

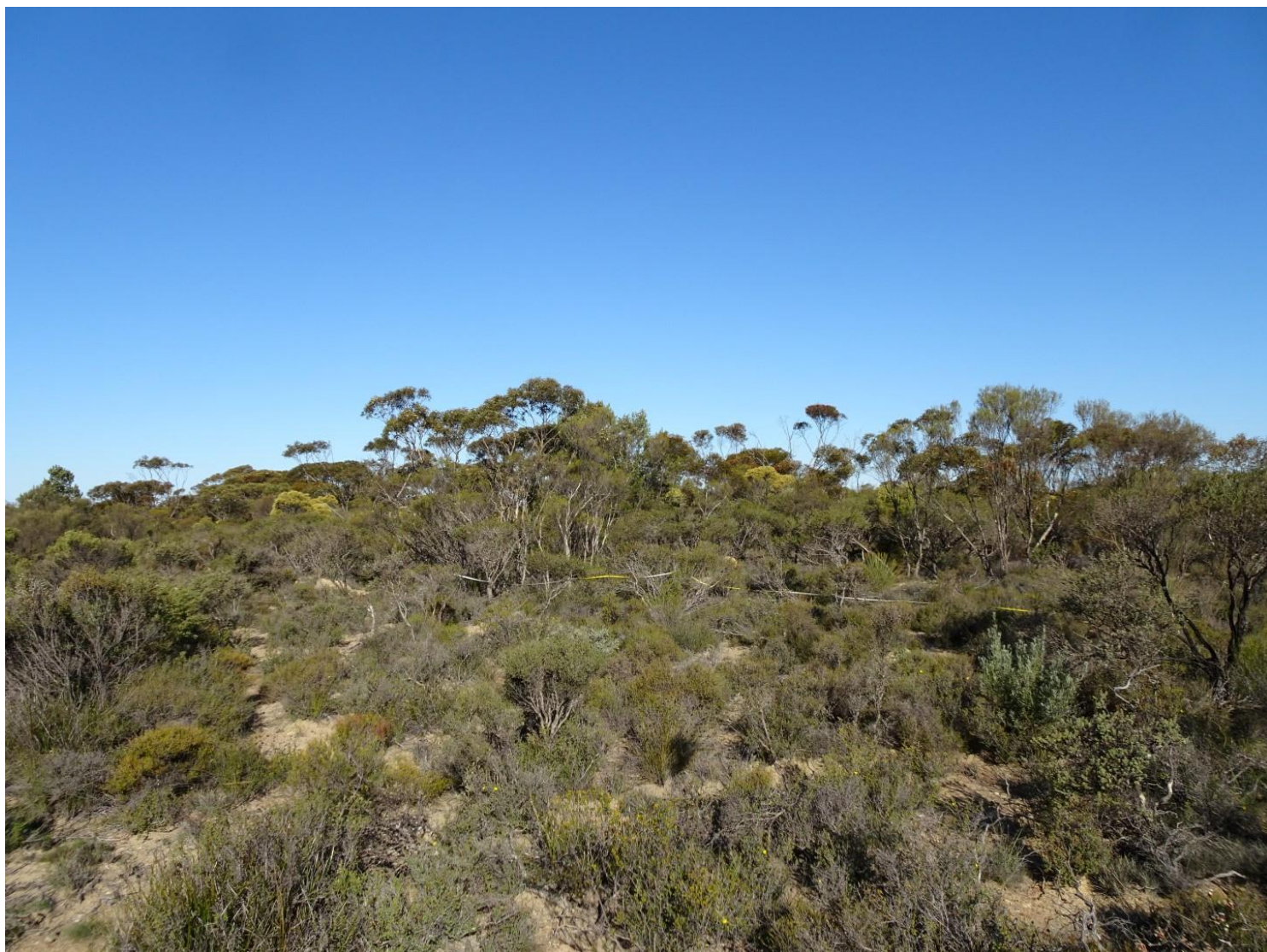


# Flora, vegetation and fauna assessment

## Newdegate Storage Facility and Entry Road

Prepared for  
**CBH Group**

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# Abbreviations

Abbreviation	Description
BC Act	Biodiversity Conservation Act 2016
BoM	Bureau of Meteorology
CBH	CBH Group
CEMP	Construction Environmental Management Plan
CEO	Chief Executive Officer
DAFWA	Department of Agriculture and Food Western Australia
DBCA	Department of Biodiversity, Conservation and Attractions
DER	Department of Environment Regulation
DoE	Department of the Environment
DoEE	Department of the Environment and Energy
DPIRD	Department of Primary Industry and Regional Development
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities
DWER	Department of Water and Environmental Regulation
EAS	Environmental Approvals Strategy
ELA	Eco Logical Australia
EP Act	<i>Environmental Protection Act 1986</i>
EPA	Environmental Protection Authority
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
Eucalypt Woodlands TEC	Eucalypt woodlands of the Western Australian Wheatbelt community
HQC	Habitat quality categories
IBSA	Index of Biodiversity Surveys for Assessments
mg/L TDS	Milligrams per litre total dissolved solids
NVCP	Native Vegetation Clearing Permit
PEC	Priority Ecological Community
TEC	Threatened Ecological Community
WAH	Western Australian Herbarium
WAM	Western Australian Museum
WC Act	<i>Wildlife Conservation Act 1950</i>
WONS	Weeds of National Significance

# Executive summary

CBH Group (CBH) are proposing to build an alternative site entry road to access their grain stores on the Newdegate Field Day Overflow Parking Area (the Project), located approximately 1.0 km west of the town of Newdegate, in the Shire of Lake Grace, Western Australia.

Eco Logical Australia (ELA) was commissioned to undertake biological assessments including: a detailed and targeted flora survey; a Level 1 terrestrial fauna survey; and targeted surveys for Threatened species of black cockatoo and *Leipoa ocellata* (Malleefowl) to inform the environmental approvals process required for the clearing of native vegetation associated with the Project. In addition, the study area was to be ground truthed for potential Red-tailed Phascogale habitat as part of fauna habitat mapping.

The field survey was conducted on the 19 September 2018, the timing of which was considered optimal for these types of assessments, with a follow-up survey to confirm mapping boundaries conducted on the 21<sup>st</sup> January 2019

A total of 83 flora taxa from 54 genera and 29 families were recorded across the eight quadrats established across the study area and from opportunistic collections. Seven weed species were recorded, none of which were listed as a Weed of National Significance (WONS) or Declared Pest under the *Biosecurity and Agriculture Management Act 2007*. These weed species were recorded at low densities in disturbed areas associated with the adjacent tracks and main road verges.

No Threatened flora listed under section 178 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) or Part 2 of the *Biodiversity Conservation Act 2016* (BC Act) were recorded within the study area. A total of four Priority (P) flora species listed by DBCA were recorded within the study area including: *Guichenotia asteriskos* (P2), *Banksia xylothemelia* (P3), *Daviesia implexa* (P3) and *Persoonia brevihachis* (P3).

Three vegetation types were delineated and mapped within the study area. None of the three vegetation types identified within the study area were considered to represent Commonwealth or State listed Threatened Ecological Communities (TEC) or Priority Ecological Communities (PEC), based on the results of the field survey and database searches.

Vegetation condition within the study area ranged from Very Good (1.25 ha; 43.59%) to Excellent condition (1.28 hectare [ha]; 44.63%).

Three broad fauna habitats were mapped within the study area: Open Sheoak shrubland with sparse mixed shrubs; Mixed sparse shrubland; and *Eucalyptus mallee* over *Melaleuca*.

Ten species of vertebrate fauna were observed during the fauna survey including one native mammal, two introduced mammals and seven native birds. No fauna species listed as Threatened under the EPBC or BC Act, or Priority fauna listed by DBCA, were recorded during the survey.

Targeted habitat surveys for Malleefowl and black cockatoos did not record any foraging or breeding habitat present within the study area for either species. Nor was any evidence of presence observed for either species.

Black cockatoos were assessed as being unlikely to occur given the lack of foraging and/or breeding habitat available within the study area. Foraging species for black cockatoos were indeed present within two of the three mapped fauna habitats: Open Sheoak shrubland with sparse mixed shrubs; and Mixed

sparse shrubland. However, these were represented by low strands of individual Banksia and Hakea species, and were subsequently assessed as being low quality.

Based on the values identified within the study area, environmental approvals required to clear vegetation for development are likely to comprise a Native Vegetation Clearing Permit issued by the Department of Water and Environmental Regulation. As no Matters of National Environmental Significance were recorded within the study area, a Referral under the EPBC Act is unlikely to be required.



# 1 Introduction

## 1.1 Background

CBH Group (CBH) currently owns and operates grain stores on the Newdegate Field Day Overflow Parking Area, located approximately 1.0 km west of the town of Newdegate, in the Shire of Lake Grace, Western Australia (the site; Figure 1-1).

CBH are proposing to build an alternative site entry road to access the grain stores from the Newdegate-Lake Grace Road, to address road safety issues associated with the site (the Project; Figure 1-1).

The land that the Project is located on is currently vested to the Water Corporation; however, after recent discussions with the Shire of Lake Grace (the Shire), CBH has agreed to take responsibility to progress environmental approvals for works associated with the Project.

Eco Logical Australia (ELA) was commissioned to undertake biological assessments including: a detailed and targeted flora survey; a Level 1 terrestrial fauna survey; and targeted surveys for Threatened species of black cockatoo and *Leipoa ocellata* (Malleefowl) to inform the environmental approvals process required for the clearing of native vegetation associated with the Project. In addition, areas in close proximity to the study area have previously been identified as Red-tailed Phascogale habitat ('less suitable') as part of the Newdegate Grain Reveal Site assessment (ELA 2018). This assessment will be ground truthed as part of the fauna habitat mapping.

The Scope of Works (SoW) for the Project includes:

- A desktop assessment including literature review and searches of relevant State and Commonwealth databases;
- A detailed and targeted flora survey (equivalent to a Level 2 flora survey) consisting of the following tasks:
  - A desktop survey of the subject site including requesting information on Threatened species and communities from Department of Biodiversity, Conservation and Attractions (DBCA);
  - Description and mapping of vegetation types including Threatened and Priority Ecological Communities (TECs and PECs);
  - Compiling a flora species inventory (including weeds) using quadrats and opportunistic sampling;
  - Mapping of Declared Pest Plants listed under the *Biosecurity and Agriculture Management Act 2007* (BAM Act) and Weeds of National Significance (WONS);
  - Vegetation condition mapping; and
  - Targeted searches for flora of conservation significance and mapping of populations;
- A Level 1 fauna survey to map general fauna habitat present and record opportunistic observations of fauna, or evidence of fauna, present (including ground truthing habitat suitability for Red-tailed Phascogale);
- A targeted survey for Threatened species of black cockatoos and Malleefowl including:
  - Targeted searches for signs of Malleefowl in areas of suitable habitat (tracks, scats, mounds and individuals); and
  - An assessment and mapping of black cockatoo breeding, foraging and roosting habitat.

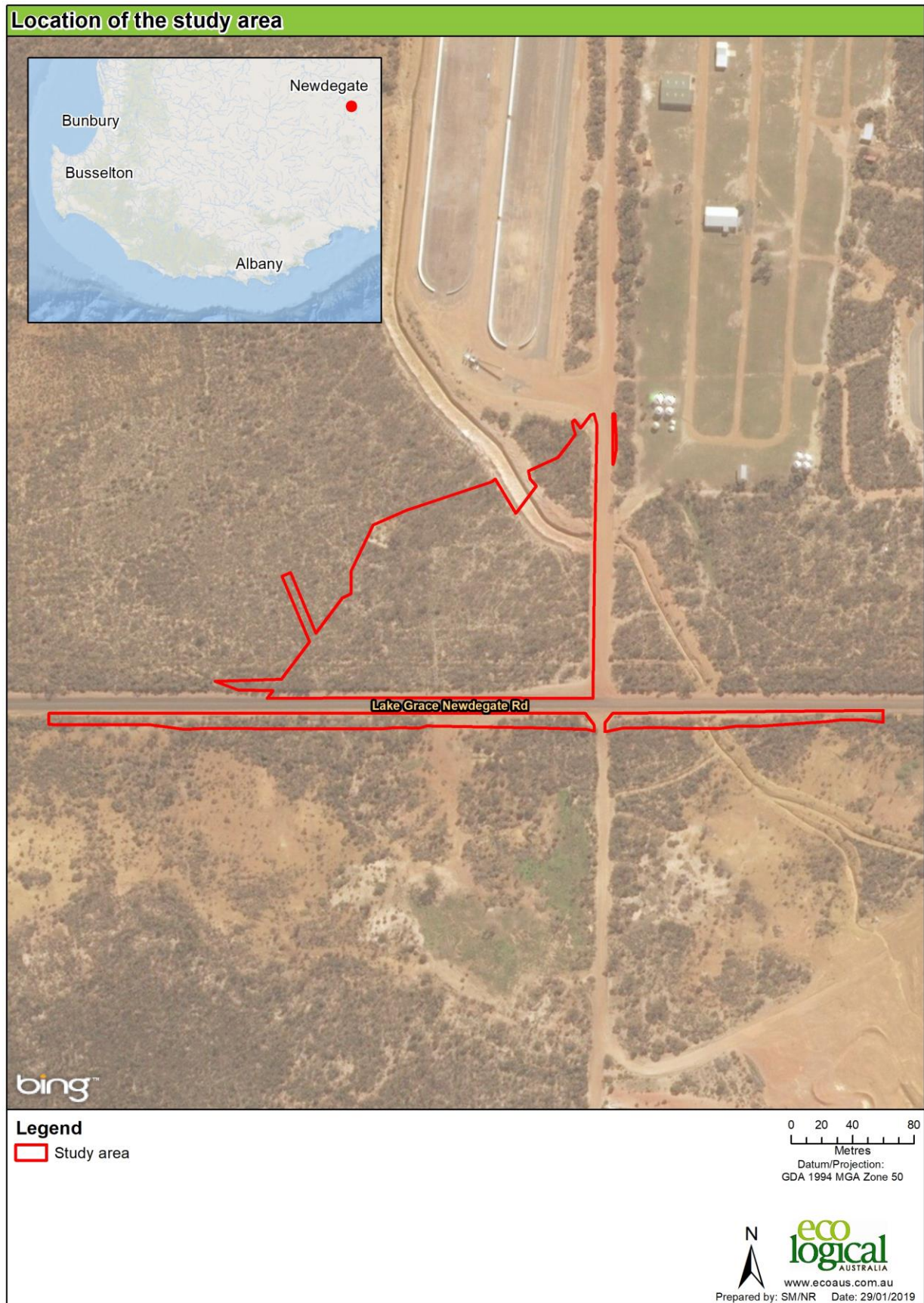
## 1.2 Legislative framework

The flora, vegetation and fauna survey was undertaken in accordance with Commonwealth and State legislation and guidelines. Specifically, the survey was undertaken in accordance with the following:

- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act);
- Western Australian (WA) *Environmental Protection Act 1986* (EP Act);
- *Biodiversity Conservation Act 2016* (BC Act; replaces the WA *Wildlife Conservation Act 1950*, effective January 2019 [WC Act]);
- Environmental Protection Authority (EPA) *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016a);
- EPA *Environmental Factor Guideline: Flora and Vegetation* (EPA 2016b);
- EPA *Technical Guidance: Terrestrial Fauna Surveys* (EPA 2016c);
- EPA *Technical Guidance: Sampling methods for Terrestrial vertebrate fauna* (EPA 2016d);
- EPA *Environmental Factor Guideline: Terrestrial Fauna* (EPA 2016e);
- EPA and Department of Environment and Conservation (DEC) *Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (EPA and DEC 2010); and
- *EPBC Act referral guidelines for three Threatened Black Cockatoo species* (Department of Sustainability, Environment, Water, Population and Communities [SEWPaC] 2012) and the revised draft referral guideline for three threatened black cockatoo species (DoEE 2017).

## 1.3 Study area

The site is located near the townsite of Newdegate in the Shire of Lake Grace, approximately 320 km south east of Perth and 200 km south of the Southern Cross (Figure 1-1). The area of the site to be surveyed is approximately 2.86 hectares (ha) in size and is bound to the south by the Newdegate-Lake Grace Road (the study area; Figure 1-1).



**Figure 1-1: Location of the study area**

## 2 Desktop assessment

### 2.1 Biophysical environment

#### 2.1.1 Regional context

The study area is located in the Western Mallee (MAL2) subregion within the Mallee Interim Biogeographic Regionalisation for Australia (IBRA) bioregion (Department of the Environment and Energy (DoEE) 2018a). The Mallee bioregion is the south-eastern part of Yilgarn Craton. It is described as having a gently undulating landscape, with partially obstructed drainage. Mallee over myrtaceous-proteaceous heaths on duplex (sand over clay) soils are common. A mosaic of mixed eucalypt woodlands and mallee occur on calcareous earth plains and sandplains overlying Eocene limestone strata in the east. The landscape is fragmented, with particular surface-types almost completely cleared as wheat fields (Beecham and Danks 2001).

#### 2.1.2 Climate

The Western Mallee subregion experiences a warm, Mediterranean climate with annual rainfall between 250 – 500 mm (Department of Conservation and Land Management [CALM] 2002). The Newdegate Research Station (station number 10692), receives an average of 372.4 mm of rainfall per annum (Bureau of Meteorology [BoM] 2018). This rainfall falls throughout the year, with the greatest amount received during winter months (June to August). Maximum mean monthly temperatures range from 31.2°C (January) to 15.2°C (July). Minimum mean monthly temperatures range from 14.1°C (February) to 4.1°C (July).

#### 2.1.3 Broad-scale vegetation mapping

Beard (1972) categorised and mapped vegetation into broad associations at a scale of 1:250,000. Based on this, the Department of Agriculture and Food Western Australia (DAFWA 2017) compiled a list of the types and extent of vegetation associations across Western Australia (WA; Shepherd et al. 2002).

One broad vegetation association has been mapped across the study area, namely 380 – *Shrublands; scrub-heath on sandplain* (**Table 2-1**). Vegetation association 380 has 14,357.62 ha remaining within the Mallee IBRA region which represents 41.78% of its pre-European extent (Government of Western Australia 2018).

**Table 2-1: Vegetation associations of the study area**

Vegetation association	Description	Pre-European Extent (ha) within the Mallee bioregion	Current Extent (ha) within the Mallee bioregion	Remaining (%)	IUCN in Current Extent (Land protected reserved for conservation) within the Mallee bioregion	% Current Extent Protected (IUCN I – IV) for Conservation (proportion of Pre-European Extent) within the Mallee bioregion
380	Shrublands; scrub-heath on sandplain	34,362.43	14,357.62	41.78	10,540.36	30.67

#### 2.1.4 Geology and soils

The following broad scale geology units have been mapped across the study area (1:250,000 scale geological maps from Geological Survey of WA and Geoscience Australia 2008):

- Qdlu (lunette dunes 72955): Quartz and gypsum dunes and mounds (kopi); may include minor silt, sand, gravel, and clay flats adjacent to playas; locally includes some playa sediments; and
- Czs (sand plain 38499): Sand or gravel plains; quartz sand sheets commonly with ferruginous pisoliths or pebbles, minor clay; local calcrete, laterite, silcrete, silt, clay, alluvium, colluvium, aeolian sand.

Soil-landscape mapping describes broad soil and landscape characteristics from regional to local scales. The site is located within the South-eastern Zone of Ancient Drainage within the Avon Province, which is described as ‘a smooth to irregularly undulating plain dominated by salt-lake chains in the main valleys with duplex and lateritic soils on the uplands’ (Department of Agriculture and Food Western Australia [DAFWA] 2014). It supports mallee vegetation on duplex soils, and proteaceous vegetation on gravels and sands (DAFWA 2014).

#### 2.1.5 Surface and groundwater

Majority of the study area lies within the Albany Coast basin, the Magenta Internal catchment and the Lake Stubbs sub-catchment (DWER 2018a). The study area is not located within in any designated wetlands or watercourses.

#### 2.1.6 Areas of conservation significance

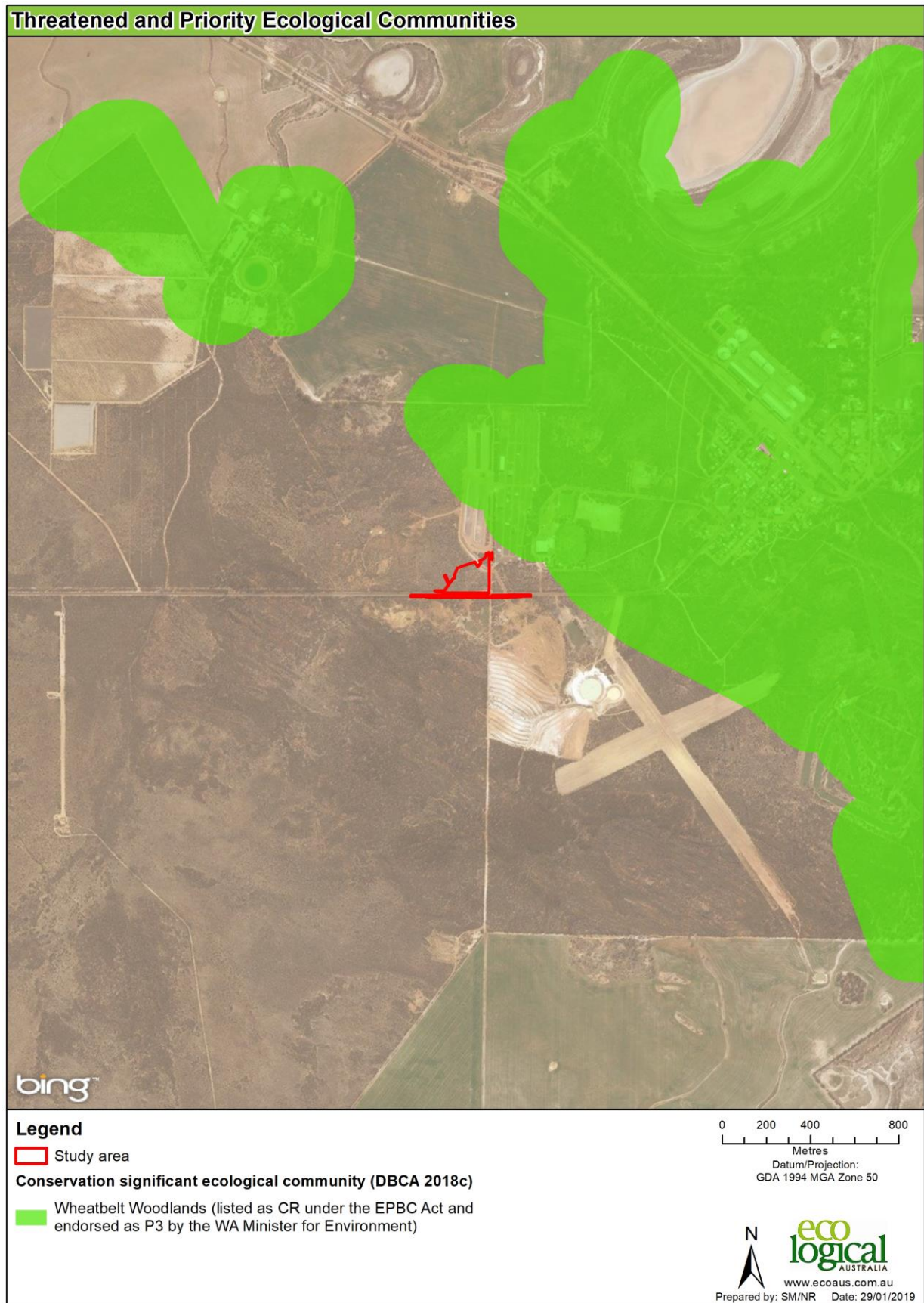
Environmentally Sensitive Areas (ESAs) are defined in the Environmental Protection Notice 2005 under section 51B of the EP Act. ESAs include areas declared as World Heritage, included on the Register of the National Estate, defined wetlands, and vegetation containing rare (Threatened) flora and Threatened Ecological Communities (TECs).

Priority Ecological Communities (PECs) are biological flora or fauna communities that are recognised to be of significance, but do not meet the criteria for a TEC. There are five categories of PECs, none of which are currently protected under legislation (see **Appendix A**).

No ESAs, TECs or PECs are known from within the study area. However, one TEC occurs approximately 980 metres (m) to the north of the study area: *Eucalypt Woodlands of the Western Australian Wheatbelt*

(Figure 2-1). This TEC is listed as Critically Endangered under the EPBC Act and as Priority 3 by DBCA (DBCA 2018c).





