MOUNT DIMER
VEGETATION AND PRIORITY FLORA UPDATE
FEBRUARY 2022

FINAL

22 February 2022

PREPARED FOR

AURUMIN LIMITED

PREPARED BY

Woodgis
ENVIRONMENTAL ASSESSMENT & MANAGEMENT

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RECOMMENDED REFERENCE:

Woodgis (2022) *Mount Dimer Vegetation and Priority Flora Update February 2022*, unpublished report by Woodgis Environmental Assessment and Management for Aurumin.

ACRONYMS AND ABBREVIATIONS

The following acronyms are used in this report for succinctness:

aff.	affinity (denotes similarity to taxon)
AOI	Area of Interest
BIF	Banded Ironstone Formation
DBCA	(WA) Department of Biodiversity, Conservation and Attractions
EPA	Environment Protection Authority
GIS	Geographic Information System
ha	hectares
IBSA	Index of Biodiversity Surveys for Assessments
ISA	Indicator Species Analysis
km	kilometres
m	metres
Mt	Mount
POW	Programme of Work
ssp.	subspecies
subsp.	subspecies
WA	Western Australia/n

EXECUTIVE SUMMARY

Aurumin engaged Woodgis to undertake desktop mapping to augment priority flora data to facilitate risk assessment and management relating to POW drilling applications.

The Area of Interest (AOI) covers 2,773 hectares of tenements held by Aurumin Ltd in the locality of Mt Dimer, approximately 55 km north-east of Koolyanobbing, 270 km west-north-west of Kalgoorlie and 190 km north-east of Merredin. The AOI is located on Unallocated Crown Land (former Jaurdi station which is proposed to be a 5(1)(H) Reserve managed for the purposes of Conservation and Mining).

The state-wide system-associations occurring in the AOI are extensive and have been subject to low levels of clearing.

All of the landform and geology units were sampled with 99 quadrats and 24 relevés:

- Sampling intensity was one site per 22.5 ha;
- No Threatened or Priority Ecological Communities were located in the AOI;
- Six vegetation types were defined on the basis of a floristic analysis;
- The vegetation types described in the AOI are not expected to be restricted as the associated landforms did not include either Banded Iron Formation (BIF), granite outcrops, riparian vegetation or permanent surface water;
- *Ptilotus holosericeus* herblands were associated with damplands, which covered a total of approximately 7 hectares of the AOI, with an additional 16 hectares across Aurumin tenements contiguous with the AOI;
- *Neurachne annularis* P3 grasslands that were not identified by WA Museum (1985) as one of the 52 major vegetation types in the Jackson-Kalgoorlie Area but this grass is extensive in the J4 Mine and Haul Road area, which is in the vicinity of the AOI.

A total of 281 plant taxa were recorded in the AOI:

- It is estimated these represent 100% of the perennial plant taxa and 74% of the annual plant taxa present;
- All 12 priority flora taxa recorded in the AOI are represented on multiple conservation estate lands (DBCA-managed lands) except *Acacia* sp. Southern Cross P1, which is known from a single population that has yet to be comprehensively surveyed, of 28 plants across 400 m x 1000 m;
- The priority flora taxa in the AOI can be characterised as having:
  - restricted distributions and possibly in low abundance (*Acacia* sp. Southern Cross P1 and *Hysterobaeckea ochropetala* subspecies *ochropetala* P1);
  - restricted distributions, and possibly under-reported rather than uncommon (*Goodenia jaurdiensis* P2 and 3 *Cryptandra crispula* P3);
  - restricted distributions but locally abundant (*Eremophila hamulata* P1 and *Neurachne annularis* P3);
  - restricted distributions but locally abundant and increasing after disturbance (*Eucalyptus formanii* P4 and *Grevillea erectiloba* P4); or
  - widespread distributions, and possibly under-reported rather than uncommon (*Austrostipa blackii* P3, *Notisia intonsa* P3, *Philotheca coateana P3* and *Eremophila caerulea* subsp. *merrallii* P4).
- Locations were recorded for *Lepidosperma* aff. *lyonsii* (*Lepidosperma lyonsii* P1 is assumed to be restricted to the banded iron formation and related geologies, which were not present in the AOI); and
- Six weeds were observed but not mapped.

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1. INTRODUCTION

1.1. Background and Objectives

Aurumin engaged Woodgis to undertake flora and vegetation surveys in the locality of Mt Dimer, to facilitate risk assessment and management relating to POW drilling applications.

This report provides an update to flora and vegetation surveys as of November 2021. The report incorporates data from 9 vegetation quadrats established by Woodgis between 15 and 16 November 2021 in conjunction with data from previous surveys:

- *Flora and Vegetation of the Mount Dimer Tenements* (Western Botanical, 2020) documented vegetation mapping of the 665-hectare mining tenement M77/427, and targeted threatened and priority flora surveys of 48 hectares therein, by two botanists 30 May - 10 June 2016 and three botanists 14 - 23 October 2016;
- *Mount Dimer Targeted Flora Survey 2020* (Woodgis, 2021a) documented the targeted priority flora surveys of contiguous areas in tenement M77/427 totalling 72 hectares by two botanists 7-13 December 2020;
- *Mount Dimer Targeted Flora Survey March 2021* (Woodgis, 2021b) documented the targeted priority flora surveys of contiguous areas in tenement M77/427 totalling 181 hectares by two botanists 2-7 March 2021;
- *Woodcutter Tenements Targeted Flora Survey May 2021* (Woodgis, 2021c) documented the targeted priority flora survey across tenements M77/0965, M77/0957, E77/1992 and P77/4568 totalling 158-hectare area in 10-17 May 2021;
- *Mount Dimer Priority Flora Update July 2021* (Woodgis, 2021d), which consolidated previous data; and
- *Mount Dimer Vegetation and Priority Flora Update October 2021* (Woodgis, 2021e) documented the establishment of 54 vegetation quadrats established between 05 August and 05 September 2021.

1.2. Location

Figure 1 shows the location of the Mt Dimer Area of Interest (AOI):

- approximately 55 km north-east of Koolyanobbing, 270 km west-north-west of Kalgoorlie and 190 km north-east of Merredin;
- on Unallocated Crown Land (former Jaurdi station which is proposed to be a 5(1)(H) Reserve managed for the purposes of Conservation and Mining); and
- in the 'Mount Manning Region', an area referred to by the EPA (2007) in providing strategic advice on Mt Manning Nature Reserve and its extensions (also known as the Yilgarn Conservation Reserves).

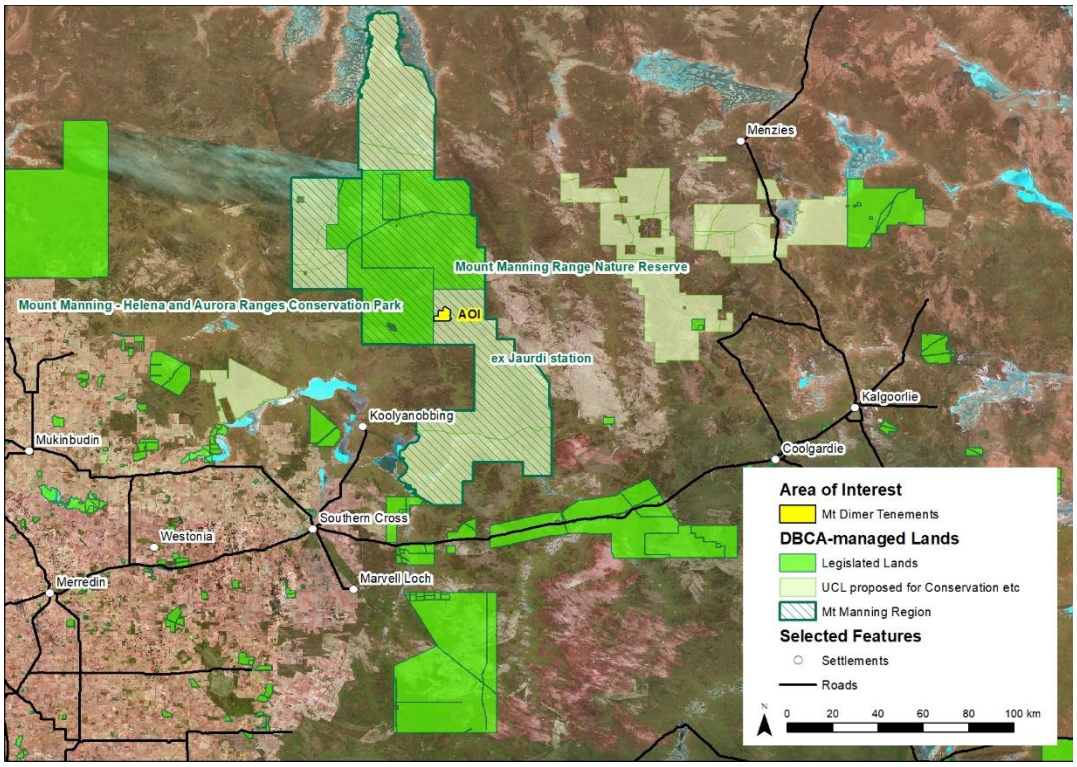

Figure 1: Location of Area of Interest at Mt Dimer

The AOI is located in the Southern Cross subregion of the Coolgardie biogeographic region, as shown in Figure 2.

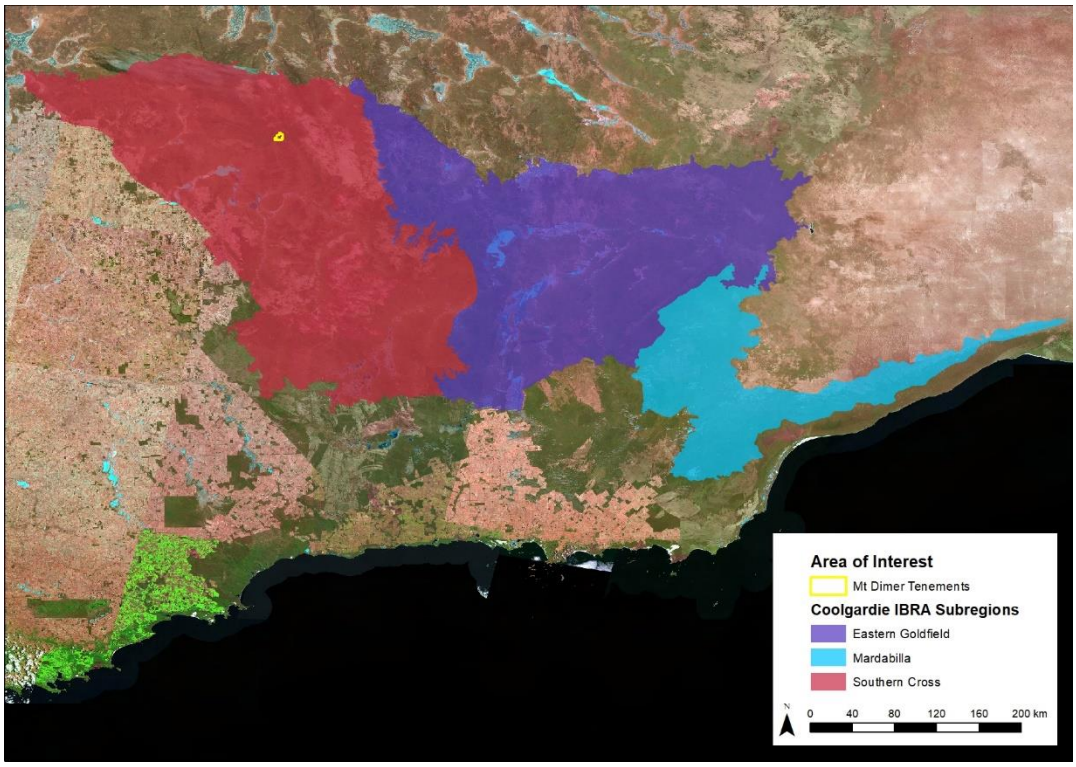

Figure 2: Location of AOI within the Coolgardie Biogeographic Region

The Coolgardie biogeographic region covers 12,912,204 ha, of which 97.96% remains uncleared; and the Southern Cross subregion covers 6,010,833 ha, of which 96.06% remains uncleared (Government of Western Australia, 2017). The biogeographic region is in an arid to semi-arid climate, and was characterised by DPaW (2002) as comprising granite strata of the Yilgarn Craton with Archaean Greenstone intrusions in parallel belts, with occluded drainage.

The Southern Cross subregion was characterised by DPaW (2002) as having subdued relief of gently undulating uplands dissected by broad valleys with bands of low greenstone hills, and consisting of:

- valleys of duplex and gradational soils that contain chains of saline playa-lakes;
- granite basement outcrops at mid-levels in the landscape;
- upper levels in the landscape are the eroded remnants of a lateritic duricrust yielding yellow sandplains, gravelly sandplains and laterite breakaways;
- scrubs rich in endemic Acacia and Myrtaceae species on uplands, as well as on sand lunettes associated with playas along the broad valley floors, and sand sheets around the granite outcrops; and
- diverse eucalypt woodlands rich in endemic Eucalyptus species around salt lakes, on the low greenstone hills, valley alluvials and broad plains of calcareous earths.

1.3. Area of Interest

The Area of Interest (AOI) shown in Figure 4 covers the 2,773 hectares and incorporates the tenements shown in Figure 4.

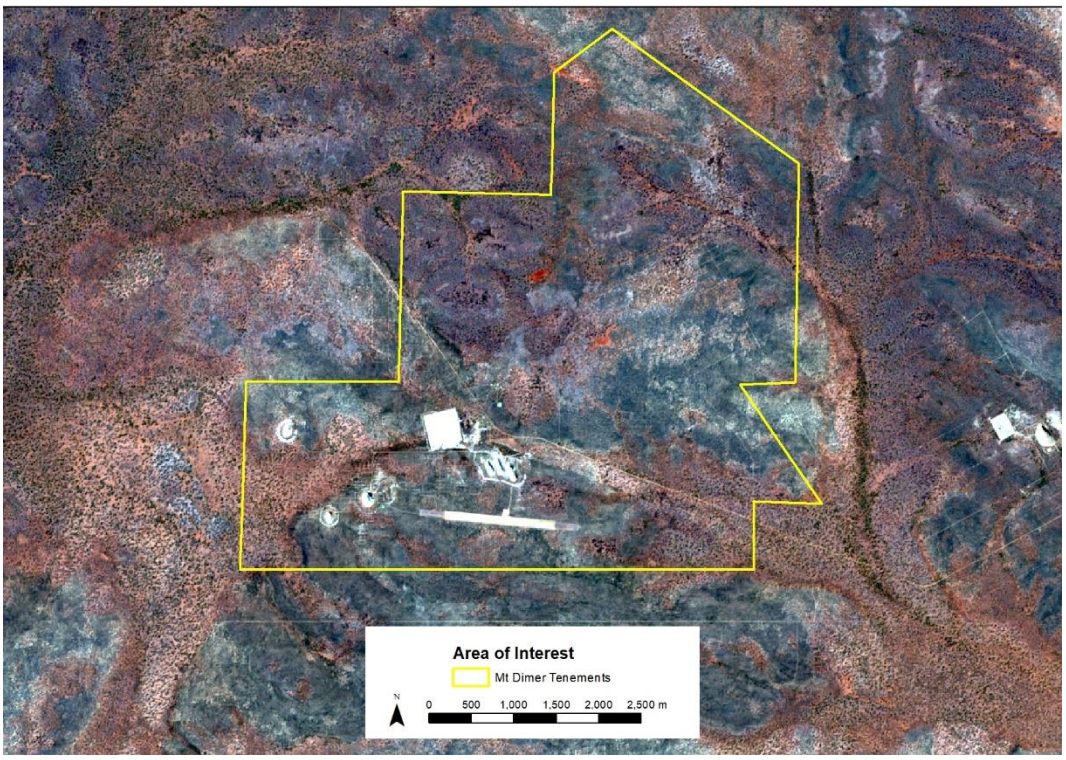

Figure 3: Area of Interest (AOI)

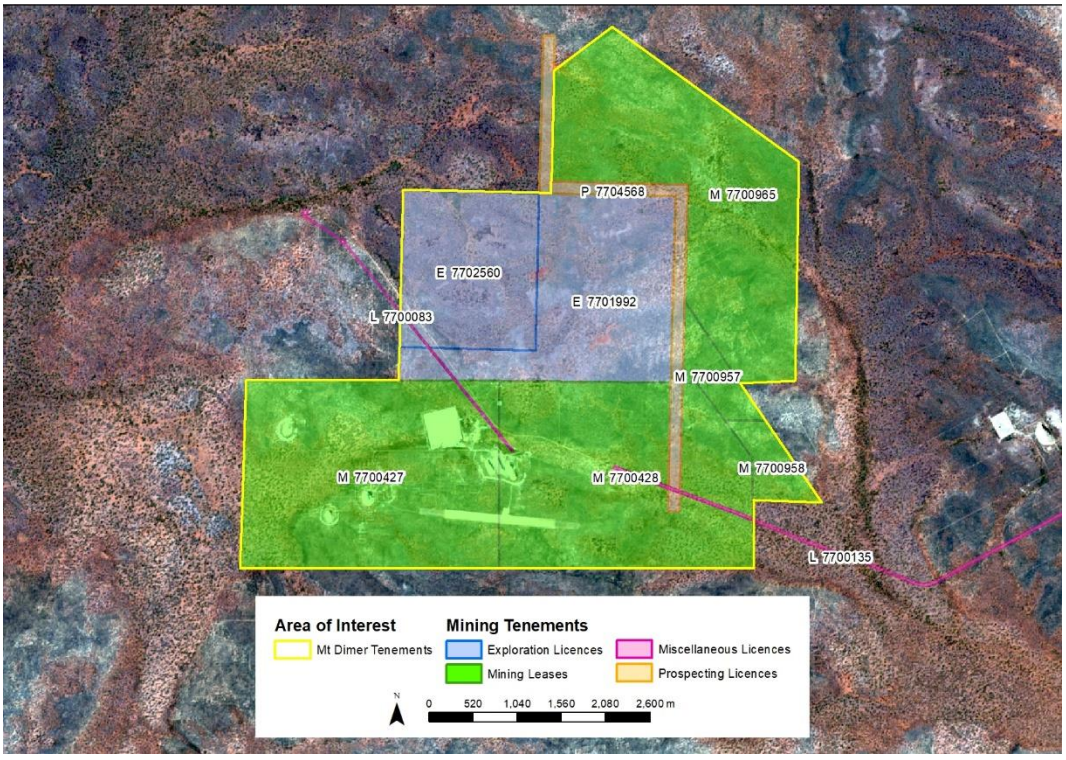

Figure 4: Tenements within AOI

Vegetation System-Associations (Associations in a Vegetation System) are the finest scale of mapping used in the Comprehensive, Adequate and Representative (CAR) reserve system analysis for Western Australia (Government of Western Australia, 2017). The system-associations in the AOI are shown in Figure 5.

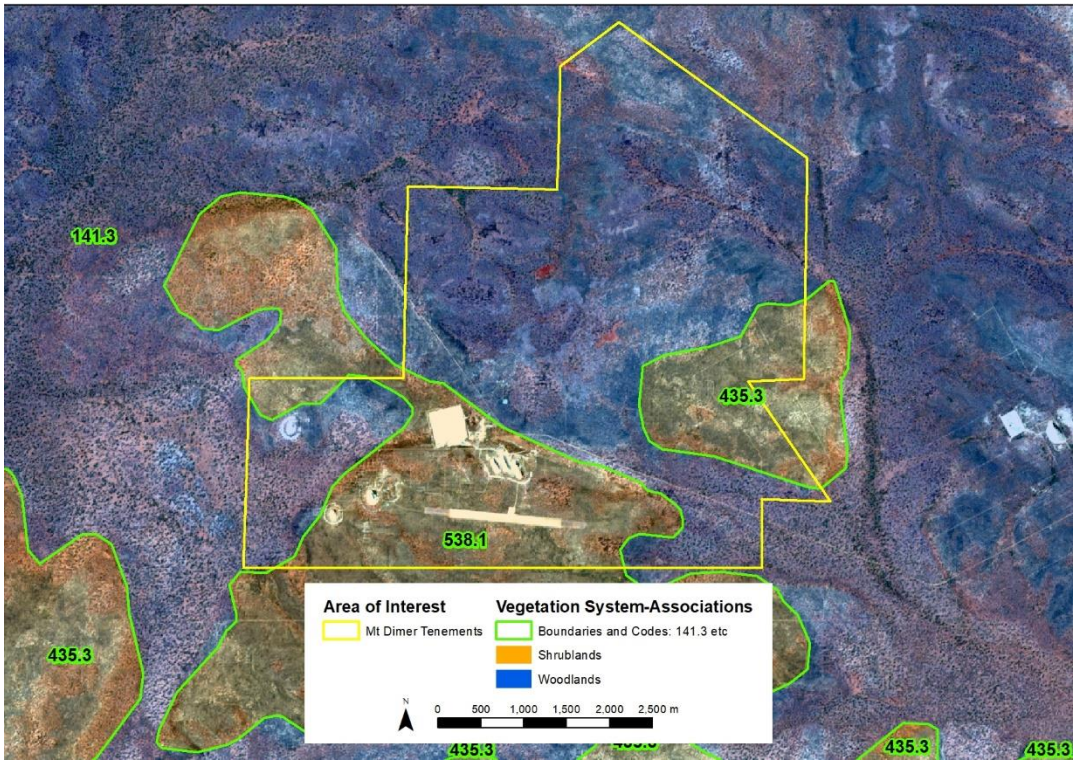

Figure 5: System-Associations in AOI

Source: Shepherd, Beeston and Hopkins (2002)

Landforms support distinctive vegetation types and soils in the Mount Manning Region (EPA, 2007) as soil, geology, landforms and vegetation are correlated in the eastern goldfields Jackson-Kalgoorlie Area (WA Museum, 1985). The landforms and surface geology across the AOI are shown in Figure 6 and Figure 7 respectively, with categories described in Table 1 and Table 2, and extents listed in Table 3.

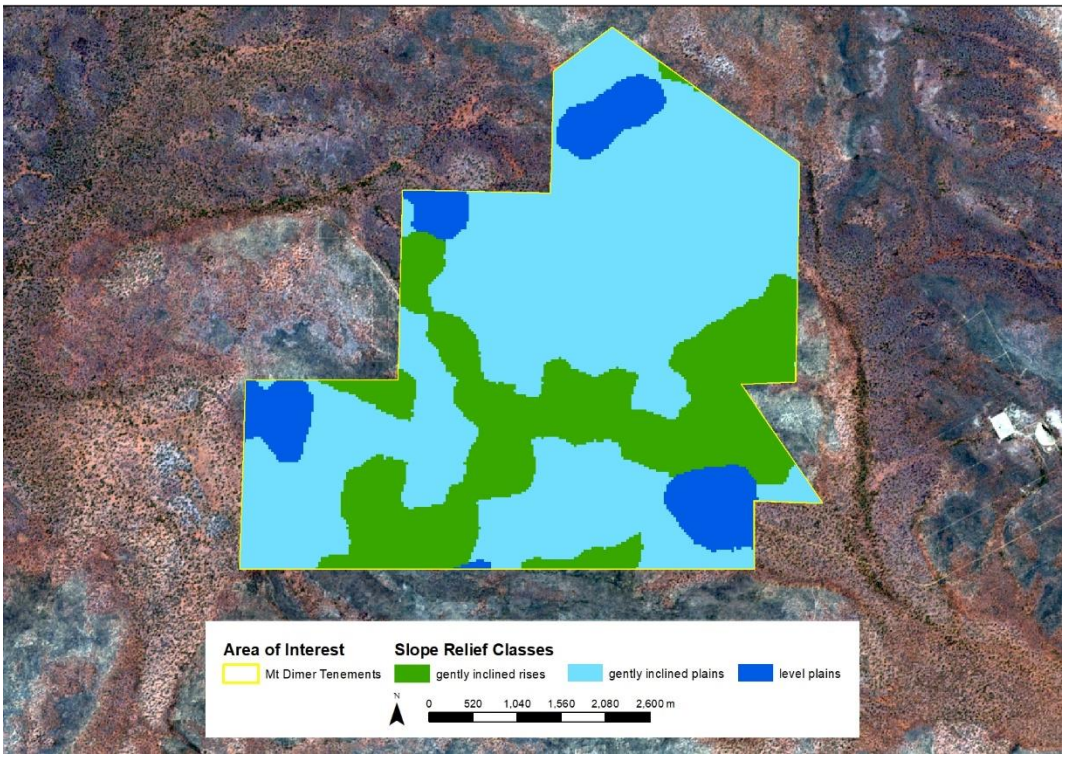

Figure 6: Landforms (Slope Relief Classes) across AOI

Source: CSIRO (2011)

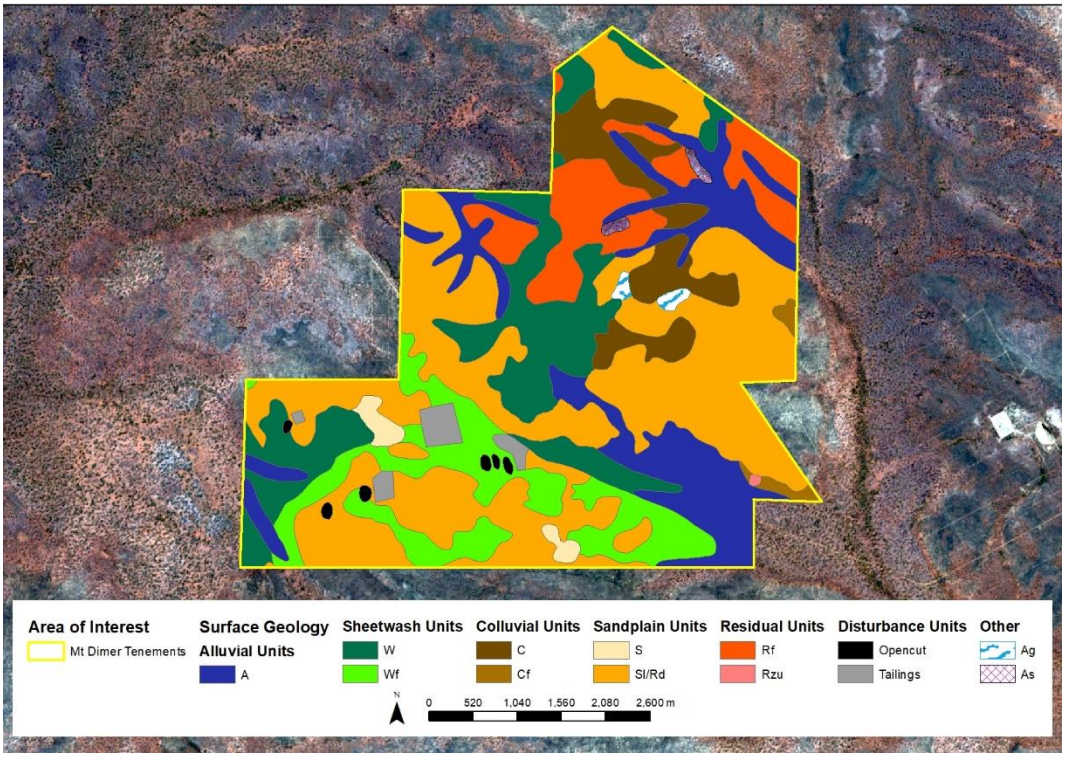

Figure 7: Survey Geology across AOI

Source: GSWA (2001)

Table 1: Slope Relief Classification

		Slope						
		Level <1%	**Very Gently Inclined 1-3%**	**Gently Inclined 3-10%**	**Moderately Inclined 10-32%**	**Steep 32-56%**	**Very Steep 56-100%**	**Precipitous >100%**
Relief	**Very High >300 m**	-	-	-	Rolling Mountains	Steep Mountains	Very Steep Mountains	Precipitous Mountains
	High 90-300 m			Undulating Hills	Rolling Hills	Steep Hills	Very Steep Hills	Precipitous Hills
	Low 30-90 m			Undulating Low Hills	Rolling Low Hills	Steep Low Hills	Very Steep Low Hills	Badlands
	Very Low 9-30 m		Gently Undulating Rises	Undulating Rises	Rolling Rises	Steep Rises	Badlands	
	Extremely Low <9 m	Level Plain	Gently Undulating Plain	Undulating Plain	Rolling Plain	Badlands		

Source: McDonald, Isbell, Speight, JG, & Hopkins (1990)

Table 2: Surface Geology Characterisation

Landform	Geology Units	Code	Description
Rock	**Granitoid**	**Ag**	Granitoid rock, undivided; includes deeply weathered rock
	Metasedimentary	**As**	Metasedimentary rock, undivided; typically deeply weathered
Sandplain	**Sandplain**	**S**	Yellow sand with minor pisolitic laterite
		Sl/Rd	Yellow sand with minor ferruginous pisoliths, silcrete, silt, and clay
	Residual	**Rf**	Lateritic duricrust; includes lateritic nodules
		Rzu	Silica caprock over ultramafic rocks
Broad Valley	**Alluvial**	**A**	Clay, silt, sand, and gravel in channels and floodplains
	Sheetwash	**W**	Clay, silt, and sand; locally ferruginous
		Wf	Sheetwash deposits with ferruginous gravel
	Colluvial	**C**	Mixed gravel and debris as proximal talus; includes sand and silt; locally ferruginous
		Cf	Ferruginous gravel and reworked laterite
Not Applicable	**Disturbance**	**Opencut**	Opencut
		Tailings	Tailings or stockpile

Source: GSWA (2001)

Table 3: Extents of Landforms and Surface Geology Units in AOI

Geology			Landform			
			Gently Inclined Rises	**Gently Inclined Plains**	**Level Plains**	**Total**
Rock	**Granitoid**	**Ag**	-	11 ha	-	**11 ha**
	Metasedimentary	**As**	-	9 ha	-	**9 ha**
Sandplain	**Sandplain**	**S**	3 ha	26 ha	-	**29 ha**
		Sl/Rd	513 ha	506 ha	82 ha	**1,101 ha**
	Residual	**Rf**	-	243 ha	5 ha	**248 ha**
		Rzu	1 ha	<1 ha	1 ha	**2 ha**
Broad Valley	**Alluvial**	**A**	73 ha	237 ha	85 ha	**395 ha**
	Sheetwash	**W**	45 ha	342 ha	24 ha	**410 ha**
		Wf	101 ha	194 ha	9 ha	**304 ha**
	Colluvial	**C**	5 ha	145 ha	47 ha	**196 ha**
		Cf	9 ha	8 ha	1 ha	**19 ha**
Not Applicable	**Disturbance**	**Opencut**	7 ha	2 ha	1 ha	**11 ha**
		Tailings	16 ha	20 ha	2 ha	**38 ha**
Total			**774 ha**	**1,743 ha**	**257 ha**	**2,773 ha**

2. METHODS

2.1. Field Surveys

Flora and vegetation surveys in the AOI are shown in Figure 8.

