
Level 1 Flora and Vegetation Survey over the Saturn Project Area,
Harmony Gold Mt Magnet

Report prepared for



March 2010

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TABLE OF CONTENTS

1.0	SUMMARY	7
2.0	INTRODUCTION	9
2.1	PROJECT BACKGROUND.....	9
2.2	SCOPE AND OBJECTIVES OF THE STUDY	9
3.0	SURVEY AREA	10
3.1	LOCATION	10
3.2	IBRA BIOREGION	13
3.3	CLIMATE.....	13
3.4	NATIONAL PARKS, NATURE RESERVES AND CONSERVATION AREA.....	14
4.0	METHODS	14
4.1	DESKTOP REVIEW.....	14
4.1.1	<i>Environment Protection and Biodiversity Conservation (EPBC) Act 1999 Protected Matters Database Search</i>	15
4.1.2	<i>Declared Rare and Priority Flora – DEC Database Search</i>	15
4.1.3	<i>Threatened Ecological Communities – DEC Database Search</i>	16
4.1.4	<i>Review of Existing Reports</i>	16
4.2	FIELD SURVEY.....	16
4.2.1	<i>Survey Methods</i>	16
4.2.2	<i>Survey limitations</i>	17
4.3	VEGETATION DESCRIPTION AND MAPPING.....	18
5.0	RESULTS AND DISCUSSION	18
5.1	DESKTOP REVIEW.....	18
5.1.1	<i>Environment Protection and Biodiversity Conservation (EPBC) Act 1999 Protected Matters Database Search</i>	18
5.1.2	<i>Declared Rare and Priority Flora – DEC Database Search</i>	19
5.1.3	<i>Threatened Ecological Communities (TECs) – DEC database search</i>	20
5.1.4	<i>Reviews of existing reports</i>	22
5.2	FIELD SURVEY.....	23
5.2.1	<i>Vegetation Descriptions and Condition Assessment</i>	23
5.2.3	<i>Conservation Significance of Vegetation</i>	25
5.3	FLORA.....	27
5.3.1	<i>Summary of Flora</i>	27
5.3.2	<i>Priority Flora Collections</i>	27
5.3.3	<i>Alien Flora</i>	28
6.0	CLEARING PRINCIPLES	29

6.1	OVERVIEW	29
6.1.1	<i>Clearing principle a) Native vegetation should not be cleared if it comprises a high level of biological diversity.....</i>	29
6.1.2	<i>Clearing principle b) Native vegetation should not be cleared if comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.</i>	29
6.1.3	<i>Clearing principle c) Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora.</i>	30
6.1.4	<i>Clearing principle d) Native vegetation should not be cleared if it comprises the whole or part of, or is necessary for the maintenance of a threatened ecological community.</i>	30
6.1.5	<i>Clearing principle e) Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.</i>	30
6.1.6	<i>Clearing principle f) Native vegetation should not be cleared if it is growing in, or in association with, and environment associated with a watercourse or wetland.</i>	30
6.1.7	<i>Clearing principle g) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.</i>	31
6.1.8	<i>Clearing principle h) Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.</i>	31
6.1.9	<i>Clearing principle i) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.</i>	31
6.1.10	<i>Clearing principle j) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding.</i>	31
7.0	CONCLUSION AND RECOMMENDATIONS	31
8.0	REFERENCES	33

List of Figures

Figure 1	Map showing the location of the Harmony Gold Mt Magnet project relative to the City of Perth (Harmony owned tenements are shown in blue).....	11
Figure 2	Map showing the location of the Saturn survey area relative to the Town of Mt Magnet.....	12
Figure 3	GoogleEarth image (Google, 2009) showing the buffers of the two priority ecological communities (PEC) identified in the DEC database search. The large, orange circle is the Lake Austin P1 PEC buffer, the smaller blue circle is the Mt Magnet P1 PEC buffer, the green polygon is the survey area.	21
Figure 4	Map illustrating the distribution of vegetation units and locations of Priority Flora as observed during the September 2009 and March 2010 surveys over the Saturn survey area (image used with permission of Warren King and Co.).....	26

List of Tables

Table 1	Summary of results from the EPBC <i>Protected Matters</i> database search, based on an area of approximately 2000 km ² with corner locations of: -27.84551, 117.62847; -28.33572, 117.62847; -28.33752, 118.134160 and -27.84551, 118.134160.	19
Table 2	Summary of Priority Flora identified in the DEC database search, WAHERB and DEC collections, search reference 42-0809 (DEC, 2009; Western Australian Herbarium, 2009).....	20

Appendices

Appendix A	Definitions of Declared Rare and Priority Flora and Threatened Ecological Community Classifications
Appendix B	Classification of Vegetation Structural Formation and Height Classes
Appendix C	Vegetation Condition Scale
Appendix D	Species List

1.0 SUMMARY

Harmony Gold Mt Magnet (Harmony) are planning to clear native vegetation and rehabilitation vegetation from areas adjacent to the Saturn open pit, which is a part of the Galaxy project Area, located within the Mt Magnet mine site. Harmony commissioned Niche Environmental Services (Niche) to conduct a flora and vegetation survey over the areas proposed to be cleared.

Based on an assessment of the proposed disturbance envelope against the factors listed in the Environmental Protection Authority (EPA) *Guidance Statement No 51: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia*, a Level 1 survey was considered appropriate.

This report documents the findings of a Level 1 survey conducted between the 11th and 14th of September 2009 and the 5th of March 2010 over the Galaxy project. This report also contains an assessment against the Ten Principles for Clearing Native Vegetation as listed under section 5 of the *Environmental Protection Act 1986*.

A desktop review was conducted prior to the site visit and included database searches for the region in regards to the proximity of known populations of Declared Rare Flora (DRF) and Priority Flora as well as Threatened Ecological Communities (TEC) and Priority Ecological Communities (PEC). A review of any heritage, natural, flora or vegetation of conservation significance listed under the *Environment Protection and Biodiversity Conservation (EPBC) Act 1999* was also conducted. Publicly available reports relevant to the survey area were also reviewed.

There were no issues identified at the site in relation to the *EPBC Act* and as such, the proposed clearing should not require referral to the Department of Environment, Heritage, Water and the Arts for assessment under the provisions of the Act.

There were no Declared Rare Flora (DRF), as defined under the Western Australian *Wildlife Conservation Act 1950*, recorded within the database search area (search reference 42-0809). A total of eight priority taxa were recorded in the database search, including two records, one for *Acacia burrowsiana* (P1) and one for *Stenanthemum mediale* (P1), that were within the Galaxy project area.

There were no TECs recorded within the database search area. There were two Priority Ecological Communities (PECs) listed in the database search. These were the P1 PEC Lake Austin Banded Ironstone Vegetation Complexes and the P1 PEC Mt Magnet Ironstone Vegetation Complexes. The two PECs are located outside of the proposed areas of disturbance documented in this report.

Seven vegetation associations were identified within the Saturn survey area. With the exception of rehabilitation vegetation and a *Tecticornia* Low Open Shrubland, the vegetation units were all variations of *Acacia* spp. associations, with the differences in abundance and cover of species thought to be an artifact of hydrology or substrate. None of the vegetation identified during the survey was considered to have conservation significance.

The vegetation across the survey area was considered to be in good to degraded condition, with the majority assessed as being degraded. The survey areas were obviously impacted by disturbances associated with mining, whether historic or ongoing. There were a number of haul roads, exploration lines and informal tracks across the survey areas. In addition to the impacts to vegetation associated with mining activities, the vegetation was also heavily grazed.

A total of 104 taxa (including subspecies and variants) from 31 families and 67 genera were recorded during the survey. Of the taxa recorded, 101 were natives and three were alien. Three priority taxa were collected during the survey; *Stenanthemum mediale* (P1); *Acacia speckii* (P3); and *Verticordia jamiesonii* (P3). The alien taxa recorded during the survey were; *Opuntia stricta*; *Nicotiana glauca*; and *Schinus molle*. One of these, *Opuntia stricta* is a P4 declared plant under the provisions of the *Agriculture Protection Act (1976)*. There were a limited number of specimens that could not be identified. The most speciose family recorded during the survey was Fabaceae, with 17 taxa.

The proposed clearing was assessed as potentially being at variance with Clearing Principle a, but was not at variance to the remaining Clearing Principles. The survey was considered to be conducted at a time and using methods consistent with the requirements of a Level 1 survey and as such, no further survey work was considered to be required over the proposed areas of disturbance.

