



Level 1
Flora and Vegetation Survey
of Lake Cowan Gypsum Operations

Prepared for
Whitfield Minerals Pty Ltd

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1. INTRODUCTION

Whitfield Minerals Pty Ltd proposes to expand current quarry operations for the Lake Cowan project. The proposed areas fall within tenements M63/148, M63/170 and M63/528. A clearing permit is currently being prepared, and will be submitted with the inclusion of this report.

The survey area is located approximately 166kms south of Kalgoorlie, or 5.6km SW of Norseman in the Coolgardie region of Western Australia (Figure 1).

The total survey area received from Whitfield Minerals covers 12.27ha which envelopes current infrastructure (existing clearing) and salt lake totalling 0.36ha (2.9% of survey area). Therefore clearing will be required for 8ha of native vegetation within the survey area of 11.91ha. This report will encompass results of the flora and vegetation survey for the expansion of the existing Gypsum operations.



Figure 1: Regional map of survey location

Whitfield Minerals Pty Ltd commissioned Native Vegetation Solutions (NVS) to complete a Level 1 Flora and Vegetation Survey of three areas totalling 11.91ha of native vegetation on the 17th of April 2012.

1.1 Objectives

EPA's Position Statement No. 3 (EPA 2002) provides indicative levels of biological survey in relation to the scale and nature of the impact and the sensitivity of the receiving environment. The EPA uses the Interim Biogeographic Regionalisation of Australia (IBRA) as the largest unit for Environmental Impact Assessment decision making in relation to the conservation of biodiversity. Given the scale and nature of the proposed disturbance as well as the existing disturbance, and that the survey area is located within the Coolgardie IBRA region, a Level 1 flora and vegetation survey was required.

The objective of this report is to document the results of the flora and vegetation component of a Level 1 assessment conducted in accordance with the Environmental Protection Authority (EPA) “*Terrestrial Biological Surveys as an Element of Biodiversity Protection; Position Statement No 3*” (EPA 2002) and *Guidance Statement No. 51 “Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia*” (EPA 2004), for the purpose of Gypsum extraction.

A Level 1 study has two components:

1). Desktop study which includes a literature review and a search of the relevant databases;

and

2). Reconnaissance survey of the survey area to verify the desktop survey, to define vegetation groups present in the area, search for species of conservation significance and to determine potential sensitivity to impact.

As part of the reporting for the Level 1 assessment, NVS has conducted a Flora and Vegetation Survey which includes broad-scale vegetation mapping and vegetation condition mapping of the survey area.

Therefore, the scope of work for the Flora and Vegetation Survey was to:

- conduct a desktop study that includes a literature review and search of the relevant databases;
- generally describe the vegetation associations in the survey area;
- prepare an inventory of species occurring in the survey area;
- identify any vegetation or flora of particular conservation significance; and
- provide recommendations, including the management of perceived impacts to flora and vegetation within the survey area.

1.2 Geology and Vegetation

The survey area lies in the Coolgardie (COO) bioregion within the Eastern Goldfields (COO3) subregion which totals over 5.1 million hectares (CALM, 2002). The COO3 subregion lies on the Yilgarn Craton's 'Eastern Goldfields Terrains'. The relief is subdued and comprises of gently undulating plains interrupted in the west with low hills and ridges of Archaean greenstones and in the east by a horst of Proterozoic basic granulite. The underlying geology is of gneisses and granites eroded into a flat plane covered with tertiary soils and with scattered exposures of bedrock. Calcareous earths are the dominant soil group and cover much of the plains and greenstone areas. A series of large playa lakes in the western half are the remnants of an ancient major drainage line. The vegetation is of Mallees, *Acacia* thickets and shrubheaths on sandplains. Diverse *Eucalyptus* woodlands occur around salt lakes, on ranges, and in valleys. Salt lakes support dwarf shrublands of samphire. Woodlands and *Dodonaea* shrubland occur on basic granitoides of the Fraser Range (CALM, 2002).

1.3 Climate

The climate is semi-arid (Dry) Warm Mediterranean and receives 300 – 500 mm of annual rainfall mainly during winter and summer thunderstorms (CALM, 2002). The nearest official meteorological weather station with the most complete and up to date information is Norseman, which is located approximately 5.5 km north east of the survey area.

1.3.1 Temperature

Mean annual minimum temperature at Norseman is 10.6°C and mean annual maximum temperature is 24.7°C. The coldest temperatures are attained in July (mean minimum

temperature 5.2°C), the hottest is December (mean maximum temperature 32.6°C) and diurnal temperature variations are relatively consistent throughout the year (Figure 2).

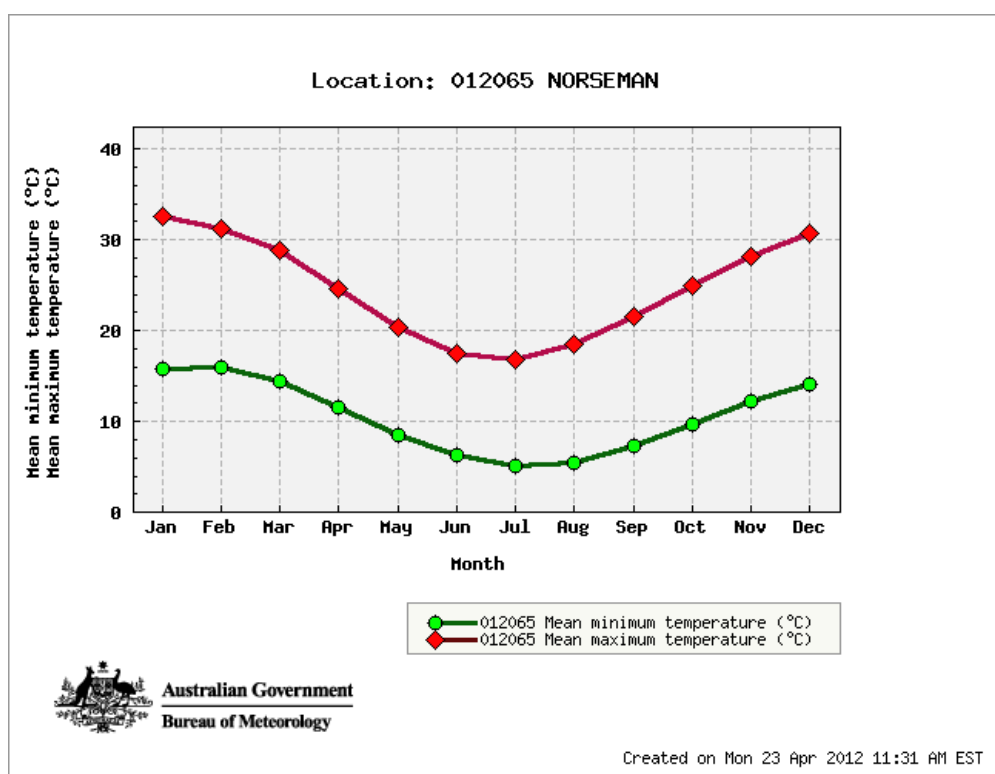


Figure 2: Mean temperature ranges for Norseman weather station

1.3.2 Rainfall

The annual average rainfall at Norseman is 288.3 mm, which falls (>1 mm) on an average of 45.6 rain-days. Rainfall is relatively even throughout the year with slightly larger rainfall events falling between the months of May and June (Figure 3). However, rainfall in January and March 2012 exceeded monthly averages, with March receiving almost three times its mean monthly average.

