

# **Preliminary Assessment of Conservation Values of Flora and Vegetation on Banded Ironstone Formations surrounding Harmony Gold operations, Mt Magnet**

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## **Summary of findings against the Clearing Principles (*Environmental Protection Act 1986*)**

The findings of the survey work have been assessed against the Clearing Principles relevant to the level of survey Principles a, c, d and h.

### **Principle (a) Native vegetation should not be cleared if it comprises a high level of biological diversity.**

Taking into account representativeness of the area within the Bioregion, ecosystem diversity, diversity of plant species at the bioregional and local level, and acknowledging that this report does not consider the fauna values in addressing this Principle, it is not considered that the proposed clearing comprises a high level of biological diversity. In addition the vegetation surveyed is mostly in a highly degraded state unlikely to be able to be restored and consequently considered of with low conservation value.

### **Principle (c) Native vegetation should not be cleared if it includes, or is necessary for the continued existence of rare flora.**

No flora that are known as Declared Rare Flora under the *Wildlife Conservation Act 1950* are known from the area or recorded during the survey. Five species of conservation significance were recorded during the survey. These comprised three Priority One taxa and two Priority Three taxa. The priority-listed taxa were located across the survey area; *Acacia speckii* was recorded from all four of the prospects. Cavanagh, Boomer and NW BIF each recorded three species of significance, in addition two species of taxonomic interest were also recorded from the Cavanagh and Hillcrest prospects.

Prior to this survey none of the five Priority Taxa and the two species of Conservation Interest were known from the Mt Magnet vicinity. A census of the extent of the populations in the region has not been undertaken.

### **Principle (d) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a threatened ecological community.**

There are no known Threatened Ecological Communities recorded from the proposed clearing area. Further detailed floristic composition survey would be required to determine the status of the plant communities across the BIFs. The discrete ironstone communities comprising habitat for the Priority One species *Ptilotus astrolasius* var. *luteolus* were limited in distribution across the Mt Magnet tenements and impact on these should be avoided.

### **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 proposed clearing is an area surrounded by existing mine operations and associated infrastructure and exhibits high levels of disturbance. There is no nearby or adjacent conservation area.

## 1.0 Introduction and Objectives

Harmony Gold Australia, Mt Magnet operates open cut and underground mining just outside the town of Mt Magnet. A series of low lying, narrow ridges comprised of Banded Ironstone Formations (BIFs) occur throughout the MMG tenements. Within the broad footprint of current mine operations, many of these have been subjected to historical and recent disturbance. A series of five long, low, linear BIF ridges occur throughout MMG tenements in areas proposed for exploration drilling. For the purposes of this survey we have distinguished four distinct and separate BIF's (the survey area).

Western Botanical was commissioned in October 2006 by Harmony Gold Australia, Mt Magnet (MMG) to undertake a flora and vegetation survey of several areas across MMG tenements. The survey areas comprised proposed pits waste dumps and exploration tenements. The findings of the survey were presented in a series of five reports; three of these for specific areas (Eclipse, Golden Stream and Hesperus) have been previously reported (Kern & True 2006a, 2006b, 2006c).

This report documents the results of a Level 1 Targeted Flora Reconnaissance survey of the four prospect areas known as:

- Cavanaghs (comprising 2 ridges that with a north-south alignment, lying in the west of the tenements;
- Hillcrest lies to the south east of the tenements;
- NW BIF, a series of BIF ridges with an east/south east-west alignment adjacent to the west of Brown Hill; and
- Boomer, series of ridges aligned north-south that lie to the east of the tenements.