2.0 INTRODUCTION

2.1 Project Background

Harmony Gold Mt Magnet (Harmony) are planning to clear native vegetation and rehabilitation vegetation from areas adjacent to the Saturn open pit, which is a part of the Galaxy Project Area, located within the Mt Magnet mine site. The area is to be cleared as part of a proposed open pit cut-back mining programme and to facilitate the creation of new waste landforms, mining related infrastructure and for the diversion of the Boogardie-Mt Farmer Road. Harmony commissioned Niche Environmental Services (Niche) to conduct a flora and vegetation survey over the areas proposed to be cleared.

2.2 Scope and Objectives of the Study

To determine the appropriate level of survey for the area over which clearing is proposed, the disturbance was considered in the context of the Environmental Protection Authority (EPA) *Position Statement No 3: Terrestrial Biological Surveys as an Element of Biodiversity Protection and Guidance Statement No 51: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia*. The scale and nature of the impact and the bioregion within which the sites are located should guide the setting of the level of the survey.

In the EPA *Guidance Statement 51*, the state is broken into three sensitivity groups (at the bioregion level). The Murchison bioregion, within which the proposed areas of disturbance are located, is located within Group 2 bioregion group (EPA, 2004). Where the scale and nature of the impact is low to moderate and the area of proposed disturbance is within Group 2, a Level 1 survey as defined by the EPA (2002; 2004) is considered appropriate. Based on the scale and nature of the proposed disturbance and an assessment of the area, it was determined that a Level 1 survey was adequate.

A Level 1 survey consists of the following:

- A desktop review to collect ecological data relevant to the area to be surveyed and surrounds, including:
 - Searches of relevant DEC databases;
 - A search of the EPBC Act Protected Matters database; and
 - Reviews of publicly-available ecological information.
- A site visit to
 - Conduct a reconnaissance survey with the objectives of:
 - Verifying the information collected in the desktop review;
 - Completing a census of the flora, with a focus on determining the presence of any flora of conservation significance;
 - Assessing the condition of the vegetation;

- Developing a preliminary delineation and description of the vegetation; and
- Identifying any potential impacts.

This report contains the following

- An overview of the survey sites, which serves to place the survey sites in a regional context;
- The findings of the desktop review;
- A detailed description of the methods used;
- A summary of the flora recorded, with reference to flora of conservation significance;
- The findings of the quadrat-based survey. This includes a description of the vegetation, an assessment of the condition using the scale devised by Keighery (1994), an assessment in the context of the extent of the vegetation and an assessment of the conservation significance of the vegetation with the specific objective of determining whether any TECs or PECs are present;
- Limitations of current survey and recommendations for additional surveys to address limitations; and
- An assessment against the Ten Principles for Clearing Native Vegetation as listed under section 5 of the *Environmental Protection Act* 1986.

3.0 SURVEY AREA

3.1 Location

The survey area was located within the Harmony Gold Mt Magnet Operations, which is located near the Town of Mt Magnet, approximately 550km northeast of Perth, Western Australia (**Figure 1**). The location of the survey area relative to the Town of Mt Magnet and the Harmony Gold Operations is shown in **Figure 2**.

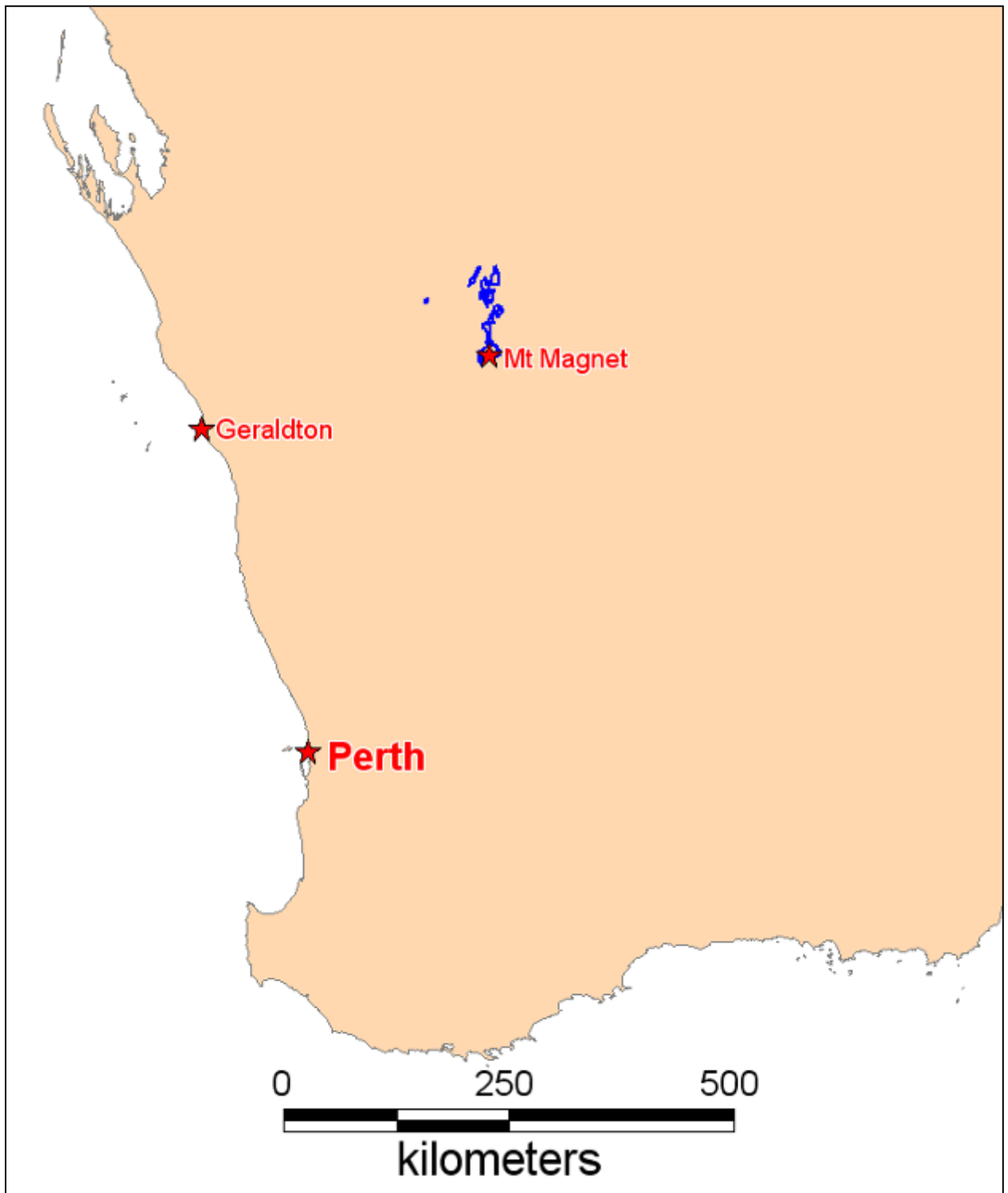


Figure 1 Map showing the location of the Harmony Gold Mt Magnet project relative to the City of Perth (Harmony owned tenements are shown in blue)