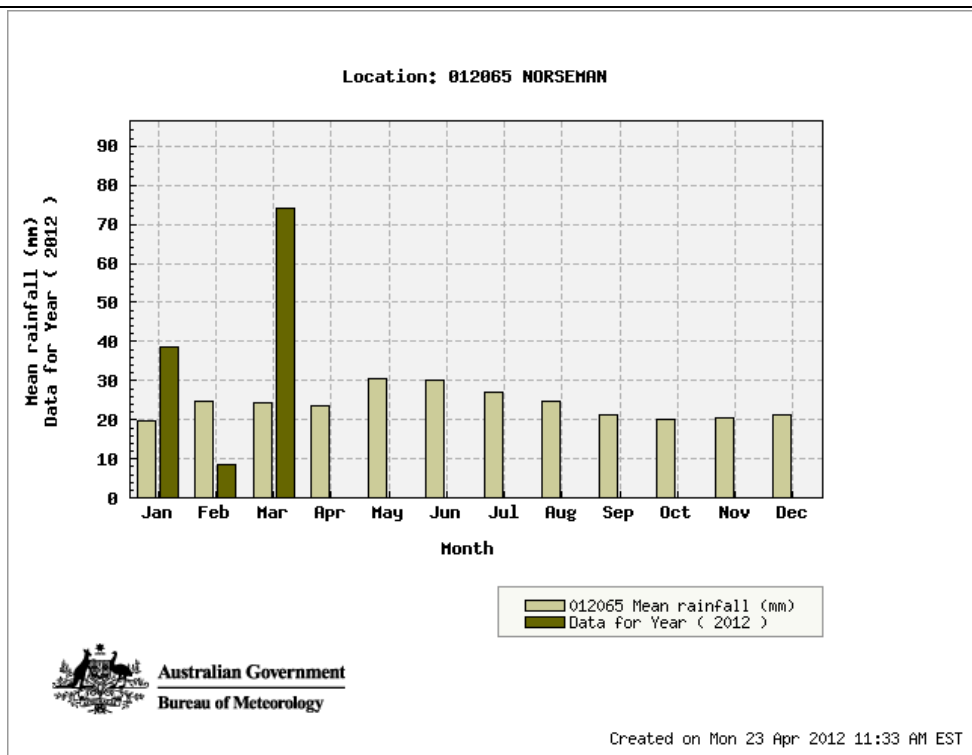


Figure 3: Monthly and mean rainfall for Norseman weather station 2012

2. ASSESSMENT METHODOLOGY

2.1 Preliminary Desktop Study

A preliminary assessment of the survey area and its potential constraints was undertaken by reviewing a number of government agency managed databases (see Appendix 1) and consulting where necessary. The following sections provide a summary of the methodology used for each potential environmental aspect associated with the project.

2.1.1 *Environment Protection and Biodiversity Conservation Act Protected Matters*

The *Environment Protection and Biodiversity Conservation (EPBC) Act 1999* Protected Matters Search tool was utilised to provide results for matters of National Environmental Significance within the survey area.

(<http://www.environment.gov.au/arccgis-framework/apps/pmst/pmst-coordinate.jsf>)

2.1.2 Threatened Flora and Communities

The Species and Communities Branch of the Department of Environment and Conservation (DEC) was contacted for a search of their databases containing known populations of threatened flora (Reference: 33-0412FL).

The presence of Threatened and Priority Ecological Communities (TECs & PECs) was determined by examining Geographic Information System (GIS) data supplied by the DEC upon request (Reference: 29-0412EC).

2.1.3 Environmentally Sensitive Areas (ESAs) and Conservation Reserves

DEC's Native Vegetation Map Viewer was used to determine the location of any ESAs (<http://www.dec.wa.gov.au/content/view/2920/1572/1/1/>).

The location of any Conservation Reserves was determined by examining GIS data available from the DEC website and consulting with the local DEC office where necessary.

2.1.4 Vegetation Type, Extent and Status

Vegetation extent and status data was sourced from the Department of Agriculture and Food (DAFWA) report “Land-Use and Vegetation in Western Australia- National Land and Water Resources Audit Report” and its’ associated GIS file. This data comprises Beard’s Pre-European vegetation groups.

Note: This data was provided to Native Vegetation Solutions via a license agreement with the DAFWA.

2.1.5 Wetlands

The location of wetlands within the project area was determined by examining DAFWA’s Wetland Base (<http://spatial.agric.wa.gov.au/wetlands/>).

2.1.6 Dieback

Dieback is only considered a potential issue for the project if both the mean annual rainfall of the area is >400mm, and if the project area resides below the 26th parallel.

2.2 Site Investigation

A site visit was carried out by Botanist Eren Reid and Consultant Ashley Owen from Native Vegetation Solutions on the 17/4/2012, to examine the flora and vegetation groups contained within the survey area. A total of 5 hours was spent on site traversing the survey area, on foot.

The survey was conducted in accordance with relevant EPA’s Statements and Guidelines (Section 1.1).

2.2.1 Licenses

Flora was collected for identification under the Scientific Collection License SL009444 held by Mr E. R. Reid with expiry 17/05/2012.

2.3 Personnel and Reporting

The following personnel were involved in the preparation of this report;

- Eren Reid *BSc (Biological Science)*, Principal Botanist, Native Vegetation Solutions, undertook the survey, species identification and review of the report;
- Ashley Owen *DipSc*, Botanist/Consultant, undertook the survey, data collation and preparation of report; and
- Frank Obbens *BSc*, Consultant Senior Botanist/Plant Taxonomist, undertook identification of unknown specimens collected during fieldwork.

2.4 Limitations

Table 1 lists potential limitations that may have affected the survey. These are based on the listing given in the *Guidance Statement No. 51 Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* (EPA, 2004). As shown, this survey was not limited by any factors listed below.

Table 1: List of potential survey limitations

Potential Limitations	Constraint (Y/N)	Comment
Competency and experience of the consultants undertaking the survey	N	Mr Eren Reid is an experienced botanist who has conducted many flora and vegetation surveys in the Goldfields, Pilbara and South-west regions of WA.
Proportion of flora identified during survey	N	As the survey was planned to target species of conservation significance and flora within a small survey area a complete census of the species present was attempted (Approx. 95%). Sufficient identifications were made to allow vegetation descriptions to be made.
Sources of information	N	Threatened and Priority Flora GIS information was available from DEC.
Proportion of the task achieved	N	All tasks completed
Timing/Season	N	The targeted survey was conducted in Autumn 2012. Recent rainfall allowed the emergence of some ephemeral species, with many other species in flower.
Disturbance in survey area	N	Disturbance was present in the form of current exploration as well as grazing.
Intensity of survey effort	N	Transects were walked through the survey area with all parts visited
Resources	N	Adequate resources were available
Access problems	N	No problems with access
Availability of contextual information on the region	N	Information on the Coolgardie Bioregion is readily available.

