



**Western
Botanical**

Flora and Vegetation Assessment, Leonora Gold Project
JUNE 2019

Prepared for: Kin Mining Pty Ltd

Report Ref: WB903



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2 Including discussion of Land Systems and Groundwater Dependent Ecosystems.	G. Cockerton	G. Cockerton	9 th June 2019

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Executive Summary

Kin Mining Pty Ltd (Kin) is in the process of seeking approval to develop the Leonora Gold Project (LGP) comprised of a series of adjoining tenements some 31 km east and north-east of Leonora (the Study Area), Figure 1. Western Botanical (WB) was commissioned to undertake an assessment of the flora and vegetation associations of the 139 sq. km Study Area in support of a Mining Proposal.

A desktop assessment of (i) any listed Threatened Ecological Communities (TECs) and Priority Ecological Communities (PECs); and (ii) likely conservation significant flora in the region was undertaken prior to the field works by Kin and the results supplied to WB. These were then assessed for likelihood of occurrence within the Study Area based on distribution, habitat preference and land systems of the Study Area.

Field surveys were undertaken over two events, 10th to 19th October 2018 and 5th to 17th February 2019 inclusive of travel, a period of 21 days with 17 days spent actively conducting assessments in the field. Vegetation was described using 74 advanced Relevés (projected foliar cover estimated for each species present), extensive in-vehicle and on-foot traverses and mapped at NVIS Level 5 *Association*. The majority of flora was collected for reference material and all species were identified using the resources of the WA Herbarium with reference to Western Botanical's reference herbarium. Species with conservation significance were mapped and species profiles generated for each vegetation association.

The Study Area intersects nine Land Systems – which are generally well represented in both the local and broader region, though often demonstrating disjunct occurrences. It includes extensive areas of (i) saline flats supporting chenopod shrublands in its central region; (ii) extensive non-saline washplains in the north and south; and (iii) substantial areas of gabbro and basalt hills in the south-east. Flora associated with the (i) saline flats and (ii) gabbro or basalt hills respectively have a high degree of correlation with their respective habitat types and can be predicted reasonably consistently in the local region. Flora of non-saline colluvial plains can be quite variable, dependent upon depth of soil over hardpan, underlying geology and soil moisture availability, inferred soil chemistry, and the frequency and duration of sheet flow or inundation.

Fifty one vegetation associations were recognised within the LGP Study Area. This relatively large number of community types is partially due to (i) the detail of mapping, (ii) the interplay between complex geological, topographic, hydrological and salinity factors within the Study Area and (iii) the elongated linear nature of the northern part of the Study Area extending some 36.8 km north-south from the Leonora – Laverton road to the Mertondale deposit area.

Table 1. Vegetation Groups of the Study Area

Vegetation Group	Number of Vegetation Associations at NVIS 5
1. Mulga Woodlands over Perennial Non-Halophytic Shrubs on hills and plains	17
2. Mulga Shrublands / Woodlands over Perennial Grasses on Plains	2
3. Acacia Woodlands over Shrubs and Grasses in Major Drainage Lines and Groves	3
4. Acacia (other than Mulga) Shrublands on Stony Hills	4
5. Acacia papyrocarpa Woodlands	4
6. Acacia victoriae Shrubland over Chenopods on Calcrete Plains	1
7. Perennial Grasslands	2
8. Hakea preissii and/or Halophytic Chenopod Shrublands	13 including 1 devoid of perennial vegetation
9. Casuarina pauper Woodland on Calcrete Outcrops	1
10. Claypans	2
11. Breakaway Complex	1 Vegetation Complex

Two hundred and thirty six species (including subspecies and varieties) from 102 genera and 42 families, inclusive of 224 native endemic species and species 12 weed species. Annuals and geophytes were largely absent due to the dry seasonal conditions prevailing at the time of both surveys. Combining the species lists from the Stantec 2017, 2018a and 2018b studies and the current works, the total flora statistics stands at around 321 species from 132 genera and 44 families, inclusive of 18 weed species, with doubtful species omitted and misidentified species corrected as best as possible.

No Threatened Flora species listed under the Biodiversity Conservation Act 2016 (WA) and no species listed under the EPBC Act 1999 (C'wlth) were encountered and none are expected in the immediate vicinity of the Study Area. Of the 224 native flora species encountered, three species (*Acacia* sp. Marshall Pool (G Cockerton 3024), *Cratystylis centralis* and *Eremophila annoscaulis*) are listed at Priority 3 Flora by the Department of Biodiversity, Conservation and

Attractions. The record of *Cratystylis centralis* lies outside the Study Area but is adjacent to the existing Cardinia access road. A fourth species, *Gunniopsis propinqua* P3, was recorded by Stantec (2017, 2018a), however, the seasonal conditions prevailing at the time of this study precluded this species from being observable.

Two collections appear to represent species new to science and are recognised here for the first time. The first is here labelled *Hibiscus* sp. Perrinvale Station (J. Warden & E. Ager WB10581), a shrub to 1m, and was confirmed at five points within the Study Area with a further four points possibly representing this species. All sites are on stony ground or hills with either chert, ironstone or basalt rocks prevalent at the surface. Seven of the nine sites occur near the proposed mine infrastructure in north-east of the existing Cardinia development envelope while two sites occur on stony chert hills in the south of the Cardinia development envelope. *Hibiscus* sp. Perrinvale Station (J. Warden & E. Ager WB10581) has been previously collected by Western Botanical on a low banded ironstone range on Perrinvale Station, on the eastern shore of Lake Barlee, some 170 km west-south-west of the LGP and 132 km north-west of Menzies. The second species is here labelled *Centrolepis* sp. Leonora (G. Cockerton & G. Grigg WB40071) and is a small herb to 5 cm high. It was recorded in association with Mulga and *Ptilotus obovatus* upright form in the region north of the Cardinia development envelope.

Of the 12 weed species encountered, the majority are small, non-invasive, widely naturalised and not of concern. One is a Weed of National Significance (*Cylindropuntia fulgida* var. *mamillata*), occurring just outside the Study Area; and one is a recognised invasive species, *Cenchrus ciliaris* (Buffel Grass) found within the southern portion of the Study Area, an artefact of historical and current Pastoral land use in the region.