**Figure 2-1: Threatened and Priority Ecological Communities within or in proximity to the study area**

## 2.2 Database searches and literature review

A desktop review was undertaken to inform the field survey and to identify the likelihood of occurrence of conservation significant flora and fauna species and ecological communities within the study area. The desktop review consisted of database searches and a review of any available literature relevant to the study area.

### 2.2.1 Database searches

The following Commonwealth and State databases were searched for information relating to conservation listed flora, fauna and ecological communities in order to compile and summarise existing data to inform the field survey. The table below presents the database searches undertaken around the study area (**Table 2-2**).

**Table 2-2: Database searches undertaken for the study area**

Database	Reference	Buffer (km)
Commonwealth EPBC Act Protected Matters Search Tool (PMST) for Threatened species and communities listed under the EPBC Act.	DoEE 2018b	5
Department of Parks and Wildlife (Parks and Wildlife) and WA Museum's (WAM) NatureMap online database.	Parks and Wildlife 2007-2018	40
DBCA Threatened and Priority flora database searches for Declared Rare Flora (DRF) listed under the latest WA Wildlife Conservation (Rare Flora) Notice and Priority Flora.	DBCA 2018a	50
DBCA Threatened and Priority database searches for Scheduled fauna listed under the EPBC Act or latest WA Wildlife Conservation (Specially Protected Fauna) Notice or Priority Fauna (including SRE).	DBCA 2018b	50
DBCA Threatened and Priority Ecological Communities' database searches	DBCA 2018c	50
Department of Environment Regulation (DER) Environmentally Sensitive Areas (ESA) database.	DER 2018	n/a

### 2.2.2 Previous ecological surveys

No surveys have been undertaken within the study area itself; however, several surveys have been undertaken within the nearby vicinity (within 5 km) including:

- Cardno 2014: *CBH Grain Facility Expansion, Newdegate. Flora, Fauna and Vegetation*;
- 360 Environmental 2015a: *Newdegate Flora and Vegetation assessment*;
- 360 Environmental 2015b: *Newdegate Black Cockatoo Habitat Assessment*; and



- ELA 2018: *Red-tailed Phascogale Assessment, Lots 102, 194 and 208 Lake Biddy Road, Newdegate.*

These studies were also reviewed where available.

### **2.3 Likelihood of occurrence assessment**

Likelihood of occurrence assessments are undertaken in order to identify conservation listed flora and fauna species that may occur within the study area from a review of key datasets and literature. Conservation listed flora and fauna species that possibly occur within the study area were identified from a review of the above mentioned key datasets and literature. An assessment of the likelihood of occurrence of conservation listed flora and fauna was made using existing species records from the database searches and the results of the field survey using the criteria outlined in **Appendix D**.

An initial 129 conservation listed flora species and 35 conservation significant fauna species were identified as possibly occurring within the study area.

Marine species were not considered in the likelihood of occurrence assessment as the study area does not contain core habitat that these species solely rely on for survival.

The full likelihood of occurrence assessments are detailed in **Appendix E** and **Appendix F**.

## 3 Methodology

### 3.1 Survey team and timing

The flora, vegetation and fauna assessment was undertaken by Dr Jeffry Cargill (Senior Ecologist) and Sarah Dalglish (Botanist). The primary survey was undertaken on the 19 September 2018, with a follow-up survey conducted on the 21<sup>st</sup> January 2019. The timing of the primary survey was considered optimal for these types of assessments (EPA 2016a & c).

The survey team's relevant qualifications, experience and licences are provided in Table 3 1.

**Table 3-1: Survey team and relevant licences**

Name	Qualification	Relevant experience	Licence numbers
Dr Jeffry Cargill	BSc. Hons. PhD	Jeff has extensive experience undertaking flora, vegetation and fauna surveys across the South-West Botanical Province, with previous survey experience in the Mallee and Avon Wheatbelt bioregions.	Flora scientific collection licence: SL012435 DRF collection licence: 23-1819
Sarah Dalglish	BSc (Hons) Environmental Management	Sarah has extensive experience undertaking flora, vegetation and fauna surveys across the South-West Botanical Province, with previous survey experience in the Mallee and Avon Wheatbelt bioregions.	Flora scientific licence: SL012349 DRF permit: 194-1718

### 3.2 Flora and vegetation survey

#### 3.2.1 Detailed survey

A Detailed flora and vegetation survey was conducted in accordance with the EPA *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016a).

The desktop review, including review of aerial imagery, informed the approximate number of quadrats required to describe the broad vegetation types within the study area. Eight quadrats were established across the study area (**Figure 3-1**) with at least three quadrats installed in each vegetation type where sufficient vegetation extent permitted (i.e. the extent of some vegetation types was too small to install three quadrats). The following information recorded at each quadrat:

- A colour photograph of representative vegetation;
- Coordinate location;
- Description of vegetation associations in accordance with Level V of the National Vegetation Information System (NVIS) and Aplin's (1979) modification of vegetation classification adapted from Specht (1970). For each stratum, this included:
  - Dominant growth form;
  - Height;
  - Cover;
  - Three dominant genera;

- Description of vegetation condition classification in accordance with EPA (2016a);
- Average % cover of leaf litter and bare ground;
- Disturbance details including:
  - Fire history (time since last fire);
  - Physical disturbance including evidence of erosion;
  - Evidence of grazing; and
  - Weed invasion.

Additional flora species which were observed during the survey of the study area were also recorded to develop an inventory of flora species present.

Voucher specimens of unfamiliar species were collected for later identification.

### 3.2.2 Targeted survey

A targeted survey was conducted in accordance with the EPA *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016a). The targeted survey was completed to identify any Threatened or Priority species, including:

- Threatened flora listed under the EPBC Act;
- Threatened (Declared Rare) Flora listed under the latest WA Wildlife Conservation (Rare Flora) Notice; and
- Priority flora recognised by DBCA.

The targeted survey methodology involved personnel traversing the study area. Within areas of high-quality remnant vegetation the traverses were spaces approximately 10-15 m apart as this habitat was suitable for several inconspicuous species (Figure 3-1). Elsewhere within the study area, traverse spacing was wider as there was no suitable habitat for inconspicuous species and the vegetation was mostly open and highly modified in these areas (Figure 3-1). For any conservation listed species identified in the study area, the following data was collected:

- Coordinate location and/or centroid coordinate location for a group of individuals within a 20 m radial circumference;
- Number of individuals and/or percent cover (recording a range of coordinates if necessary);
- Reproductive phase (flowering, fruiting, etc.);
- Description of vegetation and habitat in which the species was located.

The field survey was undertaken using an Android Nexus 7 tablet operating the ArcGIS Collector app. It should be noted that these units can have errors of 3-20 m (subject to availability of satellites on the day) with an average of 5 m, which is comparable to a standard GPS unit. Some data such as the traverse paths were recorded on Garmin GPSmap 62s GPS units.

### 3.2.3 Specimen identification and nomenclature

Nomenclature used for the flora species within this report follows the WA Plant Census as available on FloraBase (DBCA and Western Australian Herbarium [WAH] 1998 - 2018). Voucher specimens were collected in the field of all actual or potential conservation significant flora species where required, where sufficient material was available. Collections were made of other species, if required, to enable correct identification. All collections were assigned a unique collecting number.

Specimen identification was undertaken by ELA Botanist Sarah Dalglish. Species identification utilised taxonomic literature and keys with specimens confirmed using the WAH reference collection where required. Relevant specimens were also confirmed by taxonomic specialists where required.

Species marked with an asterisk (\*) in front of the genus name signify an introduced species.

### 3.3 Fauna survey

#### 3.3.1 Level 1 fauna survey

The survey design was aligned with methodology outlined in the EPA *Technical Guidance for Terrestrial Fauna Surveys* (EPA 2016c), *Technical Guidance for Sampling methods for Terrestrial vertebrate fauna* (EPA 2016c), the *EPBC Act referral guidelines for three threatened black cockatoo species* (SEWPaC 2012), and the *Survey guidelines for Australia's Threatened birds* (Department of the Environment, Water, Heritage and the Arts [DEWHA] 2010).

The Level 1 fauna survey comprised of walking search transects over the study area and undertaking the following:

- Fauna habitat mapping;
- Recording direct observations, opportunistic sightings and other signs of fauna such as tracks, scats, burrows, mounds, foraging / diggings etc.

Observations and opportunistic sightings were made over one day and also noted during the flora and vegetation assessment. These included direct sightings of active fauna such as reptiles and birds; records of bird calls; and signs of species presence such as tracks, diggings, burrows, scats and any other evidence of fauna activity.

In addition, the study area was ground truthed for habitat suitability in supporting *Phascogale calura* (Red-tailed Phascogale).

#### 3.3.2 Targeted black cockatoo survey

An assessment of black cockatoo habitat was undertaken in accordance with the EPBC Act referral guidelines (SEWPaC 2012), and with acknowledgment of DoEE (2017).

The study area is located outside the modelled distributions of *Calyptorhynchus banksia naso* (Forest Red-tailed Black Cockatoo) and *Calyptorhynchus baudinii* (Baudins Black Cockatoo), but within the modelled distribution (breeding range) of *Calyptorhynchus latirostris* (Carnaby's Black Cockatoo; SEWPaC 2012; DoEE 2017). Therefore, Carnaby's Black Cockatoo was the focus of this survey.

Survey methodology involved assessing all tree species known to support breeding for their diameter at breast height (DBH) and their potential to support hollows. Trees with a DBH over 50 cm are defined as suitable for breeding (SEWPaC 2012). Other non-breeding species of 'tall trees' within the study area were also assessed in terms of providing suitable roosting habitat (e.g. pines), however, individual pine trees are not required to be mapped under the EPBC Act referral guidelines.

Prior to the survey, aerial imagery was studied to determine the vegetation types present within the study area and their potential for providing foraging habitat for black cockatoos. These values were then ground truthed during the survey to determine the extent of potential foraging habitat within the study area.

Observations were made of black cockatoo foraging activity based on feeding residue such as chewed Banksia and eucalypt nuts, and any Black Cockatoo individuals observed foraging within the study area.

#### 3.3.3 Targeted Malleefowl survey

Targeted surveys for Malleefowl comprised of walking transects in areas of suitable habitat to search for individuals and mounds or other signs such as tracks, feathers or scats. Suitable habitat was identified prior to the survey by reviewing existing vegetation and habitat mapping where previous studies have

occurred (outside of the study area) and by aerial photographic interpretation over the study area. These areas were further ground-truthed during the survey and Malleefowl transects established if habitat was deemed suitable. Observations of individuals or other signs such as tracks, scats and mounds were recorded with a GPS location and photographed.

Approximately 6 km of ground was traversed for Malleefowl across the study area. Survey effort for the targeted Malleefowl survey is shown in **Figure 3-1**.

#### **3.3.4 Taxonomy and nomenclature**

Nomenclature used for the vertebrate fauna species within this report follows the Western Australian Museum (WAM) Checklist of the Vertebrates of Western Australia (WAM 2018). Where common names were not stated for certain species, the following references were consulted:

- Amphibians and reptiles: Bush et al. (2010);
- Reptiles: Wilson and Swan (2013);
- Birds: Simpson and Day (2010); and
- Mammals: Menkhorst and Knight (2011).

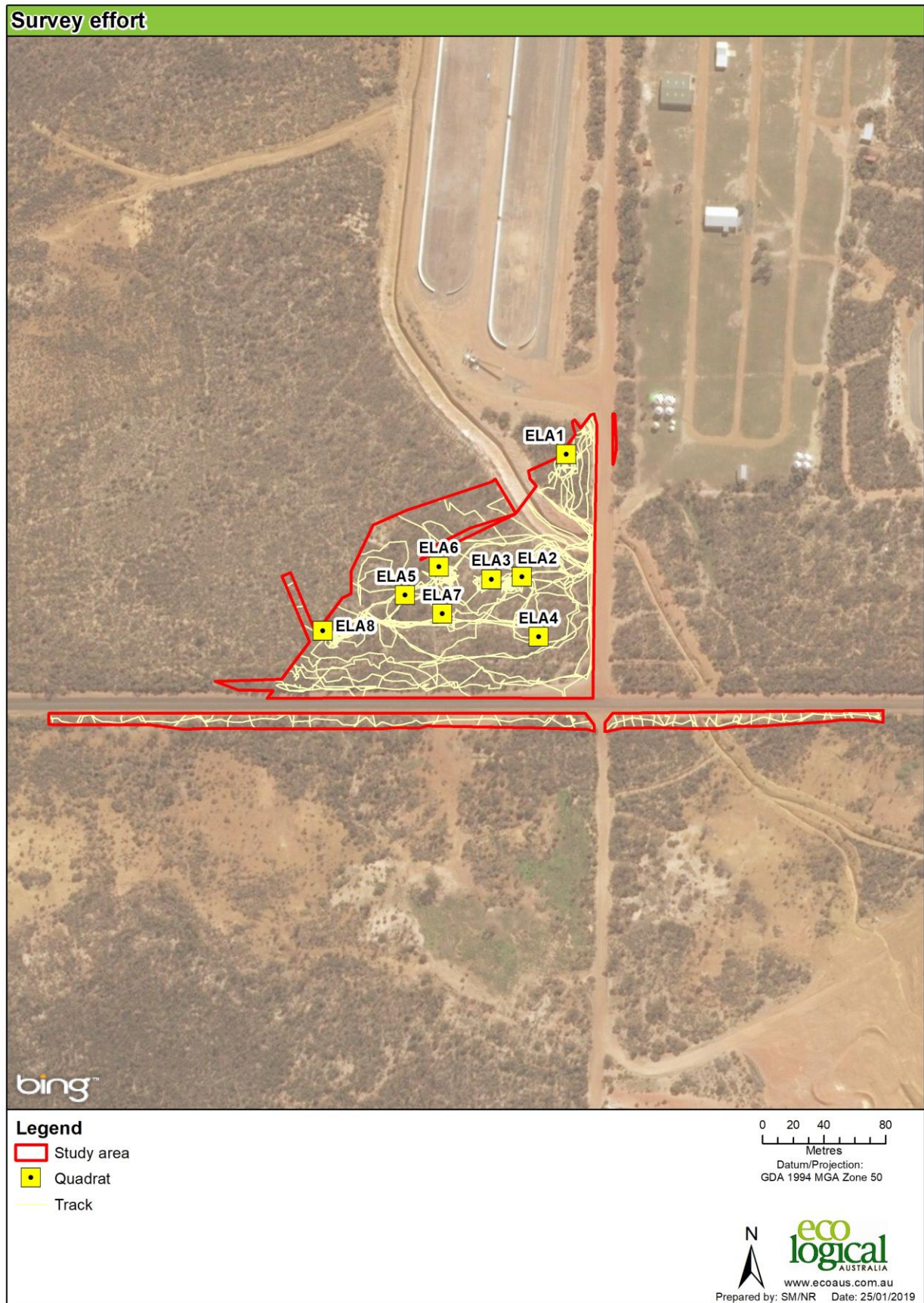


Figure 3-1: Survey effort

### 3.4 Data analysis

#### 3.4.1 Flora species accumulation curve

A flora species accumulation curve was undertaken to indicate adequacy of the survey effort (Clarke and Gorley 2006). As the number of survey sites increases, and correspondingly the size of the area surveyed increases, there should be a diminishing number of new species recorded. At some point, the number of new species recorded becomes essentially asymptotic. The asymptotic value was determined using Michaelis-Menten modelling and provided an incidence-based coverage estimator of species richness. When the number of new species being recorded for survey effort expended approaches this asymptotic value, the survey effort can be considered adequate.

#### 3.4.2 Vegetation types

Plymouth Routines in Multivariate Ecological Research v6 (PRIMER) statistical analysis software was used to analyze species-by-site data and discriminate survey sites based on their species composition (Clarke and Gorley 2006). A presence/absence transformation was applied to the dataset prior to analysis. Introduced species (weeds), specimens not identified to species level and singletons (species recorded at a single quadrat and not forming a dominant structural component) were excluded from the data set prior to analysis. In addition, annuals were also removed from the dataset prior to analysis due to the likelihood of substantial differences between years based on seasonality of local rainfall events. Computation of similarity matrices was based on the Bray-Curtis similarity measure. Data were analysed using a series of multivariate analysis routines including Similarity Profile (SIMPROF), Hierarchical Clustering (CLUSTER) and Similarity Percentages (SIMPER). Results were used to inform and support interpretation of aerial photography and delineation of individual plant communities.

### 3.5 Survey limitations

The EPA Technical Guide – *Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016a) recommends including discussion of the constraints and limitations of the survey methods used. Constraints and limitations for the detailed flora and vegetation, and Level 1 fauna survey for the study area are summarised in Table 3-2.

**Table 3-2: Survey limitations**

Limitation	Comment
Sources of information	Broad-scale vegetation mapping at a scale of 1:250,000 was available. Land system mapping at a scale of 1:2,000,000 and soil and landform mapping was also available. The information which was available was sufficient for the purposes of the work being undertaken and as such sources of information were not considered a major limitation.
Scope of works	The survey requirement of a detailed flora and vegetation survey, targeted flora survey, a Level 1 fauna survey and a targeted Malleefowl and Black Cockatoo survey within the study area in accordance with relevant State and Commonwealth guidance was adequately met.
Completeness and intensity of survey	The study area was surveyed to the satisfaction of the scope and a Detailed and Targeted flora and vegetation survey and a Level 1 fauna survey, Black Cockatoo and Malleefowl assessment as per the relevant guidelines. The survey effort was adequately met. The area was searched for conservation significant species by field staff undertaking transects across the study area spaced 10-15 m apart on average. This method provides an accurate

Limitation	Comment
	assessment of habitat characteristics and likelihood of conservation significant species. The number of quadrats established was sufficient to determine the vegetation type and to identify any vegetation of conservation significance. Adequacy of sampling effort was tested via a species accumulation curve; approximately 67% of the flora potentially present within the study area were recorded.
Timing, weather, season, cycle	The study area is located in the Mallee bioregion of Western Australia. Recommended survey timing for this region is Spring (September-November; EPA 2016a). Many flora species were flowering at the time of the survey or had sufficient material (fruit) available to identify dominant and targeted species. The timing was appropriate for conducting this level of survey.
Disturbances	Disturbances within the study area included historic tracks/clearing for infrastructure/drainage, edge effects and dumping of rubbish (bottles, waste etc.) and minor weeds. Disturbances did not limit the study.
Resources	The personnel conducting this field survey were both suitably qualified to identify specimens, having previously undertaken numerous flora and fauna surveys in the South West botanical region of Western Australia.
Accessibility/Remoteness	All relevant areas in the study area were easily accessed and able to be surveyed.



## 4 Survey results

### 4.1 Flora and vegetation survey

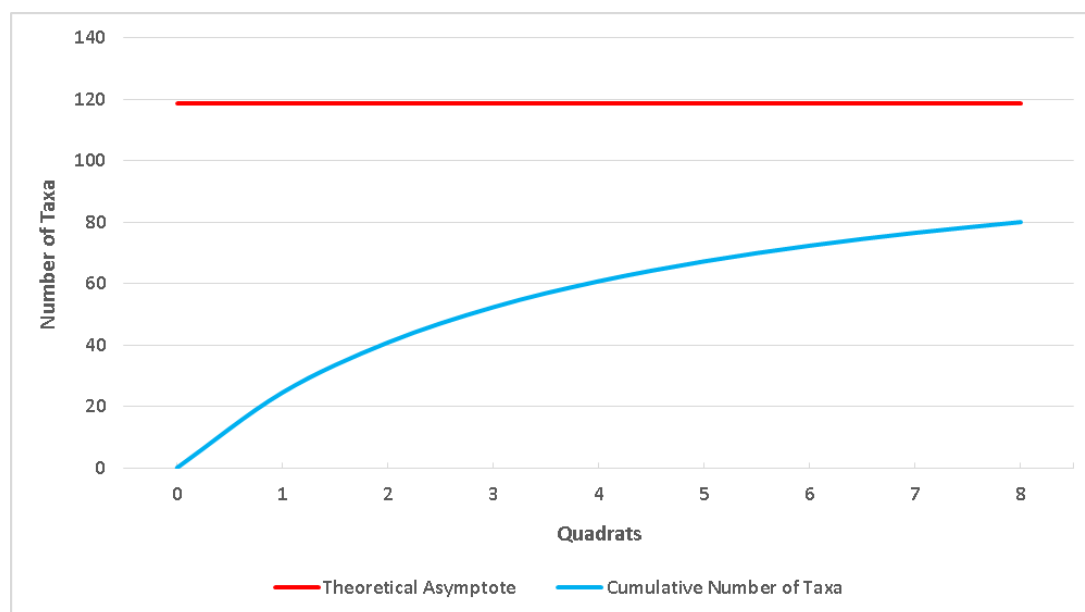
#### 4.1.1 Flora overview

A total of 83 taxa from 54 genera and 29 families were recorded across the eight quadrats established across the study area and from opportunistic collections. A complete flora species list has been provided in **Appendix G**. Average native species richness per quadrat was 25, ranging from a low of 19 at ELA3 to a high of 36 at ELA7. Families with the highest number of species included Myrtaceae (18 species), Proteaceae (eight species) and Cyperaceae (eight species). *Melaleuca* (six taxa), *Eucalyptus* (five taxa) and *Lepidosperma* (five taxa) were the best represented genera throughout the study area. Quadrat data is presented in **Appendix H**.

Seven weed species were recorded and included *\*Arctotheca calendula* (Cape Weed), *\*Avena barbata* (Bearded Oat), *Brassica napus*, *Cenchrus clandestinus* (Kikuyu Grass), *Hypochaeris glabra* (Smooth Cats-ear), *Ursinia anthemoides* (Ursinia) and *Vulpia myuros* forma *myuros* (Rat's Tail Fescue). None of these species are listed as WONS or Declared under the BAM Act. These species were recorded at low densities in disturbed areas associated with the adjacent tracks and main road verges.

#### 4.1.2 Accumulated Species – Sites Surveyed (Species-Area Curve)

A species accumulation curve (**Figure 4-1**) was used to evaluate the adequacy of sampling (Clarke and Gorley 2006). Only species data recorded from defined survey sites (quadrats) were used; no opportunistic flora collections were included. Using this analysis, the incidence-based coverage estimator of species richness was calculated to be 118.42. Based on this value, and the total of 80 species recorded within quadrats, approximately 67% of the flora species potentially present within the study area were recorded. Heath environments within this regional are innately floristically variable, with stochastic occurrences of individual species within a given area being common. In addition, the small size of the study area precluded further quadrats from being established. As a result, a figure of 67% was considered sufficient to accurately delineate vegetation communities present and provide a detailed account of the flora species present.



**Figure 4-1: Averaged randomised species accumulation curve.**

#### 4.1.3 Conservation significant flora

No Threatened flora listed under section 178 of the EPBC Act or Part 2 of the BC Act were recorded within the study area. A total of four Priority (P) flora species listed by DBCA were recorded within the study area:

- *Guichenotia asteriskos* (listed as P2 by DBCA; one individual recorded within the study area);
- *Banksia xylothemelia* (listed as P3 by DBCA; recorded at a 0.5% cover throughout Vegetation type 2);
- *Daviesia implexa* (listed as P3 by DBCA; total of 223 individuals from 46 locations; 199 individuals from 37 locations outside the study area and; 24 individuals from 9 locations inside the study area); and
- *Persoonia brevirhachis* (listed as P3 by DBCA; recorded at a 0.5% cover throughout Vegetation types 1 & 2).

Conservation significant flora species recorded within the study area are presented in Table 4-1. Locations of conservation significant flora recorded within the study area are presented in **Figure 4-2**.

Of the 129 conservation listed flora species identified in the desktop assessment as possibly occurring within the study area, four species were found to occur within the study area (as above). A further three species, *Thysanotus lavanduliflorus* (P1), *Thysanotus sabulosus* (P1) and *Thysanotus acerosifolius* (P3), were found to have the potential to occur, while the remaining 123 species were found to be unlikely to occur. This assessment was based on availability of suitable habitat, proximity of previous records and adequate survey effort. The flora likelihood of assessment is presented in **Appendix E**.