3. **RESULTS**

3.1 **Preliminary Desktop Assessment**

3.1.1 **EPBC Act Protected Matters**

The EPBC Protected Matters search tool revealed the following:

- The survey area could possibly be suitable habitat for weed species *Carrichtera annua* (Wards Weed) and *Tamarix aphylla* (Athel Tree).
 - *Carrichtera annua* was introduced into Australia from the eastern Mediterranean, and is now widespread throughout South Australia, the Interior, and Western Australia (Lamp & Collet, 1999).
 - *T. aphylla* is listed as a declared plant (P1) by DAFWA (2012). This species has naturalised at Carnarvon, in and around the Gascoyne River mouth. It is native to North Africa (Hussey *et al*, 2007).
- The search included the survey area and a 1km radius. There were no Threatened Species, Threatened Ecological Communities or Commonwealth Reserves listed as occurring within the search area (DSEWPC, 2012).
- The survey is located within the Lake Cowan waterbody (DAFWA, 2012a); however this is not considered a Nationally Important Wetland (DSEWPC, 2012).
- The survey area lies within the nominated boundary of the Great Western Woodlands. The Great Western Woodlands in the semi-arid inland of Western Australia's south-west are considered the largest remaining, and most intact, temperate woodlands left on Earth, covering an approximate area of more than 16 million hectares. This semi-arid region, with its warm Mediterranean climate and mainly winter rainfall averaging 250-300mm per year, is geologically diverse and hosts a fine, complex and richly diverse mosaic of eucalypt woodland and shrubland vegetation, which includes numerous endemic species and ecological communities (DSEWPC, 2012).

Results of the EPBC Act Protected Matters database search are included in Appendix 1.

3.1.2 Threatened Flora and Communities

The DEC database searches revealed a potential for 2 Threatened and 44 Priority Flora species to occur within a 20km radius of the survey area (DEC, 2012). No known locations of these Flora occur within the survey area, while the closest location occurs approximately 1.95km south west of the survey area.

Results of the threatened flora database search are included in Appendix 2.

The PEC/TEC search (DEC, 2012a) revealed that there are no TECs or PECs in the survey area.

3.1.3 Environmentally Sensitive Areas and Conservation Reserves

No ESA's or Nature Reserves are located within the survey area (DEC, 2012b).

3.1.4 Vegetation Type, Extent and Status

Information relating to known vegetation within the survey area has been summarised in Table 2 and 3 below. This information has been compiled through both desktop assessments and the site visit.

Table 2: Summary of information regarding Pre-European and current vegetation extent of Vegetation Association 125 within the survey area

Factor	Value				
Beard Vegetation Association*	125				
Vegetation Association Description*	Bare areas; salt lakes				
Pre-European Extent (ha)	Scale				
	<i>By Association (WA)</i>	<i>By Association (WA)</i>	<i>By IBRA Region (COO)</i>	<i>By IBRA Sub-region (COO3)</i>	<i>By Shire (Shire of Dundas)</i>
	3,578,590*	3,497,681**	546,150**	303,330**	196,040**
% Pre-European Extent Remaining*	90.46%	90.46%	N/A	N/A	N/A
Surrounding Land Use	Mining, Exploration, Residential Area				
Weed prevalence	Low				

* Source: Shepherd *et al.* (2002) Appendix 2

**Source: Shepherd *et al.* (2002) Associated GIS data

Table 3: Summary of information regarding Pre-European and current vegetation extent of Vegetation Association 3106 within the survey area

Factor	Value				
Beard Vegetation Association*	3106				
Vegetation Association Description*	Medium woodland; salmon gum & Dundas blackbutt				
Pre-European Extent (ha)	Scale				
	By Association (WA)	By Association (WA)	By IBRA Region (COO)	By IBRA Sub-region (COO3)	By Shire (Shire of Dundas)
	52,660*	52,692**	52,691**	52,691**	32,045**
% Pre-European Extent Remaining*	98.24%	98.24%	N/A	N/A	N/A
Surrounding Land Use	Mining, Exploration, Residential Area				
Weed prevalence	Low				

* Source: Government of Western Australia (2010)

**Source: Shepherd *et al.* (2002) Associated GIS data

3.1.5 Wetlands

The DAFWA WetlandBase (DAFWA, 2012a) search reveals the survey area occurs within islands surrounded by the Lake Cowan waterbody.

Lake Cowan is not considered a Nationally Important Wetland, DSEWPC (2012), and is not listed as a Ramsar site (DAFWA, 2012a).

3.1.6 Dieback

The survey area lies south of the 26th parallel, however receives average annual rainfall between 261mm and 313mm, below the 400mm threshold mark. There is no record of *Phytophthora cinnamomi* establishing in natural ecosystems in regions receiving <400mm rainfall per annum (CALM, 2003). Therefore Dieback is not considered an issue for this survey area, however all measures should be taken to prevent any possible soil contamination (seeds of non-native species *etc.*) which poses a risk in the survey area during seasonally favourable conditions.

3.2 Field Assessment

3.2.1 Threatened Flora

No plant taxa located in the survey area are gazetted as DRF pursuant to subsection 2 of Section 23F of the *Wildlife Conservation Act 1950*. No plant taxa listed as Threatened pursuant to Schedule 1 of the *Environment Protection and Biodiversity Conservation Act 1999* were located in the survey area.

3.2.2 Vegetation Type, Extent and Status

A total of 19 Families, 34 Genera and 52 Species were recorded within the survey area. Five major vegetation groups were recorded in the survey area, and are considered to be in Very Good, Good and Degraded condition (using the scale of Keighery 1994, see Appendix 3). Maps of the survey area can be seen in Appendix 4.

The vegetation groups are described in more detail below.

3.2.2.1 *Eucalyptus salicola* woodland on gypsum dunes

This vegetation group consisted of 17 Families, 29 Genera and 38 Species. The vegetation group was approximately 5.66 ha which makes up 47.5% of the survey area.

Dominant species were *Eucalyptus salicola*, *Casuarina pauper*, *Alyxia buxifolia* and *Scaevola spinescens*.



Figure 4: *Eucalyptus salicola* woodland on gypsum dunes within the survey area

3.2.2.2 *Casuarina pauper* and *Callitris columellaris* over *Melaleuca quadrifaria* and *Darwinia* sp. Karonie Shrubland

This vegetation group consisted of 11 Families, 15 Genera and 18 Species. The vegetation group was approximately 2.59 ha which makes up 21.7% of the survey area.

Dominant species were *Casuarina pauper*, *Callitris columellaris*, *Melaleuca quadrifaria* and *Darwinia* sp. Karonie.



Figure 5: *Casuarina pauper* and *Callitris columellaris* over *Melaleuca quadrifaria* and *Darwinia* sp. Karonie Shrubland within the survey area

3.2.2.3 *Tecticornia* Shrubland

This vegetation group consisted of 12 Families, 15 Genera and 22 Species. The vegetation group was approximately 2.0ha which makes up 16.8% of the survey area.