Recommendations

In order to address some of the listed priority flora, poorly collected or suspected novel species within the Study Area, the following recommendations are made:

1. Undertake an assessment of the population numbers and distribution of *Eremophila annoscaulis* Priority 3 within the Study Area and known locations nearby the Study Area to determine the local population and potential proportional impacts to this species in development of the LGP. Strategies of either avoiding disturbance, or allowable proportional impact to this species in development of the LGP, can therefore be appraised.
2. Undertake a recollection and assessment of *Centrolepis* sp. Leonora (G. Cockerton & G. Grigg WB40071) to (i) confirm its taxonomic status and (ii) determine its distribution, population numbers and potential impacts to the species within the Study Area in development of the LGP.
3. Undertake a recollection and assessment of *Hibiscus* sp. Perrinvale Station (J. Warden & E. Ager WB10581) within the Study Area and in areas of similar geology and landform outside the Study Area to (i) confirm its taxonomic status; and (ii) determine its distribution, population numbers and potential impacts to the species within the Study Area in the Cardinia development envelope.
4. During appropriate seasonal conditions, undertake an assessment of annual species throughout the current Study Area. Particular focus should be given to the areas on the fringes of the saline damp lands which may support conservation significant flora known in the region but not yet recorded within the Study Area due to prevailing seasonal conditions during the current study.

1. Introduction

Kin Mining Pty Ltd (Kin) is in the process of seeking approval to develop the Leonora Gold Project (LGP) comprised of a series of adjoining tenements some 31 km east and north-east of Leonora (the Study Area), Figure 1. Western Botanical (WB) was commissioned in mid 2018 to undertake an assessment of the flora and vegetation associations of the 139 sq. km Study Area in support of a Mining Proposal.

1.1. Previous Surveys

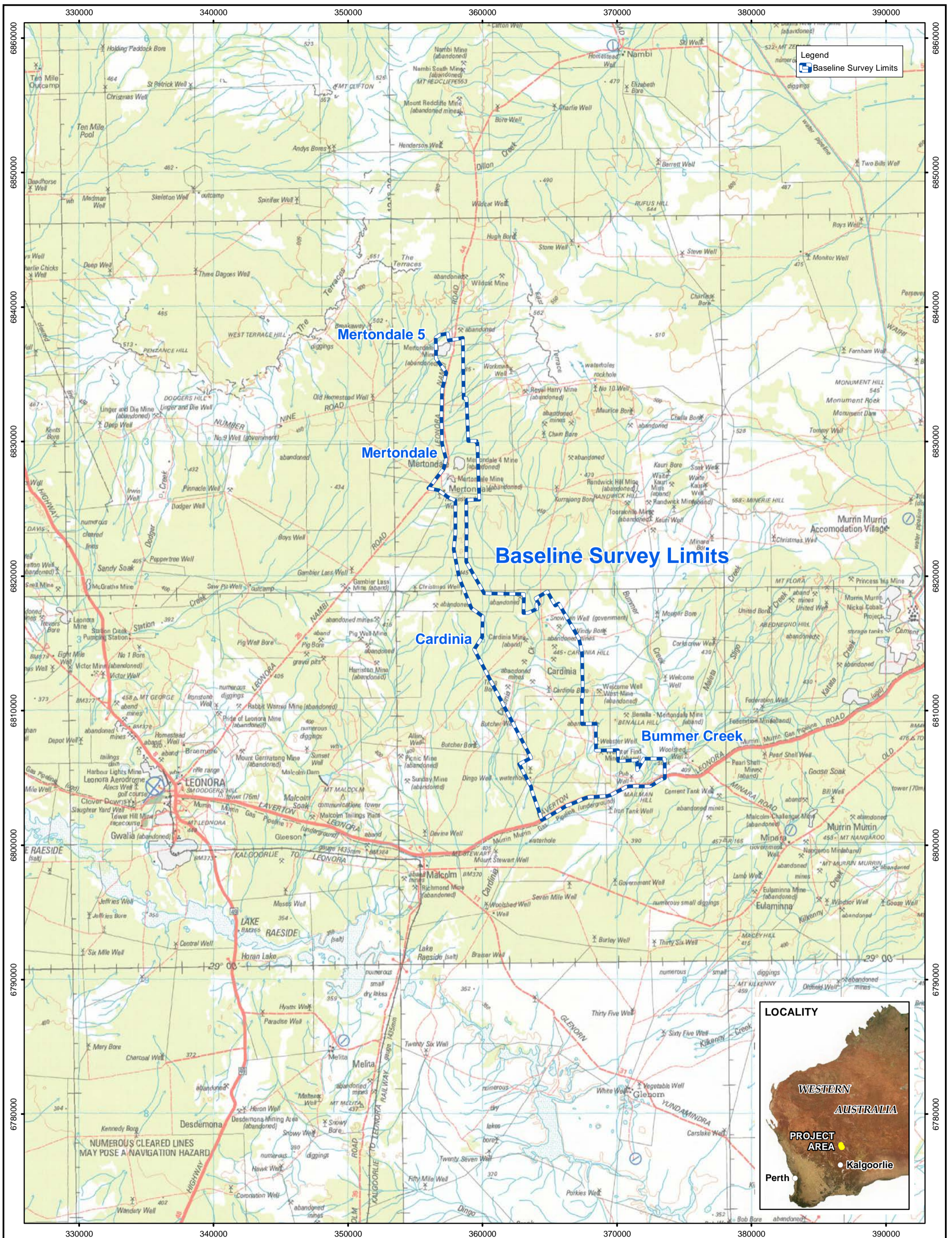
Flora and vegetation of portions of the Study Area have been assessed in the recent past by Stantec Pty Ltd, Table 2.

