
HAR	Harbour Purposes
HEP	Heritage Purposes
HER	Heritage trail
HOS	Hospital
KEN	Kennels
LGA	LGA/Shire Requirements
LPR	Landscape Protection
MIN	Mining lease
MUN	Municipal Purposes
NPK	National Park
NRE	Nature Reserve
OTH	Other
PAR	Parkland (& Recreation)
PAS	Pastoral lease
PCR	Proposed for Conservation
PFF	Protection of Flora & Fauna
PFL	Protection of Flora
PIC	Picnic ground
PLA	Plantation
PMC	Protection of Meteorite Crater
POS	Public Open Space
PPA	Public parkland
PRS	Prison site
PUR	Purchase Lease
PUT	Public Utility
QUA	Quarry
RAC	Racecourse
RAD	Radio Station
REC	Recreation
REH	Rehabilitation/Re-establish Native Plants
RRE	Railway Reserve
RUB	Rubbish
SAL	Saleyards
SAN	Sand
SCH	School-site
SET	Settlers requirements
SHO	Showgrounds
SNN	Sanitary
SOI	Soil Conservation
STO	Stopping place
STK	Stock Route
TIM	Timber
TOU	Tourism
TOW	Town-site
TRA	Training Ground
TRI	Trig station
UCL	Unallocated Crown Land
UNK	Unknown
VER	Road Verge
VPF	Vermin Proof Fence
WAT	Water
WLS	Wildlife Sanctuary
WOO	Firewood

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

ABBREVIATIONS USED IN THE WESTERN AUSTRALIAN HERBARIUM DATABASE

Geocode Method - The method that was used to record the latitude and longitude.

Auto - Indicates that the coordinate data in the record was created automatically (i.e. by software), usually by creating a coordinate from information provided in the Nearest Named Place or Locality textual description fields.

GAP - Acronym for "Generalised Arbitrary Point" as used in HISPID. GAP indicates that the coordinate data was obtained manually from the Nearest Named Place or Locality textual description fields.

GPS - Acronym for "Global Positioning System". GPS indicates that the coordinate data in the record was obtained from a GPS unit by the collector of the specimen.

MAN - Shorthand for manual. MAN indicates that the coordinate data was created by hand using some method not allowed for by one of the other manual Geocode Method values, in particular, TOPO, GAP, or GPS.

TOPO - Shorthand for topographic map. TOPO indicates that the coordinate data was obtained by plotting textual locality details against a topographic map.

None - Indicates that no coordinate data has been supplied by the collector.

Unknown - Indicates that there is no known method for determining the coordinate data. Should be used if the collector provided no indication of how they sampled the specimen's coordinate data.

PREC (Precision) - precision ratings for coordinates.

Precision 1: Absolutely precise (to nearest 100m or nearest second) and must be GPS determined. For example 35°26'42"S 123°40'26"E

Precision 2: Falling within a diameter of 3km (ca 2 minutes) or if no GPS mentioned in collecting notes. (The location must be able to be pinpointed on a 1:250 000 map, a spot locality. For example 35°26'42"S 123°40'26"E

Precision 3: Falling within a diameter of 10km (ca 7 minutes) or for degrees and minutes, where seconds have not been given. For example 35°26'_"S 123°40'_"E

Precision 4: Falling within a diameter of ca 50km (30 minutes). For example 35°26'_"S 123°40'_"E

Precision 5: Where a location is a prescribed large geographical area within a state or only the state is given. Diameter is greater than 50km. For example 35°_'_"S 123°_'_"E

Precision 6: used when localities are New Holland, Eastern Australia or Not given. Fields will be left blank.

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

CONSERVATION CODES

For Western Australian Flora and Fauna

Threatened, Extinct and Specially Protected fauna or flora[1] are species[2] which have been adequately searched for and are deemed to be, in the wild, threatened, extinct or in need of special protection, and have been gazetted as such.

