Biota Environmental Sciences

Warradarge Wind Farm Flora, Vegetation and Fauna Assessment

Prepared for Verve Energy

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Warradarge Flora, Vegetation and Fauna Assessment

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1.0 Summary

1.1 Project Background

Verve Energy is proposing to construct a 250 MW wind farm facility at a site approximately 20 km southeast of Eneabba in the Mid West region of Western Australia. The project, referred to as the Warradarge Wind Farm is currently in the feasibility stage. The final layout of the project has yet to be finalised, but it is anticipated to include up to 100 wind turbines in existing cleared areas. A transmission line route and access tracks also form a part of the conceptual design.

The proposed Warradarge Wind Farm will be located on private farmland situated 19 km northeast of the Brand Highway and Coorow-Green Head Road intersection and is located in the Shires of Carnamah and Coorow. The study area is 3,650.9 ha in size and occurs on the open Wheatbelt Plateau Landscape, which is dominated by agricultural land use. Biota Environmental Sciences (Biota) was engaged by Verve Energy to complete a biological assessment of the proposed development area (hereafter "the study area").

1.2 Flora and Vegetation

Twenty-five intact vegetation units were identified within the study area and most were in Very Good to Excellent condition.

None of the vegetation types represent Priority Ecological Communities. Two of the vegetation types (HB5 and HX1) appear similar to the description that is available for the Lesueur-Coomallo Floristic Community (D1), which is listed as a Threatened Ecological Community. These units are considered to be of Very High conservation significance.

A large proportion of the study area (76%) comprised cleared land which has no conservation value as vegetation (unit M1). The units M2 and M3 were considered to be of low conservation value and together occupied 8.8% of the study area. The remainder of the vegetation was of High conservation significance. The Warradarge study area is situated in a locality that has been subject to extensive historical land clearing and fragmentation and conservation of native vegetation is of particular significance (EPA 2010).

A total of 406 plant species from 167 genera belonging to 55 families were recorded from the study area. This number would appear to be within the expected range for a study area of this size, taking into consideration that the region is characterised by high species richness and endemism. The suite of species and the dominant genera and plant families were largely typical of the region.

Four species listed as Threatened under the WA *Wildlife Conservation Act 1950-1979* were recorded (*Acacia wilsonii, Banksia catoglypta, Eucalyptus pruiniramis,* and *Thelymitra stellata*). Two of these (*T. stellata* and *E. pruiniramis*) are also listed as Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

Twenty-two (22) species listed as Priority flora under the WA *Wildlife Conservation Act 1950-1979* were recorded. These comprised one Priority 1 (*Grevillea stenogyne)*, four Priority 2 (*Arnocrinum gracillimum*, *Baeckea* sp. Bunney Road (S. Patrick 4059), *Comesperma griffinii* and *Synaphea endothrix*), nine Priority 3 (*Allocasuarina grevilleoides*, *A. ramosissima*, *Austrostipa* sp. Cairn Hill (M.E. Trudgen 21176), *Banksia cypholoba, B. nobilis* subsp. *fragrans*, B. *splendida* subsp. *macrocarpa*, *Grevillea erinacea, Lepidobolus quadratus, Petrophile chrysantha* subsp. Watheroo (K.M. Allan 57)) and eight Priority 4 species (*Astroloma* sp. Cataby (E.A. Griffin 1022), *Banksia platycarpa, B. sclerophylla, Calytrix chrysantha, Conostephium magnum, Desmocladus elongatus, Hemiandra* sp. Watheroo (S. Hancocks 4) and *Hypolaena robusta*).

One previously undescribed species was identified (*Ptilotus* sp. nov.) and seven species were range extensions for the locality (*Cassytha glabella* forma *casuarinae, Comesperma virgatum,*

Gonocarpus cordiger, Grevillea obliquistigma subsp. *obliquistigma, Melaleuca nesophila, Schoenus breviculmis* and *Synaphea interioris.*

Twenty-one (21) species of introduced flora (weeds) were recorded from the study area, with grasses (family Poaceae) and daisies (family Asteraceae) most common. The majority were non-invasive species, however one individual of a Declared Plant, **Echium plantagineum*, was recorded.

1.3 Fauna

Five broad fauna habitats occur in the study area (modified vegetation, drainage areas, loam/clay plains, stony hills and slopes, and sandy plains and low hills). These are considered to be common and widespread within the Lesueur Sandplains subregion.

Database searches indicate that up to 187 native vertebrate fauna species may occur in the study area locality, comprising 133 bird species, 10 native mammals (seven non-volant, three volant), and 44 herpetofauna species (eight amphibians and 36 reptiles). Considering that only 15% of the study area contains intact remnant vegetation, the actual number occurring in the study area is likely to be a considerably lower subset of this total.

The desktop review identified 12 fauna species of conservation significance for the locality: three Schedule 1 species, five Schedule 3, one Priority 3, and three Priority 4 species. Seven are considered likely to occur as transitory visitors: *Calyptorhynchus latirostris (*Carnaby's Cockatoo), *Apus pacificus* (Fork-tailed Swift), *Ardea ibis* (Cattle Egret), *Haliaeetus leucogaster* (White-bellied Sea-Eagle), *Merops ornatus* (Rainbow Bee-eater), *Ardeotis australis* (Australian Bustard), and *Calamanthus campestris* subsp. *montanellus (*Rufous Fieldwren). Of these species, five are federally listed under the *EPBC Act 1999* (Carnaby's Cockatoo, Fork-tailed Swift, Cattle Egret, White-bellied Sea-eagle and Rainbow Bee-eater). Only four species, *C. latirostris, A. ibis, M. ornatus* and *A. australis*, are considered likely to be periodic visitors to the study area.

Carnaby's Cockatoo is believed to be of most relevance to the proposed wind farm, as foraging habitat (vegetation dominated by a species-rich proteaceous heath) is present in the study area. The Storr-Johnstone Bird Data Bank indicates that this species has been recorded near the study area, with most observations comprising autumn-winter visitors. No roost sites, or potential roost sites, were observed during the field visit. If clearing of foraging habitat is kept to a minimum, the local and regional conservation status of this species is unlikely to be affected.

Impact to fauna may occasionally occur due to mortality arising from construction activities and clearing of vegetation. There is also a very low risk that individual avifauna mortalities may occur as a result of bird strikes with wind turbine blades. However, given the widespread distribution of these species and their ability to fly competently in all conditions, it is unlikely to affect population numbers at a local or regional scale.

2.0 Introduction

2.1 Project Background

Verve Energy is proposing to construct a 250 MW wind farm facility at a site approximately 20 km southeast of Eneabba in the Mid West region of Western Australia (WA; see Figure 2.1). The project, referred to as the Warradarge Wind Farm, is currently in the feasibility stage. The final layout of the project has yet to be finalised, but it is anticipated to include up to 100 wind turbines in existing cleared areas. A transmission line route and access tracks also form a part of the conceptual design.

The proposed Warradarge Wind Farm will be located on private farmland situated 19 km northeast of the Brand Highway and Coorow-Green Head Road intersection and is located in the Shires of Carnamah and Coorow. Biota Environmental Sciences (Biota) was engaged by Verve Energy to undertake a flora and fauna assessment of the proposed development site. The study area for this assessment is 3,650.9 ha in size and occurs on the open Wheatbelt Plateau Landscape, which is dominated by agricultural land use.

2.2 Scope and Objectives of this Study

This report describes the results from a flora and vegetation survey completed in the study area and a desktop assessment of vertebrate fauna values. The field survey was planned and implemented as far as practicable according to the Environmental Protection Authority (EPA) Position Statement No. 2 "*Environmental Protection of Native Vegetation in Western Australia*" (EPA 2000), Environmental Protection Authority (EPA) Position Statement No. 3 "*Terrestrial Biological Surveys as an Element of Biodiversity Protection*" (EPA 2002) and Guidance Statement No. 51 "*Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia*" (EPA 2004).

The scope and objectives of the study were to:

- document the suite of flora species occurring within the study area;
- identify any plant species of conservation significance occurring within the study area, including Threatened flora species listed under the Commonwealth *Environment Protection and Biodiversity Conservation (EPBC)* Act *1999* and Western Australian (WA) *Wildlife Conservation Act 1950,* and species classified as Priority flora by the Department of Environment and Conservation (DEC);
- describe and map the vegetation communities occurring within the study area;
- identify any vegetation communities of conservation significance (see Appendix 1) within the study area;
- assess the level of weed presence in the study area;
- identify and describe fauna habitats in the study area, based on vegetation types and landforms recorded;
- identify fauna species of conservation significance that may occur in the study area, including Threatened species listed under the Commonwealth *EPBC Act 1999* and Schedule and Priority fauna listed under the WA *Wildlife Conservation Act 1950-1979*; and
- conduct a desktop assessment of potential impacts to fauna that may occur in the study area.

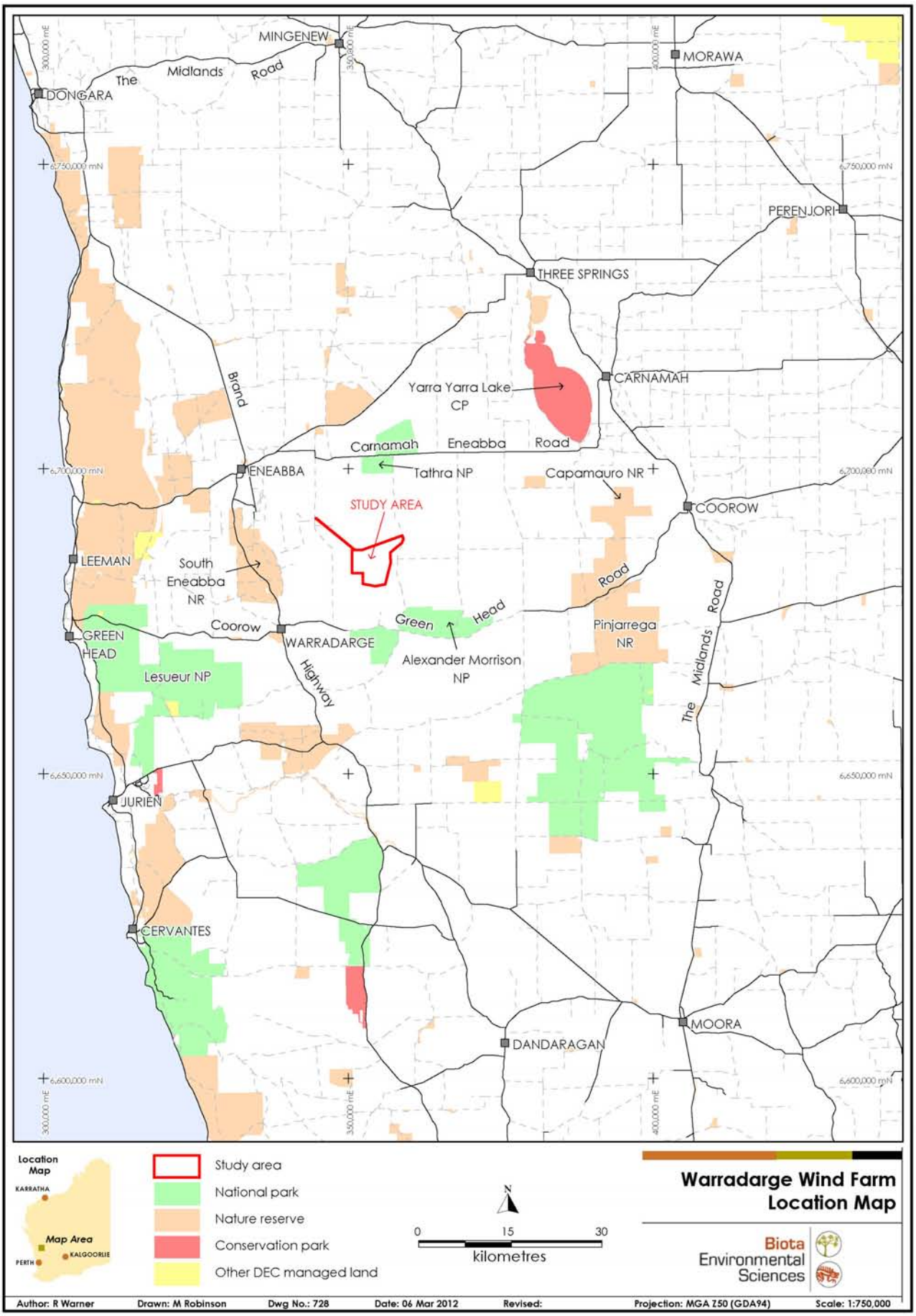

Figure 2.1: Location of the Warradarge Wind Farm study area and surrounding conservation reserves.

3.0 Methodology

3.1 Desktop Review

Database searches were conducted to identify flora and fauna species of conservation significance that had previously been recorded within or near the study area. This included species listed at State and Federal levels. The following databases were consulted:

- DECs NatureMap[1];
- WA Herbarium rare flora; and
- Protected Matters Tool[2] (*EPBC Act 1999*).

Searches were conducted around a central coordinate within the study area (29° 57' 14" S and 115° 28' 27" E) with a 15 km and 30 km buffer applied for flora and fauna searches, respectively. The results of the database searches are provided in Appendix 2, 3 and 4.

The following reports from previous surveys completed in the locality were reviewed for context:

- Mumbida Wind Farm Flora and Vegetation Survey (Biota 2001);
- Proposed Mumbida Wind Farm - Vertebrate Fauna Desktop Review (Biota 2002b); and
- A Desktop Review for the Allanooka Wind Farm Development, near Geraldton (Biota 2011).

Specialist consultants (Ron and Christine Johnstone and T. Kirkby) conducted an internal database search of the Storr-Johnstone Bird Data Bank for records of Carnaby's Cockatoo (*Calyptorhynchus latirostris*) breeding and foraging sites in the Warradarge region. They also provided information and advice about this species.

3.2 Field Survey

3.2.1 Survey Personnel and Timing

Two separate trips were conducted for the vegetation and flora survey of the study area. Trip 1 took place between the 20th and 26th of October 2011 and Trip 2 was conducted between the 17th and 20th of November, 2011. A summary of timing, personnel and qualifications is provided in Table 3.1.

All personnel completed detailed floristic quadrats, description and mapping of individual vegetation types, and recorded species of interest on an opportunistic basis.

Table 3.1: Summary of personnel and survey effort for Trip 1 and Trip 2.

Trip	Dates	Personnel	Company and Title
Trip 1	October 20-26	Rachel Warner	Biota (Senior Botanist)
		Scott Werner	Biota (Graduate Biologist)
	October 22-26	Brian Morgan	Consultant Plant Biologist
Trip 2	November 17-20	Rachel Warner	Biota (Senior Botanist)
		Pierre-Louis De Kock	Biota (Botanist)

1 http://naturemap.dec.wa.gov.au (accessed November 3rd 2011).

2 http://www.environment.gov.au/epbc/pmst/index (accessed November 3rd 2011).

3.2.2 Survey Conditions

The study area is situated between the 450 and 500 mm isohyets with almost 90% of the rainfall in the region occurring between March and October (Stuart-Street 2007). Rainfall data were obtained from the Bureau of Meteorology for the nearby Eneabba meteorological recording station (number 008225). The surveys followed two months of above-average rainfall (September and October, see Figure 3.1) with 50 mm recorded, compared to the long-term average of 34.7 mm. The preceding winter rainfall monthly totals were, however, slightly below average with 74 mm recorded, compared to the long-term average of 90 mm. Conditions at the time of the survey were considered adequate for the collection of most annual and ephemeral species.

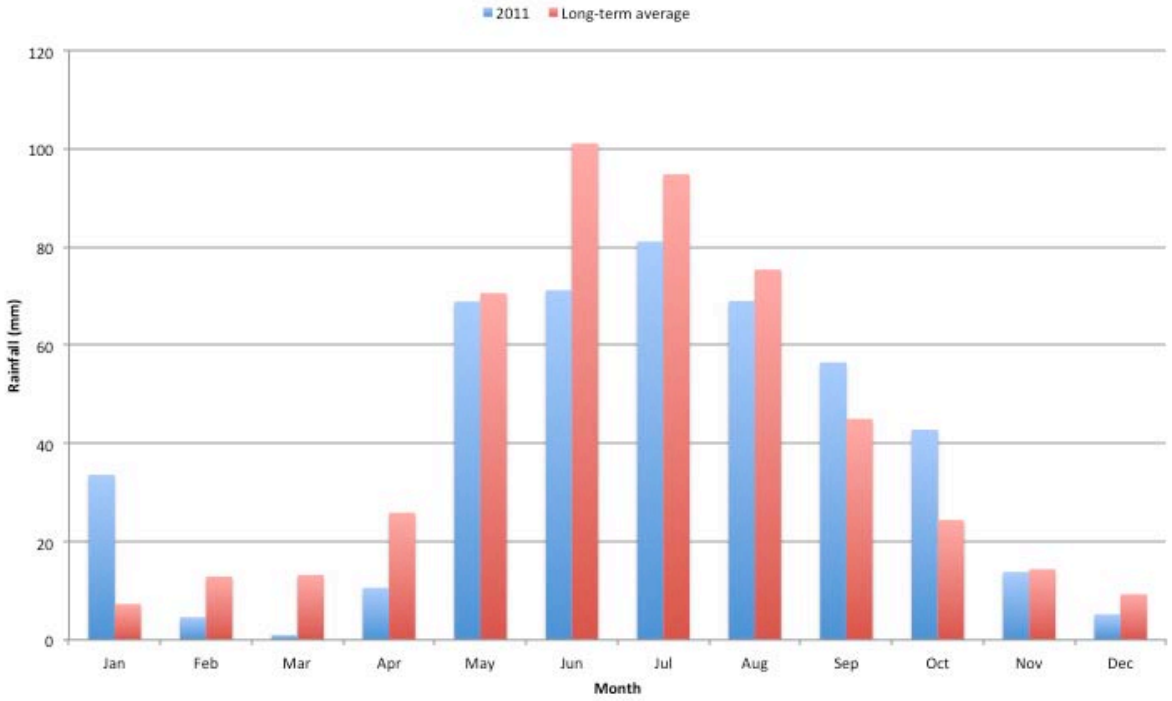

Figure 3.1: Monthly rainfall data from the Eneabba meteorological recording station (number 008225) for 2011 compared to the long-term average (1972-2011; data sourced from the WA Bureau of Meteorology).

3.2.3 Quadrat Sampling

Nineteen (19) quadrats were established within intact vegetation during the survey. Sites were selected to include the main vegetation and habitat types present within the study area and to obtain an even spatial spread. All quadrats established were 10 m x 10 m in size, which is recognised as providing an adequate sample of species presence for areas of high species diversity (George et al. 1979). This size is also used for botanical survey work in the temperate Swan Coastal Plain and lower southwest of WA (Gibson et al. 1994).

The following parameters were recorded for all quadrats:

1. Location: AMG coordinates recorded in WGS84 datum for each of the four corners of the quadrat [using a handheld Global Positioning System (GPS)];
2. Vegetation Description: A broad description based on the height and estimated cover of dominant species after the vegetation classification system presented in BushForever (Keighery 1994); see Appendix 5);
3. Habitat: A description of the landform and habitat;
4. Soil: A broad description of the soil type and stony surface mantle;
5. Disturbance details: Vegetation condition ranked according to the scale developed for BushForever [(Keighery 1994); see Appendix 5], taking into consideration evidence of grazing, physical disturbance, weed invasion and fire history; and

6. Percentage Foliar Cover and Height: For each species present, the cover and greatest height was estimated visually. Estimates were made to the nearest percentage and centimeter where possible.

Colour photographs of the vegetation were taken from the northwest corner of each quadrat, looking across to the diagonally opposite corner. A summary of all quadrat data is provided in Appendix 6. Quadrat locations are indicated on the vegetation mapping in Appendix 7.

3.2.4 Relevés and Mapping Notes

Thirteen (13) relevés and approximately 80 mapping notes were described during the survey. A relevé is an unbounded flora-sampling site whereas mapping notes are usually smaller in area and can sometimes be brief with only dominant species recorded. Mapping notes are taken primarily during foot traverses of the area with the objective of detecting boundaries and changes in vegetation types.

Opportunistic specimen collections were also taken to supplement the species list, as well as photographs and notes on landscape type and vegetation condition.

3.3 Flora Specimen Identification

Common species that were well known to the survey botanists were identified in the field. Voucher specimens of all other species were collected, pressed and dried in the field.

After returning to Perth, these collected specimens were then identified using flora keys, reference to appropriate publications and comparisons with reference collections held at Biota and the WA Herbarium. Mr Pierre-Louis de Kock, Ms Rachel Warner, Ms Rachel Butler, Ms Shadila Venkatasamy, Ms Ciaran Gibson and Ms Cassie Adams, all Biota botanists, identified most of the specimens. Specialist taxonomists from the WA Herbarium (Mr Michael Hislop, Ms Eleanor Bennett and Mr Rob Davis) were consulted for the specialist plant identifications.

3.4 Limitations of this Study

The study is considered to provide a good account of the flora, fauna and vegetation values of the Warradarge study area. However, the following limitations must be taken into account when reviewing and analysing the results.

- Systematic foot traverses were not possible through the entire study area and hence the vegetation mapping for some areas was extrapolated on the basis of the aerial photographic signature alone. Although the refined mapping presented in this report is considered to be a relatively sound model of the spatial representation of the vegetation types, some inaccuracy in delineation of the vegetation units could exist;
- The study area was not systematically searched for rare flora and weeds;
- The sampling was conducted in a single phase (over two trips). Although the field work was conducted at an appropriate time for detecting most ephemeral flora, some species would not have been present or identifiable at the time of survey. The species list should be taken as indicative rather than exhaustive;
- As most weeds were relatively widespread in the study area, specific locations of all weed species encountered were not taken and they have not been mapped. However, individual vegetation descriptions provide an indication of the level of weed density;
- No floristic analysis has been conducted using the quadrat data;
- No direct and systematic sampling of fauna was undertaken as part of the current study. The description of fauna habitats and the summary of species of conservation significance that may occur in the study area are based on a desktop review and opportunistic observations made during the flora and vegetation survey; and
- Fungi and non-vascular flora (e.g. mosses and liverworts) were not sampled.

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4.0 Regional Context

4.1 IBRA Bioregion and Subregion

The Interim Biogeographic Regionalisation for Australia (IBRA) recognises 85 bioregions and 403 subregions (Environment Australia 2000). The current study area lies within the Geraldton Sandplains bioregion and the Lesueur Sandplain subregion, which are described by May and McKenzie (2003) as:

- GS - Geraldton Sandplains: "… mainly proteaceous scrub-heaths, rich in endemics, on the sandy earths of an extensive, undulating, lateritic sandplain mantling Permian to Cretaceous strata. Extensive York Gum and Jam woodlands occur on outwash plains associated drainage".
- GS3 - Lesueur Sandplain: "… comprises coastal Aeolian and limestones, Jurassic siltstones and sandstones (often heavily laterised) of the central Perth Basin. There are extensive yellow sandplains in southeastern parts, where the subregion overlaps the western edge of the Pilbara Craton. Shrub-heaths rich in endemics occur on a mosaic of lateritic mesas, sandplains, coastal sands and limestones. "

These regions occur within the vicinity of two recognised Biodiversity Hotspots: the Geraldton to Shark Bay sand plains and Mount Lesueur- Eneabba. These hotspots have been recognised as places of high biodiversity at national and international standards (see http://www.environment.gov.au/biodiversity/hotspots/national-hotspots.html).

4.2 Regional Vegetation Mapping Encompassing the Area

Beard (1974) mapped the vegetation of the Geraldton Sandplains bioregion at a scale of 1:1,000,000. The vegetation of this area is mainly composed of proteaceous scrub-heaths rich in endemics occurring on a mosaic of lateritic mesas, sandplains, coastal sands and limestones. The study area intersects two of Beard's vegetation mapping units:

- Irwin 174: Shrublands; mixed heath (*Melaleuca, Acacia, Banksia, Allocasuarina*); and
- Irwin 210: Shrublands; scrub-heath on lateritic sandplain in the central Geraldton Sandplain Region.

The study area also lies within the Tathra Vegetation System in the West Midlands region of the Irwin Botanical District, further described by Beard (1976) as "… a diverse scrub heath [dominating] the extensive areas of sandplain of this system with taller emergents that include *Allocasuarina huegeliana, Eucalyptus todtiana, Banksia attenuata, B. prionotes* and *B. menziesii*. Smaller thickets of *Melaleuca* (*M. uncinata, M. hamulosa*) can be found associated with swamp country at the base of breakaways".

Given the general nature of Beard's mapping, these mapping units are only broadly applicable to the vegetation types occurring within the study area (see Section 5.0).

4.3 Geology and Soils

The study area intersects both the Arrowsmith and Dandaragan Plateau soil landscape zones, described by Stuart-Street (2007) as:

- Arrowsmith: "Dissected lateritic sandplain with hills, breakaways and plateau and sandplain remnants. Sandy and gravelly soils formed in colluvium and weathered in-situ rock. Deep sands, Ironstone gravelly soils and Sandy duplex"; and
- Dandaragan Plateau: "Gently undulating plateau with areas of sandplain and some laterite on Cretaceous sediments. Soils are formed in colluvium and weathered rock. Deep sands with Ironstone gravelly soils and Loamy earths".

4.4 Conservation Reserves

The study area does not occur within any conservation reserves. However, many of the larger and intact areas of remnant vegetation in the locality have been classed as conservation reserves (see Figure 2.1). Four of these are in close proximity to the study area and are listed below, along with their approximate distance and direction from the study area:

- Alexander Morrison National Park (6 km to the south);
- Tathra National Park (11 km to the north);
- South Eneabba Nature Reserve (11 km to the west); and
- Capamauro Nature Reserve (35 km to the east).

In addition, the Lesueur National Park is approximately 23 km to the southwest of the study area. This reserve is recognised for its floristic richness, with many rare and endemic species (CALM 1995).

4.5 Significant Communities Known from the Locality

Vegetation communities of the highest conservation concern are listed as Threatened Ecological Communities (TECs) by the DEC. Some TECs for WA are also listed under the Commonwealth *EPBC Act 1999*. Other communities of conservation significance are listed as Priority Ecological Communities (PECs). While these latter communities do not have any legislative protection, it is best practice environmental management to avoid disturbance to these areas. The framework for ranking communities of conservation significance is presented in Appendix 1.

4.5.1 Threatened Ecological Communities

Two Threatened Ecological Communities (TECs) listed for the Geraldton Sandplains Bioregion occur near the study area (DEC 2010).

- **Lesueur-Coomallo Floristic Community (D1)** **Critically Endangered; B) i), ii)**

  This community comprises a species-rich low heath, on moderately to well-drained lateritic gravels on lower slopes and low rises, dominated by *Allocasuarina microstachya* with *A. ramosissima, A. humilis, Baeckea grandiflora, Borya nitida, Calytrix flavescens, Calothamnus sanguineous, Conostylis androstemma, Cryptandra pungens, Dryandra armata, Gastrolobium polystachyum, Hakea auriculata, H. incrassata, H.* aff. *erinacea, Hibbertia hypericoides, Hypocalymma xanthopetalum, Melaleuca trichophylla, Petrophile chrysantha, Schoenus subflavus* and *Xanthorrhoea drummondii* (Hamilton-Brown 2002a); and

- **Lesueur-Coomallo Floristic Community (A1.2)** **Endangered; B) ii)**

  Species-rich heath with emergent *Hakea obliqua* on sand over well-drained grey sand over pale yellow sand on lateritic uplands. Associated species include *Hakea obliqua, Beaufortia* aff. *elegans, Dasypogon bromeliifolius* and *Stirlingia latifolia*ecies, *Allocasuarina humilis, Calothamnus sanguineous, Hibbertia hypericoides, Hypocalymma xanthopetalum* and *Schoenus subflavus* (Hamilton-Brown 2002b).

There are no documented occurrences of these TECs in the Warradarge study area. The Lesueur-Commallo Floristic Community A1.2 is currently known from one location in the Lesueur National Park (31 ha in size). The Lesueur-Coomallo Floristic Community D1 is known from one location (0.1 ha) from private freehold land, immediately south of the Lesueur National Park. The location of the Lesueur National Park is indicated on Figure 2.1.

4.5.2 Priority Ecological Communities

There are no known documented occurrences of PECs in the Warradarge study area. A number of PECs occur in the Geraldton Sandplains bioregion. They are described by the DEC (2011) as:

- Lesueur-Coomallo Floristic Community M2 (*Melaleuca preissiana* woodland) - Priority 1.

  "Woodland dominated by *Melaleuca preissiana* along sandy drainage lines, with *Anigozanthos pulcherrimus, Chamaescilla corymbosa, Petrophile brevifolia* and *Xanthorrhoea reflexa.*";

- Lesueur-Coomallo Floristic Community DFGH - Priority 1.

  "Mixed species-rich heath on lateritic gravel with *Hakea erinacea, Melaleuca platycalyx* and *Petrophile seminuda*: a fine scale mixture of four floristically-defined communities occurring on lateritic slopes."; and

- *Petrophile chrysantha* low heath on Lesueur dissected uplands - Priority 2.

  "Low heath dominated by *Petrophile chrysantha* on Lesueur Dissected Uplands. Associated species include *Banksia armata* and *Hakea undulata.*"

4.6 Significant Flora Known from the Locality

While all native flora are protected under the *Wildlife Conservation Act 1950*, a number of plant species are assigned an additional level of conservation significance based on the limited number of known populations and the perceived threats to these populations. Until recently, species of the highest conservation concern were listed as Declared Rare Flora (DRF); these are now listed as Threatened Flora (T) under the State listing prepared by the DEC (DEC 2010b). Species that appear to be rare or threatened, but where there is insufficient information on their conservation significance, are assigned to one of five Priority flora categories (Appendix 1).

Fifteen species currently listed as T at a State level (and Threatened under the *EPBC Act 1999*) and 46 listed as Priority Flora were identified from database searches for the study area and the immediate surrounds (Table 4.1; Appendix 2 and 4). The likelihood of each species occurring within the study area has been assessed based on current and historical database records as well as typical habitat and soil preference (Table 4.1).

Table 4.1: Likelihood of conservation significant flora occurring within the study area.

Species	Growth Form	Flowering Period	Likelihood of Occurrence
Threatened (status under the *EPBC Act 1999*)			
Andersonia gracilis (Endangered)	Shrub	Sep-Nov	Unlikely
Banksia serratuloides subsp. *perissa* (Vulnerable)	Shrub	Aug-Sept	Possible
Darwinia chapmaniana (Endangered)	Shrub	-	Possible
Eucalyptus absita (Endangered)	Mallee or Tree	Apr-Jul	Possible
Eucalyptus balanites (Endangered)	Mallee	Oct-Feb	Unlikely
Eucalyptus impensa (Endangered)	Mallee	Jun-Jul	Possible
Eucalyptus johnsoniana (Vulnerable)	Mallee	Sporadically	Possible
Grevillea curviloba subsp. *incurva* (Endangered)	Shrub	Aug-Sep	Highly Unlikely
Hakea megalosperma (Vulnerable)	Shrub	May-Jun	Likely
Hemiandra gardneri (Endangered)	Shrub	Aug-Oct	Likely
Leucopogon obtectus (Endangered)	Shrub	Aug-Oct	Possible
Paracaleana dixonii (Endangered)	Perennial Herb	Oct-Jan	Highly Unlikely
Spirogardnera rubescens (Endangered)	Shrub	Aug-Dec	Unlikely
Thelymitra stellata (Endangered)	Perennial Herb	Oct-Nov	Likely
Verticordia albida (Endangered)	Shrub	Nov-Jan	Possible
Priority 2			
Baeckea sp. Bunney Road (S. Patrick 4059)	Shrub	Oct-Mar	Likely
Boronia scabra subsp. *condensata*	Shrub	August	Highly Unlikely
Caustis gigas	Perennial Sedge	May	Possible
Daviesia debilior subsp. *debilior*	Shrub	May-Jul	Possible
Lasiopetalum sp. Badgingarra (E.A. Griffin 5278)	Shrub	-	Unlikely

Species	Growth Form	Flowering Period	Likelihood of Occurrence
Loxocarya gigas	Perennial Sedge	-	Likely
Onychosepalum microcarpum	Perennial Herb	Aug-Oct	Unlikely
Petrophile clavata	Shrub	September	Possible
Priority 3			
Acacia epacantha	Shrub	Jul- Aug	Likely
Allocasuarina ramosissima	Shrub	-	Likely
Banksia cypholoba	Shrub	August	Likely
Banksia kippistiana var. *paenepeccata*	Shrub	Oct-Nov	Possible
Banksia nobilis subsp. *fragrans*	Shrub	Jul-Sep	Possible
Banksia pteridifolia subsp. *vernalis*	Shrub	Sep-Oct	Highly Unlikely
Banksia splendida subsp. *macrocarpa*	Shrub	Jul-Aug	Likely
Banksia subulata	Shrub	September	Possible
Daviesia pteroclada	Shrub	Jul-Aug	Unlikely
Drosera marchantii subsp. *prophylla*	Perennial Herb	Jun-Jul	Possible
Grevillea granulosa	Shrub	Jul-Oct	Possible
Hemiandra sp. Eneabba (H. Demarz 3687)	Shrub	February	Possible
Jacksonia anthoclada	Shrub	April	Possible
Jacksonia carduacea	Shrub	Aug-Dec	Possible
Lasiopetalum lineare	Shrub	Aug-Nov	Possible
Mesomelaena stygia subsp. *deflexa*	Perennial Sedge	Mar-Oct	Unlikely
Persoonia rudis	Shrub	Sep-Jan	Likely
Petrophile biternata	Shrub	Aug-Oct	Likely
Phlebocarya pilosissima subsp. *pilosissima*	Perennial Herb	Aug-Oct	Possible
Schoenus griffinianus	Perennial Sedge	Sep-Oct	Unlikely
Stylidium nonscandens	Perennial Herb	Sep-Nov	Likely
Synaphea aephynsa	Shrub	Jul-Oct	Likely
Tetratheca angulata	Subshrub	-	Likely
Verticordia insignis subsp. *eomagis*	Shrub	Aug-Nov	Possibly
Verticordia muelleriana subsp. *muelleriana*	Shrub	Sep-Jan	Possibly
Verticordia rutilastra	Shrub	Sep-Nov	Possibly
Priority 4			
Banksia chamaephyton	Shrub	Oct-Dec	Highly Unlikely
Banksia platycarpa	Shrub	May-Aug	Likely
Banksia sclerophylla	Shrub	Sep-Oct	Likely
Calytrix chrysantha	Shrub	Dec-Feb	Likely
Calytrix eneabbensis	Shrub	Jul-Oct	Likely
Centrolepis caespitosa	Annual Herb	Oct-Dec	Highly Unlikely
Desmocladus elongatus	Perennial Sedge	Aug-Dec	Likely
Eucalyptus pendens	Mallee	Aug-Nov	Unlikely
Grevillea rudis	Shrub	Sporadically	High
Hemiandra sp. Watheroo (S. Hancocks 4)	Shrub	-	Possible
Hypolaena robusta	Perennial Herb	Sep-Oct	Possible
Verticordia aurea	Shrub	Sep-Dec	Likely

5.0 Vegetation

5.1 Overview

The individual vegetation types (or mapping units) identified for the Warradarge study area are described in Section 5.2, while the condition and conservation significance of the units are discussed in Sections 5.3 and 5.4, respectively. A summary of the area of each unit is provided in Table 5.1, while the distribution of the vegetation types is illustrated in Appendix 7.

Table 5.1: Summary of mapping units and their area of extent within the Warradarge study area.

Unit Code (Short)	Unit Code	Description	Area (ha)
Modified Vegetation (M)			
M1	C	Cleared Land (paddocks and some tracks)	2,784.6
M2	Eto	*Eucalyptus todtiana* low open woodland	307.9
M3	P	Planted areas	16.1
		Total	**3,108.6**
Intact Vegetation			
Drainage Areas (D)			
D1	EaEwKm	*Eucalyptus accedens, E. wandoo* woodland over *Kunzea micrantha* subsp. *petiolata* tall open shrubland	3.6
Loam/Clay Plains (LP)			
LP1	AmiREc	*Acacia microbotrya* tall open shrubland over *Regelia ciliata* shrubland	6.4
LP2	BAstBEbMsHaPEmAXn	*Banksia strictifolia*, *Baeckea* sp. Bunney Road (S. Patrick 4059) tall open shrubland over *Melaleuca seriata, Hakea anadenia* shrubland over *Petrophile megalostegia* low shrubland over *Alexgeorgea nitens* open sedgeland	9.1
Stony Hills and Slopes (H)			
Low Hillslopes and Plains Dominated by Powderbark Wandoo (*Eucalyptus accedens*) **(HP)**			
HP1	EaEw	*Eucalyptus accedens, E. wandoo* low closed to low open forest	7.4
HP2	EaBAsALhOv	*Eucalyptus accedens* low woodland over *Banksia shuttleworthiana, Allocasuarina humilis* open heath over *Opercularia vaginata* open sedgeland	5.8
Hills and Slopes dominated by *Banksia* heaths **(HB)**			
HB1	EgiEdBAam	*Eucalyptus gittinsii* (*E. drummondii*) open tree mallee over *Banksia armata* var. *armata* open heath	133.2
HB2	EdEgiBAspp	*Eucalyptus drummondii* low open woodland over *E. gittinsii* open tree mallee over *Banksia* spp. open heath	69.8
HB3	EdEaBAspp	*Eucalyptus drummondii*, *E. accedens* low woodland over *Banksia* spp. open heath	31.6
HB4	BAgHiBFbPEsBAl	*Banksia glaucifolia, Hakea incrassata, Beaufortia bracteosa, Petrophile shuttleworthiana, Banksia leptophylla* var. *melletica* open heath	1.2
HB5	HaXdBAsppMt	*Hakea anadenia, Xanthorrhoea drummondii* open shrubland over *Banksia*	36.3

Unit Code (Short)	Unit Code	Description	Area (ha)
		spp., *Melaleuca trichophylla* low shrubland	
HB6	BAspp.	*Banksia* spp. closed heath	31.5
Rocky Hillcrests and Plains with *Xanthorrhoea drummondii* Low Shrublands **(HX)**			
HX1	EMpALhHauPEsXdBAspHh	*Eremaea pauciflora, Allocasuarina humilis* tall open shrubland over *Hakea auriculata, Petrophile shuttleworthiana, Xanthorrhoea drummondii, Banksia sphaerocarpa* var. *pumilio, Hibbertia hypericoides* low open heath	56.0
HX2	EgiDAdXd	*Eucalyptus gittinsii* open tree mallee over *Daviesia daphnoides, Xanthorrhoea drummondii* open shrubland	29.8
HX3	HaHauXdMEp	*Hakea anadenia, H. auriculata, Xanthorrhoea drummondii* low open heath over *Mesomelaena pseudostygia* very open sedgeland.	2.6
Hillslopes with *Melaleuca* **(HM)**			
HM1	MuMc	*Melaleuca uncinata*, *M. coronicarpa* closed heath	1.8
HM2	CLlMasBFbLcNUa	*Calothamnus longissimus, Melaleuca aspalathoides, Beaufortia bracteosa* low shrubland to low open heath over *Lepidosperma* aff. *costale*, *Neurachne alopecuroidea* open sedgeland/grassland	18.1
HM3	EaEsbBAseMtBAk	*Eucalyptus accedens* low open woodland over *Eucalyptus* sp. Badgingarra (D. Nicolle & M. French DN 3515) very open tree mallee over *Banksia sessilis* var. *flabellifolia, Melaleuca trichophylla* tall open scrub over *B. kippistiana* var. *kippistiana* open shrubland	12.3
HM4	BEbMtLs	*Baeckea* sp. Bunney Road (S. Patrick 4059*), Melaleuca trichophylla* shrubland over *Lepidosperma squamatum* open sedgeland	1.0
Sandy Plains and Low Hills (P)			
Vegetation dominated by *Eucalyptus todtiana* (Coastal Blackbutt) Low Woodlands **(PE)**			
PE1	EtoADcXdEMpJfMEp	*Eucalyptus todtiana* low open woodland over *Adenanthos cygnorum* subsp. *cygnorum, Xanthorrhoea drummondii* open shrubland over *Eremaea pauciflora, Jacksonia floribunda* low shrubland over *Mesomelaena pseudostygia* very open sedgeland	11.0
PE2	EtoBAcLEoBAspLOh	*Eucalyptus todtiana* low woodland over *Banksia candolleana, Lepidospermum oligandrum*, *B. sphaerocarpa* var. *pumilio* open heath over *Lomandra hastilis* very open sedgeland	7.3
PE3	EtoBAcALh	*Eucalyptus todtiana* low open woodland over *Banksia candolleana, Allocasuarina humilis* shrubland	0.9
PE4	EtoADcXd	*Eucalyptus todtiana* low open woodland over *Adenanthos cygnorum* subsp. *cygnorum, Xanthorrhoea drummondii*	41.1

Unit Code (Short)	Unit Code	Description	Area (ha)
		shrubland	
Sandy Hills and Plains with *Banksia* Low Woodlands **(PB)**			
PB1	BAaBAmLEo	*Banksia attenuata, B. menziesii* low woodland over *Leptospermum oligandrum* tall open shrubland	14.2
Sandy Plains dominated by Powderbark wandoo **(PW)**			
PW1	EaEdEMpHs	*Eucalyptus accedens* low open woodland over *E. drummondii* very open tree mallee over *Eremaea pauciflora, Hibbertia subvaginata* low shrubland	9.9
PW2	EaBEbGOMp	*Eucalyptus accedens* low open forest over *Baeckea* sp. Bunney Road (S. Patrick 4059), *Gompholobium pungens* low open shrubland	1.0
		Total	**542.3**
		Intact and Modified Total	**3,650.9**

5.2 Mapping Units

5.2.1 Modified Vegetation

Three mapping units within the study area were found to be extensively disturbed and were considered Completely Degraded.

M1 Cleared Land

The majority of the survey area (2,784.6 ha, 76.3%) comprised cleared land for crops and pasture (Plate 5.1). This total includes some minor tracks.

M2 *Eucalyptus todtiana* low open woodland

This vegetation unit comprised cleared areas with scattered trees of predominantly *Eucalyptus todtiana* over pasture grasses and annual herbs (Plate 5.3). This unit occupied 8.4 % of the study area. Associated species included *Nuytsia floribunda* and **Trifolium arvense* var. *arvense*. Two Priority flora species were recorded from this modified vegetation unit (*Austrostipa* sp. Cairn Hill (M.E. Trudgen 21176) and *Hemiandra* sp. Watheroo (S. Hancocks 4)). In the east section of the study area, one record of the Priority species *Baeckea* sp. Bunney Road (S. Patrick 4059) occurred just outside a section of this vegetation unit. The condition of this unit was Completely Degraded and it is not expected to support large populations of Priority flora.

M3 Planted Areas

This vegetation unit contained predominantly non-native species that had been planted. Occupying 0.4 % of the study area, this unit occurred in the northeast section and within the proposed transmission line route. This unit did not comprise native intact vegetation (Plate 5.3).

Plate 5.1: **Vegetation unit M1.**

Plate 5.2: **Vegetation unit M2.**

Plate 5.3: **Vegetation unit M3 (left and right).**

The following 25 intact vegetation units occurred within the remainder of the study area.

5.2.2 Vegetation of Drainage Areas

D1 ***Eucalyptus accedens, E. wandoo* woodland over *Kunzea micrantha* subsp. *petiolata* tall open shrubland**

Location:	This unit occurred on grey sands in a lower-lying valley floor in the northwest section of the study area.
Comments:	Low weed cover; few understory species.
Associated species:	**Bromus rubens, Lomandra hastilis* and *Melaleuca uncinata*.
Vegetation Condition:	Excellent
Quadrats:	None
Relevés:	None
Photograph:	Plate 5.4

Plate 5.4: Vegetation unit D1.

5.2.3 Vegetation of Plains

LP1 *Acacia microbotrya* tall open shrubland over *Regelia ciliata* shrubland

Location:	This vegetation occurred on red loam/clay plains in the northwest section of the study area.
Comments:	This unit had an open structure, with a large area of bare ground. Soil type appears to be unusual for the locality.
Associated species:	*Astroloma glaucescens, Austrodanthonia setacea, Crassula colorata, Gnephosis tenuissima* and *Kunzea micrantha* subsp. *petiolata.*
Vegetation Condition:	Excellent. Some signs of disturbance (old fencing material).
Quadrats:	None
Relevés:	None
Photograph:	Plate 5.5

LP2 *Banksia strictifolia*, *Baeckea* sp. Bunney Road (S. Patrick 4059) tall open shrubland over *Melaleuca seriata, Hakea anadenia* shrubland over *Petrophile megalostegia* low shrubland over *Alexgeorgea nitens* open sedgeland.