**Table 4-1: Conservation significant flora species recorded in the study area.**



*Guichenotia asteriskos* (P2)



*Banksia xylothemelia* (P3)



*Daviesia implexa* (P3)



*Persoonia brevirhachis* (P3)



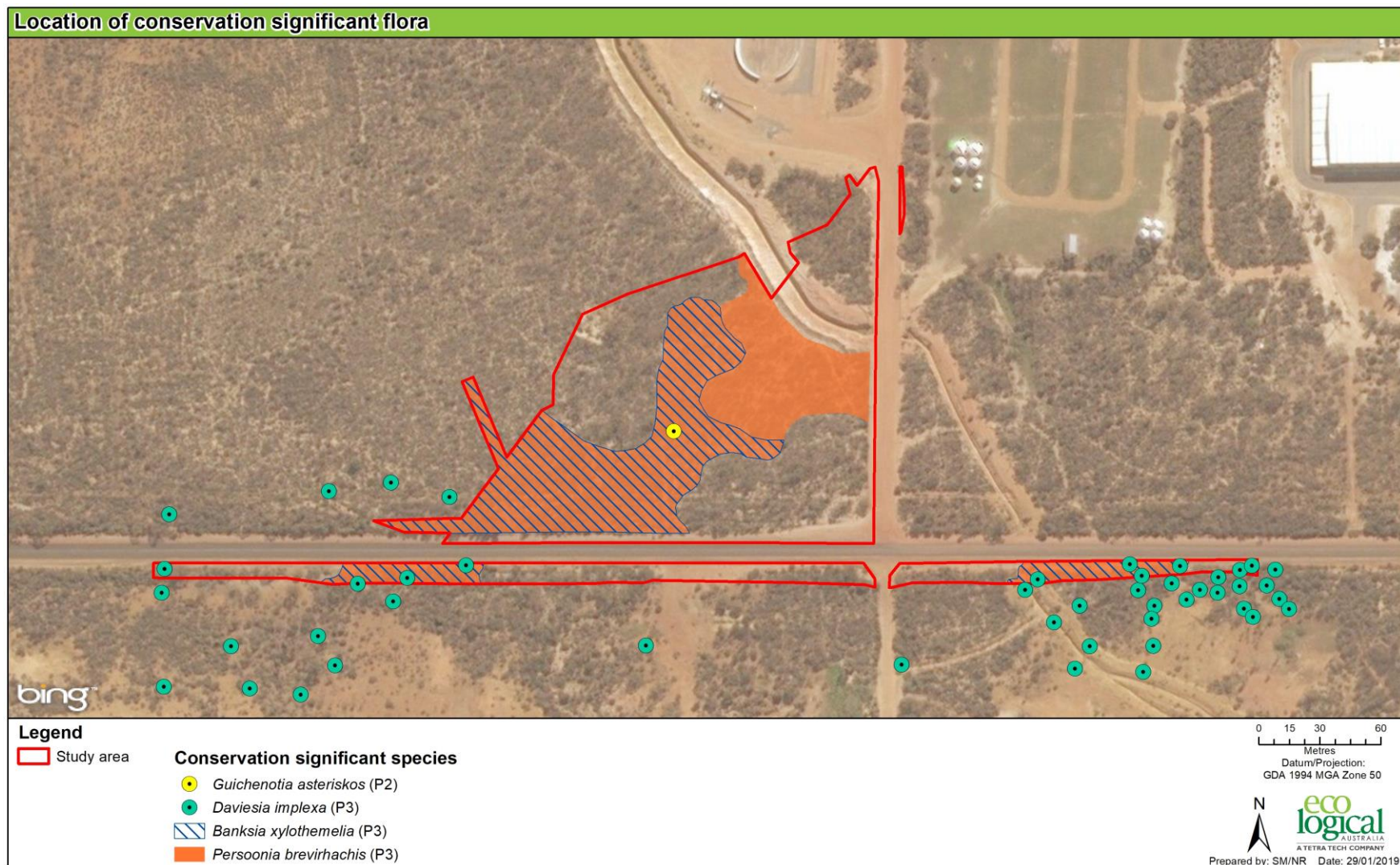


Figure 4-2: Location of conservation significant flora species recorded during the survey

#### 4.1.4 Vegetation types

Similarity Profile Analysis (SIMPROF) separated the eight survey sites into three statistically dissimilar groupings (**Appendix I**). Based on this result, three vegetation types were delineated and mapped within the study area. Details of the three types, including associated species, and mapping boundaries are presented in **Table 4-2** and **Figure 4-3**, respectively.

#### 4.1.5 Vegetation condition

Vegetation condition within the study area ranged from Very Good to Excellent condition based on the vegetation condition scale, adapted from Keighery (1994) and Trudgen (1988), provided in the *Environmental Protection Authority Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment*. Vegetation was observed to be in either Excellent (1.28 ha; 44.63%) or Very Good (1.25 ha; 43.59%) condition (which was confined to vegetation type 3; **Figure 4-4**).

Disturbances within the study area included edge effects and runoff from roads to the south and east of the study area, dumped rubbish and minor weeds at low densities (along edges of road). A section of vegetation in the north of the study area has also been fragmented by a large artificial channel which may have altered natural drainage patterns and vegetation types in this area.

#### 4.1.6 Vegetation of conservation significance

An occurrence of the Eucalypt Woodlands of the Western Australian Wheatbelt TEC is located within 1.0 km of the study area. This TEC is listed as Critically Endangered under the EPBC Act and as Priority 3 by Department of Biodiversity, Conservation and Attractions (DBCA). No vegetation types identified within the study area were considered to represent this or any other Commonwealth or State listed TECs or PECs, based on the results of the field survey and database searches.

Table 4-2: Vegetation types recorded within the study area




Photo	Vegetation description	Quadrats	Extent within the study area (ha)	Portion of the study area (%)
	<p><b>V1</b> - <i>Allocasuarina acutivalvis</i> subsp. <i>acutivalvis</i> open shrubland over <i>Verticordia humilis</i>, <i>Hibbertia stowardii</i> and <i>Astroloma serratifolium</i> sparse shrubland over <i>Leucopogon dielsianus</i>, <i>Exocarpos sparteus</i> and <i>Leucopogon</i> sp. Wheatbelt (S. Murray 257) sparse low shrubland over <i>Neurachne alopecuroidea</i> isolated grasses over <i>Mesomelaena preissii</i> sparse sedgeland over <i>Conostylis argentea</i>, <i>Drosera androsacea</i> and <i>Laxmannia paleacea</i> isolated forbs</p> <p><b>Associated species:</b> <i>Comesperma volubile</i>, <i>Rinzia communis</i></p> <p><b>Average similarity:</b> 65.12</p>	ELA2, ELA3	0.37	12.91
	<p><b>V2</b> - <i>Melaleuca tuberculata</i> var. <i>macrophylla</i>, <i>Hakea marginata</i> and <i>Persoonia brevirhachis</i> (P3) sparse shrubland over <i>Beaufortia micrantha</i>, <i>Leucopogon</i> sp. Wheatbelt (S. Murray 257) and <i>Mirbelia floribunda</i> sparse low shrubland over <i>Neurachne alopecuroidea</i> sparse grassland over <i>Mesomelaena preissii</i> sparse sedgeland over <i>Dampiera lavandulacea</i> and <i>Laxmannia paleacea</i> isolated forbs</p> <p><b>Associated species:</b> <i>Exocarpos sparteus</i>, <i>Hibbertia stowardii</i>, <i>Leucopogon dielsianus</i>, <i>Petrophile glauca</i>, <i>Verticordia humilis</i>, <i>Xanthorrhoea nana</i></p> <p><b>Average similarity:</b> 65.90</p>	ELA6, ELA7, ELA8	0.91	31.72



Photo	Vegetation description	Quadrats	Extent within the study area (ha)	Portion of the study area (%)
	<p><b>V3</b> - <i>Eucalyptus phaenophylla</i> subsp. <i>phaenophylla</i> open mallee woodland over <i>Melaleuca hamata</i> sparse tall shrubland over <i>Melaleuca laxiflora</i> and <i>Melaleuca johnsonii</i> sparse shrubland over <i>Neurachne alopecuroidea</i> isolated grasses over <i>Lepidosperma</i> sp. Bandalup Scabrid (N. Eveleigh 10798) and <i>Gahnia ancistrophylla</i> sparse sedgeland</p> <p><b>Associated species:</b> <i>Eucalyptus phenax</i> subsp. <i>phenax</i>, <i>Cassytha glabella</i>, <i>Desmocladius myriocladus</i>, <i>Leptospermum nitens</i>, <i>Lomandra mucronata</i>, <i>Dianella revoluta</i> var. <i>divaricate</i>, <i>Dodonaea bursariifolia</i>, <i>Hibbertia psilocarpa</i></p> <p><b>Average similarity:</b> 50.16</p>	ELA1, ELA4, ELA5	1.25	43.60
	<b>Existing Infrastructure</b>	N/A	0.34	11.77



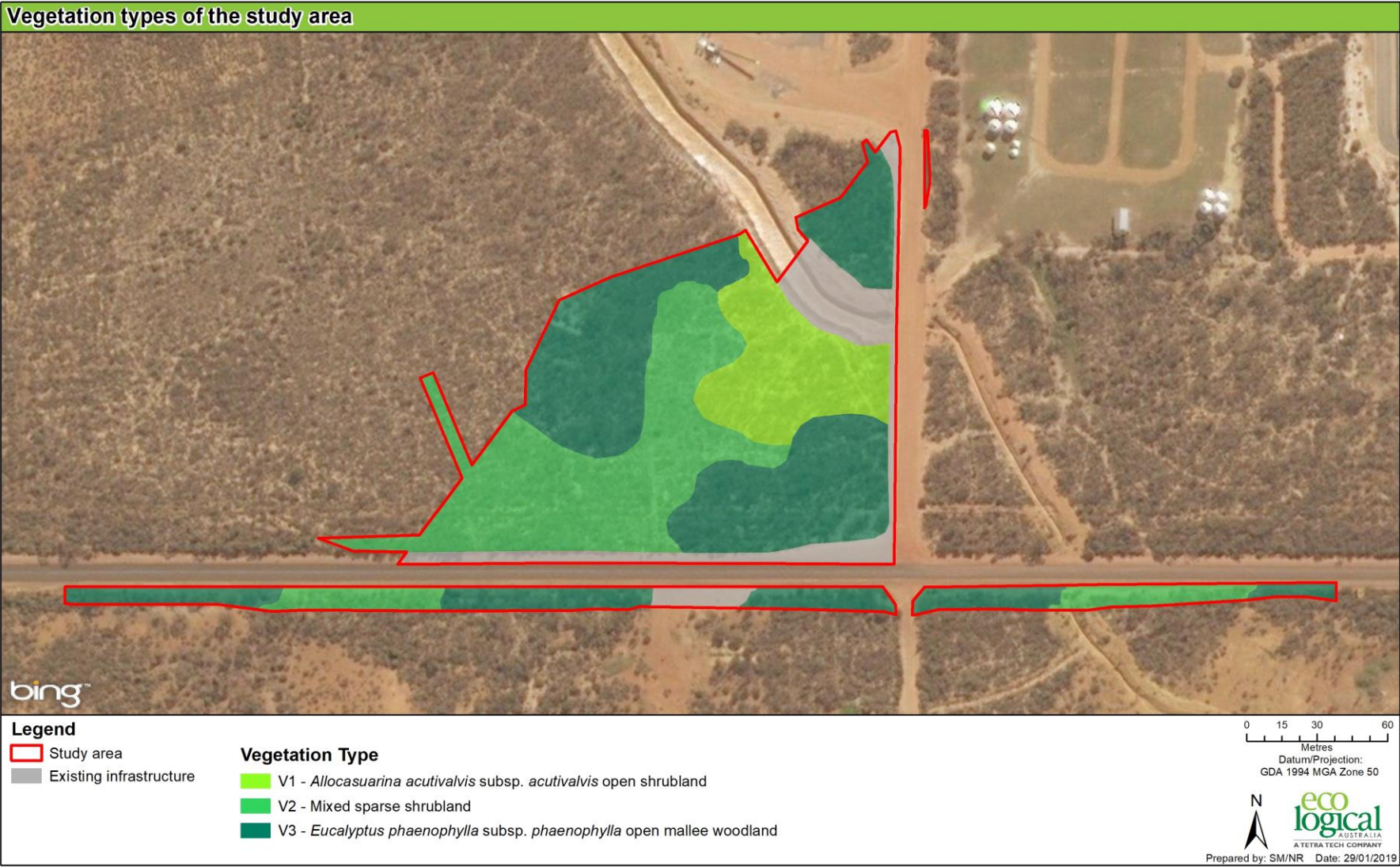


Figure 4-3: Vegetation types of the study area.

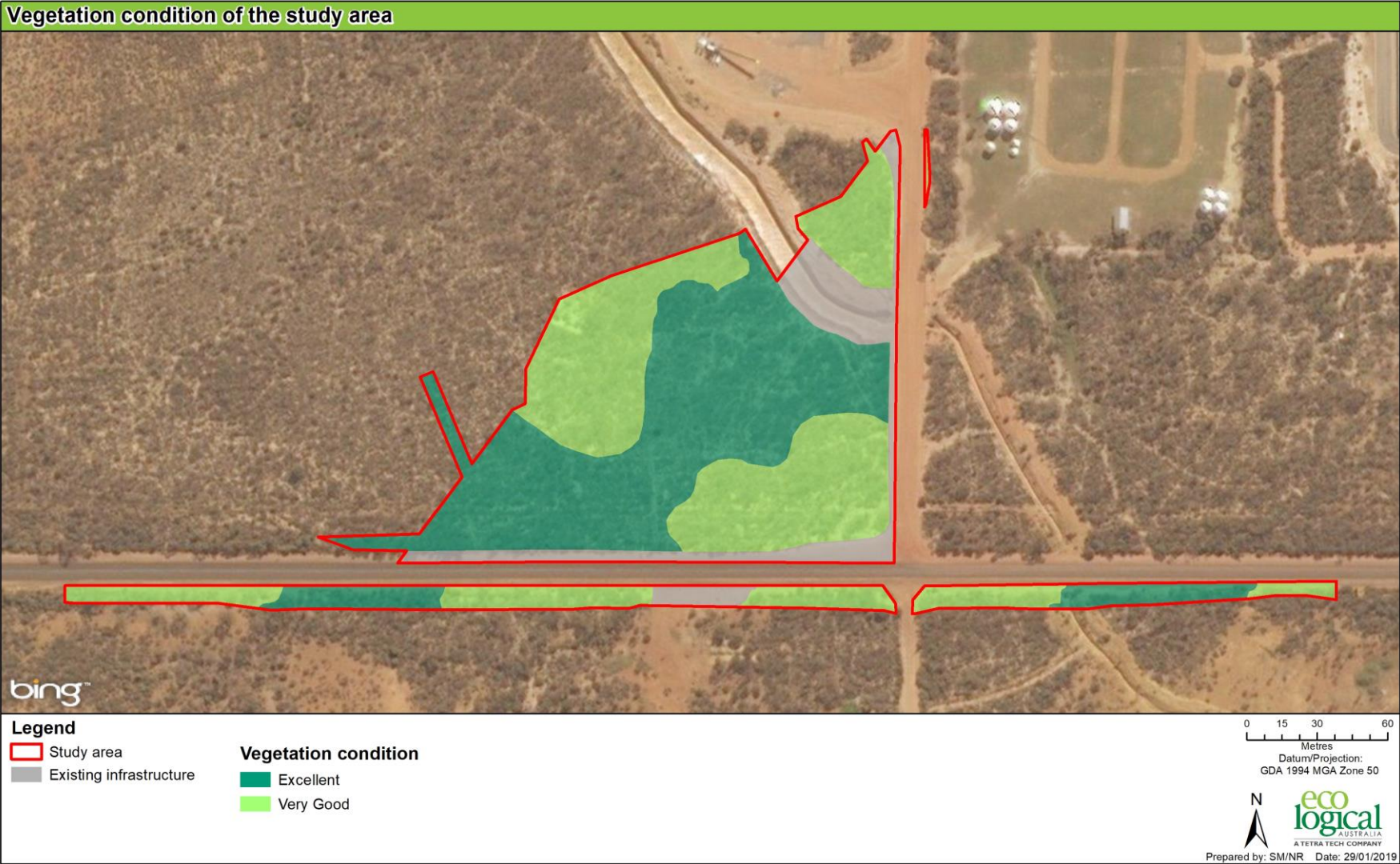


Figure 4-4: Vegetation condition of the study area



## 4.2 Fauna survey

### 4.2.1 Fauna overview

Ten species of vertebrate fauna were observed during the fauna survey including one native mammal, two introduced mammals and seven native birds (**Table 4-3**). No fauna species listed as Threatened under the EPBC or BC Act, or Priority fauna listed by DBCA, were recorded during the survey.

**Table 4-3: Fauna species recorded during the surveys**

Scientific name	Common name	Observation
<i>Anthochaera carunculata</i>	Red Wattlebird	Observed foraging
<i>Cacatua roseicapilla</i>	Galah	Observed flying over
<i>Corvus coronoides</i>	Australian Raven	Observed flying over
<i>Lichmera indistincta</i>	Brown Honeyeater	Observed foraging
<i>Macropus fuliginosus</i>	Grey Kangaroo	Scats
<i>Neophema elegans</i>	Elegant Parrot	Observed foraging
* <i>Oryctolagus cuniculus</i>	European Rabbit	Scats
<i>Pachycephala rufiventris</i>	Rufous Whistler	Observed foraging
<i>Polytelis anthopeplus</i>	Regent Parrot	Observed flying over
* <i>Vulpes vulpes</i>	European Red Fox	Scats

### 4.2.2 Broad fauna habitats

Three fauna habitats occur within the study area and are based on the vegetation types recorded (**Figure 4-3**):

- Open Sheoak shrubland with sparse mixed shrubs (vegetation type 1; 0.37 ha; 12.91% of the study area);
- Mixed sparse shrubland (vegetation type 2; 0.91 ha; 31.72% of the study area); and
- *Eucalyptus* mallee over *Melaleuca* shrubland (vegetation type 3; 1.25 ha; 43.60% of the study area).

### 4.2.3 Conservation significant fauna

No Commonwealth or State listed Threatened fauna, or Priority fauna species listed by DBCA were recorded within the study area.

Of the 35 conservation listed fauna species identified in the desktop assessment as possibly occurring within the study area, one species was considered likely to occur (*Platycercus icterotis* subsp. *xanthogenys* [Western Rosella]; listed as Priority 4 by DBCA) and nine species were considered to have the potential to occur, three of which were on a vagrant or transitional basis only including: *Leipoa ocellata* (Malleefowl); *Apus pacificus* (Fork-tailed Swift) and *Falco peregrinus* (Peregrine Falcon; **Appendix F**). The remaining species were determined unlikely to occur. This assessment was based on availability of suitable habitat, proximity of previous records and adequate survey effort.

Species considered to have the potential to occur include:

- *Pseudomys shortridgei* (Heath Mouse) – listed as Endangered (EN) under the EPBC Act and Vulnerable (Schedule [S] 3) under the WC Act<sup>1</sup>;
- *Leipoa ocellata* (Malleefowl) - listed as Vulnerable (VU) under the EPBC Act and as Vulnerable (S3) under the WC Act;
- *Phascogale calura* (Red-tailed Phascogale) - listed as VU under the EPBC Act and as S6 under the WC Act;
- Fork-tailed Swift – listed as Migratory under International Agreement under the EPBC Act, and as S5 under the WC Act;
- Peregrine Falcon - listed as S7 under the WC Act;
- *Bothriembryon bradshawi* (Bradshaw's bothriembryontid land snail [Tambellup]) – listed as Priority (P) 1 by DBCA;
- *Psophodes nigrogularis* subsp. *Oberon* (Western Whipbird [Mallee]) – listed as P4 by DBCA;
- *Notamacropus irma* (Western Brush Wallaby) - listed as P4 by DBCA; and
- *Pseudomys occidentalis* (Western Mouse); listed as P4 by DBCA).

The fauna likelihood of occurrence assessment is presented in **Appendix F**.

#### 4.2.4 Targeted black cockatoo survey

No habitat suitable for foraging, breeding or roosting by black cockatoos as defined by SEWPaC (2012) was observed within the study area. The study area comprises low mallee, heath and mixed shrublands that do not contain any of the preferred foraging species for Black Cockatoos. There are no tall trees suitable for roosting or trees with a DBH over 50 cm suitable for breeding within the study area. No individuals or evidence of foraging activity were observed within the study area. As such, Carnaby's Black Cockatoo is considered unlikely to occur within the study area (**Appendix F**).

This conclusion is supported by an indicative assessment of the importance of the two habitat types that contained potential foraging species (open Sheoak shrubland with sparse mixed shrubs and mixed sparse shrubland) using the DoEE (2017) foraging scoring tool, which categorised the habitats as low quality (**Table 4-4**). Eucalyptus mallee over Melaleuca shrubland did not contain any potential foraging species for Black Cockatoos and so was not included in the foraging quality assessment. The two fauna habitats assessed were assigned a low-quality starting score (1) as they did not support suitable foraging species other than some low strands of *Banksia* spp. (**Table 4-4**). Both fauna habitats were assigned a low-quality finishing score of minus four (-4) due to lack of breeding trees, foraging evidence and distance from resources (**Table 4-4**). It should be noted that while the tool classified all habitats as low quality, scores are heavily influenced by breeding trees which were absent from the study area.

#### 4.2.5 Targeted malleefowl assessment

No Malleefowl or evidence of Malleefowl were observed during the survey. The study area does not provide suitable foraging or nesting habitat for the species. However, given the proximity of nearby records and the availability of suitable habitat in the surrounding areas, it is considered that Malleefowl have the potential to occur within the study area, but are likely to be vagrant or transitional only.

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<sup>1</sup> The BC Act currently provides for species, subspecies or populations of native animals (fauna) to be listed as Specially Protected, Threatened (Critically Endangered, Endangered or Vulnerable) or Extinct in Western Australia however the Wildlife Conservation (Specially Protected Fauna) Notice 2018 was issued prior to the full BC Act coming into effect and therefore WC Act codes have been referred to in this document.

Table 4-4: Indicative Black Cockatoo foraging habitat assessment (DoEE 2017)

Starting score	Criteria	Habitat types and score	
		Open Sheoak shrubland with sparse mixed shrubs	Mixed sparse shrubland
10 (Very high quality)	Foraging habitat that is being managed for black cockatoos such as habitat that is the focus of successful rehabilitation, and/or has some level of protection from clearing, and/or is quality habitat described below with attributes contributing to meet a score of $\geq 10$ .		
7 (High quality)	Native shrubland, kwongan heathland and woodland dominated by proteaceous plant species such as <i>Banksia</i> spp. (including <i>Dryandra</i> spp.), <i>Hakea</i> spp. and <i>Grevillea</i> spp., as well as native eucalypt woodland and forest that contains foraging species, including along roadsides. Does not include orchards, canola, or areas under a RFA.		
5 (Quality)	Pine plantation or introduced eucalypts.		
1 (Low quality)	Individual foraging plants or small stand of foraging plants.	1	1
<b>Additions</b>	Context adjustor - attributes improving functionality of foraging habitat		
+3	Is within the Swan Coastal Plain (important foraging area).	No	No
+3	Contains trees with suitable nest hollows.	No	No
+2	Primarily comprises marri.	No	No
+2	Contains trees with potential to be used for breeding (dbh $\geq 500$ mm or $\geq 300$ mm dbh for salmon gum and wandoo).	No	No
+1	Is known to be a roosting site.	No	No
<b>Subtractions</b>	Context adjustor - attributes reducing functionality of foraging habitat		
-2	No clear evidence of feeding debris.	-2	-2
-2	No other foraging habitat within 6 km.	Foraging habitat is present within 6 km	
-1	Is $> 12$ km from a known breeding location.	-1	-1
-1	Is $> 12$ km from a known roosting site.	-1	-1
-1	Is $> 2$ km from a watering point.	-1	-1
-1	Disease present (e.g. <i>Phytophthora cinnamomi</i> or marri canker).	No disease present	
<b>Total</b>		<b>-4</b>	<b>-4</b>

## 5 Discussion

### 5.1 Flora and vegetation

A total of 83 taxa from 54 genera and 29 families were recorded within the study area. Weed species comprised 8% of the total flora taxa recorded; no Declared Pests listed under the BAM Act or WoNS were recorded within the study area. Average native perennial species richness per quadrat was 25 (range 19 to 36 taxa). Myrtaceae (18 species), Proteaceae (eight species) and Cyperaceae (eight species) were the most highly represented families occurring in the study area. *Melaleuca* (six taxa), *Eucalyptus* (five taxa) and *Lepidosperma* (five taxa) were the best represented genera.

A species accumulation curve determined that approximately 67% of the flora species potentially present within the study area were recorded. Many flora species were flowering at the time of the survey or had sufficient material (fruit) available to identify dominant and targeted species. The number of quadrats established, sampling effort and survey timing was considered adequate to accurately delineate vegetation types and identify flora and/or vegetation of conservation significance.