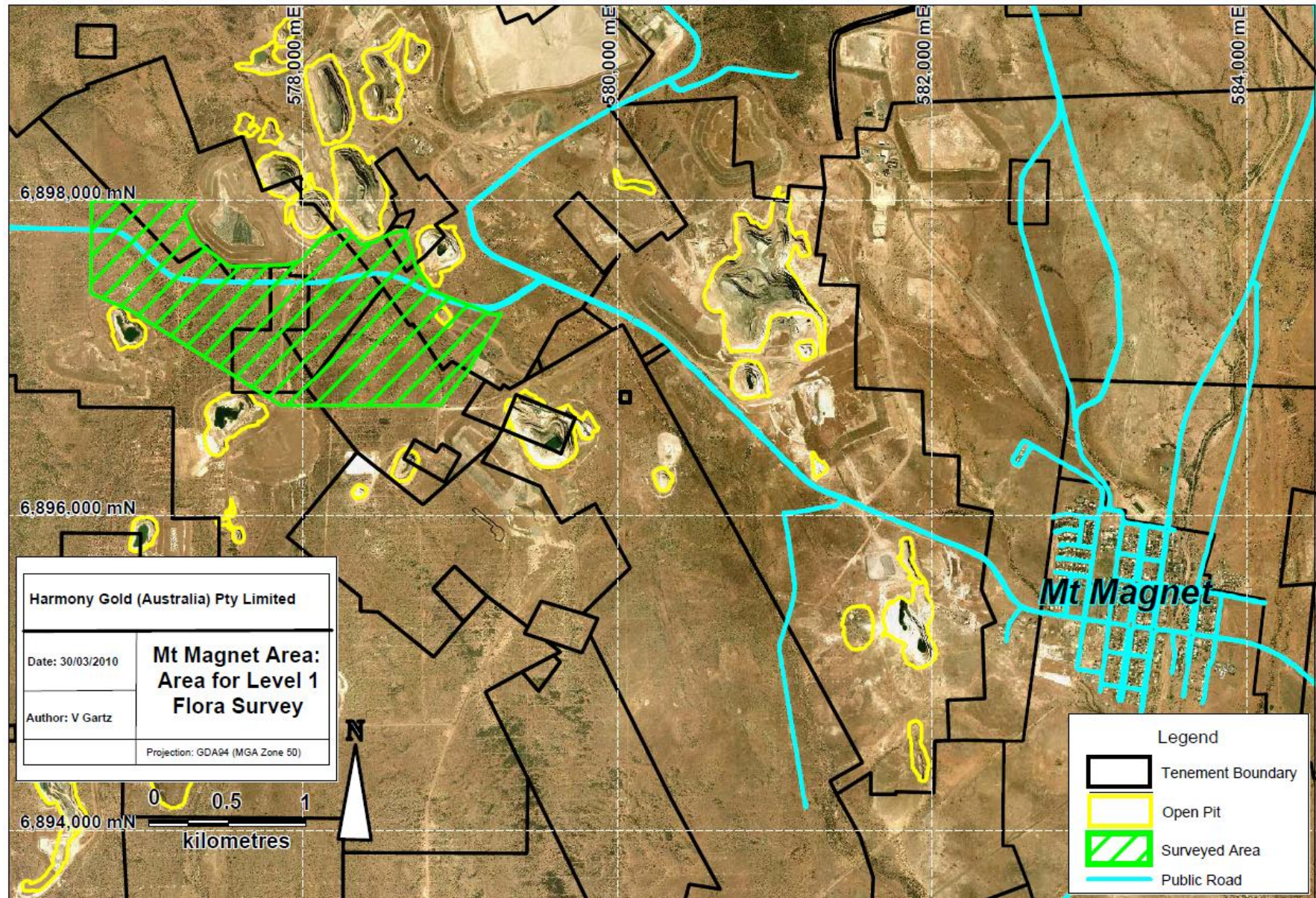


Figure 2 Map showing the location of the Saturn survey area relative to the Town of Mt Magnet.

3.2 IBRA Bioregion

The locality of Mt Magnet is located in the Murchison biogeographic region (bioregion) of the Interim Biogeographic Regionalisation for Australia (or IBRA) (Thackway and Cresswell, 1995). The Murchison bioregion comprises the northern part of the Yilgarn Craton and includes two major components, or subregions; the Eastern Murchison (MUR1), and the Western Murchison (MUR2). Mount Magnet is within the the Eastern Murchison (MUR1) subregion.

The Eastern Murchison subregion is characterised by systems of internal drainage, with extensive tracts of red sandplains, series of salt lake systems that are associated with an occluded Paleodrainage system, broad plains of red-brown soils, and breakaway complexes (Cowan, 2001). The Eastern Murchison subregion is 7,847,996 ha in size and comprises the “Southern Cross” and “Eastern Goldfields” Terranes of the Yilgarn Craton (Cowan, 2001; NLWRA, 2002). Vegetation is dominated by Mulga Woodlands that are frequently rich in ephemerals, hummock grasslands, saltbush shrublands and *Halosarcia* shrublands (Cowan, 2001). The Murchison Bioregion was described as being comparatively biodiverse, with many species having wide distributions, with many known to occur in adjoining regions (NLWRA, 2002).

Land uses of the Eastern Murchison (MUR1) subregion include (Cowan, 2001; NLWRA, 2002):

- Grazing. The dominant land use of the MUR1 subregion is grazing of stock on pastoral leases, with approximately 85.47% of the subregion is used for this purpose (Cowan, 2001).
- Mining. Extensive mining of nickel and gold is undertaken in the subregion. However, most mining leases are located on pastoral lands which come under section 97 of the *Land Administration Act 1997* and are therefore still required to be stocked.
- Unallocated Crown Land (UCL) and Crown reserves comprise just over 11% of the MUR1 subregion.
- Conservation. NLWRA (2002) state that just 1.4% of the Murchison bioregion is classified as conservation estate, with Cowan (2001) reporting 1.82% for the MUR1 subregion. Since that time a comprehensive land acquisition program has contributed additional land for conservation purposes, and in 2004 a figure of 7.46% was reported for the bioregion.

3.3 Climate

The Mt Magnet operations are located within the Murchison region, which has a climate that has been described as arid, with annual rainfall of approximately 200mm, typically recorded with a bimodal pattern (Beard, 1990, Gilligan, 1994). Monthly mean maximum temperature recorded at Mt Magnet ranges from a high of 38.2°C in January to a low of 18.7°C in July (BOM, 2009). Mean monthly rainfall recorded at Mt Magnet ranges from a high of 31.5 mm in June to a low of 7.7 mm in October (BOM, 2009). Average annual rainfall is 239.1 mm, with highest recorded annual rainfall of 642 mm and lowest recorded annual rainfall of 73.4 mm (BOM, 2009).

3.4 National Parks, Nature Reserves and Conservation Area

At the time that the Australian Natural Resources Audit (ANRA) was conducted, there were six Nature Reserves, one National Park, one Timber Reserve and five areas of UCL within the Murchison bioregion, all of which were under DEC management (NLWRA, 2002). This figure is likely to have changed since then, largely as a consequence of the DEC acquisition of pastoral lands and offsets generated by mining companies.

The conservation estates at the time ANRA was conducted covered a wide range of associations but there were still 60 ecosystems or vegetation associations that were considered to be a high priority to preserve but were poorly represented in the reserve system (NLWRA, 2002). The level of conservation within the Murchison Bioregion is lower than recommended. This likely to be addressed over the coming years as a consequence of land acquisition programmes and after the Vegetation surveys of the Banded Ironstone Formations of the Yilgarn, which has recently been completed by the DEC.

The nearest conservation reserves to the survey area are:

- Burnabinmah Nature Reserve – 75km southwest of the town of Mt Magnet.
- Black Range Reserve – 110km east of the town of Mt Magnet.
- Karroun Hill reserve – 180km south of the town of Mt Magnet.

Management within the reserves is limited. There are no feral predator programmes in place, wildfire management facilities are resource-limited and feral herbivore grazing is widespread and poses a conservation risk (NLWRA, 2002). Impacts from mining also affect conservation values; however, the most important reserve management issue relates to management and control of feral animals (NLWRA, 2002).

4.0 METHODS

4.1 Desktop Review

A desktop review was conducted prior to the field surveys to collect information about the site and surrounds that may potentially assist with the design and implementation of the field survey. For this survey, the desktop review consisted of:

- A search of the *Environment Protection and Biodiversity Conservation (EPBC) Act 1999* Protected Matters database for flora, vegetation and other considerations of conservation significance and Threatened Ecological Communities (TEC) relevant to the survey area and surrounds;
- 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 or potentially occurring within the survey area;
- A search of the DEC Threatened Ecological Communities (TEC) database for listings of Threatened Ecological Communities or Priority Ecological Communities (PEC) recorded at or in the surrounds of the survey area;
- A limited review of publicly available ecological information pertaining to the survey areas and surrounds.

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

The *EPBC Act* was enacted by the federal government to provide a means to manage threats to the natural environment. This is achieved by:

- providing for protection of biodiversity conservation by identifying threatening processes, protecting critical habitat, requiring the preparation of management plans;
- a means of ensuring compliance and enforcement through auditing and legal processes; and
- provision of a level of approval for activities likely to impact on aspects of the natural environment protected under the Act, above existing state assessments.

To assist project proponents, stakeholders and environmental practitioners, a database has been established to manage listings under the Act; the Protected Matters database. A search of the database was undertaken to determine whether there were any listings under the Act relevant to the current assessment. The search was conducted over an area of approximately 2000 km², with corner locations of: -27.84551⁰S, 117.62847⁰E; -28.33572⁰S, 117.62847⁰E; -28.33752⁰S, 118.134160⁰E and -27.84551⁰S, 118.134160⁰E.