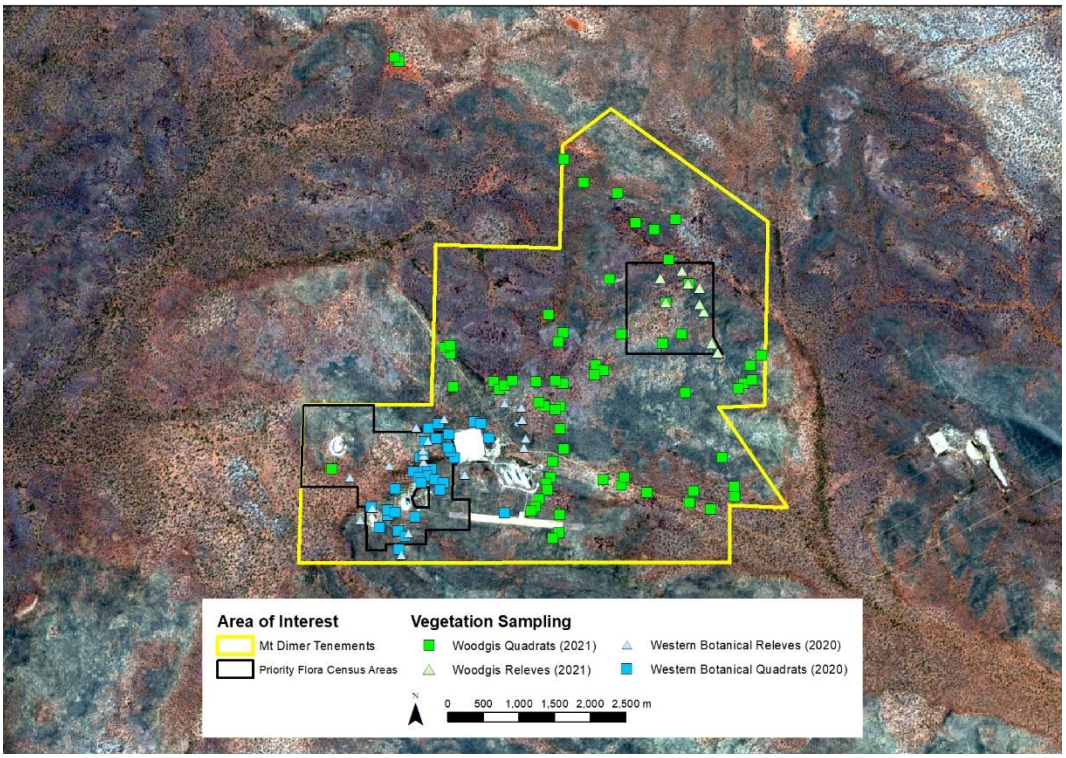

Figure 8: Vegetation and Flora Sampling across AOI

Woodgis, between 05 August and 16 November 2021, established:

- 63 quadrats in the AOI; and
- 2 quadrats in a dampland approximately 2.5 km to the northwest of the AOI (for further replication of that vegetation type).

Previously:

- 34 quadrats and 17 relevés were established by Western Botanical (2020), relevé WBR08 was removed at it had the same co-ordinates as quadrat WB26;
- 9 relevés were established by Woodgis (2021c), in November 2021 relevés WGR004 and WGR009 were converted to quadrats WG063 and WG062 respectively; and
- 459 ha (16.6% of the AOI) were searched for priority flora by Western Botanical/Woodgis.

All 20 m x 20 m quadrats were permanently marked in the field, with a photograph taken from, and a GPS location recorded at, the northwest corner.

The roles and experience of the personnel involved the Woodgis surveys are summarised in Table 4.

Table 4: Project Team

Team Member	Field Experience		Tasks
Andrew Waters Licence FB62000073 Graduate Certificate in GIS Bachelor of Science Advanced Certificate of Horticulture Certified Environmental Practitioner with EIANZ	**Since 1997 worked in:** Avon Wheatbelt Coolgardie Esperance Plains Geraldton Sandplains Great Sandy Desert Jarrah Forest	Little Sandy Desert Mallee Murchison Pilbara Swan Coastal Plain Yalgoo	Survey + Report
Dan Marsh Licence FB62000074-2 Bachelor of Science (Honours) (Ecology)	**Since 2004 worked in:** Carnarvon Coolgardie Dampierland Gascoyne Geraldton Sandplains Great Sandy Desert	Jarrah Forest Kimberley Murchison Pilbara Swan Coastal Plain Warren Yalgoo	Survey
Sharnya Yates Bachelor of Science (Botany/Zoology)	**Since 2003 worked in:** Avon Wheatbelt Carnarvon Central Kimberley Coolgardie Dampierland Esperance Plains Gascoyne Geraldton Sandplains Jarrah Forest	Mallee Murchison Northern Kimberley Pilbara Swan Coastal Plain Victoria Bonaparte Warren Yalgoo	Specimen Identification
Frank Obbens Bachelor of Science (Honours) Research associate with the WA Herbarium where he is the leading expert on the genus *Calandrinia*	**Since 1993 worked in:** Avon Wheatbelt Carnarvon Coolgardie Gascoyne Geraldton Sandplains Great Sandy Desert Great Victoria Desert Jarrah Forest	Little Sandy Desert Mallee Murchison Pilbara Swan Coastal Plain Warren Yalgoo	Specimen Identification

The following reports can be referred to for descriptions and discussion of field survey methods:

- *Flora and Vegetation of the Mount Dimer Tenements* (Western Botanical, 2020) documented vegetation mapping of the 665-hectare mining tenement M77/427, and targeted threatened and priority flora surveys of 48 hectares therein, by two botanists 30 May - 10 June 2016 and three botanists 14 - 23 October 2016;
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- *Mount Dimer Priority Flora Update July 2021* (Woodgis, 2021d), which consolidated previous data; and
- *Mount Dimer Vegetation and Priority Flora Update October 2021* (Woodgis, 2021e) documented the establishment of 54 vegetation quadrats between 05 August and 05 September 2021.

As shown in Table 5, all major landforms and geology types were sampled.

Table 5: Vegetation Sampling by Landforms and Surface Geology

Geology			Landform			
			Gently Inclined Rises	Gently Inclined Plains	Level Plains	Total Sites
Rock	Granitoid	Ag	-	2	-	2
	Metasedimentary	As	-	2	-	2
Sandplain	Sandplain	S	Not Sampled	6	-	6
		Sl/Rd	24	25	Not Sampled	49
	Residual	Rf	-	3	1	4
		Rzu	1	Not Sampled	Not Sampled	1
Broad Valley	Alluvial	A	1	5	3	9
	Sheetwash	W	4	15	2	21
		Wf	11	10	Not Sampled	21
	Colluvial	C	Not Sampled	2	Not Sampled	2
		Cf	1	Not Sampled	Not Sampled	1
Not Applicable	Disturbance	Opencut	Not Sampled	1	Not Sampled	1
		Tailings	1	1	Not Sampled	1
Total Sites			43	73	7	123

High portions of the species in the AOI have been recorded (Figure 9 and Table 6) according to estimates of the total number of species based on quadrat data:

- The 71 annual species recorded (55 species in quadrats and 16 additional species in relevés or opportunistically) represent approximately 74% of the species present; and
- The 210 perennial species recorded (151 species in quadrats and 59 additional species in relevés or opportunistically) represent approximately 100% of the species present.

Figure 9: Species Accumulation Curves

Table 6: Estimates of Percent of Species Recorded in AOI

Estimate Method	Annual Taxa		Perennial Taxa	
	Estimated Total	Portion Recorded (71 taxa recorded)	Estimated Total	Portion Recorded (210 taxa recorded)
First-order Jackknife	81	88%	185	114%
Second-order Jackknife	98	72%	201	104%
Chao 2, Classic	111	64%	187	112%
Chao 2, Bias Corrected	100	71%	184	114%
Average	97	74%	189	111%

2.2. Vegetation Classification

'Vegetation Type' is the preferred term for local scale vegetation units, with floristic composition the preferred classification system for detailed surveys (EPA, 2016).

Vegetation was described on the basis of structure (as per Table 7) in conjunction with floristics.

Table 7: Vegetation Structural Classification

Life form /height class	Canopy cover (%) 100 – 70	70 – 30	30 – 10	10 – 2
Trees over 30 m	Tall Closed Forest	Tall Open Forest	Tall Woodland	Tall Open Woodland
Trees 10 – 30 m	Closed Forest	Open Forest	Woodland	Open Woodland
Trees under 10 m	Low Closed Forest	Low Open Forest	Low Woodland	Low Open Woodland
Tree Mallee	Closed Tree Mallee	Tree Mallee	Open Tree Mallee	Very Open Tree Mallee
Shrub Mallee	Closed Shrub Mallee	Shrub Mallee	Open Shrub Mallee	Very Open Shrub Mallee
Shrubs over 2 m	Closed Tall Scrub	Tall Open Scrub	Tall Shrubland	Tall Open Shrubland
Shrubs 1 – 2 m	Closed Heath	Open Heath	Shrubland	Open Shrubland
Shrubs under 1 m	Closed Low Heath	Open Low Heath	Low Shrubland	Low Open Shrubland
Hummock Grasses	Closed Hummock Grassland	Hummock Grassland	Open Hummock Grassland	Very Open Hummock Grassland
Tussock Grasses	Closed Tussock Grassland	Tussock Grassland	Open Tussock Grassland	Very Open Tussock Grassland
Herbs	Closed Herbland	Herbland	Open Herbland	Very Open Herbland
Sedges	Closed Sedgeland	Sedgeland	Open Sedgeland	Very Open Sedgeland

Vegetation condition was rated according to Table 8.

Table 8: Vegetation Condition Scale (Eremaean and Northern Botanical Provinces)

Condition	Description
Excellent	Pristine or nearly so, no obvious signs of damage caused by human activities since European settlement.
Very Good	Some relatively slight signs of damage caused by human activities since European settlement. For example, some signs of damage to tree trunks caused by repeated fire, the presence of some relatively non-aggressive weeds, or occasional vehicle tracks.
Good	More obvious signs of damage caused by human activity since European settlement, including some obvious impact on the vegetation structure such as that caused by low levels of grazing or slightly aggressive weeds.
Poor	Still retains basic vegetation structure or ability to regenerate it after very obvious impacts of human activities since European settlement, such as grazing, partial clearing, frequent fires or aggressive weeds.
Degraded	Severely impacted by grazing, very frequent fires, clearing or a combination of these activities. Scope for some regeneration but not to a state approaching good condition without intensive management. Usually with a number of weed species present including very aggressive species.
Completely Degraded	Areas that are completely or almost completely without native species in the structure of their vegetation; i.e. areas that are cleared or 'parkland cleared' with their flora comprising weed or crop species with isolated native trees or shrubs.

Source: EPA (2004)

A floristic analysis for the 99 quadrats and 154 perennial flora taxa was undertaken using PC-ORD (McCune & Mefford, 2011):

- based on presence/absence of perennial species only, consistent with EPA guidance (2016) to remove the influence of differences in cover estimates by different surveyors and remove the influence of changes in annual species between seasons (due to rainfall variations);
- with the removal of species in the Western Botanical species x site matrix where those species were indicated to be outside the quadrat in Appendix 5 of *Flora and Vegetation of the Mount Dimer Tenements* (Western Botanical, 2020);
- with the removal from the dataset of singleton species, as species with only one or two occurrences never yield an indicator value stronger than expected by chance (McCune & Grace, 2002);
- with a Group Average linkage method and Sorensen (Bray-Curtis) distance measure;
- assigning group membership to each quadrat/relevé at each step of the associated dendrogram; and
- with question marks in taxon names (indicating a level of uncertainty in identifications) removed and changes made to the flora datasets as documented in Appendix 1 (with the omission of taxa with invalid names as per Table 36, and updates and equivalencies as per Table 37).

Figure 10 shows that an Indicator Species Analysis (ISA) using the methods of Dufrêne and Legendre (1997) supported splitting the vegetation into 5 or 17 groups as these coincided with localised peaks of relatively high total numbers of indicator species (species non-randomly occurring in groups, $p<0.05$) and high numbers of indicator species per group.

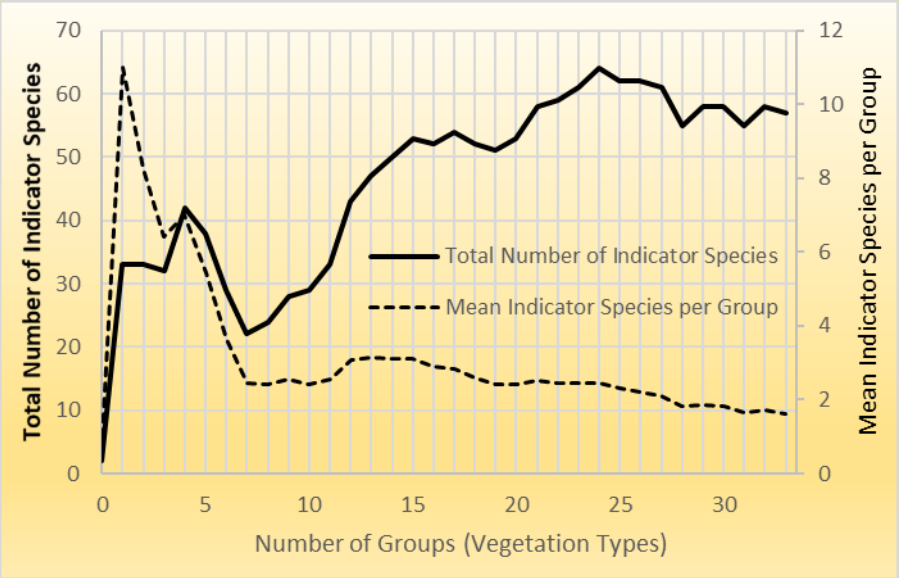

Figure 10: Indicator Species Analysis Output

The floristic analysis yielded the dendrogram shown in Figure 11, with the level at which six vegetation types and their constituent fourteen variants were defined shown (noting three quadrats were outliers due to their location in either low diversity or ecotonal sites).

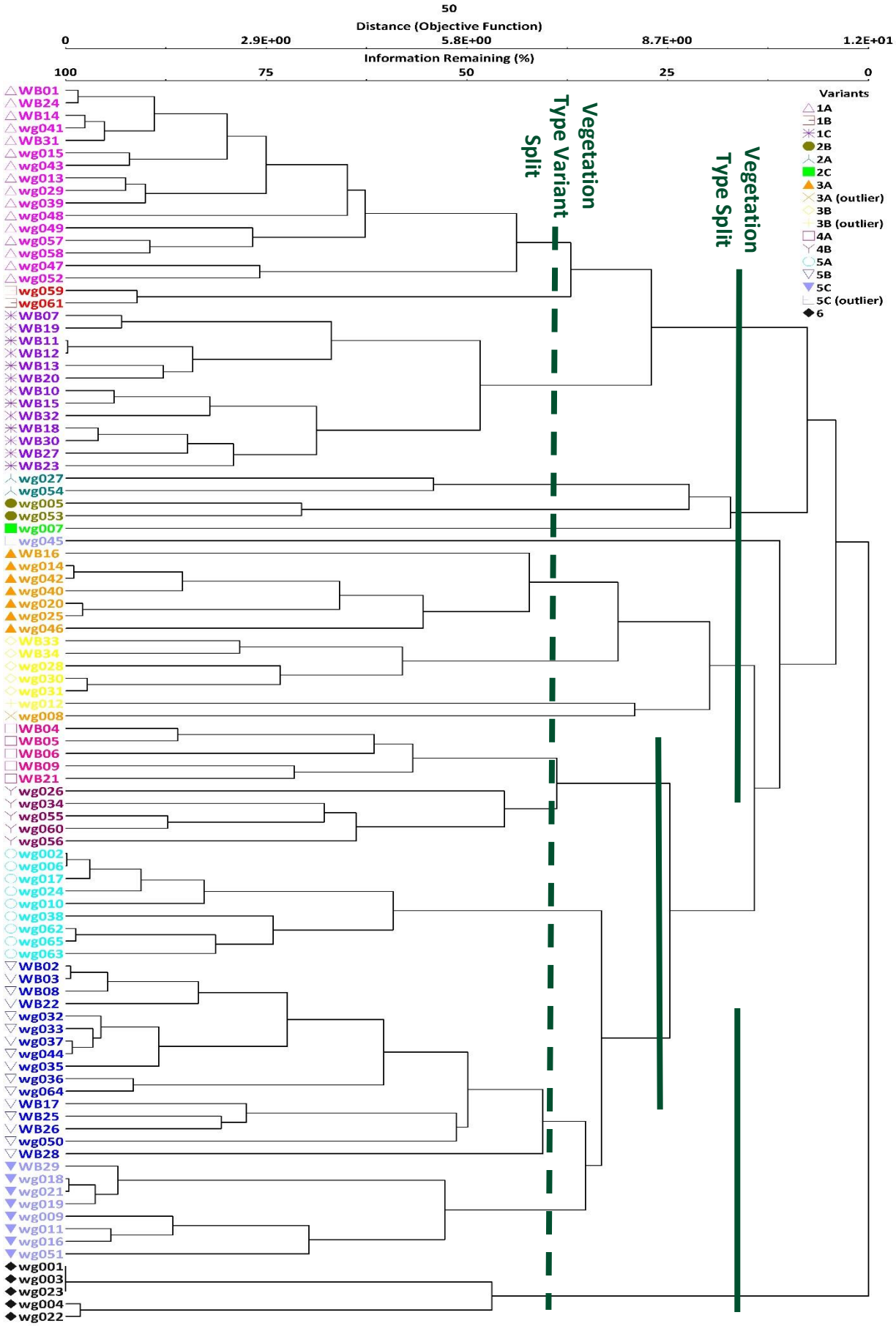

Figure 11: Dendrogram of Quadrats

The ISA strongly supported five vegetation types, but an additional split on the basis of vegetation structure was applied within the group of mixed eucalypts over tussock grasses into *Eucalyptus transcontinentalis* woodlands and *Eucalyptus loxophleba* mallees. The ISA was re-run with the six groups enforced and resulted in an average of 8 indicator species per group (which was higher than the 7 indicator species per group and 3 indicator species per group, for five or fourteen groups respectively). Other groups were not split at the same level of the dendrogram given the extent to which their component units, whilst distinct, were observed to intergrade and mosaic in the AOI.

Defining vegetation types in terms of six groups, and variants in terms of the fourteen constituent groups, is appropriate given:

- The main purpose of classification is to develop discrete and recognisable vegetation types in a robust and consistent way (McKenzie, Grundy, Webster, & Ringrose-Voase, 2008);
- The six vegetation types were all defined in terms of statistically significant indicator species and were readily identifiable both on ground and in aerial imagery, in contrast to the fourteen variants which were not all defined in terms of statistically significant indicator species and not always readily identifiable both on ground and in aerial imagery;
- Whilst Western Botanical (2020) identified eleven vegetation types in the AOI, they:
  - indicated that some of their vegetation types were difficult to differentiate between, in aerial photography and in the field, and some types/variants could/were not mapped separately;
  - noted there was a level of misalignment between vegetation types defined by their statistical analysis and the vegetation types they described and mapped;
  - comments such as 'sites differentiated by the higher Eucalyptus cover' implied their analysis used percent cover, which is not consistent with EPA guidance (2016) to use presence/absence data in analysis;
- The constituent fourteen variants extensively grade into and mosaic with each other within the six vegetation types, with intergrades under sampled due to quadrats being generally positioned to avoid vegetation boundaries or transitions and to minimise the influence of edge effects in accordance with guidance from EPA (2016);
- The fourteen groups reflected differences in data collected from 400 m^2 quadrats (the standard quadrat size for the Coolgardie Bioregion (EPA, 2016)), with some of the grouping resulting from the incomplete subset of the co-occurring tree species being recorded at many sites due to the limited number of individual large trees (with canopies in the order of 15 m in diameter) that could be accommodated within any individual 20 m x 20 m quadrat. The analysis highlighting differences at this spatial scale is consistent with Western Botanical (2020) noting that some vegetation of fairly homogenous appearance in the AOI, could be split by analysis of quadrat floristics; and
- Some of the fourteen variants represent very fine resolution vegetation patterns that are smaller than the EPA (2016) mapping threshold for local scale vegetation units (vegetation types) produced using 1:10,000 – 1:40,000 aerial imagery. Western Botanical (2020) noted that it was difficult to exclude other species from adjacent communities in 20 m wide quadrats when sampling relatively pure-stand clumps *Eucalyptus ravida* on cracking clay in the AOI). Cartographic scales should be approximately twice that of the compilation scale, and for cartographic scales of 1:20,000 - 1:80,000 the minimum width of linear features should be 20 – 80 m wide and the smallest mapped features 0.16 – 2.56 hectares (Sivertsen, 2009). The spatial resolution of the six vegetation types is appropriate for assessment and management. Polygon sizes associated with vegetation mapping in the AOI are summarised in Table 9.

Table 9: Vegetation Type Polygon Sizes

Vegetation Type	Number of Polygons	Mean Polygon Size (ha)	Maximum Polygon Size (ha)	Minimum Polygon Size (ha)
1: *Allocasuarina acutivalvis* Tall Shrubland over *Amphipogon caricinus* scattered tussock grasses	37	22.83	238.93	0.24
2: Mixed Very Open Tree Mallee / Tall Open Shrubland over *Neurachne annularis* P3 Tussock Grassland	58	1.74	78.78	0.01
3: *Eucalyptus ebbanoensis* Very Open Tree Mallee over *Triodia scariosa/tomentosa* Open Hummock Grassland	85	3.70	76.17	0.05
4: *Eucalyptus loxophleba* Very Open Tree Mallee over *Austrostipa elegantissima* scattered tussock grasses	15	14.05	79.79	0.39
5: *Eucalyptus transcontinentalis* Woodland over *Austrostipa elegantissima* scattered tussock grasses	18	66.33	651.86	0.15
6: *Ptilotus holosericeus* Very Open Herbland	3	2.47	3.33	0.98
Disturbed	7	14.49	66.81	0.28
All Polygons	**223**	**12.44**	**651.86**	**0.01**

2.3. Targeted Flora Species

Threatened flora species are those that are rare, in danger of extinction, or otherwise in need of special protection. Priority flora species are species that maybe threatened or near threatened but are data deficient. Status codes (T, P1, P2, P3 and P4) described in Appendix 2.

The datasets compiled for *Mt Dimer Flora and Vegetation Desktop Assessment* (Woodgis, 2020) indicate there are 48 threatened and priority flora species within 20 km of the tenement. Of these, 31 species are associated with the major landforms of the AOI, which are predominately a plain of gravel and sand, and a broad valley of sand/loam (Table 10 and Table 11). The 12 priority flora species recorded in the AOI are shaded in Table 11.