Dominant species were *Tecticornia moniliformis*, *T. pergranulata* subsp. *pergranulata*, *T. halocnemoides* subsp. *caudata* and *T. indica* subsp. *bidens*.



Figure 6: *Tecticornia* shrubland within the survey area

3.2.2.4 *Eucalyptus salicola* open woodland over *Casuarina pauper*, *Callitris columellaris* and *Melaleuca quadrifaria* shrubland

This vegetation group consisted of 11 Families, 15 Genera and 15 Species. The vegetation group was approximately 1.07ha which makes up 9% of the survey area.

Dominant species were *Eucalyptus salicola*, *Casuarina pauper*, *Callitris columellaris* and *Melaleuca quadrifaria*



No photo available.

3.2.2.5 *Casuarina pauper* and *Callitris columellaris* over *Melaleuca quadrifaria* shrubland

This vegetation group consisted of 11 Families, 15 Genera and 18 Species. The vegetation group was approximately 0.6 ha which makes up 5% of the survey area.

Dominant species were *Casuarina pauper*, *Callitris columellaris*, and *Melaleuca quadrifaria*.



Figure 7: *Casuarina pauper* and *Callitris columellaris* over *Melaleuca quadrifaria* shrubland within the survey area

3.2.3 Riparian Vegetation

Riparian vegetation was identified within the survey area. The riparian vegetation identified within the survey area occurs upon a series of dunes on the Lake Cowan surface. The vegetation is typical of gypsiferous dunes around salt lakes. The clearing of this vegetation is unlikely to significantly affect the ecological communities associated with the Lake as it represents only a relatively small proportion of the local vegetation association.

3.2.4 Weeds

The EPBC Protected Matters search tool revealed that the survey area could possibly be suitable habitat for weed species *Carrichtera annua* (Wards Weed) and *Tamarix aphylla* (Athel Tree). However, no weed species were recorded within the survey area.

3.2.5 Vegetation Condition

Evidence of disturbance from historic mineral exploration and extraction was observed during the field assessment.

Overall, the condition of the vegetation was determined to be “Very Good” with areas which were affected by historic exploration in either “Good” or “Degraded” condition.

4. DISCUSSION

The field assessment established that the condition of the vegetation in the proposed disturbance area is overall “Very Good”, with areas affected by exploration in “Good” and “Degraded” condition. No areas of vegetation were assessed to be in “Pristine” condition.

No DRF, TECs or PECs were recorded in the survey area. No Priority Species were recorded within the survey area.

Riparian vegetation was identified in the survey area, mainly associated with the fringing lake shoreline. The clearing of this vegetation is unlikely to significantly affect the ecological communities associated with the Lake as it represents only a relatively small proportion of the local vegetation association.

Any proposed disturbance/clearing of vegetation will result in a loss of species from the proposed expansion of the Lake Cowan quarry operations. However, given the size of the area and the extent of the Beard (1990) vegetation associations elsewhere, the impact on the vegetation and its component flora will not affect the conservation values of either, or create fragmentation or patches of remnant vegetation.

The following recommendations arise from the Level 1 flora survey:

- Where possible, avoid unnecessary clearing;
- Weed control measures should be implemented during and following earthworks

5. REFERENCES

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Appendix 1

Relevant Government Database Search Results



EPBC Act Protected Matters Report

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

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

Information 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>

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[Summary](#)

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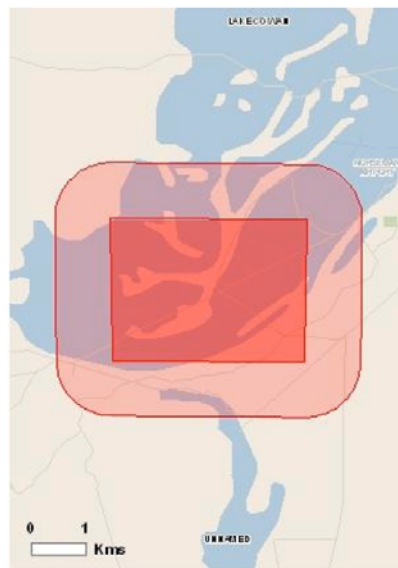
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[Other Matters Protected by the EPBC Act](#)

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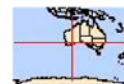
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Summary

Matters of National Environment Significance

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

World Heritage Properties:	None
National Heritage Places:	1
Wetlands of International	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Areas:	None
Threatened Ecological Communities:	None
Threatened Species:	1
Migratory Species:	7

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>

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.

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>.

Commonwealth Lands:	None
Commonwealth Heritage Places:	None
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

Place on the RNE:	None
State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	5
Nationally Important Wetlands:	None

Details

Matters of National Environmental Significance

National Heritage Properties		[Resource Information]
Name	State	Status
Natural		
Great Western Woodlands of Western Australia	WA	Nominated place
Threatened Species		[Resource Information]
Name	Status	Type of Presence
BIRDS		

Name	Status	Type of Presence
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area
Migratory Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat may occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat may occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Migratory Terrestrial Species		
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Migratory Wetlands Species		
Ardea alba Great Egret, White Egret [59541]		Species or species habitat may occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat may occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat may occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area

Extra Information

Invasive Species

[Resource Information]

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

Name	Status	Type of Presence
Mammals		
Felis catus		
Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Oryctolagus cuniculus		
Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Vulpes vulpes		
Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Carrichtera annua		
Ward's Weed [9511]		Species or species habitat likely to occur within area
Tamarix aphylla		
Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area

Coordinates

-32.21444 121.71444,-32.21472 121.74667,-32.23806 121.74639,-32.23778 121.71472,
-32.21444 121.71444

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

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

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 following provisions of the EPBC Act have been mapped:
- migratory and