4.1.2 Declared Rare and Priority Flora – DEC Database Search

Within the state of Western Australia, Declared Rare Flora (DRF) are gazetted under subsection 2 of section 23F of the *Western Australian Wildlife Conservation Act 1950*. DRF are afforded the highest level of protection and it is illegal to remove, take from or damage any DRF without Ministerial approval. Priority Flora are not subject to the same level of protection and control as DRF but are still protected under the *Environmental Protection Act 1986* and are considered when assessing the conservation value of an area, especially in the context of clearing of native vegetation. 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 collected from or thought to occur within a polygon with the northwest corner at -27⁰ 57' S, 117⁰ 43' E and a southeast corner at - 28⁰ 08' S, 117⁰ 54' E (GDA94), which was a 10km radius search.

4.1.3 Threatened Ecological Communities – DEC Database Search

In Western Australia, the DEC recognizes four categories of Threatened Ecological Communities (TECs), as developed by English and Blyth (1997). These are Presumed Totally Destroyed, Critically Endangered, Endangered and Vulnerable (**Appendix A**). It is possible that ecological communities can be under threat, but do not meet the TEC criteria. In this instance, these communities may be listed as Priority Ecological Communities. It is possible that communities that are currently only considered to be PECs may be upgraded to TECs should threatening processes continue. In light of this, any assessment of vegetation that will potentially be cleared needs to consider both categories of communities and any potential impacts to either.

Prior to the field survey, a search of the DEC TEC database was undertaken for the area of Mt Magnet, using a centre of -28.055°S, 117.823°E.

4.1.4 Review of Existing Reports

The following reports were reviewed:

- *Sirdar and Vicqueries Banded Ironstone Formations; Vegetation and Flora Survey Harmony Gold Mt Magnet* – Outback Ecology (2007).
- *Review of Flora, Vegetation and Conservation Values of the Proposed Hesperus Waste Dump Harmony Gold Mt Magnet* – Kern and True (2006a).
- *Review of Flora, Vegetation and Conservation Value of the proposed Eclipse Pit Harmony Gold, Mt Magnet* – Kern and True (2006b).
- *Review of Flora, Vegetation and Conservation Values of the proposed Golden Stream Pit Harmony Gold, Mt Magnet* – Kern and True (2006c).
- *Conservation Values of remnant flora and vegetation within current mining areas at Harmony Gold, Mt Magnet* – Kern and True (2006d).
- *Preliminary Assessment of Conservation Values of Flora and Vegetation on Banded Ironstone Formations surrounding Harmony Gold Operations, Mt Magnet* – Kern and True (2006e).

4.2 Field Survey

4.2.1 Survey Methods

The survey was conducted between the 11th of September and the 14th of September 2009, with a second site visit conducted on the 5th of March 2010 to ground truth additional areas to be cleared. The surveys were comprised of the following:

- A preliminary reconnaissance of the areas to be surveyed.
- A Level 1 survey, consisting of the development of a census of the flora and the collection of data to facilitate the description and delineation of vegetation.

Preliminary reconnaissance

The preliminary reconnaissance was conducted on the 11th of September 2009. During the reconnaissance, the proposed areas of disturbance were visited, with the objective of developing an understanding of the distribution of vegetation across the areas. The findings of the preliminary reconnaissance were used to determine appropriate locations for relevés.

Relevé and ground-truthing

A total of 20 relevés were utilised during the survey in September with an additional 10 utilised during the survey in March 2010, with ground-truthing used to determine the extent of each vegetation association. At each relevé, the following was collected:

- All flora present was recorded, with estimates of height and cover made to assist with describing the vegetation.
- The condition of the vegetation and any disturbances were noted.
- The geographical location of the site was recorded, with slope, topography and soil type recorded.
- A photograph of the vegetation within the quadrat was taken using a Canon ixus60 digital camera
- The location of the quadrat was recorded using a Magellan explorerXL gps, with the location recorded in WGS84, UTM

Traverse to develop census

All flora within the releve area and in the surrounds was collected to assist with the development of the census of the flora. All plant specimens collected were assigned a sample number in the field, with a sample collected for identification and a sample placed in a field herbarium. Specimens collected were identified by reference to taxonomic guides and Western Australian Herbarium samples. Where appropriate, guidance from relevant taxonomic authorities was sought to confirm identification of specimens

4.2.2 Survey limitations

Niche Environmental Services plan and implement flora surveys in accordance with EPA guidelines and requirements (EPA 2000, 2004). Within the survey guidelines a number of potential limitations to the completeness of surveys are presented. Niche Environmental Services have reviewed these guidelines and provide a response to these as considered relevant to this survey below.

- Competency of botanists – this survey was undertaken by a botanist from Niche Environmental Services who has extensive survey experience within the Mt Magnet region.
- Scope – the scope for this survey was clearly defined, being a flora and vegetation survey over a well-defined area, and was realistically achievable within the allocated timeframe.
- Proportion of flora identified – the majority of specimens collected during the survey were identified to a level appropriate to satisfy assessments of conservation value of flora. The

census of flora was considered to be comparatively extensive, with a high number of annual taxa collected during the survey. Those specimens that could not be identified were compared against known priority taxa to ensure that they did not have conservation value.

- Timing of survey – the assessment over the Saturn project area was completed in two passes, with the main survey completed in September 2009, after a period of above-average rainfall. The second survey was completed during March 2010, after a period of below-average rainfall. While surveys should be timed to coincide with periods after rainfall, the completion of the assessment before rainfall had been received was not considered to be a significant factor, given the breadth of the census from the September survey and the additional surveys completed in the area.
- Access to land – All survey areas were readily accessible.
- Completeness and further work – this survey was considered to meet the underlying requirements for a Level 1 survey as defined by the EPA. No further survey work was considered to be required for the proposed area of disturbance.
- Disturbances – the survey was conducted over an area in which mining has been conducted for an extensive period of time. The survey areas included currently inactive pits, sections of haul roads, waste landforms, laydown sites and other project infrastructure. The area was considered to be significantly affected by the extent of disturbance.

4.3 Vegetation Description and Mapping

Within each releve, the life-form strata and percentage cover of each stratum was described using the structural formation and height classes based on Muir (1977) (**Appendix B**). The distribution of different vegetation associations across the survey areas was mapped using a combination of field collected data and interpretations of aerial photography.

5.0 RESULTS AND DISCUSSION

5.1 Desktop Review

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

A summary of the findings of the EPBC *Protected Matters* database search and an assessment as to the likelihood of occurrence within the survey area is provided in **Table 1**. It was noted that the area was considered to be habitat for three bird species. These species were not observed during the survey. In addition to this, there were no mounds associated with *Leipoa ocellata* within the survey area. Based on this assessment, the proposed disturbance is unlikely to require referral under the provisions of the *EPBC Act (1999)*.

Table 1 Summary of results from the EPBC *Protected Matters* database search, based on an area of approximately 2000 km² with corner locations of: -27.84551, 117.62847; -28.33572, 117.62847; -28.33752, 118.134160 and -27.84551, 118.134160.

Search parameter	Result	Consideration
World Heritage Area	Nil	Nil
National Heritage Area	Nil	Nil
Wetlands of International Significance	Nil	NII
Threatened Ecological Community	Nil	NII
Threatened Flora	Nil	Nil
Threatened Fauna	<i>Leipoa ocellata</i>	Species or habitat likely to occur within area
	<i>Acanthiza iredalei iredalei</i>	Species or habitat likely to occur within area
Migratory Terrestrial Species	<i>Leipoa ocellata</i>	Species or habitat likely to occur within area
	<i>Merops ornatus</i>	Species or habitat likely to occur within area
Critical Habitats	Nil	Nil
Commonwealth Reserves	Nil	NII
State and Territory Reserves	Nil	Nil

5.1.2 Declared Rare and Priority Flora – DEC Database Search

There were no Declared Rare Flora (DRF), as defined under the Western Australian *Wildlife Conservation Act 1950*, recorded within the database search area (search reference 42-0809). A total of eight priority taxa were recorded in the database search, of which three were Priority 1, one was a Priority 2 taxon and the balance were Priority 3 (**Table 2**). It was noted that two records, one for *Acacia burrowsiana* (P1) and one for *Stenanthemum mediale* (P1) were within the Saturn survey area.