Table 10: Number of Threatened and Priority Flora Species within 20 km by Habitat

Status	Hill - BIF (Banded Ironstone Formations)	Granite (sand/loam)	Plain (gravel/laterite)	Plain (sand)	Broad Valley (sand/loam)	Broad Valley (clay)	Total
T	5						**5**
P1	4			6			**10**
P2				1	1		**2**
P3	5	1	3	16		1	**26**
P4	1		2	1	1		**5**
Total	**15**	**1**	**5**	**24**	**2**	**1**	**48**

Table 11: Typical Habitat of Threatened and Priority Flora in Vicinity

Typical Landform Habitat	Status	Taxa
Hill (BIF)	T	*Acacia shapelleae*
Hill (BIF)	T	*Lepidosperma bungalbin*
Hill (BIF)	T	*Leucopogon spectabilis*
Hill (BIF)	T	*Tetratheca aphylla* subsp. *aphylla*
Hill (BIF)	T	*Tetratheca paynterae* subsp. *paynterae*
Hill (BIF)	P1	*Acacia adinophylla*
Hill (BIF)	P1	*Beyeria rostellata*
Hill (BIF)*	P1	*Eremophila hamulata*
Hill (BIF)	P1	*Lepidosperma lyonsii*
Hill (BIF)	P3	*Hibbertia lepidocalyx* subsp. *Tuberculata*
Hill (BIF)	P3	*Lepidosperma ferricola*
Hill (BIF)	P3	*Mirbelia ferricola*
Hill (BIF)	P3	*Phlegmatospermum eremaeum*
Hill (BIF)	P3	*Stenanthemum newbeyi*
Hill (BIF)	P4	*Banksia arborea*
Granite (sand/loam)	P3	*Acacia crenulata*
Plain (gravel/laterite)	P3	*Grevillea georgeana*
Plain (gravel/laterite)	P3	*Hysterobaeckea cornuta*
Plain (gravel/laterite)	P3	*Neurachne annularis*
Plain (gravel/laterite)	P4	*Eucalyptus formanii*
Plain (gravel/laterite)	P4	*Grevillea erectiloba*
Plain (sand)	P1	*Acacia* sp. Southern Cross
Plain (sand)	P1	*Baeckea* sp. Helena and Aurora Range
Plain (sand)	P1	*Chamelaucium* sp. Koolyanobbing
Plain (sand)	P1	*Dampiera plumosa*
Plain (sand)	P1	*Hysterobaeckea ochropetala* subsp. *ochropetala*
Plain (sand)	P1	*Persoonia leucopogon*
Plain (sand)	P2	*Thysanotus* sp. Yellowdine
Plain (sand)	P3	*Acacia cylindrica*
Plain (sand)	P3	*Acacia eremophila* var. *variabilis*
Plain (sand)	P3	*Acacia formidabilis*
Plain (sand)	P3	*Austrostipa blackii*
Plain (sand)	P3	*Banksia lullfitzii*
Plain (sand)	P3	*Calytrix creswellii*
Plain (sand)	P3	*Comesperma rhadinocarpum*
Plain (sand)	P3	*Cryptandra crispula*
Plain (sand)	P3	*Cyathostemon verrucosus*
Plain (sand)	P3	*Gompholobium cinereum*
Plain (sand)	P3	*Homalocalyx grandiflorus*
Plain (sand)	P3	*Labichea eremaea*
Plain (sand)	P3	*Melichrus* sp. Bungalbin Hill
Plain (sand)	P3	*Philotheca coateana*
Plain (sand)	P3	*Stylidium choreanthum*
Plain (sand)	P3	*Verticordia mitodes*
Plain (sand)	P4	*Sowerbaea multicaulis*
Broad Valley (sand/loam)	P2	*Goodenia jaurdiensis*
Broad Valley (sand/loam)	P4	*Eremophila caerulea* subsp. *merrallii*
Broad Valley (cracking clay)	P3	*Notisia intonsa*

**Eremophila hamulata* occurs on but is not restricted to BIF landforms (EPA, 2017) and is not associated with BIF in the AOI

Grevillea georgeana P3 appears to have been erroneously documented as present in the AOI by Niche Environmental Services (2013). Specimens collected in March 2021 from previously recorded GPS locations were determined by Frank Obbens to be from the widespread and variable *Grevillea huegelii*, which has distinctly different flowers to *Grevillea georgeana* P3.

Lepidosperma lyonsii P1 has been previously recorded on sandplains at Mt Dimer by Western Botanical (2020), with a specimen lodged at the WA Herbarium. PGV Environmental (2018) reported in relation to the Sandy Ridge tenement area (20 km east of Mt Dimer), that:

- Dr Russell Barrett (Systematic Botanist, The Royal Botanic Gardens Sydney) advised that:
  - *Lepidosperma lyonsii* is restricted to the banded iron formation and related geologies in the Mt Jackson area and specimens recorded on the yellow sandplain in the Sandy Ridge tenement area are not likely to be the priority species *Lepidosperma lyonsii;*
  - there are likely to be three species in the *Lepidosperma lyonsii* complex in the area including *Lepidosperma lyonsii* and *Lepidosperma jacksonense,* which occur on rocky substrates, and *Lepidosperma* aff. *lyonsii,* which occurs on sandplain soils; and
  - related/similar *Lepidosperma* species (including taxa previously recorded onsite as *Lepidosperma lyonsii* and 'unknown Lepidosperma') on the sandplain soils in and around the Sandy Ridge tenement should be referred to as *Lepidosperma* aff. *lyonsii*, until further taxonomic work is undertaken.
- *Lepidosperma* aff. *lyonsii*:
  - does not have a conservation code assigned to it (i.e. is not a listed priority taxon);
  - specimens matched other specimens Dr Barrett had seen from the Jaurdi area on yellow sandplains, suggesting the species was not a newly collected species; and
  - is highly likely to be more widespread in the region as the sandplain soils with the associated vegetation being extensive in the region, and the taxon having been recorded approximately 100 km south of the Sandy Ridge tenement.

Dr Russell Barrett was emailed on 21/10/2021 respectively seeking further advice on *Lepidosperma lyonsii* P1 but no response has been received to date.

Kevin Thiele (Adjunct Senior Lecturer at the University of Western Australia and Director, Taxonomy Australia at The Australian Academy of Science) indicated in an email on 04/11/2021 that further taxonomic is required on *Lepidosperma lyonsii* P1, as it was described from very few specimens and the lack of taxonomic clarity in this plant complex means that identifications cannot be readily assigned to plants.

Plant counts were not undertaken for what is assumed to be *Lepidosperma* aff. *lyonsii* but locations for opportunistic observations were recorded and these are shown in Figure 12.

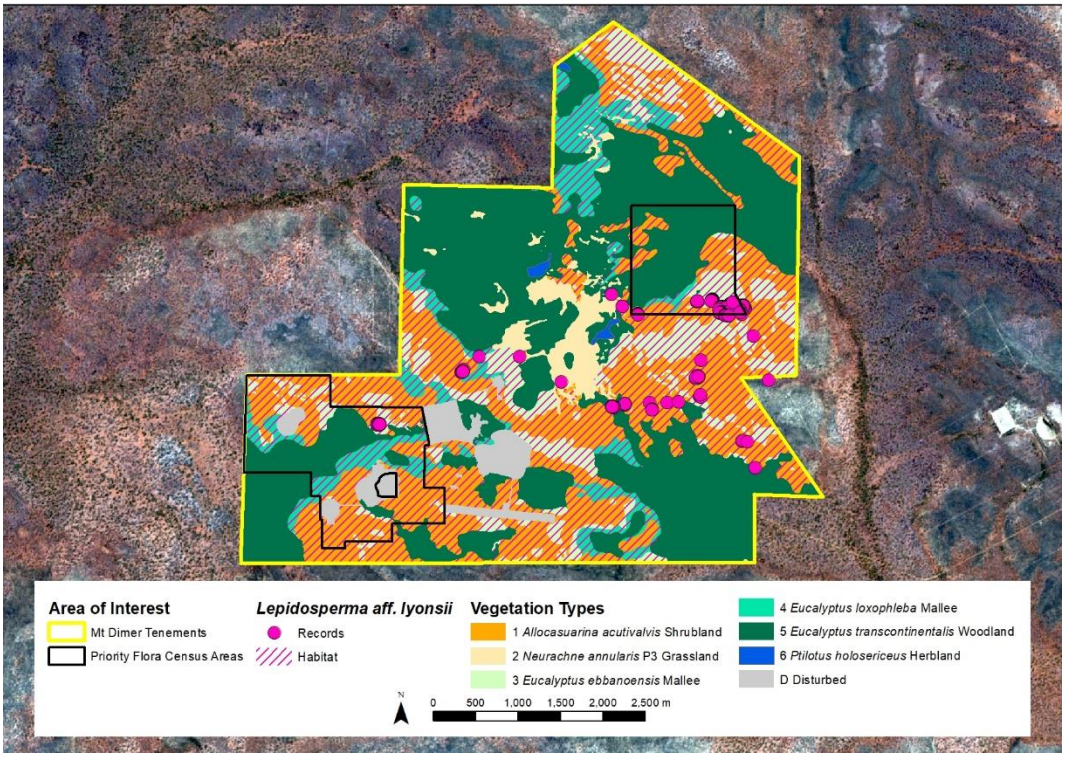

Figure 12: *Lepidosperma* aff. *lysonii* in AOI

2.4. Limitations

Access and intensity of sampling was not a limiting factor for vegetation characterisation and development of flora inventories:

- The average sampling intensity was of one quadrat/relevé site per 22.5 ha across the AOI;
- All of the landform units and of the geology units have been sampled with vegetation quadrats/relevés, with the majority of the landform/geology combinations sampled and those combinations not sampled in large part represented misalignment of datasets rather than unique features requiring sampling and covered small areas (averaging less than 8 hectares per combination);
- it is estimated that 100% of the perennial plant taxa and 74% of the annual plant taxa present were recorded; and
- there was a high level of replication in sampling of vegetation types and variants within them, as shown in Table 12.

Table 12: Replication of Sampling within Vegetation Types and Variants

Vegetation Type	Variant	Quadrats	Releves
1: *Allocasuarina acutivalvis* Tall Shrubland over *Amphipogon caricinus* scattered tussock grasses	A	16	5
	B	2	0
	C	13	2
2: Mixed Very Open Tree Mallee / Tall Open Shrubland over *Neurachne annularis* P3 Tussock Grassland	A	3	0
	B	2	0
	C	1	0
3: *Eucalyptus ebbanoensis* Very Open Tree Mallee over *Triodia scariosa/tomentosa* Open Hummock Grassland	A	7	9
	B	6	1
4: *Eucalyptus loxophleba* Very Open Tree Mallee over *Austrostipa elegantissima* scattered tussock grasses	A	5	3
	B	5	0
5: *Eucalyptus transcontinentalis* Woodland over *Austrostipa elegantissima* scattered tussock grasses	A	9	1
	B	16	3
	C	9	0
6: *Ptilotus holosericeus* Very Open Herbland	-	5	0

Flora identifications were not a limiting factor, but it is noted that:

- Valid taxa were not assigned to the 23 entities that were omitted from the floristic analysis;
- *Allocasuarina campestris* fruit varied in whether they were sessile, resulting in the identification not being definitive (*Allocasuarina eriochlamys* being a similar species);
- Triodia species were treated as a single entity - only *Triodia tomentosa* was confirmed by Woodgis but Western Botanical (2020) recorded three Triodia species (*Triodia rigidissima, Triodia scariosa* and *Triodia* species);
- Issues with the taxonomy of *Lepidosperma lyonsii* P1 are discussed in Section 2.3; and
- Information pertinent to priority flora are captured in Table 13 - in accordance with best practice, to ensure familiarity with target species and their habitat, at least one location of each of the previous record were visited in 2020/21.

Table 13: Detectability of Targeted Flora

Taxon	Lifeform	Predominate Flowering Period	Photos (Appendix 3)	Readily detected/identified year-round	Not Readily detected/identified outside flowering
Acacia sp. Southern Cross P1	Shrub	Not Documented	Photo 6 Photo 7	**X**	
Eremophila hamulata P1	Shrub	Aug to Oct	Photo 8 Photo 9		**X** **Specimens Collected – Confirmed**
Hysterobaeckea ochropetala ssp. *ochropetala* P1	Shrub	Oct	Photo 10 Photo 11		**X**
Goodenia jaurdiensis P2	Herb (perennial)	Sep to Oct	Photo 14 Photo 15		**X** **Specimens Collected – Confirmed**
Austrostipa blackii P3	Tussock Grass (perennial)	Sep to Nov	No photos not relocated in 2020 / 2021		**X**
Cryptandra crispula P3	Shrub	Jul to Sep	Photo 12 Photo 13		**X** **Specimens Collected – Confirmed**
Neurachne annularis P3	Tussock Grass (perennial)	Sep to Oct	Photo 16 Photo 17	**X**	
Notisia intonsa P3	Herb (annual)	Sep to Nov	Photo 18 Photo 19		**X** **Specimen Collected – Confirmed**
Philotheca coateana P3	Shrub	Aug to Sep	No photos not searched for in 2020 / 2021		**X**
Eremophila caerulea subsp. *merrallii* P4	Shrub	Oct to Dec	Photo 20 Photo 21	**X**	
Eucalyptus formanii P4	Tree / Mallee	Dec or Jan to Apr	Photo 22 Photo 23	**X**	
Grevillea erectiloba P4	Shrub	Sep to Oct	Photo 24 Photo 25	**X**	

The following observations are made in relation to Priority 1 taxa:

- ***Acacia* sp. Southern Cross P1** can be readily located and identified year-round.
- ***Eremophila hamulata* P1** is problematic but can be surveyed outside flowering times:
  - *Eremophila hamulata* P1 was flowering in September 2021 and observations at that time verified previous mapping of the species when it was not flowering in May 2021;
  - Three *Eremophila hamulata* P1 sterile specimens were collected in May 2021 and Frank Obbens confirmed these were consistent with *Eremophila hamulata* P1 and did not match any other obvious alternative taxa. Specimens of the Eremophila plants not recorded as *Eremophila hamulata* P1 during May 2021 were confirmed by Frank Obbens to be *Eremophila caperata, Eremophila decipiens* subsp*. decipiens, Eremophila ionantha, Eremophila oldfieldii* subsp*. angustifolia* and *Eremophila oppositifolia* subsp*. angustifolia*. A consistent distribution across the northern census was produced by the two people independently recording plants.
- ***Hysterobaeckea ochropetala* subsp*. ochropetala* P1** cannot be confidently located outside of flowering given there are a number of similar co-occurring myrtaceous species. The 2020/2021 surveys were outside this period to date (it was photographed flowering by Aurumin personnel in October, but wasn't flowering in September or November 2021).

The following observations are made in relation to Priority 2 taxa:

- ***Goodenia jaurdiensis* P2** is a small annual herb that is not detectable year-round**.** Six similar flowering Goodenia plants were collected across the AOI in September 2021. The identification of these were determined by Sharnya Yates, with three specimens then forwarded to Mike Hislop at the WA Herbarium for confirmation. Mike Hislop confirmed the identifications by Sharnya Thomson of *Goodenia jaurdiensis* P2 and *Goodenia* mimuloides and provided advice on differentiating between these species in the field. Based on the specimens *Goodenia jaurdiensis* P2 was present in, and restricted to, damplands and *Goodenia mimuloides* which was also in damplands was additionally scattered and widespread in *Eucalyptus transcontinentalis/Eucalyptus salmonophloia* tall woodlands. *Goodenia jaurdiensis* P2 seedlings recorded by Western Botanical (2020) were recommended for recollection when flowering to confirm identification. These have not been relocated at the one site that was revisited, but based on habitat these were likely *Goodenia mimuloides.* The WA Herbarium has retained a *Goodenia jaurdiensis P2* specimen and a *Goodenia mimuloides* specimen for its collection as accession ACC/9129/E.

The following observations are made in relation to Priority 3 taxa:

- ***Austrostipa blackii* P3** is a perennial grass that is not readily detectable at all year round. A single *Austrostipa blackii* P3 plant was recorded on 20/10/2016 by Western Botanical (2020) in a single quadrat (WB21) but has yet to be observed at this site in revisits by Woodgis and although other Austrostipa species were flowering no similar plants were observed in 2020/2021.
- ***Notisia intonsa* P3** seedlings were relocated at previously recorded sites in May 2021. Three specimens were collected in September 2021. The identification of these were determined by Sharnya Yates, with one specimen then forwarded to Mike Hislop at the WA Herbarium for confirmation. The plants were distinctive but very small (see Photo 19 in Appendix 3) and there is a distinct possibility that not all occurrences had germinated and were detectable.
- ***Cryptandra crispula* P3** is an indistinct small shrub not readily detectable year-round.
- ***Neurachne annularis* P3** can be readily located and identified year-round.
- ***Philotheca coateana* P3** is a relatively indistinct shrub that was not targeted due to accidental omission. It was not listed in the DBCA database search and in *Flora and Vegetation of the Mount Dimer Tenements* (Western Botanical, 2020) it listed as a priority species in the flora inventory but was not listed as a priority species in the site description or discussed as priority flora and not included in the IBSA GIS package.

The following observations are made in relation to Priority 4 taxa:

- ***Eremophila caerulea subsp. merrallii* P4** is a small shrub that is identifiable year-round upon close inspection but is relatively indistinct from a distance when not flowering. It was flowering in September 2021 although it more typically flowers October to December.
- ***Eucalyptus formanii* P4** cannot always be definitively identified without obtaining fruits in several stages of development from trees. There are other Eucalyptus species in the area that are similar including *Eucalyptus oleosa* subsp*. oleosa*, which has been recorded in the AOI by Mattiske (2008). Elsewhere, there have been issues with identifications of *Eucalyptus formanii* P4 where it appears to have been mistaken for the common *Eucalyptus horistes* (Macarthur Minerals Limited, 2013).
- ***Grevillea erectiloba* P4** and *Grevillea zygoloba* were both flowering and therefore directly comparable at Mt Dimer in December 2020. The foliage characteristics are somewhat distinct in the field but field observations appear critical to differentiating between *Grevillea erectiloba* P4 and *Grevillea zygoloba* in the absence of flowering or fruiting material. Sterile specimens of *Grevillea zygoloba* collected in May 2021 were deemed as likely to be *Grevillea zygoloba*, but could not be definitely confirmed by Frank Obbens in the absence of flowers. Records of *Grevillea erectiloba* P4 by Niche Environmental Services (2013) were not included in population counts and figures (maps) as some plants recorded by Niche Environmental Services (2013) were inspected by Woodgis in May 2021 and were considered misidentifications of *Grevillea zygoloba*, which is consistent with Western Botanical (2020) observing that 'numbers and distribution of *Grevillea erectiloba* [P4] were grossly exaggerated in the Niche 2013 report due to misidentification and confusion with the more common, and very similar, *Grevillea zygoloba*'. Western Botanical (2020) recommended:
    - Assessments of *Grevillea erectiloba* P4 be implemented when this species is in flower, as it can be readily confused with the common *Grevillea zygoloba* when not in flower;
    - The numbers of *Grevillea erectiloba* P4 surveyed in 2016 be reassessed when the plants are in flower following good seasonal conditions, as identifications at the time were largely based on vegetative characteristics and the numbers may be further refined when plants are observed in flower. The 2016 census areas were not reassessed in 2020/2021, and comparing 2016 and 2020/2021 records is problematic but there was a high level of agreement in *Grevillea erectiloba* P4 distributions. Minor discrepancies in some records were observed, but there may have been some changes between 2016 and 2020/2021 given both *Grevillea* species have established in disturbed areas; and there is an inherent margin of error in these surveys.

2.5. Results

2.6. Vegetation

Vegetation types are shown in Figure 13 and described in Table 14 and Appendix 4. Disturbance was only mapped for areas of extensive clearing, and this excluded current and historic tracks and drill pads. Most of the vegetation was in Very Good to Excellent condition.

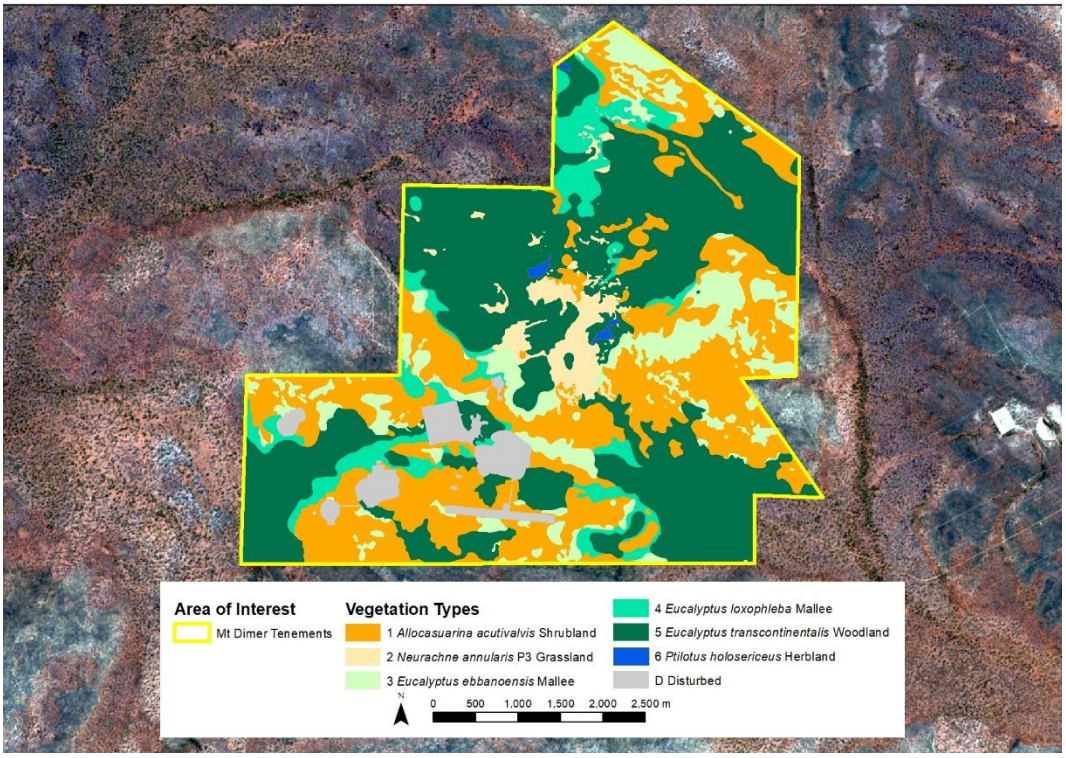

Figure 13: Vegetation Type Distributions

Table 14: Vegetation Type Descriptions

Vegetation Type	Description
1: *Allocasuarina acutivalvis* Tall Shrubland over *Amphipogon caricinus* scattered tussock grasses	*Acacia sibina, Allocasuarina acutivalvis* subsp. *acutivalvis* Tall Shrubland over *Baeckea elderiana, Hibbertia eatoniae, Leucopogon* sp. Clyde Hill, *Phebalium canaliculatum* Shrubland over scattered *Amphipogon caricinus* grasses on clay loams and clay sands
2: Mixed Very Open Tree Mallee / Tall Open Shrubland over *Neurachne annularis* P3 Tussock Grassland	*Eucalyptus loxophleba* subsp. *lissophloia, Eucalyptus formanii* P4 Very Open Tree Mallee / *Acacia acuminata, Acacia sibina, Allocasuarina acutivalvis subsp. acutivalvis, Casuarina pauper, Melaleuca hamata* Tall Open Shrubland over *Neurachne annularis* P3 Tussock Grassland over *Cheilanthes adiantoides* scattered herbs on loam clays
3: *Eucalyptus ebbanoensis* Very Open Tree Mallee over *Triodia scariosa/tomentosa* Open Hummock Grassland	*Eucalyptus ebbanoensis subsp. ebbanoensis* Very Open Tree Mallee over *Eremophila caperata, Olearia exiguifolia, Phebalium tuberculosum, Westringia cephalantha var. cephalantha* Shrubland over *Triodia scariosa/tomentosa* Open Hummock Grassland on clay loams
4: *Eucalyptus loxophleba* Very Open Tree Mallee over *Austrostipa elegantissima* scattered tussock grasses	*Eucalyptus loxophleba* subsp. *lissophloia* Very Open Tree Mallee over *Acacia acuminata* Tall Shrubland over *Eremophila decipiens* subsp. *decipiens, Eremophila granitica, Olearia pimeleoides, Prostanthera grylloana* Shrubland over *Austrostipa elegantissima* scattered tussock grasses on sand clays
5: *Eucalyptus transcontinentalis* Woodland over *Austrostipa elegantissima* scattered tussock grasses	*Eucalyptus transcontinentalis, Eucalyptus salmonophloia, Eucalyptus vittata, Eucalyptus ravida* Woodland over *Santalum acuminatum* scattered trees and *Eremophila scoparia, Exocarpos aphyllus* scattered shrubs over *Templetonia ceracea* scattered low shrubs *Maireana georgei* scattered herbs with *Austrostipa elegantissima* scattered tussock grasses on sand clays and clays
6: *Ptilotus holosericeus* Very Open Herbland	*Ptilotus holosericeus* Very Open Herbland with *Eragrostis dielsii* scattered tussock grasses on clays

The vegetation types are further characterised in terms of:

- their extents and relationship to landforms on geology in Table 15;
- their constituent variants (subtypes) in Table 16; and
- their floristic diversity at the scale of 400 m^2 quadrats in Table 17.

Table 15: Vegetation, Landforms and Geology Relationships in Area of Interest

Vegetation Type	Extent	Portion of AOI	Typical Landforms	Typical Surface Geology
1: *Allocasuarina acutivalvis* Tall Shrubland over *Amphipogon caricinus* scattered tussock grasses	844.8 ha	30.5%	Gently Inclined Plains and Rises	Sandplain
2: Mixed Very Open Tree Mallee / Tall Open Shrubland over *Neurachne annularis* P3 Tussock Grassland	100.9 ha	3.6%	Gently Inclined Plains	Sheetwash
3: *Eucalyptus ebbanoensis* Very Open Tree Mallee over Triodia scariosa/tomentosa Open Hummock Grassland	314.1 ha	11.3%	Gently Inclined Plains and Rises	Sandplain
4: *Eucalyptus loxophleba* Very Open Tree Mallee over *Austrostipa elegantissima* scattered tussock grasses	210.8 ha	7.6%	Gently Inclined Plains and Rises	Alluvial, Sheetwash, Colluvial, Residual
5: *Eucalyptus transcontinentalis* Woodland over *Austrostipa elegantissima* scattered tussock grasses	1,193.9 ha	43.0%	Gently Inclined Plains	Alluvial, Sheetwash, Colluvial, Residual
6: *Ptilotus holosericeus* Very Open Herbland	7.4 ha	0.3%	Gently Inclined Plains	Sheetwash
Disturbed	101.4 ha	3.7%	-	-
Total	**2,773.4 ha**	100.0%		

Table 16: Variants within Vegetation Types

Vegetation Type	Variant	Description
1: *Allocasuarina acutivalvis* Tall Shrubland over *Amphipogon caricinus* scattered tussock grasses	1A *Acacia sibina-Baeckea elderiana* 1B *Melaleuca leiocarpa* 1C *Eucalyptus formanii* P4 - *Phebalium canaliculatum*	Page 83
2: Mixed Very Open Tree Mallee / Tall Open Shrubland over *Neurachne annularis* P3 Tussock Grassland	2A *Eucalyptus loxophleba - Eucalyptus formanii P4* 2B *Acacia acuminata - Allocasuarina acutivalvis* 2C *Casuarina pauper - Melaleuca hamata*	Page 85
3: *Eucalyptus ebbanoensis* Very Open Tree Mallee over Triodia scariosa/tomentosa Open Hummock Grassland	3A *Eucalyptus formanii* P4 - *Olearia exiguifolia* 3B *Eucalyptus ebbanoensis - Phebalium filifolium*	Page 87
4: *Eucalyptus loxophleba* Very Open Tree Mallee over *Austrostipa elegantissima* scattered tussock grasses	4A *Eremophila granitica* 4B *Acacia tetragonophylla - Allocasuarina acutivalvis*	Page 88
5: *Eucalyptus transcontinentalis* Woodland over *Austrostipa elegantissima* scattered tussock grasses	5A *Eucalyptus ravida* 5B *Eucalyptus salmonophloia* 5C *Eucalyptus vittata*	Page 90
6: Ptilotus herblands	-	Page 92

Table 17: Flora Diversity in Quadrats by Vegetation Types and Variants

Vegetation Type	Annual Species per Quadrat	Perennial Species per Quadrat	Variant	Annual Species per Quadrat	Perennial Species per Quadrat
1: *Allocasuarina acutivalvis* Tall Shrubland over *Amphipogon caricinus* scattered tussock grasses	0.9	18.9	A B C	0.9 0.8 1.0	14.8 24.9 12.5
2: Mixed Very Open Tree Mallee / Tall Open Shrubland over *Neurachne annularis* P3 Tussock Grassland	1.3	5.7	A B C	0.7 3.0 0.0	5.0 6.0 7.0
3: *Eucalyptus ebbanoensis* Very Open Tree Mallee over Triodia scariosa/tomentosa Open Hummock Grassland	1.3	13.6	A B	1.7 0.8	11.3 16.3
4: *Eucalyptus loxophleba* Very Open Tree Mallee over *Austrostipa elegantissima* scattered tussock grasses	2.9	22.0	A B	3.6 2.2	24.0 20.0
5: *Eucalyptus transcontinentalis* Woodland over *Austrostipa elegantissima* scattered tussock grasses	2.5	16.7	A B C	3.3 2.3 2.0	14.6 20.1 12.9
6: *Ptilotus holosericeus* Very Open Herbland	7.0	2.6	-	7.0	2.6
All Vegetation Types	2.0	16.1	-	2.0	16.1

2.7. Flora

The 281 plant taxa recorded in the AOI are listed in Table 38 in Appendix 5.