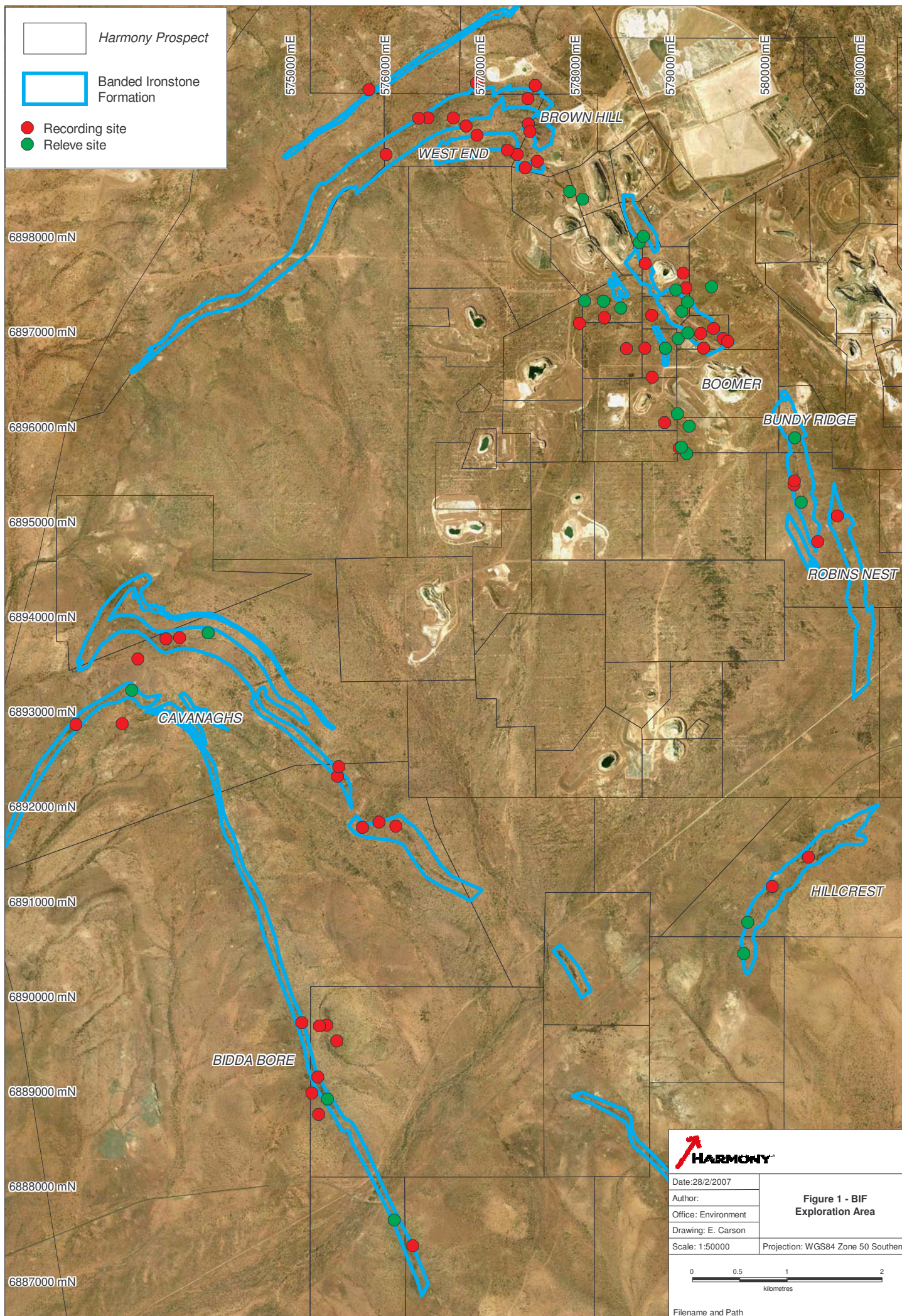
## 2.0 Methods

### 2.1 Botanical Survey

Denise True and Stephen Kern of Western Botanical conducted field surveys of the MMG tenements, during the period 10<sup>th</sup> to 15<sup>th</sup> October 2006. Selected information gathered as part of the wider surveys conducted at the time has been incorporated to provide a regional context on specific issues. A proportion of each BIF ridge was traversed on foot and relevés were conducted at several sites to represent the diversity of vegetation across the BIF's, with particular focus on the outcropping and upper slopes. Figure 1 provides an overview of the BIF's, showing recorded waypoints (indicating survey area).