No Threatened flora listed under section 178 of the EPBC Act or Part 2 of the BC Act were recorded within the study area. One Priority 2 species (*Guichenotia asteriskos*) and three Priority 3 species (*Banksia xylothemelia*, *Daviesia implexa* and *Persoonia brevirhachis*) were recorded during the field survey. *Persoonia brevirhachis* (P3) was the most widespread species being recorded at a 0.5% cover throughout two of the vegetation types (Vegetation types 1 & 2). *Banksia xylothemelia* (P3) was also recorded at a 0.5% cover and occurred throughout Vegetation type 2. *Daviesia implexa* (P3) was frequently recorded in the southern portion of the study area, predominantly in a narrow band adjacent to the lake Grace Newdegate Road. A total of 223 individuals of *D. implexa* (P3) were recorded, 89% of which were recorded outside bounds of the study area. A single individual of *Guichenotia asteriskos* (P2) was recorded within the study area. All of these species have been recorded previously either within or in close proximity to the study area and in the broader region.

*Guichenotia asteriskos* is known from a range of approximately 180 km and the study area lies toward the western edge of its range (Parks and Wildlife 2007-2018). There are 26 records for this species in NatureMap, of which some occur within nature reserves (Parks and Wildlife 2007-2018). *Banksia xylothemelia* is known from a range of approximately 180 km and the study area is near the centre of its range (Parks and Wildlife 2007-2018). There are 68 records for this species in NatureMap, several of which occur within nature reserves and one is within a National Park (Parks and Wildlife 2007-2018). *Daviesia implexa* (P3) is known from a range of approximately 300 km and the study area lies central to its range (Parks and Wildlife 2007-2018). There are 52 records for this species in NatureMap, several of which occur within nature reserves. *Persoonia brevirhachis* is known from a range of approximately 220 km and the study area is within the densest area of records for this species (Parks and Wildlife 2007-2018). There are 64 records for this species in NatureMap, several of which occur within nature reserves (Parks and Wildlife 2007-2018).

Three vegetation types were delineated and mapped within the study area, namely: V1 - *Allocasuarina acutivalvis* subsp. *acutivalvis* open shrubland; V2 – Mixed sparse shrubland; and V3 - *Eucalyptus phaenophylla* subsp. *phaenophylla* open mallee woodland. None of these vegetation types were considered to represent Commonwealth or State listed TECs or PECs, based on the results of the field survey and database searches. Vegetation condition within the study area ranged from Very Good to Excellent with minor disturbances around the edges and associated with a large drain that bisects the

study area. These disturbances included edge effects, possible increase runoff/alteration to natural drainage, rubbish dumping and minor weed presence.

One broad vegetation association occurs within the study area Hyden 380 (Beard 1972, Shepherd et al 2002). The study area represents 0.02 % of the current extent of this vegetation association. This vegetation association has 41.78 % of its pre-European extent remaining.

## 5.2 Fauna

Three fauna habitats were recorded within the study area including: open sheoak shrubland with sparse mixed shrubs; mixed sparse shrubland; and *Eucalyptus* mallee over *Melaleuca* shrubland. *Eucalyptus* mallee over *Melaleuca* shrubland represented the majority of the study area (43.60%) followed by Mixed sparse shrubland (31.72%) and Open Sheoak shrubland (12.91%). These habitat types are likely to provide suitable habitat for a variety of native mammals, birds, reptiles and amphibians. However, none were restricted or isolated in nature, with all habitat types extending beyond the study area into the immediate surrounds.

Ten species of vertebrate fauna were observed during the fauna survey including one native mammal, two introduced mammals and seven native birds. No fauna species listed as Threatened under the EPBC or BC Act, or Priority fauna listed by DBCA, were recorded during the survey.

The desktop assessment identified 10 fauna species listed under the EPBC Act, BC Act or by DBCA as being likely to occur or with the potential to occur within the study area. The Western Rosella (inland) was considered likely to occur given that records exist approximately 1.5 km away, whereas a further nine species were considered to potentially occur including: Heath Mouse (EN; VU [S3]); Malleefowl (VU; VU [S3]); Red-tailed Phascogale (VU; S6); Fork-tailed Swift (M; S5); Peregrine Falcon (S7); Bradshaw's bothriembryontid land snail (P1); Western Whipbird (Mallee; P4); Western Brush Wallaby (P4); and Western Mouse (P4). None of the likely or potentially occurring fauna would be restricted to the study area, given that preferred habitat for many species either extends into the surrounding areas, or is either not present. None of the likely or potentially occurring species would be reliant upon the study area for breeding and/or foraging, with at least three of the potentially occurring species being potential on a transitionary or vagrant basis only (Malleefowl, Fork-tailed Swift and Peregrine Falcon).

The Red-tailed Phascogale was assessed as having the potential to occur given that the species has been recorded in remnant native vegetation surrounding the study area, with the closest record being approximately 1.5 km away. Whilst the species preferred habitat does not occur within the study area, the species is also known to occur in shrublands and various mosaics of woodland, shrubland, and scrub-heath, which are present within the study area. The Red-tailed Phascogale was considered to potentially occur as it may utilise the study area for foraging, or to move between areas of preferred old growth, woodland habitat to the north and south.

Whilst the fauna habitats provide suitable habitat for a number of native fauna, including mammals, birds, reptiles and amphibians, there was no evidence of Malleefowl or black cockatoos utilising the study area. None of the fauna habitats provide foraging or breeding habitat for Malleefowl or black cockatoos. Whilst some preferred foraging species for Carnaby's Black Cockatoo were present within two of the three fauna habitat types (i.e. Banksia and Hakea species), these were represented by low lying strands of individual plants. Both habitat types were assessed as being low quality foraging habitat for black cockatoos, mainly due to the lack of breeding trees, foraging evidence and distance from resources (DoEE 2017).

No evidence of Malleefowl or black cockatoos were observed during the survey. Malleefowl were considered to potentially occur within the study area given the proximity of nearby records, however due

to the lack of preferred foraging or nesting habitat within the study area and the mobile nature of this species, Malleefowl would be expected to occur on a vagrant or transitional basis only where they may utilise the study area to move between areas of preferred habitat. Black cockatoos were assessed as being unlikely to occur given the lack of foraging and/or breeding habitat available within the study area.

### **5.3 Recommendations**

#### **5.3.1 State Environmental approvals**

Native vegetation is defined under the EP Act as *“indigenous aquatic or terrestrial vegetation and includes dead vegetation unless that dead vegetation is of a class declared by regulation to be excluded from this definition but does not include vegetation in a plantation”*.

Native vegetation can only be cleared with a clearing permit, except in some circumstances where exemptions apply pursuant to the EP Act and the Environmental Protection (Clearing of Native Vegetation) Regulations 2004 (the Regulations). Clearing permits issued pursuant to the Regulations may be issued as area permits or purpose permits.

The vegetation within the study area is not considered to resemble any known Threatened or Priority Ecological Communities or contain core habitat for any recorded Threatened fauna species listed under the BC Act. No known Threatened flora species listed under the BC Act were identified, however three Priority 3 flora species as listed by DBCA were recorded within the study area. These Priority species are not formally protected under State legislation.

Based on the values identified within the study area, environmental approvals required to clear vegetation for development are likely to comprise a Native Vegetation Clearing Permit (NVCP) issued by the Department of Water and Environmental Regulation. NVCPs are typically issued after Development Approval (or similar planning approval) has been granted, so it is likely that this approval will not be obtained until more detailed clearing footprints etc. are developed.

The State Government is committed to the National Objectives and Targets for Biodiversity Conservation (Commonwealth of Australia 2001) that includes a target that prevents a clearance of ecological communities with an extent below 30% of that present prior to European settlement. The vegetation association Hyden 380 is above this 30% target level and the clearing of 2.86 ha (or 0.02 % of the current extent of this vegetation association) is considered unlikely to lead to an unacceptable risk to the environment and prevent a NVCP being granted for the project.

#### **5.3.2 Commonwealth Environmental Approvals**

No Matters of National Environmental Significance (MNES) have been identified within the study area. The vegetation within the study area is not considered to resemble any known Commonwealth TECs or contain habitat for any recorded Threatened fauna species. No known Threatened flora species listed under the EPBC Act were identified or considered to have the potential to occur with the study area.

At a Commonwealth level, native vegetation that provides critical habitat for fauna species listed as Threatened under the EPBC Act may be protected and require approval (and potentially offsets) if there are potentially significant impacts on protected fauna.

Malleefowl, Heath Mouse and Red-tailed Phascogale, which are MNES as they are threatened under the EPBC Act, were considered to have the potential to occur in the study area based on the habitat present and the presence of nearby records. No signs of these species were observed within the study area, and as such the area is unlikely to be considered critical habitat. It is therefore unlikely that the project would cause a significant impact to these species and require Referral under the EPBC Act.



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# Appendix A Framework for conservation significant flora and fauna rankings

## **CATEGORIES OF THREATENED SPECIES UNDER THE ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999 (EPBC ACT)**

Threatened fauna and flora may be listed in any one of the following categories as defined in Section 179 of the EPBC Act. Species listed as 'conservation dependent' and 'extinct' are not Matters of National Environmental Significance and therefore do not trigger the EPBC Act.

Category	Definition
Extinct (EX)	There is no reasonable doubt that the last member of the species has died.
Extinct in the Wild (EW)	Taxa known to survive only in captivity or as a naturalised population well outside its past range; or taxa has not been recorded in its known and/or expected habitat at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
Critically Endangered (CE)	Taxa considered to be facing an extremely high risk of extinction in the wild.
Endangered (EN)	Taxa considered to be facing a very high risk of extinction in the wild.
Vulnerable (VU)	Taxa considered to be facing a high risk of extinction in the wild.
Near Threatened (NT)	Taxa has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.
Least Concern (LC)	Taxa has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.
Data Deficient (DD)	There is inadequate information to make a direct, or indirect, assessment of taxa's risk extinction based on its distribution and/or population status.
Not Evaluated (NE)	Taxa has not yet been evaluated against the criteria.
Migratory (M)	<p>Not an IUCN category.</p> <p>Species are defined as migratory if they are listed in an international agreement approved by the Commonwealth Environment Minister, including:</p> <ul style="list-style-type: none"> <li>• the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animal) for which Australia is a range state;</li> <li>• the agreement between the Government of Australian and the Government of the People's Republic of China for the Protection of Migratory Birds and their environment (CAMBA);</li> <li>• the agreement between the Government of Japan and the Government of Australia for the Protection of Migratory Birds and Birds in Danger of Extinction and their Environment (JAMBA); or</li> </ul>

Category	Definition
	<ul style="list-style-type: none"> <li>the agreement between Australia and the Republic of Korea to develop a bilateral migratory bird agreement similar to the JAMBA and CAMBA in respect to migratory bird conservation and provides a basis for collaboration on the protection of migratory shorebirds and their habitat (ROKAMBA).</li> </ul>

## **CONSERVATION CODES FOR WESTERN AUSTRALIA FLORA AND FAUNA**

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*.

Specially protected fauna or flora are species 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.

### **Threatened species (T)**

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.

Category	Code	Description
Critically Endangered species	CR	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.
Endangered species	EN	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.

Category	Code	Description
Vulnerable species	VU	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.

### 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, as follows:

Category	Code	Description
Extinct species	EX	Species which have been adequately searched for and there is no reasonable doubt that the last individual has died. Published as Specially Protected under the Wildlife Conservation Act 1950, in Schedule 4 of the Wildlife Conservation (Specially Protected Fauna) Notice for Presumed Extinct Fauna and Wildlife Conservation (Rare Flora) Notice for Presumed Extinct Flora.
Extinct in the wild species	EW	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.

Categories are detailed below.



Category	Code	Description
Migratory species	MI	<p>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).</p> <p>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.</p> <p>Published as migratory birds protected under an international agreement under schedule 5 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018.</p>
Species of special conservation interest (conservation dependent fauna)	CD	<p>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).</p> <p>Published as conservation dependent fauna under schedule 6 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018.</p>
Other specially protected species	OS	<p>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).</p> <p>Published as other specially protected fauna under schedule 7 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018.</p>

### Priority species (P)

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.

Category	Code	Definition
Priority 1	P1	<p><i>Poorly-known species</i></p> <p>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.</p>
Priority 2	P2	<p><i>Poorly-known species</i></p> <p>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.</p>
Priority 3	P3	<p><i>Poorly-known species</i></p> <p>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.</p>
Priority 4	P4	<p><i>Rare, Near Threatened and other species in need of monitoring</i></p> <p>(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.</p> <p>(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.</p> <p>(c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.</p>

## **DEFINITIONS, CATEGORIES AND CRITERIA FOR THREATENED AND PRIORITY ECOLOGICAL COMMUNITIES**

An Ecological Community is described as “a naturally occurring biological assemblage that occurs in a particular type of habitat”.

A threatened ecological community (TEC) is one which is found to fit into one of the following categories; “presumed totally destroyed”, “critically endangered”, “endangered” or “vulnerable”.

Possible TECs that do not meet survey criteria are added to DPaW's Priority Ecological Community Lists under Priorities 1, 2 and 3. Ecological Communities that are adequately known, are rare but not threatened, or meet criteria for Near Threatened, or that have been recently removed from the threatened list, are placed in Priority 4. These ecological communities require regular monitoring. Conservation Dependent ecological communities are placed in Priority 5.

### **Definitions and Criteria for Presumed Totally Destroyed, Critically Endangered, Endangered and Vulnerable Ecological Communities**

#### **Presumed Totally Destroyed (PD)**

An ecological community that has been adequately searched for but for which no representative occurrences have been located. The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future.

An ecological community will be listed as presumed totally destroyed if there are no recent records of the community being extant and either of the following applies (A or B):

- A) Records within the last 50 years have not been confirmed despite thorough searches of known or likely habitats,
- B) All occurrences recorded within the last 50 years have since been destroyed.

#### **Critically Endangered (CR)**

An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated.

An ecological community will be listed as Critically Endangered when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future. This will be determined on the basis of the best available information, by it meeting any one or more of the following criteria (A, B or C):

- A) The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 90% and either or both of the following apply (i or ii):
  - i) geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is imminent (within approximately 10 years);

ii) modification throughout its range is continuing such that in the immediate future (within approximately 10 years) the c

B) Current distribution is limited, and one or more of the following apply (i, ii or iii):

i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the short term future (within approximately 20 years);

ii) there are few occurrences, each of which is small and/or isolated and all or most occurrences are very vulnerable to known threatening processes;

iii) there may be many occurrences but total area is small and all or most occurrences are small and/or isolated and very vulnerable to known threatening processes.

C) The ecological community exists only as very modified occurrences that may be capable of being substantially restored or rehabilitated if such work begins in the short-term future (within approximately 20 years).

#### Endangered (EN)

An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future.

An ecological community will be listed as Endangered when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria (A, B, or C):

A) The geographic range, and/or total area occupied, and/or number of discrete occurrences have been reduced by at least 70% since European settlement and either or both of the following apply (i or ii):

i) the estimated geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is likely in the short term future (within approximately 20 years);

ii) modification throughout its range is continuing such that in the short term future (within approximately 20 years) the community is unlikely to be capable of being substantially restored or rehabilitated.

B) Current distribution is limited, and one or more of the following apply (i, ii or iii):

i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the short term future (within approximately 20 years);

ii) there are few occurrences, each of which is small and/or isolated and all or most occurrences are very vulnerable to known threatening processes;

iii) there may be many occurrences but total area is small and all or most occurrences are small and/or isolated and very vulnerable to known threatening processes.

C) The ecological community exists only as very modified occurrences that may be capable of being substantially restored or rehabilitated if such work begins in the short-term future (within approximately 20 years).

#### Vulnerable (VU)

An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range.

An ecological community will be listed as Vulnerable when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction or significant modification in the medium to long-term future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria (A, B or C):

A) The ecological community exists largely as modified occurrences that are likely to be capable of being substantially restored or rehabilitated.

B) The ecological community may already be modified and would be vulnerable to threatening processes, is restricted in area and/or range and/or is only found at a few locations.

C) The ecological community may be still widespread but is believed likely to move into a category of higher threat in the medium to long term future because of existing or impending threatening processes.

### **Definitions and Criteria for Priority Ecological Communities**

Possible threatened ecological communities that do not meet survey criteria or that are not adequately defined are added to the Priority Ecological Community List under priorities 1, 2 and 3. These three categories are ranked in order of priority for survey and/or definition of the community, and evaluation of conservation status, so that consideration can be given to their declaration as threatened ecological communities. Ecological communities that are adequately known, and are rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list, are placed in Priority 4. These ecological communities require regular monitoring. Conservation Dependent ecological communities are placed in Priority 5.

#### Priority One: Poorly-known ecological communities

Ecological communities that are known from very few occurrences with a very restricted distribution (generally  $\leq 5$  occurrences or a total area of  $\leq 100$ ha). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist. May include communities with occurrences on protected lands. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.

#### Priority Two: Poorly-known ecological communities

Communities that are known from few occurrences with a restricted distribution (generally  $\leq 10$  occurrences or a total area of  $\leq 200$ ha). At least some occurrences are not believed to be under immediate threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.

Priority Three: Poorly known ecological communities

(i) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or:

(ii) communities known from a few widespread occurrences, which are either large or with significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or;

(iii) communities made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes.

Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.

Priority Four: Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened or that have been recently removed from the threatened list. These communities require regular monitoring.

(i) Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands.

(ii) Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.

(iii) Ecological communities that have been removed from the list of threatened communities during the past five years.

Priority Five: Conservation Dependent ecological communities

Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.



## Appendix B PMST database search results



Australian Government  
Department of the Environment and Energy

## EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about [Environment Assessments](#) and the EPBC Act including significance guidelines, forms and application process details.

Report created: 07/11/18 18:20:07

[Summary](#)

[Details](#)

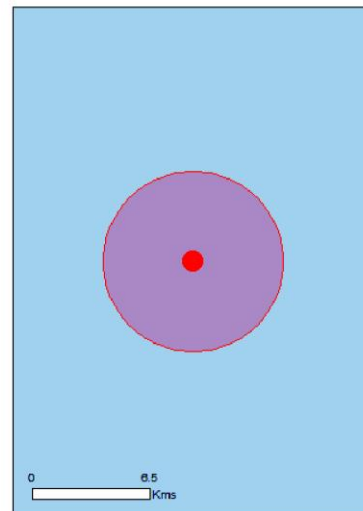
[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

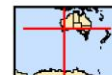
[Acknowledgements](#)



This map may contain data which are  
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[Coordinates](#)

Buffer: 5.0Km



## Summary

### Matters of National Environmental Significance

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

<a href="#">World Heritage Properties:</a>	None
<a href="#">National Heritage Places:</a>	None
<a href="#">Wetlands of International Importance:</a>	None
<a href="#">Great Barrier Reef Marine Park:</a>	None
<a href="#">Commonwealth Marine Area:</a>	None
<a href="#">Listed Threatened Ecological Communities:</a>	1
<a href="#">Listed Threatened Species:</a>	16
<a href="#">Listed Migratory Species:</a>	6

### Other Matters Protected by the EPBC Act

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

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

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

<a href="#">Commonwealth Land:</a>	1
<a href="#">Commonwealth Heritage Places:</a>	None
<a href="#">Listed Marine Species:</a>	12
<a href="#">Whales and Other Cetaceans:</a>	None
<a href="#">Critical Habitats:</a>	None
<a href="#">Commonwealth Reserves Terrestrial:</a>	None
<a href="#">Australian Marine Parks:</a>	None

### Extra Information

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

<a href="#">State and Territory Reserves:</a>	None
<a href="#">Regional Forest Agreements:</a>	None
<a href="#">Invasive Species:</a>	10
<a href="#">Nationally Important Wetlands:</a>	None
<a href="#">Key Ecological Features (Marine)</a>	None

## Details

### Matters of National Environmental Significance

#### Listed Threatened Ecological Communities [ Resource Information ]

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

Name	Status	Type of Presence
<a href="#">Eucalypt Woodlands of the Western Australian Wheatbelt</a>	Critically Endangered	Community likely to occur within area

#### Listed Threatened Species [ Resource Information ]

Name	Status	Type of Presence
------	--------	------------------

##### Birds

<a href="#">Calidris ferruginea</a> Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
<a href="#">Calyptorhynchus latirostris</a> Carnaby's Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Breeding likely to occur within area
<a href="#">Leipoa ocellata</a> Malleefowl [934]	Vulnerable	Species or species habitat known to occur within area

##### Mammals

<a href="#">Dasyurus geoffroyi</a> Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat may occur within area
<a href="#">Parantechinus apicalis</a> Dibbler [313]	Endangered	Species or species habitat may occur within area
<a href="#">Phascogale calura</a> Red-tailed Phascogale, Red-tailed Wambenger, Kenngoor [316]	Vulnerable	Species or species habitat likely to occur within area

##### Plants

<a href="#">Acacia auratiflora</a> Orange-flowered Wattle [64824]	Endangered	Species or species habitat may occur within area
<a href="#">Acacia lanuginophylla</a> Woolly Wattle [55575]	Endangered	Species or species habitat likely to occur within area
<a href="#">Caladenia hoffmanii</a> Hoffman's Spider-orchid [56719]	Endangered	Species or species habitat may occur within area
<a href="#">Duma horrida subsp. abdita</a> Remote Thorny Lignum [87538]	Critically Endangered	Species or species habitat may occur within area

Name	Status	Type of Presence
<a href="#">Eremophila subteretifolia</a> Lake King Eremophila [56702]	Endangered	Species or species habitat may occur within area
<a href="#">Eremophila verticillata</a> Whorled Eremophila [7032]	Endangered	Species or species habitat likely to occur within area
<a href="#">Grevillea involucreata</a> Lake Varley Grevillea [4631]	Endangered	Species or species habitat may occur within area
<a href="#">Ricinocarpos trichophorus</a> Barrens Wedding Bush [19931]	Endangered	Species or species habitat likely to occur within area
<a href="#">Roycea pycnophylloides</a> Saltmat [21161]	Endangered	Species or species habitat likely to occur within area
<a href="#">Verticordia staminosa var. cylindracea</a> Granite Featherflower [55823]	Endangered	Species or species habitat likely to occur within area

#### Listed Migratory Species [ Resource Information ]

\* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
<b>Migratory Marine Birds</b>		
<a href="#">Apus pacificus</a> Fork-tailed Swift [678]		Species or species habitat likely to occur within area

#### **Migratory Terrestrial Species**

<a href="#">Motacilla cinerea</a> Grey Wagtail [642]		Species or species habitat may occur within area
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#### **Migratory Wetlands Species**

<a href="#">Actitis hypoleucos</a> Common Sandpiper [59309]		Species or species habitat may occur within area
<a href="#">Calidris acuminata</a> Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
<a href="#">Calidris ferruginea</a> Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
<a href="#">Calidris melanotos</a> Pectoral Sandpiper [858]		Species or species habitat may occur within area

#### Other Matters Protected by the EPBC Act

##### Commonwealth Land [ Resource Information ]

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

Name
Commonwealth Land -

##### Listed Marine Species [ Resource Information ]

\* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
------	------------	------------------

Name	Threatened	Type of Presence
<b>Birds</b>		
<a href="#">Actitis hypoleucos</a> Common Sandpiper [59309]		Species or species habitat may occur within area
<a href="#">Apus pacificus</a> Fork-tailed Swift [678]		Species or species habitat likely to occur within area
<a href="#">Ardea alba</a> Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
<a href="#">Ardea ibis</a> Cattle Egret [59542]		Species or species habitat may occur within area
<a href="#">Calidris acuminata</a> Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
<a href="#">Calidris ferruginea</a> Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
<a href="#">Calidris melanotos</a> Pectoral Sandpiper [858]		Species or species habitat may occur within area
<a href="#">Chrysococcyx osculans</a> Black-eared Cuckoo [705]		Species or species habitat likely to occur within area
<a href="#">Haliaeetus leucogaster</a> White-bellied Sea-Eagle [943]		Species or species habitat may occur within area
<a href="#">Merops ornatus</a> Rainbow Bee-eater [670]		Species or species habitat may occur within area
<a href="#">Motacilla cinerea</a> Grey Wagtail [642]		Species or species habitat may occur within area
<a href="#">Thinornis rubricollis</a> Hooded Plover [59510]		Species or species habitat likely to occur within area

#### Extra Information

Invasive Species	[ Resource Information ]
Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resources Audit, 2001.	

Name	Status	Type of Presence
------	--------	------------------



Name	Status	Type of Presence
<b>Birds</b>		
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
<b>Mammals</b>		
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
<b>Plants</b>		
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area

## Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

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

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

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

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

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

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

## Coordinates

-33.09556 119.00467

## Acknowledgements

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

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

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

Please feel free to provide feedback via the [Contact Us](#) page.