Location:	This vegetation occurred on red to brown loam-sand plains in the north section of the study area.
Comments:	Variable rock cover (scattered laterite pebbles, cobbles and boulders). Scattered trees of *Eucalyptus accedens* and *E. drummondii* also occurred within this unit.
Associated species:	*Adenanthos cygnorum* subsp. *cygnorum, Allocasuarina microstachya, Astroloma glaucescens, Banksia catoglypta, Beaufortia elegans, Blennospora drummondii, Callitris arenaria, Dampiera lavandulacea, Eucalyptus accedens, E. drummondii, Gompholobium aristatum, Hakea trifurcata, Hemiandra* sp. Watheroo (S. Hancocks 4), *Hibbertia acerosa, H. subvaginata, Jacksonia hakeoides, Lachnostachys eriobotrya, Lepidosperma tenue, Leptospermum oligandrum, Levenhookia pusilla, L. stipitata, Neurachne alopecuroidea, Nuytsia floribunda, Opercularia vaginata, Petrophile shuttleworthiana, Pterochaeta paniculata, Schoenus andrewsii, Thysanotus manglesianus, *Ursinia anthemoides, Verticordia densiflora* and **Vulpia muralis.*
Vegetation Condition:	Excellent. The two smaller sections of this unit were rated as Very Good due to higher weed densities and signs of grazing by stock.
Quadrats:	WWF17
Relevés:	None
Photograph:	Plate 5.6

Plate 5.5: **Vegetation unit LP1.**

Plate 5.6: **Vegetation unit LP2.**

5.2.4 Vegetation of Stony Hills and Slopes

5.2.4.1 Low Hillslopes and Plains Dominated by Powderbark Wandoo (*Eucalyptus accedens*)

HP1 ***Eucalyptus accedens*, *Eucalyptus wandoo* low closed to low open forest**

Location:	This unit occurred on rocky slopes and crests in the west and southeast sections of the study area.
Comments:	Open understorey
Associated species:	*Baeckea sp.* Bunney Road (S. Patrick 4059), *Banksia glaucifolia, Crassula colorata, Hakea auriculata, H. lissocarpha, H. conchifolia, Lepidosperma squamatum, Lomandra hastilis, Melaleuca coronicarpa, Neurachne alopecuroidea, Olearia rudis, Petrophile shuttleworthiana, *Trifolium arvense* var. *arvense* and **Ursinia anthemoides.*
Vegetation Condition:	Very Good. Signs of grazing in the smaller sections of this unit, that occurred in the west.
Quadrats:	None
Relevés:	None
Photograph:	Plate 5.7

Plate 5.7: **Vegetation unit HP1 (left and right).**

HP2 ***Eucalyptus accedens* low woodland over *Banksia shuttleworthiana*, *Allocasuarina humilis* open heath over *Opercularia vaginata* open sedgeland**

Location:	This vegetation occurred in a low-lying area in the northeast section of the study area.
Comments:	Sparse cover of understorey species.
Associated species:	*Austrostipa macalpinei, A. elegantissima, Banksia strictifolia, Caustis dioica, Conostylis aculeata* subsp. *breviflora, Hakea lissocarpha, Hibbertia huegelii, *Hypochaeris glabra, Lepidosperma tenue, Neurachne alopecuroidea, Podotheca angustifolia, Schoenus pedicellatus, Trachymene pilosa, *Ursinia anthemoides* and **Vulpia muralis*.
Vegetation Condition:	Very Good. Moderate weed densities and evidence of old tracks and grazing.
Quadrats:	WWF15
Relevés:	None
Photograph:	Plate 5.8

Plate 5.8: Vegetation unit HP2.

5.2.4.2 Hills and Slopes dominated by *Banksia* heaths

HB1 ***Eucalyptus gittinsii* (*E. drummondii*) open tree mallee over *Banksia armata* var. *armata* open heath**

Location:	This vegetation occurred on rocky and elevated stands of remnant vegetation in the northeast and east sections of the study area.
Comments:	Some small areas of rocky breakaways occurred along the edges of this unit but were not mapped separately. Here, the dominant tree species was *Eucalyptus accedens* with scattered tall shrubs (predominantly *Petrophile shuttleworthiana* and *Banksia sessilis* var. *flabellifolia*) and scattered low shrubs (including *Hibbertia hibbertioides* var. *hibbertioides*).
Associated species:	*Acacia applanata, Allocasuarina humilis, Asteridea pulverulenta, Baeckea grandiflora, Baeckea* sp. Bunney Road (S. Patrick 4059), *Banksia glaucifolia, B. kippistiana* var. *kippistiana, B. sessilis* var. *flabellifolia, B. splendida* subsp. *macrocarpa, Conostylis androstemma, Dampiera lavandulacea, D. spicigera, Eucalyptus accedens, E. sp.* Badgingarra (D. Nicolle & M. French DN 3515), *Glischrocaryon aureum, Goodenia coerulea, Hakea gilbertii, H. lissocarpha, Hibbertia hypericoides, Hovea pungens, Isotoma hypocrateriformis* var. *trichogramma, Lepidosperma tenue, Lobelia rarifolia, Melaleuca ciliosa, M. trichophylla, Monotaxis grandiflora* var. *grandiflora, Opercularia vaginata, Petrophile shuttleworthiana, P. striata, Stylidium cygnorum, S. diuroides* subsp. *paucifoliatum, S. miniatum, Tetratheca confertifolia* and *Thysanotus manglesianus*.
Vegetation Condition:	Excellent
Quadrats:	WWF02, WWF03, WWF14, WWF18
Relevés:	WWFRB-11
Photograph:	Plate 5.9

Plate 5.9: Vegetation unit HB1.

HB2 *Eucalyptus drummondii* low open woodland over *E. gittinsii* open tree mallee over *Banksia* spp. open heath

Location:	This vegetation occurred in the small and medium sized pockets of remnant vegetation in the center and southeast section of the study area.
Comments:	This unit tended to occur at lower elevations than the unit HB1.
Associated species:	*Astroloma* sp. Cataby (E.A. Griffin 1022), *Austrostipa nitida, Baeckea grandiflora, Banksia cypholoba, B. glaucifolia, B. kippistiana* var. *kippistiana, B. nana, Banksia nobilis* subsp. *fragrans, B. splendida* subsp. *macrocarpa, Caustis dioica, Comesperma griffinii, Desmocladus elongatus, Drosera porrecta, Eucalyptus* sp. Badgingarra (D. Nicolle & M. French DN 3515), *Haemodorum* sp., *Hakea auriculata, Levenhookia stipitata, Melaleuca trichophylla, Microtis media* subsp. *media, Neurachne alopecuroidea, Opercularia vaginata, Petrophile shuttleworthiana, Schoenus pleiostemoneus, Stylidium cygnorum, S. miniatum Thysanotus manglesianus, *Ursinia anthemoides* and *Xanthorrhoea drummondii.*
Vegetation Condition:	Excellent to Very Good. Unfenced areas of this unit had higher weed densities and signs of grazing by stock.
Quadrats:	WWF01, WWF20
Relevés:	None
Photographs:	Plate 5.10

Plate 5.10: Vegetation unit HB2.

HB3 ***Eucalyptus drummondii, E. accedens* low woodland over *Banksia* spp. open heath**

Location:	This vegetation occurred on rocky, elevated areas in the north, south and central sections of the study area.
Comments:	This unit occupied small areas, often within existing cleared areas.
Associated species:	*Banksia armata* var. *armata, B. kippistiana* var. *kippistiana, B. glaucifolia, Glischrocaryon aureum, Hakea flabellifolia, Melaleuca trichophylla, Mesomelaena pseudostygia, Neurachne alopecuroidea, Opercularia vaginata, Petrophile shuttleworthiana, *Ursinia anthemoides* and *Velleia trinervis.*
Vegetation Condition:	Good to Very Good. Evidence of disturbance and moderate weed density.
Quadrats:	None
Relevés:	None
Photograph:	Plate 5.11

Plate 5.11: Vegetation unit HB3 (left and right).

HB4 ***Banksia glaucifolia, Hakea incrassata, Beaufortia bracteosa, Petrophile shuttleworthiana, B. leptophylla* var. *melletica* open heath**

Location:	This unit occurred in the proposed transmission line route, extending from the northwest corner of the study area
Comments:	
Associated species:	*Allocasuarina humilis, Banksia shuttleworthiana, Calothamnus sanguineus, Calytrix depressa, Glischrocaryon aureum, Hakea conchifolia, Polianthion wichurae, Verticordia densiflora* var. *cespitosa, Leucopogon phyllostachys, Melaleuca leuropoma, Mesomelaena pseudostygia, Neurachne alopecuroidea, Pileanthus filifolius, Polianthion wichurae, Synaphea* sp. and *Xanthorrhoea drummondii.*
Vegetation Condition:	Excellent to Pristine
Quadrats:	None
Relevés:	None
Photograph:	Plate 5.12

Plate 5.12: Vegetation unit HB4.

HB5 *Hakea anadenia, Xanthorrhoea drummondii* open shrubland over *Banksia* spp., *Melaleuca trichophylla* low open heath.

Location:	This vegetation occurred on the crest of a medium mesa in the southwest section of the study area. It was also recorded to the east of this mesa and on low rises further south.
Comments:	Site WWF08 was situated within a small stand of *Eucalyptus* sp. Badgingarra (D. Nicolle & M. French DN 3515) on the mesa crest. This unit was too small to be mapped separately and it was not considered substantially different from the broader crest vegetation. This unit has some similarity to the Lesueur-Coomallo Floristic Community (D1), listed as a TEC (see Section 4.5.1).
Associated species:	*Allocasuarina humilis, A. grevilleoides, A. ramosissima, Banksia cypholoba, B. glaucifolia, B. sessilis* var. *flabellifolia, B. kippistiana, B. carlinoides, Baeckea crispiflora* var. *tenuior, B. grandiflora, Calothamnus quadrifidus, Cassytha flava, Caustis dioica, Daviesia epiphyllum, Drosera menziesii* subsp. *penicillaris, Gastrolobium plicatum, Glischrocaryon aureum, Goodenia coerulea, Hakea auriculata, H. incrassata, Hibbertia* sp. Mt Lesueur (M. Hislop 174), *Jacksonia restioides, Lepidobolus quadratus, Melaleuca aspalathoides, Ptilotus* sp., *Thysanotus spiniger, Waitzia acuminata.*
Vegetation Condition:	Excellent to Very Good
Quadrats:	WWF08, WWF12
Relevés:	None
Photograph:	Plate 5.13

Plate 5.13: Vegetation unit HB5 at site WWF12 (left) and on a mesa crest near site WWF08 (right).

HB6 ***Banksia* spp. closed heath**

Location:	This vegetation occurred in the center, south and northeast of the study area.
Comments:	High *Banksia* richness.
Associated species:	*Austrostipa* sp. Cairn Hill (M.E. Trudgen 21176), *Baeckea grandiflora, Banksia carlinoides, B. kippistiana* var. *kippistiana, Banksia nana, B. platycarpa, B. sclerophylla, B. sessilis* var. *flabellifolia, B. sphaerocarpa* var. *pumilio, B. splendida* subsp. *macrocarpa, Cassytha glabella forma casuarinae, Caustis dioica Conothamnus trinervis, Dampiera spicigera, Drosera barbigera, Gastrolobium polystachyum, Haemodorum venosum, Hakea auriculata, H. gilbertii, Hibbertia fasciculiflora, H. hypericoides* var. *hypericoides, Hypocalymma hirsutum, Leucopogon phyllostachys, Levenhookia stipitata, Melaleuca platycalyx, Mesomelaena pseudostygia, Neurachne alopecuroidea, Petrophile megalostegia, P. shuttleworthiana, Schoenus brevisetis, Stylidium caricifolium, S. cygnorum, Tetraria octandra, *Vulpia myuros forma megalura* and *Xanthorrhoea drummondii.*
Vegetation Condition:	Excellent to Very Good
Quadrats:	WWF10
Relevés:	WWFRB-12
Photograph:	Plate 5.14

Plate 5.14: Vegetation unit HB6.

5.2.4.3 Rocky Hillcrests and Plains with *Xanthorrhoea drummondii* Low Shrublands

HX1 ***Eucalyptus gittinsii* open tree mallee over *Daviesia daphnoides, Xanthorrhoea drummondii* open shrubland**

Location:	This vegetation occurred on elevated, rocky areas in the east.
Comments:	Surface covering of orange pebbles and gravel (possibly laterite).
Associated species:	*Baeckea grandiflora, Commersonia pulchella, Dampiera spicigera, Eucalyptus drummondii, Gastrolobium plicatum, Glischrocaryon aureum, Grevillea erinacea, Hakea flabellifolia, Melaleuca ciliosa, Mesomelaena pseudostygia, Neurachne alopecuroidea* and **Ursinia anthemoides.*
Vegetation Condition:	Excellent, some old tracks present
Quadrats:	None
Relevés:	None
Photograph:	Plate 5.15

Plate 5.15: Vegetation unit HX1.

HX2 ***Eremaea pauciflora, Allocasuarina humilis* tall open shrubland over *Hakea auriculata, Petrophile shuttleworthiana, Xanthorrhoea drummondii, Banksia sphaerocarpa* var. pumilio, *Hibbertia hypericoides* low shrubland to low open heath**

Location:	This vegetation occurred on broad, low ridges in the southwest section of the study area.
Comments:	This unit has some similarity to the Lesueur-Coomallo Floristic Community (D1), listed as a TEC (see Section 4.5.1).
Associated species:	*Allocasuarina microstachya, Andersonia lehmanniana, Baeckea grandiflora, Banksia sphaerocarpa var. pumilio, Caustis dioica, Conostylis tomentosa, Daviesia daphnoides, Eucalyptus pruiniramis, Gnephosis tenuissima, Goodenia coerulea, Hakea auriculata, Hibbertia fasciculiflora, Jacksonia restioides, Lachnagrostis plebeia, Lepidobolus quadratus, Lepidosperma tenue, Levenhookia pusilla, Melaleuca platycalyx, Mesomelaena pseudostygia, Neurachne alopecuroidea, Schoenus brevisetis, Schoenus pleiostemoneus, Stylidium stenosepalum, Thysanotus thyrsoideus, Trachymene pilosa, *Ursinia anthemoides* and *Vulpia myuros* forma *megalura*.*
Vegetation Condition:	Excellent to Very Good. The smaller areas of this unit had higher weed densities and were rated as Very Good.
Quadrats:	None
Relevés:	RB07
Photograph:	Plate 5.16

Plate 5.16: Vegetation unit HX2 (left and right).

HX3 ***Hakea anadenia, H. auriculata, Xanthorrhoea drummondii* low shrubland over *Mesomelaena pseudostygia* very open sedgeland.**

Location:	Small areas of this vegetation occurred in the southwest section of the study area.
Comments:	Variable rock cover ranging from a continuous layer of orange pebbles to boulders (laterite).
Associated species:	*Allocasuarina humilis, Baeckea grandiflora, Beaufortia bracteosa, Banksia kippistiana* var. *kippistiana, Calothamnus sanguineus, Caustis dioica, Commersonia pulchella, Glischrocaryon aureum, Haemodorum spicatum, Lepidobolus quadratus, Lepidosperma squamatum, Leucopogon* sp. Warradarge (M. Hislop 1908), *Opercularia vaginata, Pterochaeta paniculata, Stenanthemum reissekii, Tetraria octandra, Trachymene pilosa, *Trifolium arvense var. arvense* and **Ursinia anthemoides.*
Vegetation Condition:	Very Good. Presence of weeds in low to moderate densities and tracks.
Quadrats:	None
Relevés:	None
Photograph:	Plate 5.17

Plate 5.17: Vegetation unit HX3 (left and right).

5.2.4.4 Hillslopes with *Melaleuca* and *Baeckea*

HM1 ***Melaleuca uncinata, M. coronicarpa* closed heath**

Location:	This vegetation occurred on the north facing mid to lower slopes of a low mesa in the southwest section of the study area. It also occurred nearby, in a small area northwest of the mesa.
Comments:	Soil comprised white to grey sand with some outcropping laterite boulders on the mesa slopes.
Associated species:	*Austrostipa macalpinei, Baeckea crispiflora* var. *tenuior, Baeckea* sp. Bunney Road (S. Patrick 4059), *Beaufortia elegans, Calandrinia calyptrata, Commersonia pulchella, Dampiera linearis, *Ehrharta longiflora, Hakea lissocarpha, Isotoma hypocrateriformis* var. *trichogramma, Melaleuca aspalathoides, Pentaschistis airoides, Pimelea imbricata var. piligera, Podolepis canescens, Stylidium caricifolium, Trachymene pilosa, Verticordia sp.* and *Podolepis canescens*
Vegetation Condition:	Excellent
Quadrats:	WWF07
Relevés:	WWFRB-01
Photograph:	Plate 5.18


Plate 5.18: Vegetation unit HM1 (left and right).

HM2 ***Calothamnus longissimus, Melaleuca aspalathoides, Beaufortia bracteosa* low shrubland to low open heath over *Lepidosperma* aff. *costale, Neurachne alopecuroidea* open sedgeland/grassland**

Location:	This unit occurred on the slopes of the medium mesa in the west section of the study area and the slopes of a medium ridge in the southwest corner.
Comments:	Orange pebbles and cobbles, scattered over white/grey sand.
Associated species:	*Acacia lasiocarpa* var. *lasiocarpa, A. wilsonii, Allocasuarina grevilleoides, Allocasuarina ramosissima, Baeckea crispiflora* var. *tenuior, B. grandiflora, Banksia kippistiana var. kippistiana, Calytrix chrysantha, Cassytha glabella* forma *casuarinae, Daviesia chapmanii, D. epiphyllum, Gastrolobium plicatum, Glischrocaryon aureum, Goodenia coerulea, G. glareicola, Hibbertia hypericoides, Hibbertia polystachya, Melaleuca trichophylla, Lepidobolus quadratus, Patersonia occidentalis* var. latifolia, *Petrophile megalostegia, Pimelea imbricata* var. *piligera, Podolepis canescens, Schoenus clandestinus, Stenanthemum reissekii, Stylidium diuroides* subsp. *paucifoliatum, Tetraria octandra, Thelymitra stellata* and *Trachymene pilosa.*
Vegetation Condition:	Excellent
Quadrats:	WWF07
Relevés:	WWFRB-05
Photograph:	Plate 5.19


Plate 5.19: Vegetation unit HM2 (left and right).

HM3 ***Eucalyptus accedens* low open woodland over *E.* sp. Badgingarra (D. Nicolle & M. French DN 3515) very open tree mallee over *Banksia sessilis* var. *flabellifolia*, *Melaleuca trichophylla* tall open scrub over *Banksia kippistiana* var. *kippistiana* open shrubland**

Location:	This vegetation occurred on the slopes of a low ridge in the northeast section of the study area.
Comments:	Laterite conglomerate with outcropping present.
Associated species:	*Banksia nobilis* subsp. *fragrans, Calytrix oldfieldii*, *Caustis dioica, Dampiera spicigera, Hibbertia hypericoides, Loxocarya striata, Melaleuca ciliosa, Neurachne alopecuroidea, Opercularia vaginata, Polianthion wichurae, Schoenus clandestinus* and *Tetraria octandra*.
Vegetation Condition:	Excellent
Quadrats:	None
Relevés:	WWFRB-10
Photograph:	Plate 5.20

Plate 5.20: Vegetation unit HM3.

HM4 ***Baeckea* sp. Bunney Road (S. Patrick 4059), *Melaleuca trichophylla* shrubland over *Lepidosperma squamatum* open sedgeland**

Location:	This unit occurred in a small area on the slopes of a ridge in the southwest corner of the study area.
Comments:	Associated with outcropping pink clay (see Plate 5.22).
Associated species:	*Acacia lasiocarpa* var. *lasiocarpa, Beaufortia bracteosa, Darwinia neildiana, Daviesia chapmanii, Glischrocaryon aureum, Lissanthe powelliae, Stylidium eriopodum* and *Xanthorrhoea drummondii.*
Vegetation Condition:	Excellent
Quadrats:	None
Relevés:	None
Photograph:	Plate 5.21

Plate 5.21: **Vegetation unit HM4.**

Plate 5.22: **Outcropping pink clay in vegetation unit HM4.**

5.2.5 Vegetation of Sandy Plains

5.2.5.1 Vegetation dominated by *Eucalyptus todtiana* (Coastal Blackbutt) Low Woodlands

PE1 **_Eucalyptus todtiana_ low open woodland over _Adenanthos cygnorum_ subsp. _cygnorum_, _Xanthorrhoea drummondii_ open shrubland over _Eremaea pauciflora_, _Jacksonia floribunda_ low shrubland over _Mesomelaena pseudostygia_ very open sedgeland.**

Location:	This vegetation was recorded from the western section of the study area.
Comments:	White/grey sand with no rock cover
Associated species:	*Acacia auronitens, Alexgeorgea nitens, Amphipogon turbinatus, Andersonia heterophylla, Anigozanthos humilis* subsp. *humilis, Arnocrinum gracillimum, Astroloma xerophyllum, Baeckea grandiflora, Banksia dallanneyi* subsp. *media, Comesperma virgatum, Conostylis teretifolia* subsp. *teretifolia, C. tomentosa, Daviesia podophylla, Desmocladus virgatus, Drosera echinoblastus, D. menziesii* subsp. *penicillaris, D. porrecta, Eremaea asterocarpa, E. beaufortioides* var. *microphylla, E. pauciflora, Haemodorum spicatum, Hibbertia acerosa, H. hypericoides, H. leucocrossa, H.* sp. Mt Lesueur (M. Hislop 174), *Hypolaena robusta, Jacksonia floribunda, J. lehmannii, Johnsonia pubescens, Leptospermum spinescens, Levenhookia pusilla, Melaleuca leuropoma, Mesomelaena pseudostygia, Schoenus breviculmis, S. insolitus, Stenanthemum humile, Stirlingia latifolia, Synaphea endothrix* and *Xanthosia huegelii.*
Vegetation Condition:	Excellent
Quadrats:	WWF05
Relevés:	None
Photograph:	Plate 5.23

Plate 5.23: Vegetation unit PE1.

PE2 ***Eucalyptus todtiana* low woodland over *Banksia candolleana*, *Leptospermum oligandrum*, *B. sphaerocarpa* var. *pumilio* open heath over *Lomandra hastilis* very open sedgeland**

Location:	This vegetation occurred in the west section of the study area.
Comments:	White sand with no rock cover
Associated species:	*Acacia barbinervis* subsp. *borealis, Allocasuarina humilis, Anigozanthos humilis subsp. humilis, Astroloma xerophyllum, Austrostipa macalpinei, Baeckea grandiflora, Banksia candolleana, B. shuttleworthiana, B. sphaerocarpa* var. *pumilio, Beaufortia elegans, Crassula colorata var. acuminata, Desmocladus virgatus, Drosera echinoblastus, Eremaea beaufortioides* var. *microphylla, E. pauciflora, Gompholobium tomentosum, Goodenia coerulea, Hibbertia hypericoides, H. leucocrossa, Leptospermum spinescens, Leucopogon oldfieldii, L. hermaphrodita, Melaleuca leuropoma, Mesomelaena pseudostygia, Neurachne alopecuroidea, *Pentameris airoides, Petrophile linearis, Schoenus brevisetis, S. clandestinus, S. curvifolius, Trachymene pilosa* and **Ursinia anthemoides.*
Vegetation Condition:	Excellent
Quadrats:	WWF06
Relevés:	None
Photograph	Plate 5.24

Plate 5.24: Vegetation unit PE2.

PE3 ***Eucalyptus todtiana* low open woodland over *Banksia candolleana*, *Allocasuarina humilis* shrubland**

Location:	This vegetation occurred in the proposed transmission line route.
Comments:	Soil consists of white sand.
Associated species:	*Banksia attenuata, Beaufortia elegans, Hakea incrassata, Hibbertia leucocrossa, Hypolaena robusta, Isopogon asper, I. adenanthoides, I. panduratus* subsp. *panduratus, Jacksonia floribunda, Lambertia multiflora* var. *multiflora, Leptospermum oligandrum, Mesomelaena pseudostygia, Pileanthus filifolius* and *Verticordia grandis.*
Vegetation Condition:	Excellent
Quadrats:	None
Relevés:	None
Photograph:	Plate 5.25

PE4 ***Eucalyptus todtiana* low open woodland over *Adenanthos cygnorum* subsp. *cygnorum*, *Xanthorrhoea drummondii* shrubland**

Location:	This vegetation occurred on sections of the crest of a low mesa in the southwest corner of the study area and in an area to the east.
Comments:	Grey sand and no rock cover
Associated species:	*Allocasuarina humilis, A. ramosissima, Anigozanthos humilis* subsp. *humilis, Aristida holathera* var. *holathera, Astroloma xerophyllum, Austrostipa hemipogon, A.* sp. Cairn Hill (M.E. Trudgen 21176), *Baeckea grandiflora, Banksia cypholoba, B. sclerophylla, Bossiaea eriocarpa, Caustis dioica, Conospermum nervosum, Conostylis teretifolia* subsp. *teretifolia, C. tomentosa, Crassula colorata* var. *colorata, Daviesia nudiflora* subsp. *hirtella, Desmocladus elongatus, D. virgatus, Drosera parvula, Eremaea pauciflora, Haemodorum spicatum, Hemiandra pungens, Hibbertia acerosa, H. hypericoides, H. leucocrossa, *Hypochaeris glabra, H.* sp. Mt Lesueur (M. Hislop 174), *Hovea trisperma*, *Grevillea erinacea, Jacksonia floribunda ,Laxmannia sessiliflora* subsp. *drummondii, Lepidosperma scabrum, Levenhookia stipitata, Mesomelaena pseudostygia, *Pentameris airoides, Rytidosperma setaceum, Schoenus pedicellatus, Stirlingia latifolia*, *Synaphea spinulosa* subsp. *spinulosa, Trachymene pilosa, Trifolium arvense* var. *arvense, *Ursinia anthemoides* and *Wahlenbergia capensis.*
Vegetation Condition:	Excellent
Quadrats:	WWF11, WWF13
Relevés:	None
Photograph:	Plate 5.26

Plate 5.25: Vegetation unit PE3.

Plate 5.26: Vegetation unit PE4.

5.2.5.2 Sandy Hills and Plains with *Banksia* Low Woodlands

PB1 ***Banksia attenuata, B. menziesii* low woodland over *Leptospermum oligandrum* tall open shrubland**

Location:	This vegetation occurred in the northeast of the study area on a low rise and lower slopes.
Comments:	White/ grey sand with no rock cover.
Associated species:	*Alexgeorgea nitens, Amphipogon turbinatus, Austrostipa macalpinei, Calytrix fraseri, Cassytha flava, Conostephium magnum, Cryptandra pungens, Drosera eneabba, D. humilis, Gompholobium tomentosum, Grevillea erinacea, Haemodorum spicatum, Petrophile brevifolia, Eremaea beaufortioides* var. *microphylla, Hakea incrassata, Hibbertia leucocrossa, H. subvaginata, *Hypochaeris glabra, Jacksonia hakeoides, J. nutans, Lachnostachys eriobotrya, Leptospermum squamatum, Levenhookia stipitata, Melaleuca leuropoma, Neurachne alopecuroidea, Opercularia vaginata, *Pentameris airoides, Podotheca angustifolia, Schoenus* sp. smooth culms (K.R. Newbey 7823*), Trachymene pilosa, *Ursinia anthemoides* and **Vulpia myuros forma megalura.*
Vegetation Condition:	Excellent. Low weed density.
Quadrats:	WWF04, WWF16
Relevés:	None
Photograph:	Plate 5.27

Plate 5.27: Vegetation unit PB1.

5.2.5.3 Sandy Plains dominated by Powderbark wandoo

PW1 ***Eucalyptus accedens* low open forest over *Baeckea* sp. Bunney Road (S. Patrick 4059), *Gompholobium pungens* low open shrubland**

Location:	This vegetation was recorded in the southwest section of the study area at the base of a low mesa.
Comments:	Grey/ brown sand with no rocks.
Associated species:	*Glischrocaryon aureum, Hibbertia fasciculiflora, Lepidosperma squamatum* and *Neurachne alopecuroidea*.
Vegetation Condition:	Very Good to Excellent
Quadrats:	None
Relevés:	WWFRB03
Photograph:	Plate 5.28

Plate 5.28: Vegetation unit PW1.

PW2 ***Eucalyptus accedens* low open woodland over *E. drummondii* very open tree mallee over *Eremaea pauciflora, Hibbertia subvaginata* low shrubland**

Location:	This vegetation occurred on gently undulating plains and slopes in the east section of the study area.
Comments:	This unit was recorded from sections of white/ grey sand. Its distribution was patchy, occurring in association with the unit HX2, which occurred on areas that were rocky and contained outcropping laterite.
Associated species:	*Acacia saligna, Allocasuarina humilis, Conostylis aculeata* subsp. *breviflora, Crassula colorata, Eremaea pauciflora, Hakea prostrata, Jacksonia hakeoides, Lechenaultia hirsuta, Leptospermum oligandrum, Mesomelaena pseudostygia, Pileanthus filifolius, Pityrodia verbascina, Scaevola phlebopetala, *Ursinia anthemoides* and *Verticordia* sp.
Vegetation Condition:	Excellent
Quadrats:	None
Relevés:	None
Photograph:	Plate 5.29

Plate 5.29: Vegetation unit PW2.

5.3 Vegetation Condition

The majority of intact vegetation within the study area was in Very Good to Excellent condition. The main signs of anthropogenic disturbance were minor clearing for access tracks (historic), weed invasion and grazing by sheep.

Numerous weed species (21) were recorded, however these were largely non-invasive annual grasses and daisies (see Section 6.4). Weed invasion was generally concentrated around the perimeter of the remnant vegetation. The smaller areas of remnant vegetation had higher weed densities than larger stands, and populations tended to extend through a larger proportion of these smaller areas.

Almost all of the remnant vegetation in the northern half of the study area (Judeen Farm) was fenced. The vegetation in the southern half of the study area was not fenced and the degree of disturbance was noticeably higher. Sheep were observed grazing within these areas and there was evidence of damage via trampling. Weed densities were also higher, in general, within these unfenced sections of remnant vegetation.

The soil-borne pathogens that cause Dieback disease (*Phytophthora* spp.) are known from the locality, including the Mt Lesueur National Park (Mills 1992). Other disease causing pathogens such as *Armillaria luteobubulina* and *Botryosphaeria ribis* are also known from the northern kwongan and have the potential to cause significant problems within native vegetation. These pathogens can be spread through the movement of vehicles, humans, native animals and stock.

The vegetation types which include species that would be susceptible to infection (woodlands dominated by *Banksia attenuata* and *B. menziesii* and areas supporting *Xanthorrhoea drummondii, Banksia sessillis* and species in the family Eriacaceae) appeared to be in good health, with large numbers of individuals of these plants and no obvious signs of crown dieback.

While no specific surveys for Dieback or other plant pathogens were undertaken, the Warradarge Wind Farm study area did not appear to be affected. Vegetation units including species susceptible to infection, in particular units PB1 and PE3, should be considered risk zones for the management of Dieback.

5.4 Conservation Significance of the Vegetation Types

The vegetation types of the Warradarge study area are typical of those occurring in similar habitats in the broader locality.

Two of the vegetation units (HB5 and HX1) appear similar to the description available for the Lesueur-Coomallo Floristic Community (D1), which is listed as a TEC (see Section 4.5.1). This community is currently known from one 0.1 ha location on private land adjacent to the Lesueur National Park (Hamilton-Brown 2002b). The vegetation units that may represent this TEC were recorded on stony slopes and hills in the southwest section of the study area. These units are considered to be of Very High conservation significance. Biota will report these to the DEC.

None of the vegetation types represent PECs (see Section 4.5.2; (Mills 1992)), nor are they considered restricted to the study area.

The cleared land and planted vegetation units (M1 and M3) have no conservation value for vegetation. The Completely Degraded vegetation unit M2 has low conservation value for vegetation.

The remaining vegetation units are considered to be of High conservation significance. The Warradarge study area is situated in a locality that has been subject to extensive historical land clearing. Consequently, the conservation of native vegetation is of particular significance due to this high level of fragmentation and very low protection of vegetation in conservation reserves

(EPA 2010). Remnant vegetation is also valuable habitat for flora and fauna of conservation significance in the locality (see Sections 6.3 and 7.3.2).

Within the units classified as High conservation significance, there is some significance variabity. Those vegetation units with any of the following characteristics are considered to be of elevated significance (within the category High):

- areas of large extent;
- vegetation in Excellent or Pristine condition;
- drainage areas or unusual soil types or habitats for the region; and
- support populations of Threatened and/or Priority flora.

There are only six vegetation units that, based on our survey work, do not have any of the characteristics outlined above (HP2, HB3, HB4, HX3, PE2 and PW1). Within the category High, they are of lower conservation significance.

6.0 Flora

6.1 Overview

A total of 406 native vascular plant species from 167 genera belonging to 55 families were recorded from the study area (Appendix 8). Of these, four Threatened flora and 23 Priority flora species were recorded as well as several species of potential conservation interest (see Section 6.3). Known locations of these species are shown on Figure 6.1 and are listed in Appendix 9. A further 21 introduced (weed) species were identified (Section 6.4). A complete species list is provided in Appendix 8.

6.2 Dominant Taxa and Groups

The plant families and genera with the greatest number of native taxa within the study area are shown in Table 6.1. These families and genera are those that generally dominate the habitats of the locality.

Table 6.1: Number of native plant species in the dominant families and genera within the study area.

Family	Number of Native Species
Proteaceae	62
Myrtaceae	59
Fabaceae	39
Cyperaceae	17
Goodeniaceae	17
Asteraceae	16
Ericaceae	14
Stylidaceae	13

Genus	Number of Native Species
Banksia	22
Acacia	15
Hakea	14
Stylidium	11
Eucalyptus	10
Melaleuca	10
Schoenus	10
Hibbertia	9

6.3 Flora of Conservation Significance

6.3.1 Threatened Flora

Four species listed as Threatened under the WA *Wildlife Conservation Act 1950-1979* were recorded from the study area (*Acacia wilsonii, Banksia catoglypta, Eucalyptus pruiniramis,* and *Thelymitra stellata*). Two of these (*T. stellata* and *E. pruiniramis*) are also listed as Endangered under the Commonwealth *EPBC Act 1999*. These species are described below and their locations shown on Figure 6.1.

Acacia wilsonii **Threatened**

This low spreading, wiry shrub grows to 0.5 m high and has horizontal branches bearing terete erect phyllodes that are sessile. *Acacia wilsonii* generally occurs on yellow/white sand, lateritic gravel and sandy clay over laterite in low heath vegetation. It is currently known only from three collections in the Moora District between Eneabba and Dandaragan over a range of 60 km (Patrick and Brown 2001). This species was recorded once, from the slopes of a low mesa (vegetation unit HM2) in the southwest section of the study area.

Banksia catoglypta **Threatened**

This species is a non-lignotuberous shrub growing to 1 m in height and produces flowers from June to July. It is known to occur on lateritic breakaways in kwongan heath vegetation. *Banksia catoglypta* was formally upgraded from Priority 2 to Threatened in August 2010. A single specimen of this species was collected from clay plain habitat in the northwest section of study area (vegetation unit LP2). It should be noted that an error occurred during processing this voucher specimen and there is uncertainty surrounding the accuracy of the collection location.

Eucalyptus pruiniramis **Threatened (Endangered)**

Eucalyptus pruiniramis is known to occur in skeletal soils over sandstone and laterite, usually on midslopes that are fairly high in the landscape. It generally occurs in an open, low mallee woodland structure, emergent from heath or scrub. Known associated genera include *Dryandra*, *Grevillea*, *Gastrolobium* and *Acacia*. It typically grows from 2.5 to 7 m in height and often has a straggly, hanging crown.

This species is known from nine populations, all north of the Three Springs area (see Figure 2.1) over a range of 160 km. Of these, four populations occur on road verges, four on private land, and one in a national park. The total known number of individual plants is estimated to be 58 (Patrick and Brown 2001). Within the Warradarge study area, one individual was recorded from a rocky plain in the southern section of the study area (vegetation unit HX1).

Thelymitra stellata **(Star Sun Orchid)** **Threatened (Endangered)**

This orchid is a slender perennial growing to 50 cm high. It has golden-brown flowers with yellow or orange sepals and petals on a single, robust stem that are produced from late September to November. It grows in gravelly loam among low heath and scrub in *Eucalyptus marginata* and *E. wandoo* woodland, and in low heath on lateritic hilltops (Patrick and Brown 2001). This species is uncommon but has a relatively wide distribution. It is known from 23 populations, each of approximately 10 plants or less, between Eneabba and Pinjarra, with disjunct occurrences near Dumbleyung and Corrigin (Graham and Mitchell 2000, Durell and Buehrig 2001, Patrick and Brown 2001).

Thelymitra stellata was recorded once on the southwest facing slope of a low mesa (vegetation unit HM2).

Plate 6.1: ***Thelymitra stellata*** **(collected at 351519 mE, 6684244 mN)**

6.3.2 Priority Flora

Twenty-two (22) Priority flora species were recorded from the study area. The locations are provided on Figure 6.1, on maps in Appendix 1 and listed in Appendix 9. These species are described below.

Grevillea stenogyne **Priority 1**

Grevillea stenogyne is currently known only from the type collection held at the WA Herbarium. This species was recorded once, opportunistically, from plains (of red loam) in the north section of the study area (vegetation unit LP2).

Arnocrinum gracillimum **Priority 2**

Arnocrinum gracillimum is endemic to the Moora District and is known from five populations between Eneabba and Badgingarra (Patrick and Brown 2001). This species is a perennial herb flowering from October to November with purple, terminal spikes on 30 cm long flowering stems. It is known from lateritic grey sandy soils in low scrub or heath with associated species of *Adenanthos, Calothamnus, Hakea* and *Xanthorrhoea*. This species occurred on sandy plain habitat in the western section of the study area (vegetation unit PE1).

***Baeckea* sp. Bunney Road (S. Patrick 4059)** **Priority 2**

This slender erect shrub grows to 2.5 m in height and produces flowers from October to March. It typically grows on yellow-brown loam over lateritic gravel on plains, hillslopes and breakaways. This species was widespread in the survey area, occurring in a variety of habitats and vegetation types. It was considered to be dominant in the tall open shrubland stratum of quadrat site WWF17 (plain habitat with red to brown loamy sand) and the low open shrubland stratum of relevé WWFRB03 (sandy plain). It also occurred in association with clay plains, sandy plains, low stony plains and stony hillslope habitats (corresponding to six vegetation units: LP2, HM4, PW2, HP1, HB1 and HM1).

Comesperma griffinii **Priority 2**

This herb grows to 0.15 m high and produces small white flowers in October. It has a basal rosette of clustered leaves and a slender taproot. It occurs in yellow or grey sands and is believed to be a post fire-ephemeral (Keighery 2002). It is currently known from scattered occurrences from Eneabba north to Mullewa, inland to Mount Gibson and south to Dalwallinu. *Comesperma griffinii* was recorded once from a stony hill (vegetation unit HB2).

Synaphea endothrix **Priority 2**

Synaphea endothrix is an erect, clumped shrub growing to 0.6 m high and flowering from August to September. It typically occurs in gravelly loam or sand on lateritic rises. This species was recorded once from sandy plain habitat (vegetation unit PE1).

Allocasuarina grevilleoides **Priority 3**

This small, dioecious shrub grows to 0.5 m high and flowers from September to November. It grows in grey sandy loam to white clay over lateritic gravel or quartz in low heath vegetation. This species has been recorded east of Eneabba and Badgingarra and from the Lesueur area. *Allocasuarina grevilleoides* was recorded three times from stony hillslopes in association with *Melaleuca* or *Banskia* (vegetation units HM2 and HB5).

Allocasuarina ramosissima **Priority 3**

This species is an erect, dense shrub growing to 1 m in height. It occurs on sandy loam to clay loam with lateritic gravel in low shrubland or on heath with mallee trees. It flowers from September to November and has much-divided and whorled branches. Known populations occur between Three Springs and Dandaragan, with one population occurring just south of the Moora District (Patrick and Brown 2001).

This species was recorded three times from stony hillslopes with *Melaleuca* or *Banksia* and sandy plains with *Eucalyptus todtiana* habitat (vegetation units HM2, PE4 and HB5). It was a dominant species in relevé WWFRB04 (stony hillslope habitat).

***Austrostipa* sp. Cairn Hill (M.E. Trudgen 21176) Priority 3**

This grass species was recorded four times in the study area). It was recorded from one relevé (WWFRB09) and three times opportunistically on sandy soils corresponding to stony hills and slopes (unit HB6), sandy plains (unit PE4) and modified vegetation (unit M2).

***Banksia cypholoba* Priority 3**

Banksia cypholoba has short underground fire-tolerant stems and grows in sand and gravelly loam. It typically occurs in kwongan vegetation in association with *Eucalyptus todtiana,* or in thick scrub. This species was recorded three times on stony hillslope and sandy plain habitat (corresponding to vegetation units HB2, PE4 and HB5).

***Banksia nobilis* subsp. *fragrans* Priority 3**

This erect shrub grows to 4 m without lignotubers and it usually occurs on lateritic rises in thick kwongan heath vegetation. It has yellow to green or pink flower that are produced between July and September. This species was recorded twice from stony hillslope habitat (vegetation units HM3 and HB2).

***Banksia splendida* subsp. *macrocarpa* Priority 3**

This shrub has many branches and flowers from July to August. It grows to 2 m high and occurs on sandy loam soils in kwongan heath. Its known distribution extends from Tathra National Park to Badgingarra. This species was recorded three times from stony hill and slope habitats (vegetation types HB6, HB2 and HB1). It was considered to be dominant in the shrubland stratum of quadrat WWF14 (vegetation unit HM3).

***Grevillea erinacea* Priority 3**

Grevillea erinacea is a spreading, prickly shrub to 1.8 m high, flowering mainly from July to October. It commonly grows in heath or shrubland in sandy soil over lateritic gravel and is known to occur in an area between Ellendale, Three Springs and Arrowsmith. *Grevillea erinacea* was recorded three times from sandy hills and plains dominated by *Banksia* or *Eucalyptus todtiana* woodlands, and rocky hillcrest habitat. It occurred in vegetation units PB1, HX2 and PE4.

***Lepidobolus quadratus* Priority 3**

An erect perennial sedge to 30 cm high, *Lepidobolus quadratus* flowers from August to December. The species typically grows in sand to sandy clay with laterite in open low scrub or low heath usually in association with *Calothamnus, Lambertia, Xanthorrhoea* and *Dryandra* on breakaways and uplands. This species occurred three times, from stony hills and slopes (vegetation units HM2, HX1 and HB5).

***Petrophile chrysantha* subsp. Watheroo (K.M. Allan 57) Priority 3**

This taxon is more recently known as *Petrophile septemfida* Rye & K.A. Sheph (see Rye et al. 2011).

Growing to 1.2 m high, this shrub flowers from June to October and is commonly found in sand over laterite associated with *Dryandra* and *Hakea* species. It occurs from north of Tathra National Park east to near Coorow and southeast to Watheroo National Park (Rye et al. 2011). This species was recorded once from sandy soil in vegetation unit PE3.

***Astroloma* sp. Cataby (E.A. Griffin 1022) Priority 4**

This species is a spreading or erect shrub growing to 35 cm high. It produces cream to white flowers between February and July. It usually grows in loam or sandy soils over laterite on hills and

breakaways. *Astroloma* sp. Cataby (E.A. Griffin 1022) was recorded once in association with *Banksia* heath (vegetation unit HB2).

Banksia platycarpa **Priority 4**

Banksia platycarpa is an erect shrub to 1.5 m, growing on flat to undulating sites, midslopes or hilltops. It typically occurs in heath or tall shrubland in sandy soil, sometimes with lateritic gravel, and is commonly associated with *Eucalyptus todtiana* and species of *Adenanthos*, *Hakea* and *Banksia*. It occurs from east of Eneabba, south to Mogumber and is well represented in conservation reserves. *Banksia platycarpa* was recorded once in vegetation type HB6 (representing stony hills and slopes dominated by *Banksia* heaths).

Banksia sclerophylla **Priority 4**

This species is a shrub to 60 cm with lignotubers, growing in sandy soils over laterite in kwongan scrub. This species typically flowers from September to October and is known to occur between Alexander Morrison National Park, Mount Lesueur and Badgingarra. This species occurred twice from the study area from vegetation units HB6 and PE4.

Calytrix chrysantha **Priority 4**

Calytrix chrysantha is an erect hairless shrub growing to 1.3 m tall, with yellow flowers produced from December to February. It grows on grey sand and white to yellow clayey sand over gravel. It typically occurs in high open shrubland or open woodland over heath in association with *Eucalyptus todtiana* and *Banksia attenuata*. This species is known from a few populations north and west of Eneabba over a range of 40 km, but historical records indicate a larger range of 70 km including areas to the south and east of Eneabba (Patrick and Brown 2001).

Calytrix chrysantha was recorded four times in stony hillslope habitat (vegetation unit HM2).

Conostephium magnum **Priority 4**

This species typically grows to 2 m high and flowers from July to September. It occurs in open woodland over white to grey sand, occasionally associated with lateritic gravels. Populations of *Conostephium magnum* extend from Eneabba south to Cataby, with a single isolated record further south near Gingin (Cranfield 2002). This species was recorded four times in *Banksia* low woodland (vegetation unit BAaBamLEo) on sandy hills and plains. It was also considered a dominant species in the shrubland stratum of site WWF04 (sandplain habitat).