Vegetation structure was described using a modification of the Muir (1977) classification system (Appendix 2). Complete species inventories were compiled for each of the four distinct BIF's. Any flora not readily identified in the field were collected and identified at the WA Herbarium while vouchers of all species encountered were also taken as reference material and have been retained by Western Botanical. Good quality specimens and any species with conservation significance were vouchered at the WA Herbarium.







All locations were recorded using hand held Garmin 76 GPS with an accuracy of approximately 5m using the WGS 84 datum. Photographs were taken for reference using a five megapixel digital camera.

## 2.2 Limitations and Constraints

Rainfall in was below average throughout much of Western Australia in 2006. As a result there was a very low occurrence of annual herbaceous species. In addition, flowering of perennial species was also affected. Despite the seasonal affects, only three taxa could not be fully identified to species level.

## 3.0 Results

### 3.1 Flora

A total of 99 taxa from 28 families were recorded from within the survey area including one weed *Cuscuta epithymum* (Appendix 1). The majority of taxa were represented by the families: Mimosaceae (15 taxa), Myoporaceae (9 taxa), Poaceae (8 taxa), Amaranthaceae (7 taxa) and Myrtaceae (6 taxa), Chenopodiaceae (14 taxa), Goodeniaceae (6 taxa) and Malvaceae (6 taxa).

Four taxa could not be successfully identified to species level due to insufficient flowering material. One specimen that closely resembles *Acacia cockertoniana* (SOK142) (P3), will require further material for confirmation.