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# Appendix C NatureMap database search results



# NatureMap Species Report

Created By Guest user on 08/01/2019

**Kingdom** Plantae  
**Conservation Status** Conservation Taxon (T, X, IA, S, P1-P5)  
**Current Names Only** Yes  
**Core Datasets Only** Yes  
**Method** 'By Circle'  
**Centre** 119° 00' 25" E, 33° 05' 52" S  
**Buffer** 40km

Name ID	Species Name	Naturalised	Conservation Code	<sup>1</sup> Endemic To Query Area
1.	14053 <i>Acacia auratiflora</i>		T	
2.	3295 <i>Acacia depressa</i> (Echidna Wattle)		T	
3.	14619 <i>Acacia dissona</i> var. <i>indoloria</i>		P3	
4.	11829 <i>Acacia dreviana</i> subsp. <i>minor</i>		P2	
5.	3357 <i>Acacia grisea</i>		P4	
6.	12260 <i>Acacia lanei</i>		P3	
7.	12261 <i>Acacia lanuginophylla</i>		T	
8.	14127 <i>Acacia mutabilis</i> subsp. <i>stipulifera</i>		P3	
9.	3456 <i>Acacia newbeyi</i>		P3	
10.	11765 <i>Acacia sclerophylla</i> var. <i>teretiuscula</i>		P1	
11.	14679 <i>Acacia sedifolia</i> subsp. <i>pulvinata</i>		P3	
12.	14141 <i>Acacia singula</i>		P3	
13.	14152 <i>Acacia undosa</i>		P3	
14.	12654 <i>Allocasuarina tortiramula</i> (Twisted Sheoak)		T	
15.	23469 <i>Angianthus halophilus</i>		P3	
16.	7831 <i>Angianthus micropodioides</i>		P3	
17.	48323 <i>Anticoryne melanosperma</i>		P3	
18.	42143 <i>Astroloma chloranthum</i>		P2	
19.	41743 <i>Astroloma</i> sp. <i>Dumbylung</i> (A.J.G. Wilson 146)		P3	
20.	32545 <i>Banksia epimicta</i>		P2	
21.	32543 <i>Banksia erythrocephala</i> var. <i>inopinata</i>		P3	
22.	32497 <i>Banksia idiogenes</i>		P2	Y
23.	32158 <i>Banksia porrecta</i>		P4	
24.	32139 <i>Banksia pteridifolia</i> subsp. <i>inretita</i>		P2	
25.	32095 <i>Banksia rufa</i> subsp. <i>chelomacarpa</i>		P3	
26.	32094 <i>Banksia rufa</i> subsp. <i>flavescens</i>		P3	
27.	32015 <i>Banksia xylothemelia</i>		P3	
28.	3150 <i>Bentleya spinescens</i>		P4	
29.	19831 <i>Borya</i> sp. <i>Wheatbelt</i> (A.S. George 16470)		P2	
30.	30251 <i>Bossiaea atrata</i>		P3	
31.	18498 <i>Bossiaea oxyclada</i>		P2	
32.	3720 <i>Bossiaea spinosa</i>		P3	
33.	17667 <i>Brachyloma nguba</i>		P1	
34.	20716 <i>Caladenia graniticola</i>		T	
35.	13857 <i>Caladenia hoffmanii</i>		T	
36.	19313 <i>Calactasia obtusa</i>		P3	
37.	19310 <i>Calactasia pignattiana</i>		T	
38.	5467 <i>Calytrix nematoclada</i>		P3	
39.	43551 <i>Calytrix patrickiae</i>		P2	
40.	7914 <i>Cassinia arcuata</i> (Chinese Shrub)		P2	
41.	16193 <i>Cryptandra polyclada</i> subsp. <i>polyclada</i>		P3	
42.	7431 <i>Dampiera decurrens</i>		P2	
43.	7460 <i>Dampiera orchardii</i>		P2	
44.	48322 <i>Daviesia implexa</i>		P3	
45.	14200 <i>Daviesia lineata</i>		P2	Y
46.	14287 <i>Daviesia tortuosa</i>		P3	
47.	14288 <i>Daviesia uncinata</i>		P3	
48.	46359 <i>Desmocladius eludens</i>		P2	
49.	40867 <i>Dielsiodoxa leucantha</i> subsp. <i>leucantha</i>		P3	
50.	12936 <i>Diuris recurva</i>		P4	
51.	13226 <i>Drosera grievii</i>		P1	

NatureMap is a collaborative project of the Department of Parks and Wildlife and the Western Australian Museum.





Name ID	Species Name	Naturalised	Conservation Code	<sup>1</sup> Endemic To Query Area
52.	44466 <i>Duma horrida</i> subsp. <i>abdit</i>		T	
53.	7268 <i>Eremophila serpens</i> (Snake Eremophila)		P4	
54.	12929 <i>Eremophila veneta</i>		P4	
55.	7279 <i>Eremophila verticillata</i> (Whorled Eremophila)		T	
56.	12878 <i>Eucalyptus microschema</i>		P3	
57.	19638 <i>Eucalyptus mimica</i> subsp. <i>continens</i>		P1	
58.	19637 <i>Eucalyptus mimica</i> subsp. <i>mimica</i>		P3	
59.	5732 <i>Eucalyptus omata</i> (Silver Mallet)		P3	
60.	12623 <i>Fitzwillia axilliflora</i>		P2	
61.	5198 <i>Frankenia drummondii</i>		P3	
62.	20488 <i>Gastrolobium cruciatum</i>		P3	
63.	20401 <i>Gastrolobium euryphyllum</i>		P1	
64.	7999 <i>Gnephosis multiflora</i>		P3	
65.	1952 <i>Grevillea aneura</i>		P4	
66.	1959 <i>Grevillea asteriscosa</i> (Star-leaf Grevillea)		P4	
67.	2024 <i>Grevillea involucrata</i> (Lake Varley Grevillea)		T	
68.	2048 <i>Grevillea newbeyi</i>		P3	
69.	19540 <i>Grevillea petrophiloides</i> subsp. <i>remota</i>		P3	
70.	2074 <i>Grevillea prostrata</i> (Pailarup Grevillea)		P4	
71.	17714 <i>Guichenotia asteriskos</i>		P2	
72.	2782 <i>Gyrostemon prostratus</i>		P3	
73.	12627 <i>Haegiela tatei</i>		P4	
74.	2133 <i>Hakea brachyptera</i> (Short-winged Hakea)		P3	
75.	12229 <i>Hakea lasiocarpa</i>		P3	
76.	6860 <i>Hemigenia obovata</i>		P1	
77.	19390 <i>Hemigenia</i> sp. <i>Newdegate</i> (E. Bishop 75)		P1	
78.	19429 <i>Hibbertia carinata</i>		P1	
79.	6235 <i>Hydrocotyle muriculata</i>		P1	
80.	14749 <i>Jacksonia debilis</i>		P1	
81.	31014 <i>Kunzea</i> sp. <i>Dragon Rocks</i> (K. Kershaw KK 2184)		P2	Y
82.	31772 <i>Lepidosperma amantiferrum</i>		P1	
83.	31763 <i>Lepidosperma lyonsii</i>		P4	
84.	29138 <i>Lepidosperma</i> sp. <i>Pigeon Rocks</i> (H. Pringle 30237)		P3	
85.	6362 <i>Leucopogon bossiaea</i>		P2	
86.	6384 <i>Leucopogon cymbiformis</i>		P2	
87.	6415 <i>Leucopogon multiflorus</i>		P2	
88.	41769 <i>Leucopogon</i> sp. <i>Lake Magenta</i> (K.R. Newbey 3367)		P1	
89.	13269 <i>Melaleuca fissurata</i>		P4	
90.	13278 <i>Melaleuca sculponeata</i>		P3	
91.	4088 <i>Mirbelia densiflora</i>		P3	
92.	6197 <i>Myriophyllum petraeum</i> (Granite Myriophyllum)		P4	
93.	12637 <i>Olearia lacinifolia</i>		P2	
94.	34840 <i>Oxymyrrhine plicata</i>		P3	
95.	14082 <i>Persoonia brevihachis</i>		P3	
96.	2265 <i>Persoonia hakeiformis</i>		P2	
97.	4499 <i>Phebalium drummondii</i>		P3	
98.	2407 <i>Ptilostyles collina</i>		P4	
99.	12733 <i>Podothea pritzelii</i>		P3	
100.	20786 <i>Pultenaea indira</i> subsp. <i>monstrosita</i>		P3	
101.	6017 <i>Rinzia affinis</i> (Two-flowered Rinzia)		P4	
102.	2588 <i>Roycea pycnophylloides</i> (Saltmat)		T	
103.	48432 <i>Salicornia globosa</i>		P3	
104.	14796 <i>Spyridium mucronatum</i> subsp. <i>recurvum</i>		P3	
105.	12589 <i>Stylidium edentatum</i>		P2	
106.	19260 <i>Stylidium sacculatum</i>		P3	
107.	7801 <i>Stylidium squamellosum</i> (Maize Trigger Plant)		P2	
108.	20609 <i>Stylidium thylax</i>		P2	
109.	16765 <i>Synaphea bifurcata</i>		P3	
110.	17292 <i>Synaphea boyaginensis</i>		P2	
111.	17272 <i>Synaphea cervifolia</i>		P2	
112.	16770 <i>Synaphea flexuosa</i>		P2	
113.	16767 <i>Synaphea parviflora</i>		P2	
114.	16763 <i>Synaphea tripartita</i>		P3	
115.	29490 <i>Tetralthea aphylla</i> subsp. <i>megacarpa</i>		T	
116.	1713 <i>Thelymitra psammophila</i> (Sandplain Sun Orchid)		T	
117.	1316 <i>Thysanotus acerosifolius</i>		P2	
118.	1337 <i>Thysanotus lavanduliflorus</i>		P1	
119.	1349 <i>Thysanotus sabulosus</i>		P1	
120.	1484 <i>Tribonanthes purpurea</i> (Granite Pink)		T	
121.	43440 <i>Tricostularia</i> sp. <i>Lake King</i> (A.M. Coates 2298)		P2	

NatureMap is a collaborative project of the Department of Parks and Wildlife and the Western Australian Museum.







	Name ID	Species Name	Naturalised	Conservation Code	<sup>1</sup> Endemic To Query Area
122.	17052	<i>Trymalium myrtillus subsp. pungens</i>		P1	
123.	12427	<i>Verticordia gracilis</i>		P3	
124.	12435	<i>Verticordia integra</i>		P4	
125.	36780	<i>Verticordia setacea</i>		P2	
126.	12463	<i>Verticordia staminosa var. cylindracea</i>		T	
127.	12464	<i>Verticordia staminosa var. erecta</i>		T	

**Conservation Codes**

T - Rare or likely to become extinct  
 X - Presumed extinct  
 IA - Protected under international agreement  
 S - Other specially protected fauna  
 1 - Priority 1  
 2 - Priority 2  
 3 - Priority 3  
 4 - Priority 4  
 5 - Priority 5

<sup>1</sup> For NatureMap's purposes, species flagged as endemic are those whose records are wholly contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

## Appendix D Likelihood of occurrence criteria

### Criteria used for likelihood of occurrence assessment

Likelihood	Criteria
Known to occur:	Recorded from the study area, through database search results and/or from previous surveys of the study area (<20 years)
Likely to occur:	<p>The study area is within the species current distribution and contains suitable habitat for the species, however;</p> <ul style="list-style-type: none"> <li>The species utilises seasonal habitat or has a large home range, so is not always present/visible in the study area; and/or</li> <li>Survey limitations identified.</li> </ul>
Potential to occur:	<p>The study area is within the species current distribution and contains habitat, however (at least two of below);</p> <ul style="list-style-type: none"> <li>The study area is located on the edge of the species range or it has a patchy distribution; and/or</li> <li>Survey limitations identified; and/or</li> <li>Habitat is less suitable; and/or</li> <li>Species is cryptic, and/or difficult to record utilising traditional survey methods.</li> </ul>
Potential to occur - vagrant	<p>Species has the potential to occur on a vagrant, or transient, basis only in that:</p> <ul style="list-style-type: none"> <li>May occasionally occur within the site;</li> <li>May occasionally fly or forage over the site (aerial species only);</li> <li>Are unlikely to utilise the site for foraging, breeding or nesting; and</li> <li>Are unlikely to utilise the site on an ongoing or permanent basis.</li> </ul>
Unlikely to occur	<p>The study area is within the species current distribution and either:</p> <ul style="list-style-type: none"> <li>Contains habitat, was adequately surveyed (including for seasonal, migratory and cryptic species and fauna species with large home ranges) and did not record the species; or</li> <li>The habitat is modified and unlikely to support the species and survey limitations identified.</li> </ul>
Does not occur	<p>The study area is within the species current distribution, and was adequately surveyed (including for seasonal, migratory and cryptic species and fauna species with large home ranges) and did not record the species. The study area may not contain suitable habitat. There is certainty that the species is not present in the study area.</p>

## Appendix E Flora likelihood of occurrence assessment

Species Name	Conservation status			Source <sup>4</sup>	Lifeform/Habitat	Likelihood
	EPBC Act <sup>1</sup>	WC Act <sup>2</sup>	DBCA <sup>3</sup>			
<i>Duma horrida</i> subsp. <i>abdit</i>	CR	En	T	NatureMap PMST	The species is found on clay and silt depressions in seasonally inundated freshwater wetlands.	<b>Unlikely.</b> Habitat not suitable and the closest record is 30 km away.
<i>Acacia auratiflora</i>	EN	VU	T	NatureMap PMST DBCA (2018a)	Sandy clay, clay, clayey loam. Plains, wet depressions.	<b>Unlikely.</b> The study area contained marginally suitable habitat and the closest record is 10 km away. However, this species is a spreading shrub 0.3-1 m high, to 2 m wide, and would have been visible if present.
<i>Acacia lanuginophylla</i>	EN	VU	T	NatureMap PMST DBCA (2018a)	White/grey sand, clayey sand, gravelly soils. Flats, along drainage lines.	<b>Unlikely.</b> Marginally suitable habitat and the closest record is 16 km away, species is also a shrub 0.5-1.2 m high and would have been visible if present.
<i>Caladenia hoffmanii</i>	EN	EN	T	NatureMap PMST	Clay, loam, laterite, granite. Rocky outcrops and hillsides, ridges, swamps and gullies.	<b>Unlikely.</b> No suitable habitat and the closest record is 28 km away.
<i>Eremophila subteretifolia</i>	EN	CR	T	PMST	Grows under a range of eucalypt species around salt lake margins in light, slightly saline, sandy loam over clay. It grows among open scrub and low sedge on the edges of samphire flats and salt lakes and generally occurs in open woodland areas of <i>Eucalyptus kondininensis</i> and <i>E. decipiens</i> .	<b>Unlikely.</b> Habitat not suitable and the closest record is 50 km away.

Species Name	Conservation status			Source <sup>4</sup>	Lifeform/Habitat	Likelihood
	EPBC Act <sup>1</sup>	WC Act <sup>2</sup>	DBCA <sup>3</sup>			
<i>Eremophila verticillata</i> (Whorled Eremophila)	EN	CR	T	NatureMap PMST	Habitat is powdery brown loam over dolomite in open low Eucalypt woodland of <i>E. longicornis</i> (red morrel), <i>E. annulata</i> (open fruited mallee) and <i>E. flocktoniae</i> (Merrit) over <i>Maireana eriolada</i> (rosy bluebush) and <i>Threlkeldia diffusa</i> (coast bonefruit).	<b>Unlikely.</b> Habitat not suitable and the closest record is 11 km away. This species is also a shrub that grows to 1m high and it would have been visible if present.
<i>Grevillea involucrata</i> (Lake Varley Grevillea)	EN	EN	T	NatureMap PMST DBCA (2018a)	Gravelly sand.	<b>Unlikely.</b> Habitat is potentially suitable and the closest record is 6.5 km away, however this species is a shrub that grows to 0.15-0.3 m high and would have been visible if present.
<i>Ricinocarpos trichophorus</i>	EN	VU	T	PMST	It is found in rocky, sandy clay along watercourses or in areas that collect run-off. It is associated with Bushy Yate ( <i>Eucalyptus lehmannii</i> ), Tallerack ( <i>E. tetragona</i> ), Broom Bush ( <i>Melaleuca uncinata</i> ), and sheoaks ( <i>Allocasuarina</i> spp.).	<b>Unlikely.</b> Habitat not suitable and the closest record is 87 km away. This species is also a shrub to 1.6 m high and would have been visible if present.
<i>Roycea pycnophylloides</i> (Saltmat)	EN	VU	T	NatureMap PMST	Plants grow along shorelines or on slight rises above open saline flats and major drainage channels in white to pale brown sand over sandy clay, either on their own or within nearby fringing vegetation.	<b>Unlikely.</b> Habitat not suitable and the closest record is 45 km away, species would have also been visible if present.

Species Name	Conservation status			Source <sup>4</sup>	Lifeform/Habitat	Likelihood
	EPBC Act <sup>1</sup>	WC Act <sup>2</sup>	DBCA <sup>3</sup>			
<i>Verticordia staminosa</i> var. <i>cylindracea</i>	EN	VU	T	NatureMap PMST	Soil pockets. Granite outcrops.	<b>Unlikely.</b> Habitat not suitable and the closest record is 21 km away. This species is also a shrub to 0.3-0.8 m high and would have been visible if present.
<i>Acacia depressa</i> (Echidna Wattle)	VU	EN	T	NatureMap DBCA (2018a)	Lateritic gravelly soils. Low hills & rises.	<b>Unlikely.</b> Species is currently only known from near Lake Grace. Also, laterite which this species is closely associated with is not present in the study area.
<i>Allocasuarina tortiramula</i> (Twisted Sheoak)	VU	VU	T	NatureMap	Loam soil on granite.	<b>Unlikely.</b> No suitable habitat and the closest record is 42 km away, species is also a shrub ca 1.7 m high and would have been visible if present.
<i>Calectasia pignattiana</i>	VU	VU	T	NatureMap	Sand to sandy clay over granite or laterite, gravel. Plains and gentle slopes.	<b>Unlikely.</b> Habitat is potentially suitable and the closest record is 30 km away, however this species grows to 0.5 m high and the survey was during its flowing time and it would have been visible if present.
<i>Tetratheca aphylla</i> subsp. <i>megacarpa</i>	VU	VU	T	NatureMap DBCA (2018a)	Yellow sand, brown sandy loam, yellow-brown clay loam, gravel, laterite. Rises and ridges.	<b>Unlikely.</b> Habitat marginally suitable and the closest record is 13 km away, however species would have been detectable at the time of the survey if present.



Species Name	Conservation status			Source <sup>4</sup>	Lifeform/Habitat	Likelihood
	EPBC Act <sup>1</sup>	WC Act <sup>2</sup>	DBCA <sup>3</sup>			
<i>Thelymitra psammophila</i> (Sandplain Sun Orchid)	VU	VU	T	NatureMap	Sandy clay, loam.	<b>Unlikely.</b> Habitat is potentially suitable and the closest record is 30 km away, however this species would have also been flowering at the time of the survey and visible if present.
<i>Tribonanthes purpurea</i> (Granite Pink)	VU	VU	T	NatureMap DBCA (2018a)	Seasonally wet soils in moss swards & herbfields among granite rocks.	<b>Unlikely.</b> Habitat not suitable and the closest record is 10 km away.
<i>Verticordia staminosa</i> var. <i>erecta</i>		CR	T	NatureMap DBCA (2018a)	Soil pockets. Granite outcrops.	<b>Unlikely.</b> Habitat not suitable and the closest record is 13 km away. This species is also a shrub to 0.3-0.8 m high and would have been visible if present.
<i>Caladenia graniticola</i>		EN	T	NatureMap	Gritty sandy clay, granite. Near low exposed rock outcrops.	<b>Unlikely.</b> No suitable habitat and the closest record is 30 km away.
<i>Acacia sclerophylla</i> var. <i>teretiuscula</i>			P1	NatureMap DBCA (2018a)	Clay & loamy soils.	<b>Unlikely.</b> Habitat is potentially suitable and the closest record is 12 km away, however this species is a shrub 0.25-2.5 m high and would have been visible if present.
<i>Brachyloma nguba</i>			P1	NatureMap	White to brown sandy clay, shallow sandy loam. Open mallee woodland, mallee scrub, flat plains.	<b>Unlikely.</b> Habitat is potentially suitable and the closest record is 33 km away, however this species is a shrub that grows 0.8 m high and would have been visible if present.

Species Name	Conservation status			Source <sup>4</sup>	Lifeform/Habitat	Likelihood
	EPBC Act <sup>1</sup>	WC Act <sup>2</sup>	DBCA <sup>3</sup>			
<i>Drosera grieviei</i>			P1	NatureMap	Clayey sand.	<b>Unlikely.</b> Habitat is potentially suitable and the closest record is 25 km away, this species would have been flowering and visible at the time of the survey if present.
<i>Eucalyptus mimica</i> subsp. <i>continens</i>			P1	NatureMap DBCA (2018a)	Sand, sandy clay. Flats, moist areas.	<b>Unlikely.</b> Habitat is potentially suitable and the closest record is 13 km away, however this species is a mallee that grows 2-6 m high and would have been visible if present.
<i>Gastrolobium euryphyllum</i>			P1	NatureMap DBCA (2018a)	Sand over laterite. Rolling sand dunes.	<b>Unlikely.</b> Habitat marginally suitable and the closest record is 12 km away. This species is a shrub and would have been visible if present.
<i>Hemigenia obovata</i>			P1	NatureMap	White or black wet sand. Flats.	<b>Unlikely.</b> Habitat not suitable and the closest record is 32 km away, species is also a shrub and would have been visible if present.
<i>Hemigenia</i> sp. Newdegate (E. Bishop 75)			P1	NatureMap DBCA (2018a)	Clay loam. Disturbed sites.	<b>Unlikely.</b> Habitat is potentially suitable and the closest record is 19 km away, however this species is a shrub and would have been visible if present.
<i>Hibbertia carinata</i>			P1	NatureMap	Well-drained gravelly sand, yellow sand with gravel.	<b>Unlikely.</b> Habitat is potentially suitable and the closest record is 36 km away, however this species is a shrub and would have been visible if present.

Species Name	Conservation status			Source <sup>4</sup>	Lifeform/Habitat	Likelihood
	EPBC Act <sup>1</sup>	WC Act <sup>2</sup>	DBCA <sup>3</sup>			
<i>Hydrocotyle muriculata</i>			P1	NatureMap DBCA (2018a)	Margins of salt lakes & flats.	<b>Unlikely.</b> Habitat not suitable and the closest record is 3 km away. This species would have also been flowering at the time of the survey and visible if present.
<i>Jacksonia debilis</i>			P1	NatureMap DBCA (2018a)	White or grey clayey sand.	<b>Unlikely.</b> Habitat is potentially suitable and the closest record is 14 km away, however this species is a shrub and would have been visible if present.
<i>Lepidosperma amantiferrum</i>			P1	NatureMap	Yellow sandy loam with banded ironstone gravel and rocks. Gentle lower slopes.	<b>Unlikely.</b> Habitat not suitable and the closest record is 25 km away. Defining characters of this species not present in <i>Lepidosperma</i> species recorded in the survey.
<i>Leucopogon</i> sp. Lake Magenta (K.R. Newbey 3387)			P1	NatureMap DBCA (2018a)	Sand over laterite.	<b>Unlikely.</b> Habitat is potentially suitable and the closest record is 7 km away, however this species is a shrub and would have been visible if present.
<i>Thysanotus lavanduliflorus</i>			P1	NatureMap DBCA (2018a)	Sand, sandy loam.	<b>Potential.</b> Habitat is potentially suitable and the closest record is 10 km away, given this species flowers in November - December, it may not have been readily visible during the field survey
<i>Thysanotus sabulosus</i>			P1	NatureMap	Sand, lateritic gravel.	<b>Potential.</b> Habitat is potentially suitable and the closest record is 10 km away, given this species flowers in November

Species Name	Conservation status			Source <sup>4</sup>	Lifeform/Habitat	Likelihood
	EPBC Act <sup>1</sup>	WC Act <sup>2</sup>	DBCA <sup>3</sup>			
						- December, it may not have been readily visible during the field survey
<i>Trymalium myrtillus</i> subsp. <i>pungens</i>			P1	NatureMap	Clay loam. Ridge.	<b>Unlikely.</b> Habitat marginally suitable and the closest record is 43 km away, however species would have been detectable at the time of the survey if present.
<i>Acacia drewiana</i> subsp. <i>minor</i>			P2	NatureMap DBCA (2018a)	Sandy & gravelly soils.	<b>Unlikely.</b> Habitat is potentially suitable and the closest record is 25 km away, however this species is a shrub 0.15-0.5 m high and would have been visible if present.
<i>Astroloma chloranthum</i>			P2	NatureMap DBCA (2018a)	Usually occurs low in the landscape in sandy or sandy loam soils, probably with clay at depth, and is associated with mallee woodland where the understorey is typically dominated by various species of <i>Melaleuca</i> .	<b>Unlikely.</b> Habitat is potentially suitable and the closest record is 13 km away, however this species is a low spreading shrub and would have been visible if present.
<i>Banksia epimicta</i>			P2	NatureMap	Sandy loam, white sand.	<b>Unlikely.</b> Habitat is potentially suitable and the closest record is 31 km away, however this species is a low spreading shrub and would have been visible if present.

