



Wingellina Nickel Project

Baseline Vegetation and Flora Assessment

April 2009



METALS X LIMITED

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EXECUTIVE SUMMARY

Outback Ecology was commissioned by Metals X Limited to conduct a baseline vegetation and flora survey of the Wingellina Nickel Project, within exploration tenement E69/535 in Western Australia. The vegetation and flora survey was one component of a broader study undertaken concurrently by Outback Ecology, including assessment of terrestrial fauna, subterranean fauna, soils and waste materials within the project area.

The project area is approximately 8 km south-west of Surveyor Generals Corner, within the Wingellina Hills, which lie to the north of the Musgrave Ranges in the Ngaanyatjarra Lands Indigenous Protected Area. The project area lies within the Mann-Musgrave subregion of the Central Ranges bioregion and is approximately 1400km north-east of Perth.

The vegetation and flora survey was planned and implemented as far as practicable in accordance with the 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 objectives of the flora and vegetation survey were to:

- i. Undertake a census and develop an inventory of flora located within the project area. This incorporated a desktop review of available information and a detailed quadrat-based field survey;
- ii. Define, describe, delineate and map vegetation associations across the survey area;
- iii. Undertake a review of significant flora species (including Declared Rare and Priority Flora) located, or likely to occur, within the survey area;
- iv. Provide an initial assessment of the regional and local conservation value of the flora and vegetation; and
- v. Provide quantitative data that will provide a baseline against which future impacts and rehabilitation can be assessed, and form the basis of a monitoring programme.

A total of 176 specimens were collected during the April 2008 survey of the Wingellina project area, of which 154 were identified to species level. Of the identified flora, there were 100 taxa (including subspecies and variants) from 40 genera and 24 families. The flora was dominated by Mimosaceae, with 17 taxa from 1 genus and Poaceae, with 16 taxa from 11 genera recorded.

No Declared Rare or Priority Flora were recorded during the survey.

No Threatened or Priority Ecological Communities were recorded from the survey area.

One alien taxon, **Cenchrus ciliaris* (Buffel grass), was recorded during the survey.

Seven vegetation units were described from this survey of the Wingellina study area. The majority of these units were composed of *Eucalyptus* Shrub Mallee which shows variation on the hills in the study area, however the majority of the vegetation is *Acacia aneurq* (Mulga) Woodland.

Vegetation condition in the Wingellina area varied from Excellent to Degraded. The main sources of disturbance were considered to be human activities (including repeated fires) and grazing by feral camels.

Outback Ecology conducted surveys in the project area in a manner that was sensitive to the traditional owners. During the field survey, a traditional elder of the Wingellina community accompanied the field surveyors on several occasions.

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1.0 INTRODUCTION

1.1 Project Background

Outback Ecology was commissioned by Metals X Limited to conduct a comprehensive baseline flora and vegetation survey of the Wingellina Nickel Project, within exploration tenement E69/535 in Western Australia. The flora and vegetation survey was one component of a broader study undertaken concurrently by Outback Ecology, including assessment of terrestrial fauna, subterranean fauna, soils, and waste materials within the project area. The survey was conducted during April 2008.

The project area is defined by the E69/535 tenement boundary, approximately 8 km south-west of Surveyor Generals Corner (**Figure 1**) within the Wingellina Hills, which lie to the north of the Musgrave Ranges in the Ngaanyatjarra Lands Indigenous Protected Area. The area lies within the Mann-Musgrave sub-region of Central Ranges bioregion, one of the 85 biogeographic regions of the Interim Biogeographic Regionalisation for Australia (IBRA) (Thackway and Cresswell, 1995).

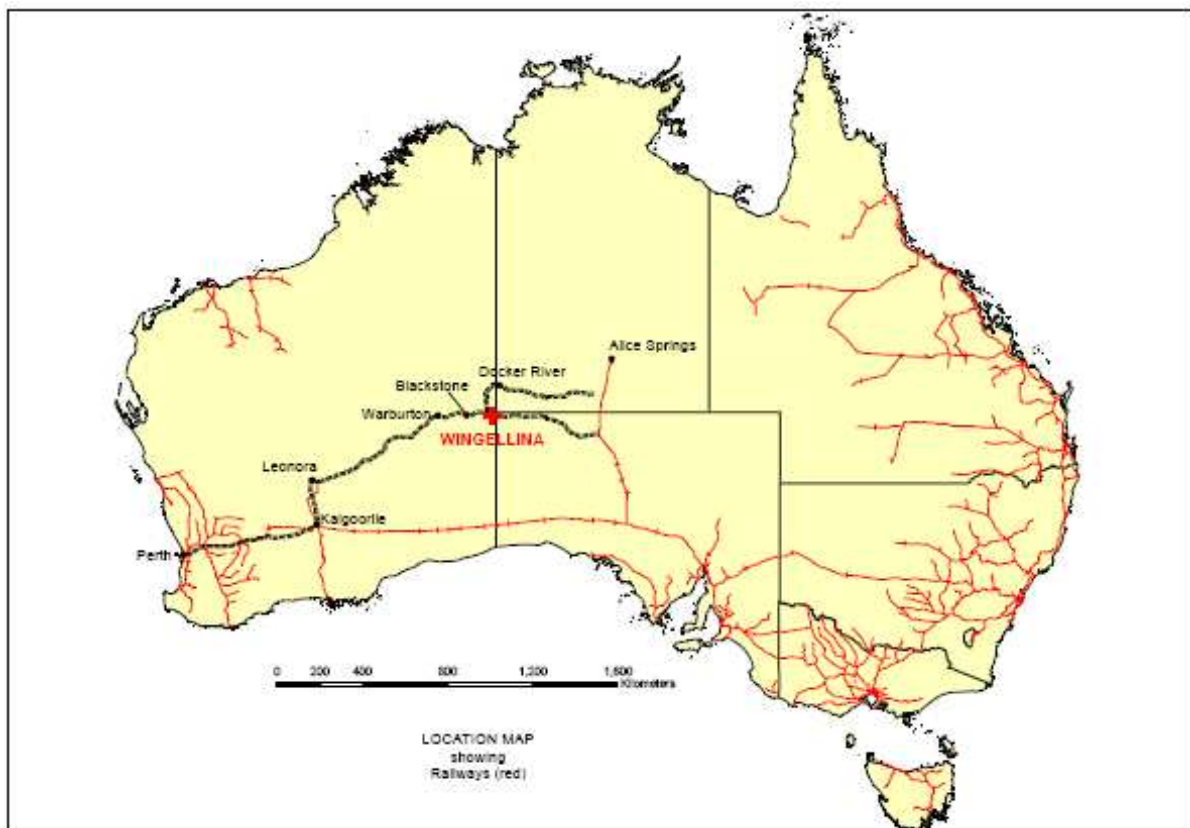


Figure 1 Location of the Wingellina Project Area

1.2 Scope and Objectives of the Study

This report documents the results of an initial flora and vegetation survey over the tenement E69/535, located within the area of the Wingellina Nickel Project. The survey was planned and implemented as

far as practicable in accordance with the 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 objectives of the flora and vegetation survey were to:

- Undertake a census and develop an inventory of flora located within the project area. This incorporated a desktop review of available information and a detailed quadrat-based field survey;
- Define, describe, delineate and map vegetation associations across the survey area;
- Undertake a review of significant flora species (including Declared Rare and Priority Flora) located, or likely to occur, within the survey area;
- Provide an initial assessment of the regional and local conservation value of the flora and vegetation; and
- Provide quantitative data that will provide a baseline against which future impacts and rehabilitation can be assessed, and form the basis of a monitoring programme.

2.0 EXISTING ENVIRONMENT

2.1 IBRA Region – Central Ranges 1 Mann –Musgrave Block Subregion

The Wingellina Nickel Project is located within the Mann-Musgrave block of the Central Ranges bioregion. The Mann-Musgrave subregion is located in Western Australia and the south-west corner of the Northern Territory (Graham and Cowan, 2001). This subregion is characterised by a high proportion of Proterozoic ranges (both volcanic and quartzites) and derived soil plains, interspersed with red Quaternary sandplains with some Permian exposure (Graham and Cowan, 2001).

The sandplains support low open woodlands of either Desert Oak or Mulga over *Triodia basedowii* hummock grasslands, while low open woodlands of Ironwood and Corkwoods over tussock or hummock grasses often fringe the ranges (Graham and Cowan, 2001). The ranges support mixed wattle scrub or *Callitris glaucophylla* woodlands over hummock and tussock grasslands.

2.2 Climate

The Wingellina Nickel Project is located within a region that has a climate classified as a true arid desert, with hot summers and mild winters (BOM, 2008). The region is influenced by a northern tropical/summer climatic pattern. Rainfall is variable, however the majority is received during summer, largely due to the movement of low pressure troughs and tropical lows associated with monsoon troughs move south in the region. Winters are mild and associated with a high pressure subtropical ridge (BOM, 2008).

The Giles weather station is the nearest registered meteorological station, located approximately 130km to the north-west of the Wingellina Nickel Project. Mean annual rainfall recorded at Giles is 284mm, with the majority received between November and March (**Figure 2**). Mean maximum daily temperature of 37.2 °C is recorded during January, with the minimum mean temperature of 6.8 °C recorded during July (BOM, 2008).

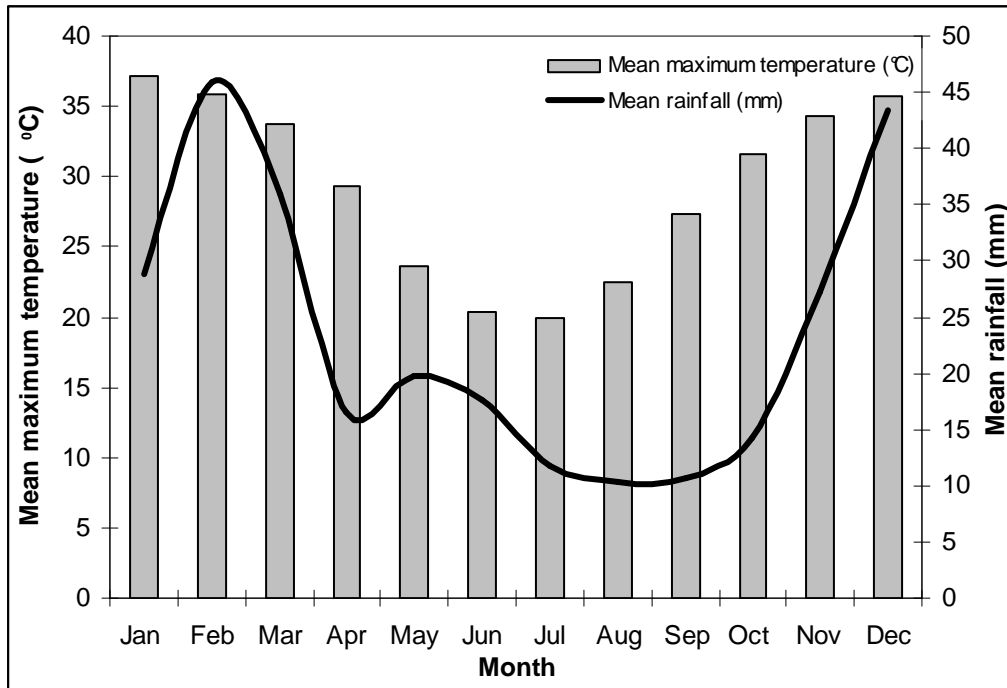


Figure 2 Climate data for the Giles Bureau of Meteorology (BOM) recording station (adapted from BOM, 2008).