Table 2 Summary of Priority Flora identified in the DEC database search, WAHERB and DEC collections, search reference 42-0809 (DEC, 2009; Western Australian Herbarium, 2009)

DEC Code	Species
P1	<i>Acacia burrowsiana</i>
P3	<i>Alyxia tetanifolia</i>
P3	<i>Calytrix erosipetala</i>
P3	<i>Calytrix uncinata</i>
P3	<i>Dodonaea amplisemina</i>
P2	<i>Hoalocalyx inerrabundus</i>
P1	<i>Ptilotus astrolasius var luteolus</i>
P1	<i>Stenanthemum mediale</i>

5.1.3 Threatened Ecological Communities (TECs) – DEC database search

There were no TECs recorded within the database search area. There were two Priority Ecological Communities (PECs) listed in the database search (**Figure 3**). These were:

- The Lake Austin Banded Ironstone Vegetation Complexes – this is a P1 PEC with a 20,000m buffer. The PEC is located approximately 30km north of the Hill 50 project area; however, the buffer extends to within approximately 7,000m of the areas detailed within this report.
- The Mt Magnet Ironstone Vegetation Complexes – this is a P1 PEC with a 7,500m buffer. This PEC is located approximately 10.5km north of the Hill 50 project area; however, the buffer extends to within 2,500m of the areas detailed within this report.

Priority ecological communities are considered to be potential Threatened Ecological Communities (TEC) that do not meet the survey criteria or are not adequately defined to be classed as a a TEC. A Priority One PEC is a described as a poorly known ecological community, with few, small occurrences, of which most are not actively managed for conservation and for which current threats exist. Communities may be included if they are known from a number of locations but do not meet the adequacy of survey requirements, and/or are not well defined and appear to be under therat from known threatening processes across their range (DEC, 2007).

These two listings fall outside of the proposed area of disturbance and as such are unlikely to be affected by any activities within the areas documented in this report.



Figure 3 GoogleEarth image (Google, 2009) showing the buffers of the two priority ecological communities (PEC) identified in the DEC database search. The large, orange circle is the Lake Austin P1 PEC buffer, the smaller blue circle is the Mt Magnet P1 PEC buffer, the green polygon is the survey area.

5.1.4 Reviews of existing reports

The vegetation within and around the Saturn and Persistence survey areas has been the subject of a series of surveys and reports, with the following reviewed as part of this survey. The reports reviewed and a brief summary of each is presented below.

Sirdar and Vicqueries Banded Ironstone Formations; Vegetation and Flora Survey Harmony Gold Mt Magnet – Outback Ecology (2007). This report documents the findings of a Level 2 survey, conducted using a modified version of the DEC BIF survey protocols. The surveys were conducted on the Sirdar and Vicqueries BIF ridges, which are located on numerous leases within the Harmony Mt Magnet Gold operations. In the report, 15 vegetation associations were described and delineated, with condition assessed ranging from good to degraded and was deemed to have little conservation value. A Priority 3 species, *Acacia speckii*, and a potential range extension of *Acacia sphacelata*, were recorded during the survey. The potential range extension was an incorrect identification of a heavily grazed *A. tetragonophylla*. The *Stenanthemum* sp discussed in the report is likely to be *Stenanthemum mediale*, which is a P1 species.

Review of Flora, Vegetation and Conservation Values of the Proposed Hesperus Waste Dump Harmony Gold Mt Magnet – Kern and True (2006a). This report detailed the findings of a Level 1 survey over the proposed Hesperus waste dump. During the survey, a total of 52 taxa were recorded, which included the P3 *Acacia speckii*. The vegetation was described as being three types of Mulga vegetation units, with variation based on substrate. The vegetation was described as being in highly degraded condition.

Review of Flora, Vegetation and Conservation Value of the proposed Eclipse Pit Harmony Gold, Mt Magnet – Kern and True (2006b). This report documents the findings of a Level 1 survey over the proposed Eclipse footprint. During the survey, a total of 59 taxa were recorded, with no DRF or Priority taxa recorded. The vegetation described was Mulga Shrubland, with variation due to substrate. The vegetation was described as being in a highly degraded condition.

Review of Flora, Vegetation and Conservation Values of the proposed Golden Stream Pit Harmony Gold, Mt Magnet – Kern and True (2006c). This report documents the findings of a Level 1 survey over the proposed Golden Stream Pit. During the survey, a total of 59 taxa were recorded, including the Priority 3 taxa, *Acacia speckii*. The vegetation was described as being variation of Mulga Shrubland, with the differences attributed to species densities changing due to substrate. The condition of the vegetation was not detailed, but it would be likely to have been in degraded condition.

Conservation Values of remnant flora and vegetation within current mining areas at Harmony Gold, Mt Magnet – Kern and True (2006d). This report documents the findings of a Level 1 survey over areas within the Saturn and Perserverance project area. During the survey, a total of 104 taxa were collected, including the Priority 3 taxa *Acacia speckii*. The vegetation observed during the survey included a mix of Mulga shrublands, Chenopod shrublands and Caltrix shrublands. All of the vegetation was described as being highly degraded.

Preliminary Assessment of Conservation Values of Flora and Vegetation on Banded Ironstone Formations surrounding Harmony Gold Operations, Mt Magnet – Kern and True (2006e). This report summarises the findings of Level 1 surveys conducted over a range of vegetation located on the following BIF ridges:

Cavanaghs – two ridges with a north-south alignment

Hillcrest

NW BIF – a series of BIF ridges adjacent to Brown Hill

Boomer

During the surveys, a total of 99 taxa were recorded, with five Priority taxa recorded, being *Dodonaea* sp. Ninghan (now *D. amplisemina*, P1), *Ptilotus astrolasius* var *luteolus* (P1) and *Stenanthemum mediale* P1), *Acacia speckii* (P3) and *Acacia cockertoniana* (no longer a priority species). The vegetation was described as being *Acacia* spp Very Open Scrub to Scattered Tall Shrub over Open Low Scrub over Open Dwarf Scrub. The vegetation was noted as being variable. No assessment of the condition of the vegetation was provided in the report.

5.2 Field Survey

5.2.1 Vegetation Descriptions and Condition Assessment

A total of seven vegetation units were described and delineated across the Saturn survey area. The full list of species observed in each association is presented in **Appendix D**. Vegetation is described using Muir's key (**Appendix B**). The condition of the vegetation was assessed according to the scale of Keighery (1994) (**Appendix C**). The vegetation across the survey area was considered to be in good to degraded condition, with the majority assessed as being degraded. The survey areas were obviously impacted by disturbances associated with mining, whether historic or ongoing. There were a number of haul roads, exploration lines and informal tracks across the survey areas. In addition to the impacts to vegetation associated with mining activities, the vegetation was also heavily grazed, with a number of species in particular being grazed to the extent that collecting specimens to facilitate identification was difficult. The condition of vegetation in each association is presented with the description of each association. With the exception of two associations, the balance was essentially the same dominant species, in different densities and with different co-dominant or co-occurring species. The differences in associations were a direct product of the substrate/hydrology on which the associations were occurring.

AcLOFdl – Low Open Forest of *Acacia* spp. over Low Open Shrubland of mixed species over Very Open Herbland of mixed species in an ephemeral drainage line.

This vegetation association was located in two sections of the Saturn survey area (**Figure 4**). The vegetation consisted of an overstorey to 4m of *Acacia aneura* var. *aneura*, *A. tetragonophylla*, *A. craspedocarpa*, *A. aneura* var. *fuliginea*, *A. ramulosa* var. *ramulosa* over a midstorey of *Eremophila clarkei*, *E. galeata*, *E. georgei*, *Thryptomene costata* over an understorey of *Stenopetalum filifolium*, *Olearia stuartii*, *Maireana planifolia*, *Trachymene costata*, *Velleia rosea*, *Pogonolepis stricta*, *Eriachne pulchella* ssp. A full list of species for this association is presented in **Appendix D**. Vegetation in this association was noted as being in good condition. Whilst the drainage line had been dissected by roads and tracks and had also been affected by proximity to mining infrastructure, the vegetation was comparatively diverse and the structure of the creek bed was intact.

AcLWbif – Low Woodland of *Acacia* spp over Low Open Shrubland of mixed species on a low Banded Ironstone Formation.