Weeds were not mapped but those recorded onsite to date were:

- *Brassica aff. juncea* (Indian Mustard);
- *Carrichtera annua* (Wards Weed);
- *Cynodon dactylon* (Couch);
- *Erodium cicutarium* (Storksbill);
- *Rumex vesicarius* (Ruby Dock), shown in Photo 1;
- *Sonchus oleraceus* (Common Sowthistle);

Photo 1: *Rumex vesicarius* (Ruby Dock) Weeds on Bund

Table 18 and Table 19 list the vegetation types and variants that priority flora taxa were recorded in, noting that there were no quadrats placed in disturbed areas which cover 101.4 ha (3.7%) of the AOI.

Table 18: Frequency of Priority Flora in Quadrats by Vegetation Types

Taxa	Vegetation Type	1	2	3	4	5	6
	Extent in AOI	844.8 ha 30.5%	100.9 ha 3.6%	314.1 ha 11.3%	210.8 ha 7.6%	1,193.9 ha 43.0%	7.4 ha 0.3%
Acacia sp. Southern Cross P1	Page 36					3%	
Eremophila hamulata P1	Page 37					15%	
Hysterobaeckea ochropetala ssp. *ochropetala* P1	Page 38	*					
Goodenia jaurdiensis P2	Page 39						40%
Austrostipa blackii P3	Page 40				10%		
Cryptandra crispula P3	Page 41			*			
Neurachne annularis P3	Page 42	3%	100%	23%	10%		
Notisia intonsa P3	Page 44				10%	*	80%
Philotheca coateana P3	Page 45			8%			
Eremophila caerulea subsp. merrallii P4	Page 46					*	
Eucalyptus formanii P4	Page 47	45%	33%	38%			
Grevillea erectiloba P4	Page 49	23%					

* *Hysterobaeckea ochropetala* ssp. *ochropetala* P1 not recorded in any quadrats - only recorded opportunistically
Notisia intonsa P3 not recorded in quadrats in vegetation type 5 but recorded opportunistically
Philotheca coateana P3 not recorded in any quadrats - recorded in single relevé
Eremophila caerulea subsp. *merrallii* P4 not recorded in any quadrats - only recorded opportunistically

Table 19: Frequency of Priority Flora in Quadrats by Vegetation Variants

Vegetation Variant Taxa	1A	1B	1C	2A	2B	2C	3A	3B	4A	4B	5A	5B	5C	6
Acacia sp. Southern Cross P1											11%			
Eremophila hamulata P1											56%			
Hysterobaeckea ochropetala ssp. *ochropetala* P1	*													
Goodenia jaurdiensis P2														40%
Austrostipa blackii P3									20%					
Cryptandra crispula P3							*							
Neurachne annularis P3	6%			100%	100%	100%		50%		20%				
Notisia intonsa P3									20%		*			80%
Philotheca coateana P3							14%							
Eremophila caerulea subsp. merrallii P4											*			
Eucalyptus formanii P4	19%		85%	67%			71%							
Grevillea erectiloba P4	13%		38%											

* *Hysterobaeckea ochropetala* ssp. *ochropetala* P1 not recorded in any quadrats - only recorded opportunistically
Notisia intonsa P3 not recorded in quadrats in vegetation type 5 but recorded opportunistically
Philotheca coateana P3 not recorded in any quadrats - recorded in single relevé
Eremophila caerulea subsp. *merrallii* P4 not recorded in any quadrats - only recorded opportunistically

Acacia sp. Southern Cross P1 records in the AOI are shown in Figure 14.

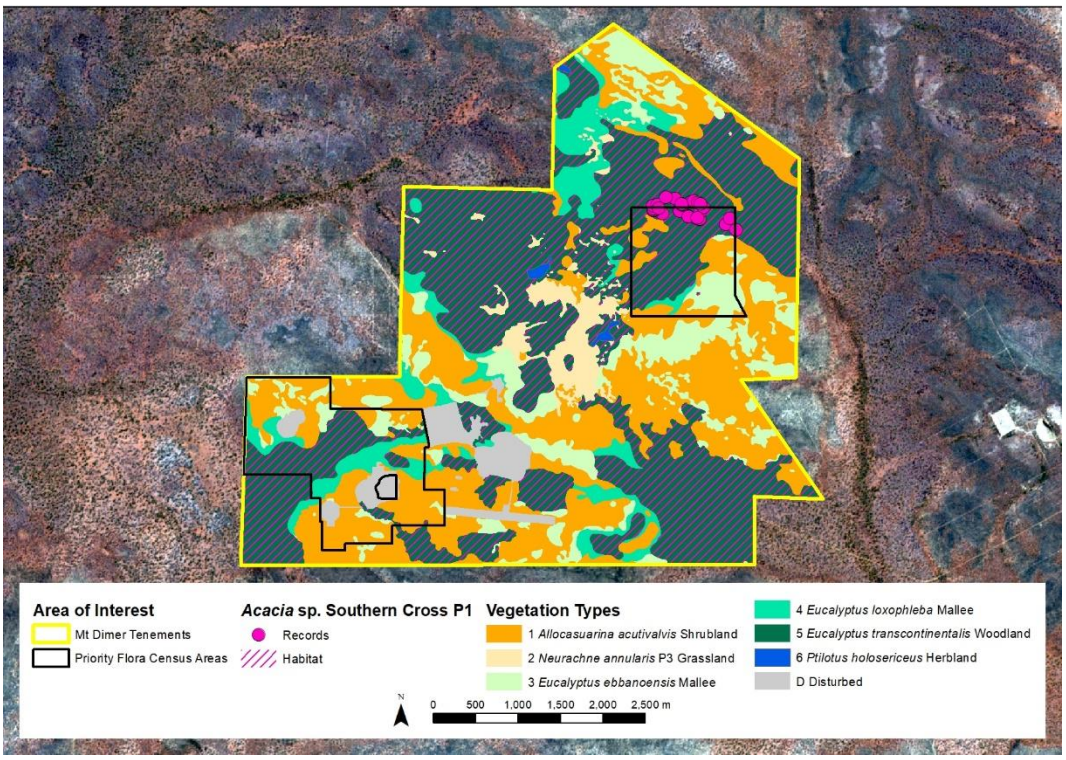

Figure 14: *Acacia sp. Southern Cross* P1 in AOI

Acacia sp. Southern Cross P1 densities or occurrences cannot be extrapolated over larger areas given only one population has been located. Quadrat data indicates this species only occurs in vegetation variant 5A, but plants were also recorded in variant 5B. Despite only being observed at one location, the habitat (5: *Eucalyptus transcontinentalis* Woodland over *Austrostipa elegantissima* scattered tussock grasses) covers 1,193.9 ha (43.0%) of the AOI. *Acacia sp. Southern Cross* P1 appears to be associated with colluvial soils (surface geology unit "C' of mixed gravel and debris as proximal talus; includes sand and silt; locally ferruginous). A surface geology combination in the northern but not the southern census area.

Eremophila hamulata P1 records in the AOI are shown in Figure 15.

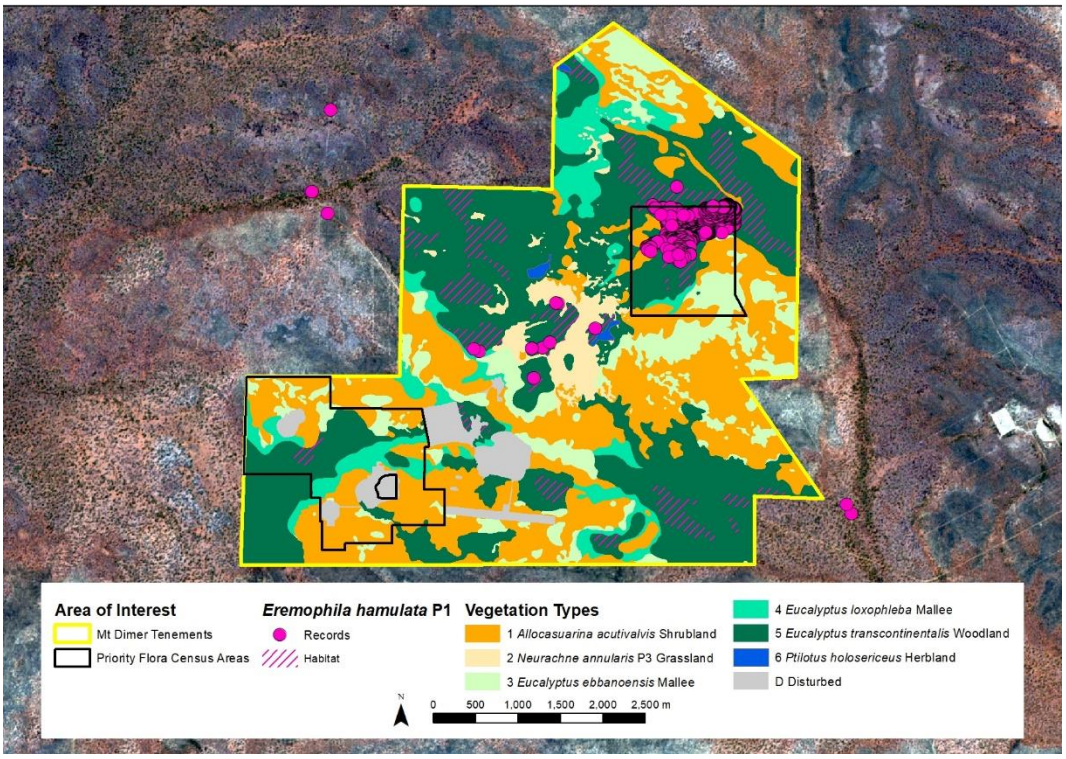

Figure 15: *Eremophila hamulata* P1 in AOI

Eremophila hamulata P1 is relatively abundant in, and indicative of, vegetation type variant 5A (*Eucalyptus ravida* woodlands) in the AOI, and therefore can be extrapolated over larger areas. *Eucalyptus ravida* trees are scattered through vegetation 5 (*Eucalyptus transcontinentalis* woodlands) and Western Botanical (2020) noted that it was difficult to exclude other species from adjacent communities in 20 m wide quadrats when sampling relatively pure-stand clumps *Eucalyptus ravida* on cracking clay in the AOI. However, given *Eremophila hamulata* is a P1 species and vegetation type 5 is extensive, larger areas of *Eucalyptus ravida* were mapped in the AOI. Table 20 provides population estimates based on average densities from vegetation variant 5A in the 458.5 ha of Census Areas. If mapping is expanded, then extrapolations could be updated on the basis of quadrats density but the current small dataset of 5 quadrats in which *Eremophila hamulata* P1 was present did not yield a robust estimate due to variation in quadrat densities. An estimate of 3,155 plants (based on an average quadrat density of 21.8 plants/ha and population extent of 114.7 ha) was less than the 3,214 plants directly counted in the Census Areas.

Table 20: Extrapolation of *Eremophila hamulata* P1 Abundance and Extent across AOI

A Extent of Vegetation Variant 5A	B Frequency Occurrence in 5A Quadrats	C Density in 5A Polygons in Census Areas	D Estimated Extent of Populations (A x B)	D Estimated Abundance of Populations (C x D)
260.51 ha	56%	61.4 plants/ha (2,528 plants in 41.2 ha)	144.72 ha	8,880 plants

Eremophila hamulata P1 appears to be associated with alluvial soils (surface geology unit 'A' of clay, silt, sand, and gravel in channels and floodplains) in contact with colluvial soils (surface geology unit 'C'). A surface geology combination present in the northern but not southern census area.

Hysterobaeckea ochropetala subsp. *ochropetala* P1 records in the AOI are shown in Figure 16.

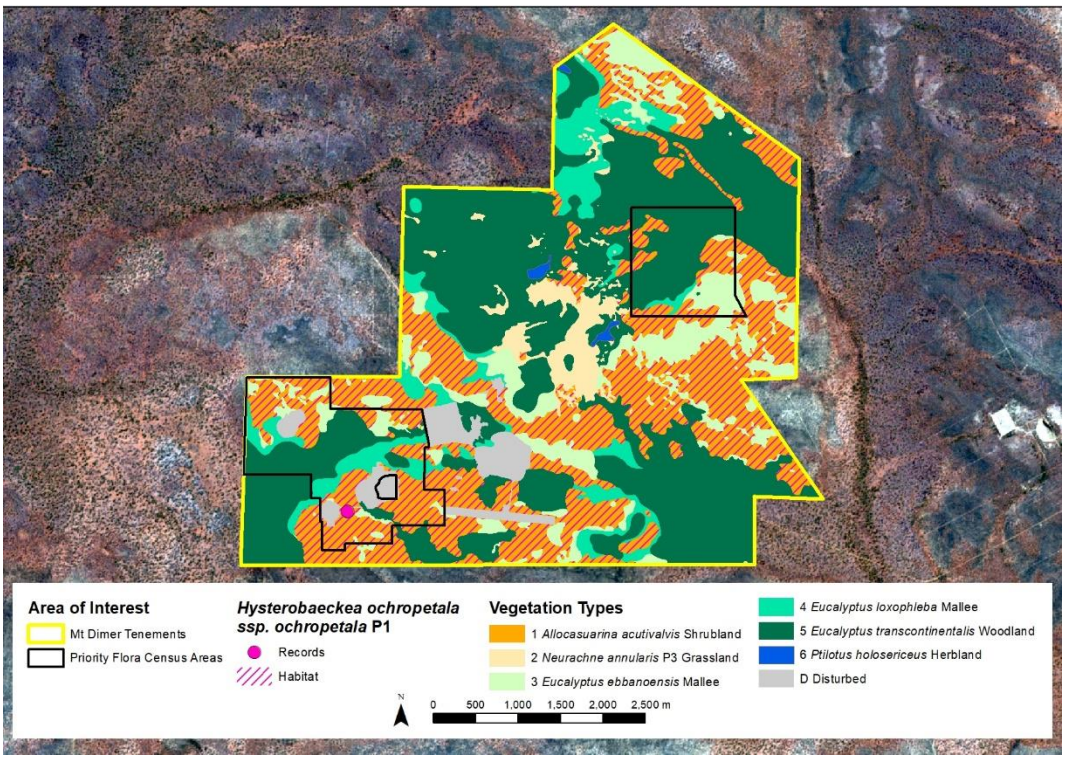

Figure 16: *Hysterobaeckea ochropetala* subsp. *ochropetala* P1 in AOI

Hysterobaeckea ochropetala subsp. *ochropetala* P1 densities or occurrences cannot be extrapolated over larger areas given a single plant has been located. There are insufficient observations onsite to determine whether this taxon is restricted to vegetation variant 1C (shrublands on sands on flats) or additionally present on variant 1A (shrublands on gravelly rises). *Hysterobaeckea ochropetala* subsp. *ochropetala* P1 occurs in yellow sand or other sandy habitats, some records being of sand over laterite (Rye, 2018).

Hysterobaeckea ochropetala subsp. *ochropetala* P1 cannot be confidently located outside of flowering given small leaves need to be examined to differentiate between a number of similar co-occurring myrtaceous species. The 2020/2021 surveys were outside this period to date (the one confirmed plant was photographed flowering by Aurumin personnel in October, but wasn't flowering in September or November 2021). The previous surveys by Western Botanical (2020), which detected this plant on 18/10/2016 in a single quadrat (WB11), included searches that were 'thorough and exhaustive'.

Goodenia jaurdiensis P2 records in the AOI are shown in Figure 17.

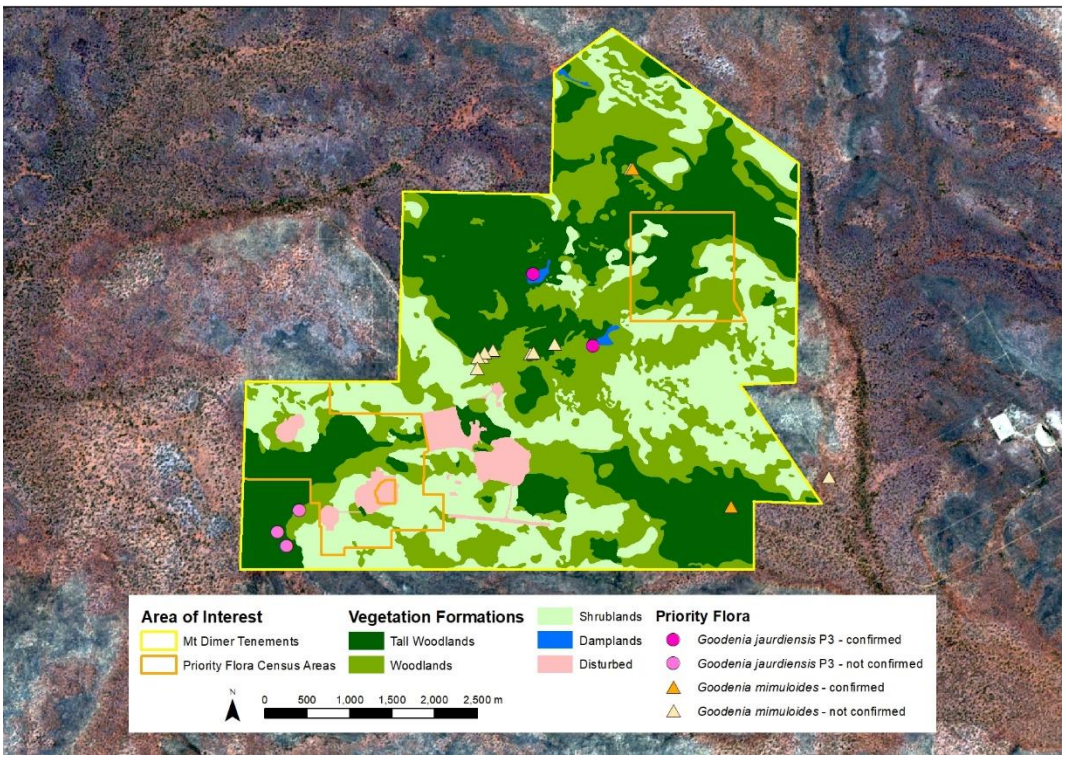

Figure 17: *Goodenia jaurdiensis* P3 in AOI

Impact assessment and management for *Goodenia jaurdiensis* P2 should be based on the extent of habitat rather than numbers individual plants:

- As discussed in Section 2.4, it appears that *Goodenia jaurdiensis* P2 is restricted to damplands;
- *Goodenia jaurdiensis* P2 cannot be reliably/consistently observed due to it being a short lived annual:
  - it became detectable at different times of spring across the AOI
  - it was counted in quadrat WG022 in November, and previously when the site was visited in September was detectable but was not detectable in August 2021;
- Damplands were mapped as *Ptilotus holosericeus* Very Open Herbland covering approximately 7.4 hectares of the AOI, and an additional 16 hectares across Aurumin tenements contiguous with the AOI; and
- *Goodenia jaurdiensis* P2 was recorded in November 2021 at densities of 7,725 plants/ha and 2,100 plants/ha in dampland quadrats WG022, and WG004 respectively.

Austrostipa blackii P3 records in the AOI are shown in Figure 18.

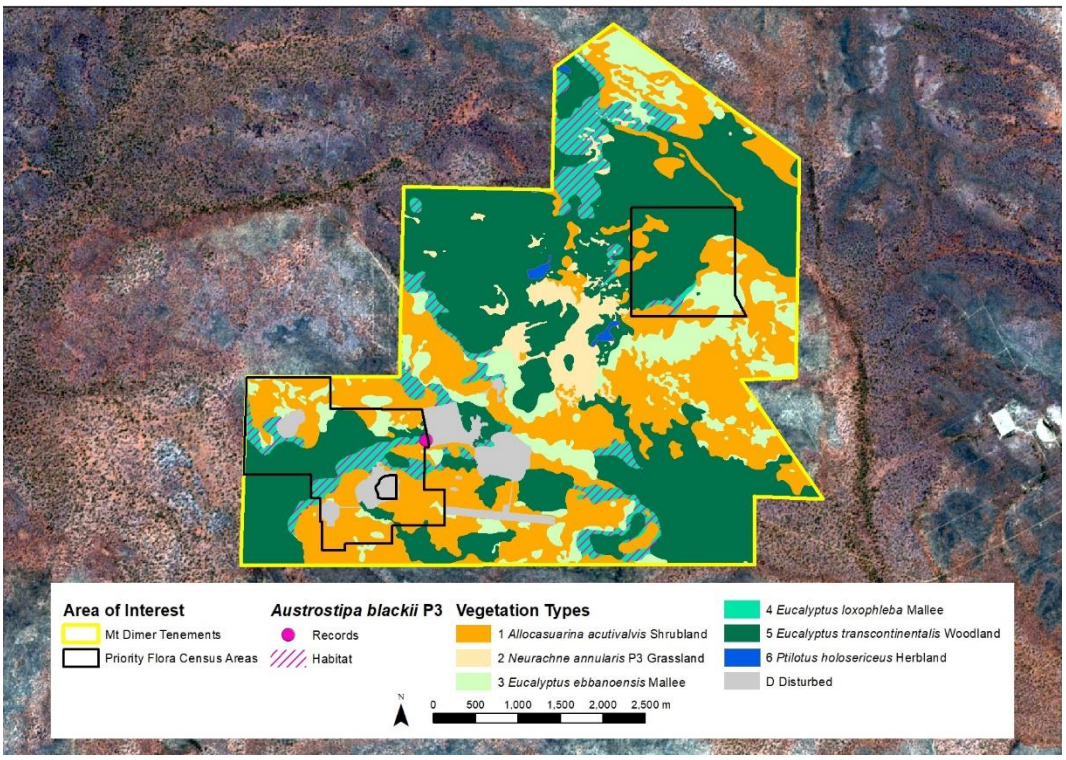

Figure 18: *Austrostipa blackii* P3 in AOI

Austrostipa blackii P3 densities or occurrences cannot be extrapolated over larger areas given a single plant has been located.

A single *Austrostipa blackii* P3 plant was recorded on 20/10/2016 by Western Botanical (2020) in a single quadrat (WB21) but has yet to be observed at this site in revisits by Woodgis and although other Austrostipa species were flowering no similar plants were observed in 2020/2021. Quadrat WB21 supports *Eucalyptus loxophleba* Open Woodland over *Acacia acuminata* Thicket over *Prostanthera grylloana* Low Open Shrubland. Its habitat (4: *Eucalyptus loxophleba* Very Open Tree Mallee over *Austrostipa elegantissima* scattered tussock grasses) covers 210.8 ha (7.6%) of the AOI.

Cryptandra crispula P3 records in the AOI are shown in Figure 18.

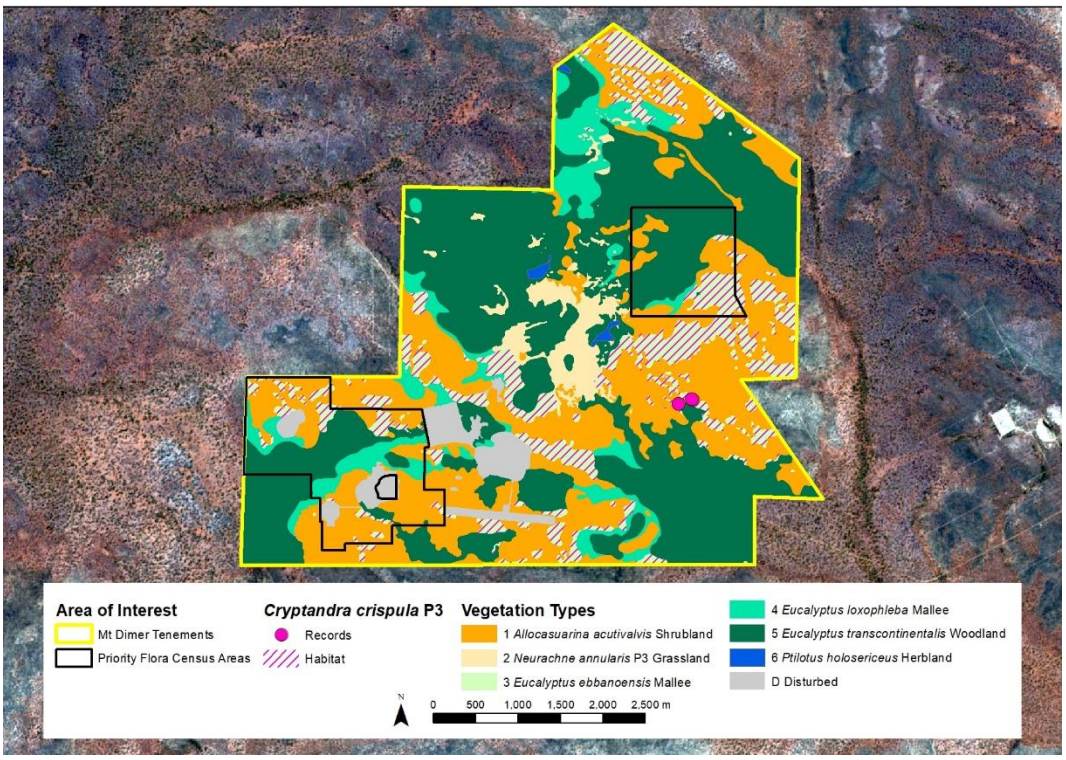

Figure 19: *Cryptandra crispula* P3 in AOI

Cryptandra crispula P3 densities or occurrences cannot be extrapolated over larger areas given only one population has been located.