Table 2. Previous Assessments

Author, Date	Title	Summary Findings
Stantec 2017	Leonora Gold Project: Level 1 Flora, Vegetation and Fauna Assessment	Survey of two areas in two events: eight days field assessment in Nov-Dec 2016 and three days in May 2017 at a total of 66 releve sites. Two hundred and fifty seven flora species including one Priority 3 taxon <i>Gunniopsis propinqua</i> , a putative hybrid <i>Acacia</i> sp. nov. aff. <i>resinimarginea</i> ¹ and eight weeds including one weed of National Significance (WoNS), <i>Cylindropuntia fulgida</i> var. <i>mamillata</i> , were recorded. Four broad habitat types were recognised.
Stantec 2018a	Leonora Gold Project Proposed Mertondale Haul Road and Pipeline Deviation and Cardinia Access Road Flora, vegetation and Fauna Report	Assessment of flora, vegetation and fauna of relatively narrow linear alignments for proposed haul road and pipeline from Myrtondale prospect to the LGP proposed processing facility and the Cardinia Access Road. Field study over 5 days at 14 releve sites. Findings included 14 vegetation types and 120 flora species with no conservation-significant flora noted.
Stantec 2018b	Leonora Gold Project Flora and Fauna Extrapolation Exercise Report	Desktop and short reconnaissance survey in March 2018 expanding the vegetation mapped around the Cardinia site from previously ground truthed surveys.
Western Botanical 2018	Regional survey for <i>Acacia</i> sp. Marshall Pool (G. Cockerton 3024)	Regional survey for <i>Acacia</i> sp. Marshall Pool (G. Cockerton 3024) incorporating the results of a targeted assessment of <i>Acacia</i> sp. Marshall Pool within a portion of the Leonora Gold Project tenements.

¹ *Acacia* sp. nov. aff. *resinimarginea* was later verified as a new species, *Acacia* sp. Marshall Pool (G. Cockerton 3024) and subsequently listed as Priority 3 by DBCA.

Figure 1. Study Area



Source: Topography: GSA

Consultant

Layout

0 2,800 5,600 m
 Scale: 1:250,000
 MGA94 (Zone 51)
 CAD Ref: a2553_Veg_WB_01_01
 Date: May 2019 Rev: A A3

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**Leonora Gold Project
 Locality**

1.2. Current Survey

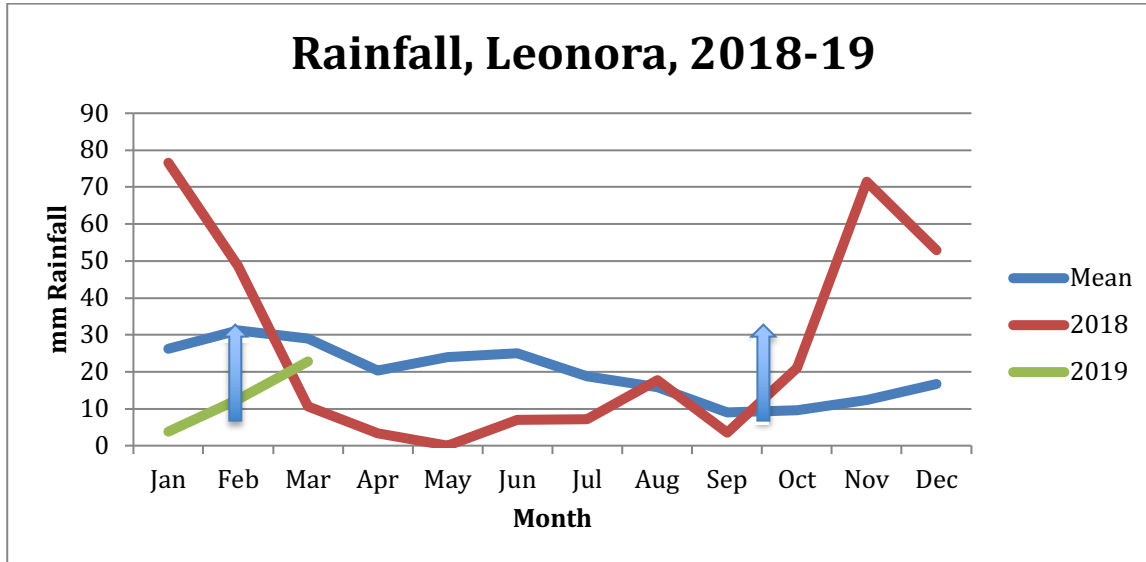
The Study Area consists of a 139 sq. km (13945.84 ha) polygon extending northwards from the Leonora – Laverton road to the mining prospects north of the proposed Leonora Gold Project (LGP) Cardinia Processing Facility and included a narrow linear alignment extending northwards to the old Mertondale minesite. The area formally assessed in this survey excludes most areas previously mapped by Stantec (2017, 2018a, 2018b) at the Cardinia site and around three prospects to the north, though observations of flora and vegetation were conducted within these areas as necessary. Given the narrow proposed haul road and pipeline alignment from Cardinia northwards to Mertondale, this area was included in the current works program and therefore vegetation mapping here supersedes that prepared by Stantec.

1.3. Physical Environment

1.3.1. Climate

The mean rainfall recorded at Leonora over the period 1989 – 2019 is 238.1 mm with a distinct summer maximum experienced from November to February associated with summer thunderstorm and cyclonic events. The period April to October tends to be dry with less than 20mm recorded monthly.

Figure 2. Rainfall Leonora



Arrows indicate Survey timing: October 2018 and February 2019.

1.4. Biological Environment

1.5. Interim Biogeographic Regionalisation of Australia

The Study Area lies within the MUR 1 eastern Murchison biogeographic sub region which includes broad vegetation assemblages characterised by (i) Mulga (*Acacia aneura* and its allies) woodlands on hardpan plains; (ii) Mulga over perennial Wanderrrie Grasses on shallow sandy soils, (iii) Spinifex hummocked grasslands on deeper sandplains, (iv) *Acacia* shrublands on stony hills, (v) minor breakaways with associated kaolinised slopes, (vi) Drainage tracts with Mulga and other *Acacia* species and (vii) Saline plains supporting Samphire and other chenopods. These broad vegetation formations are widespread within the Murchison biogeographic region.

1.6. Land Systems

Land Systems are broad areas of similar geology, landscape and vegetation mapped by the Department of Agriculture (DoA 1994). Nine Land Systems are present within the Study Area, Table 3, Figure 3. These are also grouped with underlying geology and soils noted in Table 4.

Rocky hills in the Study area are represented by the Laverton, Leonora and Wyarri Land Systems. The Laverton Land system with its greenstone metagabbro and basalt geology is prevalent in the south and south-east of the Study Area and support the well known *Acacia* sp. Marshall Pool (Priority 3) on non-saline soils. This is also present south and west of the Study area and supports a similar suite of species including *Acacia* sp. Marshall Pool. The Leonora Land System also has the underlying greenstone geology but has saline soils supporting halophytic shrublands. The Wyarri Land System with its granitic geology is only present in a small part of the northern extent of the transport corridor near the Mertondale prospect.