-
- marine

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

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

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

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

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

Acknowledgements

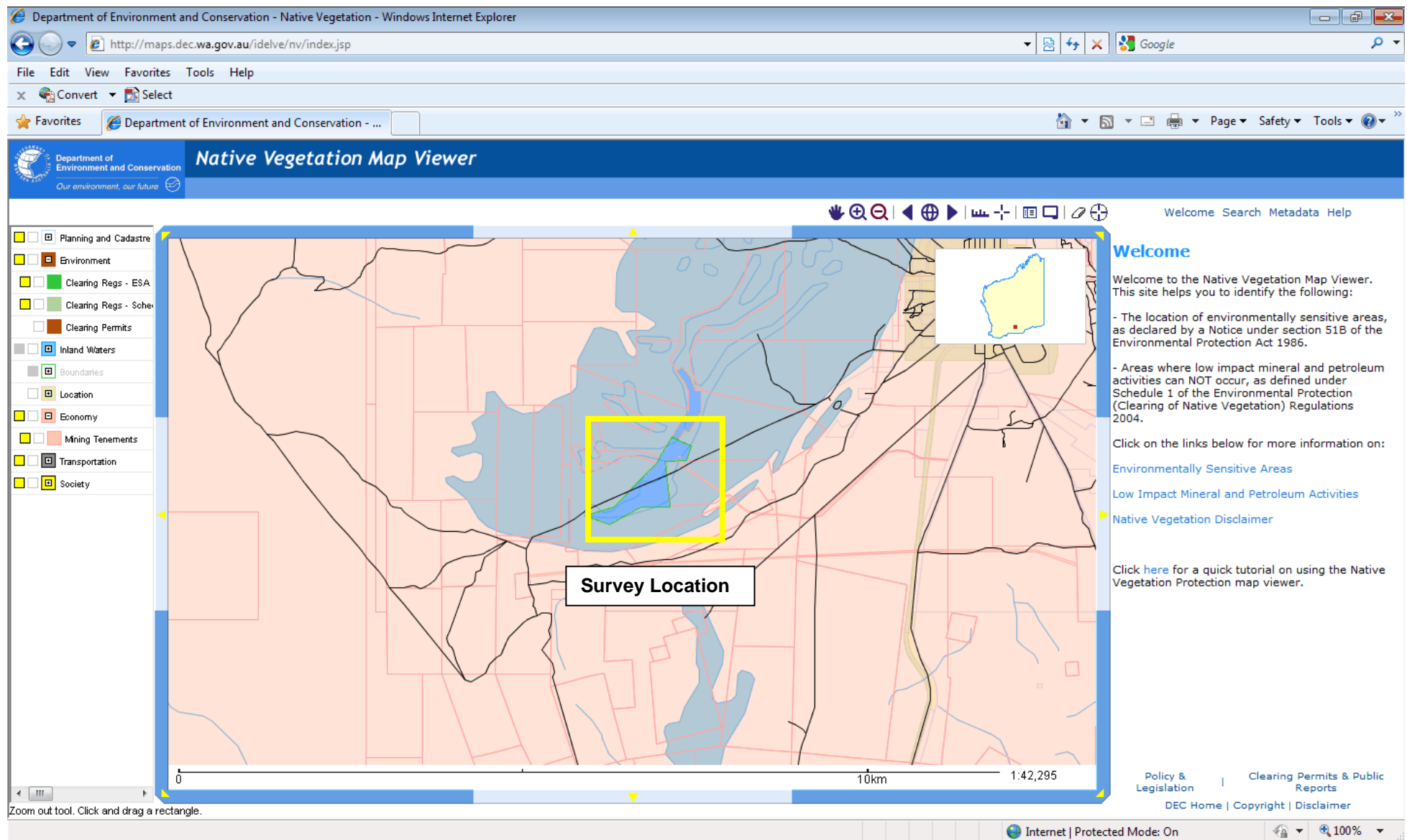
This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- [Department of Environment, Climate Change and Water, New South Wales](#)
- [Department of Sustainability and Environment, Victoria](#)
- [Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [Department of Environment and Natural Resources, South Australia](#)
- [Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts](#)
- [Environmental and Resource Management, Queensland](#)
- [Department of Environment and Conservation, Western Australia](#)
- [Department of the Environment, Climate Change, Energy and Water](#)
- [Birds Australia](#)
- [Australian Bird and Bat Banding Scheme](#)
- [Australian National Wildlife Collection](#)
- [Natural history museums of Australia](#)
- [Museum Victoria](#)
- [Australian Museum](#)
- [SA Museum](#)
- [Queensland Museum](#)
- [Online Zoological Collections of Australian Museums](#)
- [Queensland Herbarium](#)
- [National Herbarium of NSW](#)
- [Royal Botanic Gardens and National Herbarium of Victoria](#)
- [Tasmanian Herbarium](#)
- [State Herbarium of South Australia](#)
- [Northern Territory Herbarium](#)
- [Western Australian Herbarium](#)
- [Australian National Herbarium, Atherton and Canberra](#)
- [University of New England](#)
- [Ocean Biogeographic Information System](#)
- [Australian Government, Department of Defence](#)
- [State Forests of NSW](#)
- Other groups and individuals

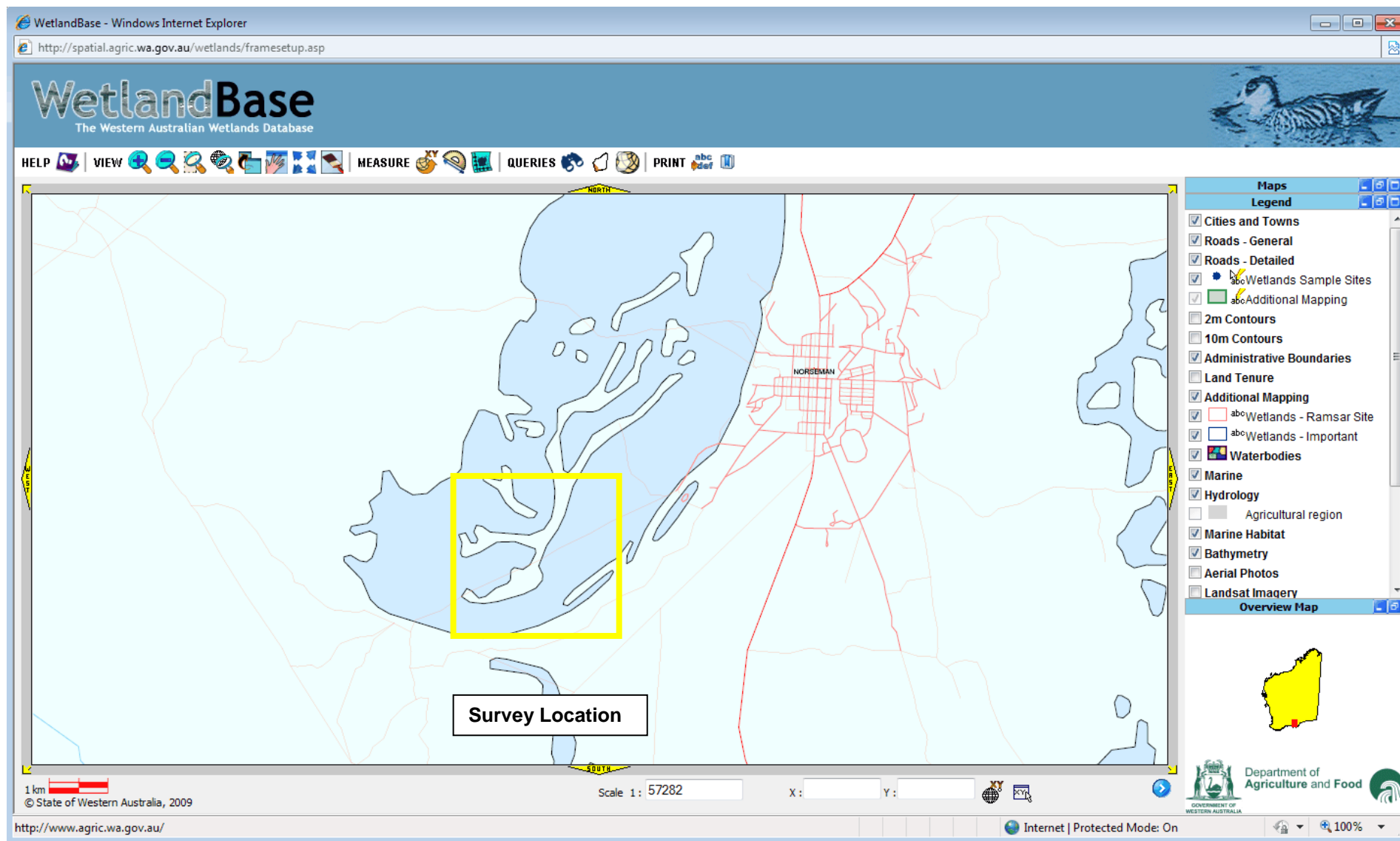
The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

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

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DEC's Native Vegetation Map Viewer showing no ESA's (dark green shaded areas) within the survey area (DEC, 2012b)



DAFWA Wetland Database showing the Lake Cowan waterbody within the survey area (DAFWA, 2012a).