This vegetation association was located on a series of low Banded Ironstone Formation ridges located in the east of the survey area (**Figure 4**). This vegetation association consisted of an overstorey of *Acacia aneura* var. *aneura*, *A. tetragonophylla*, *A. ramulosa* var. *ramulosa* over a mid storey of *Philotheca brucei* ssp. *brucei*, *Aluta aspera* ssp. *hesperia*, *Eremophila latrobei* ssp. *latrobei* over an understorey of *Arthropodium dyeri*, *Cheilanthes seiberi*, *Eragrostis eriopoda*. A full list of species for this association is presented in **Appendix D**. Vegetation within this association was noted as varying from poor to good condition. The vegetation was located on a series of low BIF ridges that had been affected by historic and ongoing activities associated with mining and exploration.

AcLWqu – Low Woodland of *Acacia* spp. over Low Open Shrubland of mixed species on gibber flat with quartz and ironstone.

This vegetation association was located in the east of the survey area (**Figure 4**). The vegetation consisted of an overstorey to 4m of *Acacia aneura* var. *aneura*, *A. tetragonophylla*, *A. ramulosa* var. *ramulosa* over a midstorey of *Eremophila latrobei* ssp. *latrobei*, *E. lachnocalyx*, *E. clarkei*. A full list of the species for this association is presented in **Appendix D**. This vegetation was assessed as being in good condition. The vegetation was noted as having been affected by disturbances associated with proximity to a road and a waste landform.

AcLOWfl – Low Open Woodland of *Acacia* spp. over a Low Open Shrubland of mixed species on flats.

This vegetation was widespread across the project area (**Figure 4**). This vegetation consisted of an overstorey to 4m of *Acacia aneura* var *aneura*, *A. ramulosa* var *ramulosa*, *A. aneura* var *fuliginea* over a midstorey of *Eremophila forestii* spp *forestii*, *Ptilotus obovatus*. A full list of species for this association is presented in **Appendix D**. This vegetation was assessed as being in poor to degraded vegetation, with the vegetation clearly affected by a large number of tracks, historic mining and exploration activities and the impacts of grazing by goats.

AcLOWsl – Low Open Woodland of *Acacia* spp. over a Low Open Shrubland of mixed species on lower gibber slopes of BIF ridges.

This association was restricted to areas around the BIF ridges located in the western portion of the survey area (**Figure 4**). The vegetation consisted of an overstorey to 4m of *Acacia aneura* var *aneura*, *A. ramulosa* var *ramulosa* over a Low Open Shrubland of *Eremophila forestii* ssp *forestii*, *Ptilotus obovatus*. A full list of the species for this association is presented in **Appendix D**. The vegetation in this association was assessed as being in poor to degraded condition. The vegetation was heavily impacted by a number of tracks and old workings in the area, as well as the impacts of grazing by goats.

TeclScp – Low Open Shrubland of *Tecticornia disarticulata* on a clay pan.

This association was restricted to one area (**Figure 4**). The association was depauperate of species, with the main species being *Tecticornia disarticulata*. A full species list for this association is presented in **Appendix D**. This vegetation association was assessed as being in degraded condition, with a number of tracks dissecting the area.

Reh2 - Rehabilitation vegetation comprised of a mix of *Acacia* spp and *Eucalyptus* spp over an understorey of *Maireana* spp.

This vegetation was limited to one area within the Galaxy project area (**Figure 4**). As this vegetation was not considered to be *sensu strictu* native, a condition assessment according to the scale of Keighery (1994) or use of Muir's (1977) descriptive key for vegetation were not applied. A full species list for this association is presented in **Appendix D**.

5.2.3 Conservation Significance of Vegetation

The vegetation was either recognised as a widespread association, or when not widespread, was not considered to be in a condition consistent with vegetation that would be described as a representative unit. Based on this assessment, the vegetation within the survey areas was not considered to have any conservation significance.

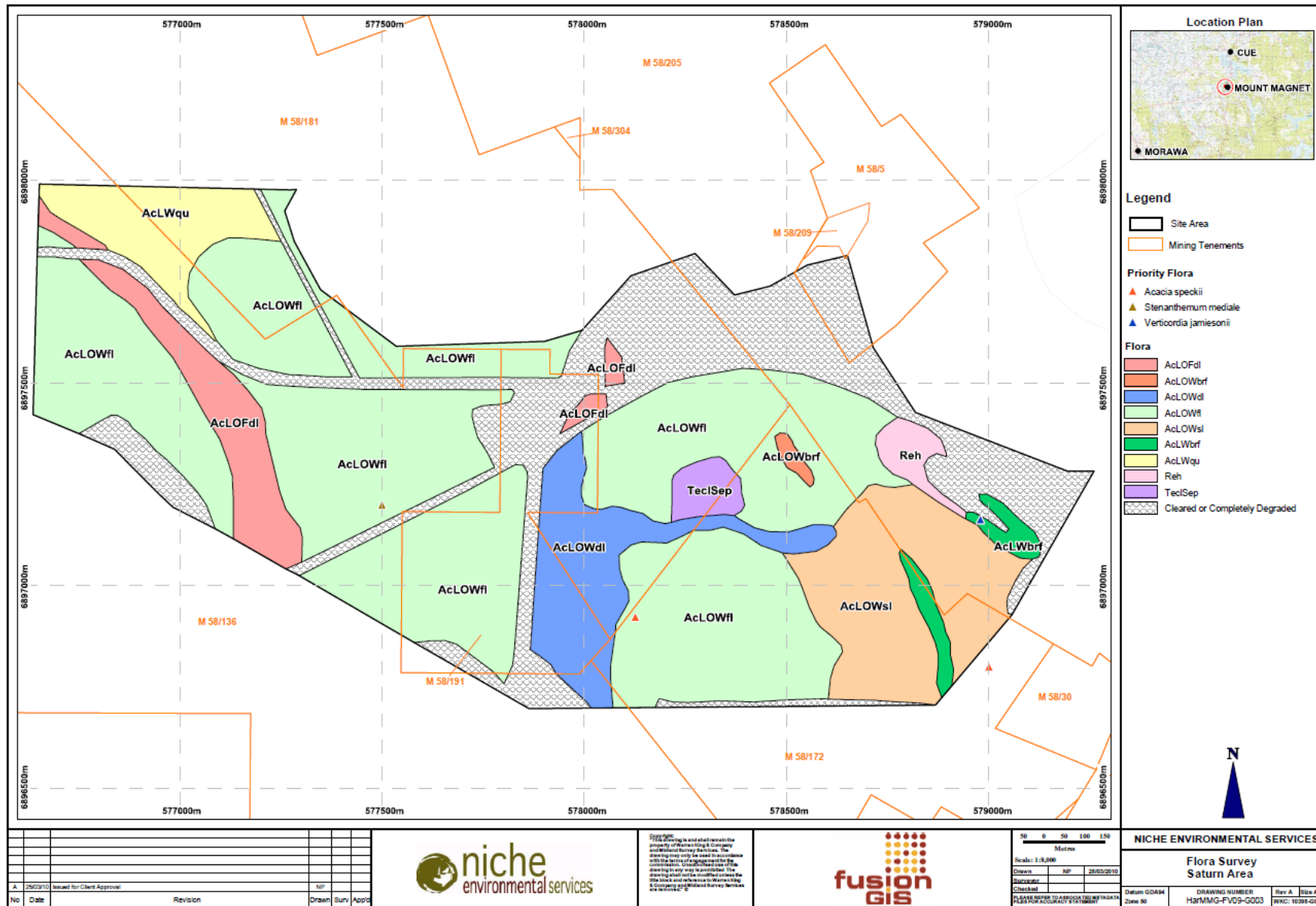


Figure 4 Map illustrating the distribution of vegetation units and locations of Priority Flora as observed during the September 2009 and March 2010 surveys over the Saturn survey area (image used with permission of Warren King and Co.).

5.3 Flora

5.3.1 Summary of Flora

A total of 104 taxa (including subspecies and variants) from 31 families and 67 genera were recorded during the survey. Of the taxa recorded, 101 were natives and three were alien. Three priority taxa were collected during the survey; *Stenanthemum mediale* (P1); *Acacia speckii* (P3); and *Verticordia jamiesonii* (P3). These taxa are detailed in the next section. The alien taxa recorded during the survey were; *Opuntia stricta*; *Nicotiana glauca* and *Schinus molle*. There were a limited number of specimens that could not be identified. These were compared against known priority taxa to ensure that they were not flora of conservation significance.

The most speciose families recorded during the survey were; Fabaceae, with 17 taxa; Chenopodiaceae, with 14 taxa; and Asteraceae, with 12 taxa. The full census of the flora and the distribution within vegetation types is presented in **Appendix D**.