Species Name	Conservation status			Source <sup>4</sup>	Lifeform/Habitat	Likelihood
	EPBC Act <sup>1</sup>	WC Act <sup>2</sup>	DBCA <sup>3</sup>			
<i>Banksia idiogenes</i>			P2	NatureMap DBCA (2018a)	Sandy loam over gravel.	<b>Unlikely.</b> Potentially suitable habitat and the closest record is 1.1 km away (though is historic and may be inaccurate), species is also a shrub 0.5(-0.7) m high and would have been visible if present.
<i>Banksia pteridifolia</i> subsp. <i>inretita</i>			P2	NatureMap	Sandy loam over gravel.	<b>Unlikely.</b> Habitat is potentially suitable and the closest record is 22 km away, however this species is a shrub 0.5-1.5 m high and would have been visible if present.
<i>Borya</i> sp. Wheatbelt (A.S. George 16470)			P2	NatureMap	Dark brown sandy loam over granite. Rock outcrops.	<b>Unlikely.</b> No suitable habitat and the closest record is 20 km away. This species would have been visible if present.
<i>Bossiaea oxyclada</i>			P2	NatureMap	Spongolitic loam. Breakaway slope.	<b>Unlikely.</b> No suitable habitat and the closest record is 30 km away. This species would have been visible if present.
<i>Calytrix patrickiae</i>			P2	NatureMap	Occurs in rich heathlands in sand, often also with gravel present.	<b>Unlikely.</b> Habitat is potentially suitable and the closest record is 30 km away, however this species is a shrub that grows to 0.4 m high and it would have been visible if present.

Species Name	Conservation status			Source <sup>4</sup>	Lifeform/Habitat	Likelihood
	EPBC Act <sup>1</sup>	WC Act <sup>2</sup>	DBCA <sup>3</sup>			
<i>Cassinia arcuata</i> (Chinese Shrub)			P2	NatureMap	Dark reddish brown loam	<b>Unlikely.</b> Habitat not suitable and the closest record is 30 km away, this species is also a shrub that grows to 2.0 m high and it would have been visible if present.
<i>Dampiera decurrens</i>			P2	NatureMap	Sandy soils. Granite rocks.	<b>Unlikely.</b> No suitable habitat and the closest record is 35 km away.
<i>Dampiera orchardii</i>			P2	NatureMap DBCA (2018a)	Sand.	<b>Unlikely.</b> Habitat is potentially suitable and the closest record is 15 km away, however this species is a perennial herb that grows 0.2-0.4 m high and it would have been visible if present.
<i>Daviesia lineata</i>			P2	NatureMap DBCA (2018a)	White or yellow sand, sometimes over lateritic gravel. Undulating plains, low sand ridges.	<b>Unlikely.</b> Habitat is potentially suitable and the closest record is 20 km away, however this species is a shrub that grows 0.6-2.0 m high and it would have been visible if present.
<i>Desmocladius eludens</i>			P2	NatureMap	Sandy soils on gentle slopes.	<b>Unlikely.</b> Habitat is marginally suitable and the closest record is 34 km away, this species would also have been visible if present.
<i>Fitzwillia axilliflora</i>			P2	NatureMap DBCA (2018a)	Sand, clay loam. Margins of salt lakes, saline flats.	<b>Unlikely.</b> Habitat not suitable and the closest record is 1.2 km away. This species would have also been flowering at the time of the survey and visible if present.

Species Name	Conservation status			Source <sup>4</sup>	Lifeform/Habitat	Likelihood
	EPBC Act <sup>1</sup>	WC Act <sup>2</sup>	DBCA <sup>3</sup>			
<i>Guichenotia asteriskos</i>			P2	NatureMap DBCA (2018a)	Sandy clay or loam with gravel.	<b>Known to occur.</b> This species has been recorded previously and was recorded in the study area during the current survey.
<i>Kunzea</i> sp. Dragon Rocks (K. Kershaw KK 2184)			P2	NatureMap	Sandy soils over clay. Low lying area, down slope from granite. Undulating plain.	<b>Unlikely.</b> Habitat is potentially suitable and the closest record is 32 km away, however this species is a shrub and would have been visible if present.
<i>Leucopogon bossiaea</i>			P2	NatureMap	Gravelly sand.	<b>Unlikely.</b> Habitat is potentially suitable and the closest record is 36 km away, however this species is a shrub and would have been visible if present.
<i>Leucopogon cymbiformis</i>			P2	NatureMap	White/grey or yellow sand, lateritic gravelly soils. Sandplains, wet flats, foothills.	<b>Unlikely.</b> Habitat is marginally suitable and the closest record is 37 km away, however this species is a shrub and would have been visible if present.
<i>Leucopogon multiflorus</i>			P2	NatureMap	White/grey sand. Rocky slopes, coastal sand dunes, amongst quartzite or granite rocks.	<b>Unlikely.</b> Habitat not suitable and the closest record is 35 km away. This species is also a shrub and would have been visible if present.
<i>Olearia laciniifolia</i>			P2	NatureMap DBCA (2018a)	White sand. Around playa lakes.	<b>Unlikely.</b> Habitat not suitable and the closest record is 8 km away. This species is also a shrub and would have been visible if present.



Species Name	Conservation status			Source <sup>4</sup>	Lifeform/Habitat	Likelihood
	EPBC Act <sup>1</sup>	WC Act <sup>2</sup>	DBCA <sup>3</sup>			
<i>Persoonia hakeiformis</i>			P2	NatureMap DBCA (2018a)	Gravelly clay loam or sand over laterite. Lateritic ridges.	<b>Unlikely.</b> Habitat is potentially suitable and the closest record is 1.1 km away (though is historic and may be inaccurate), however this species is a shrub and would have been visible if present.
<i>Stylidium edentatum</i>			P2	NatureMap	White sand. Floodplains.	<b>Unlikely.</b> Habitat not suitable and the closest record is 26 km away, species would have been flowering and detectable at the time of the survey if present.
<i>Stylidium squamellosum</i> (Maize Trigger Plant)			P2	NatureMap	Brown to red-brown clay loam. Winter-wet habitats and depressions, open woodland, shrubland.	<b>Unlikely.</b> Habitat marginally suitable and the closest record is 32 km away, species would have been detectable at the time of the survey if present.
<i>Stylidium thylax</i>			P2	NatureMap DBCA (2018a)	Sand. Gentle slopes and plains. Heath, mallee shrubland.	<b>Unlikely.</b> Habitat is potentially suitable and the closest record is 18 km away, however this species would have been visible if present. <i>Stylidium</i> individuals recorded in the survey did not have defining characteristics of this species.
<i>Synaphea boyaginensis</i>			P2	NatureMap	Gravelly clay-loam.	<b>Unlikely.</b> Habitat is potentially suitable and the closest record is 32 km away, however this species would have been visible if present.

Species Name	Conservation status			Source <sup>4</sup>	Lifeform/Habitat	Likelihood
	EPBC Act <sup>1</sup>	WC Act <sup>2</sup>	DBCA <sup>3</sup>			
<i>Synaphea cervifolia</i>			P2	NatureMap DBCA (2018a)	Sandy clay & gravel.	<b>Unlikely.</b> Habitat is potentially suitable and the closest record is 12 km away, however this species would have been visible if present.
<i>Synaphea flexuosa</i>			P2	NatureMap	Sandy loam, brown sand.	<b>Unlikely.</b> Habitat is potentially suitable and the closest record is 15 km away, however this species would have been visible if present.
<i>Synaphea parviflora</i>			P2	NatureMap	Gravelly soils.	<b>Unlikely.</b> Habitat is potentially suitable and the closest record is 33 km away, however this species would have been visible if present.
<i>Thysanotus acerosifolius</i>			P2	NatureMap DBCA (2018a)	Sand, laterite, clayey loam. Sandplains.	<b>Potential.</b> Habitat is potentially suitable and the closest record is 10 km away, given this species flowers in December, it may not have been readily visible during the field survey
<i>Tricostularia</i> sp. Lake King (A.M. Coates 2298)			P2	NatureMap	White sand, sand over clay, plains	<b>Unlikely.</b> Habitat potentially suitable and the closest record is 43 km away, however species would have been detectable at the time of the survey if present.
<i>Verticordia setacea</i>			P2	NatureMap	Lateritic soil or sand over laterite, in kwongan.	<b>Unlikely.</b> Habitat potentially suitable and the closest record is 30 km away, however species is a shrub to 1 m and

Species Name	Conservation status			Source <sup>4</sup>	Lifeform/Habitat	Likelihood
	EPBC Act <sup>1</sup>	WC Act <sup>2</sup>	DBCA <sup>3</sup>			
						would have been detectable at the time of the survey if present.
<i>Acacia dissona</i> var. <i>indoloria</i>			P3	NatureMap	Sand, sandy loam. Undulating plains.	<b>Unlikely.</b> Habitat is potentially suitable and the closest record is 25 km away, however this species is a shrub 0.5-2 m high and would have been visible if present.
<i>Acacia lanei</i>			P3	NatureMap	Clay, clay loam, gravelly loam. Along drainage lines & creeks.	<b>Unlikely.</b> No suitable habitat and the closest record is 30 km away, species is also a shrub 1.5-2.3 m high and would have been visible if present.
<i>Acacia mutabilis</i> subsp. <i>stipulifera</i>			P3	NatureMap DBCA (2018a)	Loam or clay, usually slightly saline soils.	<b>Unlikely.</b> Marginally suitable habitat and the closest record is 17 km away, species is also a shrub 0.3-1 m high and would have been visible if present.
<i>Acacia newbeyi</i>			P3	NatureMap	Lateritic gravelly soils.	<b>Unlikely.</b> Habitat is marginally suitable and the closest record is 39 km away, however this species is a shrub 0.3-1 m high and would have been visible if present.
<i>Acacia sedifolia</i> subsp. <i>pulvinata</i>			P3	NatureMap DBCA (2018a)	Gravelly sand or clay. Laterite hills, gravelly ridges.	<b>Unlikely.</b> No suitable habitat and the closest record is 18 km away, species is also a shrub 0.75-1.8 m high and would have been visible if present.

Species Name	Conservation status			Source <sup>4</sup>	Lifeform/Habitat	Likelihood
	EPBC Act <sup>1</sup>	WC Act <sup>2</sup>	DBCA <sup>3</sup>			
<i>Acacia singula</i>			P3	NatureMap DBCA (2018a)	Gravelly sand over laterite, white or yellow sand. Rises, hilltops.	<b>Unlikely.</b> No suitable habitat and the closest record is 0.6 km away (though is historic and may be inaccurate), species is also a shrub 0.35-2 m high and would have been visible if present.
<i>Acacia undosa</i>			P3	NatureMap	Sandy clay loam, clayey sand. Undulating plains, low-lying areas.	<b>Unlikely.</b> Marginally suitable habitat and the closest record is 30 km away, species is also a shrub 0.3-1.5 m high and would have been visible if present.
<i>Angianthus halophilus</i>			P3	NatureMap	Saline soils. Gypsum-rich dunes in salt lakes.	<b>Unlikely.</b> No suitable habitat and the closest record is 40 km away.
<i>Angianthus micropodioides</i>			P3	NatureMap	Saline sandy soils. River edges, saline depressions, claypans.	<b>Unlikely.</b> No suitable habitat and the closest record is 40 km away.
<i>Anticoryne melanosperma</i>			P3	NatureMap	On sandplains, in sand over laterite or rarely associated with granite.	<b>Unlikely.</b> Habitat potentially suitable and the closest record is 30 km away, this species is also a shrub 0.2–1 m high and would have been visible if present.
<i>Astroloma</i> sp. Dumblebung (A.J.G. Wilson 146)			P3	NatureMap DBCA (2018a)	Low breakaway. Dry rocky pale brown sandy loam over decomposed granite. Also on flats and road verges.	<b>Unlikely.</b> Habitat is potentially suitable and the closest record is 8 km away, however this species is a low spreading shrub and would have been visible if present.
<i>Banksia erythrocephala</i> var. <i>inopinata</i>			P3	NatureMap	White sand over laterite, gravelly clay.	<b>Unlikely.</b> Habitat is potentially suitable and the closest record is 26 km away,

Species Name	Conservation status			Source <sup>4</sup>	Lifeform/Habitat	Likelihood
	EPBC Act <sup>1</sup>	WC Act <sup>2</sup>	DBCA <sup>3</sup>			
						however this species is a shrub 0.6-1 m high and would have been visible if present.
<i>Banksia rufa</i> subsp. <i>chelomacarpa</i>			P3	NatureMap DBCA (2018a)	Sandy loam over gravel.	<b>Unlikely.</b> Habitat is potentially suitable and the closest record is 1.2 km away, however this species is a low shrub and would have been visible if present.
<i>Banksia rufa</i> subsp. <i>flavescens</i>			P3	NatureMap	Sandy loam or sand with gravel.	<b>Unlikely.</b> Habitat is potentially suitable and the closest record is 23 km away, however this species is a low shrub and would have been visible if present.
<i>Banksia xylothemelia</i>			P3	NatureMap DBCA (2018a)	Sandy loam, usually over laterite. Sandplains.	<b>Known to occur.</b> This species was recorded in the study area during the current survey.
<i>Bossiaea atrata</i>			P3	NatureMap	White sand or sandy loam over laterite or clay, quartzite sand, clay.	<b>Unlikely.</b> Habitat is potentially suitable and the closest record is 23 km away, however this species grows to 1.2 m high and would have been visible if present.
<i>Bossiaea spinosa</i>			P3	NatureMap	Gravelly, sandy soils. Undulating plains.	<b>Unlikely.</b> Habitat is potentially suitable and the closest record is 41 km away, however this species is a shrub that grows 0.15-0.5 m high and would have been visible if present.

Species Name	Conservation status			Source <sup>4</sup>	Lifeform/Habitat	Likelihood
	EPBC Act <sup>1</sup>	WC Act <sup>2</sup>	DBCA <sup>3</sup>			
<i>Calectasia obtusa</i>			P3	NatureMap DBCA (2018a)	Sand, clay loam, gravel, laterite. Flats.	<b>Unlikely.</b> Habitat is potentially suitable and the closest record is 16 km away, however this species grows 0.25-0.4 m high and the survey was during its flowing time and it would have been visible if present.
<i>Calytrix nematoclada</i>			P3	NatureMap	Yellow or grey sand. Sandplains.	<b>Unlikely.</b> Habitat is potentially suitable and the closest record is 35 km away, however this species grows to 0.5 m high and the survey was during its flowing time and it would have been visible if present.
<i>Cryptandra polyclada</i> subsp. <i>polyclada</i>			P3	NatureMap	Sand. Sandplains.	<b>Unlikely.</b> Habitat is potentially suitable and the closest record is 38 km away, however this species is a shrub that grows 0.1-0.7 m high and it would have been visible if present.
<i>Daviesia implexa</i>			P3	NatureMap DBCA (2018a)	Grows in gravelly sand in heath (kwongan) dominated e.g. by Allocasuarina.	<b>Known to occur.</b> This species was recorded in the study area during the current survey.
<i>Daviesia tortuosa</i>			P3	NatureMap	Gravelly loam over laterite.	<b>Unlikely.</b> Habitat is potentially suitable and the closest record is 38 km away, however this species is a shrub that grows to 1.0 m high and it would have been visible if present.

Species Name	Conservation status			Source <sup>4</sup>	Lifeform/Habitat	Likelihood
	EPBC Act <sup>1</sup>	WC Act <sup>2</sup>	DBCA <sup>3</sup>			
<i>Daviesia uncinata</i>			P3	NatureMap DBCA (2018a)	Gravelly lateritic sand, loamy sand. Undulating plains.	<b>Unlikely.</b> Habitat is potentially suitable and the closest record is 15 km away, however this species is a shrub that grows to 0.2-0.7 m high and it would have been visible if present.
<i>Dielsiodoxa leucantha</i> subsp. <i>leucantha</i>			P3	NatureMap	Occurs in open woodland, heathland or open shrub mallee and are usually associated with breakaways, often with white soils and quartz and/or lateritic gravel.	<b>Unlikely.</b> Habitat is marginally suitable and the closest record is 25 km away, this species is a shrub 0.2–1.3 m high and would also have been visible if present.
<i>Eucalyptus microschemata</i>			P3	NatureMap DBCA (2018a)	White, yellow or grey sand, often over gravelly clay. Plains or undulating hill tops.	<b>Unlikely.</b> Habitat is potentially suitable and the closest record is 17 km away, however this species is a mallee that grows 1.2-3 m high and would have been visible if present.
<i>Eucalyptus mimica</i> subsp. <i>mimica</i>			P3	NatureMap DBCA (2018a)	White to brown sandy clay, pink to white clayey loam. Flats, near salt lakes.	<b>Unlikely.</b> Habitat is potentially suitable and the closest record is 6 km away, however this species is a mallee that grows 3.5-8 m high and would have been visible if present.
<i>Eucalyptus ornata</i> (Silver Mallet)			P3	NatureMap DBCA (2018a)	Laterite. Ridges.	<b>Unlikely.</b> Habitat not suitable and the closest record is 16 km away. This species is also a tree that grows 6-10 m high and would have been visible if present.

Species Name	Conservation status			Source <sup>4</sup>	Lifeform/Habitat	Likelihood
	EPBC Act <sup>1</sup>	WC Act <sup>2</sup>	DBCA <sup>3</sup>			
<i>Frankenia drummondii</i>			P3	NatureMap DBCA (2018a)	Sand. Lake edges.	<b>Unlikely.</b> Habitat not suitable and the closest record is 16 km away. This species is a shrub and would have been visible if present.
<i>Gastrolobium cruciatum</i>			P3	NatureMap DBCA (2018a)	Sand & clayey sand with gravel, rocky loams, laterite. Flats, gently undulating areas.	<b>Unlikely.</b> Habitat is potentially suitable and the closest record is 0.7 km away, however this species is a shrub that grows to 0.5 m high and would have been visible if present.
<i>Gnephosis multiflora</i>			P3	NatureMap	Sandy saline soils. River flats, sandy rises.	<b>Unlikely.</b> Habitat not suitable and the closest record is 37 km away.
<i>Grevillea newbeyi</i>			P3	NatureMap	Clay loam, sandy gravelly soils.	<b>Unlikely.</b> Habitat is potentially suitable and the closest record is 21 km away, however this species is a shrub and would have been visible if present.
<i>Grevillea petrophiloides</i> subsp. <i>remota</i>			P3	NatureMap	Loamy sand, granite. Base of outcrops, crevices.	<b>Unlikely.</b> Habitat not suitable and the closest record is 36 km away. This species is also a shrub 2.5 - 3 m high and would have been visible if present.
<i>Gyrostemon prostratus</i>			P3	NatureMap	Sand.	<b>Unlikely.</b> Habitat is potentially suitable and the closest record is 35 km away, however this species is a shrub and would have been visible if present.
<i>Hakea brachyptera</i> (Short-winged Hakea)			P3	NatureMap	Sand, loam, clay.	<b>Unlikely.</b> Habitat is potentially suitable and the closest record is 37 km away,



Species Name	Conservation status			Source <sup>4</sup>	Lifeform/Habitat	Likelihood
	EPBC Act <sup>1</sup>	WC Act <sup>2</sup>	DBCA <sup>3</sup>			
						however this species is a shrub and would have been visible if present.
<i>Hakea lasiocarpa</i>			P3	NatureMap	Sandy loam soils, organic litter over sand, clay or gravel. Hill tops, valleys.	<b>Unlikely.</b> Habitat not suitable and the closest record is 35 km away, species is also a shrub and would have been visible if present.
<i>Lepidosperma</i> sp. Pigeon Rocks (H. Pringle 30237)			P3	NatureMap	Granite outcrops	<b>Unlikely.</b> Habitat not suitable and the closest record is 30 km away.
<i>Melaleuca sculponeata</i>			P3	NatureMap	Grey sand. Sandplains.	<b>Unlikely.</b> Habitat is potentially suitable and the closest record is 36 km away, however this species is a shrub and would have been visible if present.
<i>Mirbelia densiflora</i>			P3	NatureMap DBCA (2018a)	Stony loam, loamy sand. Small ridges, breakaways, undulating plains.	<b>Unlikely.</b> Habitat is marginally suitable and the closest record is 1.5 km away, however this species is a shrub and would have been visible if present.
<i>Oxymyrrhine plicata</i>			P3	NatureMap	Sandy loam on undulating hills.	<b>Unlikely.</b> Habitat is potentially suitable and the closest record is 25 km away, however this species is a shrub and would have been visible if present.
<i>Persoonia brevirhachis</i>			P3	NatureMap DBCA (2018a)	White or yellow sand, gravelly sandy soils.	<b>Known to occur.</b> This species was recorded in the study area during the current survey.

Species Name	Conservation status			Source <sup>4</sup>	Lifeform/Habitat	Likelihood
	EPBC Act <sup>1</sup>	WC Act <sup>2</sup>	DBCA <sup>3</sup>			
<i>Phebalium drummondii</i>			P3	NatureMap	Gravelly sandy or clayey soils. Flats, roadsides.	<b>Unlikely.</b> Habitat is potentially suitable and the closest record is 35 km away, however this species is a shrub and would have been visible if present.
<i>Podotheca pritzelii</i>			P3	NatureMap	Sand. Sand ridges in salt flats.	<b>Unlikely.</b> Habitat is marginally suitable and the closest record is 38 km away, this species would have been flowering at the time of the survey and visible if present.
<i>Pultenaea indira</i> subsp. <i>monstrosita</i>			P3	NatureMap	Sand, sandy clay or loamy sand, gravel. Gentle slopes, flat to undulating plains, adjacent to salt lake.	<b>Unlikely.</b> Habitat is marginally suitable and the closest record is 39 km away, this species is a shrub and would have been visible if present.
<i>Salicornia globosa</i>			P3	NatureMap	Saline sand, clayey sand, salt lake margin, braided saline channels.	<b>Unlikely.</b> Habitat not suitable and the closest record is 39 km away, species is a shrub and would have also been visible if present.
<i>Spyridium mucronatum</i> subsp. <i>recurvum</i>			P3	NatureMap	Sandy & clayey soils. Plains.	<b>Unlikely.</b> Habitat is potentially suitable and the closest record is 37 km away, however this species is a shrub and would have been visible if present.
<i>Stylidium sacculatum</i>			P3	NatureMap	Clayey sand or sand. Lower slopes and flats. Open Wandoo or Marri woodland, Allocasuarina shrubland.	<b>Unlikely.</b> Habitat marginally suitable and the closest record is 20 km away, species would have been detectable at the time of the survey if present.

Species Name	Conservation status			Source <sup>4</sup>	Lifeform/Habitat	Likelihood
	EPBC Act <sup>1</sup>	WC Act <sup>2</sup>	DBCA <sup>3</sup>			
<i>Synaphea bifurcata</i>			P3	NatureMap DBCA (2018a)	Clay-loam or sand over laterite.	<b>Unlikely.</b> Habitat is potentially suitable and the closest record is 15 km away, however this species would have been visible if present.
<i>Synaphea tripartita</i>			P3	NatureMap	Lateritic gravel, clay.	<b>Unlikely.</b> Habitat is potentially suitable and the closest record is 25 km away, however this species would have been visible if present.
<i>Verticordia gracilis</i>			P3	NatureMap	Yellow sand, gravelly sand, sandy loam.	<b>Unlikely.</b> Habitat potentially suitable and the closest record is 39 km away, however species would have been detectable at the time of the survey if present.
<i>Acacia grisea</i>			P4	NatureMap	Lateritic gravelly loamy soils. Undulating plains, slopes.	<b>Unlikely.</b> Habitat is potentially suitable and the closest record is 25 km away, however this species is a shrub 0.1-0.6 m high and would have been visible if present.
<i>Banksia porrecta</i>			P4	NatureMap	White/grey sand, sandy loam.	<b>Unlikely.</b> Potentially suitable habitat and the closest record is 30 km away, species is also a sprawling shrub and would have been visible if present.
<i>Bentleya spinescens</i>			P4	NatureMap DBCA (2018a)	Sandy clay.	<b>Unlikely.</b> Habitat is potentially suitable and the closest record is 0.8 km away, however this species is a perennial

Species Name	Conservation status			Source <sup>4</sup>	Lifeform/Habitat	Likelihood
	EPBC Act <sup>1</sup>	WC Act <sup>2</sup>	DBCA <sup>3</sup>			
						shrub and would have been visible if present.
<i>Diuris recurva</i>			P4	NatureMap	Loam. Winter-wet areas.	<b>Unlikely.</b> Habitat not suitable and the closest record is 30 km away and is on the southernmost edge of its range.
<i>Eremophila serpens</i> (Snake Eremophila)			P4	NatureMap DBCA (2018a)	White/grey sand, alluvium, loam. Winter-wet depressions, sub-saline flats, drainage lines, salt lakes.	<b>Unlikely.</b> Habitat not suitable and the closest record is 17 km away this species is also a low shrub and would have been visible at the time of the survey if present.
<i>Eremophila veneta</i>			P4	NatureMap DBCA (2018a)	Clay to loam, white/grey sand. Plains & flats, slopes.	<b>Unlikely.</b> Habitat is potentially suitable and the closest record is 2 km away, however this species is a shrub that grows 0.3-1.2 m high and it would have been visible if present.
<i>Grevillea aneura</i>			P4	NatureMap	Sand, sandy clay, gravel.	<b>Unlikely.</b> Habitat is potentially suitable and the closest record is 36 km away, however this species is a shrub that grows to 0.5-2.8 m high and would have been visible if present.
<i>Grevillea asteriscosa</i> (Star-leaf Grevillea)			P4	NatureMap	Gravelly or granitic soils. Gravel rises, granite outcrops.	<b>Unlikely.</b> Habitat is marginally suitable and the closest record is 30 km away, this species is also a shrub that grows to 0.3-2.6 m high and would have been visible if present.