Appendix 2

Threatened Flora Databases Search Results

NameID	Taxon	Status	Rank	IUCN Criteria	EPBC	DEC Region	DEC District	Distribution	Flowering Period	Recovery Plan
14048	Acacia ancistrophylla var. perarctuata	3				SCST,WHTB	ESPERANCE,GREAT SOUTHERN,CENTRAL WHEATBELT	Bruce Rock, Carrabin, Mukinbudin, Korbel, Dundas, Mt Andrew,Nungarin, Westonia, Merredin		
12256	Acacia dorsenna	1				SCST	ESPERANCE	Norseman, Lake Cowan	Aug	
16014	Acacia eremophila numerous-nerved variant (A.S. George 11924)	3				GOLD,SCST	ESPERANCE,KALGOORLIE	Norseman, Neale Junction, Great Victoria Desert, Balladonia, Plumridge Lakes	Sep,Jul	
3400	Acacia kerryana	2				GOLD,SCST,WHTB	ESPERANCE,KALGOORLIE,GREAT SOUTHERN	Norseman, Jimberlana Hill, Bremer Range, Lake Cronin, Spargoville	Dec-Feb	
13897	Allocasuarina eriochlamys subsp. grossa	3				GOLD,SCST	ESPERANCE,KALGOORLIE	Zanthus, Lake Cowan, Norseman		
12607	Angianthus newbeyi	2				SCST	ESPERANCE	Jyndabinbin Rock, Dundas NR		
17127	Astartea sp. Esperance (A. Fairall 2431)	1				SCST	ESPERANCE	Esperance, Dowak, Norseman	Oct	
17037	Astartea sp. Jyndabinbin Rocks (K.R. Newbey 7689)	2				SCST	ESPERANCE	Jyndabinbin Rocks, Dundas NR	Sep-Dec	
17520	Atriplex lindleyi subsp. conduplicata	3				GOLD,MWST,PILB,SCST	ESPERANCE,KALGOORLIE,KARRAT HA,GERALDTON	Credo Stn, Norseman, Karratha Stn, Balfour Downs Stn		
34298	Beyeria sulcata var. truncata	3				SCST,WHTB	ALBANY,ESPERANCE,GREAT SOUTHERN	Jerdacuttup, Ravensthorpe, Norseman, Lake King, Frank Hann N.P.	Oct	
30235	Bossiaea arcuata	1				SCST	ESPERANCE	Norseman	Sep	
30237	Bossiaea aurantiaca	1				SCST	ESPERANCE	Norseman	Sep,Oct	
30255	Bossiaea saxosa	1				SCST	ESPERANCE	Norseman	Sep,Dec	
14664	Comesperma calcicola	3				SCST,WHTB	ESPERANCE,CENTRAL WHEATBELT	Kau Rock, Pine Hill, Norseman, Forrestania, Mount Ragged		
7474	Dampiera sericantha	3				SCST	ESPERANCE	Norseman, Munglinup	Oct-Nov	
5525	Darwinia polycephala	4				SCST	ESPERANCE	Lake Halbert (NE Mt Ridley), Grasspatch, Scaddan, Norseman	Mar	
12327	Daviesia microcarpa	T	CR	B2ab(iii,iv,v); C2a(i)	EN	SCST	ESPERANCE	NE of Norseman, Southern Cross	Aug-Sep	IRP
17549	Eremophila lucida	1				SCST,WHTB	ESPERANCE,GREAT SOUTHERN	Forrestania, Norseman	Jul-Oct	
14593	Eremophila parvifolia subsp. parvifolia	4				SCST	ESPERANCE	Norseman, Balladonia, Bardoc, Caiguna to South Australia		
7258	Eremophila purpurascens	3				SCST	ESPERANCE	Norseman	Oct-Nov	
5569	Eucalyptus brockwayi	3				SCST	ESPERANCE	Norseman	Apr-Jun	
12888	Eucalyptus histophylla	3				GOLD,SCST,WHTB	ESPERANCE,KALGOORLIE,CENTRAL WHEATBELT	Newman Rock, Balladonia, W of Lake Johnson, Diamond Rock, Dundas N.R., Holleaton	Apr-Jun	
12378	Eucalyptus jimberlanica	1				SCST	ESPERANCE	Jimberlana Hill, Norseman	-	
13645	Eucalyptus platydisca	T	VU	D2	VU	SCST	ESPERANCE	Norseman, Mt Norcott	Mar-May	
5754	Eucalyptus pterocarpa	4				SCST	ESPERANCE	Norseman, Bronzite Ridge	Sep-Nov	
13053	Eucalyptus websteriana subsp. norsemanica	1				GOLD,SCST	ESPERANCE,KALGOORLIE	Norseman, Coolgardie	-	
30791	Eutaxia actinophylla	3				GOLD,SCST,WHTB	ESPERANCE,KALGOORLIE,CENTRAL WHEATBELT	Norseman, Salmon Gums, Mt Newmont, Bruce Rock, Wallaroo Rock, Mt Willgonarinya	Sep-Dec	
5202	Frankenia glomerata	3				GOLD,MWST,SCST,SWAN,WHTB	PERTH HILLS,ESPERANCE,KALGOORLIE,GERALDTON,GREAT SOUTHERN,CENTRAL WHEATBELT	Waeel, Cunderdin, Lake King, Northam, Little Sandy Desert, Carnarvon Range, Norseman, Arrino, Kellerberrin, Three Springs, Yenyenning Lakes	Mar,Nov	
19197	Gastrolobium hians	1				SCST	ESPERANCE	Norseman	Sep	