The census of the flora during this survey was considered to be comparatively detailed, particularly in relation to the number of annual and ephemeral taxa collected and in consideration of the degree of disturbance within the areas surveyed. The census was compared against those for other surveys in the area, being Kern and True (2006a, 2006b, 2006c, 2006d, 2006e) and Outback Ecology (2007) and was noted as being comparable in terms of diversity of species recorded and specific species records.

5.3.2 Priority Flora Collections

A total of three collections of three priority taxa were recorded during the survey, with three of the collections within the survey area and one outside of the survey area. A map showing the locations of the records is presented in **Figure 4**. The priority taxa recorded were:

- *Acacia speckii* (P3) – This species has been recorded during a number of surveys over the Mt Magnet area, with records made by; Kern and True (2006a, 2006b, 2006c, 2006d and 2006e); and Outback Ecology (2007). The number of records made of this species would potentially be an indication that this species is comparatively common within the area, and potentially the region, and any impacts to plants identified during this survey would be minor.
- *Stenanthemum mediale* (P1) – This species has been recorded during previous surveys over the project area, with a record by the author of this report (Outback, 2007), where the specimen was tentatively identified as this species, but there was insufficient plant matter to facilitate a confident identification, and a record by Kern and True (2006a) over the Boomer project area. It was considered likely that the records made at the area are all from the same population. This population is unlikely to be affected by the proposed disturbance.

- *Verticordia jamiesonii* (P3) – This was a new record of this species for the area and the first time the species has been recorded in the area. Discussions in relation to this species were held with Dr Matthew Barrett, from the Botanic Gardens and Parks Authority (BGPA). Dr Barrett is currently conducting a revision of this genus and this species was noted as being one for which a change of status and modification of taxonomy was being considered. The guidance provided from Dr Barrett in relation to this species was that this population, whilst being a new record, was within the range for which no revision or change of status was planned.

The area within which this species was noted was searched by Volker Gartz, Exploration Manager for Harmony Mt Magnet Gold, with the aim of determining the extent and abundance of the species and to determine whether the species would be impacted by the proposed disturbance. Approximately 30 plants were recorded in the area from which the collection was made by the botanist from Niche, with another 10 plants recorded approximately 100m southeast by Mr Gartz. None of these plants will be impacted by the proposed disturbance. A specimen will be lodged with the Western Australian Herbarium.

5.3.3 Alien Flora

The potential impacts of alien flora, hereafter referred to as weeds, on agricultural and natural systems are well documented and discussions of this fall outside of the scope of works. Mechanisms exist for the identification and prioritisation of the management of weeds, with input from a number of bodies. Key amongst these are Weeds of National Significance (WONS), the *Agriculture Protection Act 1976* and the Environmental Weeds Strategy.

The WONS programme was established in 1997 and produced a finalized list of 20 species in 1999 (Thorp, 1999). The purpose of the programme was to facilitate the control and eradication of the 20 species. The species that were listed as WONS were all recognised as having significant ecological and economic impacts across Australia and should thus be viewed in that context. No WONS-listed weeds were recorded during the survey.

The *Agriculture Protection Act 1976* was enacted to protect the agricultural industry by facilitating the identification and enforcing the management of weed species. The act is administered by the Agriculture Protection Board (this will be transferred to the Department of Agriculture and Food, Western Australia in 2009). Under Section 37 of the act, a plant can be “declared”, after which, landholders must engage in a certain level of activity to manage said “declared plant”. Plants can be declared into five levels, which are:

- P1 – Prohibits movement of plants or seeds within the state. This prohibits the movement of machinery and produce including livestock and fodder.
- P2 – Eradicate infestation to destroy and prevent propagation each year until no plants remain.

- P3 – Control infestation in such a way that prevents the spread of seed or plant parts within and from the property on or in livestock, fodder, grain, vehicles and/or machinery. Treat to destroy and prevent seed set on plants.
- P4 – Prevent the spread of infestation from the property or in livestock, fodder, grains, vehicle and/or machinery. Treat to destroy and prevent seed set on plants.
- P5 – Infestations on public land must be controlled.

There was one declared plant recorded during the survey, being *Opuntia stricta*. This species is a P4 species. Landholders with P4 species must prevent the spread of infestation and treat to destroy and prevent seedset. It is recommended that the area is searched for this species prior to undertaking any clearing, with populations clearly marked and treated in accordance with the conditions above.

6.0 CLEARING PRINCIPLES

6.1 Overview

The Ten Principles for Clearing Native Vegetation are listed under section 5 of the *Environmental Protection Act 1986*. Under the Act, applications for permission to clear native vegetation must address the principles, which are considered by the CEO of the DEC, or delegated person, when determining whether to grant or deny permission to clear native vegetation. The following section provides an assessment of the proposed clearing as documented in the report against these principles.

6.1.1 Clearing principle a) Native vegetation should not be cleared if it comprises a high level of biological diversity

The census of the flora for the proposed area of disturbance was over 100 species, which was considered to be a comparatively high number, especially when compared to census values for other surveys in the Mt Magnet project area. While the majority of flora recorded was widespread, with each vegetation association essentially containing the same mix of species in different abundances and densities, there were four records of three priority taxa, of which two were species previously recorded in the area and one represented a new record. Based on this assessment, the proposed clearing may be at variance with this principle.

6.1.2 Clearing principle b) Native vegetation should not be cleared if comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.

No native fauna were observed during the survey. The vegetation in the area of proposed disturbance has no connectivity with surrounding areas of vegetation and as such, would be unlikely to serve as a corridor for the movement of native fauna. In addition to this, the vegetation observed

within the proposed area of disturbance was considered to be widespread in the area and as such, the removal would not constitute a loss of habitat, in whole or part. Based on this assessment, the proposed clearing was not considered to be at variance with this principle.

6.1.3 Clearing principle c) Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora.

No Declared Rare Flora were recorded during the survey and there have been no records of Declared Rare Flora in the region, therefore, the proposed clearing is not at variance to this principle.

6.1.4 Clearing principle d) Native vegetation should not be cleared if it comprises the whole or part of, or is necessary for the maintenance of a threatened ecological community.

There are no Threatened Ecological Communities within or close to the proposed area of disturbance. There are two Priority Ecological Communities in proximity to the proposed area of disturbance, the nearest being the Mt Magnet Ironstone Vegetation Complexes whose buffer zone extends to within 2.5km of the Saturn project area. The proposed clearing does not occur within these communities or within their buffers. Based on this information, the proposed clearing is not at variance to this principle.

6.1.5 Clearing principle e) Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.

The vegetation for which permission to clear is being sought is located in close proximity to a road, several disused haul roads and a number of sites containing mining infrastructure. The vegetation has limited connectivity, is highly disturbed and would not be considered to be representative of the vegetation in an undisturbed or poorly disturbed state and as such would not be considered to be significant as a remnant of vegetation in the area. Based on this assessment, the proposed clearing was not considered to be at variance with this principle.

6.1.6 Clearing principle f) Native vegetation should not be cleared if it is growing in, or in association with, and environment associated with a watercourse or wetland.

There were a number of ephemeral drainage lines within the proposed area of disturbance. The drainage lines have been dissected by existing roads and infrastructure and have no connection with other drainage lines in the surrounding area. There was no evidence of water in any of the drainage lines at the time of the survey. During the survey, it was noted that the density of vegetation increased in the ephemeral drainage lines, but the vegetation was noted as being the same species occurring on the plains and ridges and was not noted as being groundwater dependent vegetation. Based on these factors, the proposed clearing was not considered to be at variance with this principle.

6.1.7 Clearing principle g) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.

The area within which the clearing is proposed was observed as being highly disturbed. The area was traversed by a number of tracks, old workings and roads. In addition to this, the vegetation was clearly affected by grazing by goats and rabbits. The area has been subject to ongoing disturbance for a number of years, which has affected the condition of the vegetation and would be considered to have already led to a considerable amount of degradation. The capacity for high levels of additional degradation to occur is limited, and based on this assessment, the proposed clearing is considered to not be at variance with this principle.

6.1.8 Clearing principle h) Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.

The nearest conservation area to the proposed area of disturbance is located approximately 75km away. Based on this information, the proposed clearing is not at variance to this principle.