3.0 METHODS

3.1 EPA Survey Guidelines

The methods adopted for the survey were formulated as far as practicable in context with the 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 purpose of Position Statement No 3 (EPA, 2002) is to provide an overarching guide to the principles employed by the EPA when assessing the potential environmental impacts of an activity. Within the Position Statement, two levels of biological survey (fauna and flora) are detailed. The requirements of the two levels of survey are summarised below:

Level 1 survey

- Desktop review – incorporating a literature review, database searches and reviews of maps of proposed area of disturbance; and
- Reconnaissance survey – a site visit by suitably qualified personnel to:
 - Verify desktop review;
 - Catalogue flora, with a focus on the potential sensitivity of flora to disturbance; and
 - Broad-scale vegetation and vegetation condition mapping based on selected sites.

Level 2 survey

- Desktop review;
- Reconnaissance survey; and
- Comprehensive flora survey – comprehensive survey of the site and surrounding area, if appropriate, to assess vegetation in a local – regional context. Key features:
 - Quadrat-based survey;
 - Multiple site visits, with a minimum of one site visit to occur in the season following the majority of rainfall; and
 - Application of statistical analyses to data.

Position Statement No 3 (EPA, 2002) provides proponents with a guide to the instances within which the different levels of survey would be considered appropriate. The suitability of the two levels of surveys is a product of the location (bioregion) of the project and the proposed scale and nature of the impact. Where the scale and nature of impact is low, a Level 1 survey is considered adequate (EPA, 2002). Where the scale and nature of the impact is moderate to high, a Level 2 survey is required (EPA, 2002). For the initial survey of the Wingellina study area an enhanced Level 1 survey was chosen, with a quadrat-based survey being conducted and statistical analysis applied to data, but only one visit undertaken in a single season.

3.2 Desktop Review

A review of databases and publicly available information was conducted prior to the field surveys. The desktop review consisted of the following:

- A search of the *Environment Protection and Biodiversity Conservation (EPBC) Act 1999* Protected Matters database for flora of conservation significance and Threatened Ecological Communities (TEC) known, or likely, to occur within the survey areas;
- A search of the Department of Environment and Conservation (DEC) *Threatened (Declared Rare) Flora* database, the *Western Australian Herbarium (WAHERB)* database and the *Declared Rare and Priority Flora List* for Rare and Priority flora collected from the survey area and surrounds;
- A search of the DEC Threatened Ecological Communities (TEC) database for listings of communities recorded within the survey area and surrounds;
- A search of the South Australian herbarium databases for information regarding flora of conservation significance collected from the area within South Australia adjacent to the project area;
- A search of the Northern Territory Department of Natural Resources, Environment and the Arts (NRETA) for flora of conservation significance collected from the area within the Northern Territory adjacent to the project area; and
- A limited review of publicly available ecological information pertaining to the survey areas and surrounds.

3.2.1 Environment Protection and Biodiversity Conservation (EPBC) Act 1999 Protected Matters Database Search

The *EPBC Act* is a federal government act that was enacted to protect the environment, with a focus on matters of National Environmental Significance (DEWHA, 2008). The Act serves to provide a means to manage threats to the natural environment by:

- providing for the protection of biodiversity conservation through the identification of threatening processes, protecting critical habitat, preparation of management plans and issuing conservation orders;
- providing for compliance and enforcement through a range of actions including court injunctions and environmental auditing; and
- providing for an additional level of approval for activities likely to impact on aspects of the natural environment protected under the Act.

A database has been established to manage listings under the Act; the Protected Matters database. A search of the Commonwealth *EPBC Protected Matters* database was undertaken for an area within a radius of 100km around a centre of 26° 4' 4.94", 128° 57' 54.59" to determine whether there were any listings under the Act for the project area. In particular, the search was employed to determine whether there were any TEC or protected flora known or likely to occur within the project areas. Threatened Ecological Communities classified as threatened are protected by Schedule 2 of the *Environment Protection and Biodiversity Conservation (EPBC) Act 1999*. Approval from the Minister

for the Environment and Heritage must be sought to undertake any action that is likely to have a significant impact on a listed TEC. There are three categories of TECs under the *EPBC Act 1999* – ‘Critically Endangered’, ‘Endangered’ and ‘Vulnerable’.

3.2.2 Declared Rare and Priority Flora – DEC Database Search

Declared Rare Flora (DRF) are gazetted under subsection 2 of section 23F of the *Western Australian Wildlife Conservation Act 1950* and as such it is an offence to damage such flora. The Priority Flora list does not have the same legal status as the DRF Schedule, however Priority Flora are considered under the *Environmental Protection Act 1986* as enforced by the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*, when determining biodiversity value of an area (DoIR, 2006). Definitions of Declared Rare and Priority Flora species are provided in **Appendix A**.

Prior to the field survey, a search was conducted of the Department of Environment and Conservation’s *Threatened (Declared Rare) Flora* database and the *Western Australian Herbarium Specimen* database for Rare and Priority species opportunistically collected within a radius of approximately 50km surrounding the central point **26°03’16”S, 128°56’53”E** of the Wingellina survey area. Due to the paucity of flora records from the Wingellina area and the proximity of the South Australian and Northern Territory state borders, a search of Threatened Flora databases for both those states was also made for the same area. In addition, the South Australian Herbarium made available a species list from a survey of the Wingellina area made by the South Australian Herbarium in 2006. Species lists provided by South Australian DEH and Herbarium were checked against FloraBase to determine Priority Status in Western Australia

3.2.3 Threatened Ecological Communities – DEC Database Search

In Western Australia, the Department of Environment and Conservation (DEC) recognizes four categories of Threatened Ecological Communities (TECs), as developed by English and Blyth (1997). These include – ‘Presumed Totally Destroyed’, ‘Critically Endangered’, ‘Endangered’ and ‘Vulnerable’ (**Appendix B**). Other ecological communities that are considered to possibly be under threat but do not meet the survey criteria associated with TECs, are listed under the Department’s Priority Ecological Community List under Priorities 1, 2 and 3. Those communities which are considered to be adequately known, and are rare but not threatened, or which have been recently removed from the threatened list, are classified as Priority 4 and require regular monitoring. Conservation-dependent ecological communities are placed in Priority 5 (Naturebase, 2006).

In addition to TECs, ecosystems may also be described as being ‘at risk’. The status of ‘at risk’ is recognised by the DEC and the Department of Environment, Water, Heritage and the Arts. While not conferring any form of legislative protection, the application of the ‘at risk’ status is a useful tool that highlights ecosystems that may be subject to threatening processes and as such, could potentially become a TEC in the future.

A search of the DEC TEC database was undertaken for an area with a radius of 50km surrounding the central point **26°03'16"S, 128°56'53"E** of the Wingellina study area. In addition, the potential presence of 'at risk' ecosystems within the survey areas was determined by reviewing listings in the DEC biodiversity audit report for the Central Ranges 1 Bioregion (Graham and Cowan, 2001).

3.2.4 Review of Existing Reports

The following reports were reviewed:

- Halpern Glick Maunsell. (2002) *Acclaim Exploration NL Wingellina Baseline Biological Survey*.
- Robinson, A.C., Copley, P.B., Canty, P.D., Baker, L.M., and Nesbitt, B.J. (2003) *A Biological survey of the Anangu Pitjantjatjara Lands, South Australia 1991-2001*.
- Beard, J. (1974). *Great Victoria Desert: Explanatory Notes to Sheet 3. 1:1,000,000 series. Vegetation Survey of Western Australia*.
- Pearson D., Miller J., Butler M., Butler M., Brennan K., Thompson W. (2006). Learning about country. Landscape Vol. 23 No.2 Summer 2007-08 Naturebase. Department of Environment and Conservation.

3.3 Vegetation Field Survey

3.3.1 Timing of Surveys

The survey was undertaken between April 13th – 22nd, 2008. Rainfall in the three months immediately preceding the survey was below average; however, rainfall received during December of 2007 was significantly above the long term average (**Figure 3**). A period of four to six weeks after heavy rainfall is considered sufficient to allow germination and growth of many species to an easily identifiable stage, and the extra time since peak rainfall in this instance was considered to have allowed adequate growth time for maturity.

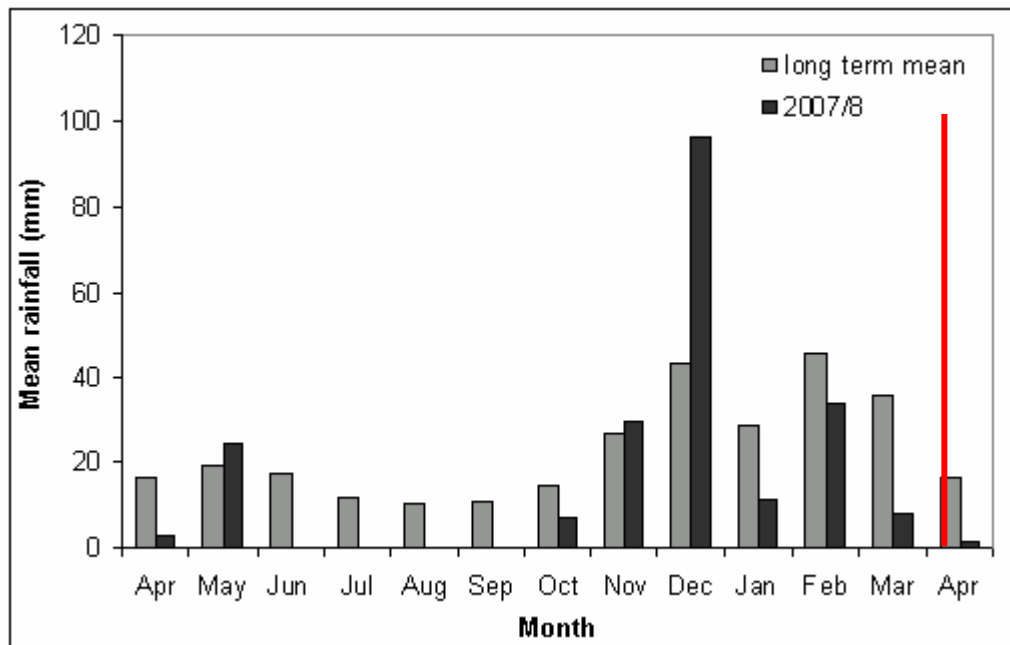


Figure 3 Monthly rainfall received at Giles weather station from April 2007 – April 2008 in comparison to the long-term mean monthly rainfall. The red line indicates the timing of survey.