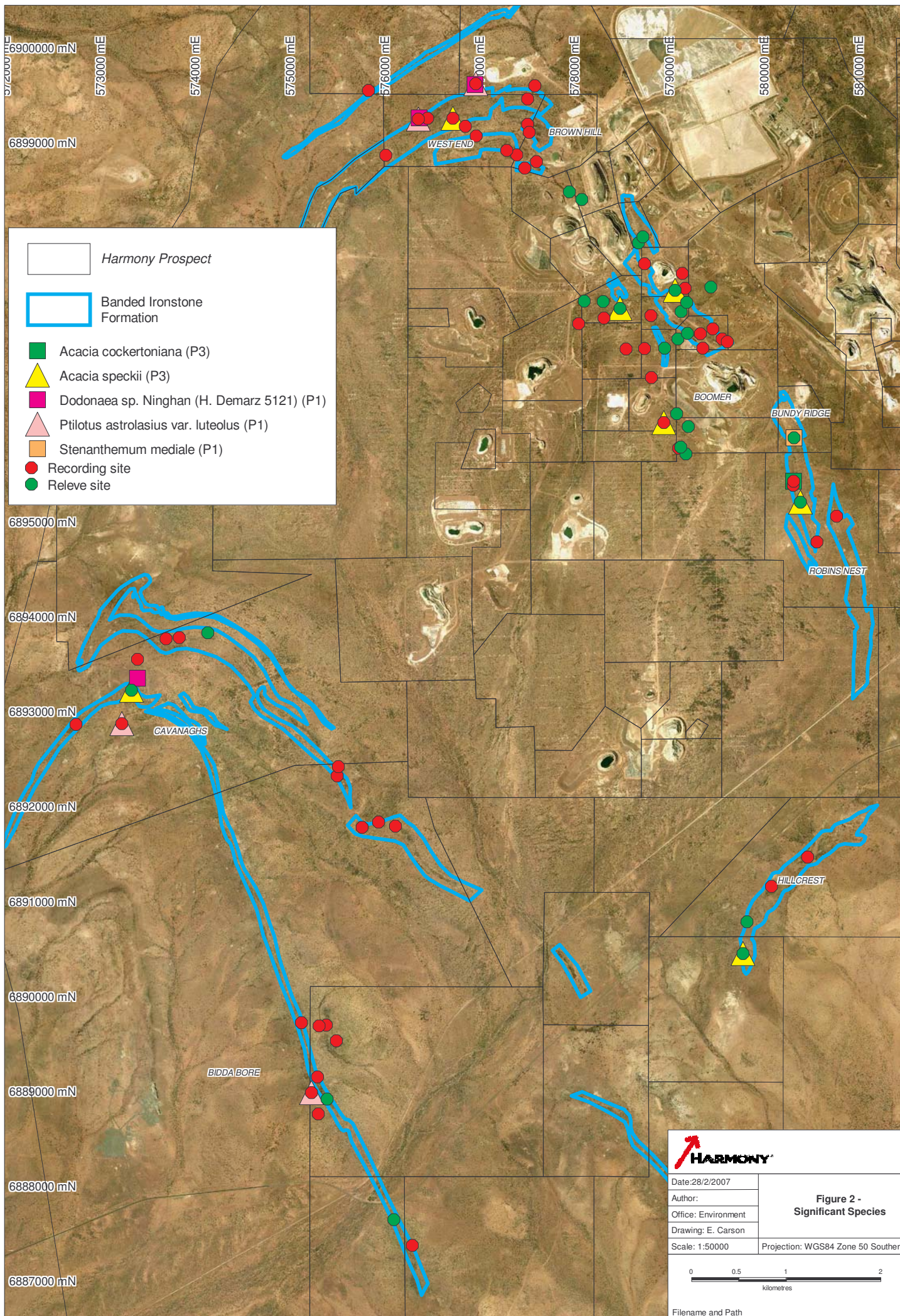
#### 3.2.1 Rare and Priority Flora

Five priority-listed taxa were located across the survey area (Table 1, Figure 2). These comprised three Priority One taxa and two Priority Three taxa.

**Table 1 Occurrence of Priority-listed taxa at each BIF prospect within the survey area.**

Species	Conservation Status	Boomer	NW BIF	Cavanaghs	Hillcrest
<i>Dodonaea</i> sp. Ninghan (H. Demarz 5121)	P1		X		
<i>Ptilotus astrolasius</i> var. <i>luteolus</i>	P1		X	X	
<i>Stenanthemum mediale</i>	P1	X			
<i>Acacia speckii</i>	P3	X	X	X	X
<i>Acacia cockertoniana</i>	P3	X		tbc	
<i>Acacia aneura</i> "Ironstone variant"	-			X	
<i>Tribulus adelacanthus</i>	-				X





**Figure 2 -  
Significant Species**



***Dodonaea* sp. Ninghan (H. Demarz 5121), Priority 1**

The undescribed taxon, *Dodonaea* sp. Ninghan (H. Demarz 5121), is a dome shaped, much-branched shrub to 50cm tall by 70cm wide with a 'tangled' appearance (Plates 1 & 2). It has been collected from locations between Yandhanoo Hill (south of Paynes Find) and Peak Hill (north of Meekatharra), representing a range of almost 500km. This is a new record for the Mt Magnet area, the closest other known location at Cue, 80km north. This taxon was recorded from three populations (two from NW BIF, one from Cavanaghs) (Figure 2). All populations were located on the gravelly slopes of the banded ironstone outcrop ridges, commonly associated with the Priority One taxon *Ptilotus astrolasius* var. *luteolus*.



**Plates 1 & 2** *Dodonaea* sp. Ninghan (H. Demarz 5121)

***Ptilotus astrolasius* var. *luteolus*, Priority 1**

*Ptilotus astrolasius* var. *luteolus* is a small compact shrub to 30cm tall, with a distinctive cream-coloured appearance (Plates 3 & 4). A total of four populations were recorded from the survey area. These comprised two populations of approximately 100 plants each recorded on the NW BIF prospect area and two small populations (of three and one individual) occurred on the Cavanaghs prospect area (Figure 2). All populations occurred on the gravelly slopes of the banded ironstone outcrop ridges. Previously unknown from Mt Magnet, these collections represent a southern range extension for the species. The nearest known population is near Meekatharra, approximately 170km northeast.