The four *Cryptandra crispula* P3 plants recorded in the AOI by Western Botanical (2020) represented a 50 km range extension for the taxa. This is a small indistinct small shrub that is not readily detectable year-round. More than four plants were observed flowering when the population was revisited in November 2021 but there was insufficient time to conduct a comprehensive population census.

Cryptandra crispula P3 was recorded in *Eucalyptus formanii* P4 mallee.

This habitat (vegetation type 3: *Eucalyptus ebbanoensis* Very Open Tree Mallee over *Triodia scariosa/tomentosa* Open Hummock Grassland) covers 314 ha (11%) of the AOI.

Neurachne annularis P3 records in the AOI records are shown in Figure 20.

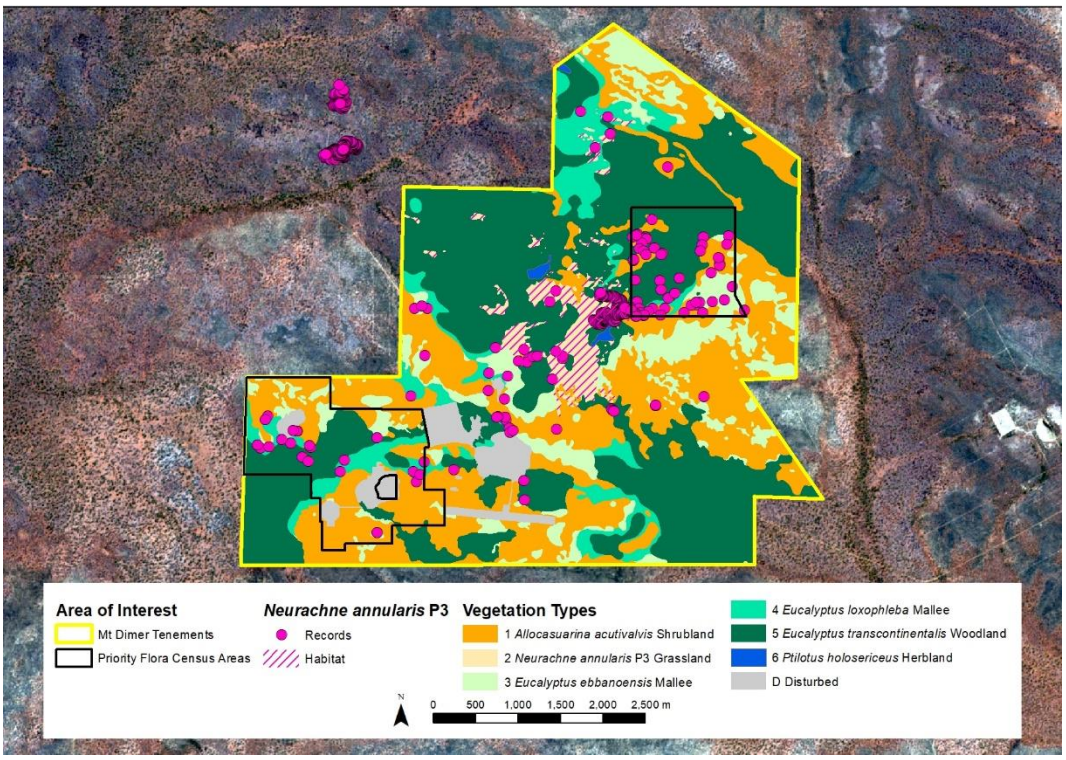

Figure 20: *Neurachne annularis* P3 in AOI

Neurachne annularis P3 impact assessments should be based on extents rather than numbers of individual plants:

- Counts of individual *Neurachne annularis* P3 plants are not useful in impact assessment (Western Botanical, 2020);
- The grass is widespread and dominates understorey both in the vicinity and at the Helena and Aurora Range and the population intersecting the AOI would be in the tens of thousands of clumps of plants (Western Botanical, 2020);
- More than one million plants were documented in assessment of *Jackson 5 and Bungalbin East Iron Ore Project* (EPA, 2017)*;*
- *Neurachne annularis* P3 was recorded in 37.1% of the 281 quadrats in the J4 Mine and Haul Road Vegetation Assessment (extending from 20 km south-east to 40 km west-north-west of the AOI) with the grass dominant on hillslopes and footslopes and less common on the plains (Ecologica Environment, 2013);
- It is difficult to determine whether clumps of this abundant ringing-forming clonal species consist of one or more individual plants (Photo 17 on page 78),
- Larger occurrences can be mapped directly from aerial imagery, and occurrences less than 100 m^2 can be recorded as points of 50 m^2; and
- This habitat (vegetation type 2: Mixed Very Open Tree Mallee / Tall Open Shrubland over *Neurachne annularis* P3 Tussock Grassland) covers 110.9 ha (3.6%) of the AOI.

Whilst Western Botanical (2020) noted that *Neurachne annularis* P3 does not come back readily following track clearing, Mattiske (2013) observed in the Bungalbin East area, it frequently grew on the disturbed ground of existing tracks and drill pads, and that it potentially grows well on disturbed ground. These observations may point to survival/re-establishment being influenced by the type and degree of disturbance and soil conditions. In the AOI plants appear to survive being infrequently driven over (Photo 2).

Photo 2: *Neurachne annularis* P3 plants in wheel ruts on historic track

Notisia intonsa P3 records in the AOI are shown in Figure 21.

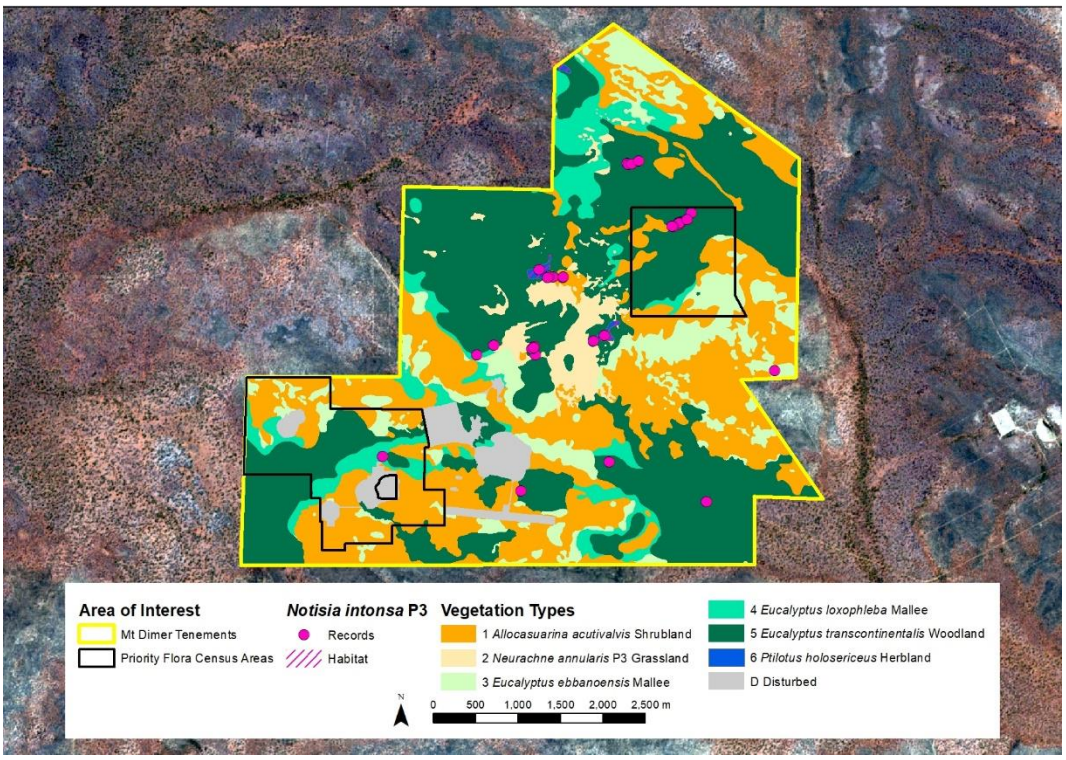

Figure 21: *Notisia intonsa* P3 in AOI

Notisia intonsa P3 is a short lived annual of clayey depressions subject to waterlogging. It appears very abundant in damplands and in scattered patches throughout *Eucalyptus transcontinentalis* woodlands (especially at sites of impeded drainage including on tracks) in the AOI.

Impact assessment and management for *Notisia intonsa* P3 should be based on the extent of habitat rather numbers of individual plants:

- *Notisia intonsa* P3 cannot be reliably/consistently observed due to it being a short lived annual:
  - it became detectable at different times of spring across the AOI
  - it was counted in quadrat WG022 on August and when the site was revisited was detectable on September but not detectable in November 2021
- Impacts from clearing, would not likely be significant outside of the damplands where the majority of plants were observed;
- Damplands were mapped as *Ptilotus holosericeus* Very Open Herbland covering approximately 7.4 hectares of the AOI, and an additional 16 hectares across Aurumin tenements contiguous with the AOI;
- *Notisia intonsa* P3 was recorded at densities of 2,300 plants/ha, 1,450 plants/ha and 200 plants/ha in dampland quadrats WG022, WG001, WG003.

Philotheca coateana P3 records in the AOI are shown in Figure 22.

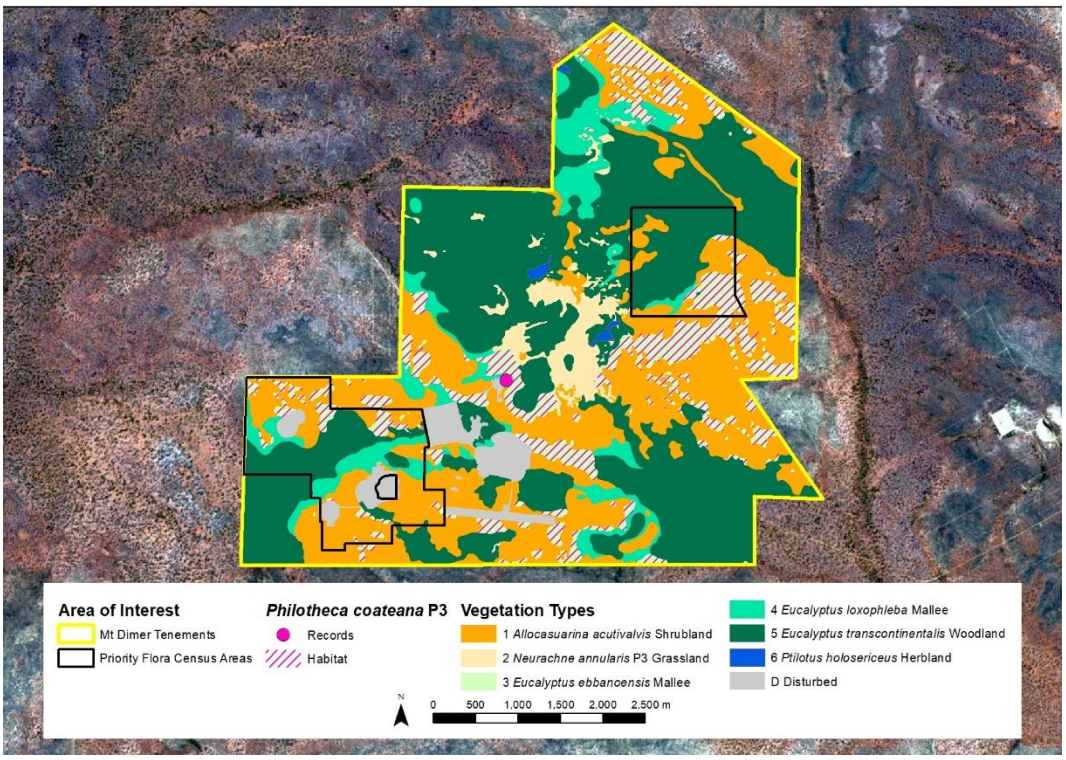

Figure 22: *Philotheca coateana* P3 in AOI

Philotheca coateana P3 densities or occurrences cannot be extrapolated over larger areas given a single plant has been located

Philotheca coateana P3, a shrub of red sands was recorded at less than 1% cover in a single site, relevé WBR13, where the vegetation was described as *Eucalyptus ebbanoensis* and *Eucalyptus corrugata* woodland over *Allocasuarina acutivalvis* scattered shrubs over *Triodia scariosa/tomentosa* open hummock grassland.

Its habitat (vegetation type 3: *Eucalyptus ebbanoensis* Very Open Tree Mallee over *Triodia scariosa/tomentosa* Open Hummock Grassland) covers 314 ha (11%) of the AOI.

Eremophila caerulea subsp*. merrallii* P4 records in the AOI are shown in Figure 23.

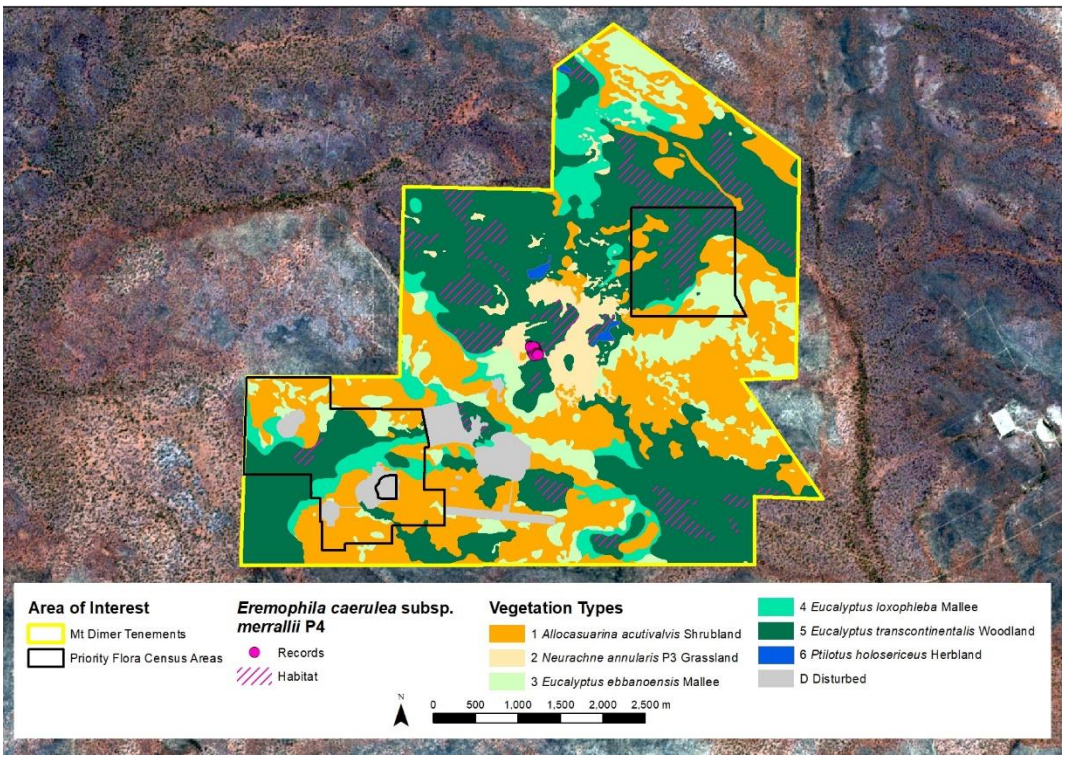

Figure 23: *Eremophila caerulea subsp. merrallii* P4 in AOI

Eremophila caerulea subsp*. merrallii* P4 densities or occurrences cannot be extrapolated over larger areas given only one population has been located.

Eremophila caerulea subsp*. merrallii* P4 was comprehensively counted where it was located over approximately 100 m x 120 m at one site within *Eucalyptus ravida* tall woodland.

Its habitat (vegetation variant 5A: *Eucalyptus ravida* woodlands) covers 260.5 ha (9.4%) of the AOI.

Eucalyptus formanii P4 records in the AOI are shown in Figure 24.

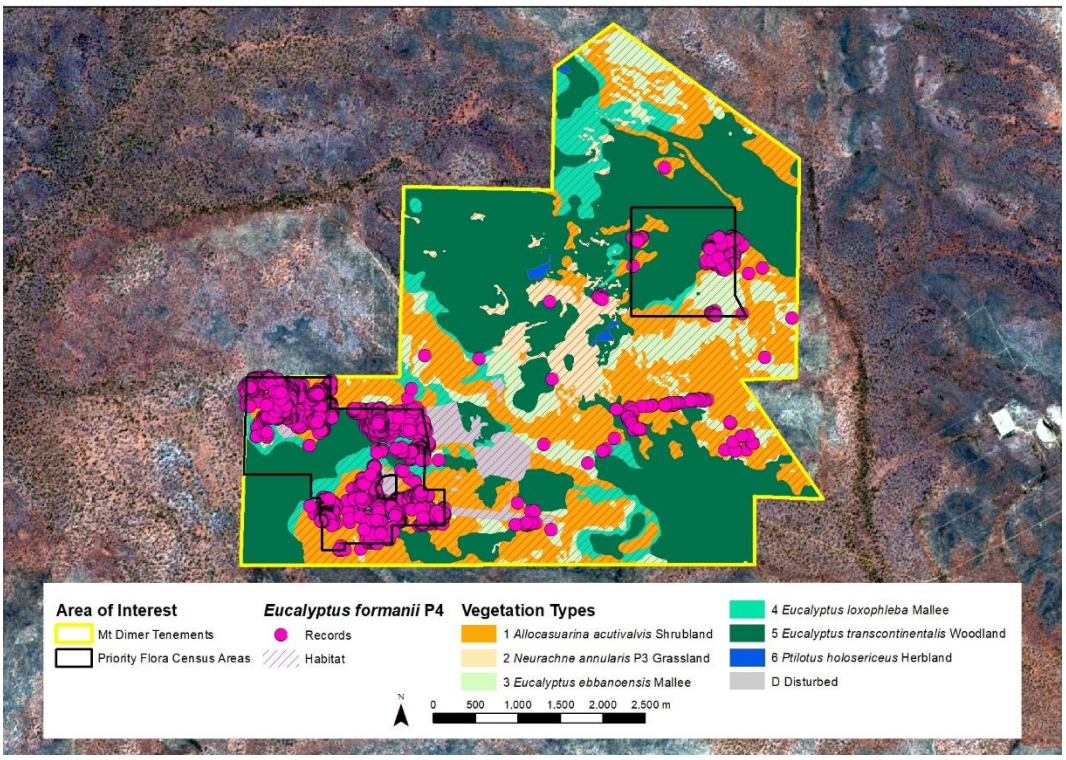

Figure 24: *Eucalyptus formanii* P4 in AOI

Eucalyptus formanii P4 is relatively abundant in, and indicative of, vegetation types 1, 2, 3 and 4 and disturbed areas in the AOI, and therefore can be extrapolated over larger areas. Table 21 provides population estimates based on average densities from the 458.5 ha of Census Areas, except for vegetation types 2 and 6 which were based on quadrat data as they did not occur in these areas. If mapping is expanded, then extrapolations could be updated on the basis of quadrat densities but the census data is considered more robust than the quadrat data available at present. *Eucalyptus formanii* P4 is not indicative of vegetation type 5 and the calculated 0.5 plants/ha will reflect interzones and/or imprecision in vegetation boundaries.

Table 21: Extrapolation of *Eucalyptus formanii* P4 Abundance and Extent across AOI

Vegetation Type	A Extent of Vegetation Type in AOI	B Frequency Occurrence in Quadrats in AOI	C Density in Vegetation Polygons in Census Areas	D Estimated Extent of Populations in AOI (A x B)	D Estimated Abundance of Populations in AOI (A x C)
1	844.8 ha	45%	8.6 plants/ha	380.2 ha	7,265 plants
2	100.9 ha	33%	16.7 plants/ha[1]	33.3 ha	1,685 plants
3	314.1 ha	33%	22.6 plants/ha	103.7 ha	7,099 plants
4	210.8 ha	38%	1.4 plants/ha	80.1 ha	295 plants
5	1,193.9 ha	0%	0.5 plants/ha	0.0 ha	597 plants
6	7.4 ha	0%	0 plants/ha[2]	0 ha	-
D	101.4 ha	NA	13.8 plants/ha	NA	1,399 plants
Total	2,773 ha	-	-	597.214 ha	18,340 plants

1 Density based on total of 4 plants in 6 quadrats in AOI as vegetation type not in Census Areas
2 Density based on total of 0 plants in 5 quadrats in AOI as vegetation type not in Census Areas

Eucalyptus formanii P4 is likely to be widespread across the 1,915-hectare shrubland on sandplains shown in Figure 25.

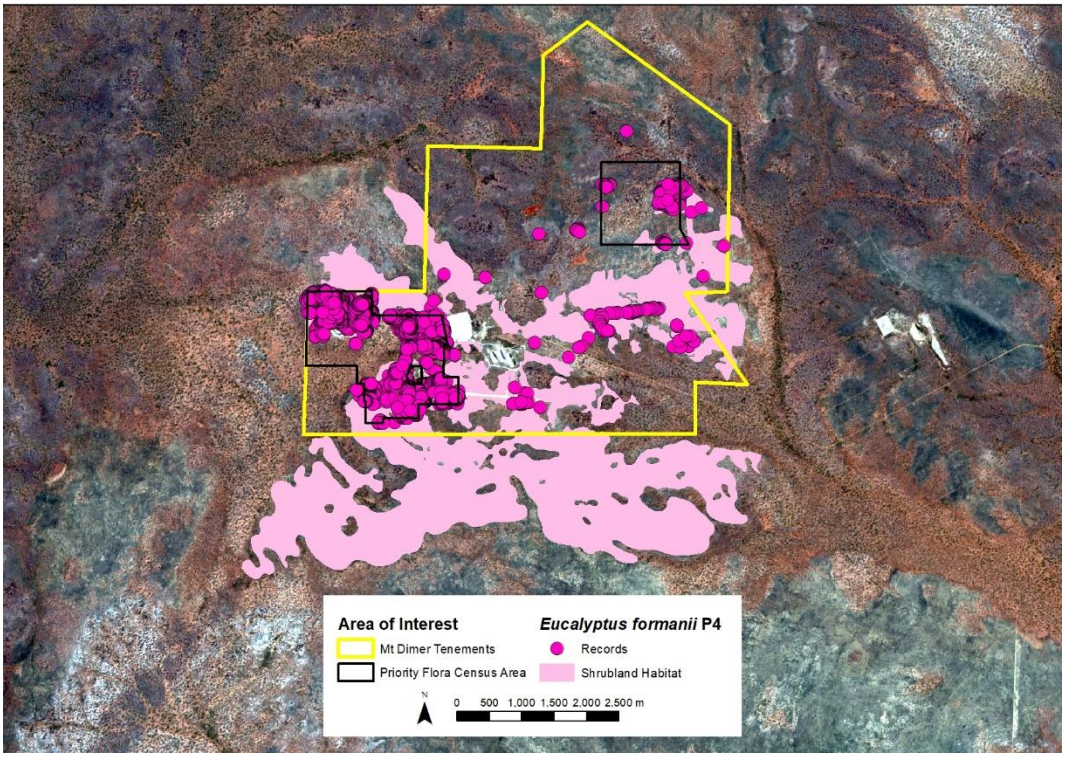

Figure 25: *Eucalyptus formanii* P4 records across sandplains intersecting AOI

Eucalyptus formanii P4 was observed by Woodgis (2021a) having established in disturbed areas, as demonstrated by it growing on a bund in Photo 3.

Photo 3: *Eucalyptus formanii* P4 on Bund

Grevillea erectiloba P4 records in the AOI are shown in Figure 26.

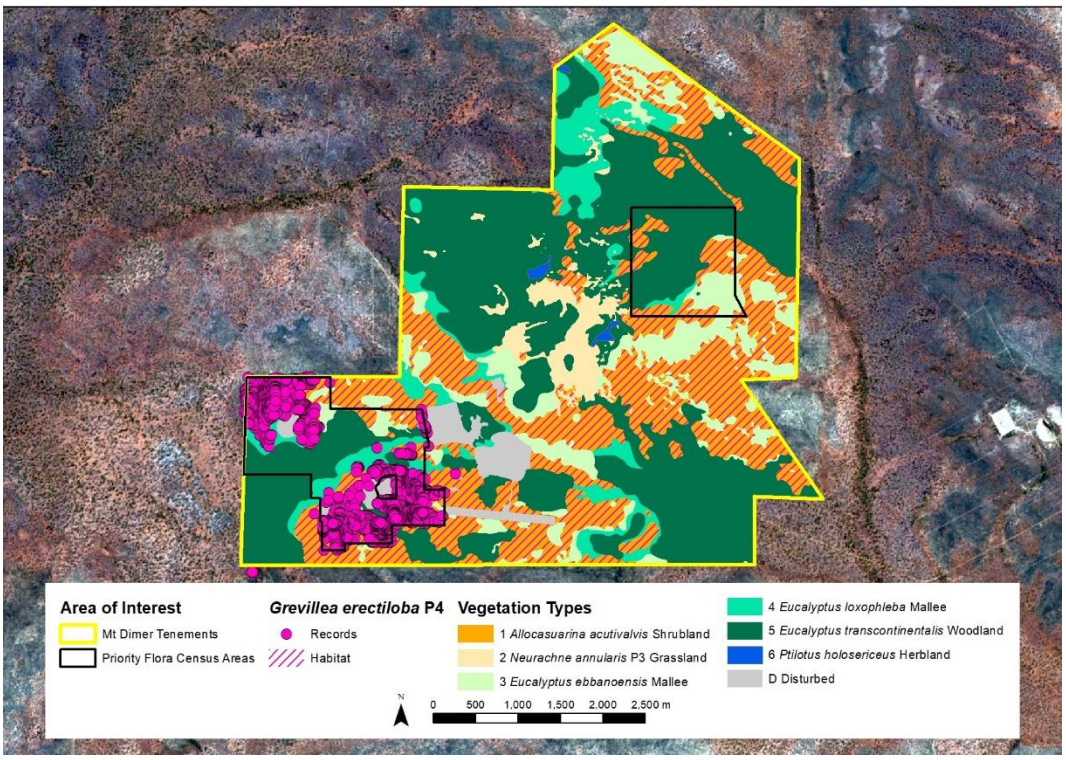

Figure 26: *Grevillea erectiloba* P4 in AOI

Grevillea erectiloba P4 is relatively abundant in, and indicative of, vegetation type 1 and disturbed areas in the AOI, and therefore can be extrapolated over larger areas. Table 22provides population estimates based on average densities from the 458.5 ha of Census Areas, except for vegetation types 2 and 6 which were based on quadrat data as they did not occur in these areas. If mapping is expanded, then extrapolations could be updated on the basis of quadrat densities but the census data is considered more robust than the quadrat data available at present. *Grevillea erectiloba* P4 is not indicative of vegetation type 3, 4 or 5 and the low densities in these vegetation types will reflect interzones and/or imprecision in vegetation boundaries.