Irregular plains with low rises are comprised of the Nubev Land System with limonitic (iron rich) geology and saline soils while the Violet Land System also has a predominantly limonitic geology but generally has non-saline soils. These may support populations of *Eremophila annoscaulis* (Priority 3).

Washplains with underlying hardpan are represented by the Monk Land System as well as the Jundee (gravely hardpans) and Rainbow (hardpan) Land Systems. These support varying communities with a Mulga overstorey.

Stony Plains and lower alluvial plains with saline soils and halophytic shrublands are represented by the Gundockerta land system with extensive calcrete and associated alkaline soils.

Broad drainage tracts, and associated outwash hardpan plains supporting Mulga or *Acacia* are represented by the Monk Land System with sandy soils supporting Mulga (Cardinia Creek) and the Monitor Land System with sandy soil supporting Mulga (and/or *Acacia burkittii*) (Bummer Creek and associated outwash plain).

Table 3. Land Systems of the Study Area

Land Type	Land System	Description	Area (ha) within Study Area	Percentage of the Study Area	Total Area (ha) within the North-Eastern Goldfields	Percentage of the area of the NE Goldfields
Hills with <i>Acacia</i> shrublands	Laverton	Ridges and hills on greenstone and basalt with <i>Acacia</i> , <i>Ptilotus obovatus</i> , <i>Maireana sedifolia</i> shrublands	803.58	5.76%	10,590,000	0.0143%
	Wyarri	Granite domes, hills and tor fields with gritty surfaced fringing plains supporting Mulga and Granite Wattle (<i>Acacia quadrimarginea</i>)	85.03	0.61%	8,710,000	0.0010%
Irregular plains and low rises supporting Mulga, Bowgada and halophytic shrublands	Nubev	Gently undulating plains and low rises with limonite above alluvial plains with saline soils supporting Mulga and halophytic <i>Maireana pyramidata</i> , <i>M. sedifolia</i> shrublands	2,501.08	17.93%	14,050,000	0.0178%
	Violet	Undulating plains with stony and gravely mantles and low rises with limonite supporting Mulga (SIMS) shrublands	1,295.09	9.29%	16,110,000	0.0080%
Low hills with eucalypt or <i>Acacia</i> – halophyte shrublands	Leonora	Low hills and plains on greenstone with ironstone ridges supporting mixed stony chenopod (<i>Maireana pyramidata</i> , <i>M. sedifolia</i>) shrublands on plains	2,229.73	15.99%	10,740,000	0.0208%
Stony Plains and lower alluvial plains with saline soils and halophytic shrublands	Gundockerta	Extensive gently undulating calcareous plains with stony mantles and lower alluvial tracts on weathered greenstone supporting Bluebush shrublands	3,003.40	21.54%	21,050,000	0.0143%

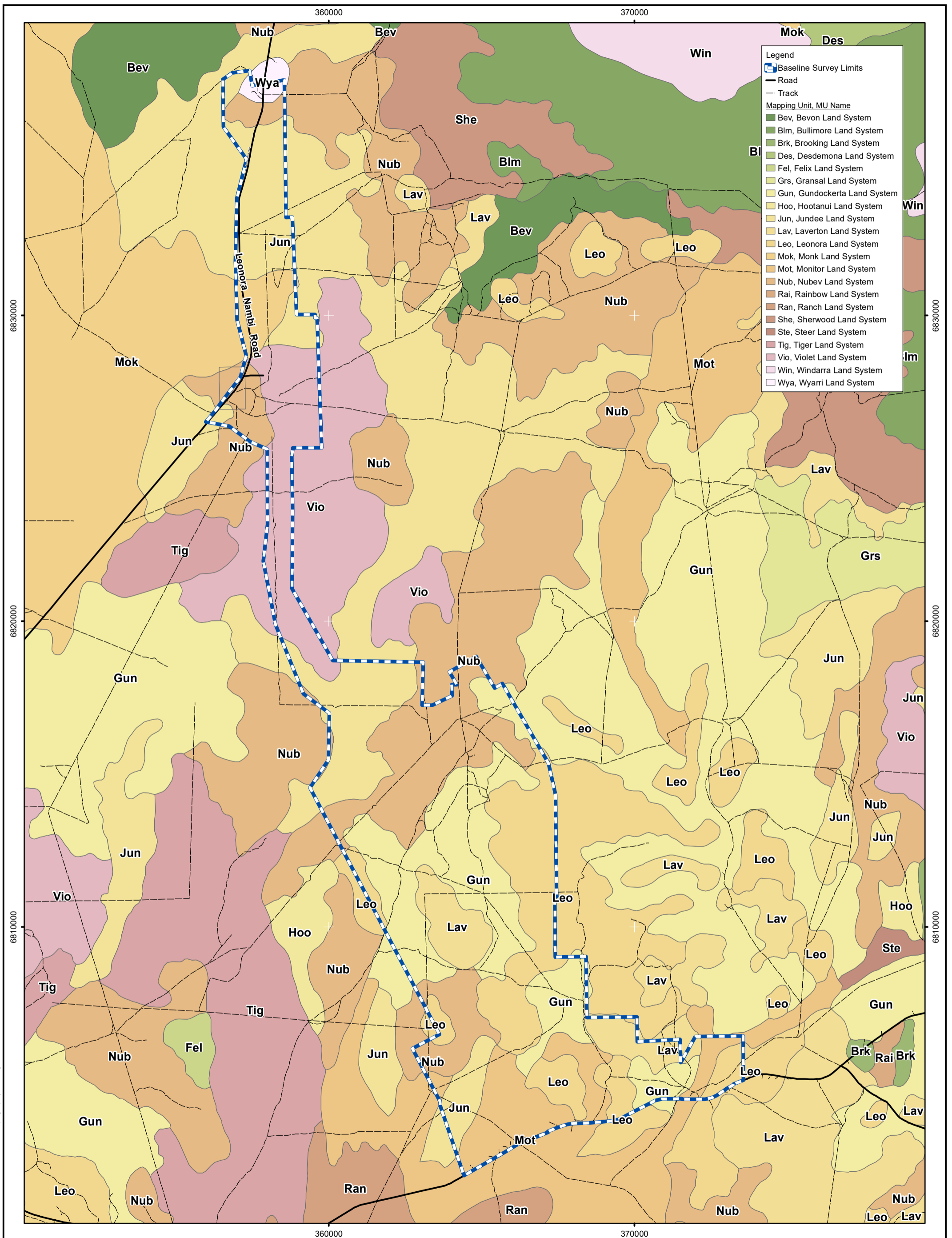
Land Type	Land System	Description	Area (ha) within Study Area	Percentage of the Study Area	Total Area (ha) within the North-Eastern Goldfields	Percentage of the area of the NE Goldfields
Washplains and sandy tracts on hardpan, with Mulga and Wanderrie grasses	Monk	Hardpan plains with occasional sandy banks supporting Mulga Shrublands (HPMS, GRMU) and Wanderrie grasses (MUWA)	363.23	2.60%	81,620,000	0.0004%
	Monitor	Alluvial fans and wash plains receiving distributary flow from adjacent greenstone systems	1,171.08	8.40%	5,630,000	0.0208%
Washplains on hardpan with Mulga Shrublands	Jundee	Level to very gently inclined hardpan wash plains with mantles of fine ironstone gravel supporting Mulga shrublands	2,493.40	17.88%	26,560,000	0.0094%
Total			13,945.84	100%		