3.3.2 Survey personnel

Personnel involved in the flora and vegetation survey of the Wingellina Nickel Project were:

Mr Brett Neasham	BSc. (Biol) Hons (Env. Man)	Botanist/Environmental Scientist
Ms Belinda Newman	BSc. Env Biol	Botanist/Environmental Scientist

Specimen identifications:

Mr Brett Neasham	Bsc. (Biol) Hons (Env Man)	Botanist/Environmental Scientist
Ms Belinda Newman	BSc. Env Biol	Botanist/Environmental Scientist
Dr Aleida Williams	PhD (Plant Science)	Botanist/Plant Physiologist
Mr David Leach	BSc. (Hons)	Botanist/Environmental Scientist
Helen Vonow	Collection Manager	State Herbarium of South Australia

3.3.3 Survey Methods

A total of thirty 30m x 30m quadrats were sampled within tenement E69/535, located at the Wingellina Nickel Project, during the April 2008 survey conducted by Outback Ecology (**Figure 4**). The quadrats were positioned to represent the various geographical, geomorphologic and floristic variations within the project area. The quadrats were located to avoid areas of local cultural significance. Initial site selection was based on interpretations of aerial photography, with further refinement in the field. As far as was practicable, a minimum of two quadrats were located within each perceived vegetation unit.

In each quadrat, the following was recorded:

- Location (recorded in WGS84 UTM)

- Estimated height and percentage foliage cover of all flora species. Minimum cut-off cover value was 2%, below 2% was scored as <2%. Height values were derived based on an approximated mean height value. Where species had a significant disparity in heights, values were based on the most commonly observed range of heights.
- Topographic position.
- Slope.
- Soil type.
- Type of litter and percent cover.
- Type and percent cover of exposed rock or surface rocks (where appropriate).
- Assessment of the condition of vegetation, based on the scale of Keighery (1994) (**Appendix B**).
- A photograph of the vegetation

All specimens collected were assigned a sample number in the field, with a sample collected for identification and a sample placed in a field herbarium. Where possible, multiple samples were collected to allow for variation between populations to be accounted for. Fruit was also collected when possible. A tag was attached to each specimen, identifying location, date of collection, height, presence of flowers/fruit and brief description, specimen number and additional notes of information to aid description of habitat if required. Specimens collected were identified by reference to taxonomic guides and Western Australian Herbarium samples. Where specimens could not be identified by botanists from OES, a specialist botanist was utilized. Nomenclature follows Paczkowska and Chapman (2000) except for name changes, which were sourced from the Western Australian Herbarium (2007).

3.4 Data Analysis and Interpretation

3.4.1 Analysis of Floristic Data

All data was entered into a dedicated MS Access database and relevant factors were exported to MS Excel spreadsheets to facilitate analysis in PRIMER, with nil and <2% cover values removed and all other values entered as recorded. Data was square-root-transformed prior to performing a resemblance analysis between samples using Bray-Curtis similarity as the measure. The resemblance output was then further examined using CLUSTER to produce a dendrogram showing vegetation relationships.

3.4.2 Vegetation Description

Within each quadrat, the life-form strata and percentage cover of each main stratum was described using the structural formation and height classes based on Keighery (1994) (**Appendix E**). The PRIMER outputs and field observations were used to group the floristic survey sites into vegetation types based on dominant species in each stratum, estimated percent foliar cover, and height.

3.4.3. Vegetation Mapping

Description of vegetation mapping units was based on the outputs from the PRIMER analysis, field observations and interpretations of aerial photography of the project areas. The boundaries of vegetation types were identified and marked on aerial photography for plotting. Mapping of vegetation over the project area was undertaken at a scale of 1:10,000.

3.5 Limitations of Survey

The EPA (2004) lists a number of possible limitations and constraints that may impinge on the adequacy of flora and vegetation surveys. These are replicated in **Table 1** below with an assessment relating to the current survey undertaken by Outback Ecology.

Table 1 Summary of Potential Flora and Vegetation Survey Constraints

Aspect	Constraint?	Comment Regarding Current Survey
Competency/experience of consultants	Limited	The lead botanist on this project is experienced in conducting baseline vegetation surveys within the Murchison bioregion. Neither of the botanists who undertook the field survey had been involved in surveys in the Central Ranges bioregion prior to this survey.
Scope	No	The scope was clearly defined and realistically achievable within the designated timeframe.
Proportion of flora identified	Yes	Records from the region are limited. In addition to this, many keys required for identifying flora are either dated or do not provide for adequate resolution of taxa. The quality of samples collected ranged from excellent to very poor. This was considered to be a product of seasonal influences.
Information sources (eg historic or recent)	Yes	Limited detailed information is available for the project area and surrounds.
Proportion of task achieved, and further work which might be needed	Yes	Access to areas that were considered to host vegetation that was different to that over the majority of the project areas was not available due to cultural activities that occurred during the timing of the survey. These areas may require surveying to be able to complete the census and describe all vegetation within the project area.
Timing / weather / season / cycle	Limited	In the three months prior to the survey, below average rainfall was recorded in the region. However, above average rainfall was recorded during December 2007.
Disturbances	Yes	Some areas within the survey area have been subjected to extensive burning. In addition to this, there has been damage done to vegetation as a consequence of heavy grazing by camels.
Intensity	Yes.	Area within which access was readily available were intensively surveyed. Areas within which access was not granted were not surveyed during the field assessment. Delineation of vegetation occurring within these restricted areas was undertaken via aerial imagery interpretation.
Completeness	Yes	Access to areas within the project area was not granted due to Aboriginal cultural activities occurring during the survey period
Resources	No	All resources required were available.
Remoteness / access problems	Yes	The project site itself was accessible, however parts of the area were not, due to cultural activities.
Availability of contextual information	Yes	The region within which the project is located has not been extensively surveyed. As such, there was a paucity of information available for the area. The Wingellina Nickel Project Area was surveyed by Halpern Glick Maunsell during 2000. This report was reviewed prior to undertaking the surveys.

4.0 RESULTS

4.1 Desktop Review

4.1.1 Environment Protection and Biodiversity Conservation (EPBC) Act 1999 Protected Matters Database Search

There are no Threatened Ecological Communities or flora as defined under the *EPBC Act 1999* known within 100km of the Wingellina Nickel Project.

4.1.2 Declared Rare and Priority Flora

A total of 64 taxa ascribed a conservation code have been collected in the search area in Western Australia, South Australia and the Northern Territory (**Table 2**). None of these taxa are considered Declared Rare Flora, as defined under the Western Australian *Wildlife Conservation Act 1950*. Four Priority taxa (as defined by the DEC) have been lodged with the Western Australian Herbarium from the study area, and five other species that are ranked as Priority species in Western Australia have been collected close by in the Northern Territory and/or South Australia, but not Western Australia, although it could be assumed that they are found here.

Conservation codes and their application differed between WA, SA and NT databases. Four Priority species in WA; *Calotis latiuscula* (P3), *Acacia calcicola* (P4), *Eucalyptus sparsa* (P3), and *Stackhousia clementii* (P1), do not have conservation codes in SA or NT, and two of them (the *Calotis* and *Stackhousia*) hold a ranking of LC (Least Concern) in the NT. By contrast, three species, *Samolus eramaeus*, *Dampiera roycei* and *Ophioglossum polyphyllum*, are considered rare by SA but are not assigned conservation codes in either WA or NT.

A number of species that have been listed as occurring within the 50km search area are unknown in the Western Australian Flora, not having been collected in this State.

For the purpose of this report Conservation codes will be applied according to the situation in Western Australia. For this reason the nine species that have Western Australian Conservation Codes are considered of primary importance. Species with conservation rankings in other States are also treated as significant.

4.1.3 Threatened Ecological Communities

No TECs or PECs were identified as potentially occurring within the Wingellina search area by the DEC database search. No ecosystems at risk have been identified in the Western Australian part of the CR1 bioregion (Graham and Cowan, 2001)

Table 2 Summary of Database Results for Flora of Conservation Significance Collected in the Region Within which the Wingellina Project is Located.

The table summarises the results of DEC, SA herbarium (South Australia) and NRETA (Northern Territory) database searches based on a centre of 26°03'16"S, 128°56'53"E and a radius of 50 km. Definitions of conservation codes for each state/territory are given in Appendix 1; nt= near threatened, V=vulnerable, R=rare, P=priority, LC= least concern, No code=no conservation code assigned. No record= species not listed in database search results, Unknown=unknown in the WA flora.

Family	Species	Western Australia		South Australia		Northern Territory	
		Conservation code	Number of records	Conservation code	Number of records	Conservation code	Number of records
APIACEAE	<i>Trachymene bialata</i>					nt	4
ASTERACEAE	<i>Calotis latiuscula</i>	P3	3	No code	4	LC	
ASTERACEAE	<i>Chthonocephalus pseudevax</i>					nt	3
ASTERACEAE	<i>Minuria multiseta</i>					nt	
ASTERACEAE	<i>Rhodanthe laevis</i>					nt	1
BRASSICACEAE	<i>Arabidella nasturtium</i>					nt	1
BRASSICACEAE	<i>Cuphonotus andraeanus</i>					nt	1
BRASSICACEAE	<i>Menkea lutea</i>	P1	1	R	5	Not found	
BRASSICACEAE	<i>Menkea sphaerocarpa</i>					nt	1
CAESALPINIACEAE	<i>Senna artemisioides</i> subsp. <i>glaucifolia</i>					nt	1
CAMPANULACEAE	<i>Lobelia gibbosa</i> var. <i>gibbosa</i>					nt	2
CHENOPODIACEAE	<i>Dysphania sphaerosperma</i>					nt	1
CHENOPODIACEAE	<i>Einadia nutans</i> subsp. <i>nutans</i>					nt	3
CHENOPODIACEAE	<i>Maireana lanosa</i>					nt	1
CHENOPODIACEAE	<i>Maireana pentatropis</i>					nt	1
CHENOPODIACEAE	<i>Tecticornia</i> (syn. <i>Halosarcia</i>) <i>pruinosa</i>					nt	2
EPACRIDACEAE	<i>Leucopogon sonderensis</i>	Unknown				nt	3

Family	Species	Western Australia		South Australia		Northern Territory	
		Conservation code	Number of records	Conservation code	Number of records	Conservation code	Number of records
EUPHORBIACEAE	<i>Monotaxis luteiflora</i>					nt	2
EUPHORBIACEAE	<i>Poranthera leiosperma</i>					nt	2
FRANKENIACEAE	<i>Frankenia punctata</i>					nt	2
GOODENIACEAE	<i>Dampiera dentata</i>					nt	5
GOODENIACEAE	<i>Dampiera roycei</i>			R	1	LC	
GOODENIACEAE	<i>Goodenia brunnea</i>	Unknown		R	1	nt	1
GOODENIACEAE	<i>Goodenia glandulosa</i>					nt	1
GOODENIACEAE	<i>Goodenia occidentalis</i>					nt	2
GOODENIACEAE	<i>Goodenia rupestris</i>	Unknown				nt	1
HALORAGACEAE	<i>Glischrocaryon aureum</i> var. <i>angustifolium</i>					nt	2
JUNCACEAE	<i>Juncus continuus</i>	Unknown				nt	4
LAMIACEAE	<i>Microcorys macredieana</i>	P3	No record	No record	No record	nt	1
LAMIACEAE	<i>Prostanthera wilkieana</i>					nt	2
LAMIACEAE	<i>Teucrium grandiusculum</i> subsp. <i>grandiusculum</i>	P2	1	v	4	nt	1
LILIACEAE	<i>Arthropodium strictum</i>	Unknown				nt	2
LILIACEAE	<i>Caesia chlorantha</i>					nt	1
LILIACEAE	<i>Tricoryne elatior</i>					nt	3
LILIACEAE	<i>Wurmbea centralis</i> subsp. <i>centralis</i>					nt	11
LILIACEAE	<i>Wurmbea deserticola</i>					nt	1
LYTHRACEAE	<i>Lythrum paradoxum</i>	P3	1	No record		Not record	
MALVACEAE	<i>Hibiscus brachychlaenus</i>					nt	1
MALVACEAE	<i>Sida calyxhymenia</i>					nt	5
MIMOSACEAE	<i>Acacia abbreviata</i>	Unknown				nt	1
MIMOSACEAE	<i>Acacia ammobia</i>	Unknown				nt	21
MIMOSACEAE	<i>Acacia auricoma</i>	P3	No record	No record	No record	nt	18