Table 22: Extrapolation of *Grevillea erectiloba* P4 Abundance and Extent across AOI

Vegetation Type	A Extent of Vegetation Type in AOI	B Frequency Occurrence in Quadrats in AOI	C Density in Vegetation Polygons in Census Areas	D Estimated Extent of Populations in AOI (A x B)	D Estimated Abundance of Populations in AOI (A x C)
1	844.8 ha	23%	17.9	194.3 ha	15,122 plants
2	100.9 ha	0%	0 plants/ha[1]	0 ha	-
3	314.1 ha	0%	1.7	0 ha	534 plants
4	210.8 ha	0%	1.8	0 ha	379 plants
5	1,193.9 ha	0%	0.2	0 ha	239 plants
6	7.4 ha	0%	0 plants/ha[2]	0 ha	-
D	101.4 ha	NA	14.3	0 ha	1,450 plants
Total	2,773 ha	-	-	194.3 ha	17,724 plants

1 Density based on total of 0 plants in 6 quadrats in AOI as vegetation type not in Census Areas
2 Density based on total of 0 plants in 5 quadrats in AOI as vegetation type not in Census Areas

Grevillea erectiloba P4 appears to be more abundant in vegetation type variant 1C (shrublands on low sandplains) in the southwest of the AOI than 1A (shrublands on gravelly rises) or 1B (shrublands on rocky rises), but refining *Grevillea erectiloba* P4 estimates would require further investigations into *Grevillea erectiloba* P4 densities and vegetation (variant) mapping.

Grevillea erectiloba P4 is likely to be widespread across the 1,915-hectare shrubland shown in Figure 27.

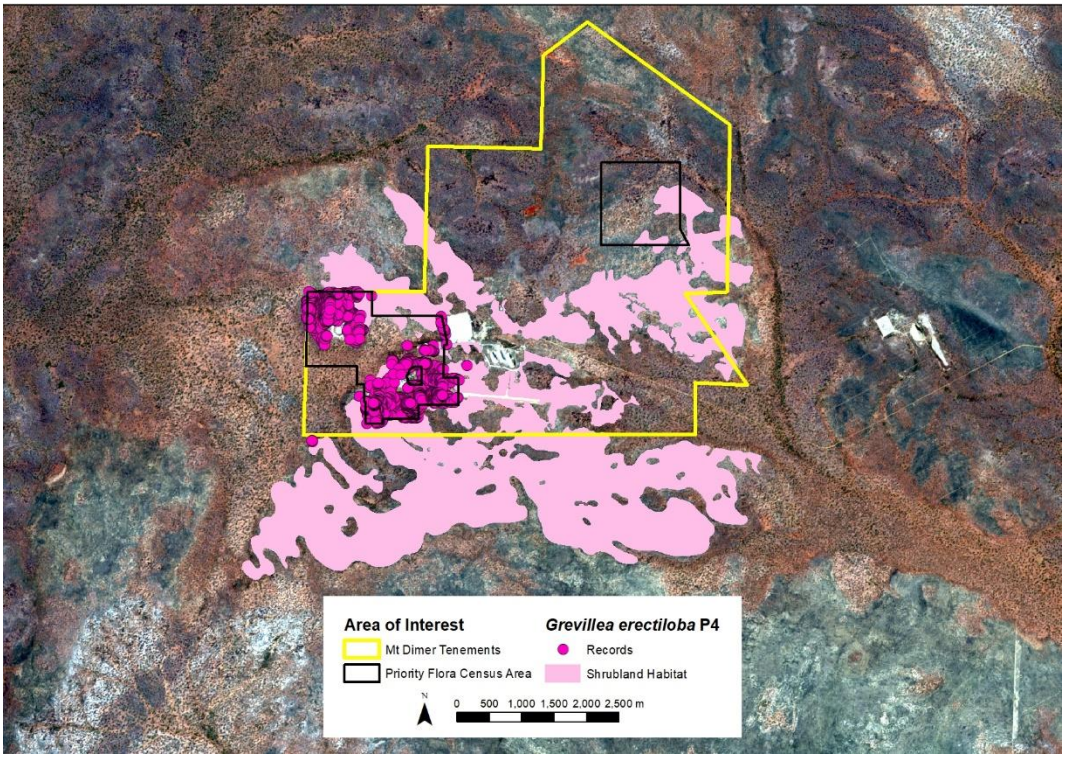

Figure 27: *Grevillea erectiloba* P4 records across sandplains intersecting AOI

Grevillea erectiloba P4 was observed by Woodgis (2021a) having established in disturbed areas, as demonstrated by it growing on previously cleared ground around a pit void in Photo 4 and along old tracks in Photo 5.

Photo 4: *Grevillea erectiloba* P4 around Pit

Photo 5: *Grevillea erectiloba* P4 along old track

3. DISCUSSION

3.1. Regional Context for Vegetation

The EPA established a position of applying a presumption against clearing of vegetation in areas where native vegetation had already been extensively cleared (in *Position Statement No. 2* (EPA, 2000) and *Guidance Statement 10* (EPA, 2006)). In non-constrained areas (i.e. outside urban areas), such as the AOI, the presumption against clearing applies:

- where the total extent remaining of a regional vegetation type is below a threshold of 30% of its estimated pre-European settlement extent; or
- when clearing would result in the percentage remaining falling below 30%.

The state-wide vegetation associations occurring in the tenements are extensive and have been subject to low levels of clearing, as shown in Table 23.

Table 23: Total Extents of Associations

Vegetation Association	Tenement Extents	Pre-European Extent	Current Extent	% Remaining	% Current Extent Protected (IUCN I-IV) for Conservation	Reservation Priority
141 Medium woodland; York gum, salmon gum & gimlet	12,639 ha	1,158,760 ha	960,756 ha	82.91%	12.02%	Low
435 Shrublands; Acacia neurophylla, Acacia beauverdiana & Acacia resinomarginea thicket	1,776 ha	984,502 ha	761,436 ha	77.34%	13.45%	Low
538 Shrublands; Acacia brachystachya scrub	1,680 ha	147,822 ha	144,203 ha	97.55%	11.50%	Low

Sources: Government of Western Australia (2017), DPaW (2002)

The state-wide system-associations occurring in the AOI are extensive and have been subject to low levels of clearing, as shown in Table 24.

Table 24: Total Extents of System-Associations (in the Jackson Vegetation System)

System-Association	Tenement Extents	Pre-European Extent	Current Extent	% Remaining	% Current Extent Protected (IUCN I-IV) for Conservation
141.3	12,639 ha	644,280 ha	643,140 ha	99.82 %	15.60 %
435.3	1,776 ha	310,799 ha	306,669 ha	98.67 %	28.45 %
538.1	1,680 ha	100,912 ha	100,140 ha	99.26 %	14.27 %

Source: Government of Western Australia (2017)

The Department of Biodiversity, Conservation and Attractions (DBCA) maintains a state-wide dataset of ecological communities (naturally occurring biological assemblages that occur in a particular type of habitat) that are:

- Threatened Ecological Communities (TECs), which are ecological communities at risk of extinction through human action or inaction; and
- Priority Ecological Communities (PECs) for which there is insufficient information available for consideration as a TEC, or which are rare communities that are not currently threatened.

In addition to this recognition of significance by the Government of Western Australia through these listing, 17 of the TECs are also listed as Matters of National Environmental Significance (threatened ecological communities) and protected under the Commonwealth *EPBC Act 1999.*

The PECs recorded by DBCA in the vicinity of the AOI (DBCA database search reference number Ref: 48-1020EC) are shown in Figure 28 and characterised in Table 25. The conservation status codes used by the DBCA for ecological communities are defined in Appendix 1.

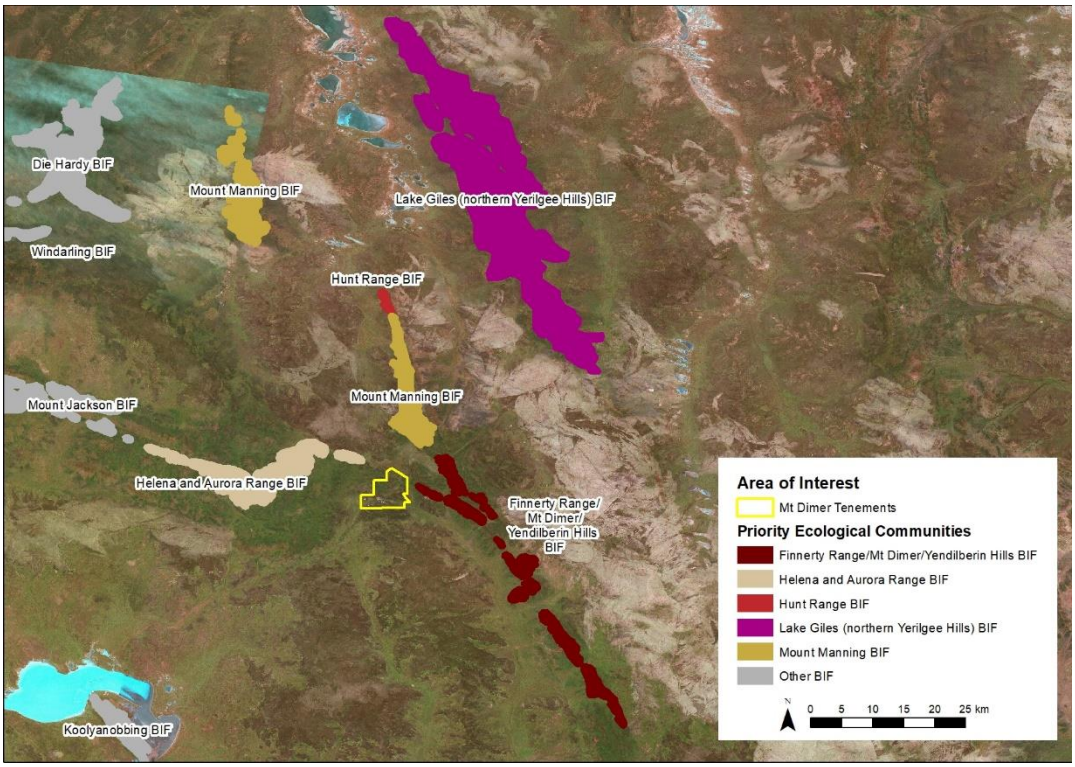

Figure 28: PECs in Vicinity of AOI

Source: DBCA database search 48-1020EC

Table 25: Characteristics of Priority Ecological Communities Closest to AOI

PECs	Status	Total Extent	Threats listed by DBCA
Finnerty Range/Mt Dimer/Yendilberin Hills vegetation complexes (banded ironstone formation)	Priority 1	11,686 ha	clearing for mining
Helena and Aurora Range vegetation complexes (banded ironstone formation)	Priority 1	11,749 ha	clearing for mining
Mount Manning Range vegetation complex (banded ironstone formation)	Priority 1	14,305 ha	clearing for mining
Hunt Range vegetation complexes (banded ironstone formation)	Priority 1	660 ha	clearing for mining
Lake Giles vegetation complexes (banded ironstone formation)	Priority 1	46,114 ha	clearing for mining

All the PECs in the vicinity of the AOI are Band Ironstone Formations (BIFs). The EPA (2016) considers vegetation as significant if it is listed as a PEC, and 41 BIFs had been listed as PECs in WA by the DBCA (as at 28 July 2020), with:

- 22 BIF PECs in the Goldfields;
- 15 BIF PECs in the Midwest;
- 2 BIF PECs in the Wheatbelt; and
- 2 BIF PECs on south Coast.

Although forming a very small proportion of the landscape, BIF ranges are of very significant biodiversity value, as a consequence of their unique geology, soils and relative isolation (DEC/DOIR, 2007). The EPA (2018) has noted that 'Banded Ironstone Formation (BIF) ranges are amongst the oldest landforms on earth, deposited as chemical sediments at the bottom of the sea over two billion years ago, and later uplifted by tectonic processes. The hard, iron-rich rock is erosion resistant, leaving craggy hills and ridges isolated in predominately flat landscape. BIF ranges are high points in the landscape, with their cooler, wetter conditions forming island-like refuges for plants and animals not found in the surrounding flat, dry plains. This includes species and communities that have highly restricted distribution and range endemics (species which only occur on one range). Being distinct features in an otherwise flat landscape, they also support social and economic values including tourism.'

The *Strategic review of the conservation and resource values of the banded iron formation of the Yilgarn Craton* (DEC/DOIR, 2007) stated that BIF ranges are important due to the presence of endemic plant species, rare and restricted plant species and highly restricted and distinct plant communities:

- each of the BIF range systems appear floristically distinct from one other, with the composition of vegetation on each range different from adjoining range;
- The ranges in the Mount Manning area are of interest as they have very high spatial biodiversity due to being located in a transitional zone between the Goldfields and Wheatbelt regions; and
- Across the Midwest and Goldfields BIFs the highest concentrations of identified endemic floristic communities are the Helena and Aurora Range, Windarling, Mount Jackson Range and the nearby Koolyanobbing and Die Hardy Range vegetation complexes.

The *Strategic review of the conservation and resource values of the banded iron formation of the Yilgarn Craton* (DEC/DOIR, 2007) made recommendations that included:

- No development activity to proceed in the Yilgarn Craton BIFs that would result in the IUCN threat category of any given plant taxa or ecological community increasing;
- A minimum of 15% and up to 60% of the total number of ranges should be reserved in their entirety, protecting complete examples of the landform and ecosystem;
- Conservation reserves to include at least 60% of largely contiguous ecosystem/habitat for each of the key banded ironstone species and ecological communities which are restricted to BIF ranges;
- The aim of detailed mine-site planning and assessment should be to maximise the protected area of any floristic community restricted to the BIF, or dependent on the BIF for its conservation; and
- Landscape, geodiversity, indigenous heritage values and potential for nature-based tourism should be taken into account in developing a reserve system.

In addition to TECs/PECs, DPaW (2002) listed 'ecosystems at risk' in the Southern Cross IBRA Subregion as including:

- flora assemblages of granite rock pools;
- granite moss sheet communities; and
- fringing vegetation in riparian areas.

The vegetation types described in the AOI would not expected to be restricted as the associated landforms did not include either BIF, granite outcrops, riparian vegetation or permanent surface water.

The WA Museum (1985) identified 52 vegetation types in the Jackson-Kalgoorlie Area, of which 18 vegetation types occurred at most, on any landforms rarely and in small patches (had an average patch size of less than 5 ha). Table 26 lists these 18 restricted vegetation types, noting:

- one vegetation type, *Acacia aneura* Low Woodland, occurred on two landform units;
- a number of these vegetation types may be rare and restricted in the vicinity because they are near the boundaries of their distribution, and they may be abundant elsewhere in Western Australia. The Mount Manning Region is located in a transitional zone for rainfall and vegetation corresponding to the limits of many vegetation types of the goldfields and wheatbelt (EPA, 2007); and
- Myrtaceous-Proteaceous heaths common on sandplains of the south-west extend to the north of the AOI (WA Museum, 1985); and
- The *Neurachne annularis* P3 grasslands were not identified by WA Museum (1985) as one of the 52 major vegetation types in the Jackson-Kalgoorlie Area but this grass is extensive in the vicinity of the AOI. This grass was recorded in 37.1% of the 281 quadrats in the J4 Mine and Haul Road Vegetation Assessment (extending from 20 km south-east to 40 km west-north-west of the AOI) with the grass dominant on hillslopes and footslopes and less common on the plains (Ecologica Environment, 2013).

Table 26: Rare and Restricted Vegetation Types in Jackson-Kalgoorlie Area

Landform	Vegetation Type Number and Name	Average Patch Size		Mapped in AOI
		< 1ha	< 5ha	
Breakaway	2. *Frankenia pauciflora* Low Shrubland	+		
Granite Exposure	4 *Acacia lasiocalyx* Mallee 5 *Allocasuarina huegeliana* Low Woodland 11 *Acacia jibberdingensis* Tall Shrubland 13 *Leptospermum erubescens* Tall Shrubland	+		
	6 *Eucalyptus comitae-vallis* Mallee 7 *Eucalyptus ewartiana* Mallee 12 *Acacia tetragonophylla* Tall Shrubland 14 Mixed species Tall Shrubland		+	
Hill (BIF)	16 *Acacia aneura* Low Woodland	+		Yes
Salt Lake Feature	28 *Acacia ligulata* Tall Shrubland	+		
	32 *Melaleuca* aff. *cuticularis* Tall Shrubland		+	
Sandplain	38 *Allocasuarina eriochlamys* Tall Shrubland	+		
	16 *Acacia aneura* Low Woodland 40 *Callitris preissii* subsp. *verrucosa* Tall Shrubland		+	
Undulating Plain	No rare vegetation types			
Broad Valley	47 *Eucalyptus kochii subsp. plenissima* Low Woodland	+		
	49 *Eucalyptus sheathiana* Low Woodland 51 *Eucalyptus cylindrocarpa* Mallee 52 *Melaleuca lateriflora* Tall Shrubland		+	Yes

Source: WA Museum (1985)

3.2. Regional Context for Flora

Table 27 lists the 12 priority flora species recorded in the AOI:

- All the priority flora are represented on multiple conservation estate lands (DBCA-managed lands) except *Acacia* sp. Southern Cross P1, which is known from a single population that has yet to be comprehensively surveyed, of 28 plants across 400 m x 1000 m;
- Eight species can be categorised as local endemics (i.e. restricted distribution), although at least some of which are locally abundant, with further information in Table 28 to Table 32; and
- Four species can be categorised as widespread and uncommon or widespread and poorly documented, with further information in Table 33 and Table 34.

Populations are significantly under-reported in Table 29, Table 31, Table 32, Table 34 and given:

- Local plant numbers are based on small survey areas relative to plants and habitat observed in the vicinity; and
- Regional plant numbers are based on a very small portion of the number of sites where the species have been recorded in the region (Table 27).

Local population counts exclude duplicate counts from overlapping surveys of local populations (where duplicates exist numbers are deducted from earlier surveys). Mapping of *Neurachne annularis* P3 from aerial imagery superseded previous records within the AOI, which are omitted from Table 31.

Counts of individual *Neurachne annularis* P3 plants are not useful in impact assessment (Western Botanical, 2020). It is difficult to determine whether clumps of this abundant clonal species consist of one or more individual plants, and therefore it is documented in terms of extents. Larger occurrences can be, and were, mapped directly from aerial imagery. Occurrences less than 100 m^2 are to be recorded as points of 50 m^2.

Table 27: NatureMap Records of Priority Flora

	Taxa	NatureMap Records	WA Range (measured on NatureMap)	DBCA Managed Lands (containing NatureMap Records with ex-Jaurdi always included given tenement location)
Restricted Distribution	*Acacia* sp. Southern Cross P1	1 record 1 bioregion	<5 km north-south <5 km east-west	UCL - ex Jaurdi
	Eremophila hamulata P1	9 records 2 bioregions	300 north-south 130 km east-west	Mt Manning – Helena and Aurora Ranges Conservation Park Peak Charles National Park UCL - ex Jaurdi
	Hysterobaeckea ochropetala ssp. *ochropetala* P1	9 records 2 bioregions	150 km north-south 170 km east-west	Lake Campion Nature Reserve UCL - ex Jaurdi UCL - ex Diemals
	Goodenia jaurdiensis P2	11 records 1 bioregions	70 km north-south 45 km east-west	Mt Manning – Helena and Aurora Ranges Conservation Park UCL - ex Jaurdi
	Cryptandra crispula P3	11 records 1 bioregions	80 km north-south 80 km east-west	Dundas Nature Reserve UCL - ex Jaurdi
	Neurachne annularis P3	86 records 1 bioregion	80 km north-south 80 km east-west	Mt Manning – Helena and Aurora Ranges Conservation Park Mt Manning Nature Reserve UCL - ex Jaurdi UCL - ex Ennuin
	Eucalyptus formanii P4	191 records 3 bioregions	190 km north-south 70 km east-west	Mt Manning – Helena and Aurora Ranges Conservation Park Mt Manning Nature Reserve UCL - ex Jaurdi UCL - ex Diemals UCL- ex Mt Elvire
	Grevillea erectiloba P4	92 records 2 bioregions	120 km north-south 190 km east-west	Mt Manning – Helena and Aurora Ranges Conservation Park Mt Manning Nature Reserve UCL - ex Jaurdi Station UCL - ex Diemals UCL- ex Mt Elvire
Widespread Distribution	*Austrostipa blackii* P3	99 records 4 bioregions	400 km north-south 480 km east-west	Mount Manning Nature Reserve Kangaroo Hills Timber Reserve Yallari Timber Reserve Kambalda Timber Reserve Kambalda Nature Reserve Tutanning Nature Reserve UCL - ex Jaurdi UCL – ex Credo UCL – ex Diemals UCL - ex Ennuin UCL – ex Karara UCL - ex Warriedar
	Notisia intonsa P3	29 records 4 bioregions	490 km north-south 90 km east-west	Mt Manning – Helena and Aurora Ranges Conservation Park Dundas Nature Reserve UCL - ex Jaurdi Station UCL - ex Diemals UCL- ex Credo
	Philotheca coateana P3	16 records 2 bioregions	340 km north-south 180 km east-west	UCL- ex Mt Jackson UCL – ex Goongarrie
	Eremophila caerulea subsp. *merrallii* P4	40 records 3 bioregions	280 km north-south 310 km east-west	Mt Manning – Helena and Aurora Ranges Conservation Park Mt Manning Nature Reserve Jilbadji Nature Reserve

Philotheca coateana P3 based on ALA records – Naturemap taken offline indefinitely 17/12/2021

Table 28: Comments on Priority 1 Flora with Restricted Distributions

Taxa	Comments
Acacia sp. Southern Cross P1	• First and only known population is on Woodcutters tenements: • This species is new to science and has not previously been collected (Western Botanical, 2020)

Eremophila hamulata P1	• The EPA (2017) noted that in relation to the *Jackson 5 and Bungalbin East Iron Ore Project:*
	  • *Eremophila hamulata* was newly described and records of *Eremophila rugosa* in the study area are now considered to represent records of *Eremophila hamulata*.
	  • The species was recorded from more than 20 quadrats and it is highly likely that more records would be found if targeted surveys were undertaken.
	  • Within the study area this species is restricted to the plains around the BIF ridges The EPA is of the view that given this species is not restricted to BIF landforms

Hysterobaeckea ochropetala ssp. *ochropetala* P1	• 9,740 individuals at Deception Deposit, approximately 150 km N of Southern Cross (Biota Environmental Services, 2011) • *Baeckea* sp. Lake Brown (E. Merrall s.n. 1889) and *Hysterobaeckea ochropetala* are informal synonyms.

Table 29: Minimum Numbers of Plants of Restricted P1 Flora

Survey	*Hysterobaeckea ochropetala* ssp. *ochropetala* P1		*Acacia* sp. Southern Cross P1		*Eremophila hamulata* P1	
	Local Population	Regional Population	Local Population	Regional Population	Local Population	Regional Population
Mount Dimer Vegetation and Priority Flora Update February 2022 (Woodgis, 2022)					8,880 (see Table 20 on page 37)	8,880 (see Table 20 on page 37)
Flora and Vegetation of the Mount Dimer Tenements (Western Botanical, 2020)	1	1				
Deception Deposit Vegetation and Flora Survey (Biota Environmental Services, 2011)		9,740				
Woodcutter Tenements Targeted Flora Survey May 2021 (Woodgis, 2021c)			28	28	3,214	3,214
Atlas of Living Australia (Atlas of Living Australia, 2021) Record 3615 (No abundance for records 2945, 6430, 6605, 9450 & 6605)						+100
Total Population	**1**	**9,741**	**28**	**28**	8,880 estimate 3,214 partial count	8,880 estimate 3,314 partial count

Table 30: Comments on Priority 2, 3 and Priority 4 Flora with Restricted Distributions

Taxa	Comments
Goodenia jaurdiensis P2	• There is limited information on this species, which was described in 2007, in the public domain.
Cryptandra crispula P3	• This species is 'unlikely to be endangered as it occurs in a poorly known inland area where access is often difficult' and the known distribution is over 200 km long (Rye, New species and keys for Cryptandra and Stenanthemum (Rhamnaceae) in Western Australia Nuytsia, 2007), which is more extensive than the 80 km range indicated by NatureMap records in Table 27

Neurachne annularis P3	• Can occur in very large populations, but has a relatively restricted range of distribution and grows on (but is not restricted to) ironstone outcrops where it can be affected by mining (Macfarlane, 2007)
	• *Neurachne* sp. Helena & Aurora (K.R. Newbey 8972) is an informal synonym
	• 1,292,668 plants documented in assessment of *Jackson 5 and Bungalbin East Iron Ore Project* (EPA, 2017)
	• 4,086 plants within the Bungalbin East survey area, where it was frequently growing on disturbed ground on the existing tracks and drill pad areas, and potentially grows well on disturbed ground (Mattiske Consulting, 2013)
	• Ecologica Environment (2013) in *J4 Mine and Haul Road Flora and Vegetation Assessment:*
	  • Estimated >340,000 plants at 2,507 locations, based on records of 190,402 plants from 503 location and presence in 23 of 30 vegetation units within the study area
	  • Concluded this species was the most abundant priority species in the survey. The recorded populations and estimated individuals being an under-representation of the true extent of the taxon's abundance as it was so common that recording each location was unfeasible.
	  • Dominant ground stratum throughout much of the survey area, dominating habitats including: sandy and gravelly plains, rocky footslopes, midslopes and hilltops.