**Plates 3 & 4** *Ptilotus astrolasius* var. *luteolus*



***Stenanthemum mediale*, Priority 1**

*Stenanthemum mediale* is an upright shrub to 60cm tall (Plates 5 & 6, Figure 2). It was flowering during the October surveys. This is the first collection from the Mt Magnet area. Only two other records of this taxon exist, the closest being 140km east near Sandstone. One small population of approximately 20 individuals was recorded on the Boomer prospect area growing on one of the banded ironstone outcrops.



**Plates 5 & 6** *Stenanthemum mediale*

***Acacia speckii*, Priority 3**

The Priority Three taxon, *Acacia speckii*, was recorded from all four BIF prospect areas (Table 1, Figure 2). *Acacia speckii* is a tall shrub to 3m known from populations ranging from 100 km north of Meekatharra to Yalgoo (Florabase 2006). Surveys conducted on other BIFs within MMG tenements recorded this species from three additional locations. It is therefore likely that this species is locally common and abundant, though population sizes were not quantified as part of this survey.

***Acacia cockertoniana*, Priority 3**

*Acacia cockertoniana* is a tall shrub to 3m (Plates 7 & 8). It has been collected from several BIF's including Jack Hills, Die Hardy Ranges, Windarling Ranges and one location near Wiluna. However this is the first collection from the Mt Magnet region and represents a significant range extension of approximately 200km. A population of at least 10 individuals was recorded on the Boomer prospect area (Figure 2).



**Plate 7** *Acacia cockertoniana* in flower



**Plate 8** *Acacia cockertoniana*



### 3.2.2 Species of Taxonomic Interest

#### *Acacia aneura* "Ironstone form" (G. Cockerton & G. O'Keefe 11005)

*Acacia aneura* "Ironstone form" (G Cockerton & G O'Keefe 11005) is a distinct ovate - twisted leaved form of Mulga. This species, recognised by Geoff Cockerton and Gemma O'Keefe (Western Botanical), is known from a few, geographically isolated sites in the Leinster - Yakabindie - Mt Keith, however, populations are small and it is estimated that fewer than 1000 individuals are known. It is always found on the rocky summits of low ironstone hills, hence the unofficial phrase name applied here.

This species has been referred to *Acacia* specialist Bruce Maslin at the WA Herbarium for further determination of its taxonomic and conservation status.

#### *Tribulus adelacanthus*

*Tribulus adelacanthus* is a prostrate shrub. It is poorly collected being known from only from four collections across a wide range: Bulloo downs (south of Newman), Mt Magnet, Leonora district, and Wongawol (near Lake Carnegie). Very little is known of this taxon, the flower structure is unknown. Further collections will aid in the determination of the conservation status of the species.

### 3.2 Vegetation

The vegetation of the BIF ridges was typically *Acacia aneura*, *Acacia quadrimarginea* and *Acacia ramulosa* var. *ramulosa* Very Open Scrub to Scattered Tall Shrub over *Acacia speckii*, *Thryptomene decussata* Open Low Scrub over *Eremophila* spp., *Philotheca brucei* ssp. *brucei*, *Aluta aspera* ssp. *hesperia* Open Dwarf Scrub (Appendix 3).

Species composition was observed to vary along the ridges and between the ridges. Further detailed quadrat based survey would be required to determine the variation of plant communities across each BIF.

Currently there are no known Threatened Ecological Communities recorded from the prospects. Further detailed floristic composition survey would be required to determine the status of the plant communities across the BIFs. The discrete ironstone communities comprising habitat for the Priority One species *Ptilotus astrolasius* var. *luteolus* were limited in distribution across the Mt Magnet tenements and impact on these should be avoided.