Species Name	Conservation status			Source <sup>4</sup>	Lifeform/Habitat	Likelihood
	EPBC Act <sup>1</sup>	WC Act <sup>2</sup>	DBCA <sup>3</sup>			
<i>Grevillea prostrata</i> (Pallarup Grevillea)			P4	NatureMap DBCA (2018a)	White, grey or yellow sand, gravel. Sandplains.	<b>Unlikely.</b> Habitat is potentially suitable and the closest record is 3 km away, however this species is a shrub and would have been visible if present.
<i>Haegiela tatei</i>			P4	NatureMap DBCA (2018a)	Clay, sandy loam, gypsum. Saline habitats.	<b>Unlikely.</b> Habitat not suitable and the closest record is 16 km away. This species would have also been flowering and visible at the time of the survey if present.
<i>Lepidosperma lyonsii</i>			P4	NatureMap	Pale orange skeletal sandy loam with banded ironstone gravel & rock, well-drained shallow stony loamy with quartz. Gentle hill slopes, upper slopes of large hill.	<b>Unlikely.</b> Habitat not suitable and the closest record is 25 km away. Defining characters of this species not present in <i>Lepidosperma</i> species recorded in the survey.
<i>Melaleuca fissurata</i>			P4	NatureMap	White/grey sand, sandy loam. Samphire flats, salt pans.	<b>Unlikely.</b> Habitat not suitable and the closest record is 33 km away. This species is also a shrub and would have been visible if present.
<i>Myriophyllum petraeum</i> (Granite Myriophyllum)			P4	NatureMap	Strictly confined to ephemeral rock pools on granite outcrops.	<b>Unlikely.</b> No suitable habitat and the closest record is 27 km away.
<i>Pilostyles collina</i>			P4	NatureMap	On <i>Oxylobium linearifolium</i> , <i>Nemcia leakeana</i> & <i>Gastrolobium velutinum</i> .	<b>Unlikely.</b> Closest record is 35 km away, no host species recorded within the study area.

Species Name	Conservation status			Source <sup>4</sup>	Lifeform/Habitat	Likelihood
	EPBC Act <sup>1</sup>	WC Act <sup>2</sup>	DBCA <sup>3</sup>			
<i>Rinzia affinis</i> (Two-flowered Rinzia)			P4	NatureMap DBCA (2018a)	Yellow sand, loam or sand with lateritic pebbles. Hills.	<b>Unlikely.</b> Habitat not suitable and the closest record is 9 km away. This species is also a shrub and would have been visible if present.
<i>Verticordia integra</i>			P4	NatureMap DBCA (2018a)	Sandy soils over laterite.	<b>Unlikely.</b> Habitat potentially suitable and the closest record is 1.1 km away, however species would have been detectable at the time of the survey if present.

<sup>1</sup>EPBC Act = Flora listed under the Environment Protection and Biodiversity Conservation Act 1999.

CR = listed as Critically Endangered under the EPBC Act

EN = listed as Endangered under the EPBC Act

VU = listed as Vulnerable under the EPBC Act

<sup>2</sup>WC Act = Flora listed under the Wildlife Conservation Act 1950. NB: the BC Act currently provides for species, subspecies or populations of native animals (fauna) to be listed as Specially Protected, Threatened (Critically Endangered, Endangered or Vulnerable) or Extinct in Western Australia however the Wildlife Conservation (Specially Protected Fauna) Notice 2018 was issued prior to the BC Act coming into effect and therefore WC Act codes have been included in the likelihood table.

S1 = Schedule 1: Flora that are considered likely to become extinct or rare, as critically endangered flora

S2 = Schedule 2: Flora that are considered likely to become extinct or rare, as endangered flora

S3 = Schedule 3: Flora that are considered likely to become extinct or rare, as vulnerable flora

<sup>3</sup>DBCA = Flora listed as Priority species under the Department of Biodiversity, Conservation and Attractions

P1 = Priority 1: Species that are known from one or a few locations (generally five or less) which are potentially at risk. Listed by DBCA

P2 = Priority 2: Poorly known species that are known from one or a few locations. Listed by DBCA.

P3 = Priority 3: Poorly known species that are known from several locations and the species does not appear to be under imminent threat. Listed by DBCA.

P4 = Priority 4: Rare, Near Threatened and other species in need of monitoring. Listed by DBCA.

<sup>4</sup>DBCA = Department of Biodiversity, Conservation and Attractions Threatened and Priority Flora database search (DBCA 2018a).

NatureMap = NatureMap database search (DBCA 2007-2018)

PMST = EPBC Act Protected Matters Search Tool report (DoEE 2018b).

## Appendix F Fauna likelihood of occurrence

Scientific name	Common name	Conservation status <sup>3</sup>		Source <sup>4</sup>	Likelihood of occurrence
		EPBC Act <sup>1</sup>	WC Act / DBCA <sup>2</sup>		
<i>Bettongia penicillata ogilbyi</i>	Woylie, Brush-tailed Bettong	CR	CR	DBCA NatureMap	<b>Does not occur.</b> This species is regionally extinct.
<i>Calidris ferruginea</i>	Curlew Sandpiper	CR & IA	VU & IA	PMST	<b>Unlikely</b> - suitable habitat is not present. The closest record is approximately 60 km away, and there are very few records in the region. This species mainly occurs on intertidal mudflats in sheltered coastal areas.
<i>Botaurus poiciloptilus</i>	Australasian Bittern	EN	EN	PMST	<b>Unlikely</b> - suitable habitat is not present. This species occurs in permanent and seasonal freshwater habitats, particularly those dominated by sedges, rushes and reeds.
<i>Calyptorhynchus latirostris</i>	Carnaby's Cockatoo	EN	EN	DBCA NatureMap PMST	<b>Unlikely</b> – there is no suitable foraging, roosting or breeding habitat within the study area. There are records within 18 km of the study area and the species may be present in surrounding areas, but there is no suitable foraging, roosting or breeding habitat within the study area itself.
<i>Parantechinus apicalis</i>	Dibbler	EN	EN	PMST	<b>Does not occur.</b> There are no records in the region of this species
<i>Pseudomys shortridgei</i>	Heath Mouse	EN	VU	DBCA NatureMap	<b>Potential</b> – suitable habitat occurs within the study area (heath) and there are records to the north and south of the study area, with the closest record being approximately 12.5 km away.
<i>Rostratula australis</i>	Australian Painted Snipe	EN	EN	PMST	<b>Unlikely</b> – there is no suitable habitat within the study area. The species prefers shallow freshwater marshes and edges of deep freshwater marshes.
<i>Dasyurus geoffroyi</i>	Chuditch, Western Quoll	VU	VU	DBCA PMST	<b>Unlikely.</b> This species has been recorded recently (2014 and 2015) in Dragon Rocks Nature Reserve. The closest record is 34 km from the study area. While potentially suitable habitat is present in the project area (mallee shrublands), given the lack of records in the remnant vegetation surrounding Newdegate, it is considered unlikely to occur in the study area. Low density cage trapping (72 trap nights) and camera trapping (36 trap nights) undertaken



Scientific name	Common name	Conservation status <sup>3</sup>		Source <sup>4</sup>	Likelihood of occurrence
		EPBC Act <sup>1</sup>	WC Act / DBCA <sup>2</sup>		
					as part of a targeted Red-tailed Phascogale survey in surrounding remnant vegetation did not record the species.
<i>Leipoa ocellata</i>	Malleefowl	VU	VU	NatureMap PMST	<b>Potential - vagrant.</b> There is no suitable habitat for Malleefowl within the study area. In addition, the recent Level 1 fauna survey did not record any evidence of species presence. However, given the proximity of nearby records it is possible that the Malleefowl would traverse through the area and is therefore considered to be potential but on a vagrant or transitional basis.
<i>Macrotis lagotis</i>	Bilby	VU		DBCA NatureMap	<b>Does not occur.</b> This species is regionally extinct.
<i>Myrmecobius fasciatus</i>	Numbat	VU	EN	DBCA	<b>Unlikely.</b> Records at Dragon Rocks Reserve (42 km from the project area) are from a translocated population. The only known remnant populations are located in the Dryandra Woodland and the Upper Warren area.
<i>Phascogale calura</i>	Red-tailed Phascogale	VU	VU	DBCA PMST	<b>Potential - vagrant:</b> - the species has been recorded in remnant native vegetation surrounding the study area, with the closest record being approximately 1.5 km away. Whilst the species preferred habitat 'woodlands, particularly of old-growth Wandoo ( <i>Eucalyptus wandoo</i> ) and York gum ( <i>E. loxophleba</i> )' does not occur within the study area, the species is also known to occur in shrublands and various mosaics of woodland, shrubland, and scrub-heath, which are present within the study area.
<i>Pseudocheirus occidentalis</i>	Western Ringtail Possum	VU	CR	NatureMap	<b>Does not occur.</b> This species is regionally extinct.
<i>Apus pacificus</i>	Fork-tailed Swift	IA	S5	DBCA PMST	<b>Potential - vagrant.</b> The closest record is 80 km away. This aerial forager has a wide distribution and may occasionally fly or forage over the study area but is otherwise unlikely to utilise the habitat within the study area.

Scientific name	Common name	Conservation status <sup>3</sup>		Source <sup>4</sup>	Likelihood of occurrence
		EPBC Act <sup>1</sup>	WC Act / DBCA <sup>2</sup>		
<i>Ardea alba</i>	Cattle Egret			PMST	<b>Unlikely</b> – there is no suitable habitat within the study area: The species prefers wetlands, swamps and marsh habitats, none of which are present within the study area.
<i>Ardea ibis</i>	Great Egret			PMST	<b>Unlikely</b> – there is no suitable habitat within the study area: The species prefers wetlands, swamps and marsh habitats, none of which are present within the study area.
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	IA	S5	DBCA PMST	<b>Unlikely.</b> The closest record is 35 km away and the species tends to occur on muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation. There is no suitable habitat present within the study area.
<i>Calidris melanotos</i>	Pectoral Sandpiper	IA	S5	PMST	<b>Unlikely.</b> The closest record is 128 km away, and this species is rarely recorded in WA. It occurs in shallow fresh to saline wetlands, usually near coastal habitat but occasionally found further inland. They forage in shallow water or soft mud at the edge of wetlands. The habitat present within the project area is unlikely to be suitable for this species.
<i>Calidris ruficollis</i>	Red-necked Stint	IA	S5	DBCA NatureMap	<b>Unlikely.</b> The closest record is 1.2 km from the project area, in Lake Burkett. This migratory species mainly forages on bare wet mud on intertidal mudflats or sandflats, or in very shallow water. There is no suitable habitat present within the study area.
<i>Motacilla cinerea</i>	Grey Wagtail	M	S5	PMST	<b>Unlikely.</b> Closest record is over 300 km from the project area.
<i>Limosa lapponica</i>	Bar-tailed Godwit	IA	S5	DBCA NatureMap	<b>Unlikely.</b> This species is mainly found in coastal habitats.

Scientific name	Common name	Conservation status <sup>3</sup>		Source <sup>4</sup>	Likelihood of occurrence
		EPBC Act <sup>1</sup>	WC Act / DBCA <sup>2</sup>		
<i>Plegadis falcinellus</i>	Glossy Ibis	IA	S5	DBCA	<b>Unlikely.</b> This species prefers swamps and lakes. No suitable habitat occurs within the study area and there are no records of this species nearby.
<i>Tringa hypoleucos</i>	Common Sandpiper	IA	S5	PMST	<b>Unlikely.</b> Suitable habitat is not present. This species forages in shallow water and bare soft mud at the edges of wetlands and lakes.
<i>Tringa nebularia</i>	Greenshank	IA	S5	DBCA NatureMap	<b>Unlikely.</b> This species is found in a wide variety of inland wetlands where it is known to forage at edges of wetlands, in soft mud on mudflats, in channels, or in shallows around the edges of water around sparse, emergent or fringing vegetation, such as sedges or saltmarsh. The closest record is 35 km from the study area; and there is no suitable habitat present within the study area.
<i>Falco peregrinus</i>	Peregrine Falcon		S7	DBCA NatureMap	<b>Potential - vagrant.</b> The closest record is 9 km from the project area. This species inhabits a wide range of habitats and has a wide distribution. It may occasionally fly over or forage in the study area.
<i>Bothriembryon bradshawi</i>	Bradshaw's bothriembryontid land snail (Tambellup)		P1	DBCA	<b>Potential</b> - closest record is 42 km from the project area. Suitable habitat for this species is unknown. It is likely this species is under-studied and records do not reflect its true distribution. Due to uncertainty over habitat preferences, the species is considered to have the potential to occur.
<i>Hylaeus globuliferus</i>	Wooleybush Bee		P3	DBCA NatureMap	<b>Unlikely.</b> The closest record is 24 km from the Study area, and this species is known to feed on <i>Adenanthos</i> sp., <i>Grevillea</i> spp. and <i>Banksia attenuata</i> , none of which are present within the study area.
<i>Isoodon obesulus fusciventer</i>	Quenda, Southern Brown Bandicoot		P4	DBCA	<b>Unlikely.</b> The closest record is 40 km from the project area in Lake Magenta Nature Reserve, however quenda are no longer detectable in this reserve (Morris et al. 2008). This species prefers low, dense vegetation such as heath and swampy habitat and is often associated with forests, woodland, shrubland and riparian areas. Low density cage trapping (72 trap nights) and camera trapping (36 trap nights) undertaken as part of a targeted Red-tailed

Scientific name	Common name	Conservation status <sup>3</sup>		Source <sup>4</sup>	Likelihood of occurrence
		EPBC Act <sup>1</sup>	WC Act / DBCA <sup>2</sup>		
					Phascogale survey in surrounding native vegetation did not record the species (ELA 2018 <i>in prep</i> ). While potentially suitable habitat is present in the study area, given the lack of nearby records, lack of records during recent surveys, and lack of evidence of presence recorded, it is considered unlikely to occur in the study area.
<i>Notamacropus eugenii</i> subsp. <i>derbianus</i>	Tammar Wallaby		P4	DBCA NatureMap	<b>Unlikely.</b> The only record within 50 km is from 1988, and this species is only known from a selection number of locations.
<i>Notamacropus irma</i>	Western Brush Wallaby		P4	DBCA NatureMap	<b>Potential</b> - there is suitable habitat present within the project area. This species occurs in open forest and woodland with open scrubby thickets and low grasses. There are three records of this species within 20 km of the project area.
<i>Oxyura australis</i>	Blue-billed Duck		P4	DBCA NatureMap	<b>Unlikely</b> - suitable habitat is not present within the project area, as it prefers deep water in large permanent wetlands and swamps with dense aquatic vegetation.
<i>Platycercus icterotis</i> subsp. <i>xanthogenys</i>	Western Rosella (inland)		P4	DBCA NatureMap	<b>Likely</b> - the closest record is less than 1 km from the study area. In addition, there are records of the species in numerous patches of remnant vegetation surrounding the study area. This species, while relatively uncommon, is found in open dry eucalypt forest and timbered areas, with a heath understorey. Suitable habitat occurs within the study area and immediate surrounds.
<i>Psophodes nigrogularis</i> subsp. <i>Oberon</i>	Western Whipbird (Mallee)		P4	DBCA NatureMap	<b>Potential</b> - this species occurs in mallee, often in open mallee vegetation with a dense, tall shrub layer up to 1.5 m tall. The closest record is 16 km away; given some suitable habitat is present on site, this species has the potential to occur within the study area.
<i>Pseudomys occidentalis</i>	Western Mouse		P4	DBCA NatureMap	<b>Unlikely.</b> While suitable habitat is present within the study area, the closest record is 20 km away and Elliott trapping (713 trap nights) in nearby remnant

Scientific name	Common name	Conservation status <sup>3</sup>		Source <sup>4</sup>	Likelihood of occurrence
		EPBC Act <sup>1</sup>	WC Act / DBCA <sup>2</sup>		
					vegetation did not record this species (ELA 2018 <i>in prep</i> ). It is therefore considered unlikely to occur.
<i>Thinornis rubricollis</i>	Hooded Plover		P4	DBCA Naturemap	<b>Unlikely.</b> This species moves from the coast to salt lakes some distance inland in winter. Whilst there are records within 6 km of the study area, there is no suitable habitat available on site.

<sup>1</sup> EPBC Act = Environment Protection and Biodiversity Conservation Act 1999 List of Threatened Fauna

<sup>2</sup>WC Act = Wildlife Conservation Act 1950 Threatened Fauna (Rare Fauna) NB: the BC Act currently provides for species, subspecies or populations of native animals (fauna) to be listed as Specially Protected, Threatened (Critically Endangered, Endangered or Vulnerable) or Extinct in Western Australia however the Wildlife Conservation (Specially Protected Fauna) Notice 2018 was issued prior to the BC Act coming into effect and therefore WC Act codes have been included in the likelihood table.

<sup>3</sup>Conservation codes:

CR = listed as Critically Endangered under the EPBC Act.

EN = listed as Endangered under the EPBC Act.

VU = listed as Vulnerable under the EPBC Act.

M = listed as Migratory under the EPBC Act.

S1 = Schedule 1: Fauna that is rare or is likely to become extinct as critically endangered fauna (CR)

S2 = Schedule 2: Fauna that is rare or likely to become extinct as endangered fauna (EN).

S3 = Schedule 3: Flora that are considered likely to become extinct or rare, as vulnerable flora (VU) under the WC Act.

S5 = Schedule 5: Migratory birds protected under an international agreement (IA).

S6 = Schedule 6: Fauna that is of special conservation need as conservation dependent fauna.

S7 = Schedule 7: Other specially protected fauna (OS).

T = Threatened species: flora that has been declared likely to become extinct or is rare, or otherwise in need of special protection, pursuant to section 23F(2) of the WC Act.

P4 = Priority 4: Rare, Near Threatened and other species in need of monitoring but not currently threatened; could become threatened if present circumstances change. Listed by DBCA.

<sup>4</sup>NatureMap = NatureMap database search (Parks and Wildlife 2007 - 2018)

PMST = EPBC Act Protected Matters Report (DoEE 2018b)

## Appendix G Flora species list


Family	Species
Asparagaceae	<i>Laxmannia paleacea</i>
	<i>Lomandra mucronata</i>
	<i>Thysanotus patersonii</i>
Asteraceae	<i>Brachyscome ciliaris</i>
Casuarinaceae	<i>Allocasuarina acutivalvis</i> subsp. <i>acutivalvis</i>
Cupressaceae	<i>Callitris preissii</i>
Cyperaceae	<i>Gahnia ancistrophylla</i>
	<i>Lepidosperma</i> sp. 1
	<i>Lepidosperma</i> sp. 2
	<i>Lepidosperma</i> sp. 3
	<i>Lepidosperma sanguinolentum</i>
	<i>Lepidosperma</i> sp. Bandalup Scabrid (N. Eveleigh 10798)
	<i>Mesomelaena preissii</i>
	<i>Schoenus subfascicularis</i>
Dasypogonaceae	<i>Calectasia valida</i>
Dilleniaceae	<i>Hibbertia exasperata</i>
	<i>Hibbertia gracilipes</i>
	<i>Hibbertia psilocarpa</i>
	<i>Hibbertia stowardii</i>
Droseraceae	<i>Drosera</i> sp.
	<i>Drosera androsacea</i>
Ericaceae	<i>Astroloma serratifolium</i>
	<i>Leucopogon dielsianus</i>
	<i>Leucopogon</i> sp. Wheatbelt (S. Murray 257)
	<i>Lysinema pentapetalum</i>
Euphorbiaceae	<i>Beyeria sulcata</i> var. <i>gracilis</i>
Fabaceae	<i>Acacia sphacelata</i> subsp. <i>recurva</i>
	<i>Acacia</i> ? <i>densiflora</i>
	<i>Daviesia intricata</i> subsp. <i>intricata</i>
	<i>Daviesia scoparia</i>
	<i>Gastrolobium spinosum</i>
	<i>Mirbelia floribunda</i>

Family	Species
	<i>Templetonia rossii</i>
Goodeniaceae	<i>Dampiera lavandulacea</i>
Haemodoraceae	<i>Conostylis argentea</i>
Hemerocallidaceae	<i>Dianella revoluta</i> var. <i>divaricata</i>
Lauraceae	<i>Cassytha glabella</i>
Malvaceae	<i>Guichenotia asteriskos</i> (P2)
	<i>Guichenotia micrantha</i>
	<i>Lasiopetalum rosmarinifolium</i>
Myrtaceae	<i>Beaufortia micrantha</i>
	<i>Chamelaucium virgatum</i>
	<i>Ericomyrtus drummondii</i>
	<i>Eucalyptus neutra</i>
	<i>Eucalyptus phaenophylla</i> subsp. <i>phaenophylla</i>
	<i>Eucalyptus phenax</i> subsp. <i>phenax</i>
	<i>Eucalyptus sporadica</i>
	<i>Eucalyptus uncinata</i>
	<i>Leptospermum nitens</i>
	<i>Melaleuca hamata</i>
	<i>Melaleuca johnsonii</i>
	<i>Melaleuca lateriflora</i>
	<i>Melaleuca laxiflora</i>
	<i>Melaleuca spicigera</i>
	<i>Melaleuca tuberculata</i> var. <i>macrophylla</i>
	<i>Rinzia communis</i>
	<i>Tetrapora preissiana</i>
	<i>Verticordia humilis</i>
Orchidaceae	<i>Ericksonella saccharata</i>
	<i>Pterostylis scabra</i>
Poaceae	<i>Neurachne alopecuroidea</i>
Polygalaceae	<i>Comesperma volubile</i>
Proteaceae	<i>Banksia sphaerocarpa</i> var. <i>caesia</i>
	<i>Banksia xylothemelia</i> (P3)



Family	Species
	<i>Daviesia implexa</i> (P3)
	<i>Hakea incrassata</i>
	<i>Hakea marginata</i>
	<i>Persoonia brevirhachis</i> (P3)
	<i>Petrophile glauca</i>
	<i>Petrophile media</i>
	<i>Petrophile seminuda</i>
Restionaceae	<i>Desmocladius myriocladus</i>
	<i>Lepidobolus preissianus</i>
Rhamnaceae	<i>Cryptandra wilsonii</i>
Rutaceae	<i>Phebalium microphyllum</i>
Santalaceae	<i>Santalum acuminatum</i>
	<i>Santalum murrayanum</i>
	<i>Exocarpos sparteus</i>
Sapindaceae	<i>Dodonaea bursariifolia</i>
	<i>Dodonaea pinifolia</i>
Stylidiaceae	<i>Stylidium</i> sp.
	<i>Stylidium eriopodum</i>
	<i>Stylidium repens</i>
Xanthorrhoeaceae	<i>Xanthorrhoea nana</i>

## Appendix H Quadrat data

Site name and number	Date	Site type	Observer
ELA1	19/09/2018	10 x 10 m understorey 20 x 20 m overstorey	SD & JC
Condition	Disturbance	Fire history - years	Landscape type
Very Good	Runoff, tracks, edge effects	Old (>20 years)	Plain
Soil type/geology	Soil colour	Leaf litter cover (%)	Bare ground cover (%)
Sandy clay/loam, quartz	Pale yellow	60%	0.1%
Easting		Northing	
127499		6330838	
			