Family	Species	Western Australia		South Australia		Northern Territory	
		Conservation code	Number of records	Conservation code	Number of records	Conservation code	Number of records
MIMOSACEAE	<i>Acacia calcicola</i>	P4	1	No code	1	No record	No record
MYOPORACEAE	<i>Eremophila alternifolia</i>					nt	9
MYOPORACEAE	<i>Eremophila clarkei</i>					nt	4
MYOPORACEAE	<i>Eremophila maculata</i> subsp. <i>brevifolia</i>					nt	1
MYRTACEAE	<i>Eucalyptus sparsa</i>	P3	No record	No code	5	dd	13
MYRTACEAE	<i>Melaleuca faucicola</i>	Unknown				nt	4
MYRTACEAE	<i>Melaleuca fulgens</i> subsp. <i>corrugata</i>					nt	2
OPHIOGLOSSACEAE	<i>Ophioglossum lusitanicum</i>					nt	2
OPHIOGLOSSACEAE	<i>Ophioglossum polyphyllum</i>			R	1		
POACEAE	<i>Enneapogon caerulescens</i>					nt	3
POACEAE	<i>Eragrostis sterilis</i>	unknown				nt	5
POACEAE	(<i>Eriachne scleranthoides</i>)					nt	7
PRIMULACEAE	<i>Samolus eremaeus</i>	No code		R	2		
PROTEACEAE	<i>Grevillea pterosperma</i>					nt	2
PROTEACEAE	<i>Hakea standleyensis</i>	unknown				nt	1
RHAMNACEAE	<i>Stenanthemum petraeum</i>					nt	11
SANTALACEAE	<i>Santalum acuminatum</i>					v	5
STACKHOUSIACEAE	<i>Stackhousia clementii</i>	P1	No record	No code	1	LC	3
STERCULIACEAE	<i>Rulingia luteiflora</i>					nt	3
VERBENEACEAE	<i>Pityrodia loxocarpa</i>					nt	1
XANTHORRHOEACEAE	<i>Xanthorrhoea thornstonii</i>					nt	4
ZYGOPHYLLACEAE	<i>Zygophyllum ovatum</i>					nt	1

4.1.4 Review of Existing Reports

Beard, J. (1974). *Great Victoria Desert. Explanatory Notes to Sheet 3, 1:1 000 000 Series. Vegetation Survey of Western Australia.*

This broad-scale vegetation mapping provides a generalised overview of the vegetation associations of the Great Victoria Desert and the Eremaean Botanical Province as defined by Beard (1974). Descriptions of the vegetation associations are the result of interpretation of aerial photographs and ground-truthing.

The project area is located in the Giles Botanical District (sometimes referred to as the Warburton Region) (Beard, 1974). The Giles Botanical District is approximately equivalent to the Central Ranges 1 (Mann-Musgrave Block Subregion) IBRA region. Beard (1974) broadly describes the vegetation of the region in relation to the underlying topography as being very varied, from low rounded quartzite ranges, sandy plains, confused dune systems, to salt lakes and kopi dunes.

Three of the vegetation communities described by Beard (1974) occur within the project area:

- *Acacia aneura* Low Woodland occurring mostly over sandhills, however some patches on flat plains (a₁Li).
- *Acacia aneura* Scrub occurring on stony hills (a₁Si).
- *Allocasuarina decaisneana*, *Melaleuca* spp. steppe over *Triodia basedowii*, *T. melvillei* grass steppe (c₁mp₂t₂Hi).

Beard (1974) noted that the sandhills of the Giles Botanical District are often vegetated by *Grevillea stenobotrya*, *Acacia* spp., *Gyrostemon ramulosus*, *Crotalaria cunninghamii* and *Triodia melvillei*. Interdunal vegetation is typically a shrub steppe including *Hakea lorea* subsp. *suberea* (syn. *Hakea lorea* subsp. *lorea*, *Acacia pruinocarpa*, *A. aneura*, *A. cuthbertsonii*, *A. coriacea*, *Eucalyptus gamophylla*, *E. oxymitra*, *Eremophila forrestii* and *Triodia basedowii*. Groves of *Allocasuarina decaisneana* were also observed with no apparent pattern in their distribution or density.

Halpern Glick Maunsell (HGM) (2002). *Wingellina Baseline Biological Survey.*

This report includes an inventory of all the flora and fauna recorded during a Level 1 survey of the project area in April 2002 (an area of approx. 100 km²).

A total of 188 plants were recorded during this survey, 75 of which had not been previously recorded for the area. No Declared Rare or Priority flora were identified. Six introduced taxa were recorded, five of which were new records for the Central Ranges Bioregion. HGM concluded that a high level of human activity in the vicinity of the Wingellina Community had exacerbated the spread of weed species.

Seven vegetation communities were identified during the survey, none of which were restricted to the survey area. None of the communities recorded in the survey are nationally listed as threatened

ecological communities under the EPBC Act. However, three communities were considered to be regionally significant;

- Grassland of Poaceae spp. with occasional *Senna glutinosa* subsp. *glutinosa* and *Sida fibulifera* in patches of cracking clay.
- Low Scrub over *Triodia* spp. in sand over sand dunes.
- Low Open Woodland of *Eucalyptus gamophylla* and *Eucalyptus socialis* subsp. *eucentrica* over *Acacia validinervia* over mixed shrubs over *Triodia scariosa* in clay loam on upper slopes of mafic ridges.

These vegetation communities were considered to be regionally significant due to their isolation and underlying geomorphology.

A. C. Robinson, P. B. Copley, P. D. Canty, L. M. Baker and B. J. Nesbitt (Eds) (2003). A Biological Survey of the Anangu Pitjantjatjara Lands, South Australia.

This report includes an inventory of all the flora and fauna recorded during a survey of the Anangu-Pitjantjatjara (AP) lands in the north-western region of South Australia. It forms part of a comprehensive biological survey of South Australia spanning 10 years. A total of 719 species were recorded in the Anangu-Pitjantjatjara lands, nearly 10% of which represented species new to the State, region or science, attesting to the status of botanical knowledge in the area. A number of species recorded in this survey are also known from collections within Western Australia.

Pearson D., Miller J., Butler M., Butler M., Brennan K., Thompson W. (2006). Learning about country. Landscape Vol. 23 No.2 Summer 2007-08 Naturebase, Department of Environment and Conservation

In 2006, a survey of the Ngaanyatjarra lands was undertaken by the Western Australia Museum (WAM), Department of Environment and Conservation (DEC), South Australian Museum, Department of Environment and Heritage (DEH) (South Australia) and the Ngaanyatjarra people. The survey investigated flora, vertebrate fauna, invertebrates and subterranean fauna. Seven hundred and twenty plant specimens were recorded, including thirty seven species that were either new records or significant range extensions.

4.2 Field Survey

4.2.1 Flora composition

A total of 176 specimens were collected during the April 2008 survey of the Wingellina project area, of which 154 have been identified to species level. Of the identified flora, there were 100 taxa (including subspecies and variants) from 40 genera and 24 families. The flora was dominated by Mimosaceae, with 17 taxa from 1 genus and Poaceae, with 16 taxa from 11 genera recorded (**Table 4**). The families Caesalpiniaceae, Chenopodiaceae and Malvaceae were also species rich (**Table 4**).

A total of 22 specimens still require additional work to confirm identity. Within this collection, there are samples that are considered to be potentially duplicates of samples that have been identified or are

samples collected to capture the range of variation within a species. This is particularly so for samples of *Eucalyptus* species. The remaining specimens require significant attention and potentially additional collections to facilitate identification.

A Site Species Matrix is provided as **Appendix G**.

Table 3 Summary of dominant plant families in the Wingellina study area

Family	Number of Taxa	Number of genera
Mimosaceae	17	1
Poaceae	16	11
Chenopodiaceae	12	6
Caesalpiniaceae	12	2
Malvaceae	6	4

4.2.2 Conservation Significant Flora Species and Vegetation Communities

No Declared Rare or Priority Flora were identified during the April 2008 flora and vegetation survey. No TEcs or PECs were found to occur in the Wingellina study area

4.2.3 Introduced Flora

One introduced species, **Cenchrus ciliaris* (Buffel Grass), was recorded during this survey. While not recorded as having a large foliage cover, it was recorded in fourteen of the thirty quadrats, or 46%. Of the quadrat records 2.7% were of this single introduced species and this is a marginal increase on the 2.5% of quadrat records that were introduced species in Robinson *et al.* (2003). However, these are records of a single species and the previous survey shows records of 25 taxa recorded in that survey. This would appear to show that the vegetation at Wingellina is becoming increasingly degraded by invasion of **Cenchrus ciliaris*. This is possibly a result of uncontrolled grazing by camels or by human activities

4.2.4 Data Analysis

A dendrogram was produced using PRIMER, as reproduced below, and was used to help determine groupings of vegetation units.

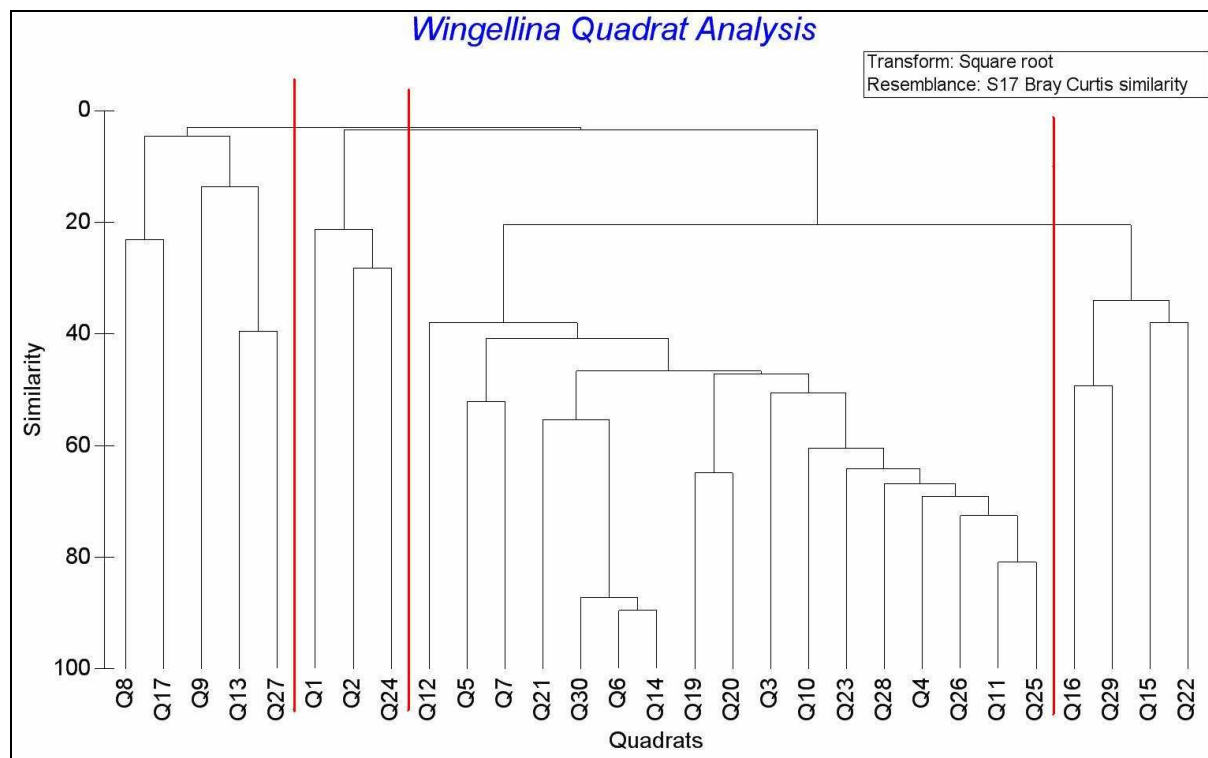


Figure 4 PRIMER dendrogram of relationships between vegetation communities

The dendrogram shows four major groupings in the vegetation based on presence/absence analysis, and these are defined by the vertical red lines in **Figure.4**. These correspond broadly to topographical features. A description of the basis for the site groupings is below, moving from left to right across the x axis of **Figure 4**:

Group 1: Q8-Q27; These sites are on sandplain around the hills and are predominately Mulga woodlands,

Group 2: Q1-Q24; *Eucalyptus* Shrub Mallee on upper slopes and ridges,

Group 3: Q12-Q25; A mixture of sites from valleys, broad flats and drainages and the low hills south/south-east of Wingellina of *Eucalyptus* Mallee over Mulga. Sites Q3 and Q4 are sites from upper slopes and low ridges but have mixed *Eucalyptus* canopies as opposed to single species *Eucalyptus* canopies, separating them out from others in Group 2.

Group 4: Q16-Q22; The same mixture of landform and canopy as Group 3, separated due to differences in understorey species.

This analysis is consistent with the observed vegetation distribution in the study area and shows results consistent with previous studies, although with more definition. The groupings of sites represented in the dendrogram appear to show a realistic picture of vegetation relationships in the Wingellina study area

4.2.5 Vegetation Types – Descriptions

Seven vegetation units were described from this survey of the Wingellina study area. The greatest number of these units are composed of *Eucalyptus* Shrub Mallee, comprising various *Eucalyptus* species. The quadrats recorded within each vegetation unit are listed after each description. A vegetation map is included as **Figure 5**.

Ega

Eucalyptus gamophylla (*Eucalyptus mannensis* subsp. *mannensis*) (Very) Open Shrub Mallee over *Senna* spp., *Acacia* spp. Open Shrubland/Scattered Shrubs over *Triodia* spp. Hummock Grassland on upper slopes and ridges.

WIN 01, 02, 03, 04, 24

Eso

Eucalyptus socialis subsp. *eucentrica* Open Shrub Mallee occasionally with *E. gamophylla*, *E. mannensis* subsp. *mannensis* Scattered Mallees over *Acacia aneura*, *A. kempeana*, *A. oswaldii*, *A. valdinervia* Scattered Tall Shrubs/Open Shrubland/Low Shrubland over mixed shrubs over *Triodia* spp. Hummock Grassland, *Eragrostis eriopoda*, *Enteropogon ramosus* Scattered Grasses/Very Open Grassland. On valley floors and plains associated with increased moisture availability.

WIN 05, 10, 11, 12, 16, 23, 25, 26 28, 29

Egyp

Eucalyptus gypsophila (Very) Open Shrub Mallee often with *E. socialis*, subsp. *eucentrica* over mixed *Acacia* spp. over *Ptilotus obovatus* var. *obovatus* Low Shrubland/Open Shrubland over *Triodia helmsii*/*T. pungens* Hummock Grassland. On low hills and slopes.

WIN 06, 14, 19, 22, 30

Aca

Acacia aneura var. *aneura*, *A. aneura* var. *intermedia* Low Woodland-Scattered Tall Shrubs over mixed *Acacia* spp., *Senna artemisioides* Scattered Shrubs/Open Shrubland over *Eragrostis eriopoda*, *Aristida* spp., *Enteropogon ramosus* Open-Closed Grassland. On plains surrounding Wingellina.

WIN 07, 08, 09, 13, 15, 27

Hdi

Hakea divaricata Low Open Woodland over **Cenchrus ciliaris*, *Enteropogon ramosus* Open Grassland. Apparently restricted unit on flats.

WIN 17

Apr

Acacia pruinocarpa, *Hakea lorea* subsp. *lorea* Tall Open Shrubland over *Senna artemisioides* subsp. *oligophylla* x *helmsii*, *Acacia kempeana* Low Open Shrubland over *Triodia helmsii* Hummock

Grassland, *Cymbopogon oblectus* Very Open Tussock Grassland. On low hills to the south of Wingellina.

WIN 20

Ccot

Codonocarpus cotinifolius Low Open Woodland over *Eucalyptus gamophylla* Scattered Mallee over *Senna glutinosa*, *Acacia kempeana*, *Hakea lorea* subsp. *lorea* Open Shrubland over *Acacia valdinervia*, *Ptilotus exaltatus* var. *exaltatus* Low Open Shrubland over *Triodia helmsii* Hummock Grassland, *Cymbopogon oblectus* Very Open Tussock Grassland. On low hills to the south of Wingellina, outside the study area.

WIN 21

The Shrub Mallee and Mulga units described here largely correlate with those described by HGM in 2002, although boundaries may differ.

Three units described by HGM (2002) are not included as the sites were not surveyed due to time, cultural or geographical constraints. These are HGM's A2, A3 and B3(u), all small units in the context of the overall site. HGM recommended that unit B3(u) remain undisturbed, and given the approximate locations of A2 and A3 it is unlikely that they will be impacted. HGM was of the opinion that these three units are of regional significance due to their isolation and underlying geomorphology.

Three of the units described by this survey appear to be restricted:

Hdi was recorded from one site to the south-east of the airstrip, in a broad valley between low hills. After reviewing aerial photography it is possible that this unit is more widespread around the low hills in the south of the study area than would be indicated by one sampling.

Apr was also recorded at one site, on a low hill in the south of the study area. As this landform is repeated both within and outside the survey area it is likely this unit is not as restricted as may appear.

Ccot is described from one site that falls outside the southern tenement boundary, however the northern extent of the low hill it is situated on is within the tenement. From available aerial photography it would appear to be more common than one sample site shows.

These three vegetation units, due to their location within the tenement and their size, should be treated as restricted until further information is gathered. None of them is likely to be impacted by any proposed development at Wingellina.

Photographs of each site and its description are included in **Appendix F**.

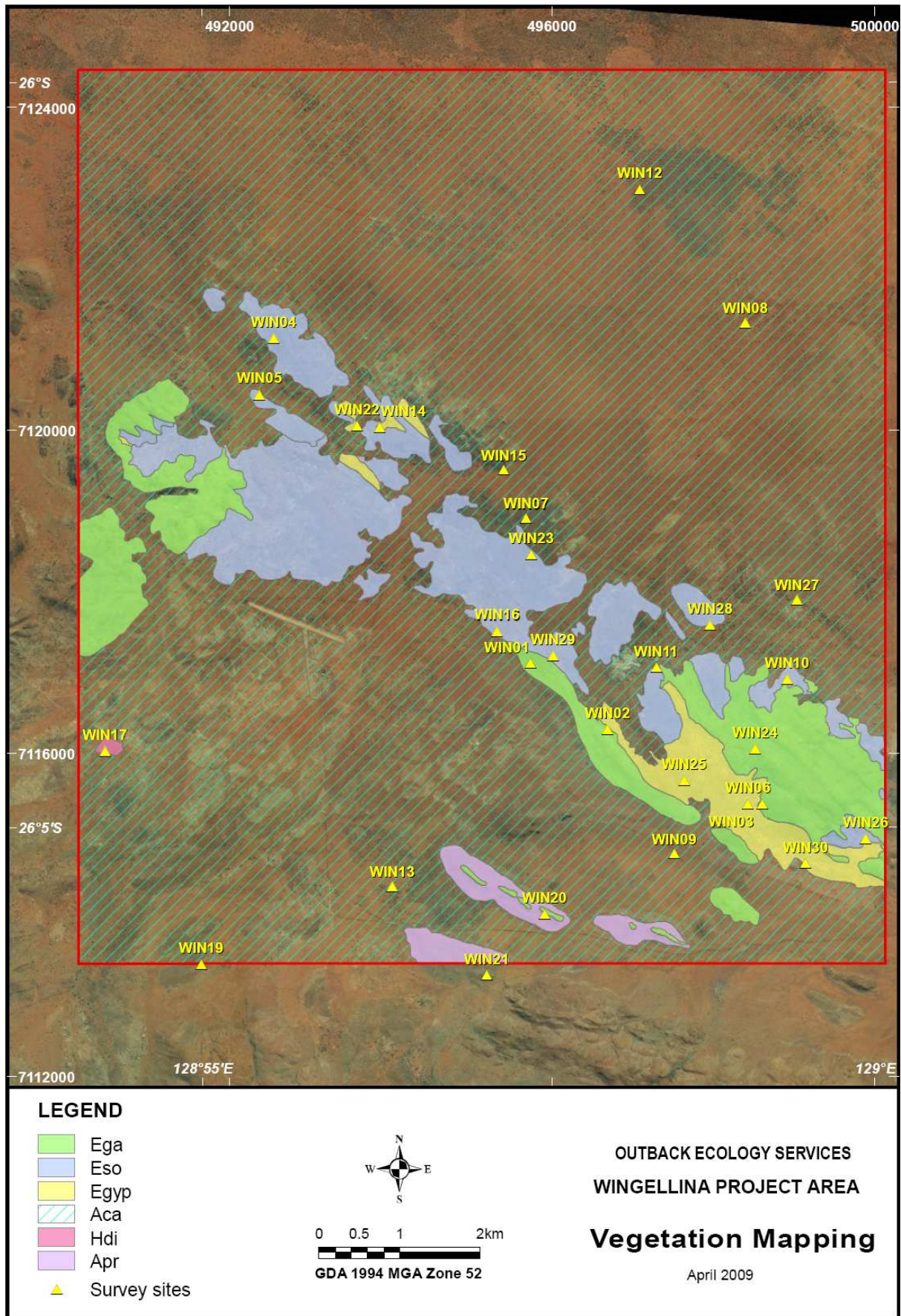


Figure 5 Vegetation map of the Wingellina study area

4.2.6 Vegetation Condition Assessment

The condition of vegetation within the study area was assessed using the scale of Keighery (1994) (**Appendix B**). The majority of vegetation within the survey area was assessed as being in excellent to very good condition, using the scale of Keighery (1994) (**Table 4**). This assessment reflects evidence of low level disturbance, in vegetation that was otherwise near pristine. The remaining vegetation was assessed as being predominately in good condition, with a small number of sites assessed as degraded (**Table 4**).

The main causes of disturbance to vegetation were considered to be repeated fires and grazing damage by camels. Extensive areas of vegetation have been repeatedly burnt, which has resulted in the loss of *Acacia aneura* var. *aneura* (Mulga) trees from many areas within the survey area.