## 4.0 Discussion

The flora of the MMG tenements is representative of the overall flora of the Austin Botanical District (Murchison Biogeographic Region); the vegetation as described by Beards (1990), is predominately mulga low woodland on plains, reduced to scrub on hills.

Within the MMG tenements a series of low lying, narrow, Banded Ironstone Formations (BIFs) ridges occur. Banded Iron Formations (BIFs) are highly prospective for iron ore however it is the adjacent gold deposits of interest in this situation. Most if not all of the surrounding BIFs have been subjected to either exploration or mining. Equally there is significant interest in the conservation values of BIF ranges, as studies have shown high levels of floristic endemism and unique ecological communities associated with these ranges.

Five species of conservation significance were recorded during the survey of the four prospects. These comprised three Priority One taxa and two Priority Three taxa. The priority-listed taxa were located across the survey area; *Acacia speckii* was recorded from all four of the prospects. Scattered individuals of *A. speckii* were recorded at three locations within the active mining area as well. (Kern & True 2006 a, b, c).

Cavanagh, Boomer and the NW BIF each recorded three species of significance in addition, two species of taxonomic interest were recorded from the Cavanagh and Hillcrest prospects.

Prior to this survey, there were no previous records of the five Priority Taxa and the two species of Conservation Interest were known from the Mt Magnet vicinity. A census of the extent of the populations in the region has not been undertaken to date.

The Department of Environment and Conservation is undertaking detailed floristic studies of the flora and vegetation of banded iron formations of the Yilgarn Ranges. The aim of the study is to expand on the currently limited knowledge of the flora and vegetation that occur on the ranges where banded ironstone occurs and to place the plant communities described during the survey into a regional context with other ranges throughout the Yilgarn Craton.

Species composition was observed to vary along the ridges and between the ridges within the prospects. Further detailed quadrat based survey would be required to determine the variation of plant communities across BIF in the area.

The discrete ironstone communities comprising habitat for the Priority One species *Ptilotus astrolasius* var. *luteolus* were limited in distribution across the Mt Magnet tenements and impact to these habitats should be avoided.



## 5.0 References

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<http://florabase.calm.wa.gov.au/browse/flora> (accessed September 21, 2006).
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## Appendix 1 Species Recorded within Survey Area

Family	Species	Boomer	Cavanaghs	Hillcrest	NW BIF
Adiantaceae	<i>Cheilanthes sieberi subsp. sieberi</i>		1	1	1
Poaceae	<i>Aristida contorta</i>	1	1	1	1
	<i>Austrostipa nitida</i>		1		
	<i>Cymbopogon ambiguus</i>		1		
	<i>Enneapogon caerulescens</i>		1		
	<i>Eragrostis eriopoda</i>			1	
	<i>Eragrostis helmsii</i>				1
	<i>Eriachne pulchella</i>		1	1	
	<i>Paspalidium basicladum</i>		1		
Phormiaceae	<i>Dianella revoluta</i>	1			
Casuarinaceae	<i>Allocasuarina acutivalvis</i>	1	1		1
Proteaceae	<i>Grevillea berryana</i>		1		1
	<i>Grevillea deflexa</i>	1			
	<i>Grevillea nematophylla subsp. supraplana</i>		1		1
	<i>Hakea preissii</i>		1		1
	<i>Hakea recurva subsp. recurva</i>			1	
Santalaceae	<i>Santalum spicatum</i>		1	1	1
Chenopodiaceae	<i>Maireana convexa</i>			1	
	<i>Maireana georgei</i>	1			
	<i>Sclerolaena densiflora</i>	1			
	<i>Sclerolaena fusiformis</i>		1		
Amaranthaceae	<i>Ptilotus astrolasius var. luteolus</i>		1		1
	<i>Ptilotus gaudichaudii</i>	1			
	<i>Ptilotus helipteroides var. helipteroides</i>	1	1	1	
	<i>Ptilotus obovatus</i>	1	1	1	1
	<i>Ptilotus polystachyus</i>		1	1	
	<i>Ptilotus rotundifolius</i>		1		1
	<i>Ptilotus schwartzii</i>	1	1	1	
Portulacaceae	<i>Calandrinia creethae</i>	1		1	1
	<i>Calandrinia sp. SOK130</i>		1		
	<i>Calandrinia sp. SOK097</i>	1		1	1
Mimosaceae	<i>Acacia ?cockertoniana SOK142</i>		1		
	<i>Acacia ?quadrimarginea</i>				1
	<i>Acacia aneura "Ironstone variant"</i>		1		
	<i>Acacia aneura var. aneura</i>	1	1	1	1
	<i>Acacia aneura var. argentea</i>	1	1	1	
	<i>Acacia aneura var. fuliginea</i>		1		
	<i>Acacia aulacophylla</i>		1		1
	<i>Acacia cockertoniana</i>	1			
	<i>Acacia craspedocarpa</i>	1		1	
	<i>Acacia exocarpoides</i>				1
	<i>Acacia grasbyi</i>		1		1
	<i>Acacia quadrimarginea</i>	1	1	1	1
	<i>Acacia ramulosa var. ramulosa</i>		1	1	1