Desmocladus elongatus **Priority 4**

Desmocladus elongatus is an erect, rhizomatous sedge growing to 35 cm. It flowers from August to November and typically grows in deep sand to sandy clay over laterite on slopes and uplands in heath. It is known to occur from Eneabba south to Cataby with most populations recorded from disturbed road verges (Patrick and Brown 2001). *Desmocladus elongatus* was recorded twice from the study area, from stony hills and sandy plains (vegetation units HB2 and PE4).

***Hemiandra* sp. Watheroo (S. Hancocks 4)** **Priority 4**

Hemiandra sp. Watheroo is a small, erect shrub up to 50 cm high, growing on white-grey sand on flat ground, slopes or low hills in open woodland and open scrub. It produces flowers between October and January. Flower colour may be consistent in individual plants but is likely to vary within a population. This species has a restricted distribution of approximately 380 km^2, and as of 2005 is known to occur in four surveyed populations containing 11,300 mature individuals, with 98% of the total population located in conservation parks and Crown Land (DEWHA n.d.).

This species was recorded twice from the study area, in the north of the study area on red loam plains and in disturbed *Eucalyptus todtiana* woodland (units LP2 and M2).

Hypolaena robusta **Priority 4**

Hypolaena robusta is a dioecious, perennial herb to 0.5 m high, typically occurring on white sand and flowering from September to October. This species is very distinct from other *Hypolaena*

species in its exceptionally stout rhizomes and taller culms. This species was recorded in vegetation types PE1 and PE3, corresponding to *Eucalyptus todtiana* dominated sandy plains and low hills.

6.3.3 Other Flora of Conservation Interest

A number of specimens collected are considered species of interest for the following reasons:

- they are a newly discovered species;
- they represent significant range extensions to the known distribution (as indicated by the current voucher specimen records shown on FloraBase); and
- the record fills an apparent gap in the range (as shown on FloraBase).

Where there is adequate voucher material, specimens of all the above taxa will be submitted to the WA Herbarium. These species are described below.

6.3.3.1 Newly Discovered Species

***Ptilotus* sp. nov.**

A new species, *Ptilotus* sp. nov., was collected at site WWF12. This site was situated on a broad stony ridge dominated by *Banksia* heaths over light brown sandy loam with lateritic pebbles, cobbles and boulders (vegetation unit HB5). Mr Rob Davis, of the WA Herbarium, has indicated that this entity will be named *Ptilotus* sp. Warradarge (pers. comm. January 2012). As an interim measure it will be classified as a Priority 1 species.

6.3.3.2 Significant Range Extensions or Filled Gaps in Known Range

Cassytha glabella* forma *casuarinae

Cassytha glabella forma *casuarinae* was recorded twice, from quadrats WWF09 and WWF10, corresponding to hillslope habitat dominated by *Banksia* or *Melaleuca* over brown/grey sandy-loam (vegetation units HM2 and HB6). Current specimens vouchered for WA are from as far north as the Swan Coastal Plain bioregion.

Comesperma virgatum

This species was recorded eight times during the survey. It occurred on stony hills and slopes containing *Banksia* heath, rocky hillcrests and plains containing *Xanthorrhoea drummondii*, and *Eucalyptus todtiana* dominated sandy plains and low hills (corresponding to vegetation units HB6, PE4, HB5, PE1 and HX1). Currently, only one voucher has been made for the Geraldton Sandplains bioregion, 150 km northwest of the study area.

Gonocarpus cordiger

The single collection of this species in the study area represents a range extension from its known distribution that is currently concentrated in the Jarrah Forest and northern parts of the Swan Coastal Plain bioregions. The specimen was collected from stony hillslope habitat with *Eucalyptus* spp. woodland over mixed proteaceous shrubland (vegetation unit HM3).

Grevillea obliquistigma* subsp. *obliquistigma

This *Grevillea* species is currently distributed along the border separating the Eremaean and South West Botanical Provinces, with the majority of vouchered specimens occurring in the former. Very few records exist in the Geraldton Sandplains bioregion, and none are situated as far west as the study area. This species was collected once from stony hillslope habitat within vegetation unit HB2.

Melaleuca nesophila

Currently only vouchered from the Esperance bioregion, it is likely that this *Melaleuca* species was introduced to the study area. A single collection was made from an area of modified (re-planted) vegetation, classified as vegetation unit M3.

Schoenus breviculmis

There are very few records of *Schoenus breviculmis* on FloraBase and most are scattered along the southern coast of Western Australia from Albany to Esperance. The closest record is 300 km southeast of the study area in the Jarrah Forest bioregion, indicating that this collection represents a large range extension. The single specimen was recorded from an area of sandy plains and low hills with *Eucalyptus todtiana* open woodland (vegetation unit PE1).

Synaphea interioris

On opportunistic collection of *Synaphea interioris* was made from an area of stony hills and slopes dominated by a proteaceous-myrtaceous rich shrubland (vegetation unit HB5). Currently there are no specimens vouchered for the Geraldton Sandplains bioregion. The majority of records are in the Avon Wheatbelt bioregion, extending towards southeast coastal, and inland bioregions. This collection represents a range extension of approximately 150 km.

Table 6.2: Locations of conservation significant flora and other flora of interest, and their corresponding vegetation units.

Species	Vegetation Unit	Location		
		Collection	Easting (mE)	Northing (mN)
Threatened				
Acacia wilsonii	HM2	WWF09	351728	6684273
Banksia catoglypta	LP2	Opportunistic	356339	6687948
Eucalyptus pruiniramis	HX1	Opportunistic	353534	6682041
Thelymitra stellata	HM2	Opportunistic	351519	6684244
Priority 1				
Grevillea stenogyne	LP2	Opportunistic	356095	6688024
Ptilotus sp.	HB5	WWF12	352345	6684019
Priority 2				
Arnocrinum gracillimum	PE1	Opportunistic	350803	6684780
Baeckea sp. Bunney Road (S. Patrick 4059)	None	Opportunistic	355798	6684475
	HM4	Opportunistic	352468	6681973
	HM1	WWF07	351524	6684410
	LP2	WWF17	356139	6688065
	HM1	WWFRB01	351092	6684630
	PW2	WWFRB03	351408	6684446
	HB1	Opportunistic	357422	6687891
	HB1	Opportunistic	356589	6684859
	HP1	Opportunistic	356347	6684584
Comesperma griffinii	HB2	WWF20	355105	6684325
Synaphea endothrix	PE1	WWF05	350803	6684780
Priority 3				
Allocasuarina grevilleoides	HB5	WWF12	352345	6684019
	HM2	WWFRB04	351392	6684376
	HM2	WWFRB05	351534	6684227
Allocasuarina ramosissima	HB5	Opportunistic	352665	6682144
	PE4	WWF11	351992	6683898
	HB5	WWF12	352345	6684019
	HM2	WWFRB04	351392	6684376
Austrostipa sp. Cairn Hill (M.E. Trudgen 21176)	HB6	Opportunistic	353246	6684913
	Eto	WWFRB09	353128	6683659
	Eto	Opportunistic	350803	6684891
	PE4	Opportunistic	352947	6684281
Banksia cypholoba	HB5	WWF12	352345	6684019
	HB2	WWF20	355105	6684325
	PE4	Opportunistic	352171	6683295
Banksia nobilis subsp. *fragrans*	HB2	Opportunistic	356600	6684252
	HM3	Opportunistic	355961	6686309
Banksia splendida subsp. *macrocarpa*	HB1	WWF14	355840	6686327
	HB6	Opportunistic	353343	6684754
	HB2	WWF20	355105	6684325
Grevillea erinacea	HX2	Opportunistic	356566	6684442
	PB1	WWF16	356640	6686289
	PE4	Opportunistic	353135	6684386
Lepidobolus quadratus	HM2	Opportunistic	351513	6684251
	HX1	Opportunistic	352014	6683282
	HB5	Opportunistic	352346	6684140
Petrophile chrysantha subsp.	PE3	Opportunistic	350157	6687432

Species	Vegetation Unit	Location		
		Collection	Easting (mE)	Northing (mN)
Watheroo (K.M. Allan 57)[#]				
Priority 4				
Astroloma sp. Cataby (E.A. Griffin 1022)	HB2	WWF01	354420	6686098
Banksia platycarpa	HB6	Opportunistic	353246	6684913
Banksia sclerophylla	HB6	WWF10	353364	6684706
	PE4	Opportunistic	551959	6683933
Calytrix chrysantha	HM2	Opportunistic	351407	6684397
	HM2	WWFRB05	351534	6684227
	HM2	Opportunistic	351618	6684288
	HB5	WWF12	352345	6684019
Conostephium magnum	PB1	WWF04	356403	6686689
	PB1	WWF16	356640	6686289
	PB1	WWF16	356640	6686289
	PB1	Opportunistic	356387	6686759
Desmocladus elongatus	HB2	WWF01	354420	6686098
	PE4	Opportunistic	352171	6683295
Hemiandra sp. Watheroo (S. Hancocks 4)	Eto	WWFRB09	353128	6683659
	LP2	Opportunistic	356339	6687948
Hypolaena robusta	PE3	Opportunistic	350157	6687432
	PE1	WWF05	350803	6684780
	PE1	Opportunistic	350806	6684824
Range Extensions				
Cassytha glabella forma *casuarinae*	HM2	WWF09	351728	6684273
	HB6	WWF10	353364	6684706
Comesperma virgatum	HX1	Opportunistic	353534	6682041
	PE1	WWF05	350803	6684780
	PE1	Opportunistic	350811	6684787
	PE1	Opportunistic	350803	6684780
	HB5	Opportunistic	351550	6684343
	HB5	Opportunistic	352345	6684019
	PE4	Opportunistic	351959	6683933
	HB6	Opportunistic	353364	6684706
Gonocarpus cordiger	HM3	Opportunistic	356164	6686367
Grevillea obliquistigma subsp. *obliquistigma*	HB2	Opportunistic	356293	6683398
Melaleuca nesophila	P	Opportunistic	356811	6687212
Schoenus breviculmis	PE1	WWF05	350803	6684780
Synaphea interioris	HB5	Opportunistic	352345	6684019

[#]more recently known as *Petrophile septemfida* Rye & K.A. Sheph (see Rye et al. 2011).

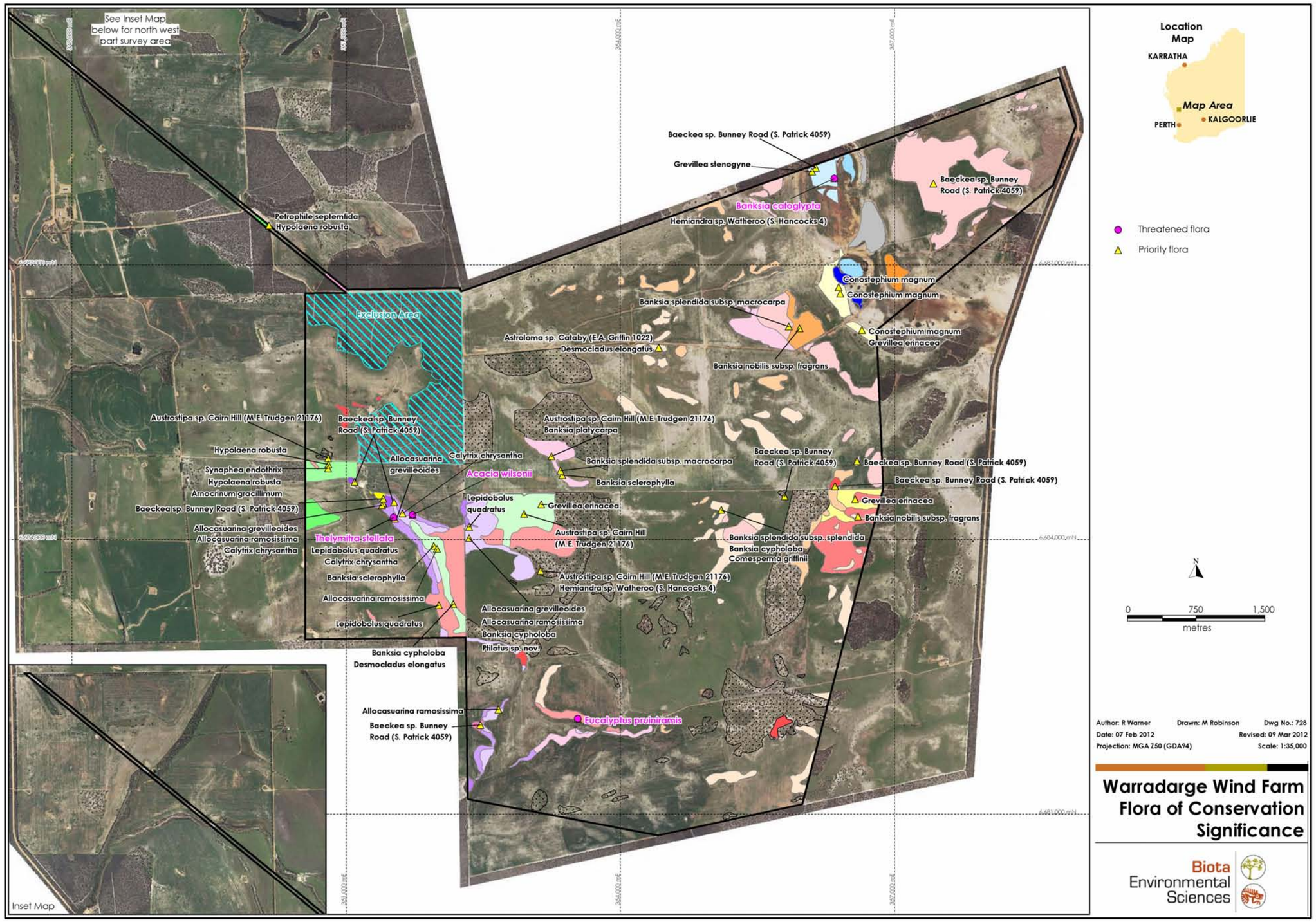

Figure 6.1: **Locations of Threatened and Priority flora species in the study area.**

6.4 Introduced Flora (Weeds)

A total of 21 introduced species were recorded from the study area (see Table 6.3). As most weeds were relatively widespread within the study area, individual locations were not recorded consistently. Many of the annual species that were recorded from only single specimens or a small number of locations may be more widespread.

Most weed species recorded were non-invasive. However, Paterson's Curse (**Echium plantagineum*) is listed as a Declared Plant for WA (category P1 and P4[3]) under the *Agriculture and Related Resources Protection Act 1976.*

The majority of weed species recorded (seven) were grasses or daisies (families Poaceae and Asteraceae). Given that the study area has been extensively cleared and is currently used for agricultural purposes, the presence of introduced species was expected and not considered unusual for the region. Higher densities of weeds occurred in unfenced areas of remnant vegetation, and where remnant vegetation pockets were small in area. Weed densities also tended to be higher on the perimeter of the remnants.

Table 6.3: Introduced flora species (weeds) recorded from the study area (the prefix * denotes an introduced species).

Family	Species	Number of Records from Study Area
Poaceae	**Bromus diandrus*	2
	**Bromus rubens*	1
	**Ehrharta longiflora*	3
	**Pentameris airoides*	8
	**Vulpia fasciculata*	1
	**Vulpia muralis*	4
	**Vulpia myuros* forma *megalura*	3
Asteraceae	**Arctotheca calendula*	2
	**Hypochaeris glabra*	13
	**Hypochaeris radicata*	1
	**Ursinia anthemoides*	10
Brassicaceae	**Brassica barrelieri* subsp. *oxyrrhina*	1
	**Diplotaxis muralis*	1
	**Raphanus raphanistrum*	1
Boraginaceae	**Echium plantagineum*	1
Campanulaceae	**Wahlenbergia capensis*	6
Cyperaceae	**Isolepis marginata*	1
Fabaceae	**Acacia iteaphylla*	1
	**Trifolium arvense* var. *arvense*	2
Geraniaceae	**Erodium botrys*	1
Scrophulariaceae	**Zaluzianskya divaricata*	1

Weed species recorded from the study area are described below.

****Acacia iteaphylla* (Flinders Range Wattle)**
This wattle is a large, weeping shrub to 5 m with narrow grey-green phyllodes to 10 cm and yellow flowers. **Acacia iteaphylla* grows mainly in *Eucalyptus marginata* woodlands on sandy soils and is currently distributed in the coastal and sub-coastal districts of WA.

[3] P1: prohibits movement of plants and their seeds within the State. This prohibits the movement of contaminated machinery and produce including livestock and fodder; P4: prevent the spread of infestation from the property on or in livestock, fodder, grain, vehicles and/or machinery. Treat to destroy and prevent seed set on all plants.

***Arctotheca calendula* (Cape Weed)**
**Arctotheca calendula* is a rosette-forming annual that is native to South Africa. This daisy occurs in all habitats in the southwest of WA, often dominating cropland and pastures.

***Brassica barrelieri* subsp. *oxyrrhina* (Smooth-stem Turnip)**
This species is a rosetted annual growing to 0.5 m high, generally in disturbed areas. It produces white, cream or yellow flowers in early spring and is recorded mainly in the Swan Coastal Plain bioregion, with scattered occurrences throughout the South-west Botanical Province.

***Bromus diandrus* (Great Brome)**
This annual species is a common weed of pastures, crops and disturbed sites, but also occurs in native grasslands, woodlands and in coastal habitats. This highly competitive grass species is widely distributed throughout southwest WA from Denham to Esperance and inland to Kalgoorlie.

***Bromus rubens* (Red Brome)**
**Bromus rubens* is a slender annual deciduous grass with red-purple flowers produced in early spring. It commonly occurs in shallow, dry or poorly textured clay soils and is capable of displacing native flora species. It is widely distributed throughout the entire South-west Botanical Province with scattered occurrences inland to Kalgoorlie and along the coast from Esperance to Eucla.

***Diplotaxis muralis* (Wall Rocket)**
This erect to ascending annual species grows to 0.5 m high and mainly occurs on sandy soils and in association with limestone. Its current distribution is predominantly coastal from Denham to Esperance with occasional records inland between Geraldton and Albany.

***Echium plantagineum* (Paterson's Curse)**
This large, bristly annual produces numerous purple flowers during late winter and spring. **Echium plantagineum* occurs in disturbed areas, including agricultural land and roadsides, throughout the southwest of WA. This species is a Declared Plant (P1 and P4) under the *Agriculture and Related Resources Protection Act 1976*.

***Ehrharta longiflora* (Annual Veldt Grass)**
**Ehrharta longiflora* is a tufted annual to 30 cm with a greenish-purple inflorescence. It occurs on offshore islands, coastal dunes and sandy soils from Shark Bay to Eucla and inland along disturbed creeklines and grazed woodlands in the western wheatbelt.

***Erodium botrys* (Long Storksbill)**
An ascending or decumbent annual growing to 20 cm, this species flowers from August to November and is distributed throughout the South-west Botanical Province.

***Hypochaeris glabra* (Smooth Catsear)**
**Hypochaeris glabra* is a rosetted annual or short-lived perennial with yellow, dandelion-like flower heads and smooth leaves. This weed is widely distributed throughout the southwest of WA.

***Hypochaeris radicata* (Flat Weed)**
**Hypochaeris radicata* is a rosetted annual to 0.5 m high, flowering throughout the year. This species is common in disturbed areas and can also be found invading natural vegetation in riparian zones and along the coast. Its current distribution is from Perth to Ravensthorpe.

***Isolepis marginata* (Coarse Club-rush)**
This species is a small annual sedge occurring in winter-wet depressions, along watercourses, and on granite outcrops from Shark Bay to east of Esperance.

***Pentameris airoides* (False Hairgrass)**
**Pentameris airoides* is a delicate tufted annual grass. This is a common and widespread weed of granite rocks, woodlands, shrublands and disturbed sites from Carnarvon to Kalgoorlie.

***Raphanus raphanistrum* (Wild Radish)**
**Raphanus raphanistrum* is an erect annual weed of highly disturbed edges, winter crops, degraded pastures and other disturbed habitats. It grows on a range of soil types and flowers from autumn to summer. It is currently recorded from major cities throughout the north of WA and across the southwest of WA.

***Trifolium arvense* var. *arvense* (Hare's Foot Clover)**
This erect or spreading annual to 0.5 m high is found in low rainfall areas of southwest WA. It mainly occurs in association with sandy loam and granite, generally in agricultural areas. This species flowers year-round, apart from late winter.

***Ursinia anthemoides* (Ursinia)**
**Ursinia anthemoides* is a slender, erect annual with divided leaves. It is a common and widespread weed in various habitats of southwest WA. Ursinia was the most common weed species in the study area.

***Vulpia fasciculata* (Dune Fescue)**
**Vulpia fasciculata* is an annual grass to 0.5 m high with stiff, erect or ascending stems. It produces flowers between September and December. Most records of this weed are from coastal habitats, between Perth to Esperance.

***Vulpia muralis* (Wall Fescue)**
Vulpia muralis is a slender annual grass growing to 0.6 m high and flowering from August to December. Current records of this weed species are scattered throughout the South-west Botanical Province and further inland into the Murchison, Yalgoo and Coolgardie Bioregions.

***Vulpia myuros* forma *megalura* (Foxtail Fescue)**
This species is a small, tufted annual grass to 0.7 m high, flowering between late winter and early spring. It is a weed of agricultural land and disturbed areas, preferring sandy soils and gravels. It has the ability, however, to tolerate a wide range of substrates. Scattered records of this weed occur throughout the southwest of WA but are concentrated in the Swan Coastal Plain and Jarrah Forest bioregions.

***Wahlenbergia capensis* (Cape Bluebell)**
This species is a slender, erect annual to 50 cm high with blue or greenish flowers. It occurs from Geraldton to Ravensthorpe, on sandy soils in woodlands or heaths and on roadsides.

***Zaluzianskya divaricata* (Spreading Night Phlox)**
Zaluzianskya divaricata is an erect annual herb growing to 35 cm high. The leaves are opposite, ovate and toothed. Flowers are produced in spring in an open terminal cluster and petals are yellow with a central red line. This species prefers habitats of sandy soils and is often abundant in agricultural areas and disturbed woodlands.

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7.0 Fauna

7.1 Overview

When determining the significance of fauna species and fauna habitats, their distribution and abundance across the relevant bioregions is typically assessed. The following four elements are considered:

1. the broad fauna habitats available within the study area;
2. an inventory of the terrestrial fauna, including migratory birds, likely to occur in the study area;
3. possible species of conservation significance and their corresponding habitats; and
4. possible impacts to fauna likely to occur in the study area.

7.2 Fauna Habitats

7.2.1 Overview

A total of five broad fauna habitats were identified for the study area based on the vegetation mapping, field groundtruthing and an examination of aerial photography. These comprised:

1. **Modified Vegetation**

- Consisting of cleared land, planted areas, or *Eucalyptus todtiana* low open woodland with a degraded understorey, on deep yellow to white sands.

2. **Drainage Areas**

- *Eucalyptus* spp. woodland over *Kunzea* tall open shrubland.

3. **Loam/Clay Plains**

- *Acacia* tall open shrubland over *Regelia ciliata* shrubland.
- *Eucalyptus* low open woodland over a layered Proteaceous-Myrtaceous tall to low shrubland over an open sedgeland.

4. **Stony Hills and Slopes**

- Low hill slopes and plains dominated by *Eucalyptus accedens* (Powderbark Wandoo).
- Hills and slopes dominated by *Melaleuca, Baeckea* and species-rich *Banksia* heaths.
- Rocky hillcrests and plains of *Xanthorrhoea drummondii* low shrublands.

5. **Sandy Plains and Low Hills**

- *Eucalyptus todtiana* (Coastal Blackbutt) low woodlands on deep white sand.
- Sandy plains dominated by either *Eucalyptus accedens* (Powderbark Wandoo) or *Banksia* low woodlands.

7.2.2 Fauna Habitat of Conservation Significance

The five broad fauna habitats described for the study area are considered to be common and widespread within the Lesueur Sandplains subregion. Vegetation dominated by a species-rich proteaceous heath (see Table 7.1, Appendix 1) is of particular conservation significance, as it is typical foraging habitat for Carnaby's Cockatoo (*Calyptorhynchus latirostris*), a conservation significant species (described in detail in Section 7.3.2.2). Those units likely to be foraging habitat for this species are listed in Table 7.1, and shown in Plate 7.1.

Table 7.1: Vegetation units representing typical *Calyptorhynchus latirostris* foraging habitat and the extent and broad location within the study area.

Unit Code	Study area location	Area (ha)
Hills and Slopes dominated by *Banksia* heaths		
HB1	Majority of the northeast, including some large stands	133.2
HB2	Scattered small remnants in the center	69.8
HB3	Scattered small remnants in the north	31.6
HB4	Most southern section of the transmission line route	1.2
HB5	Western section on low mesa crest and adjacent areas; low broad ridges in the south-west corner	36.3
HB6	Four remnants scattered through study area	31.5
Sandy Hills and Plains with Banksia Low Woodlands		
PB1	Two remnants in the northeast (divided by minor track).	14.2
	Total	**317.8**

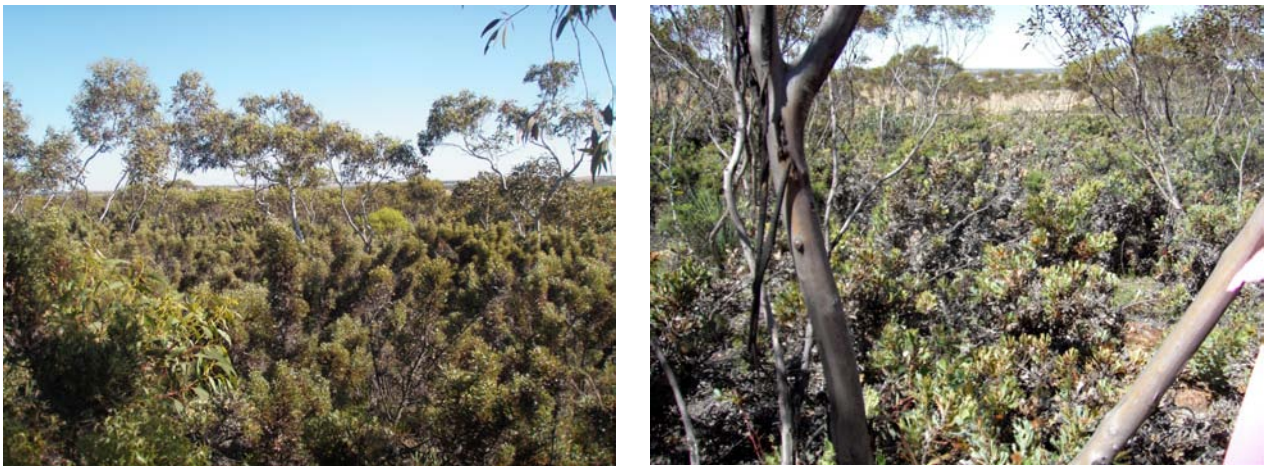

Plate 7.1: Typical foraging habitat for Carnaby's Cockatoo (*Calyptorhynchus latirostris*) in the study area (*Eucalyptus* mallee over *Banksia* spp. heath; HB1 (left) and HB2 (right)).

None of the vegetation of the study area included mature trees of sufficient diameter to provide nesting resources for *C. latirostris*. Typical eucalypt trunks within the study area are shown in Plate 7.1.

7.3 Database Search Results

7.3.1 Fauna Assemblage

Database searches indicated that a total of 187 native vertebrate fauna species potentially occur in the Warradarge locality (see Table 7.2, Appendix 10). This total comprises 133 bird species, 10 native mammals (seven non-volant, three volant), and 44 herpetofauna species (eight amphibians and 36 reptiles). Considering that only 15% of the study area contains intact remnant vegetation, the actual number occurring in the study area is likely to be a considerably lower subset of this total.

Table 7.2: Number of vertebrate fauna species potentially occurring in the study area.

Fauna Group	Number of Potentially Occurring Species
Avifauna	133
Native Non-volant Mammals	7
Native Volant Mammals	3
Amphibians	8
Reptiles	36
Total	**187**

7.3.2 Fauna of Conservation Significance

7.3.2.1 Statutory Framework

Native fauna species that are rare, threatened with extinction, or have high conservation value, are specially protected by law under the WA *Wildlife Conservation Act 1950-1979*.
In addition, many of these species are listed under the Federal *EPBC Act 1999*. Some avifauna species are also listed under the Japan and Australia Migratory Bird Agreement (JAMBA), Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA) and the China and Australia Migratory Bird Agreement (CAMBA). The framework for ranking communities of conservation significance is presented in Appendix 1.

7.3.2.2 Fauna of Conservation Significance known from the Locality

Relevant database searches (Appendix 3 and 4) identified 12 fauna species of conservation significance that may occur in the study area (see Table 7.3). Of these, three species are State listed as Schedule 1, as well as being Federally listed, under the *EPBC Act 1999,* as either Endangered or Vulnerable. Also listed were five migratory birds protected jointly under three bilateral Migratory Birds Agreements and the *EPBC Act 1999*.

Table 7.3: Fauna species of conservation significance that may occur within the study area.

Species	Status		International Agreements
	State	Federal	
Calyptorhynchus latirostris (Carnaby's Cockatoo)	Schedule 1	Endangered	-
Calyptorhynchus baudinii (Baudin's Cockatoo)	Schedule 1	Vulnerable	-
Leipoa ocellata (Malleefowl)	Schedule 1	Vulnerable/ Migratory	J
Apus pacificus (Fork-tailed Swift)	Schedule 3	Migratory	C, J, R
Ardea alba (Great Egret, White Egret)	Schedule 3	Migratory	C, J
Ardea ibis (Cattle Egret)	Schedule 3	Migratory	C, J
Haliaeetus leucogaster (White-bellied Sea-eagle)	Schedule 3	Migratory	C
Merops ornatus (Rainbow Bee-eater)	Schedule 3	Migratory	J
Neelaps calonotos (Black-striped Snake)	Priority 3		-
Ardeotis australis (Australian Bustard)	Priority 4		-
Calamanthus campestris subsp. *montanellus* (Rufous Fieldwren)	Priority 4		-
Oreoica gutturalis subsp. *gutturalis* (Crested Bellbird)	Priority 4		-

NB: CAMBA=China-Australia Migratory Bird Agreement ; JAMBA=Japan-Australia Migratory Bird Agreement; and ROKAMBA=Republic of Korea-Australia Migratory Bird Agreement.

The likelihood of occurrence within the study area is discussed for each species below, along with a brief description of their ecology and distribution.

***Calyptorhynchus latirostris* (Carnaby's Cockatoo) Schedule 1, Endangered**

Distribution and Ecology: *Calyptorhynchus latirostris* is endemic and confined to the south-west of Western Australia, ranging north to the lower Murchison River and east to Durokoppin and Cape Arid (Johnstone et al. 2006). Its range is believed to have contracted by more than 30% since the late 1940s (Mawson 1997).

Carnaby's Cockatoo generally favours proteaceous scrubs, kwongan heaths, and adjacent *Eucalyptus* woodlands and forests occurring on sandplains (R.E. Johnstone, pers. comm. 2012), especially those that contain *Eucalyptus salmonophloia* and *E. wandoo* (Saunders 1986). It also occurs in remnant patches of native vegetation on land otherwise cleared for agriculture (Saunders 1974).

It is attracted to seeding *Banksia, Hakea, Eucalyptus, Corymbia, Grevillea, Melaleuca, Callistemon* and *Allocasuarina* species (Storr 1991, Mawson 1995) and nests in large hollows in tall,

smooth-barked eucalypts, particularly *Eucalyptus wandoo* (Saunders 1979, Storr 1991, Cale 2003), *E. camaldulensis*, and *E. occidentalis* (R.E. Johnstone, pers. comm. 2012). This species is resident in high-rainfall areas, and is a breeding migrant to drier regions and at sites where most of the native vegetation has been cleared (Saunders 1980).

Significance of The Warradarge Region: According to R.E. Johnstone (pers. comm. 2012), breeding has been recorded in several localities (Dookanooka, Three Springs, Coorow, Coomallo, and Carnamah) and along numerous roads and tracks (Eneabba-Three Springs Road, Coorow-Green Head Road, and Marchagee Track) in close proximity to the study area. The majority of the individuals that have been recorded in the Warradarge area were non-breeding autumn-winter visitors, most likely from breeding sites to the northeast and east (e.g. the Three Springs, Carnamah and Coorow regions).

Extracts from the Storr-Johnstone Bird Data Bank indicate that birds in the central Wheatbelt (Three Springs, Coorow, Badgingarra and Moora regions) tend to move west after breeding in February into higher rainfall areas, especially towards coastal sandplains supporting *Banksia* scrubs (Higgins 1999), and then further south onto Kwongan heaths and pine plantations on the Swan Coastal Plain. The exceptions are some large flocks (300 or more individuals) that have remained throughout the entire autumn-winter period in the Eneabba area and Badgingarra National Park where suitable feeding and roosting habitat is available (R.E. Johnstone, pers. comm. 2012).

Likelihood of Occurrence: Based on available records (historical and recent), the greater Carnamah-Coorow region contains important breeding and roosting habitat for Carnaby's Cockatoos. Some areas within, and in close proximity to, the study area are likely to provide important feeding habitat for both local and migratory flocks. It is likely that this species will occur in the study area, feeding on typical proteaceous heath vegetation, or in passing during migration movements. No large trees were observed, and the study area does not therefore appear to offer any nesting opportunities for *Calyptorhynchus latirostris*.

***Calyptorhynchus baudinii* (Baudin's Cockatoo)** **Schedule 1, Vulnerable**

Distribution and Ecology: *Calyptorhynchus baudinii* is found only in the extreme south-west of Western Australia. The range of this species, which is generally bounded by the 750 mm isohyet, extends from Albany northward to Gidgegannup and Mundaring and inland to the Stirling Ranges and near Boyup Brook (Storr 1991).

Likelihood of Occurrence: Database searches indicate that Baudin's Cockatoo was historically recorded in the area. However, this is probably because it was formerly grouped with Carnaby's Cockatoo (*Calyptorhynchus latirostris)* and treated as a single species. Due to the current known range of *C. baudinii,* this species is highly unlikely to occur within the study area.

***Leipoa ocellata* (Malleefowl)** **Schedule 1, Vulnerable**

Distribution and Ecology: In Western Australia, Malleefowl are known from semi-arid rangelands and the central and eastern wheatbelt of Western Australia (Benshemesh 2010). The species is mostly located south and west of a line extending from Cape Farquhar, north of Carnarvon, through to Eucla in the south-east (Barrett et al. 2003), with the area of occupancy known to be decreasing (Garnett and Crowley 2000). *Leipoa ocellata* is at very low density in the northern sandplains, with few recent records.

The species occupies a variety of habitats including shrublands and low woodlands that are dominated by mallee vegetation. It also occurs in other habitat types including eucalypt or native pine (*Callitris*) woodlands, *Acacia* shrublands, *Melaleuca uncinata* vegetation or coastal heathlands, and they are also known to forage in croplands that lie adjacent to more typical habitat (Benshemesh 2010).

Likelihood of Occurrence: Based on its current known distribution, Malleefowl are considered unlikely to occur in the study area. No evidence of the species presence (its distinctive mounds) were recorded during the field survey.

***Apus pacificus* (Fork-tailed Swift)** **Schedule 3, Migratory**

Distribution and Ecology: The Fork-tailed Swift is a non-breeding visitor to all states and territories of Australia, usually between October and late April. This species mainly occurs over inland plains, above foothills and are widespread in coastal and subcoastal areas. Terrestrial habitats include dry or open areas, riparian woodland and tea-tree swamps, low scrub, and heathland. They are also found near open farmland and inland and coastal sand-dunes (Higgins 1999). The Fork-tailed Swift is an aerial eater, flying anywhere from 1 m to 300 m above the ground to forage.

Likelihood of Occurrence: The Fork-tailed Swift does not breed in Australia. It may be a transitory visitor to the area.

***Ardea alba* (Great Egret, White Egret)** **Schedule 3, Migratory**

Distribution and Ecology: *Ardea alba* is widespread in Australia and occurs in all states and territories. Minor breeding sites are scattered across its known distribution and include a wide range of wetland habitats in south-western WA (Phillimore and Recher 2004), particularly in *Melaleuca* swamps (Marchant and Higgins 1990). In south-western WA, multi-directional post-breeding movements of up to 280 km have been recorded (McKilligan 2005). Regular seasonal movements are mostly to and from breeding colonies, and towards the coast in the dry season (Marchant and Higgins 1990).

Likelihood of Occurrence: It is considered unlikely that *Ardea alba* occurs within the study area or its immediate surrounds as typical habitat is absent.

***Ardea ibis* (Cattle Egret)** **Schedule 3, Migratory**

Distribution and Ecology: In WA and the Northern Territory, *Ardea ibis* is generally located from Wyndham to Arnhem Land, although non-breeding populations have been recorded in the far southwest coastal areas of WA (Marchant and Higgins 1990). Typical habitat includes temperate grasslands, wooded lands and terrestrial wetlands. High numbers have also been observed in moist, low-lying poorly drained pastures with an abundance of high grass, and in farmland areas (Marchant and Higgins 1990).

Likelihood of Occurrence: This species may occur in the locality, based on its preferred habitat and known distribution.

***Haliaeetus leucogaster* (White-bellied Sea-Eagle)** **Schedule 3, Migratory**

Distribution and Ecology: *Haliaeetus leucogaster* is distributed along the coastline of mainland Australia. The inland limits of the species are restricted in southwest WA, where it is confined to a narrow band along the coast (Blakers et al. 1984). Home ranges occupied by the White-bellied Sea-Eagle can be up to 100 km² (Mooney and Brothers 1986). Within these ranges, breeding areas are typically located close to water (Emison and Bilney 1982).

The species' terrestrial habitats include coastal dunes, tidal flats, grassland, heathland, woodland, forest and even urban areas (Bell 1984). While the White-bellied Sea-Eagle generally forages over large expanses of open water, it will also forage over open terrestrial habitats such as grasslands (Sedgwick 1978). This species is sensitive to disturbance when nesting, especially during the early stages of the breeding season, and may desert nests and young if disturbed by humans or exposed to human activity (Stokes 1996).

Likelihood of Occurrence: Due to the inland location of the study area, it is unlikely that nesting sites will be present, and it would be at best an infrequent visitor to the area.

***Merops ornatus* (Rainbow Bee-eater)** **Schedule 3, Migratory**

Distribution and Ecology: The Rainbow Bee-eater is distributed across much of mainland Australia and is said to be seasonally common and locally abundant throughout much of its range (Birdlife International 2005). Records indicate that the distribution of the species has expanded in southwestern WA (Storr and Johnstone 1988). The southern populations of the Rainbow Bee-eater migrate northward from February to April, and return to their breeding grounds in September and October (Serventy and Whittell 1976). The species occurs mainly in open forests, woodlands, shrublands (Higgins 1999), and in various cleared or semi-cleared habitats (Morris 1977), including farmland (Leach 1988).

Likelihood of Occurrence: It is considered likely that the species will occur in the study area due to its high abundance, widespread distribution across mainland Australia, and known occurrence in cleared habitats including farmland.

***Neelaps calonotus* (Black-striped Snake)** **Priority 3**

Distribution and Ecology: This bright orange-red snake is restricted to the sandy coastal strip near Perth, between Mandurah and Lancelin. It occurs on dunes and sandplains vegetated with eucalypt/*Banksia* heaths and woodlands (Wilson and Swan 2010).

Likelihood of Occurrence: The study area is outside the known range for this species and it is considered highly unlikely to occur.

***Ardeotis australis* (Australian Bustard)** **Priority 4**

Distribution and Ecology: The Australian Bustard occurs over much of Western Australia, with the exception of the more heavily wooded southern portions of the State (Johnstone and Storr 1998). This species prefers open or lightly wooded grassland and is highly nomadic and apparently moves in response to rainfall (Marchant and Higgins 1993). This species breeds from March to September and the eggs are laid on bare, preferably stony, ground (Johnstone and Storr 1998), which makes the eggs and young vulnerable to predation by foxes and cats.

Likelihood of Occurrence: The Australian Bustard is considered likely to periodically occur in the study area.

***Calamanthus campestris* subsp. *montanellus* (Rufous Fieldwren)** **Priority 4**

Distribution and Ecology: Rufous Fieldwren is endemic to the southwest WA wheatbelt region and in some coastal heathlands to the southwest, in lower densities (Blakers et al. 1984). It typically inhabits saltmarsh, samphire and low, sparse heaths (Higgins and Peter 2002) and forages in low vegetation.

Likelihood of Occurrence: This species may occur occasionally in the study area.

***Oreoica gutturalis* subsp. *gutturalis* (Crested Bellbird)** **Priority 4**

Distribution and Ecology: The present range of the Crested Bellbird has contracted towards inland regions in southwestern Australia (Saunders and Ingram 1995). This bird lives in the shrub-layer of eucalypt woodland, mallee, *Acacia* shrubland and heath (Blakers et al. 1984). The species has been eliminated from much of its former range by clearing and is particularly sensitive to fragmentation (Traill and Duncan 2000).

Likelihood of Occurrence: This species was last recorded close to the locality in Moora in 1982 and 1989. It is considered unlikely to occur in the study area.

7.3.2.3 Migratory Avifauna

Species listed as Migratory that potentially occur within the study area include *Apus pacificus* (Fork-tailed Swift), *Ardea alba* (Great Egret), *Ardea ibis* (Cattle Egret), *Haliaeetus leucogaster* (White-bellied Sea-Eagle), and *Merops ornatus* (Rainbow Bee-Eater). Of these five migratory avifauna, all except *Ardea alba* would be expected to occur within the study area. They are

expected to be transitory visitors only, and it is considered unlikely that the area would comprise important habitat for these species.

7.3.2.4 Summary

Of the 12 conservation signficant species listed on database searches, only four are considered likely to occur in the current study area. This is based on preferred habitat and ecology:

- *Calyptorhynchus latirostris (*Carnaby's Cockatoo) – Schedule 1, Vulnerable
- *Ardea ibis (*Cattle Egret) - Migratory
- *Merops ornatus (*Rainbow Bee-eater) - Migratory
- *Ardeotis australis (*Australian Bustard) – Priority 4

As discussed above, all of these species are likely to only be transitory visitors to the habitats of the study area and none would be reliant on the area for any significant breeding purposes.

7.4 Potential Impacts to Fauna

Potential impacts to fauna include:

- loss of habitat through clearing of vegetation for turbines, tracks and associated infrastructure;
- direct mortality during clearing and construction activities; and
- mortality (birds and bats) arising from collisions with wind turbine blades.

While direct mortalities from wind turbine blades and infrastructure do pose a potential threat to volant (flying) fauna (birds and bats) the most relevant factor for the current proposal is the removal of habitat by clearing remnant native vegetation, in particular the Federally listed *Calyptorhynchus latirostris*. Potential impacts to fauna are discussed by group below.

7.4.1 Avifauna

The most relevant factor for avifauna is the removal of habitat by clearing vegetation. In particular, the potential loss of significant stands of foraging and feeding habitat for Carnaby's Cockatoo, which includes vegetation dominated by *Eucalyptus* mallee over a species-rich proteaceous heath. The study area contains a total of 317.8 ha of this foraging habitat, within small and large pockets of remnant vegetation (see Section 7.2.2). Verve Energy is adopting a design approach of maximising the use of existing cleared areas and minimising further clearing of vegetation. Implementation of this in the final design will mean the impact of habitat removal should not be significant.

Previous studies into fauna impacts associated with wind farms in Australia have indicated that the construction of wind turbines could result in bird and bat mortalities. While these studies indicate that the rate of strike fatalities in birds is small, it can be up to seven birds per turbine each year if located on a major migratory path (Biota 2008). Other studies describe significant numbers of bird deaths including resident, migratory and often endangered species, although most of the mortalities have been due to stationary structures such as buildings, towers and powerlines (Biota 2002a). In fine weather conditions, birds tend to fly into objects that they cannot see clearly or cannot discriminate from the background, for example transmission wires cause the greatest mortality of birds and guy ropes around turbines cause greater mortality than the actual towers themselves (Dillon Consulting Ltd 2000). The Warradarge study area is not sited in proximity to any wetlands or known major roosts or breeding locations for migratory species and it is unlikely to be on a major migratory path. The wind farm is unlikely to present a high risk to migratory birds.

Resident birds most at risk of turbine strikes would be species using the updrafts and thermals to gain height (such as raptors and other birds of prey) along with those that might fly at turbine height, such as migrant species flying amongst eucalypt woodland and those visiting the low heaths to feed (e.g. Carnaby's Cockatoo; Johnstone 2002).

Direct bird strikes with turbines and individuals that are caught in wind currents represents another possible risk to the Threatened species *Calyptorhynchus latirostris*. However, R.E. Johnstone (pers. comm. 2012) advises that the probability of this species encountering the proposed turbines and related infrastructure is very low for the following reasons:

- There is a low rate at which *Calyptorhynchus latirostris* appears to visit open farmland in the Warradarge area. In general, small flocks of less than 50 individuals are recorded as irregular visitors flying over farmland, compared to very large aggregations reported from intact bushland in the Eneabba and Badgingarra areas;
- Actual site utilisation would be very low at the Warradarge study area as it is mostly cleared and has relatively limited feeding, roosting and breeding habitat in close proximity;
- Although the species generally flies at turbine height (30-100 m above ground), they are very competent flyers in all conditions and would be capable of avoiding wind turbines. Individuals have been observed navigating around turbines and similar structures, even under low light conditions (R.E. Johnstone, pers. com. 2009); and
- The Storr-Johnstone Bird Data Bank contains no records of *C. latirostris* hitting powerlines.