Table 4. Land Types and Land Systems with Underlying Geology and Soils.

Land Type	Land System (underlying Geology or soil type)
Hills with <i>Acacia</i> shrublands	Laverton (Greenstone), Wyarri (Granite)
Low hills with eucalypt or <i>Acacia</i> – halophyte shrublands	Leonora (Greenstone, Ironstone)
Irregular plains and low rises supporting Mulga, Bowgada and halophytic shrublands	Nubev (Limonite, saline), Violet (Limonite, non-saline)
Stony Plains and lower alluvial plains with saline soils and halophytic shrublands	Gundockerta (Calcrete)
Washplains and sandy tracts on hardpan, with Mulga and Wanderrie grasses	Monk (hardpan)
Washplains on hardpan with Mulga Shrublands	Jundee (gravely soils), Rainbow (hardpan)
Broad drainage tracts, hardpan plains supporting Mulga or <i>Acacia</i>	Monk (sandy soils supporting Mulga), Monitor (sandy soil supporting <i>Acacia burkittii</i> and/or Mulga)

The representation of each land system within the Study Area represents very small proportions of the overall area of each Land System within the north-eastern Goldfields: between 0.0208% (Leonora and Monitor Land Systems) to 0.004% (Monk Land System). At this broad scale, the Study Area incorporates very minor proportions of each of the Land Systems mapped in the entire north-eastern Goldfields in a regional sense.

Figure 3. Land Systems of the Study Area



Source: Land Systems: DPIRD, Tenements: DMIRS, Topography: Landgate

Consultant

Layout

0 1,250 2,500m

Scale: 1:110,000
MGA94 (Zone 51)

CAD Ref: a2553_Veg_WB_02_01
Date: Jun 2019 | Rev: B | A3

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Author: G Cockerton | KM Ref:
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Leonora Gold Project Rangelands Soil Landscape

1.7. Beard Pre-European Vegetation

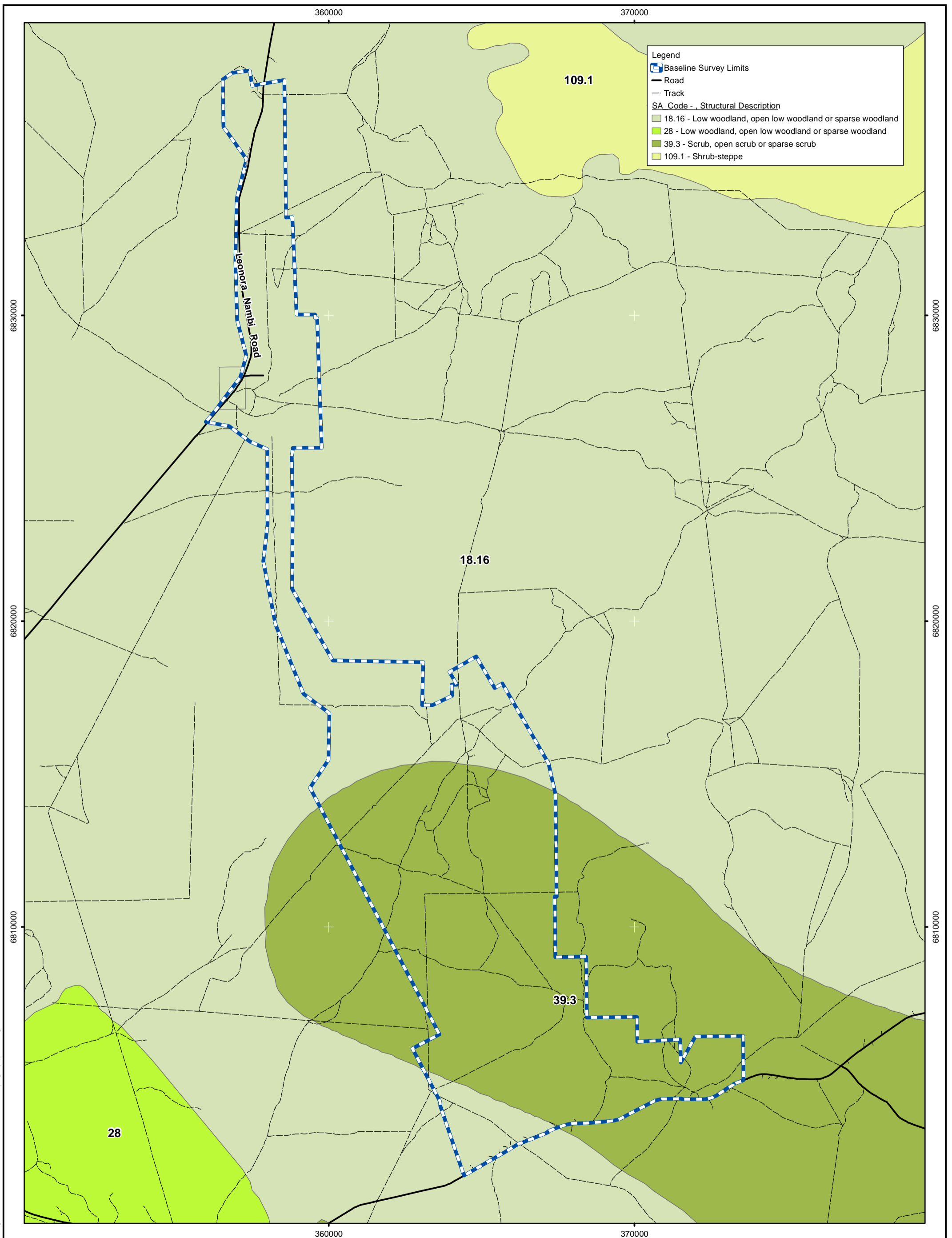
The Beard (1976) Pre-European vegetation mapped at a scale of 1:1 million is useful in defining only the broadest vegetation units within the Study Area and across the region, Table 5 . Unit 18.16 Low Woodlands, low open woodland or sparse woodland representing the areas dominated by Mulga and other *Acacia* species; and unit 39.3 Scrub, open scrub or sparse scrub represent the low halophytic chenopod shrublands (*Tecticornia*, *Maireana* shrublands) prevalent in the south-central portion of the Study Area and common to salt lake margins in the region.