Table 4 Vegetation condition assessment of survey sites within the study area.

	Pristine	Excellent	Very good	Good	Degraded	Completely degraded
Quadrats		1, 2, 3, 4, 5, 6, 7, 12, 19, 21, 22, 24, 26	14, 16, 20, 25, 30	9, 10, 11, 15, 17, 18, 23, 25, 29	8, 13, 27, 28	
% of sites	0	43.3%	16.7%	26.7	13.3%	0

5.0 SUMMARY AND RECOMMENDATIONS

Outback Ecology undertook a flora and vegetation survey over the Wingellina project area in April 2008. This survey builds on previous baseline botanical information acquired by HGM (Maunsell) during a Level 1 survey of the project area in 2002.

A search of relevant databases revealed that there are no Threatened or Priority Ecological Communities or Declared Rare Flora (DRF) known within the Wingellina project area. In addition, this survey did not collect specimens of any known DRF or Priority Flora, or identify any Threatened or Priority Ecological Communities in the study area.

A total of 176 specimens were collected during the April 2008 survey of the Wingellina project area, of which 154 have been identified. Of the identified flora, there were 100 taxa (including subspecies and variants) from 40 genera and 24 families. The flora was dominated by Mimosaceae, with 17 taxa from 1 genus and Poaceae, with 16 taxa from 11 genera recorded. The families Caesalpiniaceae, Chenopodiaceae and Malvaceae were also species rich. One alien taxon, **Cenchrus ciliaris* (Buffel grass), was recorded during the survey.

Vegetation units in the study area appear relatively uniform in distribution and are related to landform. The descriptions and distribution of vegetation units in this report are believed to accurately represent the vegetation present in the Wingellina study area. Three units described from this study were sampled once and may be restricted, however they are to the south of the proposed mining area and are unlikely to be impacted. Two minor vegetation units described by Maunsell (2002) were not sampled during this survey due to time and access constraints imposed by traditional cultural events occurring at the time of survey.

The following general management guidelines below are suggested to minimise potential impacts to the flora and vegetation within the Wingellina project area:

- Reduce vegetation clearance to an absolute minimum where practicable.
- Conserve topsoil and progressively rehabilitate waste dumps, tailings dams and pits with local flora species to an appropriate standard
- Minimise impacts to surface hydrology by avoiding drainage features wherever possible, as this may be important for long-term Mulga growth
- Assess the likely impact of dewatering and any groundwater drawdown on vegetation
- Implement standard dust suppression strategies across the project area, during both construction and operation periods, to reduce impacts to surrounding vegetation.
- Systematic culling of camels where practicable to reduce the negative impacts on surviving Mulga woodlands

- Prevent the establishment of new weed species, and the further spread of existing weed species
- Consider the preparation and implementation of a comprehensive Fire Management Plan, not only to reduce the risk of fire within the project area, but also to mitigate against wildfire from off-site ignition sources.

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Appendix A

**Definitions of Declared Rare and Priority Flora and Threatened Ecological
Community Classifications**

Definition of Declared Rare and Priority Flora Species (CALM, 2005)

Conservation Code	Category Description
R	<u>Declared Rare Flora – Extant Taxa</u> “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.”
P1	<u>Priority One – Poorly Known Taxa</u> “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. 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	<u>Priority Two – Poorly Known Taxa</u> “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	<u>Priority Three – Poorly Known Taxa</u> “Taxa which are known from several populations, and the taxa are not believed to be under immediate threat (i.e. not currently endangered), either due to the number of known populations (generally >5), or known populations being large, and either widespread or protected. Such taxa are under consideration for declaration as ‘rare flora’ but are in need of further survey.”
P4	<u>Priority Four – Poorly Known Taxa</u> “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.”

Definition of Threatened Ecological Community classifications (English, 2003)

TEC Classification	Description
Presumed Totally Destroyed	Community is unlikely to be able to be rehabilitated.
Critically Endangered	There are immediate threats throughout its range.
Endangered	Threatened throughout most of its range in near future.
Vulnerable	Vulnerable to threatening processes/may move into higher threat category.

Appendix B
Vegetation Condition Scale

Vegetation Condition Scale (Keighery, 1994).

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

Classification of Vegetation Structural Formation and Height Classes

Vegetation Structure Classification (Keighery 1994)

<u>Life Form/ Height Class</u>	<u>Canopy Cover (percentage)</u>			
	<u>100% - 70%</u>	<u>70% - 30%</u>	<u>30% - 10%</u>	<u>10% - 2%</u>
<u>Trees 10-30m</u> <u>Trees < 10m</u>	<u>Closed Forest</u> <u>Low Closed</u> <u>Forest</u>	<u>Open Forest</u> <u>Low Open Forest</u>	<u>Woodland</u> <u>Low</u> <u>Woodland</u>	<u>Open Woodland</u> <u>Low Open</u> <u>Woodland</u>
<u>Shrub Mallee</u>	<u>Closed Shrub</u> <u>Mallee</u>	<u>Shrub Mallee</u>	<u>Open Shrub</u> <u>Mallee</u>	<u>Very Open Shrub</u> <u>Mallee</u>
<u>Shrubs > 2m</u> <u>Shrubs 1-2m</u> <u>Shrubs <1m</u>	<u>Closed Tall</u> <u>Scrub</u> <u>Closed Heath</u> <u>Closed Low</u> <u>Heath</u>	<u>Tall Open Scrub</u> <u>Open Heath</u> <u>Open Low Heath</u>	<u>Tall</u> <u>Shrubland</u> <u>Shrubland</u> <u>Low</u> <u>Shrubland</u>	<u>Tall Open</u> <u>Shrubland</u> <u>Open Shrubland</u> <u>Low Open</u> <u>Shrubland</u>
<u>Grasses</u>	<u>Closed</u> <u>Grassland</u>	<u>Grassland</u>	<u>Open</u> <u>Grassland</u>	<u>Very Open</u> <u>Grassland</u>
<u>Herbs</u>	<u>Closed</u> <u>Herbland</u>	<u>Herbland</u>	<u>Open</u> <u>Herbland</u>	<u>Very Open</u> <u>Herbland</u>
<u>Sedges</u>	<u>Closed</u> <u>Sedgeland</u>	<u>Sedgeland</u>	<u>Open</u> <u>Sedgeland</u>	<u>Very Open</u> <u>Sedgeland</u>

Appendix D
DEC Database Searches

WAHERB SPECIMEN DATABASE
GENERAL ENQUIRY

Calotis latiuscula
F.Muell. & Tate (Asteraceae)
CONSERVATION STATUS:P3
Coll.: A.S. George 5228 Date: 21 07 1963 (PERTH 00421952)
LOCALITY Mt Aloysius E of Blackstone Range WA
LAT 26 Deg 2 Min 0.000 Sec S LONG 128 Deg 35 Min 59.000 Sec E
near creek bed on rocky hillside
Previous det.: *Calotis latiuscula* F.Muell.& Tate

Calotis latiuscula
F.Muell. & Tate (Asteraceae)
CONSERVATION STATUS:P3
Coll.: A.S. George 4849 Date: 08 07 1963 (PERTH 00421960)
LOCALITY Mount Fanny, NE of Blackstone Range WA
LAT 25 Deg 47 Min 0.000 Sec S LONG 128 Deg 34 Min 7.000 Sec E
Herb to 50 cm. Flowers yellow. On rocky hillside.
Previous det.: *Calotis latiuscula* F.Muell.& Tate

Calotis latiuscula
F.Muell. & Tate (Asteraceae)
CONSERVATION STATUS:P3
Coll.: D.J. Edinger, B. & B. Backhouse & G. M DJE 2434 Date: 06 05 2001 (PERTH 05853303)
LOCALITY On plain at base of Mount Aloysius, 27 km E of Blackstone, Central Ranges, WA
LAT 25 Deg 58 Min 19.900 Sec S LONG 128 Deg 34 Min 10.800 Sec E
Daisy, flowers yellow. Under trees.
Frequency:common.

Lythrum paradoxum
Koehne (Lythraceae)
CONSERVATION STATUS:P3
Coll.: B. Lay 865 Date: 29 08 1973 (PERTH 04903242)
LOCALITY Fanny's Peak [Mount Fanny], ca 85 km S of Giles Meteorological Station, on road to Warburton Mission WA
LAT 25 Deg 47 Min 0.000 Sec S LONG 128 Deg 34 Min 42.000 Sec E
Perennial. Shrub 1 m high x 2 m in diameter. Rocky gully.
Previous det.: *Lythrum paradoxum* Koehne
Frequency:common.

Menkea lutea
E.A.Shaw (Brassicaceae)
CONSERVATION STATUS:P1
Coll.: Symon D.E. 2165 Date: 31 07 1962 (PERTH 1138847)
LOCALITY Wingelena air strip, Tomkinson Range. WA
LAT 26 Deg 3 Min Sec S LONG 128 Deg 48 Min Sec E
Flowers bright yellow.

Teucrium grandiusculum
F.Muell. & Tate subsp. *grandiusculum* (Lamiaceae)
CONSERVATION STATUS:P2
Coll.: D.J. Pearson DJP 632 Date: 25 06 1989 (PERTH 1158902)
LOCALITY Purnawara Rockhole, 4 km N of Boundary Peak, Bell Rock Range, WA
LAT 26 Deg 18 Min Sec S LONG 128 Deg 48 Min Sec E
Dwarf shrub 50 cm tall. Flowers white. On rocky slope in red sand.
In hummock grassland with *Triodia* sp., *Dodonaea* sp., *Ptilotus* spp.
Previous det.: *Teucrium grandiusculum* F.Muell.& Tate
Frequency:occasional.

Appendix E
Environment Protection and Biodiversity Conservation (EPBC) Act Protected
Matters Database Search

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Information on the coverage of this report and qualifications on data supporting this report are contained in the [caveat](#) at the end of the report.

You may wish to print this report for reference before moving to other pages or websites.

The Australian Natural Resources Atlas at <http://www.environment.gov.au/atlas> may provide further environmental information relevant to your selected area. Information about the EPBC Act including significance guidelines, forms and application process details can be found at <http://www.environment.gov.au/epbc/assessmentsapprovals/index.html>

This map may contain data which are
© (Geoscience Commonwealth of Australia)
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Search Type: Point
Buffer: 100 km
Coordinates: -26.06803,128.9651

Report Contents: [Summary](#)
[Details](#)

- [Matters of NES](#)
- [Other matters protected by the EPBC Act](#)
- [Extra Information](#)

[Caveat](#)
[Acknowledgments](#)

Summary

Matters of National Environmental Significance

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

<http://www.environment.gov.au/epbc/assessmentsapprovals/guidelines/index.html>.

World Heritage Properties: None
National Heritage Places: None
Wetlands of International Significance: None
(Ramsar Sites)
Commonwealth Marine Areas: None
Threatened Ecological Communities: None
[Threatened Species:](#) 5

Migratory Species:

5

Other Matters Protected by the EPBC Act

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

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

Please note that the current dataset on Commonwealth land is not complete. Further information on Commonwealth land would need to be obtained from relevant sources including Commonwealth agencies, local agencies, and land tenure maps.

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species. Information on EPBC Act permit requirements and application forms can be found at <http://www.environment.gov.au/epbc/permits/index.html>.