Studies also indicate that raptors are especially susceptible to negative impacts by wind farms (Stewart et al. 2007, Smallwood et al. 2009) and are more likely to collide with turbine blades than many other avian species due to their morphology, foraging behaviour (Janss 2000), and tendency to fly at turbine blade heights. Compounding the problem, raptors are long-lived, have a low reproductive output (six years old; Marchant and Higgins 1993), and breed in solitary and monogamous pairs, making them particularly susceptible to mortality events. However, a number of studies have found that the risk of collision is very low, with individuals avoiding the swept area of the turbine blades in most cases [over 99%; (Smales 2006)].

In additionally, the low heath communities of the area mainly support species belonging to the Acanthizidae (Scrubwrens, Thornbills) and Maluridae (Wrens and Emu-wrens) families. These are low fliers and likely to spend most of their time within the denser heath habitat, and are therefore not considered to be at risk from the wind turbines.

7.4.2 Bats

While the majority of literature on the impacts of wind farms tends to focus on bird species, most of the findings are similarly applicable to bat species. The main risk to bats is blade strikes as echolocation calls attenuate quickly in air, and it has been suggested that bats may not have enough warning to avoid a collision (Horn et al. 2008).

Two bat species may occur in the vicinity of the study area, *Vespadelus regulus* (Southern Forest Bat) and *Nyctophilus geoffroyi* (Lesser Long-eared Bat; Appendix 10). The presence of these species is dictated by the availability of preferred roost sites (typically tree hollows) and foraging habitats (forest, woodland and scrub)(Hosken 1996). The likelihood of these species coming into contact with wind turbines while foraging or commuting (Horn et al. 2008), is dependent to some degree on their foraging range and height. *Vespadelus regulus* generally forages along the edges of vegetation, in closed zones and it occasionally ventures into the open. *Nyctophilus geoffroyi* is very agile and forages mainly in closed areas, gleaning insects from surfaces (Fullard et al. 1991, Bullen and McKenzie 2001).

The movement of local resident species between pockets of remnant vegetation might also bring them into contact with turbines. Since the placement of turbines in the study area will mean they are in close proximity to native vegetation, it is possible that the risk of collision will be greater for species that forage away from native vegetation, or change roost sites on a regular basis (such as *N. geoffroyi*; Hosken 1996). While no detailed studies have been conducted on south-western bats, it is likely that species that forage in closed habitats or follow the contours of the vegetation (*V. regulus* and *N. geoffroyi*) would be less likely to cross open areas and therefore encounter turbines.

The Warradarge region is not identified as having a particularly rich bat fauna. This is because large areas of the region have been cleared for agriculture, vegetation is generally low heathland and roosting habitat (rocky areas and caves) are absent. Based on the available data, the risk to bats from the proposed wind farm is considered to be very low. None of the bats previously recorded or predicted to occur in the locality are species that are specially protected under State or Federal legislation.

7.4.3 Ground-dwelling Fauna

The main impacts to ground-dwelling fauna from the proposed project is the localised loss of individuals and local scale habitat removal. Direct mortalities are likely to arise from the clearing of habitat associated with the construction of wind farm infrastructure and turbine access roads. In order to minimise impacts, existing tracks should be used wherever possible and unused cleared areas should be rehabilitated as soon as practicable to re-establish fauna habitat.

A number of indirect modifications may also occur to fauna habitats as a result of construction, ongoing operations and maintenance. These include the spread of weeds and soil borne pathogens, and the spread of feral or introduced animals. As the majority of the land within the study area has been extensively cleared for agricultural use, it is considered unlikely that any additional disturbances within the immediate vicinity will have lasting detrimental impacts on local fauna populations.

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8.0 Summary of Findings

8.1.1 Vegetation

A large proportion of the study area (76%) comprised cleared land (predominantly for pasture), which has no conservation value as vegetation.

The unit M2 (*Eucalyptus todtiana* low open woodland) was scattered throughout the study area and occupied a small proportion (8.4%). Its condition was rated as Completely Degraded, containing an understorey of predominantly pasture grasses. There was a very small proportion (0.4%) of the unit M3, which contained mostly non-native trees and shrubs. These two units were considered to be of low conservation value.

Twenty-five intact vegetation units were identified within the study area and most were in Very Good to Excellent condition. The main signs of anthropogenic disturbance were minor clearing for access tracks, weed invasion and grazing by sheep. There was no evidence of Dieback or other plant pathogens, however susceptible species did occur in the area. In particular, vegetation units PB1 and PE3 should be considered risk zones for the management of Dieback.

None of the vegetation types represent PECs. Two of the vegetation types (HB5 and HX1) appear similar to the description that is available for the Lesueur-Coomallo Floristic Community (D1), which is listed as a TEC. These units are considered to be of Very High conservation significance. Clearing of these units should be avoided, where possible.

The remainder of the vegetation was of High conservation significance. The Warradarge study area is situated in a locality that has been subject to extensive historical land clearing. Consequently, the conservation of native vegetation is of particular significance due to this high level of fragmentation and very low protection of vegetation in conservation reserves (EPA 2010).

8.1.2 Flora

A total of 406 native vascular plant species from 167 genera belonging to 55 families were recorded from the study area. This number would appear to be within the expected range for a study area of this size, taking into consideration that the region is characterised by high species richness and endemism. For comparison, a spring survey of the Mumbida property, approximately 100 km north-northwest of the Warradarge study area, recorded a total of 197 native flora species from 107 genera and 47 families (Biota 2001). While the Mumbida survey area was considerably smaller in size than the area under review (356 ha compared to 3650.9 ha), it contained a comparable area of intact vegetation (542.3 ha). In addition, the Mount Lesueur National Park (some 27, 000 ha) is believed to contain approximately 900 flora species (DEC n.d.)

The suite of species recorded in the Warradarge study area, and the dominant genera and plant families, were largely typical of the Geraldton Sandplains bioregion.

Four species listed as Threatened under the WA *Wildlife Conservation Act 1950-1979* were recorded from the study area (*Acacia wilsonii, Banksia catoglypta, Eucalyptus pruiniramis,* and *Thelymitra stellata*). Two of these (*T. stellata* and *E. pruiniramis*) are also listed as Endangered under the Commonwealth *EPBC Act 1999*.

In addition, 22 species listed as Priority flora under the WA *Wildlife Conservation Act 1950-1979* were recorded from the study area. These comprised one Priority 1 (*Grevillea stenogyne)*, four Priority 2 (*Arnocrinum gracillimum*, *Baeckea* sp. Bunney Road (S. Patrick 4059), *Comesperma griffinii* and *Synaphea endothrix*), nine Priority 3 (*Allocasuarina grevilleoides*, *A. ramosissima*, *Austrostipa* sp. Cairn Hill (M.E. Trudgen 21176), *Banksia cypholoba, B. nobilis* subsp. *fragrans*, B. *splendida* subsp. *macrocarpa*, *Grevillea erinacea, Lepidobolus quadratus, Petrophile chrysantha* subsp. Watheroo (K.M. Allan 57)) and eight Priority 4 species (*Astroloma* sp. Cataby (E.A. Griffin

1022), *Banksia platycarpa, B. sclerophylla, Calytrix chrysantha, Conostephium magnum, Desmocladus elongatus, Hemiandra* sp. Watheroo (S. Hancocks 4) and *Hypolaena robusta*).

One new species was identified (*Ptilotus* sp. nov.) and seven species were range extensions for the locality (*Cassytha glabella* forma *casuarinae, Comesperma virgatum, Gonocarpus cordiger, Grevillea obliquistigma* subsp. *obliquistigma, Melaleuca nesophila, Schoenus breviculmis* and *Synaphea interioris.*

Twenty-one (21) species of introduced flora (weeds) were recorded from the study area. Of these, grasses (family Poaceae) and daisies (family Asteraceae) comprised 52%. The majority were non-invasive species, however **Echium plantagineum* is a Declared Plant under the *Agriculture and Related Resources Protection Act 1976.* Only one individual of this species was recorded in the study area.

8.1.3 Fauna

A total of five broad fauna habitats have been identified for the study area (modified vegetation, drainage areas, loam/clay plains, stony hills and slopes and sandy plains and low hills). These are considered to be common and widespread within the Lesueur Sandplains subregion.

Database searches indicated that up 187 native vertebrate fauna species may occur in the study area. This total comprises 133 bird species, 10 native mammals (seven non-volant, three volant), and 44 herpetofauna species (eight amphibians and 36 reptiles). Considering that only 15% of the study area contains intact remnant vegetation, the actual number occurring in the study area is likely to be a considerably lower subset of this total.

Twelve fauna species of conservation significance were identified for the locality comprising three Schedule 1 species, five Schedule 3, one Priority 3, and three Priority 4 species. Of these, seven are considered likely to occur as transitory visitors: *Calyptorhynchus latirostris (*Carnaby's Black-Cockatoo), *Apus pacificus* (Fork-tailed Swift), *Ardea ibis* (Cattle Egret), *Haliaeetus leucogaster* (White-bellied Sea-Eagle), *Merops ornatus* (Rainbow Bee-eater), *Ardeotis australis* (Australian Bustard), and *Calamanthus campestris* subsp. *montanellus (*Rufous Fieldwren). Of these, five are federally listed under the *EPBC Act 1999* (Carnaby's Cockatoo, Fork-tailed Swift, Cattle Egret, White-bellied Sea-eagle and Rainbow Bee-eater). Only four species, C. *latirostris, A. ibis, M. ornatus* and *A. australis*, are considered likely to be periodic visitors to the study area.

Of these, Carnaby's Cockatoo is believed to be of most relevance to the proposed wind farm, as preferred foraging habitat (vegetation dominated by a species-rich proteaceous heath) is present in the study area. This species has been recorded historically, and more recently, in close proximity to the study area. The majority of these observations are autumn-winter visitors from breeding sites to the northeast and east as they migrate south to the Swan Coastal Plain. No roost sites, or potential roost sites, were observed in the study area. If clearing of foraging habitat for this species is kept to a minimum, the local and regional conservation status of this species is unlikely to be affected.

There is also a very low risk that individual avifauna mortalities may occur as a result of bird strikes with wind turbine blades. The low heath communities of the area typically support low flying species from the Acanthizidae and Maluridae families, and as such are not at risk. Carnaby's Cockatoos would appear to be the only species at any risk from bird strikes, although it is still considered to be a very low risk. Given the widespread distribution of these species and their ability to fly competently in all conditions, it is unlikely that the proposed project will have a detrimental effect on population numbers at a local or regional scale.

Based on the available data, it appears that the risk to bats from the proposed wind farm would not be significant. The vegetation of the study area is generally low heathland, and significant roost sites (e.g. tree hollows) are absent.

9.0 Glossary and Acronyms

Annual (plant)	A plant that lives for only one year or season.
Anthropogenic	Caused by humans
CAMBA	China and Australia Migratory Bird Agreement.
Conservation significant	A plant or animal that is recognised to be rare, unusual, new or poorly sampled and has an assigned conservation ranking (see Appendix 1 for more on the conservation framework).
DEC	Department of Environment and Conservation.
Dominant species	The species that occurred most abundantly in a stratum.
DRF	Declared Rare Flora.
Endemic	Being unique to a defined geographic location.
EPBC Act 1999	The Federal *Environment Protection and Biodiversity Conservation Act 1999*.
EPA	Environmental Protection Authority.
Herpetofauna	Amphibians and Reptiles, collectively.
IBRA	Interim Biogeographic Regionalisation for Australia
Isohyet	A line drawn through geographical points recording equal amounts of precipitation during a specific period.
JAMBA	Japan and Australia Migratory Bird Agreement.
Kwongan	A type of heath vegetation found on the coastal plains of Western Australia.
Lignotuber	A woody swelling of the stem below or just above the ground. Assists in regeneration after fire.
Mapping note	An unbounded flora survey site that it recorded for the purposes of vegetation mapping. These sites record a more brief set of data than a quadrat site.
Myrtaceous	Relating to, or denoting plants of the Myrtaceae family.
NatureMap	An online database of Western Australian flora and fauna used to produce maps and lists of species of a given area; http://naturemap.dec.wa.gov.au
Opportunistic	A plant species collected from outside the formal quadrat sites.
PEC	Priority Ecological Community
Perennial	A plant that lives for more than two growing seasons.
Phyllode	Leaf like structure
Proteaceous	Relating to, or denoting plants of the Proteaceae family.
Quadrat	A 100 m^2 bounded sample area of uniform vegetation (usually 10 m by 10 m) in which all species present are recorded.
Raptor	Bird of prey, such as eagles and hawks.
Relevé	An unbounded flora quadrat site
ROKAMBA	Republic of Korea-Australia Migratory Bird Agreement.
Stratum	A horizontal level of vegetation defined by growth habit and/or height.
Taxon (pl. taxa)	A taxonomic distinction at a species level or below.
Taxonomist	Scientist who identifies and names species (taxonomy)
TEC	Threatened Ecological Community

Vertebrate	Having a backbone or spinal column.
Volant	The ability to fly and/or glide.
WA	Western Australia

10.0 References

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6.4 Introduced Flora (Weeds)

A total of 21 introduced species were recorded from the study area (see Table 6.3). As most weeds were relatively widespread within the study area, individual locations were not recorded consistently. Many of the annual species that were recorded from only single specimens or a small number of locations may be more widespread.

Most weed species recorded were non-invasive. However, Paterson's Curse (**Echium plantagineum*) is listed as a Declared Plant for WA (category P1 and P4[3]) under the *Agriculture and Related Resources Protection Act 1976.*

The majority of weed species recorded (seven) were grasses or daisies (families Poaceae and Asteraceae). Given that the study area has been extensively cleared and is currently used for agricultural purposes, the presence of introduced species was expected and not considered unusual for the region. Higher densities of weeds occurred in unfenced areas of remnant vegetation, and where remnant vegetation pockets were small in area. Weed densities also tended to be higher on the perimeter of the remnants.

Table 6.3: Introduced flora species (weeds) recorded from the study area (the prefix * denotes an introduced species).

Family	Species	Number of Records from Study Area
Poaceae	**Bromus diandrus*	2
	**Bromus rubens*	1
	**Ehrharta longiflora*	3
	**Pentameris airoides*	8
	**Vulpia fasciculata*	1
	**Vulpia muralis*	4
	**Vulpia myuros* forma *megalura*	3
Asteraceae	**Arctotheca calendula*	2
	**Hypochaeris glabra*	13
	**Hypochaeris radicata*	1
	**Ursinia anthemoides*	10
Brassicaceae	**Brassica barrelieri* subsp. *oxyrrhina*	1
	**Diplotaxis muralis*	1
	**Raphanus raphanistrum*	1
Boraginaceae	**Echium plantagineum*	1
Campanulaceae	**Wahlenbergia capensis*	6
Cyperaceae	**Isolepis marginata*	1
Fabaceae	**Acacia iteaphylla*	1
	**Trifolium arvense* var. *arvense*	2
Geraniaceae	**Erodium botrys*	1
Scrophulariaceae	**Zaluzianskya divaricata*	1

Weed species recorded from the study area are described below.

****Acacia iteaphylla* (Flinders Range Wattle)**
This wattle is a large, weeping shrub to 5 m with narrow grey-green phyllodes to 10 cm and yellow flowers. **Acacia iteaphylla* grows mainly in *Eucalyptus marginata* woodlands on sandy soils and is currently distributed in the coastal and sub-coastal districts of WA.

[3] P1: prohibits movement of plants and their seeds within the State. This prohibits the movement of contaminated machinery and produce including livestock and fodder; P4: prevent the spread of infestation from the property on or in livestock, fodder, grain, vehicles and/or machinery. Treat to destroy and prevent seed set on all plants.

***Arctotheca calendula* (Cape Weed)**
**Arctotheca calendula* is a rosette-forming annual that is native to South Africa. This daisy occurs in all habitats in the southwest of WA, often dominating cropland and pastures.

***Brassica barrelieri* subsp. *oxyrrhina* (Smooth-stem Turnip)**
This species is a rosetted annual growing to 0.5 m high, generally in disturbed areas. It produces white, cream or yellow flowers in early spring and is recorded mainly in the Swan Coastal Plain bioregion, with scattered occurrences throughout the South-west Botanical Province.

***Bromus diandrus* (Great Brome)**
This annual species is a common weed of pastures, crops and disturbed sites, but also occurs in native grasslands, woodlands and in coastal habitats. This highly competitive grass species is widely distributed throughout southwest WA from Denham to Esperance and inland to Kalgoorlie.

***Bromus rubens* (Red Brome)**
**Bromus rubens* is a slender annual deciduous grass with red-purple flowers produced in early spring. It commonly occurs in shallow, dry or poorly textured clay soils and is capable of displacing native flora species. It is widely distributed throughout the entire South-west Botanical Province with scattered occurrences inland to Kalgoorlie and along the coast from Esperance to Eucla.

***Diplotaxis muralis* (Wall Rocket)**
This erect to ascending annual species grows to 0.5 m high and mainly occurs on sandy soils and in association with limestone. Its current distribution is predominantly coastal from Denham to Esperance with occasional records inland between Geraldton and Albany.

***Echium plantagineum* (Paterson's Curse)**
This large, bristly annual produces numerous purple flowers during late winter and spring. **Echium plantagineum* occurs in disturbed areas, including agricultural land and roadsides, throughout the southwest of WA. This species is a Declared Plant (P1 and P4) under the *Agriculture and Related Resources Protection Act 1976*.

***Ehrharta longiflora* (Annual Veldt Grass)**
**Ehrharta longiflora* is a tufted annual to 30 cm with a greenish-purple inflorescence. It occurs on offshore islands, coastal dunes and sandy soils from Shark Bay to Eucla and inland along disturbed creeklines and grazed woodlands in the western wheatbelt.

***Erodium botrys* (Long Storksbill)**
An ascending or decumbent annual growing to 20 cm, this species flowers from August to November and is distributed throughout the South-west Botanical Province.

***Hypochaeris glabra* (Smooth Catsear)**
**Hypochaeris glabra* is a rosetted annual or short-lived perennial with yellow, dandelion-like flower heads and smooth leaves. This weed is widely distributed throughout the southwest of WA.

***Hypochaeris radicata* (Flat Weed)**
**Hypochaeris radicata* is a rosetted annual to 0.5 m high, flowering throughout the year. This species is common in disturbed areas and can also be found invading natural vegetation in riparian zones and along the coast. Its current distribution is from Perth to Ravensthorpe.

***Isolepis marginata* (Coarse Club-rush)**
This species is a small annual sedge occurring in winter-wet depressions, along watercourses, and on granite outcrops from Shark Bay to east of Esperance.

***Pentameris airoides* (False Hairgrass)**
**Pentameris airoides* is a delicate tufted annual grass. This is a common and widespread weed of granite rocks, woodlands, shrublands and disturbed sites from Carnarvon to Kalgoorlie.

***Raphanus raphanistrum* (Wild Radish)**
**Raphanus raphanistrum* is an erect annual weed of highly disturbed edges, winter crops, degraded pastures and other disturbed habitats. It grows on a range of soil types and flowers from autumn to summer. It is currently recorded from major cities throughout the north of WA and across the southwest of WA.

***Trifolium arvense* var. *arvense* (Hare's Foot Clover)**
This erect or spreading annual to 0.5 m high is found in low rainfall areas of southwest WA. It mainly occurs in association with sandy loam and granite, generally in agricultural areas. This species flowers year-round, apart from late winter.

***Ursinia anthemoides* (Ursinia)**
**Ursinia anthemoides* is a slender, erect annual with divided leaves. It is a common and widespread weed in various habitats of southwest WA. Ursinia was the most common weed species in the study area.

***Vulpia fasciculata* (Dune Fescue)**
**Vulpia fasciculata* is an annual grass to 0.5 m high with stiff, erect or ascending stems. It produces flowers between September and December. Most records of this weed are from coastal habitats, between Perth to Esperance.

***Vulpia muralis* (Wall Fescue)**
Vulpia muralis is a slender annual grass growing to 0.6 m high and flowering from August to December. Current records of this weed species are scattered throughout the South-west Botanical Province and further inland into the Murchison, Yalgoo and Coolgardie Bioregions.

***Vulpia myuros* forma *megalura* (Foxtail Fescue)**
This species is a small, tufted annual grass to 0.7 m high, flowering between late winter and early spring. It is a weed of agricultural land and disturbed areas, preferring sandy soils and gravels. It has the ability, however, to tolerate a wide range of substrates. Scattered records of this weed occur throughout the southwest of WA but are concentrated in the Swan Coastal Plain and Jarrah Forest bioregions.

***Wahlenbergia capensis* (Cape Bluebell)**
This species is a slender, erect annual to 50 cm high with blue or greenish flowers. It occurs from Geraldton to Ravensthorpe, on sandy soils in woodlands or heaths and on roadsides.

***Zaluzianskya divaricata* (Spreading Night Phlox)**
Zaluzianskya divaricata is an erect annual herb growing to 35 cm high. The leaves are opposite, ovate and toothed. Flowers are produced in spring in an open terminal cluster and petals are yellow with a central red line. This species prefers habitats of sandy soils and is often abundant in agricultural areas and disturbed woodlands.

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7.0 Fauna

7.1 Overview

When determining the significance of fauna species and fauna habitats, their distribution and abundance across the relevant bioregions is typically assessed. The following four elements are considered:

1. the broad fauna habitats available within the study area;
2. an inventory of the terrestrial fauna, including migratory birds, likely to occur in the study area;
3. possible species of conservation significance and their corresponding habitats; and
4. possible impacts to fauna likely to occur in the study area.

7.2 Fauna Habitats

7.2.1 Overview

A total of five broad fauna habitats were identified for the study area based on the vegetation mapping, field groundtruthing and an examination of aerial photography. These comprised:

1. **Modified Vegetation**

- Consisting of cleared land, planted areas, or *Eucalyptus todtiana* low open woodland with a degraded understorey, on deep yellow to white sands.

2. **Drainage Areas**

- *Eucalyptus* spp. woodland over *Kunzea* tall open shrubland.

3. **Loam/Clay Plains**

- *Acacia* tall open shrubland over *Regelia ciliata* shrubland.
- *Eucalyptus* low open woodland over a layered Proteaceous-Myrtaceous tall to low shrubland over an open sedgeland.

4. **Stony Hills and Slopes**

- Low hill slopes and plains dominated by *Eucalyptus accedens* (Powderbark Wandoo).
- Hills and slopes dominated by *Melaleuca, Baeckea* and species-rich *Banksia* heaths.
- Rocky hillcrests and plains of *Xanthorrhoea drummondii* low shrublands.

5. **Sandy Plains and Low Hills**

- *Eucalyptus todtiana* (Coastal Blackbutt) low woodlands on deep white sand.
- Sandy plains dominated by either *Eucalyptus accedens* (Powderbark Wandoo) or *Banksia* low woodlands.

7.2.2 Fauna Habitat of Conservation Significance

The five broad fauna habitats described for the study area are considered to be common and widespread within the Lesueur Sandplains subregion. Vegetation dominated by a species-rich proteaceous heath (see Table 7.1, Appendix 1) is of particular conservation significance, as it is typical foraging habitat for Carnaby's Cockatoo (*Calyptorhynchus latirostris*), a conservation significant species (described in detail in Section 7.3.2.2). Those units likely to be foraging habitat for this species are listed in Table 7.1, and shown in Plate 7.1.

Table 7.1: Vegetation units representing typical *Calyptorhynchus latirostris* foraging habitat and the extent and broad location within the study area.

Unit Code	Study area location	Area (ha)
Hills and Slopes dominated by *Banksia* heaths		
HB1	Majority of the northeast, including some large stands	133.2
HB2	Scattered small remnants in the center	69.8
HB3	Scattered small remnants in the north	31.6
HB4	Most southern section of the transmission line route	1.2
HB5	Western section on low mesa crest and adjacent areas; low broad ridges in the south-west corner	36.3
HB6	Four remnants scattered through study area	31.5
Sandy Hills and Plains with Banksia Low Woodlands		
PB1	Two remnants in the northeast (divided by minor track).	14.2
	Total	**317.8**

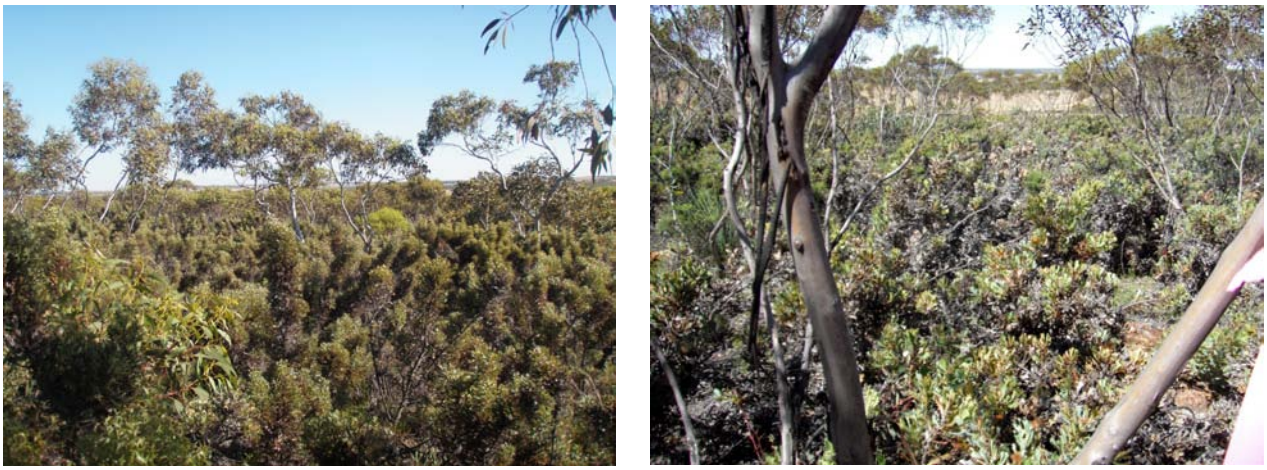

Plate 7.1: Typical foraging habitat for Carnaby's Cockatoo (*Calyptorhynchus latirostris*) in the study area (*Eucalyptus* mallee over *Banksia* spp. heath; HB1 (left) and HB2 (right)).

None of the vegetation of the study area included mature trees of sufficient diameter to provide nesting resources for *C. latirostris*. Typical eucalypt trunks within the study area are shown in Plate 7.1.

7.3 Database Search Results

7.3.1 Fauna Assemblage

Database searches indicated that a total of 187 native vertebrate fauna species potentially occur in the Warradarge locality (see Table 7.2, Appendix 10). This total comprises 133 bird species, 10 native mammals (seven non-volant, three volant), and 44 herpetofauna species (eight amphibians and 36 reptiles). Considering that only 15% of the study area contains intact remnant vegetation, the actual number occurring in the study area is likely to be a considerably lower subset of this total.

Table 7.2: Number of vertebrate fauna species potentially occurring in the study area.

Fauna Group	Number of Potentially Occurring Species
Avifauna	133
Native Non-volant Mammals	7
Native Volant Mammals	3
Amphibians	8
Reptiles	36
Total	**187**

7.3.2 Fauna of Conservation Significance

7.3.2.1 Statutory Framework

Native fauna species that are rare, threatened with extinction, or have high conservation value, are specially protected by law under the WA *Wildlife Conservation Act 1950-1979*.
In addition, many of these species are listed under the Federal *EPBC Act 1999*. Some avifauna species are also listed under the Japan and Australia Migratory Bird Agreement (JAMBA), Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA) and the China and Australia Migratory Bird Agreement (CAMBA). The framework for ranking communities of conservation significance is presented in Appendix 1.

7.3.2.2 Fauna of Conservation Significance known from the Locality

Relevant database searches (Appendix 3 and 4) identified 12 fauna species of conservation significance that may occur in the study area (see Table 7.3). Of these, three species are State listed as Schedule 1, as well as being Federally listed, under the *EPBC Act 1999,* as either Endangered or Vulnerable. Also listed were five migratory birds protected jointly under three bilateral Migratory Birds Agreements and the *EPBC Act 1999*.

Table 7.3: Fauna species of conservation significance that may occur within the study area.

Species	Status		International Agreements
	State	Federal	
Calyptorhynchus latirostris (Carnaby's Cockatoo)	Schedule 1	Endangered	-
Calyptorhynchus baudinii (Baudin's Cockatoo)	Schedule 1	Vulnerable	-
Leipoa ocellata (Malleefowl)	Schedule 1	Vulnerable/ Migratory	J
Apus pacificus (Fork-tailed Swift)	Schedule 3	Migratory	C, J, R
Ardea alba (Great Egret, White Egret)	Schedule 3	Migratory	C, J
Ardea ibis (Cattle Egret)	Schedule 3	Migratory	C, J
Haliaeetus leucogaster (White-bellied Sea-eagle)	Schedule 3	Migratory	C
Merops ornatus (Rainbow Bee-eater)	Schedule 3	Migratory	J
Neelaps calonotos (Black-striped Snake)	Priority 3		-
Ardeotis australis (Australian Bustard)	Priority 4		-
Calamanthus campestris subsp. *montanellus* (Rufous Fieldwren)	Priority 4		-
Oreoica gutturalis subsp. *gutturalis* (Crested Bellbird)	Priority 4		-

NB: CAMBA=China-Australia Migratory Bird Agreement ; JAMBA=Japan-Australia Migratory Bird Agreement; and ROKAMBA=Republic of Korea-Australia Migratory Bird Agreement.

The likelihood of occurrence within the study area is discussed for each species below, along with a brief description of their ecology and distribution.

***Calyptorhynchus latirostris* (Carnaby's Cockatoo) Schedule 1, Endangered**

Distribution and Ecology: *Calyptorhynchus latirostris* is endemic and confined to the south-west of Western Australia, ranging north to the lower Murchison River and east to Durokoppin and Cape Arid (Johnstone et al. 2006). Its range is believed to have contracted by more than 30% since the late 1940s (Mawson 1997).

Carnaby's Cockatoo generally favours proteaceous scrubs, kwongan heaths, and adjacent *Eucalyptus* woodlands and forests occurring on sandplains (R.E. Johnstone, pers. comm. 2012), especially those that contain *Eucalyptus salmonophloia* and *E. wandoo* (Saunders 1986). It also occurs in remnant patches of native vegetation on land otherwise cleared for agriculture (Saunders 1974).

It is attracted to seeding *Banksia, Hakea, Eucalyptus, Corymbia, Grevillea, Melaleuca, Callistemon* and *Allocasuarina* species (Storr 1991, Mawson 1995) and nests in large hollows in tall,

smooth-barked eucalypts, particularly *Eucalyptus wandoo* (Saunders 1979, Storr 1991, Cale 2003), *E. camaldulensis*, and *E. occidentalis* (R.E. Johnstone, pers. comm. 2012). This species is resident in high-rainfall areas, and is a breeding migrant to drier regions and at sites where most of the native vegetation has been cleared (Saunders 1980).

Significance of The Warradarge Region: According to R.E. Johnstone (pers. comm. 2012), breeding has been recorded in several localities (Dookanooka, Three Springs, Coorow, Coomallo, and Carnamah) and along numerous roads and tracks (Eneabba-Three Springs Road, Coorow-Green Head Road, and Marchagee Track) in close proximity to the study area. The majority of the individuals that have been recorded in the Warradarge area were non-breeding autumn-winter visitors, most likely from breeding sites to the northeast and east (e.g. the Three Springs, Carnamah and Coorow regions).

Extracts from the Storr-Johnstone Bird Data Bank indicate that birds in the central Wheatbelt (Three Springs, Coorow, Badgingarra and Moora regions) tend to move west after breeding in February into higher rainfall areas, especially towards coastal sandplains supporting *Banksia* scrubs (Higgins 1999), and then further south onto Kwongan heaths and pine plantations on the Swan Coastal Plain. The exceptions are some large flocks (300 or more individuals) that have remained throughout the entire autumn-winter period in the Eneabba area and Badgingarra National Park where suitable feeding and roosting habitat is available (R.E. Johnstone, pers. comm. 2012).

Likelihood of Occurrence: Based on available records (historical and recent), the greater Carnamah-Coorow region contains important breeding and roosting habitat for Carnaby's Cockatoos. Some areas within, and in close proximity to, the study area are likely to provide important feeding habitat for both local and migratory flocks. It is likely that this species will occur in the study area, feeding on typical proteaceous heath vegetation, or in passing during migration movements. No large trees were observed, and the study area does not therefore appear to offer any nesting opportunities for *Calyptorhynchus latirostris*.

***Calyptorhynchus baudinii* (Baudin's Cockatoo)** **Schedule 1, Vulnerable**

Distribution and Ecology: *Calyptorhynchus baudinii* is found only in the extreme south-west of Western Australia. The range of this species, which is generally bounded by the 750 mm isohyet, extends from Albany northward to Gidgegannup and Mundaring and inland to the Stirling Ranges and near Boyup Brook (Storr 1991).

Likelihood of Occurrence: Database searches indicate that Baudin's Cockatoo was historically recorded in the area. However, this is probably because it was formerly grouped with Carnaby's Cockatoo (*Calyptorhynchus latirostris)* and treated as a single species. Due to the current known range of *C. baudinii,* this species is highly unlikely to occur within the study area.

***Leipoa ocellata* (Malleefowl)** **Schedule 1, Vulnerable**

Distribution and Ecology: In Western Australia, Malleefowl are known from semi-arid rangelands and the central and eastern wheatbelt of Western Australia (Benshemesh 2010). The species is mostly located south and west of a line extending from Cape Farquhar, north of Carnarvon, through to Eucla in the south-east (Barrett et al. 2003), with the area of occupancy known to be decreasing (Garnett and Crowley 2000). *Leipoa ocellata* is at very low density in the northern sandplains, with few recent records.

The species occupies a variety of habitats including shrublands and low woodlands that are dominated by mallee vegetation. It also occurs in other habitat types including eucalypt or native pine (*Callitris*) woodlands, *Acacia* shrublands, *Melaleuca uncinata* vegetation or coastal heathlands, and they are also known to forage in croplands that lie adjacent to more typical habitat (Benshemesh 2010).

Likelihood of Occurrence: Based on its current known distribution, Malleefowl are considered unlikely to occur in the study area. No evidence of the species presence (its distinctive mounds) were recorded during the field survey.

***Apus pacificus* (Fork-tailed Swift)** **Schedule 3, Migratory**

Distribution and Ecology: The Fork-tailed Swift is a non-breeding visitor to all states and territories of Australia, usually between October and late April. This species mainly occurs over inland plains, above foothills and are widespread in coastal and subcoastal areas. Terrestrial habitats include dry or open areas, riparian woodland and tea-tree swamps, low scrub, and heathland. They are also found near open farmland and inland and coastal sand-dunes (Higgins 1999). The Fork-tailed Swift is an aerial eater, flying anywhere from 1 m to 300 m above the ground to forage.

Likelihood of Occurrence: The Fork-tailed Swift does not breed in Australia. It may be a transitory visitor to the area.

***Ardea alba* (Great Egret, White Egret)** **Schedule 3, Migratory**

Distribution and Ecology: *Ardea alba* is widespread in Australia and occurs in all states and territories. Minor breeding sites are scattered across its known distribution and include a wide range of wetland habitats in south-western WA (Phillimore and Recher 2004), particularly in *Melaleuca* swamps (Marchant and Higgins 1990). In south-western WA, multi-directional post-breeding movements of up to 280 km have been recorded (McKilligan 2005). Regular seasonal movements are mostly to and from breeding colonies, and towards the coast in the dry season (Marchant and Higgins 1990).

Likelihood of Occurrence: It is considered unlikely that *Ardea alba* occurs within the study area or its immediate surrounds as typical habitat is absent.

***Ardea ibis* (Cattle Egret)** **Schedule 3, Migratory**

Distribution and Ecology: In WA and the Northern Territory, *Ardea ibis* is generally located from Wyndham to Arnhem Land, although non-breeding populations have been recorded in the far southwest coastal areas of WA (Marchant and Higgins 1990). Typical habitat includes temperate grasslands, wooded lands and terrestrial wetlands. High numbers have also been observed in moist, low-lying poorly drained pastures with an abundance of high grass, and in farmland areas (Marchant and Higgins 1990).

Likelihood of Occurrence: This species may occur in the locality, based on its preferred habitat and known distribution.

***Haliaeetus leucogaster* (White-bellied Sea-Eagle)** **Schedule 3, Migratory**

Distribution and Ecology: *Haliaeetus leucogaster* is distributed along the coastline of mainland Australia. The inland limits of the species are restricted in southwest WA, where it is confined to a narrow band along the coast (Blakers et al. 1984). Home ranges occupied by the White-bellied Sea-Eagle can be up to 100 km² (Mooney and Brothers 1986). Within these ranges, breeding areas are typically located close to water (Emison and Bilney 1982).

The species' terrestrial habitats include coastal dunes, tidal flats, grassland, heathland, woodland, forest and even urban areas (Bell 1984). While the White-bellied Sea-Eagle generally forages over large expanses of open water, it will also forage over open terrestrial habitats such as grasslands (Sedgwick 1978). This species is sensitive to disturbance when nesting, especially during the early stages of the breeding season, and may desert nests and young if disturbed by humans or exposed to human activity (Stokes 1996).

Likelihood of Occurrence: Due to the inland location of the study area, it is unlikely that nesting sites will be present, and it would be at best an infrequent visitor to the area.

***Merops ornatus* (Rainbow Bee-eater)** **Schedule 3, Migratory**

Distribution and Ecology: The Rainbow Bee-eater is distributed across much of mainland Australia and is said to be seasonally common and locally abundant throughout much of its range (Birdlife International 2005). Records indicate that the distribution of the species has expanded in southwestern WA (Storr and Johnstone 1988). The southern populations of the Rainbow Bee-eater migrate northward from February to April, and return to their breeding grounds in September and October (Serventy and Whittell 1976). The species occurs mainly in open forests, woodlands, shrublands (Higgins 1999), and in various cleared or semi-cleared habitats (Morris 1977), including farmland (Leach 1988).

Likelihood of Occurrence: It is considered likely that the species will occur in the study area due to its high abundance, widespread distribution across mainland Australia, and known occurrence in cleared habitats including farmland.

***Neelaps calonotus* (Black-striped Snake)** **Priority 3**

Distribution and Ecology: This bright orange-red snake is restricted to the sandy coastal strip near Perth, between Mandurah and Lancelin. It occurs on dunes and sandplains vegetated with eucalypt/*Banksia* heaths and woodlands (Wilson and Swan 2010).

Likelihood of Occurrence: The study area is outside the known range for this species and it is considered highly unlikely to occur.

***Ardeotis australis* (Australian Bustard)** **Priority 4**

Distribution and Ecology: The Australian Bustard occurs over much of Western Australia, with the exception of the more heavily wooded southern portions of the State (Johnstone and Storr 1998). This species prefers open or lightly wooded grassland and is highly nomadic and apparently moves in response to rainfall (Marchant and Higgins 1993). This species breeds from March to September and the eggs are laid on bare, preferably stony, ground (Johnstone and Storr 1998), which makes the eggs and young vulnerable to predation by foxes and cats.

Likelihood of Occurrence: The Australian Bustard is considered likely to periodically occur in the study area.

***Calamanthus campestris* subsp. *montanellus* (Rufous Fieldwren)** **Priority 4**

Distribution and Ecology: Rufous Fieldwren is endemic to the southwest WA wheatbelt region and in some coastal heathlands to the southwest, in lower densities (Blakers et al. 1984). It typically inhabits saltmarsh, samphire and low, sparse heaths (Higgins and Peter 2002) and forages in low vegetation.

Likelihood of Occurrence: This species may occur occasionally in the study area.

***Oreoica gutturalis* subsp. *gutturalis* (Crested Bellbird)** **Priority 4**

Distribution and Ecology: The present range of the Crested Bellbird has contracted towards inland regions in southwestern Australia (Saunders and Ingram 1995). This bird lives in the shrub-layer of eucalypt woodland, mallee, *Acacia* shrubland and heath (Blakers et al. 1984). The species has been eliminated from much of its former range by clearing and is particularly sensitive to fragmentation (Traill and Duncan 2000).

Likelihood of Occurrence: This species was last recorded close to the locality in Moora in 1982 and 1989. It is considered unlikely to occur in the study area.

7.3.2.3 Migratory Avifauna

Species listed as Migratory that potentially occur within the study area include *Apus pacificus* (Fork-tailed Swift), *Ardea alba* (Great Egret), *Ardea ibis* (Cattle Egret), *Haliaeetus leucogaster* (White-bellied Sea-Eagle), and *Merops ornatus* (Rainbow Bee-Eater). Of these five migratory avifauna, all except *Ardea alba* would be expected to occur within the study area. They are

expected to be transitory visitors only, and it is considered unlikely that the area would comprise important habitat for these species.

7.3.2.4 Summary

Of the 12 conservation signficant species listed on database searches, only four are considered likely to occur in the current study area. This is based on preferred habitat and ecology:

- *Calyptorhynchus latirostris (*Carnaby's Cockatoo) – Schedule 1, Vulnerable
- *Ardea ibis (*Cattle Egret) - Migratory
- *Merops ornatus (*Rainbow Bee-eater) - Migratory
- *Ardeotis australis (*Australian Bustard) – Priority 4

As discussed above, all of these species are likely to only be transitory visitors to the habitats of the study area and none would be reliant on the area for any significant breeding purposes.

7.4 Potential Impacts to Fauna

Potential impacts to fauna include:

- loss of habitat through clearing of vegetation for turbines, tracks and associated infrastructure;
- direct mortality during clearing and construction activities; and
- mortality (birds and bats) arising from collisions with wind turbine blades.

While direct mortalities from wind turbine blades and infrastructure do pose a potential threat to volant (flying) fauna (birds and bats) the most relevant factor for the current proposal is the removal of habitat by clearing remnant native vegetation, in particular the Federally listed *Calyptorhynchus latirostris*. Potential impacts to fauna are discussed by group below.

7.4.1 Avifauna

The most relevant factor for avifauna is the removal of habitat by clearing vegetation. In particular, the potential loss of significant stands of foraging and feeding habitat for Carnaby's Cockatoo, which includes vegetation dominated by *Eucalyptus* mallee over a species-rich proteaceous heath. The study area contains a total of 317.8 ha of this foraging habitat, within small and large pockets of remnant vegetation (see Section 7.2.2). Verve Energy is adopting a design approach of maximising the use of existing cleared areas and minimising further clearing of vegetation. Implementation of this in the final design will mean the impact of habitat removal should not be significant.

Previous studies into fauna impacts associated with wind farms in Australia have indicated that the construction of wind turbines could result in bird and bat mortalities. While these studies indicate that the rate of strike fatalities in birds is small, it can be up to seven birds per turbine each year if located on a major migratory path (Biota 2008). Other studies describe significant numbers of bird deaths including resident, migratory and often endangered species, although most of the mortalities have been due to stationary structures such as buildings, towers and powerlines (Biota 2002a). In fine weather conditions, birds tend to fly into objects that they cannot see clearly or cannot discriminate from the background, for example transmission wires cause the greatest mortality of birds and guy ropes around turbines cause greater mortality than the actual towers themselves (Dillon Consulting Ltd 2000). The Warradarge study area is not sited in proximity to any wetlands or known major roosts or breeding locations for migratory species and it is unlikely to be on a major migratory path. The wind farm is unlikely to present a high risk to migratory birds.

Resident birds most at risk of turbine strikes would be species using the updrafts and thermals to gain height (such as raptors and other birds of prey) along with those that might fly at turbine height, such as migrant species flying amongst eucalypt woodland and those visiting the low heaths to feed (e.g. Carnaby's Cockatoo; Johnstone 2002).

Direct bird strikes with turbines and individuals that are caught in wind currents represents another possible risk to the Threatened species *Calyptorhynchus latirostris*. However, R.E. Johnstone (pers. comm. 2012) advises that the probability of this species encountering the proposed turbines and related infrastructure is very low for the following reasons:

- There is a low rate at which *Calyptorhynchus latirostris* appears to visit open farmland in the Warradarge area. In general, small flocks of less than 50 individuals are recorded as irregular visitors flying over farmland, compared to very large aggregations reported from intact bushland in the Eneabba and Badgingarra areas;
- Actual site utilisation would be very low at the Warradarge study area as it is mostly cleared and has relatively limited feeding, roosting and breeding habitat in close proximity;
- Although the species generally flies at turbine height (30-100 m above ground), they are very competent flyers in all conditions and would be capable of avoiding wind turbines. Individuals have been observed navigating around turbines and similar structures, even under low light conditions (R.E. Johnstone, pers. com. 2009); and
- The Storr-Johnstone Bird Data Bank contains no records of *C. latirostris* hitting powerlines.