Species	Cover (%)	Height Class	Form/stratum
<i>Cryptandra wilsonii</i>	0.1	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Daviesia scoparia</i>	0.1	2 (0.5-1 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Dianella revoluta</i> var. <i>divaricata</i>	0.1	1 (<0.5 m)	Forb (G)
<i>Dodonaea bursariifolia</i>	1	2 (0.5-1 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Eucalyptus neutra</i>	20	6 (<10)	Tree mallee (U)
<i>Eucalyptus phaenophylla</i> subsp. <i>phaenophylla</i>	2	6 (<10)	Tree mallee (U)
<i>Eucalyptus uncinata</i>	10	6 (<10)	Tree mallee (U)
<i>Gahnia ancistrophylla</i>	2	1 (<0.5 m)	Sedge (G)
<i>Hibbertia psilocarpa</i>	0.1	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Lasiopetalum rosmarinifolium</i>	0.1	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Lepidosperma</i> sp. 1	0.1	1 (<0.5 m)	Sedge (G)
Species	Cover (%)	Height Class	Form/stratum

<i>Lepidosperma</i> sp. Bandalup Scabrid (N. Eveleigh 10798)	0.1	1 (<0.5 m)	Sedge (G)
<i>Melaleuca hamata</i>	15	4 (>2)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Melaleuca johnsonii</i>	1	3 (1-2m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Melaleuca lateriflora</i>	1	3 (1-2m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Melaleuca laxiflora</i>	1	3 (1-2m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Melaleuca spicigera</i>	5	3 (1-2m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Neurachne alopecuroidea</i>	0.1	1 (<0.5 m)	Other grass (G)
<i>Santalum murrayanum</i>	1	3 (1-2m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Schoenus subfascicularis</i>	0.1	1 (<0.5 m)	Sedge (G)
<i>Templetonia rossii</i>	0.1	2 (0.5-1 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Thysanotus patersonii</i>	0.1	1 (<0.5 m)	Forb (G)

Site name and number	Date	Site type	Observer
ELA2	19/09/2018	10 x 10 m understorey 20 x 20 m overstorey	SD & JC
Condition	Disturbance	Fire history - years	Landscape type
Excellent	Runoff, tracks	Old (>20 years)	Plain
Soil type/geology	Soil colour	Leaf litter cover (%)	Bare ground cover (%)
Clay, quartz/laterite	Light yellow	3%	0.3
Easting		Northing	
127475		6330757	



Species	Cover (%)	Height Class	Form/stratum
<i>Allocasuarina acutivalvis</i> subsp. <i>acutivalvis</i>	35	4 (>2)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Astroloma serratifolium</i>	1	2 (0.5-1 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Banksia sphaerocarpa</i> var. <i>caesia</i>	0.1	2 (0.5-1 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Calectasia valida</i>	1	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Comesperma volubile</i>	0.1	1 (<0.5 m)	Vine (G)
<i>Conostylis argentea</i>	0.25	1 (<0.5 m)	Forb (G)
<i>Dodonaea pinifolia</i>	0.5	2 (0.5-1 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Drosera androsacea</i>	0.1	1 (<0.5 m)	Forb (G)
<i>Exocarpos sparteus</i>	0.25	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Hibbertia exasperata</i>	0.1	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Hibbertia stowardii</i>	0.25	2 (0.5-1 m)	Shrub, cycad, grass-tree, tree-fern (M)

Species	Cover (%)	Height Class	Form/stratum
<i>Laxmannia paleacea</i>	0.1	1 (<0.5 m)	Forb (G)
<i>Lepidobolus preissianus</i>	0.1	1 (<0.5 m)	Rush (G)
<i>Lepidosperma</i> sp. 2	6	1 (<0.5 m)	Sedge (G)
<i>Leucopogon dielsianus</i>	0.5	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Leucopogon</i> sp. Wheatbelt (S. Murray 257)	0.1	2 (0.5-1 m)	Sedge (G)
<i>Mesomelaena preissii</i>	4	1 (<0.5 m)	Sedge (G)
<i>Mirbelia floribunda</i>	0.1	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Neurachne alopecuroidea</i>	0.1	1 (<0.5 m)	Other grass (G)
<i>Petrophile seminuda</i>	0.25	3 (1-2m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Rinzia communis</i>	0.25	2 (0.5-1 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Stylidium eriopodum</i>	0.1	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Verticordia humilis</i>	0.25	2 (0.5-1 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Xanthorrhoea nana</i>	2	2 (0.5-1 m)	Shrub, cycad, grass-tree, tree-fern (M)

Site name and number	Date	Site type	Observer
ELA3	19/09/2018	10 x 10 m understorey 20 x 20 m overstorey	SD & JC
Condition	Disturbance	Fire history - years	Landscape type
Excellent	Tracks	Old (>20 years)	Plain
Soil type/geology	Soil colour	Leaf litter cover (%)	Bare ground cover (%)
Clay loam, sparse laterite nodules	Light grey	1%	45%
Easting		Northing	
127455		6330754	

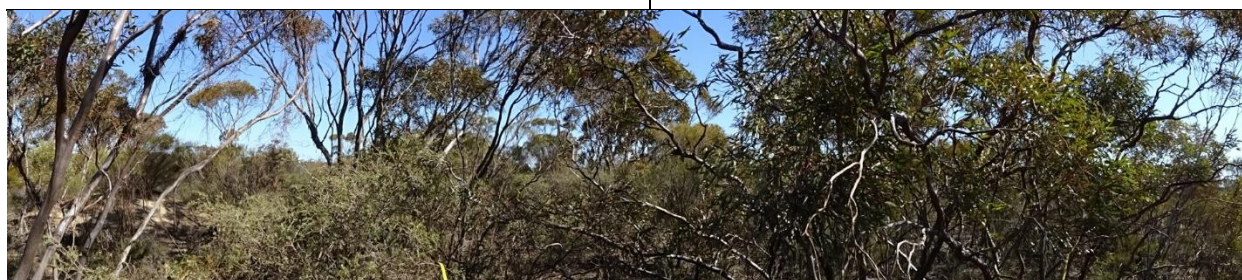


Species	Cover (%)	Height Class	Form/stratum
<i>Allocasuarina acutivalvis</i> subsp. <i>acutivalvis</i>	45	4 (>2)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Astroloma serratifolium</i>	0.25	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Beaufortia micrantha</i>	0.1	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Comesperma volubile</i>	0.1	1 (<0.5 m)	Vine (G)
<i>Conostylis argentea</i>	0.1	1 (<0.5 m)	Forb (G)
<i>Drosera</i> sp.	0.1	1 (<0.5 m)	Forb (G)
<i>Drosera androsacea</i>	0.1	1 (<0.5 m)	Forb (G)
<i>Exocarpos sparteus</i>	0.1	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Hibbertia stowardii</i>	0.25	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Laxmannia paleacea</i>	0.1	1 (<0.5 m)	Forb (G)
<i>Lepidosperma</i> sp. 3	2	1 (<0.5 m)	Sedge (G)
<i>Leucopogon dielsianus</i>	0.5	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)

Species	Cover (%)	Height Class	Form/stratum
<i>Leucopogon</i> sp. Wheatbelt (S. Murray 257)	0.5	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Mesomelaena preissii</i>	3	1 (<0.5 m)	Sedge (G)
<i>Neurachne alopecuroidea</i>	0.25	1 (<0.5 m)	Other grass (G)
<i>Persoonia brevihachis</i> (P3)	0.5	2 (0.5-1 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Rinzia communis</i>	0.1	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Stylidium</i> sp.	0.1	1 (<0.5 m)	Forb (G)
<i>Verticordia humilis</i>	0.25	2 (0.5-1 m)	Shrub, cycad, grass-tree, tree-fern (M)



Site name and number	Date	Site type	Observer
ELA4	19/09/2018	10 x 10 m understorey 20 x 20 m overstorey	SD & JC
Condition	Disturbance	Fire history - years	Landscape type
Very Good	Nil	Old (>20 years)	Plain
Soil type/geology	Soil colour	Leaf litter cover (%)	Bare ground cover (%)
Loamy clay	light brown	45%	5%
Easting		Northing	
127488		6330718	



Species	Cover (%)	Height Class	Form/stratum
<i>Beyeria sulcata</i> var. <i>gracilis</i>	2	2 (0.5-1 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Cassytha glabella</i>	0.1	1 (<0.5 m)	Vine (G)
<i>Desmocladius myriocladus</i>	0.1	1 (<0.5 m)	Rush (G)
<i>Dianella revoluta</i> var. <i>divaricata</i>	0.5	1 (<0.5 m)	Forb (G)
<i>Dodonaea bursariifolia</i>	0.25	2 (0.5-1 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Ericomyrtus drummondii</i>	0.25	2 (0.5-1 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Eucalyptus phaenophylla</i> subsp. <i>phaenophylla</i>	5	6 (<10)	Tree mallee (U)
<i>Eucalyptus phenax</i> subsp. <i>phenax</i>	35	6 (<10)	Tree mallee (U)
<i>Eucalyptus sporadica</i>	10	6 (<10)	Tree mallee (U)
<i>Gahnia ancistrophylla</i>	0.75	1 (<0.5 m)	Sedge (G)
<i>Hibbertia psilocarpa</i>	0.25	2 (0.5-1 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Lasiopetalum rosmarinifolium</i>	0.25	2 (0.5-1 m)	Shrub, cycad, grass-tree, tree-fern (M)


Species	Cover (%)	Height Class	Form/stratum
<i>Lepidosperma</i> sp. Bandalup Scabrid (N. Eveleigh 10798)	0.25	1 (<0.5 m)	Sedge (G)
<i>Leptospermum nitens</i>	4	2 (0.5-1 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Lomandra mucronata</i>	0.1	1 (<0.5 m)	Forb (G)
<i>Melaleuca hamata</i>	5	3 (1-2m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Melaleuca johnsonii</i>	3	3 (1-2m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Melaleuca laxiflora</i>	2	3 (1-2m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Neurachne alopecuroidea</i>	0.1	1 (<0.5 m)	Other grass (G)
<i>Santalum acuminatum</i>	1	3 (1-2m)	Shrub, cycad, grass-tree, tree-fern (M)

Site name and number	Date	Site type	Observer
ELA5	19/09/2018	10 x 10 m understorey 20 x 20 m overstorey	SD & JC
Condition	Disturbance	Fire history - years	Landscape type
Very Good	Edge effects	Old (>20 years)	Plain
Soil type/geology	Soil colour	Leaf litter cover (%)	Bare ground cover (%)
Loamy clay	Light brown	65%	10%
Easting		Northing	
127399		6330741	



Species	Cover (%)	Height Class	Form/stratum
<i>Acacia sphacelata</i> subsp. <i>recurva</i>	0.25	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Beaufortia micrantha</i>	0.25	2 (0.5-1 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Cassytha glabella</i>	0.1	1 (<0.5 m)	Vine (G)
<i>Conostylis argentea</i>	0.1	1 (<0.5 m)	Forb (G)
<i>Cryptandra wilsonii</i>	0.1	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Desmocladius myriocladus</i>	0.25	1 (<0.5 m)	Rush (G)
<i>Drosera</i> sp.	0.1	1 (<0.5 m)	Forb (G)
<i>Eucalyptus phaenophylla</i> subsp. <i>phaenophylla</i>	2	6 (<10)	Tree mallee (U)
<i>Eucalyptus phenax</i> subsp. <i>phenax</i>	40	6 (<10)	Tree mallee (U)
<i>Gahnia ancistrophylla</i>	0.25	1 (<0.5 m)	Sedge (G)
<i>Hibbertia exasperata</i>	0.1	2 (0.5-1 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Lepidosperma sanguinolentum</i>	0.25	1 (<0.5 m)	Sedge (G)
Species	Cover (%)	Height Class	Form/stratum

<i>Lepidosperma</i> sp. Bandalup Scabrid (N. Eveleigh 10798)	0.25	1 (<0.5 m)	Sedge (G)
<i>Leptospermum nitens</i>	2	2 (0.5-1 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Lomandra mucronata</i>	0.1	1 (<0.5 m)	Forb (G)
<i>Melaleuca hamata</i>	2	4 (>2)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Melaleuca johnsonii</i>	4	3 (1-2m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Melaleuca laxiflora</i>	1	3 (1-2m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Neurachne alopecuroidea</i>	0.25	1 (<0.5 m)	Other grass (G)
<i>Phebalium microphyllum</i>	0.1	2 (0.5-1 m)	Shrub, cycad, grass-tree, tree-fern (M)

Site name and number	Date	Site type	Observer
ELA6	19/09/2018	10 x 10 m understorey 20 x 20 m overstorey	SD & JC
Condition	Disturbance	Fire history - years	Landscape type
Excellent	Nil	Old (>20 years)	Plain
Soil type/geology	Soil colour	Leaf litter cover (%)	Bare ground cover (%)
Clay loam, laterite nodules	Light brown	0.1%	5%
Easting		Northing	
127420		6330760	
			
Species	Cover (%)	Height Class	Form/stratum
<i>Astroloma serratifolium</i>	0.25	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Banksia sphaerocarpa</i> var. <i>caesia</i>	0.1	3 (1-2m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Beaufortia micrantha</i>	4	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Conostylis argentea</i>	0.25	1 (<0.5 m)	Forb (G)
<i>Dampiera lavandulacea</i>	0.1	1 (<0.5 m)	Forb (G)
<i>Drosera androsacea</i>	0.1	1 (<0.5 m)	Forb (G)
<i>Exocarpos sparteus</i>	0.1	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Hakea incrassata</i>	0.25	3 (1-2m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Hakea marginata</i>	2	2 (0.5-1 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Hibbertia gracilipes</i>	0.25	2 (0.5-1 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Hibbertia stowardii</i>	0.25	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)

Species	Cover (%)	Height Class	Form/stratum
<i>Laxmannia paleacea</i>	0.1	1 (<0.5 m)	Forb (G)
<i>Lepidosperma</i> sp. 3	0.1	1 (<0.5 m)	Sedge (G)
<i>Leptospermum nitens</i>	1	3 (1-2m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Leucopogon dielsianus</i>	0.1	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Leucopogon</i> sp. Wheatbelt (S. Murray 257)	0.25	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Lysinema pentapetalum</i>	0.1	2 (0.5-1 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Melaleuca tuberculata</i> var. <i>macrophylla</i>	0.5	2 (0.5-1 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Mesomelaena preissii</i>	0.75	1 (<0.5 m)	Sedge (G)
<i>Mirbelia floribunda</i>	0.25	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Mirbelia floribunda</i>	0.25	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Neurachne alopecuroidea</i>	0.1	1 (<0.5 m)	Other grass (G)
<i>Persoonia brevihachis</i> (P3)	0.1	2 (0.5-1 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Petrophile glauca</i>	1	2 (0.5-1 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Petrophile seminuda</i>	0.75	3 (1-2m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Santalum acuminatum</i>	0.1	2 (0.5-1 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Verticordia humilis</i>	0.1	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Xanthorrhoea nana</i>	0.25	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)

Site name and number	Date	Site type	Observer
ELA7	19/09/2018	10 x 10 m understorey 20 x 20 m overstorey	SD & JC
Condition	Disturbance	Fire history - years	Landscape type
Excellent	Nil	Old (>20 years)	Plain
Soil type/geology	Soil colour	Leaf litter cover (%)	Bare ground cover (%)
Clay loam	Light yellow	0.1%	0.15%
Easting		Northing	
127424		6330730	



Species	Cover (%)	Height Class	Form/stratum
<i>Acacia ?densiflora</i>	0.25	2 (0.5-1 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Astroloma serratifolium</i>	2	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Banksia xylothemelia</i> (P3)	0.25	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Beaufortia micrantha</i>	5	2 (0.5-1 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Cassytha glabella</i>	0.1	1 (<0.5 m)	Vine (G)
<i>Comesperma volubile</i>	0.1	1 (<0.5 m)	Vine (G)
<i>Dampiera lavandulacea</i>	0.1	1 (<0.5 m)	Forb (G)
<i>Daviesia intricata</i> subsp. <i>intricata</i>	0.1	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Drosera androsacea</i>	0.1	1 (<0.5 m)	Forb (G)
<i>Exocarpos sparteus</i>	0.1	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Gastrolobium spinosum</i>	0.5	2 (0.5-1 m)	Shrub, cycad, grass-tree, tree-fern (M)
Species	Cover (%)	Height Class	Form/stratum



<i>Guichenotia asteriskos</i> (P2)	0.1	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Guichenotia micrantha</i>	0.1	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Hakea marginata</i>	1	2 (0.5-1 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Hibbertia stowardii</i>	0.5	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Laxmannia paleacea</i>	0.25	1 (<0.5 m)	Forb (G)
<i>Lepidobolus preissianus</i>	0.1	1 (<0.5 m)	Rush (G)
<i>Lepidosperma</i> sp. 3	0.1	1 (<0.5 m)	Sedge (G)
<i>Lepidosperma</i> sp. Bandalup Scabrid (N. Eveleigh 10798)	0.1	1 (<0.5 m)	Sedge (G)
<i>Leucopogon dielsianus</i>	0.1	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Leucopogon</i> sp. Wheatbelt (S. Murray 257)	0.5	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Lomandra mucronata</i>	0.1	1 (<0.5 m)	Forb (G)
<i>Lysinema pentapetalum</i>	0.25	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Melaleuca johnsonii</i>	0.25	3 (1-2m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Melaleuca tuberculata</i> var. <i>macrophylla</i>	0.5	2 (0.5-1 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Melaleuca tuberculata</i> var. <i>macrophylla</i>	1	2 (0.5-1 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Mesomelaena preissii</i>	1	1 (<0.5 m)	Sedge (G)
<i>Mirbelia floribunda</i>	0.1	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Neurachne alopecuroidea</i>	0.25	1 (<0.5 m)	Other grass (G)
<i>Persoonia brevihachis</i> (P3)	0.25	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Petrophile glauca</i>	0.1	2 (0.5-1 m)	Shrub, cycad, grass-tree, tree-fern (M)
Species	Cover (%)	Height Class	Form/stratum



<i>Pterostylis scabra</i>	0.1	1 (<0.5 m)	Forb (G)
<i>Schoenus subfascicularis</i>	0.1	1 (<0.5 m)	Sedge (G)
<i>Stylidium repens</i>	0.1	1 (<0.5 m)	Forb (G)
<i>Tetrapora preissiana</i>	0.1	2 (0.5-1 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Verticordia humilis</i>	0.25	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Xanthorrhoea nana</i>	0.1	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)

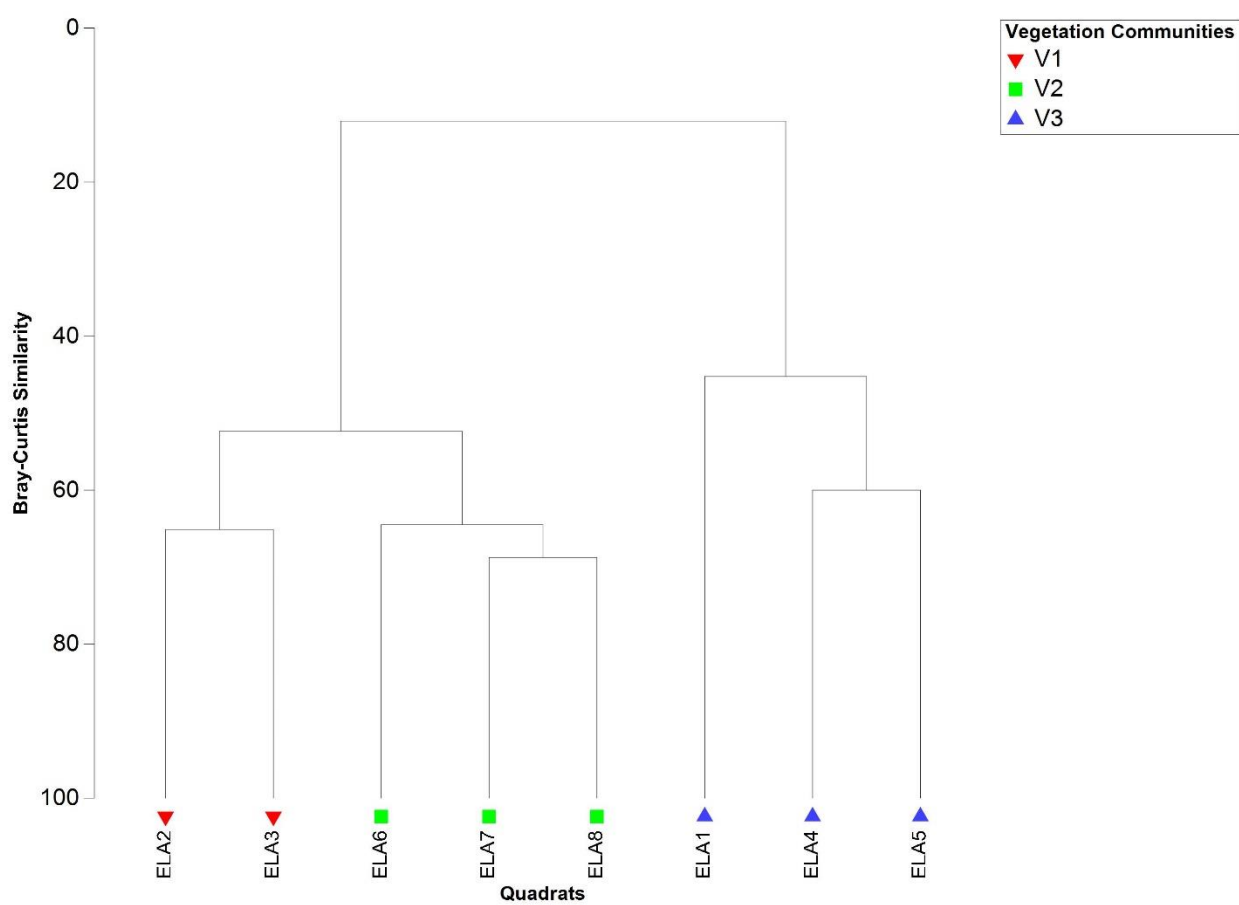
Site name and number	Date	Site type	Observer
ELA8	19/09/2018	10 x 10 m understorey 20 x 20 m overstorey	SD & JC
Condition	Disturbance	Fire history - years	Landscape type
Excellent	Nil	Old (>20 years)	Plain
Soil type	Soil colour	Leaf litter cover (%)	Bare ground cover (%)
Clay loam	Light yellow	0.1%	0.2%
Easting		Northing	
127347		6330714	



Species	Cover (%)	Height Class	Form/stratum
<i>Banksia sphaerocarpa</i> var. <i>caesia</i>	2	2 (0.5-1 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Banksia xylothemelia</i> (P3)	1	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Beaufortia micrantha</i>	0.75	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Calectasia valida</i>	0.1	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Cassytha glabella</i>	0.1	1 (<0.5 m)	Vine (G)
<i>Chamelaucium virgatum</i>	0.1	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Dampiera lavandulacea</i>	0.1	1 (<0.5 m)	Forb (G)
<i>Drosera</i> sp.	0.1	1 (<0.5 m)	Forb (G)
<i>Exocarpos sparteus</i>	0.25	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Hakea incrassata</i>	0.5	2 (0.5-1 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Hakea marginata</i>	0.5	2 (0.5-1 m)	Shrub, cycad, grass-tree, tree-fern (M)

Species	Cover (%)	Height Class	Form/stratum
<i>Hibbertia stowardii</i>	0.25	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Laxmannia paleacea</i>	0.1	1 (<0.5 m)	Forb (G)
<i>Lepidobolus preissianus</i>	0.25	1 (<0.5 m)	Rush (G)
<i>Leucopogon dielsianus</i>	0.1	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Leucopogon</i> sp. Wheatbelt (S. Murray 257)	0.25	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Melaleuca johnsonii</i>	5	2 (0.5-1 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Melaleuca tuberculata</i> var. <i>macrophylla</i>	6	2 (0.5-1 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Mesomelaena preissii</i>	1	1 (<0.5 m)	Sedge (G)
<i>Mirbelia floribunda</i>	0.1	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Neurachne alopecuroidea</i>	0.1	1 (<0.5 m)	Other grass (G)
<i>Persoonia brevirhachis</i> (P3)	0.5	2 (0.5-1 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Petrophile glauca</i>	0.5	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Petrophile media</i>	0.5	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Pterostylis scabra</i>	0.1	1 (<0.5 m)	Forb (G)
<i>Stylidium repens</i>	0.1	1 (<0.5 m)	Forb (G)
<i>Verticordia humilis</i>	2	2 (0.5-1 m)	Shrub, cycad, grass-tree, tree-fern (M)
<i>Xanthorrhoea nana</i>	0.25	1 (<0.5 m)	Shrub, cycad, grass-tree, tree-fern (M)

## Appendix I Hierarchical clustering dendrogram





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