Commonwealth Lands: 1

Commonwealth Heritage Places: None

Places on the RNE: 1

Listed Marine Species: 4

Whales and Other Cetaceans: None

Critical Habitats: None

Commonwealth Reserves: None

Extra Information

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

State and Territory Reserves: 2

Other Commonwealth Reserves: None

Regional Forest Agreements: None

Details

Matters of National Environmental Significance

Threatened Species [Dataset Information]	Status	Type of Presence
Birds		
Leipoa <i>ocellata</i> Malleefowl	Vulnerable	Species or species habitat likely to occur within area
Mammals		
Dasycercus <i>cristicauda</i> Mulgara	Vulnerable	Species or species habitat likely to occur within area

[Notoryctes typhlops](#) Endangered Species or species habitat likely to occur within area
Yitjarritjarri, Southern Marsupial Mole

[Petrogale lateralis MacDonnell Ranges race](#) Vulnerable Species or species habitat may occur within area
Warru, Black-footed Rock-wallaby (MacDonnell Ranges race)

Reptiles

[Egernia kintorei](#) Vulnerable Species or species habitat may occur within area
Great Desert Skink, Tjakura, Warrarna, Mulyamiji

Migratory Species [[Dataset Information](#)] Status Type of Presence

Migratory Terrestrial Species

Birds

[Leipoa ocellata](#) Migratory Species or species habitat likely to occur within area
Malleefowl

[Merops ornatus](#) Migratory Species or species habitat may occur within area
Rainbow Bee-eater

Migratory Wetland Species

Birds

[Charadrius veredus](#) Migratory Species or species habitat may occur within area
Oriental Plover, Oriental Dotterel

[Glareola maldivarum](#) Migratory Species or species habitat may occur within area
Oriental Pratincole

Migratory Marine Birds

[Apus pacificus](#) Migratory Species or species habitat may occur within area
Fork-tailed Swift

Other Matters Protected by the EPBC Act

Listed Marine Species [[Dataset Information](#)] Status Type of Presence

Birds

[Apus pacificus](#) Listed - Species or species habitat may occur overfly marine area
Fork-tailed Swift

[Charadrius veredus](#) Listed - Species or species habitat may occur overfly marine area
Oriental Plover, Oriental Dotterel

[Glareola maldivarum](#) Listed - Species or species habitat may occur overfly marine area
Oriental Pratincole

[Merops ornatus](#) Listed - Species or species habitat may occur overfly marine area
Rainbow Bee-eater

Commonwealth Lands [[Dataset Information](#)]

Defence

Places on the RNE [[Dataset Information](#)]
Note that not all Indigenous sites may be listed.

Natural

[Ranges of the Western Desert WA](#)

Extra Information

State and Territory Reserves [[Dataset Information](#)]

Ngaanyatjarra Lands Indigenous Protected Area, WA

Watarru Indigenous Protected Area, SA

Caveat

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

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

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

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

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under "type of presence". For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the [migratory](#) and [marine](#) provisions of the Act have been mapped.

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

threatened species listed as [extinct or considered as vagrants](#)

some species and ecological communities that have only recently been listed

[some terrestrial species](#) that overfly the Commonwealth marine area

migratory species that are very [widespread, vagrant, or only occur in small numbers](#).

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

non-threatened seabirds which have only been mapped for recorded breeding sites;

seals which have only been mapped for breeding sites near the Australian continent.

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

Acknowledgments

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

[New South Wales National Parks and Wildlife Service](#)

[Department of Sustainability and Environment, Victoria](#)

[Department of Primary Industries, Water and Environment, Tasmania](#)

[Department of Environment and Heritage, South Australia Planning SA](#)

[Parks and Wildlife Commission of the Northern Territory](#)

[Environmental Protection Agency, Queensland](#)

[Birds Australia](#)

[Australian Bird and Bat Banding Scheme](#)

[Australian National Wildlife Collection](#)
Natural history museums of Australia
[Queensland Herbarium](#)
[National Herbarium of NSW](#)
[Royal Botanic Gardens and National Herbarium of Victoria](#)
[Tasmanian Herbarium](#)
[State Herbarium of South Australia](#)
[Northern Territory Herbarium](#)
[Western Australian Herbarium](#)
[Australian National Herbarium, Atherton and Canberra](#)
[University of New England](#)
Other groups and individuals

Appendix F
Site Vegetation Descriptions and Photographs



Plate 1 - Win001 *Eucalyptus gamophylla* Very Open Shrub Mallee over *Senna artemisioides* subsp. *oligophylla* x *helmsii*, *Acacia oswaldii* Low Open Shrubland over *Triodia schinzii* (Closed) Hummock Grassland



Plate 2 - Win002 *Eucalyptus gamophylla* Open Shrub Mallee over *Senna glaucifolia* Scattered Shrubs over *Dodonaea viscosa* subsp. *spathulata* Open/Closed Low Heath



Plate 3 - Win003 *Eucalyptus gamophylla*, *Eucalyptus mannensis* subsp. *mannensis* Open Mallee Shrubland over *Eremophila duttonii* Low Open Shrubland over *Triodia helmsii* Hummock Grassland



Plate 4 - Win004 *Eucalyptus gamophylla*, *E. mannensis* subsp. *mannensis* Mallee Shrubland over *Acacia kempeana*, *Senna artemisioides* subsp. *artemisioides* Tall Shrubland over *Ptilotus obovatus* var. *obovatus* Open Shrubland over *Rahgodia eremaea* Low Open Shrubland over *Triodia helmsii* Closed Hummock Grassland



Plate 5 - Win005 *Eucalyptus socialis* subsp. *eucentrica* Very Open Shrub Mallee over Scattered mixed *Acacia* spp. over *Ptilotus obovatus* var. *obovatus* Low Shrubland over *Triodia helmsii* Hummock Grassland, *Eragrostis eriopoda*, *Digitaria ammophila*, *Aristida contorta*, *A. holathera* var. *holathera* Open Tussock Grassland



Plate 6 - Win006 *Eucalyptus gypsophila*, *E. socialis* subsp. *eucentrica* Shrub Mallee over *Acacia kempeana*, *A. nyssophylla* Scattered Tall Shrubs over *Ptilotus obovatus* var. *obovatus* Low Shrubland over *Triodia helmsii* Hummock Grassland



Plate 7 - Win007 *Acacia aneura* var. *aneura*, *A. aneura* var. *intermedia* Tall Open Shrubland over *Eremophila latrobei* var. *latrobei*, *Senna glaucifolia* Open Shrubland over *Ptilotus obovatus* var. *obovatus* Low Shrubland over *Triodia helmsii* Hummock Grassland, **Cenchrus ciliaris*, *Enneapogon caerulescens* var. *caerulescens*, *Eragrostis eriopoda* Open Tussock Grassland



Plate 8 - Win008 *Acacia aneura* var. *aneura* Low Open Woodland over *A. aneura* var. *conifera*, *Sida excedentifolia* Scattered Low Shrubs over *Eragrostis* sp. (BGN050), *Enteropogon ramosus*, *Eragrostis eriopoda* Open Tussock Grassland



Plate 9 - Win009 *Acacia aneura* var. *aneura*, *A. aneura* var. *intermedia* Tall Open Shrubland over *Senna artemisioides* subsp. *filifolia* Open Shrubland over *Eragrostis eriopoda* Grassland



Plate 10 - Win010 *Eucalyptus socialis* subsp. *eucentrica* Very Open Shrub Mallee over *Acacia kempeana* Low Open Shrubland over *Triodia helmsii* Hummock Grassland, *Eragrostis eriopoda* Very Open Grassland



Plate 11 - Win011 *Eucalyptus socialis* subsp. *eucentrica*, *E. gamophylla* Open Shrub Mallee over *Triodia helmsii* Hummock Grassland, *Enteropogon ramosus*, *Eragrostis eriopoda* Very Open Grassland



Plate 12 - Win012 *Eucalyptus socialis* var. *eucentrica*, *E. gamophylla* Open Shrub Mallee over *Acacia aneura* var. *intermedia*, *Acacia prairii* Scattered Low Trees over *Acacia oswaldii* Scattered Low Shrubs over *Senna pleurocarpa* var. *pleurocarpa* Low Open Shrubland over *Triodia pungens* Closed Hummock Grassland



Plate 13 - Win013 *Acacia aneura* var. *aneura*, *Acacia tetragonophylla* Scattered Tall Shrubs over *Senna artemisioides* subsp. *artemisioides* Scattered Shrubs over *Sclerolaena* sp. (BGN087) Open Low Heath over *Aristida contorta*, *A. latifolia* Closed Tussock Grassland



Plate 14 - Win014 *Eucalyptus gypsophila*, *E. socialis* subsp. *eucentrica* Open Shrub Mallee over *Ptilotus obovatus* var. *obovatus* Low Open Shrubland over *Triodia helmsii* Hummock Grassland



Plate 15 - Win015 *Acacia kempeana*, *Acacia aneura* var. *intermedia* Tall Open Scrub over *Ptilotus obovatus* var. *obovatus* Low (Open) Shrubland over *Eragrostis eriopoda*, **Cenchrus ciliaris* Very Open Grassland



Plate 16 - Win016 *Eucalyptus socialis* subsp. *eucentrica* Open Shrub Mallee over *Acacia oswaldii* Shrubland over *Acacia kempeana*, *Ptilotus obovatus* var. *obovatus*, *Rhagodia eremaea* Low Shrubland over *Triodia scariosa* Hummock Grassland, *Enteropogon ramosus* Scattered Grasses



Plate 17 - Win017 *Hakea divaricata* Low Open Woodland over **Cenchrus ciliaris*, *Enteropogon ramosus* Open Grassland



Plate 18 - Win019 *Eucalyptus gypsophila* Very Open Shrub Mallee over *Acacia pruinoarpa*, *A. valdinervia*, *Eremophila alternifolia*, *Hakea lorea* subsp. *lorea* Shrubland over *Halgania cyanea* Low Open Shrubland over *Triodia helmsii* Hummock Grassland, *Cymbopogon obtectus* Very Open Grassland



Plate 19 - Win020 *Acacia pruinocarpa*, *Hakea lorea* subsp. *lorea* Tall Open Shrubland over *Senna artemisioides* subsp. *oligophylla* x *helmsii*, *Acacia kempeana* Low Open Shrubland over *Triodia helmsii* Hummock Grassland, *Cymbopogon obtectus* Very Open Tussock Grassland



Plate 20 - Win021 *Codonocarpus cotinifolius* Low Open Woodland over *Eucalyptus gamophylla* Scattered Mallee over *Senna glutinosa*, *Acacia kempeana*, *Hakea lorea* subsp. *lorea* Open Shrubland over *Acacia valdinervia*, *Ptilotus exaltatus* var. *exaltatus* Low Open Shrubland over *Triodia helmsii* Hummock Grassland, *Cymbopogon obtectus* Very Open Tussock Grassland



Plate 21 - Win022 *Eucalyptus gypsophila*, *E. socialis* subsp. *eucentrica*, *E. trivalva* Open Shrub Mallee over *Acacia clelandii*, *Eremophila glabra* subsp. *glabra* Tall Open Shrubland over *Senna glaucifolia*, *Acacia nysophylla* Open Shrubland over *Ptilotus obovatus* var. *obovatus* Low Open Shrubland over *Triodia pungens* Hummock Grassland, **Cenchrus ciliaris* Scattered Grasses