Studies also indicate that raptors are especially susceptible to negative impacts by wind farms (Stewart et al. 2007, Smallwood et al. 2009) and are more likely to collide with turbine blades than many other avian species due to their morphology, foraging behaviour (Janss 2000), and tendency to fly at turbine blade heights. Compounding the problem, raptors are long-lived, have a low reproductive output (six years old; Marchant and Higgins 1993), and breed in solitary and monogamous pairs, making them particularly susceptible to mortality events. However, a number of studies have found that the risk of collision is very low, with individuals avoiding the swept area of the turbine blades in most cases [over 99%; (Smales 2006)].

In additionally, the low heath communities of the area mainly support species belonging to the Acanthizidae (Scrubwrens, Thornbills) and Maluridae (Wrens and Emu-wrens) families. These are low fliers and likely to spend most of their time within the denser heath habitat, and are therefore not considered to be at risk from the wind turbines.

7.4.2 Bats

While the majority of literature on the impacts of wind farms tends to focus on bird species, most of the findings are similarly applicable to bat species. The main risk to bats is blade strikes as echolocation calls attenuate quickly in air, and it has been suggested that bats may not have enough warning to avoid a collision (Horn et al. 2008).

Two bat species may occur in the vicinity of the study area, *Vespadelus regulus* (Southern Forest Bat) and *Nyctophilus geoffroyi* (Lesser Long-eared Bat; Appendix 10). The presence of these species is dictated by the availability of preferred roost sites (typically tree hollows) and foraging habitats (forest, woodland and scrub)(Hosken 1996). The likelihood of these species coming into contact with wind turbines while foraging or commuting (Horn et al. 2008), is dependent to some degree on their foraging range and height. *Vespadelus regulus* generally forages along the edges of vegetation, in closed zones and it occasionally ventures into the open. *Nyctophilus geoffroyi* is very agile and forages mainly in closed areas, gleaning insects from surfaces (Fullard et al. 1991, Bullen and McKenzie 2001).

The movement of local resident species between pockets of remnant vegetation might also bring them into contact with turbines. Since the placement of turbines in the study area will mean they are in close proximity to native vegetation, it is possible that the risk of collision will be greater for species that forage away from native vegetation, or change roost sites on a regular basis (such as *N. geoffroyi*; Hosken 1996). While no detailed studies have been conducted on south-western bats, it is likely that species that forage in closed habitats or follow the contours of the vegetation (*V. regulus* and *N. geoffroyi*) would be less likely to cross open areas and therefore encounter turbines.

The Warradarge region is not identified as having a particularly rich bat fauna. This is because large areas of the region have been cleared for agriculture, vegetation is generally low heathland and roosting habitat (rocky areas and caves) are absent. Based on the available data, the risk to bats from the proposed wind farm is considered to be very low. None of the bats previously recorded or predicted to occur in the locality are species that are specially protected under State or Federal legislation.

7.4.3 Ground-dwelling Fauna

The main impacts to ground-dwelling fauna from the proposed project is the localised loss of individuals and local scale habitat removal. Direct mortalities are likely to arise from the clearing of habitat associated with the construction of wind farm infrastructure and turbine access roads. In order to minimise impacts, existing tracks should be used wherever possible and unused cleared areas should be rehabilitated as soon as practicable to re-establish fauna habitat.

A number of indirect modifications may also occur to fauna habitats as a result of construction, ongoing operations and maintenance. These include the spread of weeds and soil borne pathogens, and the spread of feral or introduced animals. As the majority of the land within the study area has been extensively cleared for agricultural use, it is considered unlikely that any additional disturbances within the immediate vicinity will have lasting detrimental impacts on local fauna populations.

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8.0 Summary of Findings

8.1.1 Vegetation

A large proportion of the study area (76%) comprised cleared land (predominantly for pasture), which has no conservation value as vegetation.

The unit M2 (*Eucalyptus todtiana* low open woodland) was scattered throughout the study area and occupied a small proportion (8.4%). Its condition was rated as Completely Degraded, containing an understorey of predominantly pasture grasses. There was a very small proportion (0.4%) of the unit M3, which contained mostly non-native trees and shrubs. These two units were considered to be of low conservation value.

Twenty-five intact vegetation units were identified within the study area and most were in Very Good to Excellent condition. The main signs of anthropogenic disturbance were minor clearing for access tracks, weed invasion and grazing by sheep. There was no evidence of Dieback or other plant pathogens, however susceptible species did occur in the area. In particular, vegetation units PB1 and PE3 should be considered risk zones for the management of Dieback.

None of the vegetation types represent PECs. Two of the vegetation types (HB5 and HX1) appear similar to the description that is available for the Lesueur-Coomallo Floristic Community (D1), which is listed as a TEC. These units are considered to be of Very High conservation significance. Clearing of these units should be avoided, where possible.

The remainder of the vegetation was of High conservation significance. The Warradarge study area is situated in a locality that has been subject to extensive historical land clearing. Consequently, the conservation of native vegetation is of particular significance due to this high level of fragmentation and very low protection of vegetation in conservation reserves (EPA 2010).

8.1.2 Flora

A total of 406 native vascular plant species from 167 genera belonging to 55 families were recorded from the study area. This number would appear to be within the expected range for a study area of this size, taking into consideration that the region is characterised by high species richness and endemism. For comparison, a spring survey of the Mumbida property, approximately 100 km north-northwest of the Warradarge study area, recorded a total of 197 native flora species from 107 genera and 47 families (Biota 2001). While the Mumbida survey area was considerably smaller in size than the area under review (356 ha compared to 3650.9 ha), it contained a comparable area of intact vegetation (542.3 ha). In addition, the Mount Lesueur National Park (some 27, 000 ha) is believed to contain approximately 900 flora species (DEC n.d.)

The suite of species recorded in the Warradarge study area, and the dominant genera and plant families, were largely typical of the Geraldton Sandplains bioregion.

Four species listed as Threatened under the WA *Wildlife Conservation Act 1950-1979* were recorded from the study area (*Acacia wilsonii, Banksia catoglypta, Eucalyptus pruiniramis,* and *Thelymitra stellata*). Two of these (*T. stellata* and *E. pruiniramis*) are also listed as Endangered under the Commonwealth *EPBC Act 1999*.

In addition, 22 species listed as Priority flora under the WA *Wildlife Conservation Act 1950-1979* were recorded from the study area. These comprised one Priority 1 (*Grevillea stenogyne)*, four Priority 2 (*Arnocrinum gracillimum*, *Baeckea* sp. Bunney Road (S. Patrick 4059), *Comesperma griffinii* and *Synaphea endothrix*), nine Priority 3 (*Allocasuarina grevilleoides*, *A. ramosissima*, *Austrostipa* sp. Cairn Hill (M.E. Trudgen 21176), *Banksia cypholoba, B. nobilis* subsp. *fragrans*, B. *splendida* subsp. *macrocarpa*, *Grevillea erinacea, Lepidobolus quadratus, Petrophile chrysantha* subsp. Watheroo (K.M. Allan 57)) and eight Priority 4 species (*Astroloma* sp. Cataby (E.A. Griffin

1022), *Banksia platycarpa, B. sclerophylla, Calytrix chrysantha, Conostephium magnum, Desmocladus elongatus, Hemiandra* sp. Watheroo (S. Hancocks 4) and *Hypolaena robusta*).

One new species was identified (*Ptilotus* sp. nov.) and seven species were range extensions for the locality (*Cassytha glabella* forma *casuarinae, Comesperma virgatum, Gonocarpus cordiger, Grevillea obliquistigma* subsp. *obliquistigma, Melaleuca nesophila, Schoenus breviculmis* and *Synaphea interioris.*

Twenty-one (21) species of introduced flora (weeds) were recorded from the study area. Of these, grasses (family Poaceae) and daisies (family Asteraceae) comprised 52%. The majority were non-invasive species, however **Echium plantagineum* is a Declared Plant under the *Agriculture and Related Resources Protection Act 1976.* Only one individual of this species was recorded in the study area.

8.1.3 Fauna

A total of five broad fauna habitats have been identified for the study area (modified vegetation, drainage areas, loam/clay plains, stony hills and slopes and sandy plains and low hills). These are considered to be common and widespread within the Lesueur Sandplains subregion.

Database searches indicated that up 187 native vertebrate fauna species may occur in the study area. This total comprises 133 bird species, 10 native mammals (seven non-volant, three volant), and 44 herpetofauna species (eight amphibians and 36 reptiles). Considering that only 15% of the study area contains intact remnant vegetation, the actual number occurring in the study area is likely to be a considerably lower subset of this total.

Twelve fauna species of conservation significance were identified for the locality comprising three Schedule 1 species, five Schedule 3, one Priority 3, and three Priority 4 species. Of these, seven are considered likely to occur as transitory visitors: *Calyptorhynchus latirostris (*Carnaby's Black-Cockatoo), *Apus pacificus* (Fork-tailed Swift), *Ardea ibis* (Cattle Egret), *Haliaeetus leucogaster* (White-bellied Sea-Eagle), *Merops ornatus* (Rainbow Bee-eater), *Ardeotis australis* (Australian Bustard), and *Calamanthus campestris* subsp. *montanellus (*Rufous Fieldwren). Of these, five are federally listed under the *EPBC Act 1999* (Carnaby's Cockatoo, Fork-tailed Swift, Cattle Egret, White-bellied Sea-eagle and Rainbow Bee-eater). Only four species, C. *latirostris, A. ibis, M. ornatus* and *A. australis*, are considered likely to be periodic visitors to the study area.

Of these, Carnaby's Cockatoo is believed to be of most relevance to the proposed wind farm, as preferred foraging habitat (vegetation dominated by a species-rich proteaceous heath) is present in the study area. This species has been recorded historically, and more recently, in close proximity to the study area. The majority of these observations are autumn-winter visitors from breeding sites to the northeast and east as they migrate south to the Swan Coastal Plain. No roost sites, or potential roost sites, were observed in the study area. If clearing of foraging habitat for this species is kept to a minimum, the local and regional conservation status of this species is unlikely to be affected.

There is also a very low risk that individual avifauna mortalities may occur as a result of bird strikes with wind turbine blades. The low heath communities of the area typically support low flying species from the Acanthizidae and Maluridae families, and as such are not at risk. Carnaby's Cockatoos would appear to be the only species at any risk from bird strikes, although it is still considered to be a very low risk. Given the widespread distribution of these species and their ability to fly competently in all conditions, it is unlikely that the proposed project will have a detrimental effect on population numbers at a local or regional scale.

Based on the available data, it appears that the risk to bats from the proposed wind farm would not be significant. The vegetation of the study area is generally low heathland, and significant roost sites (e.g. tree hollows) are absent.

9.0 Glossary and Acronyms

Annual (plant)	A plant that lives for only one year or season.
Anthropogenic	Caused by humans
CAMBA	China and Australia Migratory Bird Agreement.
Conservation significant	A plant or animal that is recognised to be rare, unusual, new or poorly sampled and has an assigned conservation ranking (see Appendix 1 for more on the conservation framework).
DEC	Department of Environment and Conservation.
Dominant species	The species that occurred most abundantly in a stratum.
DRF	Declared Rare Flora.
Endemic	Being unique to a defined geographic location.
EPBC Act 1999	The Federal *Environment Protection and Biodiversity Conservation Act 1999*.
EPA	Environmental Protection Authority.
Herpetofauna	Amphibians and Reptiles, collectively.
IBRA	Interim Biogeographic Regionalisation for Australia
Isohyet	A line drawn through geographical points recording equal amounts of precipitation during a specific period.
JAMBA	Japan and Australia Migratory Bird Agreement.
Kwongan	A type of heath vegetation found on the coastal plains of Western Australia.
Lignotuber	A woody swelling of the stem below or just above the ground. Assists in regeneration after fire.
Mapping note	An unbounded flora survey site that it recorded for the purposes of vegetation mapping. These sites record a more brief set of data than a quadrat site.
Myrtaceous	Relating to, or denoting plants of the Myrtaceae family.
NatureMap	An online database of Western Australian flora and fauna used to produce maps and lists of species of a given area; http://naturemap.dec.wa.gov.au
Opportunistic	A plant species collected from outside the formal quadrat sites.
PEC	Priority Ecological Community
Perennial	A plant that lives for more than two growing seasons.
Phyllode	Leaf like structure
Proteaceous	Relating to, or denoting plants of the Proteaceae family.
Quadrat	A 100 m^2 bounded sample area of uniform vegetation (usually 10 m by 10 m) in which all species present are recorded.
Raptor	Bird of prey, such as eagles and hawks.
Relevé	An unbounded flora quadrat site
ROKAMBA	Republic of Korea-Australia Migratory Bird Agreement.
Stratum	A horizontal level of vegetation defined by growth habit and/or height.
Taxon (pl. taxa)	A taxonomic distinction at a species level or below.
Taxonomist	Scientist who identifies and names species (taxonomy)
TEC	Threatened Ecological Community

Vertebrate	Having a backbone or spinal column.
Volant	The ability to fly and/or glide.
WA	Western Australia

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Appendix 1

Framework for Listing the Conservation Status of Species and Communities in Western Australia

A. Definitions, Categories and Criteria for Threatened and Priority Ecological Communities

1. General Definitions

Ecological Community
A naturally occurring biological assemblage that occurs in a particular type of habitat.

Note: The scale at which ecological communities are defined will often depend on the level of detail in the information source, therefore no particular scale is specified.

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 threatened ecological communities that do not meet survey criteria are added to DEC'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.

An **assemblage** is a defined group of biological entities.

Habitat is defined as the areas in which an organism and/or assemblage of organisms lives. It includes the abiotic factors (e.g. substrate and topography), and the biotic factors.

Occurrence: a discrete example of an ecological community, separated from other examples of the same community by more than 20 metres of a different ecological community, an artificial surface or a totally destroyed community.

By ensuring that every discrete occurrence is recognised and recorded future changes in status can be readily monitored.

Adequately Surveyed is defined as follows:
"An ecological community that has been searched for thoroughly in most likely habitats, by relevant experts."

Community structure is defined as follows:
"The spatial organisation, construction and arrangement of the biological elements comprising a biological assemblage" (e.g. *Eucalyptus salmonophloia* woodland over scattered small shrubs over dense herbs; structure in a faunal assemblage could refer to trophic structure, e.g. dominance by feeders on detritus as distinct from feeders on live plants).

Definitions of **Modification** and **Destruction** of an ecological community:

Modification: "changes to some or all of ecological processes (including abiotic processes such as hydrology), species composition and community structure as a direct or indirect result of human activities. The level of damage involved could be ameliorated naturally or by human intervention."

Destruction: "modification such that reestablishment of ecological processes, species composition and community structure within the range of variability exhibited by the original community is unlikely within the foreseeable future even with positive human intervention."

Note: Modification and destruction are difficult concepts to quantify, and their application will be determined by scientific judgement. Examples of modification and total destruction are cited below:

Modification of ecological processes: The hydrology of Toolibin Lake has been altered by clearing of the catchment such that death of some of the original flora has occurred due to dependence on fresh water. The system may be bought back to a semblance of the original state by redirecting saline runoff and pumping waters of the rising underground watertable away to restore the hydrological balance. Total destruction of downstream lakes has occurred due to hydrology being altered to the point that few of the original flora or fauna species are able to tolerate the level of salinity and/or water logging.

Modification of structure: The understorey of a plant community may be altered by weed invasion due to nutrient enrichment by addition of fertiliser. Should the additional nutrients be removed from the system the balance may be restored, and the original plant species better able to compete. Total destruction may occur if additional nutrients continue to be added to the system causing the understorey to be completely replaced by weed species, and death of overstorey species due to inability to tolerate high nutrient levels.

Modification of species composition: Pollution may cause alteration of the invertebrate species present in a freshwater lake. Removal of pollutants may allow the return of the original inhabitant species. Addition of residual highly toxic substances may cause permanent changes to water quality, and total destruction of the community.

Threatening processes are defined as follows:
"Any process or activity that threatens to destroy or significantly modify the ecological community and/or affect the continuing evolutionary processes within any ecological community."

Examples of some of the continuing threatening processes in Western Australia include: general pollution; competition, predation and change induced in ecological communities as a result of introduced animals; competition and displacement of native plants by introduced species; hydrological changes; inappropriate fire regimes; diseases resulting from introduced micro-organisms; direct human exploitation and disturbance of ecological communities.

Restoration is defined as returning an ecological community to its pre-disturbance or natural state in terms of abiotic conditions, community structure and species composition.

Rehabilitation is defined as the re-establishment of ecological attributes in a damaged ecological community although the community will remain modified.

2. Definitions and Criteria for Presumed Totally Destroyed, Critically Endangered, Endangered and Vulnerable Ecological Communities

ECOLOGICAL COMMUNITIES

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

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

A) Records within the last 50 years have not been confirmed despite thorough searches of known or likely habitats or

B) All occurrences recorded within the last 50 years have since been destroyed

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

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

A) The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 90% and either or both of the following apply (i or ii):

   i) geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is imminent (within approximately 10 years);

   ii) modification throughout its range is continuing such that in the immediate future (within approximately 10 years) the community is unlikely to be capable of being substantially rehabilitated.

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

   i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the immediate future (within approximately 10 years);

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

iii) there may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes.

C) The ecological community exists only as highly modified occurrences that may be capable of being rehabilitated if such work begins in the immediate future (within approximately 10 years).

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.

3. Definitions and Criteria for Priority Ecological Communities

PRIORITY ECOLOGICAL COMMUNITY LIST
Possible threatened ecological communities that do not meet survey criteria or that are not adequately defined are added to the Priority Ecological Community Lists 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 with apparently few, small occurrences, all or most not actively managed for conservation (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) and for which current threats exist. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.

Priority Two: Poorly-known ecological communities
Communities that are known from few small occurrences, all or most of which are actively managed for conservation (e.g. within national parks, conservation parks, nature reserves, State forest, unallocated Crown land, water reserves, etc.) and not under imminent threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.

Priority Three: Poorly known ecological communities

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

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

(iii) communities made up of large, and/or widespread occurrences, that may or 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.

(a) 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.

(b) 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.

(c) 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.

Reference:
DEC (2010): Definitions, Categories and Criteria for Threatened and Priority Ecological Communities: http://www.dec.wa.gov.au/content/view/849/2017/, accessed on 13th December 2011.

B. Threatened Flora Statutory Framework

In Western Australia, all native flora species are protected under the *Wildlife Conservation Act 1950-1979,* making it an offence to remove or harm native flora species without approval. In addition to this basic level of statutory protection, a number of plant species are assigned an additional level of conservation significance based on the fact that there are a limited number of known populations, some of which may be under threat.

Species of the highest conservation significance are designated Declared Rare Flora (DRF), either extant or presumed extinct:

- **X: Threatened Flora - Presumed Extinct**: taxa which have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or of which all known wild populations have been destroyed more recently, and have been gazetted as such, following approval by the Minister for the Environment, after recommendation by the State's Endangered Flora Consultative Committee;
- **T: Threatened Flora - Extant**: taxa which have been adequately searched for, and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such, following approval by the Minister for the Environment, after recommendation by the State's Endangered Flora Consultative Committee. *(= Threatened Flora = Endangered + Vulnerable)*

Species that appear to be rare or threatened, but for which there is insufficient information to properly evaluate their conservation significance, are assigned to one of four Priority flora categories:

- **P1: Priority One - Poorly Known**: taxa which are known from one or a few (generally <5) populations which are under threat, either due to small population size, or being on lands under immediate threat, e.g. road verges, urban areas, farmland, active mineral leases, etc., or the plants are under threat, e.g. from disease, grazing by feral animals, etc. May include taxa with threatened populations on protected lands. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.
- **P2: Priority Two - Poorly Known**: taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.
- **P3: Priority Three - Poorly Known**: taxa which are known from several populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but are in need of further survey.
- **P4: Priority Four - Rare**: taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5–10 years.
- **P5: Priority Five – Conservation Dependent Taxa**: Taxa that are not threatened but are subject to a specific conservation program, the cessation of which would result in the taxa becoming threatened within five years.

Note that of the above classifications, only 'Declared Rare Flora' has statutory standing. The Priority Flora classifications are employed by the Department of Environment and Conservation to manage and classify their database of species considered potentially rare or at risk, but these categories have no legislative status. Note also that proposals that appear likely to affect DRF require formal written approval from the Minister for the Environment under Section 23(f) of the *Wildlife Conservation Act 1950-1979* in addition to the requirements of the *Environmental Protection (Native Vegetation Clearing) Regulations 2004*.

Reference:

DEC (2011). Listing of Species and Ecological Communities: http://www.dec.wa.gov.au/content/view/852/2010/1/1/, accessed on 13th December 2011.

C. Threatened Fauna Statutory Framework

Native fauna species that are rare, threatened with extinction, or have high conservation value are specially protected by law under the Western Australian *Wildlife Conservation Act 1950-1979*. In addition, many of these species are listed under the Federal *Environment Protection and Biodiversity Conservation Act 1999* (*EPBC Act 1999*).

Classification of rare and endangered fauna under the *Wildlife Conservation (Specially Protected Fauna) Notice 2005* recognises four distinct schedules of taxa:

Schedule 1 Taxa that are rare or likely to become extinct and are declared to be fauna in need of special protection;

Schedule 2 Taxa that are presumed to be extinct and are declared to be fauna in need of special protection;

Schedule 3 Birds that are subject to an agreement between the governments of Australia and Japan relating to the protection of migratory birds and birds in danger of extinction, which are declared to be fauna in need of special protection; and

Schedule 4 Taxa that are in need of special protection, otherwise than for the reasons mentioned in paragraphs (1), (2) and (3).

In addition to the above classification, fauna are also classified under five different Priority codes:

Priority One **Taxa with few, poorly known populations on threatened lands.**
Taxa that are known from a few specimens or sight records from one or a few localities on lands not managed for conservation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.

Priority Two **Taxa with few, poorly known populations on conservation lands, or taxa with several, poorly known populations not on conservation lands.**
Taxa that are known from few specimens or sight records from one or a few localities on l ands not under immediate threat of habitat destruction or degradation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.

Priority Three **Taxa with several, poorly known populations, some on conservation lands.**
Taxa that are known from few specimens or sight records from several localities, some of which are on lands not under immediate threat of habitat destruction or degradation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.

Priority Four **Taxa in need of monitoring.**
Taxa which are considered to have been adequately surveyed or for which sufficient knowledge is available and which are considered not currently threatened or in need of special protection, but could be if present circumstances change. These taxa are usually represented on conservation lands. Taxa which are declining significantly but are not yet threatened.

Priority Five **Taxa in need of monitoring**
Taxa that are not considered threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

Fauna species of national conservation significance are listed under the *EPBC Act 1999*, and may be classified as 'critically endangered', 'endangered', 'vulnerable' or 'conservation dependent' (consistent with IUCN categories; see http://www.redlist.org/info/categories_criteria2001.html).

Appendix 2

NatureMap Database Search Results- Flora

NatureMap Species Report

Created By Guest user on 21/09/2011

Kingdom Plantae
Method 'By Circle'
Centre 115°28' 27" E,29°57' 14" S
Buffer 15km
Group By Family

Family	Species	Records
Apiaceae	2	2
Asparagaceae	5	5
Asteraceae	2	2
Boraginaceae	1	3
Boryaceae	1	1
Byblidaceae	1	1
Campanulaceae	1	1
Casuarinaceae	3	10
Cyperaceae	17	36
Dilleniaceae	6	11
Droseraceae	5	10
Ecdeiocoleaceae	1	1
Elaeocarpaceae	1	2
Ericaceae	13	24
Euphorbiaceae	5	6
Fabaceae	42	76
Goodeniaceae	11	15
Gyrostemonaceae	1	1
Haemodoraceae	18	39
Hemerocallidaceae	2	2
Lamiaceae	7	12
Lauraceae	2	3
Loganiaceae	1	1
Malvaceae	3	6
Myrtaceae	69	158
Orchidaceae	5	8
Poaceae	2	3
Proteaceae	82	190
Restionaceae	12	31
Rhamnaceae	1	1
Rubiaceae	1	1
Rutaceae	5	8
Sapindaceae	1	2
Stylidiaceae	8	26
Thymelaeaceae	2	2
Violaceae	1	1
TOTAL	**340**	**701**

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Apiaceae					
1.	-8357	*Platysace sp.*			
2.	14996	*Platysace sp. Eneabba (R. Hnatiuk 770001)*			
Asparagaceae					
3.	1228	*Lomandra hermaphrodita*			
4.	1243	*Lomandra sericea (Silky Mat Rush)*			
5.	1328	*Thysanotus dichotomus (Branching Fringe Lily)*			
6.	1339	*Thysanotus multiflorus (Many-flowered Fringe Lily)*			
7.	1343	*Thysanotus patersonii*			
Asteraceae					
8.	14377	*Erymophyllum ramosum subsp. ramosum*			
9.	8184	*Podotheca gnaphalioides (Golden Long-heads)*			
Boraginaceae					
10.	29716	*Halgania sp. Wongan Hills (K.F. Kenneally 2393)*			
Boryaceae					
11.	1273	*Borya sphaerocephala (Pincushions)*			
Byblidaceae					
12.	20230	*Byblis lamellata*			
Campanulaceae					

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
13.	7396	*Isotoma hypocrateriformis (Woodbridge Poison)*			
Casuarinaceae					
14.	1732	*Allocasuarina humilis (Dwarf Sheoak)*			
15.	1734	*Allocasuarina microstachya*			
16.	1736	*Allocasuarina ramosissima*		P3	
Cyperaceae					
17.	760	*Caustis dioica*			
18.	13765	*Caustis gigas*		P2	
19.	768	*Cyathochaeta avenacea*			
20.	17618	*Cyathochaeta equitans*			
21.	936	*Lepidosperma leptostachyum*			
22.	955	*Mesomelaena pseudostygia*			
23.	11623	*Mesomelaena stygia subsp. deflexa*		P3	
24.	957	*Mesomelaena tetragona (Semaphore Sedge)*			
25.	978	*Schoenus brevisetis*			
26.	984	*Schoenus curvifolius*			
27.	17606	*Schoenus griffinianus*		P3	
28.	17617	*Schoenus insolitus*			
29.	1007	*Schoenus pedicellatus*			
30.	1009	*Schoenus pleiostemoneus*			
31.	18164	*Schoenus sp. smooth culms (K.R. Newbey 7823)*			
32.	1019	*Schoenus subflavus (Yellow Bog-rush)*			
33.	1036	*Tetraria octandra*			
Dilleniaceae					
34.	5108	*Hibbertia acerosa (Needle Leaved Guinea Flower)*			
35.	5116	*Hibbertia crassifolia*			
36.	35521	*Hibbertia fasciculiflora*			
37.	-7810	*Hibbertia helianthemoides (Northern)*			
38.	5135	*Hibbertia hypericoides (Yellow Buttercups)*			
39.	5173	*Hibbertia subvaginata*			
Droseraceae					
40.	3095	*Drosera erythrorhiza (Red Ink Sundew)*			
41.	13208	*Drosera marchantii subsp. prophylla*		P3	
42.	11196	*Drosera menziesii subsp. thysanosepala*			
43.	11246	*Drosera neesii subsp. borealis*			
44.	3131	*Drosera stolonifera (Leafy Sundew)*			
Ecdeiocoleaceae					
45.	18404	*Georgeantha hexandra*			
Elaeocarpaceae					
46.	23982	*Tetratheca angulata*		P3	
Ericaceae					
47.	11606	*Andersonia lehmanniana subsp. pubescens*			
48.	6328	*Astroloma glaucescens*			
49.	6337	*Astroloma stomarrhena (Red Swamp Cranberry)*			
50.	6339	*Astroloma xerophyllum*			
51.	6348	*Conostephium pendulum (Pearl Flower)*			
52.	6374	*Leucopogon conostephioides*			
53.	6418	*Leucopogon obtectus (Hidden Beard-heath)*		T	
54.	6420	*Leucopogon oldfieldii*			
55.	6421	*Leucopogon oliganthus*			
56.	19578	*Leucopogon sp. Bifid Eneabba (M. Hislop 1927)*			
57.	34157	*Leucopogon sp. Northern ciliate (R. Davis 3393)*			
58.	37040	*Leucopogon sp. Watheroo (R.D. Royce 9616)*			
59.	20648	*Lissanthe powelliae*			
Euphorbiaceae					
60.	4662	*Monotaxis grandiflora (Diamond of the Desert)*			
61.	4666	*Monotaxis occidentalis*			
62.	4698	*Ricinocarpos muricatus*			
63.	4713	*Stachystemon axillaris (Leafy Stachystemon)*			
64.	-4004	*Stachystemon sp.*			Y
Fabaceae					
65.	3231	*Acacia auronitens*			
66.	15470	*Acacia barbinervis subsp. borealis*			
67.	3319	*Acacia epacantha*		P3	
68.	3382	*Acacia incrassata*			
69.	11678	*Acacia moirii subsp. recurvistipula*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
70.	15481	*Acacia pulchella var. glaberrima*			
71.	15480	*Acacia pulchella var. reflexa*			
72.	16142	*Acacia puncticulata*			
73.	3541	*Acacia sessilis*			
74.	3602	*Acacia willdenowiana (Grass Wattle)*			
75.	-3825	*Acacia willdenowiana (Phyllodes glaucous)*			Y
76.	3710	*Bossiaea eriocarpa (Common Brown Pea)*			
77.	13111	*Chorizema aciculare subsp. laxum*			
78.	14199	*Daviesia chapmanii*			
79.	3803	*Daviesia daphnoides*			
80.	12326	*Daviesia hakeoides subsp. subnuda*			
81.	3816	*Daviesia incrassata*			
82.	15506	*Daviesia incrassata subsp. teres*			
83.	3819	*Daviesia longifolia*			
84.	3824	*Daviesia nudiflora*			
85.	3831	*Daviesia pedunculata*			
86.	3833	*Daviesia podophylla*			
87.	14201	*Daviesia pteroclada*		P3	
88.	29078	*Dillwynia sp. Northern Sandplains (M. Hislop 3278)*			
89.	3894	*Gastrolobium callistachys (Rock Poison)*			
90.	3912	*Gastrolobium oxylobioides (Champion Bay Poison)*			
91.	3915	*Gastrolobium plicatum*			
92.	3945	*Gompholobium aristatum*			
93.	3957	*Gompholobium tomentosum (Hairy Yellow Pea)*			
94.	3967	*Hovea stricta*			
95.	19700	*Isotropis cuneifolia subsp. cuneifolia*			
96.	14747	*Jacksonia anthoclada*		P3	
97.	4003	*Jacksonia carduacea*		P3	
98.	4010	*Jacksonia floribunda (Holly Pea)*			
99.	4015	*Jacksonia hakeoides*			
100.	4018	*Jacksonia lehmannii*			
101.	14778	*Jacksonia nutans*			
102.	4025	*Jacksonia restioides*			
103.	4044	*Kennedia prostrata (Scarlet Runner)*			
104.	4091	*Mirbelia floribunda (Purple Mirbelia)*			
105.	17551	*Sphaerolobium drummondii*			
106.	10800	*Sphaerolobium pulchellum*			
Goodeniaceae					
107.	7425	*Dampiera carinata (Summer Dampiera)*			
108.	7449	*Dampiera juncea (Rush-like Dampiera)*			
109.	7454	*Dampiera linearis (Common Dampiera)*			
110.	7475	*Dampiera spicigera (Spiked Dampiera)*			
111.	7495	*Goodenia berardiana*			
112.	12520	*Goodenia fasciculata*			
113.	12522	*Goodenia glareicola*			
114.	7513	*Goodenia hassallii*			
115.	7575	*Lechenaultia formosa (Red Leschenaultia)*			
116.	7577	*Lechenaultia hirsuta (Hairy Leschenaultia)*			
117.	7619	*Scaevola lanceolata*			
Gyrostemonaceae					
118.	2791	*Tersonia cyathiflora (Button Creeper)*			
Haemodoraceae					
119.	11434	*Anigozanthos humilis subsp. humilis*			
120.	11414	*Conostylis aculeata subsp. breviflora*			
121.	1420	*Conostylis androstemma (Trumpets)*			
122.	1423	*Conostylis aurea (Golden Conostylis)*			
123.	1427	*Conostylis candicans (Grey Cottonhead)*			
124.	-12810	*Conostylis candicans x aculeata subsp. breviflora*			
125.	1428	*Conostylis canteriata*			
126.	1430	*Conostylis crassinervia*			
127.	11773	*Conostylis crassinervia subsp. absens*			
128.	11938	*Conostylis crassinervia subsp. crassinervia*			
129.	1435	*Conostylis hiemalis*			
130.	1451	*Conostylis seminuda*			
131.	-11782	*Conostylis sp.*			
132.	11870	*Conostylis teretifolia subsp. teretifolia*			
133.	1458	*Conostylis teretiuscula*			
134.	1473	*Haemodorum simulans*			
135.	1479	*Phlebocarya filifolia*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
136.	11557	*Phlebocarya pilosissima subsp. pilosissima*		P3	
Hemerocallidaceae					
137.	1276	*Caesia micrantha (Pale Grass-lily)*			
138.	19632	*Johnsonia pubescens subsp. pubescens*			
Lamiaceae					
139.	6748	*Cyanostegia corifolia (Tinsel Flower)*			
140.	6839	*Hemiandra pungens (Snakebush)*			
141.	6841	*Hemiandra rutilans (Colourful Snakebush)*		T	
142.	19411	*Hemiandra sp. Eneabba (H. Demarz 3687)*		P3	
143.	14595	*Hemiandra sp. Watheroo (S. Hancocks 4)*		P4	
144.	6780	*Lachnostachys eriobotrya (Lambswool)*			
145.	6797	*Physopsis spicata (Hill River Lambstail)*			
Lauraceae					
146.	2952	*Cassytha glabella (Tangled Dodder Laurel)*			
147.	2956	*Cassytha pomiformis (Dodder Laurel)*			
Loganiaceae					
148.	6512	*Logania spermacocea*			
Malvaceae					
149.	5005	*Commersonia pulchella*			
150.	5036	*Lasiopetalum lineare*		P3	
151.	33485	*Lasiopetalum sp. Badgingarra (E.A. Griffin 5278)*		P2	
Myrtaceae					
152.	5350	*Baeckea grandiflora (Large-flowered Baeckea)*			
153.	19948	*Baeckea sp. Bunney Road (S. Patrick 4059)*		P2	
154.	5377	*Beaufortia bicolor*		P3	
155.	5378	*Beaufortia bracteosa*			
156.	5382	*Beaufortia elegans*			
157.	5393	*Beaufortia squarrosa (Sand Bottlebrush)*			
158.	5429	*Calothamnus sanguineus (Silky-leaved Blood flower)*			
159.	5441	*Calytrix aurea*			
160.	5447	*Calytrix chrysantha*		P4	
161.	5453	*Calytrix drummondii*			
162.	5455	*Calytrix eneabbensis*		P4	
163.	5458	*Calytrix flavescens (Summer Starflower)*			
164.	5460	*Calytrix fraseri (Pink Summer Calytrix)*			
165.	5493	*Chamelaucium drummondii*			
166.	14808	*Chamelaucium drummondii subsp. drummondii*			
167.	5503	*Corynanthera flava*			
168.	34776	*Darwinia chapmaniana*		T	
169.	5518	*Darwinia neildiana (Fringed Bell)*			
170.	20090	*Darwinia sp. Watheroo (I.R. McGill 20)*			
171.	5529	*Darwinia speciosa*			
172.	13952	*Eremaea asterocarpa subsp. histoclada*			
173.	13962	*Eremaea atala*			
174.	14100	*Eremaea beaufortioides var. microphylla*			
175.	13955	*Eremaea ectadioclada*			
176.	13951	*Eremaea hadra*			
177.	5541	*Eremaea pauciflora*			
178.	13818	*Eremaea pauciflora var. lonchophylla*			
179.	14104	*Eremaea pauciflora var. pauciflora*			
180.	5543	*Eremaea violacea (Violet Eremaea)*			
181.	13953	*Eremaea x codonocarpa*			
182.	13956	*Eremaea x phoenicea*			
183.	5545	*Eucalyptus accedens (Powderbark Wandoo)*			
184.	5548	*Eucalyptus albida (White-leaved Mallee)*			
185.	5615	*Eucalyptus decipiens*			
186.	5628	*Eucalyptus drummondii (Drummond's Gum)*			
187.	18292	*Eucalyptus gittinsii subsp. illucida*			
188.	5680	*Eucalyptus johnsoniana (Johnson's Mallee)*		T	
189.	5741	*Eucalyptus pendens (Badgingarra Mallee)*		P4	
190.	29774	*Eucalyptus sp. Badgingarra (D. Nicolle & M. French DN 3515)*			
191.	5847	*Leptospermum erubescens (Roadside Teatree)*			
192.	5857	*Leptospermum spinescens*			
193.	5865	*Malleostemon roseus*			
194.	5888	*Melaleuca ciliosa*			
195.	16088	*Melaleuca coronicarpa*			
196.	5949	*Melaleuca platycalyx*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
197.	18598	*Melaleuca systena*			
198.	5983	*Melaleuca trichophylla*			
199.	15673	*Melaleuca tuberculata*			
200.	5986	*Melaleuca urceolaris*			
201.	-13046	*Melaleuca urceolaris x zonalis*			
202.	6039	*Scholtzia teretifolia*			
203.	6041	*Scholtzia umbellifera*			
204.	12389	*Verticordia albida*		T	
205.	12396	*Verticordia blepharophylla*			
206.	6071	*Verticordia brachypoda*			
207.	12402	*Verticordia chrysanthella*			
208.	6076	*Verticordia densiflora (Compacted Featherflower)*			
209.	15432	*Verticordia densiflora var. densiflora*			
210.	6083	*Verticordia grandis (Scarlet Featherflower)*			
211.	12429	*Verticordia huegelii var. decumbens*			
212.	-10108	*Verticordia insignis subsp. comagis*			
213.	12434	*Verticordia insignis subsp. eomagis*		P3	
214.	12437	*Verticordia laciniata*			
215.	14716	*Verticordia muelleriana subsp. muelleriana*		P3	
216.	10822	*Verticordia nobilis*			
217.	6103	*Verticordia ovalifolia*			
218.	6107	*Verticordia pennigera*			
219.	6109	*Verticordia picta (Painted Featherflower)*			
220.	12456	*Verticordia rutilastra*		P3	
Orchidaceae					
221.	15358	*Caladenia longicauda subsp. albella*			
222.	15404	*Cyanicula sericea*			
223.	1643	*Elythranthera brunonis (Purple Enamel Orchid)*			
224.	13867	*Paracaleana dixonii*		T	
225.	1702	*Thelymitra campanulata (Shirt Orchid)*			
Poaceae					
226.	-3593	*Amphipogon caricinus - strictus complex*			
227.	492	*Neurachne alopecuroidea (Foxtail Mulga Grass)*			
Proteaceae					
228.	1800	*Banksia attenuata (Slender Banksia)*			
229.	1807	*Banksia burdettii (Burdett's Banksia)*			
230.	1809	*Banksia candolleana (Propeller Banksia)*			
231.	32623	*Banksia carlinoides (Pink Dryandra)*			
232.	1810	*Banksia chamaephyton (Fishbone Banksia)*		P4	
233.	32596	*Banksia cypholoba*		P3	
234.	32519	*Banksia glaucifolia*			
235.	1820	*Banksia grossa*			
236.	1823	*Banksia incana*			
237.	33398	*Banksia incana var. brachyphylla*			
238.	32215	*Banksia kippistiana var. kippistiana*			
239.	32216	*Banksia kippistiana var. paenepeccata*		P3	
240.	1825	*Banksia lanata*			
241.	1828	*Banksia leptophylla*			
242.	-8408	*Banksia menziesii x prionotes*			
243.	1835	*Banksia micrantha*			
244.	32201	*Banksia nobilis subsp. fragrans*		P3	
245.	32163	*Banksia platycarpa*		P4	
246.	32138	*Banksia pteridifolia subsp. vernalis*		P3	
247.	32086	*Banksia sclerophylla*		P4	
248.	32083	*Banksia serratuloides subsp. perissa*		T	
249.	32074	*Banksia shuttleworthiana (Bearded Dryandra)*			
250.	33401	*Banksia sphaerocarpa var. pumilio*			
251.	12111	*Banksia sphaerocarpa var. sphaerocarpa (Fox Banksia)*			
252.	32073	*Banksia splendida subsp. macrocarpa*		P3	
253.	32042	*Banksia strictifolia*			
254.	32037	*Banksia subulata (Awled Honeypot)*		P3	
255.	1852	*Banksia telmatiaea (Swamp Fox Banksia)*			
256.	32032	*Banksia tridentata (Yellow Honeypot)*			
257.	32031	*Banksia vestita (Summer Dryandra)*			
258.	15512	*Conospermum boreale subsp. ascendens*			
259.	-7989	*Conospermum boreale x wycherleyi*			
260.	1859	*Conospermum brachyphyllum*			
261.	1864	*Conospermum crassinervium (Summer Smokebush)*			
262.	1876	*Conospermum incurvum (Plume Smokebush)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
263.	1878	*Conospermum nervosum*			
264.	15521	*Conospermum unilaterale*			
265.	15524	*Conospermum wycherleyi subsp. glabrum*			
266.	15522	*Conospermum wycherleyi subsp. wycherleyi*			
267.	1894	*Dryandra carlinoides (Pink Dryandra)*			Y
268.	16646	*Dryandra catoglypta*			Y
269.	16679	*Dryandra cypholoba*			
270.	13832	*Dryandra glauca*			Y
271.	16672	*Dryandra lindleyana (Couch Honeypot)*			
272.	16260	*Dryandra nivea subsp. nivea*			
273.	13990	*Dryandra platycarpa*			
274.	1932	*Dryandra sessilis (Parrot Bush)*			
275.	1934	*Dryandra shuttleworthiana (Bearded Dryandra)*			
276.	16683	*Dryandra speciosa subsp. macrocarpa*			Y
277.	1939	*Dryandra subulata (Awled Honeypot)*			
278.	2013	*Grevillea granulosa*		P3	
279.	2086	*Grevillea rudis*		P4	
280.	2116	*Grevillea uncinulata (Hook-leaf Grevillea)*			
281.	2131	*Hakea auriculata*			
282.	12225	*Hakea brownii*			
283.	16908	*Hakea eneabba*			
284.	2161	*Hakea flabellifolia (Fan-leaved Hakea)*			
285.	2164	*Hakea gilbertii*			
286.	2166	*Hakea incrassata (Marble Hakea)*			
287.	2175	*Hakea lissocarpha (Honey Bush)*			
288.	2180	*Hakea megalosperma (Lesueur Hakea)*		T	
289.	12233	*Hakea psilorrhyncha*			
290.	2205	*Hakea smilacifolia*			
291.	2219	*Isopogon adenanthoides (Spider Coneflower)*			
292.	2232	*Isopogon linearis*			
293.	14357	*Isopogon sp. Watheroo (D. Foreman 477)*			
294.	15528	*Lambertia multiflora var. multiflora*			
295.	2271	*Persoonia rudis*		P3	
296.	14368	*Petrophile aculeata*			
297.	2285	*Petrophile biternata*		P3	
298.	2286	*Petrophile brevifolia*			
299.	19763	*Petrophile clavata*		P2	
300.	2294	*Petrophile drummondii*			
301.	2303	*Petrophile megalostegia*			
302.	29208	*Petrophile pilostyla subsp. austrina*			
303.	10784	*Petrophile scabriuscula*			
304.	2310	*Petrophile shuttleworthiana*			
305.	2317	*Stirlingia simplex*			
306.	2319	*Strangea cynanchicarpa (Heath Strangea)*			
307.	16882	*Synaphea aephynsa*		P3	
308.	2329	*Synaphea spinulosa*			
309.	15532	*Synaphea spinulosa subsp. spinulosa*			
Restionaceae					
310.	1056	*Alexgeorgea nitens*			
311.	1057	*Alexgeorgea subterranea*			
312.	17833	*Chordifex microcodon*			
313.	17706	*Chordifex sinuosus*			
314.	15828	*Desmocladus elongatus*		P4	
315.	17846	*Desmocladus parthenicus*			
316.	17712	*Desmocladus semiplanus*			
317.	16455	*Desmocladus virgatus*			
318.	17622	*Hypolaena robusta*		P4	
319.	1073	*Lepidobolus chaetocephalus (Bristle-headed Chaff Rush)*			
320.	17837	*Loxocarya gigas*		P2	
321.	16470	*Onychosepalum microcarpum*		P2	
Rhamnaceae					
322.	4809	*Cryptandra pungens*			
Rubiaceae					
323.	18255	*Opercularia vaginata (Dog Weed)*			
Rutaceae					
324.	16637	*Boronia scabra subsp. condensata*		P2	
325.	4455	*Diplolaena ferruginea*			
326.	4483	*Geleznowia verrucosa*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
327.	18535	*Philotheca pinoides*			
328.	18529	*Philotheca spicata (Pepper and Salt)*			
Sapindaceae					
329.	-7799	*Diplopeltis huegelii subsp. huegelii / subintegra*			
Stylidiaceae					
330.	12846	*Stylidium albolilacinum*			
331.	7709	*Stylidium crossocephalum (Posy Triggerplant)*			
332.	7710	*Stylidium cygnorum*			
333.	7749	*Stylidium leptophyllum (Needle-leaved Triggerplant)*			
334.	7760	*Stylidium maitlandianum (Fountain Triggerplant)*			
335.	7766	*Stylidium nonscandens*		P3	
336.	7785	*Stylidium repens (Matted Triggerplant)*			
337.	25806	*Stylidium scariosum*			
Thymelaeaceae					
338.	11402	*Pimelea imbricata var. piligera*			
339.	12041	*Pimelea suaveolens subsp. suaveolens*			
Violaceae					
340.	-6765	*Hybanthus sp.*			