Eucalyptus formanii P4	• It is locally common and Western Botanical (2020) recorded it in 19 out of 52 quadrats and relevés in the vicinity. • It was observed having established in disturbed areas (Woodgis, 2021a) • A geographically restricted species that is particularly common in the vegetation types in which it occurs (Keighery, Milewski, & Hall, 1995) • It is a locally common species (EPA, 2007) • Can be considered a regional endemic of the sandplains surrounding greenstone and banded ironstone ranges, although it also occurs on the lower slopes / outwash plains of the Mt Manning Range (Gibson, 2004) • *Eucalyptus formanii* Low Woodlands occur on the nearly flat plain immediately surrounding the Mt Manning Range, and are more extensive in the Barlee-Menzies Area than the Jackson-Kalgoorlie Area (Keighery, Milewski, & Hall, 1995) • Mt Manning Range in Mt Manning Nature Reserve contains a substantial proportion of the total population of the species (Elith & Bidwell, 2004) • May, in part, be protected as part of Mount Manning Range vegetation complex (banded ironstone formation) Priority Ecological Community (Elith & Bidwell, 2004) • *Eucalyptus formanii* Low Woodlands occur on well-drained flats and dunes of aeolian sands and loams in the Barlee-Menzies Area. The soils are generally dark reddish brown to yellowish red sandy loam, with unusually coarse and nutrient-poor soil for broad valleys. Generally, the soil is deep although a lime hardpan can be apparent in places (Keighery, Milewski, & Hall, 1995) • 11,369 plants documented in assessment of *Jackson 5 and Bungalbin East Iron Ore Project* (EPA, 2017) • 1,153 plants Deception Deposit, approximately 150 km north of Southern Cross (Biota Environmental Services, 2011) • +539 plants recorded at Mt Jackson J1 Deposit, approximately 100 km north-north-west of Southern Cross (Cliffs Asia Pacific Iron Ore Pty Ltd, 2009) • 13 hectare of *Eucalyptus formanii* Woodland over Heath with *Westringia cephalantha* recorded at Mt Jackson J1 Deposit, approximately 100 km north-north-west of Southern Cross (Cliffs Asia Pacific Iron Ore Pty Ltd, 2009)
Grevillea erectiloba P4	• It is locally common and Western Botanical (2020) recorded it in 9 out of 52 quadrats and relevés in the vicinity. • It was observed having established in disturbed areas in 2020 (Woodgis, 2021a) • Mostly within a range of 200 km centred around Mt Manning, but one outlying population is approximately 200 km east of its main distribution (Markey & Dillon, 2011) and it is recorded 130 km west of Menzies (Macarthur Minerals Limited, 2013) • Can be considered a regional endemic of the greenstone and banded ironstone ranges, though it generally occurs on yellow sands over laterites around the base of ranges (Gibson, 2004) • Occurs on yellow sands over laterite in the vicinity of the Hunt Range, Yendilberin and Watt Hills (Gibson & Lyons, 2001) • This species is considered to be a regional near-endemic. Within the survey area, this species was restricted to the upland laterites of the northern Yerilgee Hills. It has been recorded from a number of habitats, including lowland plains, but many collections are from upland BIF sites on ranges south of the Yerilgee Hills (Markey & Dillon, 2011) • 4,919 plants documented in assessment of *Jackson 5 and Bungalbin East Iron Ore Project* (EPA, 2017) • 735 individuals were recorded at Deception Deposit, 150 km north of Southern Cross (Biota Environmental Services, 2011) • Plants set good quantities of seed and it regenerates from seed after fire (Olde & Marriott, 1995) • Grafted plants available at specialist nurseries (Olde & Marriott, 1995)

Table 31: Minimum Numbers of Plants of Restricted P2 and P3 Flora

Survey	*Goodenia jaurdiensis* P2		*Cryptandra crispula* P3		*Neurachne annularis* P3	
	Local Population	Regional Population	Local Population	Regional Population	Local Population	Regional Population
Mount Dimer Vegetation and Priority Flora Update February 2022 (Woodgis, 2022)					100.9 ha	
Mount Dimer Vegetation and Priority Flora Update October 2021 (Woodgis, 2021e)	24 ha	24 ha				
Baseline flora, vegetation and fauna surveys for the Parker Range Haul Road Project (Phoenix Environmental Sciences, 2021)				10		
Flora and Vegetation of the Mount Dimer Tenements (Western Botanical, 2020)			4	4		
Mount Dimer Targeted Flora Survey 2020 (Woodgis, 2021a)						4.31 ha
Targeted flora searches along proposed drill lines and drill pad locations within tenements M77/427, M77/428, M77/957 and M77/958 of the Mt Dimer project area and tenement M77/965 of the Woodcutters project area (Niche, 2013)						'too many to count'
Deception Deposit Vegetation and Flora Survey (Biota Environmental Services, 2011)						1,153
Report and recommendations of the Environmental Protection Authority - Jackson 5 and Bungalbin East Iron Ore Project (EPA, 2017) assumed to include *Drill Hole Locations within Mining Tenement M77/1097 Bungalbin East* (Mattiske Consulting, 2013)						1,292,668
Total Population	**24 ha**	**24 ha**	**4**	**14**	**100.9 ha**	**1,293,862 plants**

Table 32: Minimum Numbers of Plants of Restricted P4 Flora

Survey	*Eucalyptus formanii* P4		*Grevillea erectiloba* P4	
	Local Population	Regional Population	Local Population	Regional Population
Mount Dimer Vegetation and Priority Flora Update February 2022 (Woodgis, 2022)	18,340 (see Table 21 on page 47)	18,340 (see Table 21 on page 47)	17,724 (see Table 22 on page 49)	17,724 (see Table 22 on page 49)
Woodcutter Tenements Targeted Flora Survey May 2021 (Woodgis, 2021c)	226	226		
Mount Dimer Targeted Flora Survey March 2021 (Woodgis, 2021b)	1,602	1,602	1,718	1,718
Mount Dimer Targeted Flora Survey 2020 (Woodgis, 2021a)	727	727	1,216	1,216
Flora and Vegetation of the Mount Dimer Tenements (Western Botanical, 2020)	737	737	605	605
Ularring Hematite Project Environmental Review Document – Rev6 (Macarthur Minerals Limited, 2013)				667
Targeted flora searches along proposed drill lines and drill pad locations within tenements M77/427, M77/428, M77/957 and M77/958 of the Mt Dimer project area and tenement M77/965 of the Woodcutters project area (Niche, 2013)	140	140		
Deception Deposit Vegetation and Flora Survey (Biota Environmental Services, 2011)		1,153		735
Report and recommendations of the Environmental Protection Authority - Jackson 5 and Bungalbin East Iron Ore Project (EPA, 2017) assumed to include *Koolyanobbing Iron Ore Project - Mt Jackson J1 Deposit Environmental Impact Assessment* (Cliffs Asia Pacific Iron Ore Pty Ltd, 2009)		11,369		4,919
Total Population	**18,340 estimate 3,432 partial count**	**34,294 estimate 15,954 partial count**	**17,724 estimate 3,539 partial count**	**27,584 estimate 9,860 partial count**

Table 33: Comments on Priority Flora with Widespread Distributions

Taxa	Comments
Austrostipa blackii P3	• Widespread in South Australia, New South Wales and Victoria, but had only been collected three times in Western Australia up until 2001 (Gibson & Lyons, 2001), although subsequently it has been collected many times over a large range in WA (Table 27); • Although this species was recorded from several surveys of Yilgarn ranges from 2001-2011, it is not restricted to BIF landforms (Markey & Dillon, 2011) • 1,035 plants documented across 20 locations in Rothsay Gold Project Area, approximately 300 km NNE of Perth, though likely much higher number of individuals (Woodman Environmental, 2017) • 11 plants recorded at Mt Jackson J1 Deposit, approximately 100 km north-north-west of Southern Cross (Cliffs Asia Pacific Iron Ore Pty Ltd, 2009) • *Stipa blackii* is a nomenclatural synonym.
Notisia intonsa P3	• 54,510 plants approximately 15 km SSW of Southern Cross, where it is widespread and very abundant within wet depressions of *Eucalyptus salubris* Woodlands (Western Botanical, 2015) • 20 plants in Marda Gold Project area 114 km N of Southern Cross, opportunistically observed in November 2012 near quadrat and could be abundant in vicinity (Rapallo, 2012) • *Gnephosis intonsa* is a nomenclatural synonym.
Philotheca coateana P3	• It is fairly widespread in bioregion interzone and goldfields (EPA, 2007) • 'Locally abundant' at several sites (Atlas of Living Australia, 2021) • 139 individuals were recorded from the haul road corridor of Deception Deposit, approximately 150 km north of Southern Cross (Biota Environmental Services, 2011)
Eremophila caerulea subsp. *merrallii* P4	• It is a 'fairly widespread' taxa (EPA, 2007) • A large population is located on red clay flats over decomposing granite at the base of the Hunt Range (Gibson & Lyons, 2001). • This taxon is known from a number of populations from the Hunt Range and south to Southern Cross area and west to Bruce Rock (Gibson & Lyons, 2001). • *Eremophila merrallii* is a nomenclatural synonym.

Table 34: Minimum Numbers of Plants of Widespread P3 Flora

Survey	*Austrostipa blackii* P3		*Notisia intonsa* P3		*Philotheca coateana P3*	
	Local Population	Regional Population	Local Population	Regional Population	Local Population	Regional Population
Koolyanobbing Iron Ore Project - Mt Jackson J1 Deposit Environmental Impact Assessment (Cliffs Asia Pacific Iron Ore Pty Ltd, 2009)		11				
Rothsay Gold Project Flora and Vegetation Assessment (Woodman Environmental, 2017)		1,035				
Flora and Vegetation of the Mount Dimer Tenements (Western Botanical, 2020)	1	1	112	112	1	1
Woodcutter Tenements Targeted Flora Survey May 2021 (Woodgis, 2021c)			324	324		
Flora Survey of Battler Tenements M77/166 & P77/3645 (Western Botanical, 2015)				54,510		
Level 2 Flora and Vegetation and Targeted Priority Flora Survey of Marda Central, Golden Orb and King Brown (Rapallo, 2012)				20		
Mount Dimer Vegetation and Priority Flora Update October 2021 (Woodgis, 2021e)						
Deception Deposit Vegetation and Flora Survey (Biota Environmental Services, 2011)						139
Population dynamics, seed biology and conservation of six endangered Eremophila species (Richmond & Coates, 1995)						
Mt Manning Range Nature Reserve - populations 3,4,5 and 6 (DBCA database search 05-01020FL, 06/10/2020)						
Mount Manning - Helena and Aurora Ranges Conservation Park (DBCA database search 05-01020FL, 06/10/2020)						
Total Population	**1**	**1,047**	**436**	**54,966**	**1**	**140**

Table 35: Minimum Numbers of Plants of Widespread P4 Flora

Survey	*Eremophila caerulea subsp. merrallii P4*	
	Local Population	Regional Population
Mount Dimer Vegetation and Priority Flora Update October 2021 (Woodgis, 2021e)	299	299
Population dynamics, seed biology and conservation of six endangered Eremophila species (Richmond & Coates, 1995)		2,022
Mt Manning Range Nature Reserve -populations 3,4,5 and 6 (DBCA database search 05-01020FL, 06/10/2020)		1,186
Mount Manning - Helena and Aurora Ranges Conservation Park (DBCA database search 05-01020FL, 06/10/2020)		1,000
Total Population	**299**	**4,507**

4. CONCLUSIONS AND RECOMMENDATIONS

The state-wide system-associations occurring in the AOI are extensive and have been subject to low levels of clearing.

All of the landform and geology units in the AOI were sampled with 99 quadrats and 24 relevés:

- Sampling intensity was one site per 22.5 ha;
- No Threatened or Priority Ecological Communities were located in the AOI;
- Six vegetation types were defined on the basis of a floristic analysis;
- The vegetation types described in the AOI would not expected to be restricted as the associated landforms did not include either BIF, granite outcrops, riparian vegetation or permanent surface water;
- *Ptilotus holosericeus* herblands were associated with damplands, which covered a total of approximately 7 hectares of the AOI, with an additional 16 hectares across Aurumin tenements contiguous with the AOI;
- *Neurachne annularis* P3 grasslands that were not identified by WA Museum (1985) as one of the 52 major vegetation types in the Jackson-Kalgoorlie Area but this grass is extensive in the J4 Mine and Haul Road area, which is in the vicinity of the AOI.

A total of 281 plant taxa were recorded in the AOI:

- It is estimated these represent 100% of the perennial plant taxa and 74% of the annual plant taxa present;
- All 12 priority flora taxa recorded in the AOI are represented on multiple conservation estate lands (DBCA-managed lands) except *Acacia* sp. Southern Cross P1, which is known from a single population that has yet to be comprehensively surveyed, of 28 plants across 400 m x 1000 m;
- The priority flora taxa in the AOI can be characterised as having:
  - restricted distributions and possibly in low abundance (*Acacia* sp. Southern Cross P1 and *Hysterobaeckea ochropetala* subspecies *ochropetala* P1);
  - restricted distributions, and possibly under-reported rather than uncommon (*Goodenia jaurdiensis* P2 and 3 *Cryptandra crispula* P3);
  - restricted distributions but locally abundant (*Eremophila hamulata* P1 and *Neurachne annularis* P3);
  - restricted distributions but locally abundant and increasing after disturbance (*Eucalyptus formanii* P4 and *Grevillea erectiloba* P4); or
  - widespread distributions, and possibly under-reported rather than uncommon (*Austrostipa blackii* P3, *Notisia intonsa* P3, *Philotheca coateana P3* and *Eremophila caerulea* subsp. *merrallii* P4).
- Locations were recorded for *Lepidosperma* aff. *lyonsii* (*Lepidosperma lyonsii* P1 is assumed to be restricted to the banded iron formation and related geologies, which were not present in the AOI); and
- Six weeds were observed but not mapped.

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APPENDIX 1: TAXONOMIC RECONCILIATION FOR ANALYSIS

Table 36: Taxa Removed from Datasets Prior to Analysis

Invalid Names
Acacia sp.
Androcalva sp.
Angianthus sp.
Araliaceae sp.
Asteraceae sp.
Austrostipa sp.
Brachyscome sp.
Calandrinia sp.
Eucalyptus sp.
Gnephosis sp.
Goodeniaceae sp.
Indet. sp.
Lamiaceae sp.
Maireana sp.
Orchidaceae sp.
Phebalium sp. Helena & Aurora Range v shaped leaf in TS (G. Cockerton WB35642)
Phebalium sp. Mt Dimer 10A (G. Cockerton & S. Fox WB38086)
Phebalium sp. Mt Dimer 10B (G. Cockerton & S. Fox WB38087)
Poaceae sp.
Thysanotus sp.
Trachymene sp.
Unknown NC Climber
Westringia sp. Yellow Sandplain (G. Cockerton & J. Warden WB37996)

Table 37: Taxonomic Updates and Equivalencies made Prior to Floristic Analysis

Name in Western Botanical (2020) **Dataset**	**Name Used in Analysis**
Allocasuarina acutivalvis	*Allocasuarina acutivalvis subsp. acutivalvis*
Atriplex nummularia	*Atriplex nummularia subsp. spathulata*
Drosera macrantha subsp. macrantha	*Drosera macrantha*
Eremophila decipiens	*Eremophila decipiens subsp. decipiens*
Eucalyptus loxophleba	*Eucalyptus loxophleba subsp. lissophloia*
Eucalyptus sp. NC (aff. oleosa)	*Eucalyptus oleosa subsp. oleosa*
Velleia daviesii	*Goodenia daviesii*
Velleia rosea	*Goodenia rosea*
Gnephosis intonsa	*Notisia intonsa*
Podolepis capillaris	*Siemssenia capillaris*
Podolepis lessonii	*Panaetia lessonii*
Pterostylis sp. dainty brown (N. Gibson & M. Lyons 3690)	*Pterostylis tryphera*
Zygophyllum apiculatum	*Roepera apiculata*
Zygophyllum aurantiacum	*Roepera aurantiaca*
Zygophyllum ovatum	*Roepera ovata*
Rhyncharrhena linearis	*Vincetoxicum lineare*
Waitzia acuminata	*Waitzia acuminata var. acuminata*
Xerolirion divarcata	*Xerolirion divaricata*
Templetonia sulcata	*Templetonia ceracea*
All Triodia species (Western Botanical indicated multiple species present but not differentiated between due to lack of flowering material)	*Triodia scariosa*
Name in Woodgis (2021c) **Dataset**	**Name Used in Analysis**
Eucalyptus celastroides	*Eucalyptus calycogona*
All *Triodia* species (as per Western Botanical)	*Triodia scariosa/tomentosa*

APPENDIX 2: DBCA CONSERVATION CATEGORIES

Threatened, Extinct and Specially Protected fauna and flora species which have been adequately searched for and are deemed to be, in the wild, threatened, extinct or in need of special protection, and have been gazetted as such. Threatened, Extinct and Specially Protected species are listed under Part 2 of the Biodiversity Conservation Act 2016.

The definition of flora includes algae, fungi and lichens; and species includes all taxa (plural of taxon - a classificatory group of any taxonomic rank, e.g. a family, genus, species or any infraspecific category i.e. subspecies or variety, or a distinct population).

Categories of Threatened, Extinct and Specially Protected fauna and flora are:

T: Threatened species
Listed by order of the Minister as Threatened in the category of critically endangered, endangered or vulnerable under section 19(1), or is a rediscovered species to be regarded as threatened species under section 26(2) of the Biodiversity Conservation Act 2016(BC Act). Threatened fauna is that subset of 'Specially Protected Fauna' listed under schedules 1 to 3 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for Threatened Fauna. Threatened flora is that subset of 'Rare Flora' listed under schedules 1 to 3 of the Wildlife Conservation (Rare Flora) Notice 2018 for Threatened Flora. The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria as detailed below.

CR: Critically endangered species
Threatened species considered to be "facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as critically endangered undersection 19(1)(a) of the BC Act in accordance with the criteria set out in section 20 and the ministerial guidelines. Published under schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for critically endangered fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for critically endangered flora.

EN: Endangered species
Threatened species considered to be "facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as endangered undersection 19(1)(b) of the BC Act in accordance with the criteria set out in section 21 and the ministerial guidelines. Published under schedule 2 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for endangered fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for endangered flora.

VU: Vulnerable species
Threatened species considered to be "facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as vulnerable undersection 19(1)(c) of the BC Act in accordance with the criteria set out in section 22 and the ministerial guidelines. Published under schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for vulnerable fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for vulnerable flora.

Extinct species

Listed by order of the Minister as extinct under section 23(1) of the BC Act as extinct or extinct in the wild.

EX: Extinct species

Species where "there is no reasonable doubt that the last member of the species has died", and listing is otherwise in accordance with the ministerial guidelines (section 24 of the BC Act). Published as presumed extinct under schedule 4 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for extinct fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for extinct flora.

EW: Extinct in the wild species

Species that "is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; and it has not been recorded in its known habitat or expected habitat, at appropriate seasons, anywhere in its past range, despite surveys over a time frame appropriate to its life cycle and form", and listing is otherwise in accordance with the ministerial guidelines (section 25 of the BC Act). Currently there are no threatened fauna or threatened flora species listed as extinct in the wild. If listing of a species as extinct in the wild occurs, then a schedule will be added to the applicable.

Specially protected species

Listed by order of the Minister as specially protected under section 13(1) of the BC Act. Meeting one or more of the following categories: species of special conservation interest; migratory species; cetaceans; species subject to international agreement; or species otherwise in need of special protection. Species that are listed as threatened species (critically endangered, endangered or vulnerable) or extinct species under the BC Act cannot also be listed as Specially Protected species.

MI: Migratory species

Fauna that periodically or occasionally visit Australia or an external Territory or the exclusive economic zone; or the species is subject of an international agreement that relates to the protection of migratory species and that binds the Commonwealth; and listing is otherwise in accordance with the ministerial guidelines (section 15 of the BC Act).Includes birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and fauna subject to the Convention on the Conservation of Migratory Species of Wild Animals(Bonn Convention), an environmental treaty under the United Nations Environment Program. Migratory species listed under the BC Act are a subset of the migratory animals, that are known to visit Western Australia, protected under the international agreements or treaties, excluding species that are listed as Threatened species. Published as migratory birds protected under an international agreement under schedule 5 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018.

CD Species of special conservation interest (conservation dependent fauna)

Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened, and listing is otherwise in accordance with the ministerial guidelines (section 14 of the BC Act). Published as conservation dependent fauna under schedule 6 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018.

OS: Other specially protected species

Fauna otherwise in need of special protection to ensure their conservation, and listing is otherwise in accordance with the ministerial guidelines (section 18 of the BC Act). Published as other specially protected fauna under schedule 7 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018.

Priority Species

Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened fauna or flora. Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring. Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.

Priority One: Poorly-known species

Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.

Priority Two: Poorly-known species

Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.

Priority Three: Poorly Known species

Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.

Priority Four: Rare, Near Threatened and other species in need of monitoring

(a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands.

(b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for vulnerable but are not listed as Conservation Dependent.

(c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

APPENDIX 3: PRIORITY FLORA PHOTOGRAPHS

Photo 6: *Acacia* sp. Southern Cross P1 Foliage

Photo 7: *Acacia* sp. Southern Cross P1 Shrub

Photo 8: *Eremophila hamulata* P1 Flower

Photo 9: *Eremophila hamulata* P1 Shrub

Photo 10: *Hysterobaeckea ochropetala subsp. ochropetala* P1 Fruits

Photo 11: *Hysterobaeckea ochropetala subsp. ochropetala* P1 Shrub

Photo 12: *Cryptandra crispula* P3 Flowers

Photo 13: *Cryptandra crispula* P3 Shrub

Photo 14: *Goodenia jaurdiensis* P3 Flower

Photo 15: *Goodenia jaurdiensis* P3 Herb

Photo 16: *Neurachne annularis* P3 Flowers

Photo 17: *Neurachne annularis* P3 Grasses

Photo 18: *Notisia intonsa* P3 Seedlings

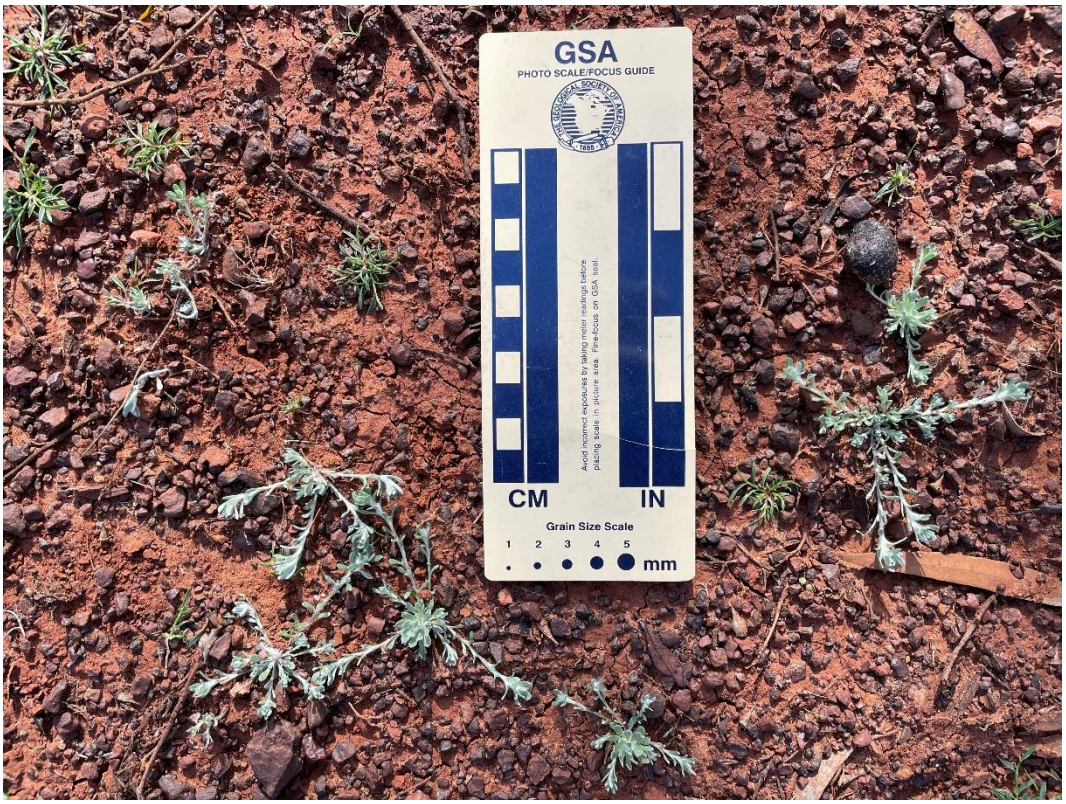


Photo 19: *Notisia intonsa* P3 Seedlings with scale

Photo 20: *Eremophila caerulea subsp. merrallii* P4 Flowers

Photo 21: *Eremophila caerulea subsp. merrallii P4* Shrub

Photo 22: *Eucalyptus formanii* P4 Juvenile Foliage

Photo 23: *Eucalyptus formanii* P4 Mallee

Photo 24: *Grevillea erectiloba* P4 Flowers

Photo 25: *Grevillea erectiloba* P4 Shrub

APPENDIX 4: VEGETATION TYPE DESCRIPTIONS

Vegetation Type 1: *Acacia acutivalvis* shrublands over *Amphipogon* tussock grasses

1A
WG052

1B
WG059

1C
WB011

No Ground Photo

Photo 26: *Acacia acutivalvis* shrublands over *Amphipogon* tussock grasses

Quadrats/Relevés in Vegetation Type 1

Variant 1A *Acacia sibina-Baeckea elderiana*
WB01, WB14, WB24, WB31, WG013, WG015, WG029, WG039, WG041, WG043, WG047, WG048, WG049, WG052, WG057, WG058, WBR01, WBR15, WGR02, WGR03, WGR07

Variant 1B *Melaleuca leiocarpa*
WG059, WG061

Variant 1C *Eucalyptus formanii-Phebalium canaliculatum*
WB07, WB10, WB11, WB12, WB13, WB15, WB18, WB19, WB20, WB23, WB27, WB30, WB32, WBR09

Indicator Species for Vegetation Type 1 (≥95% probability)
Acacia resinimarginea
Acacia sibina
Allocasuarina acutivalvis subsp. acutivalvis
Amphipogon caricinus
Baeckea elderiana
Cheiranthera filifolia
Euryomyrtus maidenii
Grevillea paradoxa
Hibbertia eatoniae
Leptospermum fastigiatum
Leucopogon sp. Clyde Hill (M.A. Burgman 1207)
Persoonia coriacea
Phebalium canaliculatum
Thryptomene urceolaris

Typical Species for Vegetation Type 1 (≥75% of quadrats, indicators in bold)
Amphipogon caricinus

Common Species for Vegetation Type 1 (≥50% of quadrats, indicators in bold)
Acacia acuminata
Acacia sibina
Allocasuarina acutivalvis subsp. acutivalvis
Baeckea elderiana
Grevillea zygoloba
Hibbertia eatoniae
Leucopogon sp. Clyde Hill (M.A. Burgman 1207)
Phebalium canaliculatum

Indicator Species for Vegetation Type 1 Variants

1A *Acacia sibina - Baeckea elderiana*
Acacia sibina
Amphipogon caricinus
Baeckea elderiana
Goodenia havilandii
Hibbertia eatoniae
Persoonia coriacea

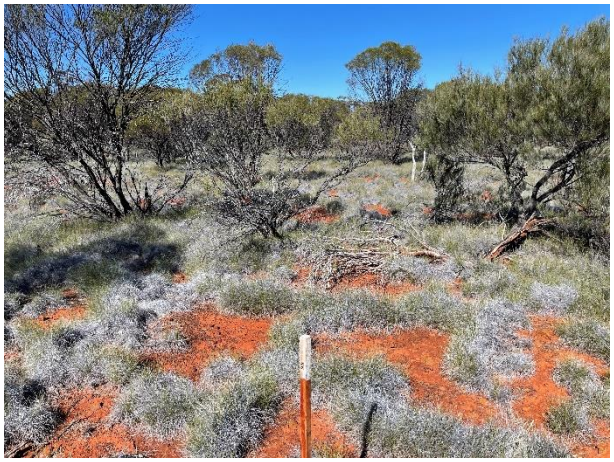
1B *Melaleuca leiocarpa*
Austrostipa eremophila
Comesperma integerrimum
Leucopogon sp. Clyde Hill (M.A. Burgman 1207)
Melaleuca leiocarpa
Philotheca brucei subsp. brucei

1C *Eucalyptus formanii* P4 - *Phebalium canaliculatum*
Callitris columellaris
Calocephalus multiflorus
Cheiranthera filifolia
Eucalyptus formanii P4
Euryomyrtus maidenii
Grevillea erectiloba P4
Homalocalyx thryptomenoides
Phebalium canaliculatum
Thryptomene urceolaris

Vegetation Type 2: Mixed Woodlands and Shrublands over *Neurachne annularis* P3 tussock grasses