Table 5. Representation of Beard Pre-European Vegetation within the Study Area

Beard (1976) Unit	Area Within the Study Area (ha)	% of the Study Area
Unit 18.16 Low Woodlands, low open woodland or sparse woodland representing the areas dominated by Mulga and other <i>Acacia</i> species	6,181.84	44.3%
Unit 39.3 Scrub, open scrub or sparse scrub represent the low halophytic chenopod shrublands (<i>Tecticornia</i> , <i>Maireana</i> shrublands)	7,764 .00	55.7%

These broad scale units are very generalised and are not particularly useful for analysis of vegetation associations within the Study Area at the level of detail required for environmental impact assessment.

Figure 4. Pre-European Vegetation of the Study Area



Legend

- Baseline Survey Limits
- Road
- Track

SA Code - , Structural Description

- 18.16 - Low woodland, open low woodland or sparse woodland
- 28 - Low woodland, open low woodland or sparse woodland
- 39.3 - Scrub, open scrub or sparse scrub
- 109.1 - Shrub-steppe

Source: Pre European Vegetation: DP/PRD, Tenements: DMIRS, Topography: Landgate

<p>Consultant</p>	<p>Layout</p>	<p>0 1,250 2,500m</p> <p>Scale: 1:110,000 MG94 (Zone 51)</p>	<p>KIN MINING NL PO Box 565, Mt Hawthorn, WA 6915 www.kinmining.com.au</p>	<h2 style="margin: 0;">Leonora Gold Project</h2> <h3 style="margin: 0;">Pre European Vegetation</h3>
		<p>CAD Ref: a2553_Veg_WB_03_01</p> <p>Date: May 2019 Rev: A A3</p>	<p>Author: G Cockerton KM Ref:</p> <p>Drawn: CAD Resources - www.cadresources.com.au</p> <p>Tel: (08) 9246 3242 ~ Fax (08) 9246 3202</p>	

2. Methods

2.1. Desktop Survey

The Desktop Assessment conducted prior to the field survey included a review of results of a recent interrogation of the Department of Biodiversity, Conservation and Attractions (DBCA) WA Herbarium (WAHERB) Threatened and Priority Flora (TPFL) databases conducted by Stantec in August 2018 and provided to WB by Kin. The database search was regarded as current, having been implemented two months prior to the first round of field assessment. Reports prepared by Stantec for Kin (Stantec 2017, 2018a, 2018b) were also reviewed and names of flora were checked against those known in the region by the author and against a NatureMap database search centred on the Study Area.

2.2. Field Survey

The field survey consisted of the Study Area being traversed in-vehicle and on-foot by Senior Botanist Geoff Cockerton and Senior Field Technician Ms. Gemma Grigg supplied by Kin. Surveys were conducted over two periods: 10th to 19th October 2018 and 5th to 17th February 2019 inclusive of travel, a period of 21 days with 17 days spent actively spent conducting assessments in the field. Field assessment consisted of mapping vegetation associations at the NVIS Level 5 '*Association*' level of detail where the three dominant flora species in each stratum observed was used to define vegetation units.

Field maps consisted of (i) 1:7,500 scale laminated A2 aerial photographs for the majority of the southern portion of the Study Area and (ii) 1:12,500 A4 non-laminated aerial photographs for additions to the Study Area in the second round of field works, inclusive of the alignment from Cardinia to Mertondale. CAD Resources provided an electronic tablet with high resolution recent aerial photography of the entire Study Area which was extremely useful in interrogating areas at higher resolution than the hard copy maps allowed.

Vegetation units were described at 74 Relevé sites where representative photographs were taken, comprehensive species profiles were assembled and assessment sites recorded using hand held GPS (typically +/- 5m accuracy) with all data entered directly into a laptop and coded polygons drawn onto field maps. In all cases, community boundaries are presented at +/- 50 to 100m accuracy.

The majority of flora was collected for reference, with each specimen being allocated a unique field collection number and any specimens not readily identified in the field were then assessed using the resources of the Western Botanical reference herbarium, the Western Australian Herbarium (WAHERB), appropriate on-line resources and published texts. Specimens of challenging taxa were reviewed by Dr. David Leach (WB). Some flora were also photographed in the field for future reference. Populations of flora with known Conservation listing were recorded using GPS.

Given large amount of historical mining, exploration and Pastoral activity in the large Study Area, numerous tracks were present for vehicular access. However, large areas of the region south of Cardinia lacked trafficable access routes and some off-track driving and walking was required to access areas for mapping and investigation of flora and vegetation.

2.3. Statistical Analysis

Statistical analysis of the advanced Relevé data was conducted by entering into proprietary Microsoft Access database (developed by Griffin 2012). Statistical analysis of these sites was conducted to investigate floristic similarity amongst sites, groupings of sites, and the relationships amongst groupings. Projected foliage cover (PFC) for each species was used to incorporate dominance of key species within vegetation association groupings.

All annual species, weed species, and singleton species (those occurring at only one site) were excluded from the dataset to minimize noise within analysis and interpretation of results. A small number of taxa were merged for the purposes of analysis:

- Taxa with uncertain determination (e.g. *Acacia ?aneura*) were assumed correct and merged with records of certain determination (*Acacia aneura*).
- Hybrid taxa (typically mulga and *Senna* identities) were merged with their first/dominant component of their hybridity.
- Taxa of the same species but different form/forma were merged where no difference in habitat was found during field survey.