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

[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely 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 3

NatureMap Database Search Results- Fauna

NatureMap Species Report

Created By Guest user on 28/11/2011

Kingdom Animalia
Method 'By Circle'
Centre 115°28' 27" E,29°57' 14" S
Buffer 30km
Group By Family

Family	Species	Records
Acanthizidae	11	253
Accipitridae	8	49
Actinopodidae	1	1
Agamidae	7	38
Agelenidae	1	1
Amaurobiidae	5	7
Anatidae	7	40
Ardeidae	2	17
Artamidae	2	50
Balaenidae	1	1
Brachionidae	2	2
Cacatuidae	2	7
Campephagidae	2	71
Casuariidae	1	18
Centropagidae	1	1
Charadriidae	4	25
Chironomidae	6	6
Colletidae	1	1
Columbidae	4	77
Corixidae	2	2
Corvidae	3	111
Cracticidae	3	108
Cuculidae	5	37
Culicidae	2	2
Curculionidae	3	4
Cycloctenidae	1	1
Cyclopoidae	1	1
Cypridae	3	3
Daphniidae	1	1
Dasyuridae	2	14
Desidae	1	1
Dicaeidae	1	3
Dicruridae	3	200
Diplodactylidae	5	22
Dytiscidae	9	9
Elapidae	7	14
Estrilidae	1	3
Eylaidae	1	1
Falconidae	3	45
Halcyonidae	3	14
Hemicorduliidae	1	1
Hirundinidae	5	112
Hydrachnidae	1	1
Hydrophilidae	3	3
Hylidae	1	1
Idiopidae	1	1
Lamponidae	3	3
Lecanidae	2	2
Lepadellidae	1	1
Leptoceridae	2	2
Lestidae	2	2
Limnadiidae	1	1
Limnodynastidae	4	12
Lycaenidae	2	3
Lycosidae	4	5
Lyncaeidae	1	1
Macropodidae	1	1
Maluridae	6	89
Meliphagidae	18	432
Meropeidae	1	1
Meropidae	1	17
Micropholcommatidae	1	1
Moinidae	1	1
Motacillidae	1	45
Muridae	3	11
Myobatrachidae	3	13
Nemesiidae	2	2
Notonectidae	2	2
Oonopidae	6	6
Otididae	1	3
Pachycephalidae	5	77
Pararchaeidae	1	2
Pardalotidae	1	46
Pentatomidae	1	1
Petroicidae	6	42
Phalacrocoracidae	2	4
Phasianidae	2	4
Podargidae	1	1
Podicipedidae	2	3

Pomatostomidae	1	1
Psittacidae	11	250
Pteropodidae	1	1
Pygopodidae	8	12
Rallidae	1	2
Recurvirostridae	3	9
Salticidae	8	10
Scarabaeidae	1	1
Scincidae	13	69
Scolopacidae	3	10
Scorpionidae	1	3
Scutelleridae	2	4
Segestriidae	1	1
Strigidae	1	1
Sylviidae	3	21
Tarsipedidae	1	18
Tenebrionidae	1	1
Theridiidae	2	2
Threskiornithidae	1	3
Turnicidae	1	1
Typhlopidae	1	1
Vespertilionidae	2	2
Zodariidae	9	12
Zosteropidae	1	59
TOTAL	**307**	**2710**

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Acanthizidae					
1.	24260	*Acanthiza apicalis (Broad-tailed Thornbill)*			
2.	24261	*Acanthiza chrysorrhoa (Yellow-rumped Thornbill)*			
3.	24262	*Acanthiza inornata (Western Thornbill)*			
4.	24265	*Acanthiza uropygialis (Chestnut-rumped Thornbill)*			
5.	24269	*Calamanthus campestris (Rufous Fieldwren)*			
6.	34000	*Calamanthus campestris subsp. montanellus (Rufous Fieldwren)*		P4	
7.	-360	*Calamanthus cautus*			
8.	25530	*Gerygone fusca (Western Gerygone)*			
9.	24278	*Pyrrholaemus brunneus (Redthroat)*			
10.	25534	*Sericornis frontalis (White-browed Scrubwren)*			
11.	30948	*Smicrornis brevirostris (Weebill)*			
Accipitridae					
12.	25536	*Accipiter fasciatus (Brown Goshawk)*			
13.	24285	*Aquila audax (Wedge-tailed Eagle)*			
14.	24289	*Circus assimilis (Spotted Harrier)*			
15.	-353	*Elanus axillaris*			
16.	24293	*Haliaeetus leucogaster (White-bellied Sea-Eagle)*			
17.	24295	*Haliastur sphenurus (Whistling Kite)*			
18.	-354	*Hieraaetus morphnoides*			
19.	-369	*Lophoictinia isura*			
Actinopodidae					
20.		*Missulena sp. 1*			
Agamidae					
21.		*Ctenoph sp B SAP*			Y
22.	30899	*Ctenophorus adelaidensis (Southern Heath Dragons)*			
23.	24881	*Ctenophorus maculatus subsp. maculatus*			
24.	24904	*Moloch horridus (Thorny Devil)*			
25.	25510	*Pogona minor*			
26.	24907	*Pogona minor subsp. minor*			
27.	25513	*Rankinia adelaidensis*			
Agelenidae					
28.		*Gen. 1 sp. 2*			
Amaurobiidae					
29.		*Gen. 1 sp. 2*			
30.		*Gen. 3 sp. 10*			
31.		*Gen. 3 sp. 12*			
32.		*Gen. 3 sp. 3*			
33.		*Gen. 5 sp. 1*			
Anatidae					
34.	24312	*Anas gracilis (Grey Teal)*			
35.	24316	*Anas superciliosa (Pacific Black Duck)*			
36.	24319	*Biziura lobata (Musk Duck)*			
37.	24321	*Chenonetta jubata (Australian Wood Duck)*			
38.	24322	*Cygnus atratus (Black Swan)*			
39.	24326	*Malacorhynchus membranaceus (Pink-eared Duck)*			
40.	24331	*Tadorna tadornoides (Australian Shelduck)*			
Ardeidae					
41.	24341	*Ardea pacifica (White-necked Heron)*			
42.	-330	*Egretta novaehollandiae*			
Artamidae					
43.	25566	*Artamus cinereus (Black-faced Woodswallow)*			
44.	24353	*Artamus cyanopterus (Dusky Woodswallow)*			
Balaenidae					
45.	24043	*Eubalaena australis (Southern Right Whale)*		T	
Brachionidae					
46.		*Keratella procurva*			
47.		*Keratella slacki*			
Cacatuidae					
48.	-439	*Cacatua sp.*			
49.	-453	*Calyptorhynchus sp.*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Campephagidae					
50.	25568	*Coracina novaehollandiae (Black-faced Cuckoo-shrike)*			
51.	-394	*Lalage sueurii*			
Casuariidae					
52.	24470	*Dromaius novaehollandiae (Emu)*			
Centropagidae					
53.		*Boeckella triarticulata*			
Charadriidae					
54.	24377	*Charadrius ruficapillus (Red-capped Plover)*			
55.	-326	*Elseyornis melanops*			
56.	24379	*Erythrogonys cinctus (Red-kneed Dotterel)*			
57.	24386	*Vanellus tricolor (Banded Lapwing)*			
Chironomidae					
58.		*Chironomus aff. alternans (V24)*			
59.		*Chironomus tepperi*			
60.		*Polypedilum nubifer*			
61.		*Procladius paludicola*			
62.		*Procladius villosimanus*			
63.		*Tanytarsus fuscithorax/semibarbitarsus*			
Colletidae					
64.	33977	*Hylaeus globuliferus (bee)*		P3	
Columbidae					
65.	24399	*Columba livia (Domestic Pigeon)*			
66.	24407	*Ocyphaps lophotes (Crested Pigeon)*			
67.	24409	*Phaps chalcoptera (Common Bronzewing)*			
68.	25587	*Phaps elegans (Brush Bronzewing)*			
Corixidae					
69.		*Agraptocorixa parvipunctata*			
70.		*Micronecta robusta*			
Corvidae					
71.	24416	*Corvus bennetti (Little Crow)*			
72.	25592	*Corvus coronoides (Australian Raven)*			
73.	-419	*Corvus sp.*			
Cracticidae					
74.	24420	*Cracticus nigrogularis (Pied Butcherbird)*			
75.	25595	*Cracticus tibicen (Australian Magpie)*			
76.	25596	*Cracticus torquatus (Grey Butcherbird)*			
Cuculidae					
77.	25598	*Cacomantis flabelliformis (Fan-tailed Cuckoo)*			
78.	-343	*Cacomantis pallidus*			
79.	-377	*Chalcites basalis*			
80.	-334	*Chalcites lucidus*			
81.	-368	*Chalcites osculans*			
Culicidae					
82.		*Anopheles annulipes*			
83.		*Culex (culex) australicus*			
Curculionidae					
84.		*Catasarcus pallidiventris*			Y
85.		*Haplonyx sp.*			
86.		*Oxyops sp.*			
Cycloctenidae					
87.		*Gen. 1 sp. 2*			
Cyclopoidae					
88.		*Australocyclops australis*			
Cyprididae					
89.		*Cypretta baylyi*			
90.		*Heterocypris incongruens*			
91.		*Ilyodromus sp. 573*			
Daphniidae					
92.		*Daphnia carinata*			
Dasyuridae					
93.	24109	*Sminthopsis dolichura (Little long-tailed Dunnart)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
94.	24112	*Sminthopsis granulipes (White-tailed Dunnart)*			
Desidae					
95.		*Gen. 1 sp. 2*			
Dicaeidae					
96.	25607	*Dicaeum hirundinaceum (Mistletoebird)*			
Dicruridae					
97.	24443	*Grallina cyanoleuca (Magpie-lark)*			
98.	-407	*Rhipidura albiscapa*			
99.	25614	*Rhipidura leucophrys (Willie Wagtail)*			
Diplodactylidae					
100.	24918	*Crenadactylus ocellatus subsp. ocellatus*			
101.	24938	*Diplodactylus ornatus*			
102.	24939	*Diplodactylus polyophthalmus*			
103.	25518	*Strophurus spinigerus*			
104.	24942	*Strophurus spinigerus subsp. spinigerus*			
Dytiscidae					
105.		*Allodessus bistrigatus*			
106.		*Antiporus sp.*			
107.		*Eretes australis*			
108.		*Lancetes lanceolatus*			
109.		*Megaporus howitti*			
110.		*Onychohydrus scutellaris*			
111.		*Paroster niger*			
112.		*Rhantus suturalis*			
113.		*Sternopriscus sp.*			
Elapidae					
114.	25251	*Echiopsis curta (Bardick)*			
115.	25366	*Hydrophis elegans*			
116.	25249	*Neelaps calonotos (Black-striped Snake)*		P3	
117.	25253	*Parasuta gouldii*			
118.	25261	*Pseudechis australis (Mulga Snake)*			
119.	25264	*Pseudonaja nuchalis (Gwardar)*			
120.	25267	*Simoselaps littoralis (West Coast Banded Snake)*			
Estrilidae					
121.	30870	*Taeniopygia guttata (Zebra Finch)*			
Eylaidae					
122.		*Eylais sp.*			
Falconidae					
123.	25621	*Falco berigora (Brown Falcon)*			
124.	25622	*Falco cenchroides (Australian Kestrel)*			
125.	25623	*Falco longipennis (Australian Hobby)*			
Halcyonidae					
126.	30901	*Dacelo novaeguineae (Laughing Kookaburra)*			
127.	-366	*Todiramphus pyrrhopygius*			
128.	25549	*Todiramphus sanctus (Sacred Kingfisher)*			
Hemicorduliidae					
129.		*Hemicordulia tau*			
Hirundinidae					
130.	-355	*Cheramoeca leucosterna*			
131.	24491	*Hirundo neoxena (Welcome Swallow)*			
132.	25629	*Hirundo nigricans (Tree Martin)*			
133.	-391	*Petrochelidon ariel*			
134.	-393	*Petrochelidon nigricans*			
Hydrachnidae					
135.		*Hydrachna nr approximata*			
Hydrophilidae					
136.		*Berosus sp.*			
137.		*Enochrus elongatus*			
138.		*Enochrus maculiceps*			
Hylidae					
139.	25388	*Litoria moorei (Motorbike Frog)*			
Idiopidae					

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140.	33917	*Idiosoma nigrum (Shield-backed Trapdoor Spider)*		T	
Lamponidae					
141.		*Lamponata daviesae*			
142.		*Lamponina sp. 2*			Y
143.		*Pseudolampona boree*			
Lecanidae					
144.		*Lecane bulla*			
145.		*Lecane hamata*			
Lepadellidae					
146.		*Lepadella cf. patella*			
Leptoceridae					
147.		*Oecetis sp.*			
148.		*Triplectides australis*			
Lestidae					
149.		*Austrolestes analis*			
150.		*Austrolestes io*			
Limnadiidae					
151.		*Limnadia sp. a (nr badia)*			
Limnodynastidae					
152.	25408	*Heleioporus albopunctatus (Western Spotted Frog)*			
153.	25410	*Heleioporus eyrei (Moaning Frog)*			
154.	25412	*Heleioporus psammophilus (Sand Frog)*			
155.	25426	*Neobatrachus pelobatoides (Humming Frog)*			
Lycaenidae					
156.		*Candalides acastus*			
157.		*Hypochrysops halyaetus*			
Lycosidae					
158.		*Artoria sp. 3*			
159.		*Gen. 1 sp. 2*			
160.		*Lycosa sp. 1*			
161.		*Lycosa sp. 6*			
Lyncaeidae					
162.		*Lynceus sp.*			
Macropodidae					
163.	24135	*Macropus robustus subsp. erubescens (Euro)*			
Maluridae					
164.	25651	*Malurus lamberti (Variegated Fairy-wren)*			
165.	25652	*Malurus leucopterus (White-winged Fairy-wren)*			
166.	24551	*Malurus pulcherrimus (Blue-breasted Fairy-wren)*			
167.	-427	*Malurus sp.*			
168.	25654	*Malurus splendens (Splendid Fairy-wren)*			
169.	25655	*Stipiturus malachurus (Southern Emu-wren)*			
Meliphagidae					
170.	24559	*Acanthagenys rufogularis (Spiny-cheeked Honeyeater)*			
171.	24560	*Acanthorhynchus superciliosus (Western Spinebill)*			
172.	24561	*Anthochaera carunculata (Red Wattlebird)*			
173.	24562	*Anthochaera lunulata (Western Little Wattlebird)*			
174.	24564	*Certhionyx variegatus (Pied Honeyeater)*			
175.	24567	*Epthianura albifrons (White-fronted Chat)*			
176.	24570	*Epthianura tricolor (Crimson Chat)*			
177.	-349	*Glyciphila melanops*			
178.	24577	*Lichenostomus ornatus (Yellow-plumed Honeyeater)*			
179.	24578	*Lichenostomus penicillatus (White-plumed Honeyeater)*			
180.	24581	*Lichenostomus virescens (Singing Honeyeater)*			
181.	25661	*Lichmera indistincta (Brown Honeyeater)*			
182.	24583	*Manorina flavigula (Yellow-throated Miner)*			
183.	25663	*Melithreptus brevirostris (Brown-headed Honeyeater)*			
184.	24594	*Phylidonyris melanops (Tawny-crowned Honeyeater)*			
185.	-396	*Phylidonyris niger*			
186.	25669	*Phylidonyris nigra (White-cheeked Honeyeater)*			
187.	24596	*Phylidonyris novaehollandiae (New Holland Honeyeater)*			
Meropeidae					
188.	33972	*Austromerope poultoni (scorpionfly)*		P2	

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Meropidae					
189.	24598	*Merops ornatus (Rainbow Bee-eater)*			
Micropholcommatidae					
190.		*Micropholcomma? sp. 4*			
Moinidae					
191.		*Moina australiensis*			
Motacillidae					
192.	-365	*Anthus novaeseelandiae*			
Muridae					
193.	24223	*Mus musculus (House Mouse)*			
194.	24230	*Pseudomys albocinereus (Ash-grey Mouse)*			
195.	24243	*Rattus fuscipes (Western Bush Rat)*			
Myobatrachidae					
196.	25401	*Crinia pseudinsignifera (Bleating Froglet)*			
197.	25420	*Myobatrachus gouldii (Turtle Frog)*			
198.	25433	*Pseudophryne guentheri (Crawling Toadlet)*			
Nemesiidae					
199.		*Merridinia sp. 2*			
200.		*Teyl sp. 16*			
Notonectidae					
201.		*Anisops hyperion*			
202.		*Anisops thienemanni*			
Oonopidae					
203.		*Gamasomorpha sp. 4*			Y
204.		*Myrmopopaea sp.*			
205.		*Opopaea sp. 1*			
206.		*Opopaea sp. 17*			Y
207.		*Opopaea sp. 18*			
208.		*Opopaea sp. 5*			
Otididae					
209.	24610	*Ardeotis australis (Australian Bustard)*		P4	
Pachycephalidae					
210.	25675	*Colluricincla harmonica (Grey Shrike-thrush)*			
211.	24618	*Oreoica gutturalis (Crested Bellbird)*			
212.	34011	*Oreoica gutturalis subsp. gutturalis (Crested Bellbird)*		P4	
213.	25679	*Pachycephala pectoralis (Golden Whistler)*			
214.	25680	*Pachycephala rufiventris (Rufous Whistler)*			
Pararchaeidae					
215.		*Pararchaea sp. 2*			
Pardalotidae					
216.	25682	*Pardalotus striatus (Striated Pardalote)*			
Pentatomidae					
217.		*Arniscus humeralis*			
Petroicidae					
218.	24652	*Eopsaltria georgiana (White-breasted Robin)*			
219.	-382	*Eopsaltria griseogularis*			
220.	-323	*Melanodryas cucullata*			
221.	25693	*Microeca fascinans (Jacky Winter)*			
222.	-403	*Petroica boodang*			
223.	24659	*Petroica goodenovii (Red-capped Robin)*			
Phalacrocoracidae					
224.	-389	*Microcarbo melanoleucos*			
225.	25699	*Phalacrocorax varius (Pied Cormorant)*			
Phasianidae					
226.	24671	*Coturnix pectoralis (Stubble Quail)*			
227.	25701	*Coturnix ypsilophora (Brown Quail)*			
Podargidae					
228.	25703	*Podargus strigoides (Tawny Frogmouth)*			
Podicipedidae					
229.	24681	*Poliocephalus poliocephalus (Hoary-headed Grebe)*			
230.	25705	*Tachybaptus novaehollandiae (Australasian Grebe)*			

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Pomatostomidae					
231.	24683	*Pomatostomus superciliosus (White-browed Babbler)*			
Psittacidae					
232.	-386	*Barnardius zonarius*			
233.	25714	*Cacatua pastinator (Western Long-billed Corella)*			
234.	25716	*Cacatua sanguinea (Little Corella)*			
235.	25717	*Calyptorhynchus banksii (Red-tailed Black-Cockatoo)*			
236.	24733	*Calyptorhynchus baudinii (Baudin's Cockatoo)*		T	
237.	24734	*Calyptorhynchus latirostris (Carnaby's Cockatoo)*		T	
238.	-3794	*Calyptorhynchus sp*			
239.	-322	*Eolophus roseicapillus*			
240.	24736	*Melopsittacus undulatus (Budgerigar)*			
241.	24742	*Nymphicus hollandicus (Cockatiel)*			
242.	25722	*Polytelis anthopeplus (Regent Parrot)*			
Pteropodidae					
243.	24173	*Pteropus scapulatus (Little Red Flying-fox)*			
Pygopodidae					
244.	24991	*Aprasia repens*			
245.	30905	*Delma concinna subsp. concinna*			
246.	25766	*Delma fraseri*			
247.	24999	*Delma grayii*			
248.	25005	*Lialis burtonis*			
249.	25509	*Pletholax gracilis (Keeled Legless Lizard)*			
250.	25007	*Pletholax gracilis subsp. gracilis*			
251.	25008	*Pygopus lepidopodus (Common Scaly Foot)*			
Rallidae					
252.	-370	*Tribonyx ventralis*			
Recurvirostridae					
253.	24774	*Cladorhynchus leucocephalus (Banded Stilt)*			
254.	25734	*Himantopus himantopus (Black-winged Stilt)*			
255.	24776	*Recurvirostra novaehollandiae (Red-necked Avocet)*			
Salticidae					
256.		*Adoxotoma chinopogon*			
257.		*Gen. 1 sp. 2*			
258.		*Gen. 3 sp. 3*			
259.		*Gen. 5 sp. 1*			
260.		*Grayenulla australensis*			
261.		*Holoplatys chudalupensis*			
262.		*Lycidas sp. 4*			
263.		*Paraplatoides sp. 1*			
Scarabaeidae					
264.		*Heteronyx sp.*			
Scincidae					
265.	25039	*Ctenotus fallens*			
266.	25047	*Ctenotus impar*			
267.	25463	*Ctenotus pantherinus (Leopard Ctenotus)*			
268.	25065	*Ctenotus pantherinus subsp. pantherinus*			
269.	25074	*Ctenotus schomburgkii*			
270.	25099	*Egernia multiscutata*			
271.	25128	*Lerista christinae*			
272.	25131	*Lerista distinguenda*			
273.	25165	*Lerista praepedita*			
274.	25184	*Menetia greyii*			
275.	25191	*Morethia lineoocellata*			
276.	25192	*Morethia obscura*			
277.	25207	*Tiliqua rugosa subsp. rugosa*			
Scolopacidae					
278.	-329	*Actitis hypoleucos*			
279.	24788	*Calidris ruficollis (Red-necked Stint)*			
280.	-437	*Genus sp.*			
Scorpionidae					
281.		*Cercophonius sp.*			
Scutelleridae					
282.		*Choerocoris sp.*			Y

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283.		*Choerocoris variegatus*			
Segestriidae					
284.		*Gen. 1 sp. 2*			
Strigidae					
285.	25747	*Ninox connivens (Barking Owl)*			
Sylviidae					
286.	25755	*Acrocephalus australis (Australian Reed Warbler)*			
287.	24833	*Cincloramphus cruralis (Brown Songlark)*			
288.	24834	*Cincloramphus mathewsi (Rufous Songlark)*			
Tarsipedidae					
289.	24167	*Tarsipes rostratus (Honey Possum)*			
Tenebrionidae					
290.		*Helaeus sp.*			
Theridiidae					
291.		*Gen. 1 sp. 2*			
292.		*Gen. 5 sp. 1*			
Threskiornithidae					
293.	24845	*Threskiornis spinicollis (Straw-necked Ibis)*			
Turnicidae					
294.	24851	*Turnix velox (Little Button-quail)*			
Typhlopidae					
295.	25288	*Ramphotyphlops waitii*			
Vespertilionidae					
296.	24194	*Nyctophilus geoffroyi (Lesser Long-eared Bat)*			
297.	24206	*Vespadelus regulus (Southern Forest Bat)*			
Zodariidae					
298.		*Australutica sp. 1*			
299.		*Cavasteron sp. 1*			
300.		*Gen. 1 sp. 2*			
301.		*Habronestes australiensis*			
302.		*Neostorena sp. 14*			
303.		*Neostorena sp. 21*			
304.		*Neostorena sp. 3*			
305.		*Nostera sp. 5*			
306.		*Phenasteron longiconductor*			
Zosteropidae					
307.	25765	*Zosterops lateralis (Grey-breasted White-eye)*			

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

[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely 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 4

EPBC Act 1999 Protected Matters Report

Matters of National Environmental Significance		
Threatened Species	**Status**	**Type of Presence**
Birds		
Calyptorhynchus latirostris (Carnaby's Black-Cockatoo)	Endangered	Breeding likely to occur within area
Leipoa ocellata (Malleefowl)	Vulnerable; Migratory	Species or species habitat likely to occur within area
Plants		
Andersonia gracilis Slender Andersonia	Endangered	Species or species habitat may occur within area
Banksia serratuloides subsp. perissa Northern Serrate Dryandra	Vulnerable	Species or species habitat likely to occur within area
Centrolepis caespitosa	Endangered	Species or species habitat may occur within area
Darwinia chapmaniana Chapman's Bell	Endangered	Species or species habitat likely to occur within area
Eucalyptus absita Badgingarra Box	Endangered	Species or species habitat may occur within area
Eucalyptus balanites Cadda Mallee	Endangered	Species or species habitat may occur within area
Eucalyptus impensa Eneabba Mallee	Endangered	Species or species habitat likely to occur within area
Eucalyptus johnsoniana Johnson's Mallee	Vulnerable	Species or species habitat likely to occur within area
Grevillea curviloba subsp. incurva Narrow curved-leafed Grevillea	Endangered	Species or species habitat may occur within area
Hakea megalosperma Lesueur Hakea	Vulnerable	Species or species habitat likely to occur within area
Hemiandra gardneri Red Snakebush	Endangered	Species or species habitat may occur within area
Leucopogon obtectus Hidden Beard-heath	Endangered	Species or species habitat likely to occur within area
Spirogardnera rubescens Spiral Bush	Endangered	Species or species habitat likely to occur within area

Migratory Species	**Status**	**Type of Presence**
Migratory Marine Birds		
Apus pacificus (Fork-tailed Swift)	Migratory	Species or species habitat may occur within area
Ardea alba (Great Egret, White Egret)	Migratory	Species or species habitat may occur within area
Ardea ibis (Cattle Egret)	Schedule 3; Migratory	Species or species habitat may occur within area
Migratory Terrestrial Species		
Haliaeetus leucogaster (White-bellied Sea-Eagle)	Schedule 3; Migratory	Species or species habitat likely to occur within area
Leipoa ocellata (Malleefowl)	Vulnerable; Migratory	Species or species habitat likely to occur within area
Merops ornatus (Rainbow Bee-eater)	Schedule 3; Migratory	Species or species habitat may occur within area
Migratory Wetland Species		
Ardea alba (Great Egret, White Egret)	Migratory	Species or species habitat may occur within area
Ardea ibis (Cattle Egret)	Migratory	Species or species habitat may occur within area

Extra Information		
Invasive Species	**Status**	**Type of Presence**
Mammals		
Capra hircus (Goat)	Invasive	Species or species habitat likely to occur within area
Felis catus (Cat, House/Domestic Cat)	Invasive	Species or species habitat likely to occur within area
Oryctolagus cuniculus (Rabbit, European Rabbit)	Invasive	Species or species habitat likely to occur within area
Sus scrofa (Pig)	Invasive	Species or species habitat likely to occur within area
Vulpes vulpes (Red Fox, Fox)	Invasive	Species or species habitat likely to occur within area
Plants		
Asparagus asparagoides Bridal Creeper	Invasive	Species or species habitat likely to occur within area
Cenchrus ciliaris Buffel-grass	Invasive	Species or species habitat may occur within area
Lycium ferocissimum African Boxthorn	Invasive	Species or species habitat may occur within area
Tamarix aphylla Athel Pine	Invasive	Species or species habitat likely to occur within area

Appendix 5

Vegetation Structural Classification and Condition Ranking Scale

Vegetation Structural Classes*

Vegetation Structural Classes used for BushForever*

Life Form / Height Class	Canopy Cover (percentage)			
	100-70%	**70-30%**	**30-10%**	**10-2%**
Trees over 30 m	Tall closed forest	Tall open forest	Tall woodland	Tall open woodland
Trees 10-30 m	Closed forest	Open forest	Woodland	Open woodland
Trees under 10 m	Low closed forest	Low open forest	Low woodland	Low open woodland
Tree Mallee	Closed tree mallee	Tree mallee	Open tree mallee	Very open tree mallee
Shrub Mallee	Closed shrub mallee	Shrub mallee	Open shrub mallee	Very open shrub mallee
Shrubs over 2 m	Tall closed scrub	Tall open scrub	Tall shrubland	Tall open shrubland
Shrubs 1-2 m	Closed heath	Open heath	Shrubland	Open shrubland
Shrubs under 1 m	Low closed heath	Low open heath	Low shrubland	Low open shrubland
Grasses	Closed grassland	Grassland	Open grassland	Very open grassland
Herbs	Closed herbland	Herbland	Open herbland	Very open herbland
Sedges	Closed sedgeland	Sedgeland	Open sedgeland	Very open sedgeland

* Keighery, B.J. (1994); adapted from Muir (1977) and Aplin (1979).
NB. We have termed any strata under 2% in cover as being "scattered".

Vegetation Condition Scale used for BushForever†

Pristine (1)	Pristine or nearly so, no obvious signs of disturbance
Excellent (2)	Vegetation structure intact; disturbance affecting individual species, and weeds are non-aggressive species
Very Good (3)	Vegetation structure altered, obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
Good (4)	Vegetation structure significantly altered by very obvious signs of multiple disturbance. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.
Degraded (5)	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
Completely Degraded (6)	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees or shrubs.

† Keighery, B.J. (1994).

Appendix 6

Quadrat and Relevé Data

Warradarge **Site** WWF01
Described by RWSW **Date** 20/11/2011 **Type** Quadrat 10 x 10 m
MGA Zone 50 354420mE 6686098mN
Habitat East facing gentle slope
Soil: White grey sand
Rock Type Laterite boulders
Vegetation *Eucalyptus gittinsii* open tree mallee over *Banksia glaucifolia, Banksia kippistiana* var. *kippistiana* open heath over *Hakea auriculata, Xanthorrhoea drummondii* scattered low shrubs over *Opercularia vaginata* scattered herbs, *Schoenus pleiostemoneus* scattered sedges, *Neurachne alopecuroidea scattered grasses.*
Veg Condition Excellent
Fire Age No sign of recent fire

Species List:

Species	Cover (%)	Height (cm)	Specimen
Allocasuarina humilis	0.1	40	WWF01-25
Arctotheca calendula	0.1	10	WWF01-15
Astroloma sp. Cataby (E.A. Griffin 1022)	0.1	30	WWF01-33
Baeckea grandiflora	0.1	40	WWF01-05
Banksia carlinoides	0.1	120	WWF01-11
Banksia glaucifolia	50	150	WWF01-27
Banksia kippistiana var. *kippistiana*	8	150	WWF01-26
Banksia sphaerocarpa var. *pumilio*	0.1	60	WWF01-24
Conostylis sp.	0.1	30	WWF01-16
Dampiera spicigera	0.1	25	WWF01-07
Daviesia decurrens	0.1	15	WWF01-28
Desmocladus elongatus	0.1	30	WWF01-30
Desmocladus virgatus	0.1	10	WWF01-14
Drosera porrecta	0.1	15	WWF01-06
Eucalyptus gittinsii subsp. *illucida*	35	400	WWF01-18
Glischrocaryon aureum	0.1	45	WWF01-20
Gompholobium knightianum	0.1	20	WWF01-13
Goodenia coerulea	0.1	35	WWF01-21
Hakea auriculata	1.5	100	WWF01-32
Hibbertia hypericoides	0.1	40	WWF01-17
Lechenaultia biloba	0.1	30	WWF01-03
Neurachne alopecuroidea	1	30	WWF01-19
Opercularia vaginata	1	15	WWF01-01
Petrophile shuttleworthiana	0.1	30	WWF01-22
Philotheca pinoides	0.1	25	WWF01-12
Schoenus pleiostemoneus	1	10	WWF01-02
Stylidium miniatum	0.1	15	WWF01-09
Tetraria octandra	0.1	20	WWF01-04
Thysanotus manglesianus	0.1	40	WWF01-08
Tricoryne elatior	0.1	35	WWF01-29
Ursinia anthemoides	0.1	10	WWF01-10
Xanthorrhoea drummondii	1	120	WWF01-23
Herb	0.1	10	WWF01-31

Warradarge **Site** WWF02
Described by RWSW **Date** 21/10/2011 **Type** Quadrat 10 x 10 m
MGA Zone 50 357519mE 6687302mN
Habitat Crest of low rise, sloping east
Soil White sand
Rock Type Scattered cobbles and pebbles of laterite
Vegetation *Eucalyptus accedens, Eucalyptus drummondii* tree mallee over *Banksia armata* var. *armata, Banksia sessilis* var. *flabellifolia, Melaleuca trichophylla*, *Banksia kippistiana* var. *kippistiana, Banksia strictifolia*, and *Petrophile megalostegia* open heath over *Loxocarya striata* scattered sedges.
Veg Condition Excellent
Fire Age No sign of recent fire

Species List:

Species	Cover (%)	Height (cm)	Specimen
Austrostipa macalpinei	0.1	10	WWF02-05
Baeckea grandiflora	0.1	20	WWF02-15
Banksia armata var. *armata*	15	200	=WWF03-09

Species	Cover (%)	Height (cm)	Specimen
Banksia kippistiana var. *kippistiana*	5	100	=WFF01-26
Banksia sessilis var. *flabellifolia*	10	200	WWF02-21
Banksia strictifolia	5	180	WWF02-12
Conostylis aculeata subsp. *breviflora*	0.1	15	WWF02-01
Dampiera lavandulacea	0.1	10	WWF02-10
Eucalyptus accedens	8	550	WWF02-23
Eucalyptus drummondii	15	300	WWF02-22
Hakea auriculata	0.1	30	WWF02-14
Hakea gilbertii	-	-	WWF02-20
Hakea lissocarpha	0.1	30	WWF02-17
Hibbertia hypericoides	0.1	40	WWF02-03
Hibbertia subvaginata	0.1	30	WWF02-11
Hovea pungens	0.1	20	WWF02-19
Hypochaeris glabra	0.1	15	WWF02-09
Lepidosperma tenue	0.1	20	WWF02-02
Loxocarya striata	1	15	WWF02-04
Melaleuca trichophylla	8	130	WWF02-16
Monotaxis grandiflora var. *grandiflora*	0.1	20	WWF02-13
Neurachne alopecuroidea	0.1	20	=WFF01-19
Opercularia vaginata	0.1	20	WWF02-06
Petrophile megalostegia	1	100	WWF02-18
Thysanotus manglesianus	0.1	25	=WFF01-08
Trachymene pilosa	0.1	2	WWF02-07
Ursinia anthemoides	0.1	5	WWF02-08

Warradarge **Site** WWF03
Described by RWSW **Date** 21/10/2011 **Type** Quadrat 10 x 10 m
MGA Zone 50 357075 **mE** 6688044 **mN**
Habitat Crest and upper slope of medium rise
Soil White grey (orange) sand
Rock Type Laterite cobbles and pebbles
Vegetation *Eucalyptus gittinsii* open tree mallee over Banksia armata var. *armata, Banksia strictifolia, Banksia kippistiana* var. *kippistiana, Petrophile shuttleworthiana*, *Hakea lissocarpha* open heath.
Veg Condition Excellent
Fire Age No sign of recent fire

Species List:

Species	Cover (%)	Height (cm)	Specimen
Acacia applanata	0.1	40	-
Banksia armata var. *armata*	30	200	WWF03-09
Banksia kippistiana var. *kippistiana*	1	100	=WFF01-26
Banksia strictifolia	2	180	=WWF02-12
Dampiera lavandulacea	0.1	30	WWF03-07
Eucalyptus gittinsii subsp. *illucida*	25	500	WWF03-01
Hakea gilbertii	0.1	50	=WFF02-20
Hakea lissocarpha	1	150	=WWF02-17
Hibbertia subvaginata	0.1	40	=WFF02-11
Lepidosperma squamatum	0.1	35	WWF03-02
Monotaxis grandiflora var. *grandiflora*	0.1	30	=WFF02-13
Opercularia vaginata	0.1	10	WWF03-08
Opercularia vaginata	0.1	10	=WFF02-06
Petrophile shuttleworthiana	1	180	=WFF01-22
Schoenus sp. smooth culms (K.R. Newbey 7823)	0.1	15	WWF03-05
Stylidium miniatum	0.1	30	WWF03-04
Tetratheca confertifolia	0.1	20	WWF03-06
Thysanotus manglesianus	0.1	30	WWF03-03

Warradarge **Site** WWF04
Described by RWSW **Date** 21/10/2011 **Type** Quadrat 10 x 10 m
MGA Zone 50 356403 mE 6686689 mN
Habitat Gentle east sloping sandplain
Soil White sand
Rock Type No surface rock type/form visible

Vegetation *Banksia attenuata* low woodland over *Leptospermum* sp., *Eremaea beaufortioides* var. *microphylla, Conostephium magnum, Jacksonia hakeoides* shrubland over *Hibbertia subvaginata* scattered low shrubs.
Veg Condition Excellent
Fire Age Very long unburnt

Species List:

Species	Cover (%)	Height (cm)	Specimen
Alexgeorgea nitens	0.1	15	WWF04-02
Amphipogon turbinatus	0.1	30	WWF04-11
Austrostipa macalpinei	0.1	40	WWF04-24
Austrostipa macalpinei	0.1	20	WWF04-07
Banksia attenuata	12	160	WWF04-23
Banksia attenuata	4	500	WWF04-22
Cassytha flava	0.1	50	WWF04-12
Conostephium magnum	2	100	WWF04-19
Drosera eneabba	0.1	2	WWF04-05
Drosera humilis	0.1	5	WWF04-04
Eremaea beaufortioides var. *microphylla*	3	100	WWF04-20
Gompholobium tomentosum	-	-	WWF04-06
Hakea incrassata	-	-	WWF04-15B
Hibbertia subvaginata	1	30	WWF04-10
Hypochaeris glabra	0.1	15	WWF04-14
Jacksonia hakeoides	1	120	WWF04-21
Lepidosperma squamatum	0.1	15	=WFF03-02
Leptospermum oligandrum	0.1	40	WWF04-15
Leptospermum sp.	20	200	WWF04-17
Levenhookia stipitata	0.1	5	WWF04-03
Neurachne alopecuroidea	0.1	40	WWF04-16
Podotheca angustifolia	0.1	5	WWF04-08
Schoenus sp. smooth culms (K.R. Newbey 7823)	0.1	50	WWF04-18
Trachymene pilosa	0.1	10	WWF04-01
Ursinia anthemoides	0.1	15	WWF04-13
Verticordia sp.	0.1	70	WWF04-09

Warradarge **Site** WWF05
Described by RWSW **Date** 22/10/2011 **Type** Quadrat 10 x 10 m
MGA Zone 50 350803 mE 6684780 mN
Habitat Very gentle west-sloping low rise
Soil White grey sand
Rock Type Nil
Vegetation *Eucalyptus todtiana* low open woodland over *Adenanthos cygnorum* subsp. *cygnorum, Xanthorrhoea drummondii, Leptospermum oligandrum* open shrubland over *Eremaea pauciflora, Jacksonia floribunda*, *Daviesia pauciflora* low shrubland over *Mesomelaena pseudostygia* very open sedgeland.
Veg Condition Excellent
Fire Age No sign of recent fire

Species List:

Species	Cover (%)	Height (cm)	Specimen
Acacia auronitens	0.1	30	WWF05-24
Adenanthos cygnorum subsp. *cygnorum*	5	140	WWF05-25
Alexgeorgea nitens	0.1	30	WWF05-31
Amphipogon turbinatus	0.1	70	WWF05-13
Andersonia heterophylla	0.1	30	WWF05-38
Anigozanthos humilis subsp. *humilis*	0.1	25	WWF05-09
Astroloma xerophyllum	0.1	60	WWF05-42
Baeckea grandiflora	0.1	35	WWF05-47
Banksia dallanneyi subsp. *media*	0.1	35	WWF05-37
Burchardia sp.	0.1	50	WWF05-32
Centrolepis pilosa	-	-	WWF05-11B
Comesperma virgatum	0.1	30	WWF05-45
Conostylis teretifolia subsp. *teretifolia*	0.1	20	WWF05-12
Conostylis tomentosa	0.1	35	WWF05-13
Daviesia podophylla	1	50	WWF05-28
Desmocladus virgatus	0.1	30	WWF05-43
Drosera echinoblastus	0.1	20	WWF05-23

Species	Cover (%)	Height (cm)	Specimen
Drosera menziesii subsp. *penicillaris*	0.1	20	WWF05-21
Drosera porrecta	0.1	20	WWF05-08
Eremaea asterocarpa	0.1	40	-
Eremaea beaufortioides var. *microphylla*	0.1	60	WWF05-36
Eremaea pauciflora	11	70	-
Eucalyptus todtiana	4	300	WWF05-34
Haemodorum spicatum	0.1	110	WWF05-10
Hibbertia acerosa	0.1	20	WWF05-07
Hibbertia hypericoides	0.1	40	WWF05-50
Hibbertia leucocrossa	0.1	25	WWF05-41
Hibbertia sp. Mt Lesueur (M. Hislop 174)	0.1	30	WWF05-04
Hypolaena robusta			WWF05-51
Jacksonia floribunda	2	40	WWF05-20
Jacksonia lehmannii	0.1	30	WWF05-02
Johnsonia pubescens	0.1	30	WWF05-03
Leptospermum oligandrum	0.1	150	WWF05-06
Leptospermum oligandrum	1	130	WWF05-18
Leptospermum spinescens	0.1	50	WWF05-29
Leucopogon sp.	-	-	-
Levenhookia pusilla	0.1	2	WWF05-16
Lomandra sp.	0.1	40	WWF05-33
Lysinema pentapetalum	0.1	35	=WWF-BM65
Melaleuca leuropoma	0.1	60	WWF05-51
Mesomelaena pseudostygia	4	120	=WWF06-33
Neurachne alopecuroidea	0.1	50	=WWF04-16
Petrophile linearis	0.1	30	WWF05-26
Phyllangium sp.	0.1	3	WWF05-17
Schoenus breviculmis	0.1	40	WWF05-44
Schoenus clandestinus	0.1	10	WWF05-01
Schoenus insolitus	0.1	60	WWF05-35
Stenanthemum humile	0.1	15	WWF05-14
Stirlingia latifolia	0.1	25	WWF05-48
Stylidium sp.	0.1	20	=WWF16-05
Stylidium sp.	0.1	15	WWF05-11A
Stylidium sp.	-	-	=WWF16-05
Synaphea endothrix	0.1	30	WWF05-27
Trachymene pilosa	0.1	5	WWF05-30
Tricoryne elatior	0.1	12	WWF05-39
Verticordia sp.	0.1	80	WWF05-46
Xanthorrhoea drummondii	2	100	WWF05-40
Xanthosia huegelii	0.1	12	WWF05-40B
Shrub	0.1	25	WWF05-05
Shrub	0.1	130	WWF05-49
Myrtaceae	0.1	50	WWF05-19

Warradarge **Site** WWF06
Described by RWSW **Date** 22/10/2011 **Type** Quadrat 10 x 10 m
MGA Zone 50 350640 mE 6684370 mN
Habitat Plain in broader undulating area
Soil White sand
Rock Type Nil
Vegetation *Eucalyptus todtiana* low woodland over *Banksia candolleana, Leptospermum oligandrum, Banksia sphaerocarpa* var. *pumilio, Leptospermum oligandrum*, *Allocasuarina humilis, Leucopogon oldfieldii* open heath over *Lomandra hastilis* very open sedgeland over *Hibbertia leucocrossa* scattered low shrubs, *Desmocladus virgatus* scattered sedges.
Veg Condition Excellent
Fire Age No sign of recent fire

Species List:

Species	Cover (%)	Height (cm)	Specimen
Acacia barbinervis subsp. *borealis*	0.1	40	WWF06-10
Allocasuarina humilis	1	160	WWF06-22
Amphipogon turbinatus	0.1	30	WWF06-15
Anigozanthos humilis subsp. *humilis*	0.1	30	=WWF05-09
Astroloma xerophyllum	0.1	80	WWF06-04
Austrostipa macalpinei	0.1	30	WWF06-06
Baeckea grandiflora	0.1	30	=WWF09-26

Species	Cover (%)	Height (cm)	Specimen
Banksia candolleana	35	120	WWF06-29
Banksia shuttleworthiana	0.1	50	WWF06-20
Banksia sphaerocarpa var. *pumilio*	4	100	WWF06-17
Beaufortia elegans	0.1	100	WWF06-35
Crassula colorata var. *acuminata*	0.1	2	=WWF08-18
Desmocladus virgatus	2.5	20	WWF06-18
Drosera echinoblastus	0.1	10	=WWF05-23
Drosera pallida	0.1	25	WWF06-16
Eremaea beaufortioides var. *microphylla*	0.1	50	WWF06-09
Eremaea pauciflora	0.1	120	-
Eucalyptus todtiana	25	300	WWF06-31
Gompholobium tomentosum	0.1	110	WWF06-07
Gompholobium tomentosum	0.1	25	WWF06-11
Gompholobium tomentosum	0.1	30	WWF06-27
Goodenia coerulea	0.1	35	WWF06-21
Hibbertia hypericoides	0.1	35	WWF06-28
Hibbertia leucocrossa	2	10	WWF06-19
Jacksonia floribunda	0.1	70	=WWF05-20
Jacksonia lehmannii	0.1	50	WWF06-13
Lasiopetalum drummondii	0.1	100	WWF06-08
Leptospermum oligandrum	5	130	=WWF05-18
Leptospermum spinescens	0.1	60	WWF06-26
Leucopogon oldfieldii	1	120	WWF06-25
Levenhookia sp.	0.1	5	WWF05-16
Lomandra hastilis	3	130	WWF06-30
Lomandra hermaphrodita	0.1	25	WWF06-12
Melaleuca leuropoma	0.1	30	WWF06-03
Melaleuca leuropoma	0.1	100	WWF06-24
Mesomelaena pseudostygia	0.1	30	WWF06-33
Neurachne alopecuroidea	0.1	40	WWF06-23
Pentameris airoides	0.1	15	WWF06-05
Petrophile linearis	0.1	50	=WWF05-26
Petrophile linearis	0.1	110	=WWF05-26
Petrophile linearis	0.1	30	WWF06-34
Proteaceae sp.	0.1	25	WWF06-14
Schoenus brevisetis	0.1	40	WWF06-32
Schoenus clandestinus	0.1	20	WWF06-01
Schoenus curvifolius	0.1	35	WWF06-02
Trachymene pilosa	0.1	5	-
Ursinia anthemoides	0.1	10	=WWF04-13
Myrtaceae	0.1	100	=WWF05-19

Warradarge **Site** WWF07
Described by SW **Date** 23/10/2011 **Type** Quadrat 10 x 10 m
MGA Zone 50 351524mE 6684410mN
Habitat Moderately steep rocky slope on north facing side of low mesa
Soil Dark brown surface layer of sandy loam
Rock Type Continuous laterite boulders, rocks, gravel with scattered outcropping
Vegetation *Melaleuca uncinata, Melaleuca coronicarpa* closed heath over *Calandrinia calyptrata* very open herbland.
Veg Condition Excellent
Fire Age No sign of recent fire
Species List:

Species	Cover (%)	Height (cm)	Specimen
Austrostipa macalpinei	0.1	20	WWF07-04
Baeckea sp. Bunney Road (S. Patrick 4059)	0.1	-	WWF07-06b
Calandrinia calyptrata	10	5	WWF07-02
Ehrharta longiflora	0.1	20	WWF07-07
Melaleuca aspalathoides	0.1	125	WWF07-06
Melaleuca coronicarpa	15	110	WWF07-03
Melaleuca uncinata	70	150	WWF07-01
Pentameris airoides	0.1	10	WWF07-09
Stylidium caricifolium	0.1	20	WWF07-08
Trachymene pilosa	0.1	10	WWF07-05

Warradarge **Site** WWF08
Described by RW **Date** 23/10/2011 **Type** Quadrat 10 x 10 m

MGA 50 351518 mE 6684366 mN
Habitat Crest of medium rise
Soil Brown sandy loam
Rock Type Pebbles, cobbles of orange sand/siltstone
Vegetation *Eucalyptus* sp. Badgingarra (D. Nicolle & M. French DN 3515) very open tree mallee over *Banksia sessilis* var. *flabellifolia, Petrophile shuttleworthiana*, *Xanthorrhoea drummondii, Calothamnus quadrifidus, Hakea auriculata*, *Hakea anadenia, Allocasuarina humilis* open heath over *Hakea lissocarpha*, *Hibbertia hypericoides, Daviesia epiphyllum* low open shrubland over *Lepidosperma tenue* scattered sedges.
Veg Condition Excellent
Fire Age No sign of recent fire
Notes Hillcrest has small linear stand of Eucalypts in which quadrat was established (on eastern side of crest).