The *Wildlife Conservation (Specially Protected Fauna) Notice 2018* and the *Wildlife Conservation (Rare Flora) Notice 2018* have been transitioned under regulations 170, 171 and 172 of the *Biodiversity Conservation Regulations 2018* to be the lists of Threatened, Extinct and Specially Protected species under Part 2 of the *Biodiversity Conservation Act 2016.*

Categories of Threatened, Extinct and Specially Protected fauna and flora are:

T **Threatened species**

Listed by order of the Minister as Threatened in the category of critically endangered, endangered or vulnerable under section 19(1), or is a rediscovered species to be regarded as threatened species under section 26(2) of the *Biodiversity Conservation Act 2016* (BC Act).
Threatened fauna is that subset of 'Specially Protected Fauna' listed under schedules 1 to 3 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for Threatened Fauna.
Threatened flora is that subset of 'Rare Flora' listed under schedules 1 to 3 of the *Wildlife Conservation (Rare Flora) Notice 2018* for Threatened Flora.
The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria as detailed below.

CR **Critically endangered species**

Threatened species considered to be "*facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines*".
Listed as critically endangered under section 19(1)(a) of the BC Act in accordance with the criteria set out in section 20 and the ministerial guidelines. Published under schedule 1 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for critically endangered fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for critically endangered flora.

EN **Endangered species**

Threatened species considered to be "*facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines*".
Listed as endangered under section 19(1)(b) of the BC Act in accordance with the criteria set out in section 21 and the ministerial guidelines. Published under schedule 2 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for endangered fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for endangered flora.

VU **Vulnerable species**

Threatened species considered to be "*facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with criteria set out in the ministerial guidelines*".
Listed as vulnerable under section 19(1)(c) of the BC Act in accordance with the criteria set out in section 22 and the ministerial guidelines. Published under schedule 3 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for vulnerable fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for vulnerable flora.

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

Extinct species

Listed by order of the Minister as extinct under section 23(1) of the BC Act as extinct or extinct in the wild.

EX Extinct species

Species where "*there is no reasonable doubt that the last member of the species has died*", and listing is otherwise in accordance with the ministerial guidelines (section 24 of the BC Act).
Published as presumed extinct under schedule 4 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for extinct fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for extinct flora.

EW Extinct in the wild species

Species that *"is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; and it has not been recorded in its known habitat or expected habitat, at appropriate seasons, anywhere in its past range, despite surveys over a time frame appropriate to its life cycle and form*", and listing is otherwise in accordance with the ministerial guidelines (section 25 of the BC Act).
Currently there are no threatened fauna or threatened flora species listed as extinct in the wild. If listing of a species as extinct in the wild occurs, then a schedule will be added to the applicable notice.

Specially protected species

Listed by order of the Minister as specially protected under section 13(1) of the BC Act. Meeting one or more of the following categories: species of special conservation interest; migratory species; cetaceans; species subject to international agreement; or species otherwise in need of special protection.
Species that are listed as threatened species (critically endangered, endangered or vulnerable) or extinct species under the BC Act cannot also be listed as Specially Protected species.

MI Migratory species

Fauna that periodically or occasionally visit Australia or an external Territory or the exclusive economic zone; or the species is subject of an international agreement that relates to the protection of migratory species and that binds the Commonwealth; and listing is otherwise in accordance with the ministerial guidelines (section 15 of the BC Act).
Includes birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and fauna subject to the *Convention on the Conservation of Migratory Species of Wild Animals* (Bonn Convention), an environmental treaty under the United Nations Environment Program. Migratory species listed under the BC Act are a subset of the migratory animals, that are known to visit Western Australia, protected under the international agreements or treaties, excluding species that are listed as Threatened species.
Published as migratory birds protected under an international agreement under schedule 5 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018*.

CD Species of special conservation interest (conservation dependent fauna)

Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened, and listing is otherwise in accordance with the ministerial guidelines (section 14 of the BC Act).
Published as conservation dependent fauna under schedule 6 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018*.

OS Other specially protected species

Fauna otherwise in need of special protection to ensure their conservation, and listing is otherwise in accordance with the ministerial guidelines (section 18 of the BC Act).
Published as other specially protected fauna under schedule 7 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018*.

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

P Priority species

Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened fauna or flora.
Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring.
Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.

1 Priority 1: Poorly-known species
Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.

2 Priority 2: Poorly-known species
Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.

3 Priority 3: Poorly-known species
Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.

4 Priority 4: Rare, Near Threatened and other species in need of monitoring
(a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands.
(b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for vulnerable but are not listed as Conservation Dependent.
(c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

[1] The definition of flora includes algae, fungi and lichens
[2]Species includes all taxa (plural of taxon - a classificatory group of any taxonomic rank, e.g. a family, genus, species or any infraspecific category i.e. subspecies or variety, or a distinct population).