The option to remove non-discriminatory (less important) species from the analysis in order to reduce ordination stress was discounted in favour of retaining such species that may be important for determining finer-scale vegetation associations.

Analysis of flora data was conducted using PATN v3.12 statistical package software (Blatant Fabrications 2004). Association (Bray and Curtis), Classification (Flexible UPGMA Agglomerative Hierarchical Fusion), and Ordination (Semi-Strong Hybrid) components of PATN were utilised in the analysis. The primary output produced was a dendrogram of site (quadrat) similarity/dissimilarity with suggested broad vegetation association groupings provided by PATN

3. Results and Discussion

3.1. Desktop Survey

Results of the desktop assessment are presented in Table 7, Table 7 and Figure 5. Information known to the author on the presence of *Acacia* sp. Marshall Pool (G. Cockerton 3024) P3 and preferred habitats of species, combined with their known distributions both nearby the Study Area and within the region, have been used to develop a Likelihood of Occurrence ranking.

Table 6. Likelihood of Occurrence

WB Assessment	Description	Stantec (2018) Assessment
Known to be present	Species is Known to be Present , has been verified within the Study Area though it's entire distribution may not be mapped and population numbers may be tentative at present.	
Probable	Based on habitat preference of the species, similar habitats within or adjoining and contiguous with the Study Area, and geographical distribution of the species in close proximity to the Study Area, it is Probable that the species may occur within the Study Area.	Very Likely
Possible	Based on habitat preference of the species, similar habitats present within the Study Area and proximal geographical distribution of the species, it is Possible that the species may occur within the Study Area.	Likely
Unlikely	Based on habitat preference of the species, suitable habitats absent within the Study Area and distant geographical distribution of the species, it is Unlikely that the species may occur within the Study Area.	

Table 7. Desktop Assessment of Likelihood of Conservation Significant Flora being present within the Study Area.

Species	Cons_Status	Source	Preferred Habitat	Likelihood of Occurrence within Kin Tenements (Stantec 2017 Assessment)
Acacia sp. Marshall Pool (G. Cockerton 3024)	P3	WAHERB, Stantec, Western Botanical	Upper slopes of gabbro and basalt hills	Known to be present
Gunniopsis propinqua	P3	WAHERB, Stantec	Samphire and Frankenia Shrublands, Saline Claypans	Known to be Present
Angianthus prostratus	P3	TPFL, WAHERB	Samphire Shrublands, Saline Claypans	Probable, (Very Likely)
Triglochin protuberans	P3	WAHERB	Drainage lines, margins of claypans	Probable (Likely)
Acacia websteri	P1	WAHERB	Drainage areas	Possible, (Very Likely)
Calandrinia quartzitica	P1	WAHERB	Samphire and Frankenia Shrublands, Saline Claypans	Possible
Stenanthemum patens	P1	TPFL, WAHERB	Stony chert, quartz and lateritic hills, granite breakaways	Possible (Likely)
Calytrix hislopii	P3	WAHERB	Lateritic and BIF hills, scree slopes	Possible
Calytrix praecipua	P3	WAHERB	Weathered granite and ironstone breakaways	Possible, (Very Likely)
Cratystylis centralis	P3	WAHERB	Calcrete expressions, non-saline	Possible, (Very Likely), known outside the Study Area
Eremophila annoscaulis	P3	WAHERB	Stony hills and associated plains	Possible (Likely)
Eremophila shonae subsp. diffusa	P3	WAHERB	Stony ironstone hill tops	Possible
Eremophila simulans subsp. megacalyx	P3	WAHERB	Stony ironstone hill tops	Possible
Eremophila veronica	P3	WAHERB	Hills, plains, drainage areas	Possible
Goodenia lyrata	P3	TPFL, WAHERB	Drainage areas, claypans	Possible (Possible)

Species	Cons_Status	Source	Preferred Habitat	Likelihood of Occurrence within Kin Tenements (Stantec 2017 Assessment)
<i>Hybanthus floribundus</i> subsp. <i>chloroxanthus</i>	P3	WAHERB	Creeklines associated with gabbro and basalt outcrops	Possible
<i>Micromyrtus serrulata</i>	P3	WAHERB	Stony lateritic, granitic, BIF hills	Possible
<i>Phyllanthus baeckeoides</i>	P3	TPFL	Creeklines associated with lateritic hills	Possible
<i>Grevillea inconspicua</i>	P4	TPFL, WAHERB	Gabbro and basalt outcrops	Possible (Likely)
<i>Hemigenia exilis</i>	P4	TPFL, WAHERB	Gabbro and basalt outcrops	Possible (Likely)
<i>Eremophila mirabilis</i>	P2	TPFL, WAHERB	Weathered granite breakaways	Possible (Likely)
<i>Ptilotus tetrandrus</i>	P1	TPFL, WAHERB	Sandplains, dunes	Unlikely (Likely)
<i>Conospermum todii</i>	P4	WAHERB	Sand Dunes	Unlikely

Note, the unconfirmed *Grevillea ?inconspicua* P4 reported in Stantec 2018a had been omitted from this assessment pending review of the identity of the taxon.

The Study Area is known to have extensive areas of (i) saline flats supporting chenopod shrublands in its central region; (ii) extensive non-saline washplains in the north and south; and (iii) substantial areas of gabbro and basalt hills in the south-east. Flora associated with the first and third areas are highly specialised and can be predicted reasonably consistently in the local region. Flora of non-saline wash plains can be variable.

Two species with Conservation listing (*Acacia* sp. Marshall Pool (G. Cockerton 3024) P3, and *Gunniopsis propinqua* P3) were known to be present within the Study Area.

Acacia sp. Marshall Pool has been recently found to be abundant within the south-eastern portion of the Study Area, specifically associated with low to moderate rounded weathered basalt hills of the Gundockerta Land System on Minara Station and adjacent areas towards Kookynie and on Weebo Station north of Leonora. It was briefly assessed both within parts of the current Study Area (Stantec 2018c) recording around 10,000 plants (an incomplete assessment of the Study Area); and in the region between Laverton, Leonora and Wiluna (Western Botanical 2018) where over 37,000 individuals were estimated. This is not considered an exhaustive assessment of the species in the region.