Plate 22 - Win023 *Eucalyptus socialis* subsp. *eucentrica*, *E. gypsophila* Open Shrub Mallee over *Acacia oswaldii*, *A. pruinocarpa* Tall Open Shrubland over *Senna artemisioides* subsp. *artemisioides* Open Shrubland over *Triodia helmsii* Hummock Grassland



Plate 23 - Win024 *Eucalyptus gamophylla* Open Shrub Mallee over *Senna artemisioides* subsp. *artemisioides*, *Halgania cyanea* Low Open Shrubland over *Triodia schinzii* Hummock Grassland



Plate 24 - Win025 *Eucalyptus socialis* subsp. *eucentrica* Open Shrub Mallee over *Acacia oswaldii*, *A. kempeana* Tall Open Shrubland over *Triodia helmsii* Hummock Grassland



Plate 25 - Win026 *Eucalyptus socialis* subsp. *eucentrica*, *E. mannensis* subsp. *mannensis* Open Shrub Mallee over *Acacia kempeana*, *A. valdinervia* Open Shrubland over *Triodia helmsii* Hummock Grassland



Plate 26 - Win027 *Acacia aneura* var. *aneura*, *A. aneura* var. *intermedia*, *Hakea lorea* subsp. *lorea* Tall Shrubland over *Aristida contorta*, *Cymbopogon obtectus*, *Eragrostis* sp. (BGN084) Grassland



Plate 27 - Win028 *Eucalyptus socialis* subsp. *eucentrica* Open Shrub Mallee over *Acacia kempeana*, *A. pruinocarpa*, *Senna artemisioides* subsp. *artemisioides*, *Halgania cyanea* Low Shrubland over *Triodia helmsii* Closed Hummock Grassland



Plate 28 - Win029 *Eucalyptus socialis* subsp. *eucentrica* Very Open Shrub Mallee over *Acacia aneura* var. *intermedia* Scattered Tall Shrubs over *Acacia oswaldii*, *Senna artemisioides* subsp. *artemisioides*, *Rhagodia eremaea* Shrubland over *Ptilotus obovatus* var. *obovatus* Low Open Shrubland over *Triodia helmsii* Very Open Hummock Grassland



Plate 29 - Win030 *Eucalyptus gypsophila* Open Shrub Mallee over *Acacia aneura* var. *aneura* Scattered Tall Shrubs over *Halgania cyanea*, *Ptilotus obovatus* var. *obovatus* Low Open Shrubland over *Triodia helmsii* Hummock Grassland

Appendix F
Site x Species Matrix

Family	Genus Species	Survey Site No																														
		001	002	003	004	005	006	007	008	009	010	011	012	013	014	015	016	017	018	019	020	021	022	023	024	025	026	027	028	029	030	
Amaranthaceae	Ptilotus clementii												+																			
Amaranthaceae	Ptilotus exaltatus var. exaltatus	+	+													+				+		+										
Amaranthaceae	Ptilotus helipteroides																						+									
Amaranthaceae	Ptilotus obovatus var. obovatus				+	+	+	+	+	+	+		+	+	+	+	+						+	+		+	+	+	+	+	+	
Amaranthaceae	Ptilotus sp.					+					+																					
Asteraceae	Chrysocephalum apiculatum					+																										
Asteraceae	Chrysocephalum eremaeum	+																														
Asteraceae	Olearia sp.																			+												
Asteraceae	Olearia stuartii															+																
Asteraceae	Pterocaulon serrulatum					+	+									+			+						+							
Asteraceae	Rhodanthe floribunda					+																										
Asteraceae	Senecio magnificus													+																		
Boraginaceae	Halgania cyanea		+																		+	+			+				+		+	
Brassicaceae	Lepidium phlebopetalum					+																										
Caesalpinaceae	Petalostylis cassioides						+																									
Caesalpinaceae	Senna artemisioides subsp. artemisioides				+						+			+		+	+	+						+	+				+	+		
Caesalpinaceae	Senna artemisioides subsp. filifolia		+							+																						
Caesalpinaceae	Senna artemisioides subsp. oligophylla				+							+																				
Caesalpinaceae	Senna artemisioides subsp. oligophylla x helmsii	+																				+	+		+			+				
Caesalpinaceae	Senna artemisioides subsp. petiolaris																														+	
Caesalpinaceae	Senna glaucifolia	+	+						+																+							
Caesalpinaceae	Senna glutinosa	+							+														+									
Caesalpinaceae	Senna pleurocarpa												+													+						
Caesalpinaceae	Senna sp.														+										+							
Chenopodiaceae	Enchylaena tomentosa var. tomentosa					+	+																									
Chenopodiaceae	Eremophea spinosa					+					+																					
Chenopodiaceae	Maireana eriosphaera							+		+									+													
Chenopodiaceae	Maireana scleroptera					+											+															
Chenopodiaceae	Maireana sp.														+	+	+						+									
Chenopodiaceae	Rhagodia eremaea				+	+	+				+				+	+	+							+		+		+		+	+	

Family	Genus Species	Survey Site No																													
		001	002	003	004	005	006	007	008	009	010	011	012	013	014	015	016	017	018	019	020	021	022	023	024	025	026	027	028	029	030
Chenopodiaceae	Salsola tragus					+			+			+		+	+	+							+					+	+		+
Chenopodiaceae	Sclerolaena convexula					+																									
Chenopodiaceae	Sclerolaena parviflora		+																											+	
Chenopodiaceae	Sclerolaena patenticuspis								+	+				+																	
Chenopodiaceae	Sclerolaena sp.					+	+							+																	
Cucurbitaceae	Mukia maderaspatana						+	+																					+		
Euphorbiaceae	Euphorbia australis						+							+	+																
Euphorbiaceae	Euphorbia boophthona	+										+				+		+													
Goodeniaceae	Goodenia glandulosa																					+									
Goodeniaceae	Goodenia ramelii						+																								
Goodeniaceae	Scaevola spinescens																						+								
Gyrostemonaceae	Codonocarpus cotinifolius																						+								
Loranthaceae	Amyema maidenii subsp. maidenii									+						+													+		
Loranthaceae	Amyema miquelii																											+			
Malvaceae	Abutilon leucopetalum						+								+																
Malvaceae	Alyogyne pinoniana												+																		
Malvaceae	Hibiscus leptocladus						+									+															
Malvaceae	Sida calyxhymenia		+			+	+		+		+	+		+	+	+	+						+			+	+	+	+	+	+
Malvaceae	Sida excedentifolia								+	+																					
Malvaceae	Sida sp.	+	+			+	+				+				+			+		+	+	+		+	+	+	+		+		
Mimosaceae	Acacia aneura var. aneura							+	+	+				+															+		+
Mimosaceae	Acacia aneura var. conifera					+		+	+																						
Mimosaceae	Acacia aneura var. intermedia							+		+			+	+		+												+		+	
Mimosaceae	Acacia aneura var. major							+																							
Mimosaceae	Acacia aneura var. tenuis													+																	
Mimosaceae	Acacia clelandii					+																	+								
Mimosaceae	Acacia dictyophleba					+																									
Mimosaceae	Acacia kempeana	+			+		+				+	+			+	+					+	+				+	+		+	+	
Mimosaceae	Acacia minyura												+																		
Mimosaceae	Acacia nyssophylla						+							+									+							+	+
Mimosaceae	Acacia oswaldii	+			+				+	+		+	+		+								+		+					+	
Mimosaceae	Acacia prainii											+																			
Mimosaceae	Acacia pruinocarpa							+													+	+		+					+		

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		001	002	003	004	005	006	007	008	009	010	011	012	013	014	015	016	017	018	019	020	021	022	023	024	025	026	027	028	029	030			
Mimosaceae	Acacia sp.																						+											
Mimosaceae	Acacia strongylophylla			+																					+									
Mimosaceae	Acacia tetragonophylla				+	+							+		+						+													
Mimosaceae	Acacia validinervia		+	+								+									+	+	+			+		+						
Mimosaceae	Acacia victoriae											+	+					+				+												
Myoporaceae	Eremophila alternifolia	+																			+	+												
Myoporaceae	Eremophila duttonii	+		+	+							+													+									
Myoporaceae	Eremophila glabra subsp. glabra													+		+							+	+										
Myoporaceae	Eremophila latrobei subsp. latrobei				+		+	+								+															+			
Myoporaceae	Eremophila sp.							+							+																			
Myrtaceae	Eucalyptus camaldulensis var. obtusa																		+															
Myrtaceae	Eucalyptus gamophylla	+	+	+								+	+										+			+								
Myrtaceae	Eucalyptus gypsophila						+							+									+	+								+		
Myrtaceae	Eucalyptus mannensis subsp. mannensis			+	+																	+						+						
Myrtaceae	Eucalyptus socialis subsp. eucentrica					+	+				+		+		+		+						+	+			+	+		+	+			
Myrtaceae	Eucalyptus sp.		+		+							+									+					+								
Myrtaceae	Eucalyptus trivalvis										+												+											
Papilionaceae	Glycine canescens																			+														
Papilionaceae	Indigofera georgei																								+									
Pittosporaceae	Pittosporum angustifolium																						+				+							
Poaceae	Aristida contorta					+			+	+				+					+	+									+	+	+	+		
Poaceae	Aristida holathera var. holathera					+																												
Poaceae	Aristida latifolia												+						+							+								
Poaceae	Cenchrus ciliaris					+		+	+	+	+	+		+	+		+	+				+	+		+					+				
Poaceae	Cymbopogon obtectus	+	+		+	+		+	+	+	+			+			+			+	+	+		+				+	+					
Poaceae	Digitaria ammophila					+																												
Poaceae	Enneapogon caerulescens var. caerulescens							+																										
Poaceae	Enteropogon ramosus							+	+	+	+		+			+	+				+					+		+						
Poaceae	Eragrostis eriopoda					+		+	+	+	+	+		+		+	+	+						+			+		+					
Poaceae	Eragrostis sp.	+			+	+			+		+				+						+			+		+		+	+	+				
Poaceae	Eriachne mucronata	+																			+	+	+											
Poaceae	Panicum decompositum													+															+					

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		001	002	003	004	005	006	007	008	009	010	011	012	013	014	015	016	017	018	019	020	021	022	023	024	025	026	027	028	029	030		
Poaceae	Themeda sp.																		+											+			
Poaceae	Themeda triandra																		+														
Poaceae	Triodia helmsii			+	+	+	+	+				+	+			+					+	+	+		+		+	+		+			
Poaceae	Triodia pungens											+						+					+										
Poaceae	Triodia scariosa																+	+															
Poaceae	Triodia schinzii	+			+																					+							
Poaceae	Triodia sp.														+																+	+	
Polygalaceae	Chamaesyce australis					+			+								+													+			
Proteaceae	Hakea divaricata																	+															
Proteaceae	Hakea lorea subsp. lorea																				+	+	+			+			+				
Rubiaceae	Psydrax attenuata var. tenella																			+													
Sapindaceae	Dodonaea lobulata																							+									
Sapindaceae	Dodonaea viscosa subsp. spatulata	+	+									+								+													
Solanaceae	Solanum ellipticum										+																						
Solanaceae	Solanum lasiophyllum										+			+																			
Solanaceae	Solanum orbiculatum subsp. orbiculatum																+										+						
Solanaceae	Solanum petrophilum										+	+																					
Zygophyllaceae	Zygophyllum apiculatum										+							+															

*Alien species