2A
WG054

2B
WG005



2C
WG007

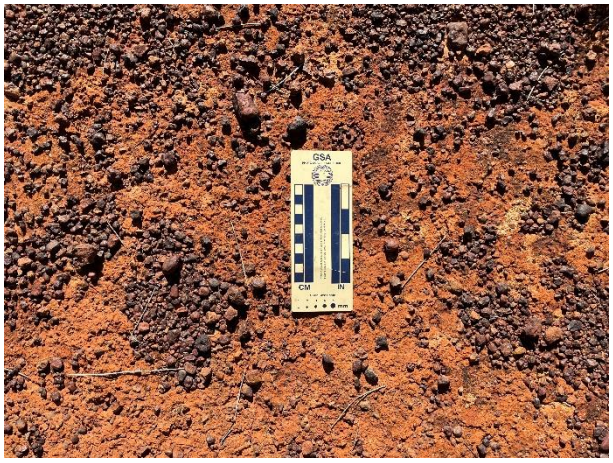


Photo 27: Mixed Woodlands and Shrublands over *Neurachne* tussock grasses

Quadrats/Relevés in Vegetation Type
Variant 2A *Eucalyptus loxophleba - Eucalyptus formanii* P4
WG027, WG054

Variant 2B *Acacia acuminata - Allocasuarina acutivalvis*
WG005, WG053

Variant 2C *Casuarina pauper - Melaleuca hamata*
WG007

Vegetation Type 2: Mixed Woodlands and Shrublands over *Neurachne* tussock grasses

Indicator Species for Vegetation Type 2 (≥95% probability)
Neurachne annularis P3
Cheilanthes adiantoides

Indicator Species for Vegetation Type 2 Variants
2A *Eucalyptus loxophleba -Eucalyptus formanii* P4
No Indicator species
Selected Common species (>50% of sites)
Eucalyptus loxophleba subsp. *lissophloia*
Eucalyptus formanii P4

2B *Acacia acuminata - Allocasuarina acutivalvis*
Neurachne annularis P3
Cheilanthes adiantoides
Cyanicula amplexans
Rinzia carnosa
Selected Common species (>50% of sites)
Acacia acuminata
Acacia sibina
Allocasuarina acutivalvis subsp. acutivalvis

2C *Casuarina pauper - Melaleuca hamata*
No Indicator species – Single Site
Selected species
Acacia sibina
Casuarina pauper
Malleostemon tuberculatus
Melaleuca hamata

Typical Species for Vegetation Type 2 (≥75% of quadrats, indicators in bold)
***Neurachne annularis* P3**

Common Species for Vegetation Type 2 (≥50% of quadrats, indicators in bold)
Acacia acuminata
Cheilanthes adiantoides
Eucalyptus loxophleba subsp. lissophloia
Grevillea zygoloba

Vegetation Type 3: *Eucalyptus ebbanoensis* mallees over *Triodia scariosa/tomentosa* hummock grasses

3A
WG046

3B
WG030

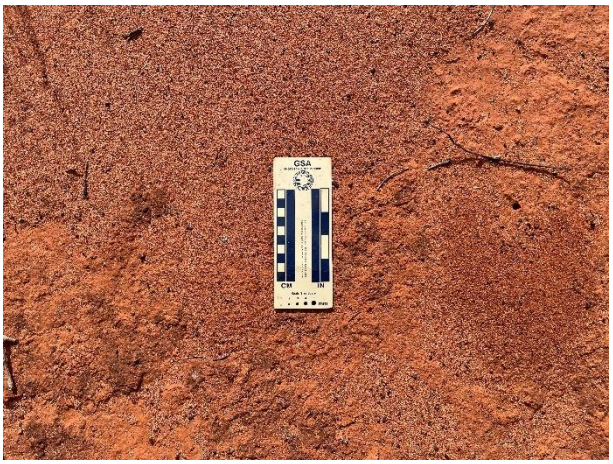


Photo 28: *Eucalyptus ebbanoensis* mallees over *Triodia scariosa/tomentosa* hummock grasses

Quadrats/Relevés in Vegetation Type 3
3A *Eucalyptus formanii* P4 - *Olearia exiguifolia*
WB16, WG014, WG020, WG025, WG040, WG042, WG046, WBR02, WBR03, WBR04, WBR12, WBR13, WBR14, WBR17, WGR01, WGR06

3B *Eucalyptus ebbanoensis - Phebalium filifolium*
WB33, WB34, WG028, WG030, WG031, WBR11

Indicator Species for Vegetation Type 3 (≥95% probability)
Eremophila caperata
Eucalyptus ebbanoensis subsp. ebbanoensis
Olearia exiguifolia
Phebalium filifolium
Phebalium tuberculosum
Triodia scariosa/tomentosa
Westringia cephalantha var. cephalantha

Indicator Species for Vegetation Type 3 Variants
3A Variant
Olearia exiguifolia
Triodia scariosa

3B Variant
Eucalyptus ebbanoensis subsp. *ebbanoensis*
Phebalium filifolium

Typical Species for Vegetation Type (≥75% of quadrats, indicators in bold)
Alyxia buxifolia
Olearia muelleri
Triodia scariosa/tomentosa
Westringia cephalantha var. cephalantha

Common Species for Vegetation Type (≥50% of quadrats, indicators in bold)
Acacia acuminata
Acacia hemiteles
Eremophila caperata
Olearia exiguifolia
Phebalium tuberculosum
Scaevola spinescens

Vegetation Type 4: *Eucalyptus loxophleba* mallees over *Austrostipa elegantissima* tussock grasses

4A
WB05

No Ground Photo

4B
WG034

Photo 29: *Eucalyptus loxophleba* mallees over *Austrostipa elegantissima* tussock grasses

Quadrats/Relevés in Vegetation Type 4

4A *Eremophila granitica*
WB04, WB05, WB06, WB09, WB21, WBR07, WBR16, WBR18

4B *Acacia tetragonophylla*
WG026, WG034, WG055, WG056, WG060

Indicator Species for Vegetation Type 4 (≥95% probability)
Acacia acuminata
Acacia tetragonophylla
Eremophila decipiens subsp. decipiens
Eremophila granitica
Eucalyptus loxophleba subsp. lissophloia
Goodenia havilandii
Olearia pimeleoides
Prostanthera grylloana
Pterostylis tryphera
Solanum nummularium

Indicator Species for Vegetation Type 4 Variants

4A *Eremophila granitica*
Eremophila granitica
Olearia pimeleoides
Austrostipa platychaeta
Pterostylis tryphera

4B *Acacia tetragonophylla-Allocasuarina acutivalvis*
Austrostipa elegantissima
Acacia tetragonophylla

Typical Species for Vegetation Type 4 (≥75% of quadrats, indicators in bold)

Acacia acuminata
Alyxia buxifolia
Eremophila granitica
Eucalyptus loxophleba subsp. lissophloia
Olearia pimeleoides
Scaevola spinescens

Common Species for Vegetation Type 4 (≥50% of quadrats, indicators in bold)

Allocasuarina acutivalvis subsp. acutivalvis
Amphipogon caricinus
Austrostipa elegantissima
Eremophila decipiens subsp. decipiens
Eremophila scoparia
Exocarpos aphyllus
Olearia muelleri
Prostanthera grylloana
Santalum acuminatum
Senna artemisioides subsp. filifolia

Vegetation Type 5: *Eucalyptus transcontinentalis* woodlands over *Austrostipa elegantissima* tussock grasses

5A
WG002

5B
WG033

5C
WG051

Photo 30: *Eucalyptus transcontinentalis* woodlands over *Austrostipa elegantissima* tussock grasses

Quadrats/Relevés in Vegetation Type 5

5A *Eucalyptus ravida*

WG002, WG006, WG010, WG017, WG025, WG038, WG062, WG063, WG065, WGR08

5B *Eucalyptus salmonophloia*

WB02, WB03, WB08, WB17, WB22, WB25, WB26, WB28, WG032, WG033, WG035, WG036, WG037, WG055, WG050, WG065, WBR05, WBR06, WGR05

5C *Eucalyptus vittata*

WB29, WG009, WG011, WG016, WG018, WG019, WG021, WG051

Indicator Species for Vegetation Type 5 (≥95% probability)
Acacia erinacea
Atriplex bunburyana
Eremophila ionantha
Eremophila scoparia
Eucalyptus salmonophloia
Eucalyptus transcontinentalis
Exocarpos aphyllus
Maireana georgei
Maireana pentagona
Rhagodia drummondii
Santalum acuminatum
Sclerolaena diacantha
Templetonia ceracea

Typical Species for Vegetation Type 5 (≥75% of quadrats, indicators in bold)
Olearia muelleri
Scaevola spinescens

Common Species for Vegetation Type 5 (≥50% of quadrats, indicators in bold)
Austrostipa elegantissima
Eremophila scoparia
Exocarpos aphyllus
Maireana georgei
Santalum acuminatum
Senna artemisioides subsp. filifolia
Templetonia ceracea

Indicator Species for Vegetation Type 5 Variants

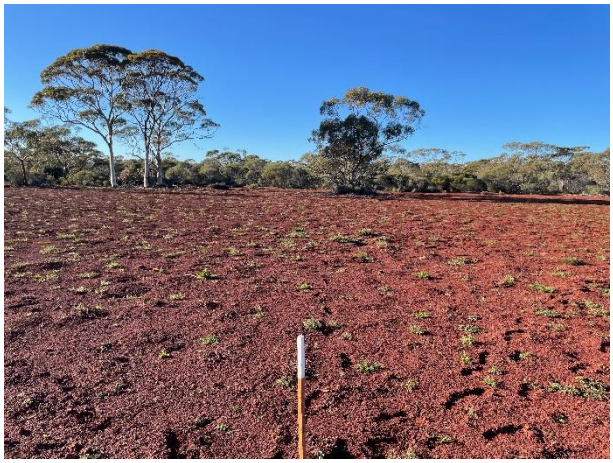
5A *Eucalyptus ravida*
Eucalyptus ravida
Sclerolaena diacantha
Templetonia ceracea
Atriplex nummularia subsp. spathulata
Eremophila hamulata P1

5B *Eucalyptus salmonophloia*
Atriplex bunburyana
Eremophila ionantha
Eucalyptus salmonophloia
Eucalyptus transcontinentalis
Exocarpos aphyllus
Olearia muelleri

5C *Eucalyptus vittata*
Acacia erinacea
Dodonaea lobulata
Eremophila oldfieldii subsp. angustifolia

Vegetation Type 6: *Ptilotus holosericeus* herblands

WG001



WG023

Photo 31: *Ptilotus holosericeus* herblands

Quadrats/Relevés in Vegetation Type 5
WG001, WG003, WG004, WG022, WG023

Indicator Species for Vegetation Type 5 (≥95% probability)
Ptilotus holosericeus
Eragrostis dielsii

Typical Species for Vegetation Type 5 (≥75% of quadrats, indicators in bold)
Ptilotus holosericeus

Common Species for Vegetation Type 5 (≥50% of quadrats, indicators in bold)
none

APPENDIX 5: FLORA INVENTORY

Table 38: Combined Woodgis/Western Botanical Flora List

Family	Taxa	Status
Amaranthaceae	*Ptilotus carlsonii*	
Amaranthaceae	*Ptilotus drummondii*	
Amaranthaceae	*Ptilotus eremita*	
Amaranthaceae	*Ptilotus exaltatus*	
Amaranthaceae	*Ptilotus gaudichaudii*	
Amaranthaceae	*Ptilotus holosericeus*	
Amaranthaceae	*Ptilotus nobilis*	
Amaranthaceae	*Ptilotus obovatus*	
Amaranthaceae	*Alternanthera* sp. #127	
Apiaceae	*Daucus glochidiatus*	
Apocynaceae	*Alyxia buxifolia*	
Apocynaceae	*Vincetoxicum lineare*	
Araliaceae	*Hydrocotyle callicarpa*	
Araliaceae	*Trachymene cyanopetala*	
Araliaceae	*Hydrocotyle* sp. #136 broadly toothed round leaf	
Asparagaceae	*Chamaexeros fimbriata*	
Asparagaceae	*Thysanotus manglesianus*	
Asparagaceae	*Xerolirion divaricata*	
Asteraceae	*Actinobole uliginosum*	
Asteraceae	*Angianthus tomentosus*	
Asteraceae	*Blennospora phlegmatocarpa*	
Asteraceae	*Brachyscome ciliaris*	
Asteraceae	*Calocephalus multiflorus*	
Asteraceae	*Calotis hispidula*	
Asteraceae	*Centipeda cunninghamii*	
Asteraceae	*Cephalipterum drummondii*	
Asteraceae	*Ceratogyne obionoides*	
Asteraceae	*Chthonocephalus pseudevax*	
Asteraceae	*Erymophyllum ramosum* subsp. *ramosum*	
Asteraceae	*Gnephosis tenuissima*	
Asteraceae	*Isoetopsis graminifolia*	
Asteraceae	*Lawrencella rosea*	
Asteraceae	*Lemooria burkittii*	
Asteraceae	*Olearia exiguifolia*	
Asteraceae	*Olearia muelleri*	
Asteraceae	*Olearia pimeleoides*	
Asteraceae	*Pseudognaphalium luteoalbum*	
Asteraceae	*Rhodanthe chlorocephala* subsp. *rosea*	
Asteraceae	*Rhodanthe floribunda*	
Asteraceae	*Rhodanthe pygmaea*	
Asteraceae	*Rhodanthe rubella*	
Asteraceae	*Schoenia cassiniana*	
Asteraceae	*Senecio pinnatifolius*	
Asteraceae	*Senecio spanomerus*	
Asteraceae	*Siloxerus multiflorus*	

Family	Taxa	Status
Asteraceae	*Sonchus oleraceus*	
Asteraceae	*Vittadinia eremaea*	
Asteraceae	*Waitzia acuminata* var. *acuminata*	
Asteraceae	*Waitzia fitzgibbonii*	
Asteraceae	*Notisia intonsa*	
Asteraceae	*Panaetia lessonii*	
Asteraceae	*Siemssenia capillaris*	
Boraginaceae	*Halgania cyanea*	
Brassicaceae	*Arabidella chrysodema*	
Brassicaceae	*Carrichtera annua*	
Brassicaceae	*Menkea australis*	
Brassicaceae	*Phlegmatospermum drummondii*	
Brassicaceae	*Stenopetalum filifolium*	
Brassicaceae	*Brassica aff. juncea*	
Campanulaceae	*Lobelia rarifolia*	
Campanulaceae	*Wahlenbergia gracilenta*	
Casuarinaceae	*Allocasuarina acutivalvis* subsp. *acutivalvis*	
Casuarinaceae	*Allocasuarina campestris*	
Casuarinaceae	*Allocasuarina corniculata*	
Casuarinaceae	*Allocasuarina spinosissima*	
Casuarinaceae	*Casuarina pauper*	
Chenopodiaceae	*Atriplex bunburyana*	
Chenopodiaceae	*Atriplex nummularia* subsp. *spathulata*	
Chenopodiaceae	*Atriplex pumilio*	
Chenopodiaceae	*Atriplex semibaccata*	
Chenopodiaceae	*Atriplex stipitata*	
Chenopodiaceae	*Enchylaena lanata*	
Chenopodiaceae	*Enchylaena tomentosa* var. *tomentosa*	
Chenopodiaceae	*Eriochiton sclerolaenoides*	
Chenopodiaceae	*Maireana convexa*	
Chenopodiaceae	*Maireana georgei*	
Chenopodiaceae	*Maireana pentagona*	
Chenopodiaceae	*Maireana trichoptera*	
Chenopodiaceae	*Maireana triptera*	
Chenopodiaceae	*Rhagodia drummondii*	
Chenopodiaceae	*Salsola australis*	
Chenopodiaceae	*Sclerolaena cuneata*	
Chenopodiaceae	*Sclerolaena diacantha*	
Chenopodiaceae	*Sclerolaena eriacantha*	
Chenopodiaceae	*Sclerolaena fusiformis*	
Chenopodiaceae	*Sclerolaena gardneri*	
Colchicaceae	*Wurmbea tenella*	
Convolvulaceae	*Wilsonia humilis*	
Crassulaceae	*Crassula colorata*	
Cupressaceae	*Callitris columellaris*	
Cupressaceae	*Callitris preissii*	
Cyperaceae	*Lepidosperma lyonsii*	
Cyperaceae	*Lepidosperma sanguinolentum*	

Family	Taxa	Status
Cyperaceae	*Schoenus nanus*	
Dilleniaceae	*Hibbertia eatoniae*	
Droseraceae	*Drosera macrantha*	
Droseraceae	*Drosera moorei*	
Ericaceae	*Leucopogon* sp. Clyde Hill (M.A. Burgman 1207)	
Euphorbiaceae	*Beyeria sulcata var. sulcata*	
Euphorbiaceae	*Euphorbia drummondii*	
Euphorbiaceae	*Euphorbia porcata*	
Fabaceae	*Acacia acuminata*	
Fabaceae	*Acacia caesaneura* (Narrow Phyllode Variant)	
Fabaceae	*Acacia colletioides*	
Fabaceae	*Acacia eremophila*	
Fabaceae	*Acacia erinacea*	
Fabaceae	*Acacia hemiteles*	
Fabaceae	*Acacia jennerae*	
Fabaceae	*Acacia murrayana*	
Fabaceae	*Acacia nyssophylla*	
Fabaceae	*Acacia prainii*	
Fabaceae	*Acacia resinimarginea*	
Fabaceae	*Acacia sibina*	
Fabaceae	*Acacia sp.*	
Fabaceae	*Acacia sp. Southern Cross* (G. Cockerton et al. WB 38518)	
Fabaceae	*Acacia tetragonophylla*	
Fabaceae	*Daviesia purpurascens*	
Fabaceae	*Glycyrrhiza acanthocarpa*	
Fabaceae	*Mirbelia microphylla*	
Fabaceae	*Senna artemisioides* subsp. *filifolia*	
Fabaceae	*Senna stowardii*	
Fabaceae	*Swainsona oliveri*	
Fabaceae	*Templetonia ceracea*	
Frankeniaceae	*Frankenia interioris*	
Gentianaceae	*Schenkia australis*	
Geraniaceae	*Erodium cicutarium*	
Geraniaceae	*Erodium crinitum*	
Geraniaceae	*Erodium cygnorum*	
Goodeniaceae	*Brunonia australis*	
Goodeniaceae	*Goodenia berardiana*	
Goodeniaceae	*Goodenia cycnopotamica*	
Goodeniaceae	*Goodenia daviesii*	
Goodeniaceae	*Goodenia havilandii*	
Goodeniaceae	*Goodenia jaurdiensis*	P2
Goodeniaceae	*Goodenia mimuloides*	
Goodeniaceae	*Goodenia occidentalis*	
Goodeniaceae	*Goodenia rosea*	
Goodeniaceae	*Goodenia* sp. #135	
Goodeniaceae	*Scaevola spinescens*	
Haloragaceae	*Haloragis trigonocarpa*	
Hemerocallidaceae	*Dianella revoluta* var. *divaricata*	

Family	Taxa	Status
Juncaginaceae	*Triglochin isingiana*	
Lamiaceae	*Hemigenia ciliata*	
Lamiaceae	*Prostanthera campbellii*	
Lamiaceae	*Prostanthera grylloana*	
Lamiaceae	*Westringia cephalantha var. cephalantha*	
Lamiaceae	*Westringia rigida*	
Lamiaceae	*Westringia* sp. Yellow Sandplain (G. Cockerton & J. Warden WB37996)	
Lauraceae	*Cassytha nodiflora*	
Loganiaceae	*Orianthera tortuosa*	
Loranthaceae	*Amyema gibberula* var. *tatei*	
Loranthaceae	*Amyema miquelii*	
Loranthaceae	*Amyema preissii*	
Loranthaceae	*Lysiana casuarinae*	
Loranthaceae	*Lysiana exocarpi* subsp. *exocarpi*	
Malvaceae	*Androcalva* sp. NC	
Malvaceae	*Hannafordia bissillii* subsp. *bissillii*	
Malvaceae	*Lawrencia diffusa*	
Malvaceae	*Lawrencia repens*	
Malvaceae	*Seringia integrifolia*	
Malvaceae	*Sida* sp. Indet. (not collected)	
Myrtaceae	*Aluta aspera* subsp. *aspera*	
Myrtaceae	*Baeckea elderiana*	
Myrtaceae	*Eucalyptus calycogona*	
Myrtaceae	*Eucalyptus corrugata*	
Myrtaceae	*Eucalyptus ebbanoensis* subsp. *ebbanoensis*	
Myrtaceae	*Eucalyptus formanii*	P4
Myrtaceae	*Eucalyptus gracilis*	
Myrtaceae	*Eucalyptus kochii subsp. plenissima*	
Myrtaceae	*Eucalyptus leptopoda*	
Myrtaceae	*Eucalyptus longicornis*	
Myrtaceae	*Eucalyptus loxophleba* subsp. *lissophloia*	
Myrtaceae	*Eucalyptus oleosa* subsp. *oleosa*	
Myrtaceae	*Eucalyptus ravida*	
Myrtaceae	*Eucalyptus salmonophloia*	
Myrtaceae	*Eucalyptus salubris*	
Myrtaceae	*Eucalyptus* sp. (Indeterminate)	
Myrtaceae	*Eucalyptus* sp. NC (sterile)	
Myrtaceae	*Eucalyptus transcontinentalis*	
Myrtaceae	*Eucalyptus vittata*	
Myrtaceae	*Eucalyptus yilgarnensis*	
Myrtaceae	*Euryomyrtus maidenii*	
Myrtaceae	*Homalocalyx thryptomenoides*	
Myrtaceae	*Hysterobaeckea ochropetala* subsp. *ochropetala*	P1
Myrtaceae	*Leptospermum fastigiatum*	
Myrtaceae	*Malleostemon tuberculatus*	
Myrtaceae	*Melaleuca eleuterostachya*	
Myrtaceae	*Melaleuca hamata*	
Myrtaceae	*Melaleuca leiocarpa*	

Family	Taxa	Status
Myrtaceae	*Melaleuca nematophylla*	
Myrtaceae	*Melaleuca vinnula*	
Myrtaceae	*Rinzia carnosa*	
Myrtaceae	*Thryptomene kochii*	
Myrtaceae	*Thryptomene urceolaris*	
Orchidaceae	*Cyanicula amplexans*	
Orchidaceae	*Pterostylis tryphera*	
Orchidaceae	*Thelymitra petrophila*	
Phyllanthaceae	*Poranthera microphylla*	
Pittosporaceae	*Cheiranthera filifolia*	
Pittosporaceae	*Pittosporum angustifolium*	
Poaceae	*Amphipogon caricinus*	
Poaceae	*Aristida contorta*	
Poaceae	*Austrostipa blackii*	P3
Poaceae	*Austrostipa elegantissima*	
Poaceae	*Austrostipa eremophila*	
Poaceae	*Austrostipa nitida*	
Poaceae	*Austrostipa platychaeta*	
Poaceae	*Austrostipa pycnostachya*	
Poaceae	*Austrostipa* sp.	
Poaceae	*Austrostipa trichophylla*	
Poaceae	*Cynodon dactylon*	
Poaceae	*Eragrostis dielsii*	
Poaceae	*Lachnagrostis filiformis*	
Poaceae	*Monachather paradoxus*	
Poaceae	*Neurachne annularis*	P3
Poaceae	*Poaceae* sp. #115 fine terete leaf to 0.1m tall	
Poaceae	*Rytidosperma caespitosum*	
Poaceae	*Rytidosperma* sp. #6	
Poaceae	*Triodia rigidissima*	
Poaceae	*Triodia scariosa*	
Polygalaceae	*Comesperma integerrimum*	
Polygonaceae	*Persicaria prostrata*	
Polygonaceae	*Rumex vesicarius*	
Portulacaceae	*Calandrinia baccata*	
Proteaceae	*Grevillea acuaria*	
Proteaceae	*Grevillea berryana*	
Proteaceae	*Grevillea erectiloba*	P4
Proteaceae	*Grevillea paradoxa*	
Proteaceae	*Grevillea zygoloba*	
Proteaceae	*Hakea minyma*	
Proteaceae	*Persoonia coriacea*	
Pteridaceae	*Cheilanthes adiantoides*	
Pteridaceae	*Cheilanthes sieberi*	
Rhamnaceae	*Cryptandra crispula*	P3
Rhamnaceae	*Stenanthemum stipulosum*	
Rubiaceae	*?Opercularia* sp. #105	
Rutaceae	*Phebalium ?tuberculosum x canaliculatum*	

Family	Taxa	Status
Rutaceae	*Phebalium ?tuberculosum x lepidotum*	
Rutaceae	*Phebalium aff. tuberculosum*	
Rutaceae	*Phebalium canaliculatum*	
Rutaceae	*Phebalium filifolium*	
Rutaceae	*Phebalium laevigatum*	
Rutaceae	*Phebalium lepidotum*	
Rutaceae	*Phebalium* sp. Helena & Aurora Range v shaped leaf in TS (G. Cockerton WB35642)	
Rutaceae	*Phebalium* sp. Mt Dimer 10A (G. Cockerton & S. Fox WB38086)	
Rutaceae	*Phebalium* sp. Mt Dimer 10B (G. Cockerton & S. Fox WB38087)	
Rutaceae	*Phebalium tuberculosum*	
Rutaceae	*Philotheca brucei* subsp. *brucei*	
Rutaceae	*Philotheca coateana*	P3
Santalaceae	*Exocarpos aphyllus*	
Santalaceae	*Santalum acuminatum*	
Santalaceae	*Santalum spicatum*	
Sapindaceae	*Dodonaea adenophora*	
Sapindaceae	*Dodonaea divaricata*	
Sapindaceae	*Dodonaea lobulata*	
Sapindaceae	*Dodonaea microzyga* var. *acrolobata*	
Sapindaceae	*Dodonaea pinifolia*	
Sapindaceae	*Dodonaea stenozyga*	
Scrophulariaceae	*Eremophila aff. granitica* (G. Cockerton & S. Fox WB38088)	
Scrophulariaceae	*Eremophila aff. granitica* (WB38088)	
Scrophulariaceae	*Eremophila alternifolia*	
Scrophulariaceae	*Eremophila caerulea* subsp. *merrallii*	P4
Scrophulariaceae	*Eremophila caperata*	
Scrophulariaceae	*Eremophila clarkei*	
Scrophulariaceae	*Eremophila decipiens* subsp. *decipiens*	
Scrophulariaceae	*Eremophila granitica*	
Scrophulariaceae	*Eremophila hamulata*	
Scrophulariaceae	*Eremophila interstans* subsp. *interstans*	
Scrophulariaceae	*Eremophila ionantha*	
Scrophulariaceae	*Eremophila oldfieldii* subsp. *angustifolia*	
Scrophulariaceae	*Eremophila oppositifolia* subsp. *angustifolia*	
Scrophulariaceae	*Eremophila scoparia*	
Solanaceae	*Solanum cleistogamum*	
Solanaceae	*Solanum hoplopetalum*	
Solanaceae	*Solanum nummularium*	
Solanaceae	*Solanum plicatile*	
Stylidiaceae	*Stylidium dielsianum*	
Zygophyllaceae	*Roepera apiculata*	
Zygophyllaceae	*Roepera aurantiaca*	
Zygophyllaceae	*Roepera ovata*	
#N/A	*Unknown NC Climber*	