Species List:

Species	Cover (%)	Height (cm)	Specimen
Allocasuarina humilis	1	110	WWF08-29
Amphipogon caricinus var. *caricinus*	0.1	30	WWF08-13
Austrostipa macalpinei	0.1	20	WWF08-02
Banksia carlinoides	0.1	120	WWF08-27
Banksia sessilis var. *flabellifolia*	50	150	WWF08-31
Calothamnus quadrifidus	1	130	WWF08-22
Commersonia pulchella	0.1	10	WWF08-05
Crassula colorata var. *acuminata*	0.1	5	WWF08-18
Cryptandra pungens	0.1	40	WWF08-26
Daviesia epiphyllum	1	50	WWF08-19
Dodonaea ericoides	0.1	25	WWF08-04
Eucalyptus sp. Badgingarra (D. Nicolle & M. French DN 3515)	9	300	WWF08-17
Glischrocaryon aureum	0.1	30	WWF08-15
Hakea anadenia	1	120	WWF08-20
Hakea auriculata	1	130	WWF08-30
Hakea incrassata	0.1	40	WWF08-25
Hakea lissocarpha	1	30	WWF08-28
Hibbertia hypericoides	1	30	WWF08-01
Hovea trisperma	0.1	25	WWF08-21
Hypochaeris glabra	0.1	2	WWF08-07
Lepidosperma tenue	1	30	WWF08-03
Loxocarya striata	0.1	15	WWF08-09
Marianthus bicolor	0.1	120	WWF08-14
Monotaxis grandiflora var. *grandiflora*	0.1	30	WWF08-23
Neurachne alopecuroidea	0.1	35	=WWF04-16
Pentameris airoides	0.1	5	WWF08-06
Petrophile shuttleworthiana	2	120	WWF08-24
Podotheca angustifolia	0.1	5	WWF08-11
Podotheca gnaphalioides	0.1	25	WWF08-08
Stylidium miniatum	0.1	25	WWF08-16
Trachymene pilosa	0.1	5	-
Ursinia anthemoides	0.1	25	-
Wahlenbergia sp.	0.1	10	WWF08-10
Xanthorrhoea drummondii	1.5	100	=OPP RW122
Poaceae	0.1	15	WWF08-12

Warradarge **Site** WWF09
Described by RWSW **Date** 23/10/2011 **Type** Quadrat 10 x 10 m
MGA Zone 50 351728 mE 6684273 mN
Habitat Lower and middle slope of medium rise
Soil Brown grey, sandy loam
Rock Type Pebbles and cobbles of orange sand/siltstone
Vegetation *Calothamnus longissimus, Melaleuca aspalathoides, Hakea auriculata* low open shrubland over *Tetraria octandra, Mesomelaena pseudostygia*, *Neurachne alopecuroidea*, *Amphipogon caricinus* open sedgeland/grassland.
Veg Condition Excellent
Fire Age No sign of recent fire

Species List:

Species	Cover (%)	Height (cm)	Specimen
Acacia lasiocarpa var. *lasiocarpa*	0.1	30	WWF09-17
Acacia wilsonii	0.1	20	WWF09-23

Amphipogon caricinus var. *caricinus*	1	20	WWF09-04
Baeckea crispiflora var. *tenuior*	0.1	30	WWF09-29
Baeckea grandiflora	0.1	25	WWF09-26
Bromus diandrus	0.1	25	WWF09-11
Calothamnus longissimus	4	50	WWF09-05
Calytrix sp.	0.1	20	WWF09-14
Cassytha glabella forma *casuarinae*	0.1	5	WWF09-10
Daviesia chapmanii	0.1	30	WWF09-18
Dodonaea ericoides	0.1	30	WWF09-21
Glischrocaryon aureum	1	50	=WWF08-15
Goodenia coerulea	0.1	25	WWF09-20
Goodenia glareicola	0.1	10	WWF09-03
Goodenia glareicola	0.1	20	WWF09-28
Goodenia trichophylla	0.1	20	WWF09-27
Hakea auriculata	1	80	=WWF08-30
Hakea lissocarpha	0.1	40	=WWF08-28
Hibbertia hypericoides	0.1	25	WWF09-24
Leucopogon phyllostachys	0.1	45	WWF09-13
Levenhookia stipitata	0.1	3	WWF09-15
Melaleuca aspalathoides	2	20	WWF09-01
Melaleuca trichophylla	0.1	35	WWF09-22
Melaleuca trichophylla	0.1	35	WWF09-02
Mesomelaena pseudostygia	1	50	WWF09-25
Monotaxis grandiflora var. *grandiflora*	0.1	10	=WWF08-23
Neurachne alopecuroidea	2	30	=WWF04-16
Opercularia vaginata	0.1	30	WWF09-19
Podolepis canescens	0.1	5	WWF09-09
Schoenus brevisetis	0.1	30	WWF09-31
Schoenus clandestinus	0.1	5	WWF09-30
Stenanthemum reissekii	0.1	15	WWF09-12
Stylidium diuroides subsp. *paucifoliatum*	0.1	35	WWF09-16
Tetraria octandra	10	30	WWF09-06
Tetraria octandra	0.1	35	WWF09-07
Trachymene pilosa	0.1	10	-
Verticordia sp.	0.1	30	WWF09-08

Warradarge **Site** WWF10
Described by RWSW **Date** 23/10/2011 **Type** Quadrat 10 x 10 m
MGA Zone 50 353364mE 6684706mN
Habitat South east facing slope in undulating plain
Soil: Nil
Rock Type Laterite pebbles, cobbles, boulders
Vegetation *Banksia sessilis* var. *flabellifolia*, (*Banksia kippistiana* var. *kippistiana*) open heath over *Hakea auriculata, Banksia sphaerocarpa* var. *pumilio, Hibbertia hypericoides* low open shrubland over *Tetraria octandra* scattered sedges.
Veg Condition Excellent
Fire Age No sign of recent fire

Species List:

Species	Cover (%)	Height (cm)	Specimen
Baeckea grandiflora	0.1	30	=WWF09
Banksia carlinoides	0.1	40	WWF10-19
Banksia kippistiana var. *kippistiana*	10	100	=WWF01-26
Banksia nana	0.1	30	WWF10-21
Banksia sclerophylla	0.1	60	WWF10-24
Banksia sessilis var. *flabellifolia*	60	140	=WWF02-21
Banksia sphaerocarpa var. *pumilio*	1	100	WWF10-20
Beaufortia bracteosa	0.1	20	WWF10-18
Calothamnus sp.	0.1	20	WWF10-23
Cassytha glabella forma *casuarinae*	0.1	25	WWF10-15
Caustis dioica	0.1	35	WWF10-06
Conothamnus trinervis	0.1	25	WWF10-09
Dampiera spicigera	0.1	35	WWF10-04
Drosera barbigera	0.1	2	WWF10-17
Gastrolobium polystachyum	0.1	20	WWF10-12
Haemodorum venosum	0.1	15	WWF10-16
Hakea auriculata	1	80	WWF10-22
Hakea gilbertii	0.1	35	WWF10-03
Hibbertia fasciculiflora	0.1	25	WWF10-02

Species	Cover (%)	Height (cm)	Specimen
Hibbertia hypericoides	1	30	=WWF09-24
Hypocalymma hirsutum	0.1	30	WWF10-07
Leucopogon phyllostachys	0.1	100	=WWF09-13
Levenhookia stipitata	0.1	3	=WWF09-15
Melaleuca platycalyx	0.1	30	WWF10-08
Mesomelaena pseudostygia	0.1	30	=WWF09-25
Neurachne alopecuroidea	0.1	30	=WWF04-16
Petrophile megalostegia	0.1	80	=WWF02-18
Petrophile shuttleworthiana	0.1	120	=WWF08-24
Restionaceae, inadequate material	0.1	10	WWF10-13
Schoenus brevisetis	0.1	20	WWF10-01
Stylidium caricifolium	0.1	10	WWF10-10
Stylidium cygnorum	0.1	15	WWF10-11
Tetraria octandra	1	40	WWF10-14
Vulpia myuros forma *megalura*	0.1	15	WWF10-05
Xanthorrhoea drummondii	0.1	60	=RW122

Warradarge **Site** WWF11
Described by RWSW **Date** 24/10/2011 **Type** Quadrat 10 x 10 m
MGA Zone 50 351992mE 6683898mN
Habitat Level top of medium rise east of breakaway
Soil White grey sand
Rock Type No visible rock type
Vegetation *Eucalyptus todtiana* low woodland over Xanthorrhoea drummondii, *Eremaea pauciflora* open shrubland over *Mesomelaena pseudostygia*, *Austrostipa macalpinei* very open sedgeland/grassland.
Veg Condition Very Good
Fire Age No sign of recent fire

Species List:

Species	Cover (%)	Height (cm)	Specimen
Allocasuarina humilis	0.1	140	WWF11-23
Anigozanthos humilis subsp. *humilis*	0.1	20	WWF11-20
Aristida holathera var. *holathera*	0.1	30	WWF11-26
Austrostipa hemipogon	0.1	40	WWF11-25
Austrostipa macalpinei	1	60	WWF11-01
Baeckea grandiflora	0.1	50	WWF11-22
Caustis dioica	0.1	10	WWF11-14
Conostylis teretifolia subsp. *teretifolia*	0.1	25	WWF11-17
Crassula colorata var. *colorata*	0.1	5	WWF11-04
Drosera sp.	0.1	10	WWF11-16
Eremaea pauciflora	2	110	-
Erodium botrys	0.1	5	WWF11-06
Eucalyptus todtiana	20	250	=WWF06-31
Haemodorum spicatum	0.1	80	=WWF05-10
Hibbertia hypericoides	0.1	30	WWF11-24
Hibbertia leucocrossa	0.1	80	WWF11-18
Hypochaeris glabra	0.1	10	WWF11-05
Hypochaeris glabra	0.1	10	WWF11-09
Hypochaeris glabra	0.1	20	WWF11-21
Hypochaeris radicata	0.1	5	WWF11-10B
Laxmannia sessiliflora subsp. *drummondii*	0.1	7	WWF11-13
Lepidosperma scabrum	0.1	40	WWF11-11
Levenhookia stipitata	0.1	3	=WWF09-15
Mesomelaena pseudostygia	2	60	=WWF09-25
Pentameris airoides	0.1	10	WWF11-07
Quinetia urvillei	-	5	WWF11-10A
Rytidosperma setaceum	0.1	20	WWF11-15
Stylidium sp.	0.1	10	WWF11-12
Trachymene pilosa	0.1	5	-
Trifolium arvense var. *arvense*	0.1	15	WWF11-02
Ursinia anthemoides	0.1	20	WWF11-19
Wahlenbergia capensis	0.1	10	WWF11-08
Wahlenbergia capensis	0.1	25	WWF11-03
Xanthorrhoea drummondii	3	120	=RW122

Warradarge **Site** WWF12

Described by RWSW **Date** 24/10/2011 **Type** Quadrat 10 x 10 m
MGA Zone 50 352345 mE 6684019 mN
Habitat Gentle northeast facing slope within broader undulating plain
Soil Grey to light brown sandy loam
Rock Type Laterite pebbles, cobbles and boulders
Vegetation *Hakea anadenia*, *Hakea auriculata, Petrophile shuttleworthiana, Hibbertia* sp. Mt Lesueur (M. Hislop 174) open shrubland over *Calothamnus torulosus*, *Daviesia epiphyllum, Banksia shuttleworthiana, Melaleuca trichophylla*, *Beaufortia bracteosa, Leucopogon* sp. Warradarge (M. Hislop 1908) low shrubland.
Veg Condition Excellent
Fire Age No sign of recent fire

Species List:

Species	Cover (%)	Height (cm)	Specimen
Acacia auronitens	0.1	25	WWF12-22
Allocasuarina grevilleoides	0.1	40	WWF12-01
Allocasuarina humilis	0.1	80	WWF12-29
Allocasuarina ramosissima	0.1	100	WWF12-26
Astroloma glaucescens	0.1	30	WWF12-34
Baeckea grandiflora	0.1	35	=WWF11-22
Banksia bipinnatifida subsp. *multifida*	0.1	20	WWF12-09
Banksia carlinoides	0.1	100	WWF12-06
Banksia cypholoba	0.1	30	WWF12-15
Banksia shuttleworthiana	5	80	=WWF06-20
Beaufortia bracteosa	1	35	WWF12-18
Calothamnus torulosus	3	40	WWF12-28
Calytrix chrysantha	0.1	100	WWF12-23
Cassytha flava	0.1	35	WWF12-12
Caustis dioica	0.1	30	WWF12-20
Dampiera spicigera	0.1	20	WWF12-32
Daviesia epiphyllum	1.5	80	WWF12-25
Desmocladus virgatus	0.1	30	WWF12-19
Drosera menziesii subsp. *penicillaris*	0.1	5	WWF12-13
Gastrolobium plicatum	0.1	30	WWF12-30
Glischrocaryon aureum	0.1	40	=RW167
Goodenia coerulea	0.1	35	WWF12-31
Hakea anadenia	6	120	=SW34
Hakea auriculata	1	120	WWF12-33
Hakea incrassata	0.1	30	WWF12-11
Hibbertia fasciculiflora	0.1	30	WWF12-37
Hibbertia leucocrossa	0.1	30	=WWF13-20
Hibbertia sp. Mt Lesueur (M. Hislop 174)	1	110	WWF12-38
Jacksonia restioides	0.1	30	WWF12-04
Lepidosperma tenue	0.1	30	WWF12-31
Leucopogon phyllostachys	0.1	35	WWF12-27
Leucopogon sp. Warradarge (M. Hislop 1908)	1	20	WWF12-17
Leucopogon sp. Warradarge (M. Hislop 1908)	0.1	20	WWF12-03
Levenhookia pusilla	0.1	2	=WWF05-16
Lobelia rarifolia	0.1	10	WWF12-05
Melaleuca aspalathoides	0.1	35	WWF12-36
Melaleuca trichophylla	1	30	WWF12-02
Melaleuca trichophylla	2	50	WWF12-21
Mesomelaena pseudostygia	0.1	35	=WWF09-25
Neurachne alopecuroidea	0.1	40	=WWF04-16
Petrophile megalostegia	0.1	15	WWF12-10
Petrophile shuttleworthiana	1	100	WWF01-22
Ptilotus sp.	0.1	20	WWF12-14
Schoenus sp. smooth culms (K.R. Newbey 7823)	0.1	15	WWF12-07
Sphaerolobium sp.	0.1	30	=RW165
Stylidium diuroides subsp. *paucifoliatum*	0.1	30	WWF12-16
Stylidium stenosepalum	0.1	25	WWF12-08
Tetraria octandra	0.1	35	WWF12-35
Thysanotus spiniger	0.1	60	WWF12-24
Xanthorrhoea drummondii	0.1	80	=RW122

Warradarge **Site** WWF13
Described by RWSW **Date** 24/10/2011 **Type** Quadrat 10 x 10 m
MGA Zone 50 352949 mE 6684281 mN

Habitat Plain in undulating area
Soil White grey sand
Rock Type Nil
Vegetation *Adenanthos cygnorum* subsp. *cygnorum (Astroloma xerophyllum*) open heath over *Daviesia nudiflora* subsp. *hirtella, Hibbertia acerosa* scattered low shrubs.
Veg Condition Excellent
Fire Age No sign of recent fire
Notes Broader vegetation has *Eucalyptus todtiana* (none sampled in quadrat)

Species List:

Species	Cover (%)	Height (cm)	Specimen
Adenanthos cygnorum subsp. *cygnorum*	60	150	WWF13-17
Astroloma xerophyllum	1	120	WWF13-21
Austrostipa hemipogon	0.1	45	WWF13-02
Baeckea grandiflora	0.1	40	=WWF11-22
Bossiaea eriocarpa	0.1	30	WWF13-10
Conospermum nervosum	0.1	110	WWF13-01
Conostylis tomentosa	0.1	30	WWF13-11
Daviesia nudiflora subsp. *hirtella*	1	90	WWF13-25
Desmocladus virgatus	0.1	70	WWF13-18
Desmocladus virgatus	0.1	35	WWF13-16
Drosera parvula	0.1	10	WWF13-05
Haemodorum spicatum	0.1	5	=WWF11
Hemiandra pungens	0.1	20	WWF13-23
Hibbertia acerosa	0.1	25	WWF13-08
Hibbertia acerosa	1	25	WWF13-06
Hibbertia leucocrossa	0.1	40	WWF13-20
Hibbertia sp. Mt Lesueur (M. Hislop 174)	0.1	25	WWF13-19
Hovea trisperma	0.1	25	WWF13-29
Hypochaeris glabra	0.1	30	WWF13-27
Jacksonia floribunda	0.1	40	WWF13-26
Lepidosperma scabrum	0.1	50	WWF13-03
Levenhookia stipitata	0.1	5	WWF13-15
Podotheca angustifolia	0.1	5	WWF13-12
Rytidosperma setaceum	0.1	10	WWF13-09
Schoenus pedicellatus	0.1	45	WWF13-28
Stirlingia latifolia	0.1	40	WWF13-22
Synaphea spinulosa subsp. *spinulosa*	0.1	35	WWF13-24
Trachymene pilosa	0.1	5	WWF13-14
Ursinia anthemoides	0.1	25	=WWF11
Wahlenbergia capensis	0.1	10	WWF13-13

Warradarge **Site** WWF14
Described by RWSW **Date** 25/10/2011 **Type** Quadrat 10 x 10 m
MGA Zones 50 355840 mE 6686327 mN
Habitat Crest of low rise in gently undulating area
Soil Grey brown sand
Rock Type Scattered pebbles (few cobbles) of laterite
Vegetation *Eucalyptus gittinsii* open tree mallee over Banksia armata var. *armata, Banksia splendida* subsp. *macrocarpa, Hakea gilbertii, Petrophile shuttleworthiana*, *Allocasuarina humilis, Banksia glaucifolia, Gastrolobium polystachyum, Banksia kippistiana* var. *kippistiana, Melaleuca trichophylla* shrubland over *Conostylis androstemma* scattered small shrubs, *Tetraria octandra* scattered sedges.
Veg Condition Excellent
Fire Age No sign of recent fire

Species List:

Species	Cover (%)	Height (cm)	Specimen
Allocasuarina humilis	2	140	WWF14-34
Andersonia lehmanniana	0.1	30	WWF14-28
Astroloma glaucescens	0.1	45	WWF14-20
Astroloma microdonta	0.1	20	WWF14-41
Baeckea grandiflora	0.1	30	WWF14-21
Banksia armata var. *armata*	6.5	190	WWF14-37
Banksia carlinoides	0.1	120	WWF14-40
Banksia glaucifolia	2	190	WWF14-35
Banksia kippistiana var. *kippistiana*	1	110	=WWF01-26
Banksia shuttleworthiana	0.1	25	WWF14-39

Banksia splendida subsp. *macrocarpa*	6	130	WWF14-26
Beaufortia bracteosa	0.1	50	WWF14-17
Calytrix angulata	0.1	30	WWF14-43
Calytrix flavescens	0.1	30	WWF14-45
Calytrix flavescens	0.1	35	WWF14-18
Caustis dioica	0.1	35	WWF14-02
Caustis dioica	0.1	60	WWF14-33
Conostylis androstemma	1	30	WWF14-25
Conothamnus trinervis	0.1	40	WWF14-44
Dampiera spicigera	0.1	20	WWF14-11
Daviesia daphnoides	0.1	150	WWF14-04
Eucalyptus drummondii	0.1	200	WWF14-36
Eucalyptus gittinsii subsp. *illucida*	17	350	WWF14-07
Gastrolobium plicatum	0.1	40	WWF14-23
Gastrolobium polystachyum	1	140	WWF14-22
Gompholobium knightianum	0.1	70	WWF14-08
Goodenia coerulea	0.1	20	WWF14-27
Hakea anadenia	0.1	120	WWF14-16
Hakea gilbertii	5.5	140	WWF14-38
Hakea incrassata	0.1	50	WWF14-31
Hakea stenocarpa	0.1	50	WWF14-29
Hibbertia fasciculiflora	0.1	25	WWF14-01
Hibbertia hypericoides	0.1	30	WWF14-42
Loxocarya striata	0.1	20	WWF14-30
Melaleuca trichophylla	1	190	WWF14-13
Neurachne alopecuroidea	0.1	45	-
Petrophile megalostegia	0.1	40	WWF14-19
Petrophile shuttleworthiana	4	130	-
Petrophile striata	0.1	120	WWF14-32
Polianthion wichurae	0.1	60	WWF14-06
Pterostylis recurva	0.1	15	WWF14-09
Schoenus brevisetis	0.1	25	WWF14-05
Stylidium cygnorum	0.1	10	WWF14-14
Stylidium miniatum	0.1	15	WWF14-12
Stylidium sp.	0.1	40	WWF14-10
Stylidium stenosepalum	0.1	30	WWF14-15
Tetraria octandra	1	45	WWF14-24
Xanthosia huegelii	0.1	20	WWF14-03

Warradarge **Site** WWF15
Described by RWSW **Date** 25/10/2011 **Type** Quadrat 10 x 10 m
MGA Zone 50 357006 mE 6686927 mN
Habitat Gently undulating plain
Soil Orange-white sand
Rock Type Laterite pebbles, cobbles, boulders
Vegetation *Eucalyptus accedens* low open forest over *Banksia shuttleworthiana*, *Allocasuarina humilis* shrubland over *Opercularia vaginata (Lepidosperma tenue*) open sedgeland.
Veg Condition Very Good
Fire Age No sign of recent fire

Species List:

Species	Cover (%)	Height (cm)	Specimen
Allocasuarina humilis	4	200	WWF15-16
Austrostipa elegantissima	0.1	50	WWF15-07
Austrostipa macalpinei	0.1	20	WWF15-13
Banksia shuttleworthiana	8.5	160	WWF15-18
Banksia strictifolia	0.1	200	WWF15-17
Caustis dioica	0.1	60	WWF15-03
Conostylis aculeata subsp. *breviflora*	0.1	25	WWF15-04
Eucalyptus accedens	45	550	WWF15-01
Hakea lissocarpha	0.1	60	WWF15-12
Hibbertia huegelii	0.1	50	WWF15-11
Hypochaeris glabra	0.1	10	WWF15-09
Lepidosperma tenue	1	40	WWF15-10
Neurachne alopecuroidea	0.1	40	WWF15-05
Neurachne alopecuroidea	0.1	30	WWF15-06
Opercularia vaginata	20	15	WWF15-15
Podotheca angustifolia	0.1	2	WWF15-08
Schoenus pedicellatus	0.1	25	WWF15-19
Trachymene pilosa	0.1	10	-

Species	Cover (%)	Height (cm)	Specimen
Ursinia anthemoides	0.1	30	-
Vulpia muralis	0.1	20	WWF15-02
Wahlenbergia sp.	0.1	10	WWF15-14

Warradarge **Site** WWF16
Described by RWSW **Date** 25/10/2011 **Type** Quadrat 10 x 10 m
MGA Zone 50 356640 mE 6686289 mN
Habitat Undulating plain, sloping to the north
Soil White over brown sand
Rock Type No rocks
Vegetation *Banksia menziesii, Banksia attenuata* low woodland over *Leptospermum* sp. tall open shrubland over *Lachnostachys eriobotrya*, *Acacia pulchella* var. *glaberrima, Jacksonia nutans* open shrubland over *Eremaea beaufortioides* var. *microphylla* scattered low shrubs over *Alexgeorgea nitens* very open sedgeland.
Veg Condition Excellent
Fire Age No sign of recent fire

Species List:

Species	Cover (%)	Height (cm)	Specimen
Acacia pulchella var. *glaberrima*	2	130	WWF16-17
Alexgeorgea nitens	2	20	WWF16-10
Amphipogon turbinatus	0.1	35	WWF16-21
Austrostipa macalpinei	0.1	15	WWF16-06
Austrostipa macalpinei	0.1	40	WWF16-12
Banksia attenuata	7	250	WWF16-20
Banksia menziesii	17.5	400	-
Conostephium magnum	0.1	30	WWF16-13
Conostephium magnum	0.1	140	WWF16-24
Cryptandra pungens	0.1	-	WWF16-11
Drosera humilis	0.1	5	WWF16-01
Eremaea beaufortioides var. *microphylla*	1	65	WWF16-08
Gompholobium tomentosum	0.1	25	WWF16-16
Grevillea erinacea	0.1	160	WWF16-12
Haemodorum spicatum	0.1	40	WWF16-04
Hibbertia leucocrossa	0.1	40	WWF16-09
Hibbertia subvaginata	0.1	80	WWF16-19
Hypochaeris glabra	0.1	20	WWF16-02
Jacksonia nutans	1	130	WWF16-15
Lachnostachys eriobotrya	3	120	WWF16-07
Leptospermum sp.	6	300	=WWF05-18
Levenhookia stipitata	0.1	5	WWF16-09
Melaleuca leuropoma	0.1	30	WWF16-22
Opercularia vaginata	0.1	20	=WWF15
Pentameris airoides	0.1	5	WWF16-03
Schoenus sp. smooth culms (K.R. Newbey 7823)	0.1	45	WWF16-23
Stylidium sp.	0.1	15	WWF16-05
Trachymene pilosa	0.1	10	-
Ursinia anthemoides	0.1	10	=WWF11
Vulpia myuros forma *megalura*	0.1	15	WWF16-18
Wahlenbergia sp.	0.1	20	=WWF15
Shrub	0.1	30	WWF16-14

Warradarge **Site** WWF17
Described by BRMS **Date** 26/10/2011 **Type** Quadrat 10 x 10 m
MGA Zone 50 356139 mE 6688065 mN
Habitat Slope of low broad dome on valley floor
Soil Dark red to brown loamy sand
Rock Type Laterite rocks, gravel, pebbles. 25% outcropping
Vegetation *Banksia strictifolia, Baeckea* sp. Bunney Road (S. Patrick 4059) tall open shrubland over *Melaleuca seriata, Hakea anadenia* shrubland over *Petrophile megalostegia, Allocasuarina microstachya, Astroloma glaucescens* low shrubland over *Alexgeorgea nitens, Lepidosperma tenue* open sedgeland.
Veg Condition Excellent
Fire Age No sign of recent fire

Species List:

Species	Cover (%)	Height (cm)	Specimen
Acacia lasiocarpa var. bracteolata	0.1	45	WWF17-19
Acacia stenoptera	0.1	35	WWF17-13
Alexgeorgea nitens	9	30	=WWF16-10
Allocasuarina microstachya	1	90	WWF17-14
Astroloma glaucescens	1	30	WWF17-25
Baeckea sp. Bunney Road (S. Patrick 4059)	5	200	WWF17-17
Banksia strictifolia	5	220	WWF17-09
Beaufortia elegans	0.1	60	WWF17-23
Blennospora drummondii	0.1	2	WWF17-06
Cyperaceae sp.	0.1	4	WWF17-05
Dampiera lavandulacea	0.1	20	WWF17-26
Drosera humilis	0.1	10	WWF17-02
Hakea anadenia	4	130	WWF17-24
Hakea ruscifolia	0.1	20	WWF17-12
Hibbertia acerosa	0.1	12	WWF17-18
Hibbertia subvaginata	0.1	20	WWF17-11
Hypocalymma angustifolium	0.1	80	WWF17-20
Hypochaeris glabra	0.1	10	-
Jacksonia hakeoides	-	-	WWF17-X1
Lachnostachys eriobotrya	0.1	120	WWF17-15
Lepidosperma tenue	1	15	WWF17-10
Levenhookia pusilla	0.1	4	WWF17-04
Levenhookia stipitata	0.1	4	WWF17-03
Melaleuca seriata	10	130	WWF17-21
Millotia tenuifolia	0.1	5	WWF17-07
Neurachne alopecuroidea	0.1	40	-
Opercularia vaginata	0.1	10	=WWF16
Petrophile megalostegia	10	50	WWF17-22
Petrophile shuttleworthiana	0.1	210	WWF17-16
Pterochaeta paniculata	0.1	4	=SW43
Thysanotus manglesianus	0.1	140	WWF17-08
Vulpia muralis	0.1	20	WWF17-27

Warradarge **Site** WWF18
Described by BRMS **Date** 26/10/2011 **Type** Quadrat 10 x 10 m
MGA Zone 50 355624 mE 6687867 mN
Habitat Gentle east facing slope of low ridge
Soil Light grey to brown sandy loam
Rock Type Continuous surface layer of laterite rocks, gravel, pebbles (few boulders). 5%
Vegetation *Eucalyptus accedens* low woodland over *Banksia armata* var. *armata*, *Petrophile shuttleworthiana* tall open scrub.
Veg Condition Excellent
Fire Age No sign of recent fire

Species List:

Species	Cover (%)	Height (cm)	Specimen
Baeckea grandiflora	0.1	40	WWF18-17
Banksia armata var. *armata*	40	250	WWF18-11
Banksia kippistiana var. *kippistiana*	0.1	120	=24/10/11
Conostylis androstemma	0.1	12	WWF18-05
Dampiera lavandulacea	0.1	10	=WWF17-26
Drosera porrecta	0.1	5	WWF18-04
Eucalyptus accedens	30	800	-
Glischrocaryon aureum	0.1	40	=WWF
Goodenia coerulea	0.1	4	WWF18-20
Goodenia coerulea	0.1	20	WWF18-16
Hakea lissocarpha	0.1	40	WWF18-09
Hibbertia fasciculiflora	0.1	15	WWF18-15
Hibbertia hypericoides	0.1	20	WWF18-08
Lepidosperma tenue	0.1	40	WWF18-19
Lepidosperma tenue	0.1	30	WWF18-18
Levenhookia pusilla	0.1	4	WWF18-02
Levenhookia pusilla	-	-	WWF18-20b
Monotaxis grandiflora var. *grandiflora*	0.1	20	WWF18-06
Neurachne alopecuroidea	0.1	4	-
Opercularia vaginata	0.1	15	=WWF17-16
Petrophile shuttleworthiana	5	200	=WWF17-16
Poranthera microphylla	0.1	5	WWF18-03

Species	Cover (%)	Height (cm)	Specimen
Pterostylis sargentii	0.1	15	WWF18-13
Schoenus sp. smooth culms (K.R. Newbey 7823)	0.1	5	WWF18-14
Stylidium miniatum	0.1	20	WWF18-12
Tetratheca confertifolia	0.1	8	WWF18-10
Thysanotus patersonii/manglesianus	0.1	10	-
Velleia trinervis	0.1	12	WWF18-07
Wahlenbergia capensis	0.1	11	WWF18-01

Warradarge **Site** WWF20
Described by PLDK **Date** 17/11/2011 **Type** Quadrat 10 x 10 m
MGA Zone 50 355105 mE 6684325 mN
Habitat Gently sloping north
Soil White cream sand with some outcropping laterite.
Rock Type Laterite
Vegetation *Eucalyptus gittinsii* very open tree mallee over *Petrophile shuttleworthiana*, *Hakea anadenia, Hakea gilbertii, Banksia* sp. open shrubland over *Banksia shuttleworthiana, Banksia kippistiana* var. *kippistiana, Calothamnus hirsutus*, *Melaleuca aspalathoides* low shrubland.
Veg Condition Excellent
Fire Age Very long unburnt

Species List:

Species	Cover (%)	Height (cm)	Specimen
Allocasuarina humilis	0.1	160	WWF20-24
Amphipogon debilis var. *debilis*	0.1	25	WWF20-38
Banksia carlinoides	0.1	80	WWF20-20
Banksia cypholoba	0.1	20	WWF20-18
Banksia glaucifolia	0.1	130	WWF20-43
Banksia kippistiana var. *kippistiana*	3	60	WWF20-09
Banksia shuttleworthiana	3	50	WWF20-05
Banksia sp.	2	120	WWF20-02
Banksia splendida subsp. *macrocarpa*	-	-	WWF20-12B
Beaufortia bracteosa	0.5	40	WWF20-04
Calothamnus hirsutus	4	25	WWF20-19
Calytrix flavescens	0.1	30	WWF20-13
Caustis dioica	0.1	30	WWF20-39
Caustis dioica	0.1	20	WWF20-14
Caustis dioica	0.1	30	WWF20-42
Comesperma griffinii	0.1	5	WWF20-32
Conothamnus trinervis	0.1	40	WWF20-06
Dampiera spicigera	0.1	20	WWF20-23
Daviesia daphnoides	0.1	60	WWF20-34
Eucalyptus gittinsii subsp. *illucida*	4	320	WWF20-01
Glischrocaryon aureum	0.1	40	-
Goodenia coerulea	0.1	30	WWF20-1125
Hakea anadenia	1	110	WWF20-11
Hakea conchifolia	0.1	50	-
Hakea gilbertii	2	150	WWF20-12A
Hakea stenocarpa	0.1	50	WWF20-10
Hibbertia fasciculiflora	-	-	WWF20-25
Hibbertia hypericoides	0.1	25	WWF20-21
Hypocalymma hirsutum	0.1	30	WWF20-29
Lambertia multiflora var. *multiflora*	0.1	30	WWF20-22
Lechenaultia biloba	0.1	25	WWF20-16
Lepidosperma leptostachyum	0.1	45	WWF20-28
Melaleuca aspalathoides	1	40	WWF20-07
Melaleuca trichophylla	0.1	40	WWF20-31
Mesomelaena pseudostygia	0.1	35	WWF20-37
Mesomelaena pseudostygia	0.1	35	WWF20-36
Neurachne alopecuroidea	0.1	40	WWF20-30
Petrophile megalostegia	0.1	45	WWF20-08
Petrophile shuttleworthiana	3	140	WWF20-03
Petrophile striata	0.1	70	WWF20-27
Schoenus brevisetis	0.1	30	WWF20-41
Schoenus clandestinus	0.1	5	WWF20-33
Stylidium sp.	0.1	25	-
Tetraria octandra	0.1	25	-

Species	Cover (%)	Height (cm)	Specimen
Thysanotus spiniger	0.1	40	WWF20-40
Xanthorrhoea drummondii	0.1	40	WWF20-17

Warradarge **Site** WWFRB01
Described by BRM **Date** 22/10/2011 **Type** Relevé
MGA Zone 50 351092mE 6684630mN
Habitat Small basin on slope
Soil White clay
Rock Type
Vegetation *Melaleuca uncinata* open to closed heath over *Melaleuca coronicarpa* open shrubland over *Baeckea crispiflora* var. *tenuior, Beaufortia elegans* scattered low shrubs over *Neurachne alopecuroidea* scattered grasses.
Veg Condition Very Good
Fire Age

Species List:

Species	Cover (%)	Height (cm)	Specimen
Baeckea crispiflora var. *tenuior*	-	-	WWFRB01-3
Baeckea sp. Bunney Road (S. Patrick 4059)	-	180	WWFRB01-13
Beaufortia elegans	-	-	WWFRB01-4
Calothamnus quadrifidus	-	-	-
Commersonia pulchella	-	-	WWFRB01-7
Conostylis sp.	-	-	-
Dampiera linearis	-	-	WWFRB01-12
Goodenia micrantha	-	5	WWFRB01-14
Hakea lissocarpha	-	110	WWFRB01-9
Isotoma hypocrateriformis var. *trichogramma*	-	-	WWFRB01-5
Lobelia rhytidosperma	-	-	WWFRB01-8
Melaleuca coronicarpa	-	-	WWFRB01-2
Melaleuca uncinata	70	200	WWFRB01-1
Neurachne alopecuroidea	-	-	-
Pimelea imbricata var. *piligera*	-	-	WWFRB01-11
Podolepis canescens	-	-	WWFRB01-10
Verticordia blepharophylla	-	-	WWFRB01-6

Warradarge **Site** WWFRB02
Described by BRM **Date** 22/10/2011 **Type** Relevé
MGA Zone 50 350689mE 6684782mN
Habitat Gently sloping northwest facing low stony rise
Soil Gravelly, pebbly grey-brown sand
Rock Type Brown conglomerate with white ?quartz
Vegetation *Allocasuarina humilis, Hakea auriculata, Banksia glaucifolia* scattered shrubs over *Gastrolobium plicatum, Eremaea pauciflora*, *Baeckea grandiflora*, *Banksia shuttleworthiana, Hibbertia* sp. low open heath over *Mesomelaena pseudostygia* open sedgeland.
Veg Condition Excellent
Fire Age: No sign of recent fire

Species List:

Species	Cover (%)	Height (cm)	Specimen
Allocasuarina humilis	-	-	WWFRB02-1
Allocasuarina microstachya	-	-	WWFRB02-11
Andersonia lehmanniana	-	-	WWFRB02-9
Baeckea grandiflora	-	-	WWFRB02-5
Banksia glaucifolia	-	-	WWFRB02-3
Banksia shuttleworthiana	-	-	=WWFBM-88
Calothamnus torulosus	-	-	=WWFBM-76
Dodonaea divaricata	-	30	WWFRB02-7
Eremaea pauciflora	-	-	-
Gastrolobium plicatum	-	-	WWFRB02-4
Goodenia coerulea	-	-	WWFRB02-12
Hakea auriculata	-	-	WWFRB02-2
Hakea auriculata	-	-	WWFRB02-14
Hakea conchifolia	-	-	=WWFBM-66
Hakea incrassata	-	-	-
Hibbertia fasciculiflora	-	-	WWFRB02-10

Species	Cover (%)	Height (cm)	Specimen
Melaleuca platycalyx	-	-	WWFRB02-13
Melaleuca trichophylla	-	20	WWFRB02-8
Mesomelaena pseudostygia	-	-	-
Verticordia blepharophylla	-	-	=WWFRB01-6
Verticordia sp.	-	-	=WWFBM-01
Hibbertia	-	-	WWFRB02-6

Warradarge **Site** WWFRB03
Described by BRM **Date** 22/10/2011 **Type** Relevé
MGA Zone 50 351408 mE 6684446 mN
Habitat Very gentle northwest facing lower slope at base of mesa
Soil Pale grey-brown sand, probably over clay
Rock Type N/A
Vegetation *Eucalyptus accedens* low woodland to low open forest over *Baeckea* sp. Bunney Road (S. Patrick 4059), *Gompholobium pungens* low open shrubland over *Neurachne alopecuroidea* scattered grasses.
Veg Condition Very Good
Fire Age Very long unburnt

Species List:

Species	Cover (%)	Height (cm)	Specimen
Baeckea sp. Bunney Road (S. Patrick 4059)	-	-	WWFRB03-1
Eucalyptus accedens	-	-	-
Gompholobium pungens	-	40	WWFRB03-2
Hibbertia fasciculiflora	-	-	WWFRB03-3
Lepidosperma squamatum	-	-	WWFRB03-4
Neurachne alopecuroidea	-	-	-

Warradarge **Site** WWFRB04
Described by BRM **Date** 23/10/2011 **Type** Relevé
MGA Zone 50 351392 mE 6684376 mN
Habitat Gentle, north facing crest of low narrow spur of low mesa
Soil Very gravelly, pebbly pale brown sand
Rock Type Brown conglomerate (?laterite) cobbles and gravel
Vegetation *Banksia kippistiana* var. *kippistiana, Gastrolobium plicatum*, *Allocasuarina ramosissima, Beaufortia bracteosa, Petrophile megalostegia* low shrubland over *Lepidosperma tenue, Schoenus clandestinus* very open sedgeland.
Veg Condition Excellent
Fire Age Very long unburnt

Species List:

Species	Cover (%)	Height (cm)	Specimen
Allocasuarina grevilleoides	-	35	WWFRB04-12
Allocasuarina ramosissima	-	60	WWFRB04-2
Banksia kippistiana var. *kippistiana*	-	-	WWFRB04-1
Beaufortia bracteosa	-	-	WWFRB04-3
Calothamnus longissimus	-	40	WWFRB04-6
Gastrolobium plicatum	-	-	=WWFBM-93
Goodenia glareicola	-	-	WWFRB04-11
Lepidosperma tenue	-	-	WWFRB04-5
Melaleuca trichophylla	-	20	WWFRB04-7
Petrophile megalostegia	-	-	WWFRB04-4
Schoenus clandestinus	-	-	WWFRB04-9
Stenanthemum reissekii	-	-	WWFRB04-10
Stylidium eriopodum	-	-	=WWFBM-99
Shrub	-	-	WWFRB04-8

Warradarge **Site** WWFRB05
Described by BRM **Date** 23/10/2011 **Type** Relevé
MGA Zone 50 351534 mE 6684227 mN
Habitat Moderate southwest facing slope of low mesa
Soil Grey brown sand
Rock Type Gravel, pebbles and cobbles of brown conglomerate rock (?laterite)
Vegetation *Allocasuarina grevilleoides, Hakea anadenia*, *Beaufortia bracteosa*, *Melaleuca trichophylla, Calytrix chrysantha, Calothamnus longissimus*, *Banksia kippistiana* var.

kippistiana low heath over *Lepidosperma* aff. *costale, Neurachne alopecuroidea* very open sedgeland/grassland.