NameID	Taxon	Status	Rank	IUCN Criteria	EPBC	DEC Region	DEC District	Distribution	Flowering Period	Recovery Plan
7996	Gnephosis intonsa	1				GOLD,SCST	ESPERANCE,KALGOORLIE	Gibraltar, Boorabbin, Dundas	Sep	
17721	Gnephosis sp. Norseman (K.R. Newbey 8096)	3				GOLD,SCST	ESPERANCE,KALGOORLIE	Jaurdi Stn, Norseman	Sep,Oct	
31833	Goodenia corralina	2				SCST	ESPERANCE	Norseman	May	
2064	Grevillea phillipsiana	1				GOLD,SCST	ESPERANCE,KALGOORLIE	Norseman, Yardina, Kambalda, Widgiemooltha	Aug-Sep	
16991	Keraudrenia adenogyna	3				SCST,WHTB	ALBANY,ESPERANCE,GREAT SOUTHERN,CENTRAL WHEATBELT	Forrestania, Cairlocup, Frank Hann NP, Mt Holland, Dundas, Gnowangerup	Sep	
36059	Leucopogon sp. Yellowdine (M. Hislop & F. Hort MH 3194)	1				GOLD,SCST,WHTB	ESPERANCE,KALGOORLIE,CENTRAL WHEATBELT	N of Yellowdine, Holleton,Hyden-Norseman Track,	Jan, May, Aug	
16727	Logania nanophylla	2				SCST	ESPERANCE	Norseman	Aug	
5891	Melaleuca coccinea	3				GOLD,SCST	ALBANY,ESPERANCE,KALGOORLIE	Karonie, Boulder, Widgiemooltha, Erayinia Hill, Norseman, Ravensthorpe	Oct-Nov	
16448	Micromyrtus papillosa	1				SCST	ESPERANCE	Norseman, Jimberlana Hill, Beacon Hill, Mt Norcott	April, Aug-Oct	
8103	Microseris scapigera	3				SCST,WHTB	ESPERANCE,GREAT SOUTHERN,CENTRAL WHEATBELT	Scaddan, Marvel Loch, Lake Grace, Fraser range, Norseman, Southern Hills Stn, Holt Rock,Marble Rocks, Pingrup, Woodanilling, Lake Magenta	Sep-Oct	
6197	Myriophyllum petraeum	4				GOLD,SCST,WHTB	ESPERANCE,KALGOORLIE,GREAT SOUTHERN,CENTRAL WHEATBELT	Sth Cross-Mt Ragged, Narembreen, Mt Madden, Norseman	Aug-Sep	
6792	Newcastelia insignis	2				GOLD,SCST	ESPERANCE,KALGOORLIE	Adelong Stn, Comet Vale, Queen Victoria Spring, Norseman	Sep-Nov	
18520	Philotheca apiculata	2				GOLD,SCST,WHTB	ESPERANCE,KALGOORLIE,CENTRAL WHEATBELT	Norseman, Mt Kirk, Widgiemooltha, Holleton	Aug-Sep	
3059	Phlegmatospermum eremaeum	2				GOLD,SCST	ESPERANCE,KALGOORLIE	Coolgardie, Norseman, Cocklebiddy, Forrest	Aug-Oct	
20602	Pityrodia sp. Yilgarn (A.P. Brown 2679)	3				GOLD,WHTB	KALGOORLIE,CENTRAL WHEATBELT	Forrestania, Marvel Loch, Jilbadji, Norseman, Southern Cross (Barker Lake), Widgiemooltha	Oct,Nov	
40782	Stackhousia stratfordiae	1				SCST	ESPERANCE	Norseman	Oct	
19393	Teucrium sp. dwarf (R. Davis 8813)	1				SCST	ESPERANCE	Mt Gordon, Norseman	April	

Appendix 3

Vegetation Condition Scale (Keighery, 1994)

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 repeating 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 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 compromising weed or crop species with isolated trees or shrubs.