Appendix E

Vegetation summary within the survey area

Site: 01

Type: 10 m x 10 m quadrat

Date: 06/09/2023

Described by: Roger

MGA zone: 50 H

Easting: 375693 Northing: 6572405

Vegetation condition: Excellent



Plate 01: from NW



Plate 02: from SE

Species List

Name	Family	Cover (%)	Height (m)
Allocasuarina humilis	Casuarinaceae	5	0.9
Amphipogon turbinatus	Poaceae	0.2	0.3
**Arctotheca calendula*	Asteraceae	0.1	0.2
Banksia dallanneyi	Proteaceae	0.1	1.5
Banksia prionotes	Proteaceae	20	8
Caladenia flava	Orchidaceae	0.1	0.1
Calothamnus sanguineus	Myrtaceae	3	0.8
Cassytha racemosa	Lauraceae	0.1	Creeper
Cyanothamnus ramosus subsp. *anethifolius*	Rutaceae	0.5	1
Desmocladus asper	Restionaceae	1	0.3
Drakaea gracilis	Orchidaceae	0.2	Prostrate
Drosera gigantea	Droseraceae	0.1	Creeper
Drosera barbigera	Droseraceae	0.1	Prostrate
Eremaea pauciflora var. *pauciflora*	Myrtaceae	5	0.7
Hakea ruscifolia	Proteaceae	1.5	1.5
Hakea varia	Proteaceae	1.5	1
Hibbertia hypericoides subsp. *Hypericoides*	Dilleniaceae	10	0.6
**Hypochaeris glabra*	Asteraceae	0.1	Prostrate
Isotropis cuneifolia subsp. cuneifolia	Fabaceae	0.1	0.1
Jacksonia nutans	Fabaceae	0.5	0.6
Lepidosperma sp.	Cyperaceae	1	0.6
Mesomelaena pseudostygia	Cyperaceae	5	0.4
Neurachne alopecuroidea	Poaceae	0.1	0.1
Opercularia vaginata	Rubiaceae	0.1	0.3
Patersonia occidentalis	Iridaceae	0.25	0.4

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Name	Family	Cover (%)	Height (m)
Pericalymma ellipticum	Myrtaceae	1.5	0.7
Petrophile brevifolia	Proteaceae	0.2	0.6
Stirlingia latifolia	Proteaceae	2	1.7
Synaphea spinulosa (Burm.f.) Merr. subsp. *spinulosa*	Proteaceae	1.5	0.5
**Ursinia anthemoides*	Asteraceae	0.1	0.1
Xanthorrhoea preissii	Xanthorrhoeaceae	0.75	1.7

Site: 02

Type: 10 m x 10 m quadrat

Date: 06/09/2023

Described by: Roger

MGA zone: 50 H

Easting: 375684 Northing: 6572367

Vegetation condition: very good



Plate 01: from NW



Plate 02: from SE

Species List

Name	Family	Cover (%)	Height (m)
Allocasuarina humilis	Casuarinaceae	7.5	0.7
Anigozanthos humilis	Haemodoraceae	0.2	0.3
**Arctotheca calendula*	Asteraceae	0.75	0.2
Banksia prionotes	Proteaceae	30	6
Caladenia flava	Orchidaceae	0.1	0.1
Cyanothamnus ramosus subsp. *anethifolius*	Rutaceae	0.75	0.9
Daviesia decurrens	Fabaceae	0.2	0.4
Desmocladus asper	Restionaceae	0.5	0.7
Goodenia reinwardtii	Goodeniaceae	3.5	1
Gyrostemon ramulosus	Gyrostemonaceae	1	0.7
Hakea varia	Proteaceae	2.5	1.5
Hibbertia hypericoides subsp. *hypericoides*	Dilleniaceae	6	0.7
Hibbertia subvillosa (P3)	Dilleniaceae	1	0.3
**Hypochaeris glabra*	Asteraceae	0.1	Pr
Isotropis cuneifolia subsp. *cuneifolia*	Fabaceae	0.2	0.3
Lechenaultia biloba	Goodeniaceae	0.1	0.3
Lepidosperma sp.	Cyperaceae	1	0.6
Mesomelaena pseudostygia	Cyperaceae	0.2	0.3
Nuytsia floribunda	Loranthaceae	2.5	7
Persoonia comata	Proteaceae	1.5	0.6
Petrophile brevifolia	Proteaceae	0.5	0.7
Poaceae sp.	Poaceae	0.2	0.6
**Romulea rosea*	Iridaceae	0.1	0.1
**Solanum nigrum*	Solanaceae	1	0.7
**Sonchus oleraceus*	Asteraceae	0.1	0.2
Stirlingia latifolia	Proteaceae	10	0.6
Synaphea spinulosa (Burm.f.) Merr. subsp. *spinulosa*	Proteaceae	1	0.3
**Ursinia anthemoides*	Asteraceae	0.1	0.1
Xanthorrhoea preissii	Xanthorrhoeaceae	1	1.5