Family	Species	Boomer	Cavanaghs	Hillcrest	NW BIF
Mimosaceae	<i>Acacia speckii</i>	1	1	1	1
	<i>Acacia tetragonophylla</i>	1	1	1	
Caesalpinaceae	<i>Senna artemisioides</i> subsp. <i>helmsii</i>				1
	<i>Senna artemisioides</i> subsp. <i>oligophylla</i>	1			
	<i>Senna artemisioides</i> subsp. <i>petiolaris</i>			1	
	<i>Senna artemisioides</i> subsp. <i>x sturtii</i>	1		1	1
	<i>Senna</i> sp. <i>Austin</i> (A. Strid 20210)		1	1	1
Zygophyllaceae	<i>Tribulus adelacanthus</i>			1	
	<i>Zygophyllum eremeum</i>	1			
Rutaceae	<i>Philotheca brucei</i> subsp. <i>brucei</i>	1	1	1	1
Sapindaceae	<i>Dodonaea microzyga</i> var. <i>acrolobata</i>	1	1		
	<i>Dodonaea petiolaris</i>	1	1	1	1
	<i>Dodonaea</i> sp. <i>Ninghan</i> (H. Demarz 5121)				1
Rhamnaceae	<i>Stenanthemum mediale</i>	1			
Tiliaceae	<i>Corchorus</i> sp.	1			
Malvaceae	<i>Abutilon cryptopetalum</i>				1
	<i>Hibiscus ?krichouffianus</i>	1			
	<i>Sida atrovirens</i>		1		
	<i>Sida excedentifolia</i>		1	1	
	<i>Sida</i> sp. <i>unisexual</i> (N.H. Speck 574)	1	1		
Sterculiaceae	<i>Brachychiton gregorii</i>	1	1		1
Myrtaceae	<i>Aluta aspera</i> subsp. <i>hesperia</i>	1	1	1	1
	<i>Calytrix desolata</i>		1		1
	<i>Micromyrtus sulphurea</i>	1	1		1
	<i>Thryptomene costata</i>		1		
	<i>Thryptomene decussata</i>	1	1	1	1
	<i>Verticordia interioris</i>		1		
Haloragaceae	<i>Haloragis trigonocarpa</i>		1		
Convolvulaceae	<i>Porana sericea</i>		1		
Cuscutaceae	* <i>Cuscuta epithymum</i>		1		
Chloanthaceae	<i>Spartothamnella teucriflora</i>		1		
Lamiaceae	<i>Hemigenia macphersonii</i>		1		
	<i>Hemigenia</i> sp. <i>Yalgoo</i> (A.M. Ashby 2624)	1	1		1
	<i>Prostanthera albiflora</i>				1
	<i>Prostanthera wilkieana</i>		1		
Solanaceae	<i>Solanum lasiophyllum</i>	1	1	1	
Myoporaceae	<i>Eremophila clarkei</i>	1	1	1	
	<i>Eremophila forrestii</i> subsp. <i>forrestii</i>	1	1		
	<i>Eremophila fraseri</i> subsp. <i>galeata</i>	1	1	1	
	<i>Eremophila glutinosa</i>	1	1	1	1
	<i>Eremophila jucunda</i> subsp. <i>jucunda</i>			1	1
	<i>Eremophila latrobei</i>	1	1	1	1
	<i>Eremophila oldfieldii</i> subsp. <i>angustifolia</i>		1		
	<i>Eremophila platycalyx</i> subsp.	1			