Veg Condition Excellent

Fire Age

Species List:

Species	Cover (%)	Height (cm)	Specimen
Allocasuarina grevilleoides	-	40	=WWFRB4-12
Banksia kippistiana var. *kippistiana*	-	-	=WWFRB04-1
Calothamnus longissimus	-	-	=WWFRB04-6
Calytrix chrysantha	-	-	=WWFBM-96
Daviesia epiphyllum	-	45	WWFRB05-2
Glischrocaryon aureum	-	-	=WWF
Hakea anadenia	-	-	=WWFBM-103
Hibbertia polystachya	-	-	WWFRB05-4
Lepidosperma aff. *costale*	-	-	WWFRB05-1
Melaleuca trichophylla	-	-	WWFRB05-3
Melaleuca trichophylla	-	-	=WWFRB04-7
Neurachne alopecuroidea	-	-	-
Opercularia vaginata	-	-	-
Stylidium eriopodum	-	-	=WWFBM-99
Shrub	-	-	=WWFRB04-8

Warradarge **Site** WWFRB06
Described by BRM **Date** 23/10/2011 **Type** Relevé
MGA Zone 50 351584mE 6684243mN
Habitat Flat crest of low mesa
Soil Grey-brown loamy sand
Rock Type Gravel and pebbles (conglomerate)
Vegetation *Banksia glaucifolia, Banksia sessilis* var. *flabellifolia* scattered shrubs with patches of shrubland over *Banksia kippistiana* var. *kippistiana, Banksia carlinoides, Calothamnus longissimus, Baeckea crispiflora* var. *tenuior*, *Melaleuca aspalathoides* closed heath over *Lepidosperma* tenue very open sedgeland.
Veg Condition Excellent
Fire Age

Species List:

Species	Cover (%)	Height (cm)	Specimen
Baeckea crispiflora var. *tenuior*	-	-	WWFRB06-3
Banksia carlinoides	-	-	WWFRB06-2
Banksia glaucifolia	-	-	WWFRB06-1
Banksia kippistiana var. *kippistiana*	-	-	=WWFRB04-1
Banksia sessilis var. *flabellifolia*	-	-	WWFRB06-10
Beaufortia bracteosa	-	-	WWFRB06-8
Calothamnus longissimus	-	-	=WWFRB04-6
Commersonia pulchella	-	-	WWFRB06-4
Daviesia epiphyllum	-	-	=WWFRB05-2
Goodenia coerulea	-	-	WWFRB06-06
Hakea conchifolia	-	-	=WWFBM66
Lechenaultia biloba	-	-	WWFRB06-11
Lepidosperma tenue	-	-	WWFRB06-5
Loxocarya striata	-	-	WWFRB06-9
Melaleuca aspalathoides	-	-	=WWFBM113
Scaevola repens subsp. Northern Sandplains (R.J. Cranfield & P.J. Spencer 8445)	-	-	WWFRB06-7

Warradarge **Site** WWFRB07
Described by BRM **Date** 23/10/2011 **Type** Relevé
MGA Zone 50 352236mE 6683548mN
Habitat Gentle, southwest facing, upper slope of broad low ridge
Soil Gravelly grey brown sand
Rock Type Gravel, cobbles of brown ?laterite conglomerate
Vegetation *Eremaea pauciflora, Allocasuarina humilis* scattered shrubs to open shrubland over *Hakea auriculata, Daviesia daphnoides, Petrophile shuttleworthiana, Banksia sphaerocarpa* var. *pumilio, Hibbertia hypericoides, Melaleuca aspalathoides* low shrubland to low open heath over *Caustis dioica, Lepidosperma tenue, Schoenus brevisetis, Mesomelaena pseudostygia, Neurachne alopecuroidea* very open sedgeland/grassland.

Veg Condition Excellent
Fire Age Very long unburnt

Species List:

Species	Cover (%)	Height (cm)	Specimen
Allocasuarina humilis	-	-	WWFRB07-1
Allocasuarina microstachya	-	45	WWFRB07-11
Banksia sphaerocarpa var. *pumilio*	-	50	=WWFBM118
Caustis dioica	-	-	WWFRB07-7
Conostylis tomentosa	-	175	WWFRB07-15
Darwinia neildiana	-	-	WWFRB07-18
Daviesia daphnoides	-	-	WWFRB07-03
Daviesia daphnoides	-	95	WWFRB07-3
Eremaea pauciflora	-	-	=WWFBM133
Gnephosis tenuissima	-	8	WWFRB07-16
Hakea auriculata	-	100	WWFRB07-02
Hibbertia hypericoides	-	40	WWFRB07-5
Hypocalymma hirsutum	-	-	WWFRB07-10
Jacksonia restioides	-	30	WWFRB07-19
Lachnagrostis plebeia	-	30	WWFRB07-20
Lechenaultia biloba	-	-	-
Lepidosperma tenue	-	-	WWFRB07-8
Levenhookia pusilla	-	-	-
Melaleuca aspalathoides	-	-	WWFRB07-6
Mesomelaena pseudostygia	-	-	-
Mesomelaena pseudostygia	-	-	-
Neurachne alopecuroidea	-	-	-
Petrophile shuttleworthiana	-	80	WWFRB07-4
Schoenus brevisetis	-	-	WWFRB07-9
Schoenus pleiostemoneus	-	-	WWFRB07-17
Stylidium stenosepalum	-	-	WWFRB07-13
Thysanotus thyrsoideus	-	40	WWFRB07-14
Trachymene pilosa	-	-	-
Vulpia myuros forma *megalura*	-	-	WWFRB07-12

Warradarge **Site** WWFRB08
Described by BRM **Date** 24/10/2011 **Type** Relevé
MGA Zone 50 352004 mE 6684021 mN
Habitat Very gentle, west facing upper slope of broad low ridge
Soil Fine grey silty sand with gravel, pebbles and cobbles
Rock Type Conglomerate (?laterite)
Vegetation *Eucalyptus* sp. Badgingarra (D. Nicolle & M. French DN 3515) low woodland over *Xanthorrhoea drummondii, Daviesia epiphyllum, Gastrolobium plicatum, Acacia pulchella* var. *reflexa, Hibbertia hypericoides, Polianthion wichurae* low open shrubland over *Tetraria octandra, Loxocarya striata, Neurachne alopecuroidea* very open sedgeland/grassland.
Veg Condition Excellent

Species List:

Species	Cover (%)	Height (cm)	Specimen
Acacia pulchella var. *reflexa*	-	35	WWFRB08-2
Astroloma glaucescens	-	-	WWFRB08-8
Daviesia epiphyllum	-	-	=WWFBM-151
Eucalyptus drummondii	-	250	WWFRB08-1
Gastrolobium plicatum	-	-	WWFRB08-7
Glischrocaryon aureum	-	-	=WWF
Hibbertia hypericoides	-	30	WWFRB08-3
Logania spermacocea	-	-	=WWFBM189
Loxocarya striata	-	-	WWFRB08-6
Neurachne alopecuroidea	-	-	-
Polianthion wichurae	-	30	WWFRB08-4
Tetraria octandra	-	-	WWFRB08-5
Thysanotus thyrsoideus	-	-	WWFRB07-14
Xanthorrhoea drummondii	-	-	=WWFBM-91

Warradarge **Site** WWFRB09
Described by BRM **Date** 24/10/2011 **Type** Relevé
MGA Zone 50 353128 mE 6683659 mN

Habitat Gentle east facing mid slope
Soil Yellow-brown sand
Rock Type N/A
Vegetation *Eucalyptus todtiana* scattered low trees over *Acacia saligna* tall shrubland over *Adenanthos cygnorum* subsp. *cygnorum* scattered shrubs over *Jacksonia hakeoides* scattered low shrubs over *Hypochaeris glabra, Trifolium arvense var. arvense* very open herbland and *Vulpia* sp., *Austrostipa* sp. Cairn Hill (M.E. Trudgen 21176) open grassland.
Veg Condition Degraded- Good
Fire Age Very long unburnt

Species List:

Species	Cover (%)	Height (cm)	Specimen
Acacia saligna	-	300	WWFRB09-1
Adenanthos cygnorum subsp. *cygnorum*	-	-	-
Austrostipa sp. Cairn Hill (M.E. Trudgen 21176)	-	-	WWFRB09-3
Eucalyptus drummondii	-	300	WWFRB09-6
Eucalyptus todtiana	-	-	-
Hemiandra sp. Watheroo (S. Hancocks 4)	-	-	WWFRB09-5
Hypochaeris glabra	-	-	-
Jacksonia hakeoides	-	-	WWFRB09-2
Ptilotus polystachyus	-	-	-
Trifolium arvense var. *arvense*	-	-	-
Verticordia sp.	-	90	WWFRB09-4

Warradarge **Site** WWFRB10
Described by BRM **Date** 25/10/2011 **Type** Relevé
MGA Zone 50 356044mE 6686335mN
Habitat Very gentle south facing upper slope of low ridge
Soil Grey sand with pebbles and cobbles
Rock Type Lateritic conglomerate, brown outcropping present
Vegetation *Eucalyptus* sp. Badgingarra (D. Nicolle & M. French DN 3515), *Eucalyptus accedens* scattered low trees to low open woodland over *Banksia sessilis* var. *flabellifolia, Melaleuca trichophylla*, Petrophile shuttleworthiana open to closed scrub over *Banksia kippistiana* var. *kippistiana* open shrubland over *Grevillea* sp. scattered low shrubs over *Loxocarya striata, Caustis dioica, Tetraria octandra* very open sedgeland.
Veg Condition Excellent
Fire Age Very long unburnt

Species List:

Species	Cover (%)	Height (cm)	Specimen
Acacia pulchella var. *reflexa*	-	-	WWFRB10-14
Banksia kippistiana var. *kippistiana*	-	-	WWFRB10-4
Banksia sessilis var. *flabellifolia*	-	-	WWFRB10-1
Calytrix oldfieldii	-	45	WWFRB10-13
Caustis dioica	-	-	WWFRB10-7
Dampiera spicigera	-	-	WWFRB10-12
Diplolaena cinerea	-	-	WWFRB10-1b
Eucalyptus accedens	-	700	=WWFBM-209
Eucalyptus sp. Badgingarra (D. Nicolle & M. French DN 3515)	-	325	=WWFBM-211
Grevillea sp.	-	-	WWFRB10-5
Hakea sp.	-	-	WWFRB10-3
Hibbertia hypericoides	-	-	WWFRB10-8
Loxocarya striata	-	-	WWFRB10-6
Melaleuca ciliosa	-	170	WWFRB10-9
Melaleuca trichophylla	-	-	WWFRB10-2
Mesomelaena pseudostygia	-	-	-
Neurachne alopecuroidea	-	-	-
Opercularia vaginata	-	-	-
Polianthion wichurae	-	-	=WWFRB08-4
Pterostylis sp.	-	-	-
Schoenus clandestinus	-	-	-
Tetraria octandra	-	-	=WWFRB08-5
Verticordia sp.	-	-	WWFRB10-10

Warradarge **Site** WWFRB11
Described by BRM **Date** 25/10/2011 **Type** Relevé
MGA Zone 50 355876mE 6686512mN

Habitat East facing breakaway of low ridge
Soil Gravelly grey brown sand
Rock Type Laterite
Vegetation *Eucalyptus accedens* low open forest over *Petrophile shuttleworthiana*, *Banksia sessilis* var. *flabellifolia* scattered tall shrubs over *Hibbertia hibbertioides* var. *hibbertioides* scattered low shrubs over *Neurachne alopecuroidea* scattered grasses.
Veg Condition Excellent
Fire Age Very long unburnt

Species List:

Species	Cover (%)	Height (cm)	Specimen
Banksia sessilis var. *flabellifolia*	-	-	=WWFRB10-1
Eucalyptus accedens	-	-	=WWFBM-209
Hibbertia hibbertioides var. *hibbertioides*	-	-	=WWFBM-205
Neurachne alopecuroidea	-	-	-
Olearia rudis	-	-	=WWFBM-210
Opercularia vaginata	-	-	-
Petrophile shuttleworthiana	-	-	=WWFRB10-11
Velleia trinervis	-	-	WWFRB11-2
Diplolaena sp.	-	55	WWFRB11-1

Warradarge **Site** WWFRB12
Described by BRM **Date** 25/10/2011 **Type** Relevé
MGA Zone 50 355564 mE 6686334 mN
Habitat Gentle, south facing slope of low ridge
Soil Gravelly grey sand
Rock Type Lateritic outcroppings
Vegetation *Eucalyptus* sp. Badgingarra (D. Nicolle & M. French DN 3515) scattered low trees to low open woodland over *Banksia sessilis* var. *flabellifolia* scattered tall shrubs over *Banksia glaucifolia, Banksia kippistiana* var. *kippistiana, Banksia carlinoides, Petrophile shuttleworthiana* closed heath over *Banksia sphaerocarpa* var. *pumilio, Isopogon asper, Hibbertia hypericoides*, *Gastrolobium plicatum* low open shrubland over *Caustis dioica, Tetraria octandra, Neurachne alopecuroidea* scattered sedges/grasses.
Veg Condition Excellent

Species List:

Species	Cover (%)	Height (cm)	Specimen
Banksia carlinoides	-	-	=WWFRB6-2
Banksia glaucifolia	-	-	WWFRB12-1
Banksia kippistiana var. *kippistiana*	-	-	=WWFRB10-4
Banksia sessilis var. *flabellifolia*	-	-	=WWFRB10-1
Banksia sphaerocarpa var. *pumilio*	-	-	=WWFBM118
Banksia sphaerocarpa var. *pumilio*	-	-	WWFRB12-3
Caustis dioica	-	-	=WWFRB10-7
Eucalyptus sp. Badgingarra (D. Nicolle & M. French DN 3515)	-	-	=WWFBM-211
Gastrolobium plicatum	-	-	WWFRB12-4
Hibbertia hypericoides	-	-	=WWFRB10-8
Isopogon asper	-	70	WWFRB12-2
Neurachne alopecuroidea	-	-	-
Petrophile shuttleworthiana	-	-	WWFRB10-11
Tetraria octandra	-	-	-
Tricoryne elatior	-	-	=WWFBM-230

Warradarge **Site** WWFRB13
Described by BRM **Date** 25/10/2011 **Type** Relevé
MGA Zone 50 356378 mE 6686595 mN
Habitat Crest of low rise
Soil Grey brown sand
Rock Type
Vegetation *Banksia menziesii, B. attenuata* low woodland over *Leptospermum oligandrum* scattered tall shrubs to tall open shrubland over *Scholtzia* sp., *Hibbertia leucocrossa* low open shrubland over *Austrostipa macalpinei* scattered grasses.
Veg Condition Very Good

Species List:

Species	Cover (%)	Height (cm)	Specimen

Austrostipa macalpinei	-	-	WWFRB13-4
Banksia attenuata	-	-	-
Banksia menziesii	-	-	-
Calytrix fraseri	-	-	=WWFRB-237
Hibbertia leucocrossa	-	-	WWFRB13-3
Leptospermum oligandrum	-	-	WWFRB13-1
Petrophile brevifolia	-	35	WWFRB13-5
Scholtzia sp.	-	45	WWFRB13-2
Verticordia sp.	-	-	WWFRB13-6

Appendix 7

Vegetation Mapping

See Inset Map below for north west section of survey area

Exclusion Area

Location Map

KARRATHA

Map Area

PERTH

KALGOORLIE

Quadrat location

N

0 750 1,500

metres

Inset Map

Author: R Warner | Drawn: M Robinson | Dwg No.: 728

Date: 07 Feb 2012 | Revised: 22 Mar 2012

Projection: MGA Z50 (GDA94) | Scale: 1:35,000

Warradarge Wind Farm Vegetation Mapping

Biota Environmental Sciences

Vegetation of Warradarge Wind Farm

Vegetation of Drainage Areas (D)

D1 — *Eucalyptus accedens, E. wandoo* woodland over *Kunzea micrantha* subsp. *petiolata* tall open shrubland

Vegetation of Loam/Clay Plains (LP)

LP1 — *Acacia microbotrya* tall open shrubland over *Regelia ciliata* shrubland

LP2 — *Banksia strictifolia*, *Baeckea* sp. Bunney Road (S. Patrick 4059) tall open shrubland over *Melaleuca seriata, Hakea anadenia* shrubland over *Petrophile megalostegia* low shrubland over *Alexgeorgea nitens* open sedgeland

Vegetation of Stony Hills and Slopes (H)

Low Hillslopes and Plains Dominated by Powderbark Wandoo (*Eucalyptus accedens*) (HP)

HP1 — *Eucalyptus accedens, E. wandoo* low closed to low open forest

HP2 — *Eucalyptus accedens* low woodland over *Banksia shuttleworthiana*, *Allocasuarina humilis* open heath over *Opercularia vaginata* open sedgeland

Hills and Slopes dominated by *Banksia* heaths (HB)

HB1 — *Eucalyptus gittinsii* (*E. drummondii*) open tree mallee over *Banksia armata* var. *armata* open heath

HB2 — *Eucalyptus drummondii* low open woodland over *E. gittinsii* open tree mallee over *Banksia* spp. open heath

HB3 — *Eucalyptus drummondii, E. accedens* low woodland over *Banksia* spp. open heath

HB4 — *Banksia glaucifolia, Hakea incrassata, Beaufortia bracteosa, Petrophile shuttleworthiana, Banksia leptophylla* var. *melletica* open heath

HB5 — *Hakea anadenia, Xanthorrhoea drummondii* open shrubland over *Banksia* spp., *Melaleuca trichophylla* low open heath

HB6 — *Banksia sessilis* var. *flabellifolia* tall open shrubland over *B. glaucifolia*, *B. kippistiana* var. *kippistiana, B. carlinoides* closed heath

Vegetation of Warradarge Wind Farm

Vegetation of Stony Hills and Slopes (H)

Rocky Hillcrests and Plains with *Xanthorrhoea drummondii* Low Shrublands (HX)

HX1 — *Eremaea pauciflora*, *Allocasuarina humilis* tall open shrubland over *Hakea auriculata*, *Petrophile shuttleworthiana*, *Xanthorrhoea drummondii*, *Banksia sphaerocarpa* var. *pumilio*, *Hibbertia hypericoides* low shrubland to low open heath

HX2 — *Eucalyptus gittinsii* open tree mallee over *Daviesia daphnoides*, *Xanthorrhoea drummondii* open shrubland

HX3 — *Hakea anadenia*, *H. auriculata*, *Xanthorrhoea drummondii* low shrubland over *Mesomelaena pseudostygia* very open sedgeland

Hillslopes with *Melaleuca* (HM)

HM1 — *Melaleuca uncinata, M. coronicarpa* closed heath

HM2 — *Calothamnus longissimus, Melaleuca aspalathoides, Beaufortia bracteosa* low shrubland to low open heath over *Lepidosperma* aff. *costale, Neurachne alopecuroidea* open sedgeland/grassland

HM3 — *Eucalyptus accedens* low open woodland over *E.* sp. Badgingarra (D. Nicolle & M. French DN 3515) very open tree mallee over *Banksia sessilis* var. *flabellifolia*, *Melaleuca trichophylla* tall open scrub over *Banksia kippistiana* var. *kippistiana* open shrubland

HM4 — *Baeckea* sp. Bunney Road (S. Patrick 4059), *Melaleuca trichophylla* shrubland over *Lepidosperma squamatum* open sedgeland

Vegetation of Warradarge Wind Farm

Vegetation of Sandy Plains and Low Hills (P)

Vegetation dominated by *Eucalyptus todtiana* (Coastal Blackbutt) Low Woodlands (PE)

PE1 — *Eucalyptus todtiana* low open woodland over *Adenanthos cygnorum* subsp. *cygnorum*, *Xanthorrhoea drummondii* open shrubland over *Eremaea pauciflora*, *Jacksonia floribunda* low shrubland over *Mesomelaena pseudostygia* very open sedgeland

PE2 — *Eucalyptus todtiana* low woodland over *Banksia candolleana*, *Leptospermum oligandrum*, *Banksia sphaerocarpa* var. *pumilio* open heath over *Lomandra hastilis* very open sedgeland

PE3 — *Eucalyptus todtiana* low open woodland over *Banksia candolleana*, *Allocasuarina humilis* shrubland

PE4 — *Eucalyptus todtiana* low open woodland over *Adenanthos cygnorum* subsp. *cygnorum*, *Xanthorhoea drummondii* shrubland

Sandy Hills and Plains with *Banksia* Low Woodlands (PB)

PB1 — *Banksia attenuata, B. menziesii* low woodland over *Leptospermum oligandrum* tall open shrubland

Sandy Plains dominated by Powderbark wandoo (PW)

PW1 — *Eucalyptus accedens* low open woodland over *E. drummondii* very open tree mallee over *Eremaea pauciflora, Hibbertia subvaginata* low shrubland

PW2 — *Eucalyptus accedens* low open forest over *Baeckea* sp. Bunney Road (S. Patrick 4059), *Gompholobium pungens* low open shrubland

Modified Vegetation (M)

M1 — Cleared land (paddocks and some tracks)

M2 — *Eucalyptus todtiana* low open woodland

M3 — Planted areas

Appendix 8

Vascular Flora List

Note: * denotes an introduced species.

Family: Amaranthaceae
Ptilotus polystachyus
Ptilotus sp. nov. (newly identified, to be named *Ptilotus* sp. Warradarge)

Family: Anarthriaceae
Lyginia imberbis

Family: Apiaceae
Actinotus humilis
Platysace xerophila
Xanthosia huegelii

Family: Araliaceae
Trachymene cyanopetala
Trachymene pilosa

Family: Asparagaceae
Laxmannia sessiliflora subsp. *drummondii*
Lomandra hastilis
Lomandra hermaphrodita
Thysanotus manglesianus
Thysanotus patersonii/manglesianus
Thysanotus sparteus
Thysanotus spiniger
Thysanotus thyrsoideus

Family: Asteraceae
**Arctotheca calendula*
Asteridea pulverulenta
Blennospora drummondii
Gnephosis tenuissima
Hyalosperma demissum
**Hypochaeris glabra*
**Hypochaeris radicata*
Millotia tenuifolia
Olearia revoluta
Olearia rudis
Pithocarpa pulchella var. *pulchella*
Podolepis canescens
Podotheca angustifolia
Podotheca gnaphalioides
Pterochaeta paniculata
Quinetia urvillei
**Ursinia anthemoides*
Waitzia acuminata var. *acuminata*
Waitzia acuminata var. *albicans*
Waitzia podolepis

Family: Boraginaceae
**Echium plantagineum*

Family: Brassicaceae
**Brassica barrelieri* subsp. *oxyrrhina*
**Diplotaxis muralis*
**Raphanus raphanistrum*

Family: Campanulaceae
Isotoma hypocrateriformis var. *trichogramma*
Lobelia rarifolia
Lobelia rhombifolia
Lobelia rhytidosperma
**Wahlenbergia capensis*

Family: Casuarinaceae
Allocasuarina acutivalvis
Allocasuarina grevilleoides
Allocasuarina humilis
Allocasuarina microstachya
Allocasuarina ramosissima

Family: Celastraceae
Tripterococcus brunonis

Family: Centrolepidaceae
Centrolepis pilosa

Family: Colchicaceae
Burchardia sp.

Family: Crassulaceae
Crassula colorata var. *acuminata*
Crassula colorata var. *colorata*

Family: Cupressaceae
Callitris arenaria

Family: Cyperaceae
Caustis dioica
**Isolepis marginata*
Lepidosperma aff. *costale*
Lepidosperma leptostachyum
Lepidosperma scabrum
Lepidosperma squamatum
Lepidosperma tenue
Mesomelaena pseudostygia
Schoenus andrewsii
Schoenus breviculmis
Schoenus brevisetis
Schoenus clandestinus
Schoenus curvifolius
Schoenus insolitus
Schoenus nanus
Schoenus pedicellatus
Schoenus pleiostemoneus
Schoenus sp. smooth culms (K.R. Newbey 7823)
Tetraria octandra

Family: Dilleniaceae
Hibbertia acerosa
Hibbertia fasciculiflora
Hibbertia hibbertioides var. *hibbertioides*
Hibbertia huegelii
Hibbertia hypericoides
Hibbertia leucocrossa
Hibbertia polystachya
Hibbertia sp. Mt Lesueur (M. Hislop 174*)*
Hibbertia subvaginata

Family: Droseraceae
Drosera barbigera

Drosera echinoblastus
Drosera eneabba
Drosera humilis
Drosera menziesii subsp. *penicillaris*
Drosera pallida
Drosera parvula
Drosera porrecta

Family: Ecdeiocoleaceae
Ecdeiocolea monostachya

Family: Elaeocarpaceae
Tetratheca confertifolia

Family: Ericaceae
Andersonia heterophylla
Andersonia lehmanniana
Astroloma glaucescens
Astroloma microdonta
Astroloma pedicellatum
Astroloma sp. Cataby (E.A. Griffin 1022) (P4*)*
Astroloma xerophyllum
Conostephium magnum
Leucopogon oldfieldii
Leucopogon phyllostachys
Leucopogon sp. Bifid Eneabba (M. Hislop 1927*)*
Leucopogon sp. Warradarge (M. Hislop 1908*)*
Lissanthe powelliae
Lysinema pentapetalum

Family: Euphorbiaceae
Beyeria sulcata var. *gracilis*
Monotaxis grandiflora var. *grandiflora*
Stachystemon axillaris

Family: Fabaceae
Acacia alata var. *tetrantha*
Acacia applanata
Acacia auronitens
Acacia barbinervis subsp. *borealis*
**Acacia iteaphylla*
Acacia lasiocarpa var. *bracteolata*
Acacia lasiocarpa var. *lasiocarpa*
Acacia microbotrya
Acacia obovata
Acacia pulchella var. *glaberrima*
Acacia pulchella var. *pulchella*
Acacia pulchella var. *reflexa*
Acacia saligna
Acacia sessilis
Acacia stenoptera
Acacia wilsonii
Bossiaea eriocarpa
Daviesia benthamii subsp. *benthamii*
Daviesia chapmanii
Daviesia daphnoides
Daviesia decurrens
Daviesia epiphyllum
Daviesia nudiflora subsp. *hirtella*
Daviesia podophylla
Gastrolobium plicatum
Gastrolobium polystachyum
Gompholobium aristatum
Gompholobium knightianum
Gompholobium muticum
Gompholobium pungens
Gompholobium tomentosum
Hovea pungens
Hovea stricta
Hovea trisperma
Jacksonia floribunda
Jacksonia hakeoides
Jacksonia lehmannii
Jacksonia nutans
Jacksonia restioides
Kennedia prostrata
**Trifolium arvense* var. *arvense*

Family: Geraniaceae
**Erodium botrys*

Family: Goodeniaceae
Dampiera carinata
Dampiera lavandulacea
Dampiera lindleyi
Dampiera linearis
Dampiera spicigera
Goodenia coerulea
Goodenia glareicola
Goodenia micrantha
Goodenia trichophylla
Lechenaultia biloba
Lechenaultia floribunda
Lechenaultia hirsuta
Lechenaultia stenosepala
Scaevola anchusifolia
Scaevola phlebopetala
Scaevola repens subsp. Northern Sandplains (R.J. Cranfield & P.J. Spencer 8445*)*
Velleia trinervis

Family: Gyrostemonaceae
Gyrostemon subnudus

Family: Haemodoraceae
Anigozanthos humilis subsp. *humilis*
Conostylis aculeata subsp. *aculeata*
Conostylis aculeata subsp. *breviflora*
Conostylis androstemma
Conostylis crassinervia subsp. *absens*
Conostylis teretifolia subsp. *teretifolia*
Conostylis tomentosa
Haemodorum simulans
Haemodorum spicatum
Haemodorum venosum
Macropidia fuliginosa

Family: Haloragaceae
Glischrocaryon aureum
Gonocarpus cordiger
Gonocarpus pithyoides

Family: Hemerocallidaceae
Arnocrinum gracillimum
Johnsonia pubescens

Tricoryne elatior

Family: Iridaceae
Patersonia occidentalis var. *latifolia*
Patersonia occidentalis var. *occidentalis*

Family: Lamiaceae
Cyanostegia corifolia
Hemiandra pungens
Hemiandra sp. Watheroo (S. Hancocks 4)
Lachnostachys eriobotrya
Physopsis spicata
Pityrodia bartlingii
Pityrodia verbascina

Family: Lauraceae
Cassytha ? racemosa forma *pilosa* (sterile material)
Cassytha flava
Cassytha glabella forma *casuarinae*

Family: Loganiaceae
Logania spermacocea

Family: Loranthaceae
Amyema miquelii
Nuytsia floribunda

Family: Malvaceae
Commersonia pulchella
Guichenotia sarotes
Keraudrenia velutina
Lasiopetalum drummondii

Family: Myrtaceae
Baeckea crispiflora var. *tenuior*
Baeckea grandiflora
Baeckea sp. Bunney Road (S. Patrick 4059)
Beaufortia bracteosa
Beaufortia elegans
Calothamnus hirsutus
Calothamnus longissimus
Calothamnus quadrifidus
Calothamnus sanguineus
Calothamnus torulosus
Calytrix angulata
Calytrix chrysantha
Calytrix depressa
Calytrix flavescens
Calytrix fraseri
Calytrix oldfieldii
Conothamnus trinervis
Darwinia neildiana
Darwinia speciosa
Eremaea asterocarpa
Eremaea beaufortioides var. *microphylla*
Eremaea pauciflora
Eremaea violacea subsp. *violacea*
Eucalyptus accedens
Eucalyptus camaldulensis subsp. *obtusa*
Eucalyptus conveniens
Eucalyptus drummondii
Eucalyptus gittinsii subsp. *illucida*
Eucalyptus macrocarpa subsp. *macrocarpa*
Eucalyptus pruiniramis
Eucalyptus sp. Badgingarra (D. Nicolle & M. French DN 3515*)*
Eucalyptus todtiana
Eucalyptus wandoo subsp. *pulverea*
Hypocalymma angustifolium
Hypocalymma hirsutum
Kunzea micrantha subsp. *petiolata*
Leptospermum oligandrum
Leptospermum spinescens
Melaleuca aspalathoides
Melaleuca ciliosa
Melaleuca coronicarpa
Melaleuca fulgens subsp. *steedmanii*
Melaleuca leuropoma
Melaleuca nesophila
Melaleuca platycalyx
Melaleuca seriata
Melaleuca trichophylla
Melaleuca uncinata
Pileanthus filifolius
Regelia ciliata
Scholtzia laxiflora
Scholtzia sp. Eneabba (S. Maley 8)
Verticordia blepharophylla
Verticordia densiflora var. *cespitosa*
Verticordia densiflora var. *densiflora*
Verticordia grandis
Verticordia huegelii var. *decumbens*
Verticordia laciniata
Verticordia ovalifolia
Verticordia pennigera

Family: Orchidaceae
? Elythranthera brunonis (inadequate material)
Microtis media subsp. *media*
Prasophyllum elatum
Pterostylis recurva
Pterostylis sargentii
Pterostylis sp. (sterile material)
Thelymitra stellata

Family: Phyllanthaceae
Poranthera microphylla

Family: Pittosporaceae
Billardiera venusta
Cheiranthera preissiana
Marianthus bicolor

Family: Poaceae
Amphipogon caricinus var. *caricinus*
Amphipogon debilis var. *debilis*
Amphipogon turbinatus
Aristida holathera var. *holathera*
Austrostipa elegantissima
Austrostipa hemipogon
Austrostipa macalpinei
Austrostipa nitida
Austrostipa sp. Cairn Hill (M.E. Trudgen 21176)
**Bromus diandrus*

**Bromus rubens*
**Ehrharta longiflora*
Lachnagrostis plebeia
Neurachne alopecuroidea
Pentameris airoides
Rytidosperma setaceum
**Vulpia fasciculata*
**Vulpia muralis*
**Vulpia myuros* forma *megalura*

Family: Polygalaceae
Comesperma griffinii
Comesperma virgatum

Family: Portulacaceae
Calandrinia calyptrata
Calandrinia granulifera

Family: Proteaceae
Adenanthos cygnorum subsp. *cygnorum*
Banksia armata var. *armata*
Banksia attenuata
Banksia bipinnatifida subsp. *multifida*
Banksia candolleana
Banksia carlinoides
Banksia catoglypta
Banksia cypholoba
Banksia dallanneyi subsp. *media*
Banksia glaucifolia
Banksia grossa
Banksia kippistiana var. *kippistiana*
Banksia leptophylla var. *leptophylla*
Banksia menziesii
Banksia nana
Banksia nobilis subsp. *fragrans*
Banksia platycarpa
Banksia sclerophylla
Banksia sessilis var. flabellifolia
Banksia shuttleworthiana
Banksia sphaerocarpa var. *pumilio*
Banksia splendida subsp. *macrocarpa*
Banksia strictifolia
Conospermum brachyphyllum
Conospermum nervosum
Grevillea crithmifolia
Grevillea erinacea
Grevillea obliquistigma subsp. *obliquistigma*
Grevillea stenogyne
Hakea anadenia
Hakea auriculata
Hakea conchifolia
Hakea flabellifolia
Hakea gilbertii
Hakea incrassata
Hakea lissocarpha
Hakea prostrata
Hakea psilorrhyncha
Hakea ruscifolia
Hakea smilacifolia
Hakea spathulata
Hakea stenocarpa
Hakea trifurcata
Isopogon adenanthoides
Isopogon asper
Isopogon dubius
Isopogon linearis
Isopogon panduratus subsp. *panduratus*
Lambertia multiflora var. *multiflora*
Persoonia comata
Petrophile brevifolia
Petrophile linearis
Petrophile megalostegia
Petrophile chrysantha subsp. Watheroo (K.M. Allan 57) (*Petrophile septemfida*)
Petrophile shuttleworthiana
Petrophile striata
Stirlingia abrotanoides
Stirlingia latifolia
Synaphea endothrix
Synaphea interioris
Synaphea spinulosa subsp. *spinulosa*
Xylomelum angustifolium

Family: Restionaceae
Alexgeorgea nitens
Alexgeorgea subterranea
Desmocladus elongatus
Desmocladus parthenicus
Desmocladus virgatus
Hypolaena robusta
Lepidobolus quadratus
Loxocarya striata

Family: Rhamnaceae
Cryptandra myriantha
Cryptandra pungens
Polianthion wichurae
Stenanthemum humile
Stenanthemum reissekii
Trymalium angustifolium

Family: Rubiaceae
Opercularia vaginata

Family: Rutaceae
Diplolaena cinerea
Diplolaena geraldtonensis
Philotheca pinoides

Family: Santalaceae
Exocarpos sparteus

Family: Sapindaceae
Dodonaea divaricata
Dodonaea ericoides

Family: Scrophulariaceae
**Zaluzianskya divaricata*

Family: Stylidiaceae
Levenhookia pusilla
Levenhookia stipitata
Stylidium caricifolium
Stylidium crossocephalum
Stylidium cygnorum
Stylidium diuroides subsp. *paucifoliatum*

Stylidium eriopodum
Stylidium maitlandianum
Stylidium miniatum
Stylidium purpureum
Stylidium scariosum
Stylidium sp. (inadequate material)
Stylidium stenosepalum

Family: Thymelaeaceae
Pimelea angustifolia
Pimelea imbricata var. *piligera*
Pimelea leucantha
Pimelea sulphurea

Family: Violaceae
Hybanthus floribundus subsp. *floribundus*

Family: Xanthorrhoeaceae
Xanthorrhoea drummondii

Family: Zamiaceae
Macrozamia fraseri

Appendix 9

Locations of Flora of Conservation Significance

Species	Location		
	Site	Easting (mE)	Northing (mN)
Threatened			
Acacia wilsonii	WWF09	351728	6684273
Banksia catoglypta	Opportunistic	356339	6687948
Eucalyptus pruiniramis	Opportunistic	353534	6682041
Thelymitra stellata	Opportunistic	351519	6684244
Priority 1			
Grevillea stenogyne	Opportunistic	356095	6688024
Ptilotus sp. nov.	WWF12	352345	6684019
Priority 2			
Arnocrinum gracillimum	Opportunistic	350803	6684780
Baeckea sp. Bunney Road (S. Patrick 4059)	Opportunistic	355798	6684475
	Opportunistic	352468	6681973
	WWF07	351524	6684410
	WWF17	356139	6688065
	WWFRB01	351092	6684630
	WWFRB03	351408	6684446
	Opportunistic	357422	6687891
	Opportunistic	356589	6684859
	Opportunistic	356347	6684584
Comesperma griffinii	WWF20	355105	6684325
Synaphea endothrix	WWF05	350803	6684780
Priority 3			
Allocasuarina grevilleoides	WWF12	352345	6684019
	WWFRB04	351392	6684376
	WWFRB05	351534	6684227
Allocasuarina ramosissima	Opportunistic	352665	6682144
	WWF11	351992	6683898
	WWF12	352345	6684019
	WWFRB04	351392	6684376
Austrostipa sp. Cairn Hill (M.E. Trudgen 21176)	Opportunistic	353246	6684913
	WWFRB09	353128	6683659
	Opportunistic	350803	6684891
	Opportunistic	352947	6684281
Banksia cypholoba	WWF12	352345	6684019
	WWF20	355105	6684325
	Opportunistic	352171	6683295
Banksia nobilis subsp. *fragrans*	Opportunistic	356600	6684252
	Opportunistic	355961	6686309
Banksia splendida subsp. *macrocarpa*	WWF14	355840	6686327
	Opportunistic	353343	6684754
	WWF20	355105	6684325
Grevillea erinacea	Opportunistic	356566	6684442
	WWF16	356640	6686289
	Opportunistic	353135	6684386
Lepidobolus quadratus	Opportunistic	351513	6684251
	Opportunistic	352014	6683282
	Opportunistic	352346	6684140
Petrophile chrysantha subsp. Watheroo (K.M. Allan 57)[#]	Opportunistic	350157	6687432
Priority 4			
Astroloma sp. Cataby (E.A. Griffin 1022)	WWF01	354420	6686098

Species	Location		
	Site	Easting (mE)	Northing (mN)
Banksia platycarpa	Opportunistic	353246	6684913
Banksia sclerophylla	WWF10	353364	6684706
	Opportunistic	551959	6683933
Calytrix chrysantha	Opportunistic	351407	6684397
	WWFRB05	351534	6684227
	Opportunistic	351618	6684288
	WWF12	352345	6684019
Conostephium magnum	WWF04	356403	6686689
	WWF16	356640	6686289
	WWF16	356640	6686289
	Opportunistic	356387	6686759
Desmocladus elongatus	WWF01	354420	6686098
	Opportunistic	352171	6683295
Hemiandra sp. Watheroo (S. Hancocks 4*)*	WWFRB09	353128	6683659
	Opportunistic	356339	6687948
Hypolaena robusta	Opportunistic	350157	6687432
	WWF05	350803	6684780
	Opportunistic	350806	6684824

[♯]more recently known as *Petrophile septemfida* Rye & K.A. Sheph (see Rye et al. 2011).

Appendix 10

List of Fauna Potentially Occurring in the Study Area

Family: Acanthizidae	*Acanthiza apicalis*
	Acanthiza chrysorrhoa
	Acanthiza inornata
	Acanthiza uropygialis
	Calamanthus campestris
	Gerygone fusca
	Pyrrholaemus brunneus
	Sericornis frontalis
	Smicornis brevirostris
Family: Accipitridae	*Accipiter fasciatus*
	Aquila audax
	Circus assimilis
	Elanus axillaris
	Haliaeetus leucogaster
	Haliastur sphenurus
	Hieraaetus morphnoides
	Lophoictinia isura
Family: Acrocephalidae	*Acrocephalus australis*
Family: Agamidae	*Ctenophorus adelaidensis*
	Ctenophorus maculatus subsp. maculatus
	Moloch horridus
	Pagona minor subsp. *minor*
	Rankinia adelaidensis
Family: Anatidae	*Anas gracilis*
	Anas superciliosa
	Biziura lobata
	Chenonetta jubata
	Cygnus atratus
	Malacorhynchus membranaceus
	Tadorna tadornoides
Family: Ardeidae	*Ardea alba*
	Ardea ibis
	Ardea pacifica
	Egretta novaehollandiae
Family: Artamidae	*Artamus cinereus*
	Artamus cyanopterus
Family: Cacatuidae	*Cacatua pastinator*
	Cacatua sanguinea
	Calyptorhynchus banksii
	Calyptorhynchus baudinii
	Calyptorhynchus latirostris
	Eolophus roseicapillus
	Nymphicus hollandicus

Family: Campephagidae	*Coracina novaehollandiae*
	Lalage sueurii
Family: Casuariidae	*Dromaius novaehollandiae*
Family: Charadriidae	*Charadrius ruficapillus*
	Elseyornis melanops
	Erythrogonys cinctus
	Vanellus tricolour
Family: Columbidae	*Columba livia*
	Ocyphaps lophotes
	Phaps chalcoptera
	Phaps elegans
Family: Corvidae	*Corvus bennetti*
	Corvus coronoides
Family: Cracticidae	*Cracticus nigrogularis*
	Cracticus tibicen
	Cracticus torquatus
Family: Cuculidae	*Cacomantis flabelliformis*
	Cacomantis pallidus
	Chalcites basalis
	Chalcites lucidus
	Chalcites osculans
Family: Dasyuridae	*Sminthopsis dolichura*
	Sminthopsis granulipes
Family: Diplodactylidae	*Crenadactylus ocellatus subsp. ocellatus*
	Diplodactylus ornatus
	Diplodactylus polyophthalmus
	Strophurus spinigerus subsp. spinigerus
Family: Elapidae	*Echiopsis curta*
	Hydrophis elegans
	Neelaps calonotos
	Parasuta gouldii
	Pseudechis australis
	Pseudechis nuchalis
	Simoselaps littoralis
Family: Estrilidae	*Taeniopygia guttata*
Family: Falconidae	*Falco berigora*
	Falco cenchroides
	Falco longipennis

Family: Halcyonidae	*Dacelo novaeguineae*
	Todiramphus pyrrhopygius
	Todiramphus sanctus
Family: Hirundinidae	*Cheramoeca leucosterna*
	Hirundo neoxena
	Petrochelidon ariel
	Pterochelidon nigricans
Family: Hylidae	*Litoria moorei*
Family: Limnodynastidae	*Heleioporus albopunctatus*
	Heleioporus eyrei
	Heleioporus psammophilus
	Neobatrachus pelobatoides
Family: Macropodidae	Macropus robustus subsp. erubescens
Family: Maluridae	*Malurus lamberti*
	Malurus leucopterus
	Malurus pulcherrimus
	Malurus splendens
	Stipiturus malachurus
Family: Megaluridae	*Cincloramphus cruralis*
	Cincloramphus mathewsi
Family: Megapodiidae	*Leipoa ocellata*
Family: Meliphagidae	*Acanthagenys rufogularis*
	Acanthorhynchus superciliosus
	Anthochaera caranculata
	Anthochaera lunulata
	Certhionyx variegatus
	Epthianura albifrons
	Epthianura tricolor
	Glyciphila melanops
	Lichenostomus ornatus
	Lichenostomus penicillatus
	Lichenostomus virescens
	Lichmera indistincta
	Manorina flavigula
	Melithreptus brevirostris
	Phylidonyris niger
	Phylidonyris novaehollandiae
Family: Meropidae	*Merops ornatus*
Family: Monarchidae	*Grallina cyanoleuca*

Family: Motacillidae	*Anthus novaeseelandiae*
Family: Muridae	*Mus musculus* *Pseudomys albocinereus* *Rattus fuscipes*
Family: Myobatrachidae	*Crinia pseudinsignifera* *Myobatrachus gouldii* *Pseudophryne guentheri*
Family: Nectariniidae	*Dicaeum hirundinaceum*
Family: Otididae	*Ardeotis australis*
Family: Pachycephalidae	*Colluricincla harmonica* *Oreoica gutturalis* *Pachycephala pectoralis* *Pachycephala rufiventris*
Family: Pardalotidae	*Pardalotus striatus*
Family: Petroicidae	*Eopsaltria georgiana* *Eopsaltria griseogularis* *Melanodryas cucullata* *Microeca fascinans* *Petroica boodang* *Petroica goodenovii*
Family: Phalacrocoracidae	*Microcarbo melanoleucos* *Phalacrocorax varius*
Family: Phasianidae	*Coturnix pectoralis* *Coturnix ypsilophora*
Family: Podargidae	*Podargus strigoides*
Family: Podicipedidae	*Poliocephalus poliocephalus* *Tachybaptus novaehollandiae*
Family: Pomatostomidae	*Pomatostomus superciliosus*
Family: Psittacidae	*Barnardius zonarius* *Melopsittacus undulatus* *Polytelis scapulatus*
Family: Pteropodidae	*Pteropus scapulatus*
Family: Pygopodidae	*Aprasia repens* *Delma concinna subsp. concinna*

	Delma fraseri
	Delma grayii
	Lialis burtonis
	Pletholax gracilis
	Pygopus lepidopodus
Family: Rallidae	*Tribonyx ventralis*
Family: Recurvirostridae	*Cladorhynchus leucocephalus*
	Himantopus himantopus
	Recurvirostra novaehollandiae
Family: Rhipiduridae	*Rhipidura albiscapa*
	Rhipidura leucophrys
Family: Scincidae	*Ctenotus fallens*
	Ctenotus impar
	Ctenotus pantherinus subsp. pantherinus
	Ctenotus schomburgkii
	Egernia multisculata
	Lerista christinae
	Lerista distinguenda
	Lerista praepedita
	Menetia greyii
	Morethia lineoocellata
	Morethia obscura
	Tiliqua rugosa subsp. rugosa
Family: Scolopacidae	*Actitis hypoleucos*
	Calidris ruficollis
Family: Strigidae	*Ninox connivens*
Family: Tarsipedidae	*Tarsipes rostratus*
Family: Threskiornithidae	*Threskiornis spinicollis*
Family: Timaliidae	*Zosterops lateralis*
Family: Turnicidae	*Turnix velox*
Family: Typhlopidae	*Ramphotyphlops waitii*
Family: Vespertilionidae	*Nyctophilus geoffroyi*
	Vespadelus regulus