Site: 03

Type: 10 m x 10 m quadrat

Date: 06/09/2023

Described by: Roger

MGA zone: 50 H

Easting: 375727 Northing: 6572366

Vegetation condition: good



Plate 01: from NW



Plate 02: from SE

Species List

Name	Family	Cover (%)	Height (m)
Adenanthos cygnorum	Proteaceae	5	2
Allocasuarina humilis	Casuarinaceae	15	0.7
Banksia prionotes	Proteaceae	15	4
Caladenia flava	Orchidaceae	0.1	0.1
Daviesia decurrens	Fabaceae	0.25	0.3
**Eragrostis curvula*	Poaceae	3	1
Eremaea pauciflora var. *pauciflora*	Myrtaceae	7.5	0.6
Gyrostemon ramulosus	Gyrostemonaceae	1	0.6
Hemiphora bartlingii	Lamiaceae	0.5	0.6
Hibbertia hypericoides subsp. *hypericoides*	Dilleniaceae	1.5	0.3
Hibbertia subvillosa (P3)	Dilleniaceae	0.25	0.3
**Hypochaeris glabra*	Asteraceae	0.1	Cr
Isotropis cuneifolia subsp. *cuneifolia*	Fabaceae	0.1	0.1
Jacksonia nutans	Fabaceae	2.5	0.5
Jacksonia sternbergiana	Fabaceae	15	5
Lechenaultia linarioides	Goodeniaceae	0.1	0.5
Lepidosperma pubisquameum	Cyperaceae	1.5	0.7
Mesomelaena pseudostygia	Cyperaceae	1.5	0.7
Persoonia comata	Proteaceae	1	0.7
Synaphea spinulosa (Burm.f.) Merr. subsp. *spinulosa*	Proteaceae	1	0.6
**Ursinia anthemoides*	Asteraceae	0.1	0.1

Releve': 01

Date: 06/09/2023

Described by: Roger

MGA zone: 50 H

Easting: 375784 Northing: 6572387

Vegetation condition: degraded



Plate 01:

Species List

Name	Family	Cover (%)	Height (m)
Adenanthos cygnorum	Proteaceae	5	2
Allocasuarina humilis	Casuarinaceae	5	0.7
**Arctotheca calendula*	Asteraceae	0.1	0.2
Banksia prionotes	Proteaceae	5	4
Calothamnus sanguineus	Myrtaceae	1	0.8
**Eragrostis curvula*	Poaceae	3	0.9
Eremaea pauciflora var. *pauciflora*	Myrtaceae	5	0.6
Hibbertia hypericoides subsp. *hypericoides*	Dilleniaceae	1.5	0.3
**Hypochaeris glabra*	Asteraceae	0.1	Cr
Ptilotus polystachyus	Amaranthaceae	1	0.3
**Sonchus oleraceus*	Asteraceae	0.1	0.2
Stirlingia latifolia	Proteaceae	5	0.6
Synaphea spinulosa (Burm.f.) Merr. subsp. *spinulosa*	Proteaceae	1	0.6
**Ursinia anthemoides*	Asteraceae	0.1	0.1
Xanthorrhoea preissii	Xanthorrhoeaceae	1	1.5
**Zantedeschia aethiopica*	Araceae	0.5	0.4