Family	Species	Boomer	Cavanaghs	Hillcrest	NW BIF
	<i>platycalyx</i> ms				
	<i>Eremophila punicea</i>	1	1	1	1
Rubiaceae	<i>Psydrax latifolia</i>				1
	<i>Psydrax rigidula</i>			1	
	<i>Psydrax suaveolens</i>		1	1	
Goodeniaceae	<i>Brunonia australis</i>	1	1		
	<i>Goodenia havilandii</i>	1	1		
	<i>Goodenia macroplectra</i>		1		
	<i>Scaevola spinescens</i>			1	1
	<i>Scaevola tomentosa</i>				1
Stylidaceae	<i>Stylidium longibracteatum</i>	1	1		1
Asteraceae	<i>Olearia humilis</i>		1		
	<i>Podolepis canescens</i>		1		

## Appendix 2 Vegetation Classification

Form/Height	Canopy Cover				
	Dense 70-100%	Mid-Dense 30-70%	Sparse 10-30%	Very Sparse 2-10%	Scattered <2%
Trees >30m	Dense Tall Forest	Tall Forest	Tall Woodland	Open Tall Woodland	Scattered Tall Trees
Trees 15-30m	Dense Forest	Forest	Woodland	Open Woodland	Scattered Trees
Trees 5-15m	Dense Low Forest A	Low Forest A	Low Woodland A	Open Low Woodland A	Scattered Low Trees A
Trees <5m	Dense Low Forest B	Low Forest B	Low Woodland B	Open Low Woodland B	Scattered Low Trees B
Mallee tree form	Dense Tree Mallee	Tree Mallee	Open Tree Mallee	Very Open Tree Mallee	Scattered Tree Mallees
Mallee shrub form	Dense Shrub Mallee	Shrub Mallee	Open Shrub Mallee	Very Open Shrub Mallee	Scattered Shrub Mallees
Shrubs >2m	Dense Thicket	Thicket	Scrub	Open Scrub	Scattered Tall Shrubs
Shrubs 1-2m	Dense Heath	Heath	Low Scrub	Open Low Scrub	Scattered Shrubs
Shrubs <1m	Dense Low Heath	Low Heath	Dwarf Scrub	Open Dwarf Scrub	Scattered Low Shrubs
Mat plants, Bunch Grass, Hummock Grass, Sedges, Herbs	Dense Mat Plants/ Grass/ Hummock Grass/ Sedges/ Herbs	Mat Plants/ Grass/ Hummock Grass/ Sedges/ Herbs	Open Mat Plants/ Grass/ Hummock Grass/ Sedges/ Herbs	Very Open Mat Plants/ Grass/ Hummock Grass/ Sedges/ Herbs	Scattered Mat Plants/ Grasses/ Hummock Grasses/ Sedges/ Herbs

\*Modification of the vegetation classification system of Muir (1977)



### Appendix 3 Photographic Records of habitats of the BIF prospects, Mt Magnet Tenements



**Plate 1** NW BIF prospect typical habitat



**Plate 2** Dwarf open scrub, *Ptilotus astrolasius* var. *luteolus* on NW BIF prospect





**Plate 3** Hillcrest prospect



**Plate 4** Cavanaghs South prospect





**Plate 5** Cavanaghs North prospect



**Plate 6** Boomer prospect