Appendix 4

Vegetation Mapping



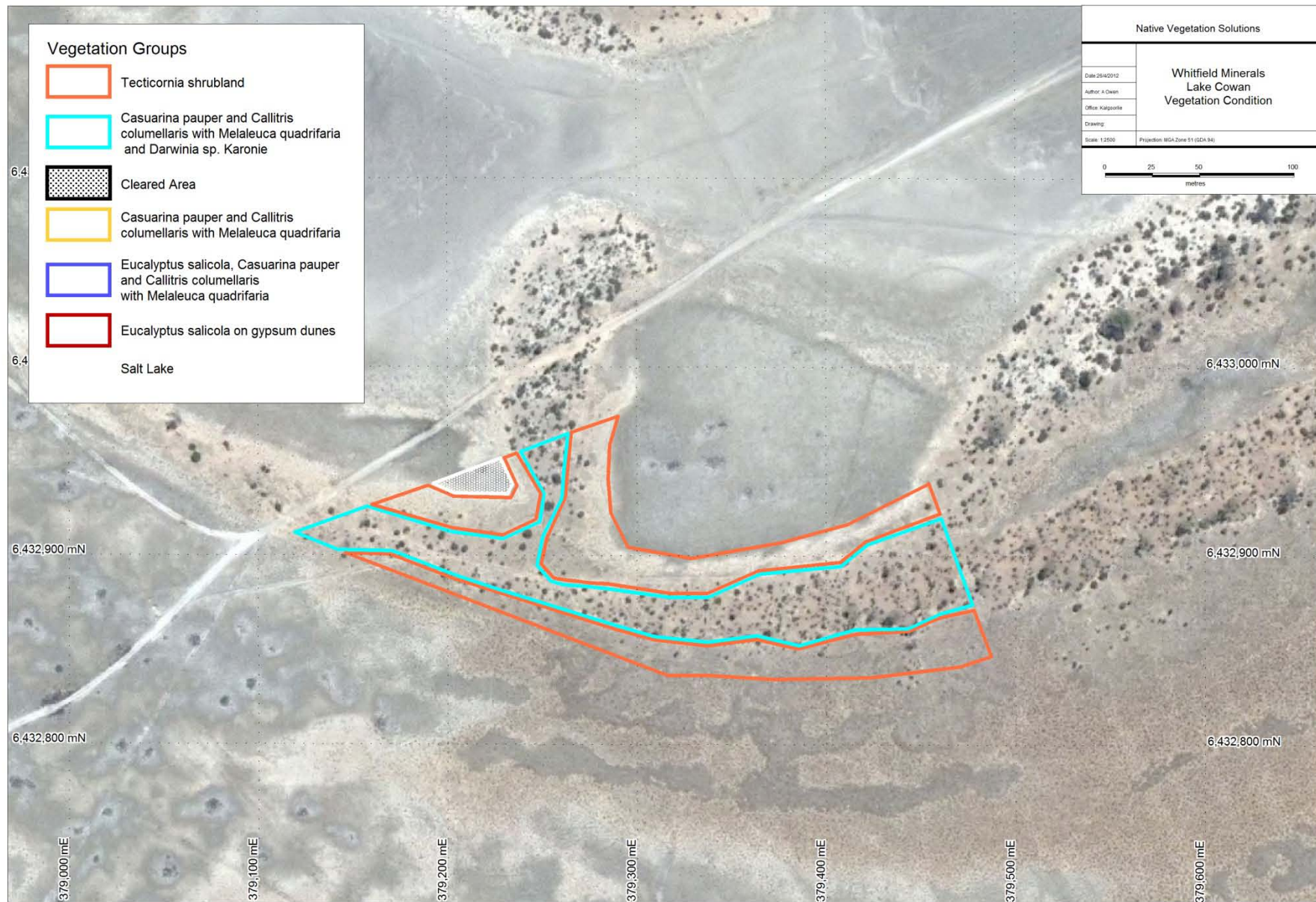
Survey Area



Vegetation Groups



Vegetation Groups



Vegetation Groups



Vegetation Condition

Appendix 5

Species List

Family	Genus	Species	P/A NN	<i>Eucalyptus salicola</i> woodland on gypsum dunes	<i>Eucalyptus salicola</i> , <i>Casuarina pauper</i> and <i>Callitris</i> <i>columellaris</i> over <i>Melaleuca</i> <i>quadrifaria</i>	<i>Tecticornia</i> Shrubland	<i>Casuarina pauper</i> and <i>Callitris</i> <i>columellaris</i> shrubland with <i>Melaleuca</i> <i>quadrifaria</i> and <i>Darwinia sp.</i> <i>Karonie</i>	<i>Casuarina pauper</i> and <i>Callitris</i> <i>columellaris</i> shrubland over <i>Melaleuca</i> <i>quadrifaria</i>
Aizoaceae	<i>Carpobrotus</i>	<i>modestus</i>	P	*				
Aizoaceae	<i>Disphyma</i>	<i>crassifolium</i>	P	*				
Aizoaceae	<i>Gunniopsis</i>	<i>quadrifida</i>	P			*		
Apocynaceae	<i>Alyxia</i>	<i>buxifolia</i>	P	*	*		*	*
Asteraceae	<i>Cratystylis</i>	<i>conocephala</i>	P	*				
Asteraceae	<i>Kippistia</i>	<i>suaedifolia</i>	P	*	*	*	*	*
Brassicaceae	<i>Lepidium</i>	<i>platypetalum</i>	P	*	*		*	*
Brassicaceae	<i>Stenopetalum</i>	<i>filifolium</i>	A	*	*		*	*
Casuarinaceae	<i>Casuarina</i>	<i>pauper</i>	P	*		*		
Chenopodiaceae	<i>Atriplex</i>	<i>stipitata</i>	P	*	*		*	*
Chenopodiaceae	<i>Enchylaena</i>	<i>tomentosa</i>	P	*				
Chenopodiaceae	<i>Lawrenzia</i>	<i>squamata</i>	P			*		
Chenopodiaceae	<i>Maireana</i>	<i>eriodactyla</i>	P	*				
Chenopodiaceae	<i>Maireana</i>	<i>oppositifolia</i>	P			*		
Chenopodiaceae	<i>Maireana</i>	<i>pentatropis</i>	P	*				
Chenopodiaceae	<i>Rhagodia</i>	<i>eremaea</i>	P	*				
Chenopodiaceae	<i>Tecticornia</i>	<i>?triandra</i>	P			*		
Chenopodiaceae	<i>Tecticornia</i>	<i>diandra</i>	P			*		
Chenopodiaceae	<i>Tecticornia</i>	<i>disarticulata</i>	P		*		*	*
Chenopodiaceae	<i>Tecticornia</i>	<i>halocnemoides subsp. caudata</i>	P	*		*		
Chenopodiaceae	<i>Tecticornia</i>	<i>indica</i>	P		*	*	*	*
Chenopodiaceae	<i>Tecticornia</i>	<i>moniliformis</i>	P	*	*	*	*	*
Chenopodiaceae	<i>Tecticornia</i>	<i>moniliformis</i>	P			*		
Chenopodiaceae	<i>Tecticornia</i>	<i>pergranulata subsp. pergranulata</i>	P			*		
Chenopodiaceae	<i>Tecticornia</i>	<i>syncarpa</i>	P		*	*		
Convolvulaceae	<i>Convolvulus</i>	<i>angustissimus subsp. angustissimus</i>	P	*	*	*	*	*
Cupressaceae	<i>Callitris</i>	<i>columellaris</i>	P	*		*		
Ericaceae	<i>Conostephium</i>	<i>drummondii</i>	P	*	*		*	*
Ericaceae	<i>Styphelia</i>	<i>intertexta</i>	P		*	*	*	*
Fabaceae	<i>Acacia</i>	<i>camptoclada</i>	P	*				
Fabaceae	<i>Acacia</i>	<i>merrallii</i>	P	*				
Fabaceae	<i>Bossiaea</i>	<i>walkeri</i>	P	*				
Frankeniaceae	<i>Frankenia</i>	<i>cinerea</i>	P		*	*	*	*
Goodeniaceae	<i>Scaevola</i>	<i>spinescens</i>	P	*	*	*	*	*
Myrtaceae	<i>Darwinia</i>	<i>sp. Karonie</i>	P	*	*		*	*
Myrtaceae	<i>Eucalyptus</i>	<i>flocktoniae</i>	P	*				
Myrtaceae	<i>Eucalyptus</i>	<i>lesouefii</i>	P	*				
Myrtaceae	<i>Eucalyptus</i>	<i>platycorys</i>	P	*				
Myrtaceae	<i>Eucalyptus</i>	<i>salicola</i>	P	*		*		
Myrtaceae	<i>Eucalyptus</i>	<i>salmonophloia</i>	P	*				
Myrtaceae	<i>Melaleuca</i>	<i>quadrifaria</i>	P	*		*		
Poaceae	<i>Austrostipa</i>	<i>elegantissima</i>	P		*		*	*
Poaceae	<i>Austrostipa</i>	<i>nitida</i>	P	*				

Family	Genus	Species	P/A NN	<i>Eucalyptus salicola</i> woodland on gypsum dunes	<i>Eucalyptus salicola,</i> <i>Casuarina pauper</i> and <i>Callitris</i> <i>columellaris</i> over <i>Melaleuca</i> <i>quadrifaria</i>	<i>Tecticornia</i> Shrubland	<i>Casuarina pauper</i> and <i>Callitris</i> <i>columellaris</i> shrubland with <i>Melaleuca</i> <i>quadrifaria</i> and <i>Darwinia sp.</i> <i>Karonie</i>	<i>Casuarina pauper</i> and <i>Callitris</i> <i>columellaris</i> shrubland over <i>Melaleuca</i> <i>quadrifaria</i>
Santalaceae	<i>Exocarpos</i>	<i>aphyllus</i>	P	*				
Santalaceae	<i>Santalum</i>	<i>acuminatum</i>	P	*	*	*	*	*
Santalaceae	<i>Santalum</i>	<i>lanceolatum</i>	P			*		
Scrophulariaceae	<i>Eremophila</i>	<i>decipiens</i> Ostenf. subsp. <i>decipiens</i>	P	*				
Scrophulariaceae	<i>Eremophila</i>	<i>deserti</i>	P	*				
Scrophulariaceae	<i>Eremophila</i>	<i>scoparia</i>	P	*				
Solanaceae	<i>Duboisia</i>	<i>hopwoodii</i>	P	*				
Solanaceae	<i>Lycium</i>	<i>australe</i>	P	*				
Thymelaeaceae	<i>Pimelea</i>	<i>microcephala</i> subsp. <i>microcephala</i>	P		*		*	*
Zygophyllaceae	<i>Zygophyllum</i>	<i>eremaeum</i>	A	*	*	*	*	*

P/A: Perennial/Annual

NN: Non Native