6.1.9 Clearing principle i) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.

There was no surface water observed during the survey of the proposed area, and any surface water likely to be found in the area would be from rainfall and the pooling would be highly ephemeral. The presence of groundwater in the area would have been affected by drawdown from pit dewatering associated with mining activities in the adjoining area. The removal of a comparatively limited amount of vegetation from the area would be unlikely to have any impact on ephemeral surface water or local aquifers of groundwater. Based on this assessment, the proposed clearing would not be considered to be at variance to this principle.

6.1.10 Clearing principle j) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding.

The region within which the proposed disturbance area is located has an arid-semi to arid climate, with annual rainfall of approximately 230mm. The area was noted as being a series of ephemeral drainage lines and plains, with vegetation generally sparse and highly disturbed. The removal of sparse vegetation in an arid-semi to arid area, with few records of local flooding, would be unlikely to either cause or exacerbate the incidence or intensity of flooding. Based on these factors, the proposed clearing was not considered to be at variance to this principle.

7.0 CONCLUSION AND RECOMMENDATIONS

The area proposed to be cleared was surveyed using methods consistent with a Level 1 survey as defined by the EPA (2002, 2004). The survey was conducted at a time considered to be consistent

with meeting the underlying assumptions for a Level 1 survey. The area proposed to be cleared was found to host three Priority taxa, including one new record. All attempts should be made to avoid impacting on these species. None of the vegetation was considered to have conservation significance and was assessed as being either widespread or in a condition that was not thought to be a representative unit.

The proposed clearing was assessed as potentially being at variance with Principle A and was assessed as not being at variance to the remaining Clearing Principles. It is recommended that despite the lack of variance to the clearing principles, any planned clearing should be kept to as small an area as is practicable and appropriate rehabilitation should be undertaken at the cessation of activity in the area. In areas where Priority Flora have been recorded, due care should be given to avoiding these populations.

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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 (DEC, 2009)

Conservation Code	Category Description
R	<u><i>Declared Rare Flora – Extant Taxa</i></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><i>Priority One – Poorly Known Taxa</i></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><i>Priority Two – Poorly Known Taxa</i></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><i>Priority Three – Poorly Known Taxa</i></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><i>Priority Four – Poorly Known Taxa</i></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 and Blyth, 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
Classification of Vegetation Structural Formation and Height Classes

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

Appendix C
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.

Appendix D
Species-Association Matrix



Family	Species	AcLOWfl	AcLOFdl	AcBIF	AcLWqu	AcLOWsl	Reh2	TeclScp
Amaranthaceae	<i>Ptilotus exaltatus</i>							
	<i>Ptilotus obovatus</i>							
	<i>Ptilotus schwartzii</i>							
Anacardiaceae	* <i>Schinus molle</i>							
Apocynaceae	<i>Sarcostemma viminale</i>							
Araliaceae	<i>Trachymene ornata</i>							
Asparagaceae	<i>Arthropodium dyeri</i>							
Asteraceae	<i>Angianthus tomentosus</i>							
	<i>Brachyscome ciliocarpa</i>							
	<i>Brachyscome perpusilla</i>							
	<i>Calotis hispidula</i>							
	<i>Centipeda thespidioides</i>							
	<i>Dielitzia tysonii</i>							
	<i>Lemooria burkittii</i>							
	<i>Myriocephalus guerinae</i>							
	<i>Myriocephalus pygmaeus</i>							
	<i>Olearia stuartii</i>							
	<i>Podolepis lessonii</i>							
	<i>Pogonolepis stricta</i>							
	Brassicaceae	<i>Stenopetalum anfractum</i>						
<i>Stenopetalum filifolium</i>								
Cactaceae	* <i>Opuntia stricta</i>							
Chenopodiaceae	<i>Einadia nutans</i>							
	<i>Enchylaena tomentosa</i> var. <i>tomentosa</i>							
	<i>Maireana carnosia</i>							
	<i>Maireana pentatropis</i>							
	<i>Maireana planifolia</i>							
	<i>Maireana pyramidata</i>							
	<i>Maireana</i> sp.							
	<i>Maireana thesioides</i>							
	<i>Maireana tomentosa</i> ssp. <i>tomentosa</i>							
	<i>Maireana triptera</i>							
	<i>Rhagodia drummondii</i>							
	<i>Sclerolaena eriacantha</i>							
	<i>Sclerolaena eurotioides</i>							
	<i>Tecticornia disarticulata</i>							
Convolvulaceae	<i>Duperreya sericea</i>							
Crassulaceae	<i>Crassula colorata</i> var. <i>acuminata</i>							
Euphorbiaceae	<i>Euphorbia drummondii</i> ssp. <i>drummondii</i>							
Fabaceae	<i>Acacia aneura</i> var. <i>aneura</i>							
	<i>Acacia aneura</i> var. <i>conifera</i>							
	<i>Acacia aneura</i> var. <i>fuligenia</i>							
	<i>Acacia aneura</i> var. <i>minyura</i>							
	<i>Acacia aulacophylla</i>							
	<i>Acacia burkittii</i>							
	<i>Acacia craspedocarpa</i>							
	<i>Acacia exocarpoides</i>							
	<i>Acacia grasbyi</i>							
	<i>Acacia pruinocarpa</i>							
	<i>Acacia quadrimarginea</i>							
	<i>Acacia ramulosa</i> var. <i>ramulosa</i>							
	<i>Acacia sclerosperma</i> ssp. <i>sclerosperma</i>							
	<i>Acacia speckii</i> (P3)							
	<i>Acacia tetragonophylla</i>							
	<i>Senna artemisioides</i> ssp. <i>x artemisioides</i>							
	<i>Senna charlesiana</i>							
	Geraniaceae	<i>Erodium cygnorum</i>						

Family	Species	AcLOWfl	AcLOFdl	AcBIF	AcLWqu	AcLOWsl	Reh2	TecLScp
Goodeniaceae	<i>Goodenia havilandii</i>							
	<i>Goodenia mimuloides</i>							
	<i>Goodenia pinnatifida</i>							
	<i>Scaevola spinescens</i>							
	<i>Velleia rosea</i>							
Hemerocallidaceae	<i>Dianella revoluta</i>							
Lamiaceae	<i>Prostanthera magnifica</i>							
	<i>Spartothamnella teucrifolia</i>							
Loranthaceae	<i>Amyema nestor</i>							
Malvaceae	<i>Brachychiton gregorii</i>							
	<i>Rulingia luteiflora</i>							
	<i>Sida</i> sp. ?ectogamia							
	<i>Sida</i> sp golden calyces glabrous							
Myrtaceae	<i>Aluta aspera</i> ssp. <i>hesperia</i>							
	<i>Eucalyptus kingsmillii</i> ssp. <i>kingsmillii</i>							
	<i>Eucalyptus striaticalyx</i>							
	<i>Micromyrtus sulphurea</i>							
	<i>Thryptomene costata</i>							
	<i>Thryptomene decussata</i>							
	<i>Verticordia jamiesonii</i> (P3)							
Poaceae	<i>Aristida contorta</i>							
	<i>Eragrostis eriopoda</i>							
	<i>Eragrostis pergracilis</i>							
	<i>Eriachne pulchella</i> ssp. <i>pulchella</i>							
	<i>Monachather paradoxus</i>							
	<i>Neurachne minor</i>							
	<i>Thyridolepis mitchelliana</i>							
Portulacaceae	<i>Calandrinia creethae</i>							
Proteaceae	<i>Grevillea berryana</i>							
	<i>Grevillea nematophylla</i> ssp. <i>supraplana</i>							
	<i>Grevillea obliquistigma</i> ssp. <i>obliquistigma</i>							
	<i>Hakea recurva</i> ssp. <i>Recurva</i>							
Pteridaceae	<i>Cheilanthes sieberi</i>							
Rhamnaceae	<i>Stenanthemum mediale</i> (P1)							
Rubiaceae	<i>Psyrax rigidula</i>							
	<i>Psyrax suaveolens</i>							
Rutaceae	<i>Philotheca brucei</i> ssp. <i>brucei</i>							
Sapindaceae	<i>Dodonaea petiolaris</i>							
Scrophulariaceae	<i>Eremophila clarkei</i>							
	<i>Eremophila forestii</i> ssp. <i>forestii</i>							
	<i>Eremophila galeata</i>							
	<i>Eremophila georgei</i>							
	<i>Eremophila lachnocalyx</i>							
	<i>Eremophila latrobei</i> ssp. <i>latrobei</i>							
	<i>Eremophila punicea</i>							
Solanaceae	<i>Solanum lasiophyllum</i>							
Stylidaceae	<i>Stylidium longibracteatum</i>							