Gunniopsis propinqua P3 is a small ephemeral halophytic herb growing to 5 cm in height. It is widespread in the Murchison and Gascoyne regions, always associated with

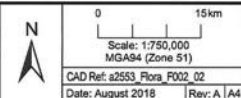
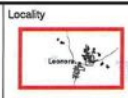
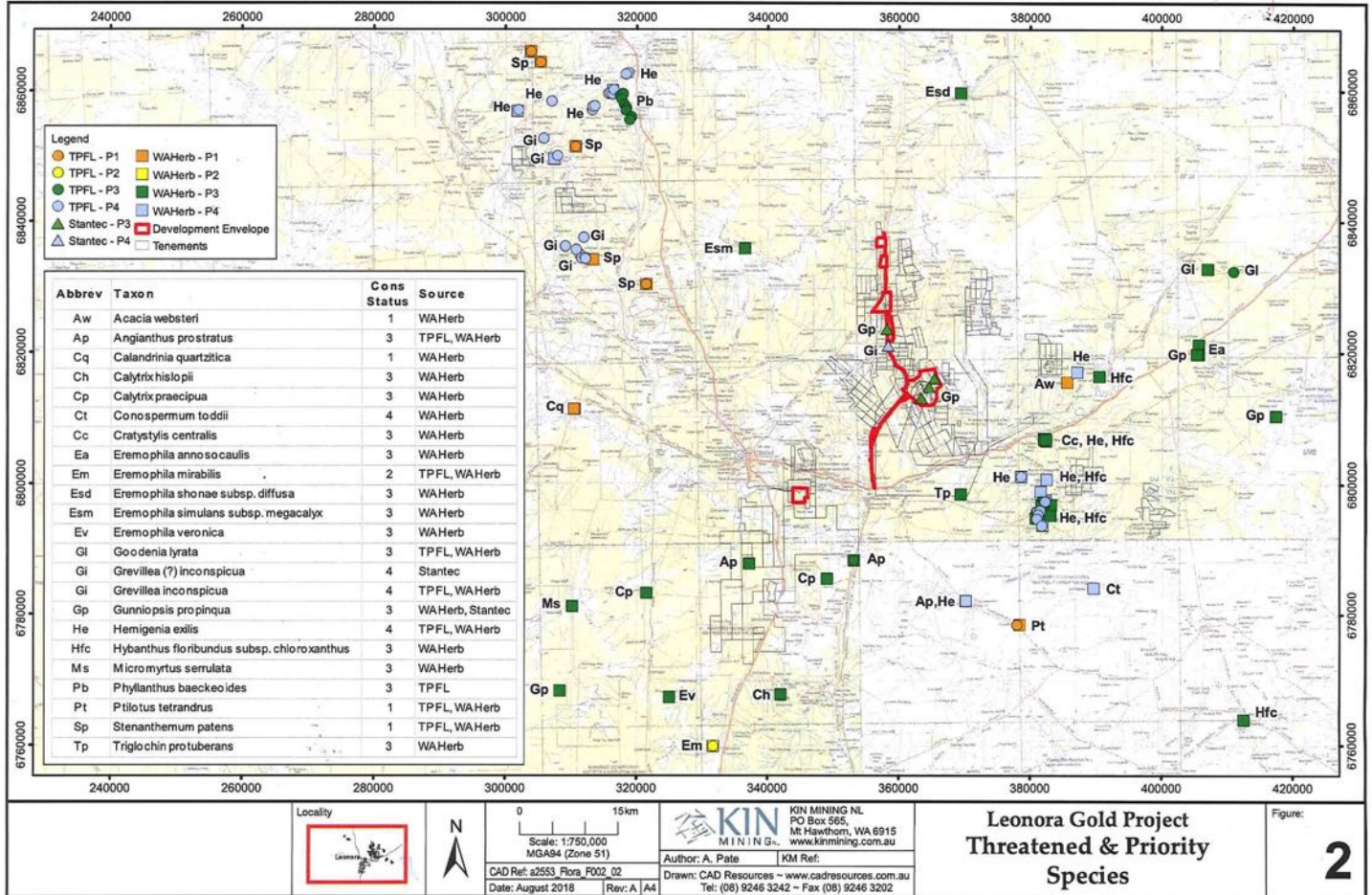
saline environments (fringes of claypans, Samphire flats, breakaway footslopes). Stantec recorded four sites supporting *Gunniopsis propinqua* within the current Study Area. It is considered highly likely that this species is both more prevalent within the Study Area and in the broader region, however, it is cryptic and can only reliably be assessed in favourable seasonal conditions.

Two species with conservation listing (*Angianthus prostratus* P3 and *Triglochin protuberans* P3), are associated with the saline margins of salt lakes and Samphire Shrublands or drainage channels and are therefore considered to have a Probable likelihood occurrence within the Study Area. *Angianthus prostratus* is an annual herb to 30 cm diameter and is known from five loci in the eastern Murchison biogeographic region, all in association with paleochannels or salt lakes. *Triglochin protuberans* is a tiny, cryptic ephemeral herb to 5 cm high and is known from six loci, five of which occur up to 250 km east of Geraldton while one lies just south-east of the Study Area within the Bummer Creek distributary fan, in the Monitor Land System. These would both need to be assessed at an appropriate time of year following sufficient rainfall.

Sixteen of the 23 species with conservation significance known in the vicinity of the Study Area are considered to have a Possible likelihood occurrence within the Study Area, Table 7. Populations of these species are known within 10 to 20 km of the Study Area, though their presence will be dependent upon on suitable geology, soils and landscapes being present. The majority are perennial shrubs that are readily recognised in the field whether plants are in flower or in a vegetative state, so timing of field survey is not critical for identification (eg: *Acacia*, *Calytrix*, *Cratystylis*, *Eremophila*, *Hybanthus*, *Phyllanthus* species). In one case, being assessed in the appropriate seasonal conditions following adequate rainfall, is critical (eg: annual species *Goodenia lyrata* P3).

Two species (*Ptilotus tetrandrus* P1 and *Conospermum todii* P4) are considered Unlikely to occur within the Study Area as they are known from Aeolian sandplains and dunes, which do not occur in the Study Area. These can therefore be discounted from further consideration.

Figure 5. Desktop Assessment of DBCA's WA Herbarium, Threatened and Priority Flora Database Search (Stantec 2018 via Kin Mining)



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Leonora Gold Project Threatened & Priority Species

3.2. Field Survey

3.2.1. Recent Climate

Total rainfall at Leonora in 2018 was 320.2 mm with 20 to 30 mm per month recorded January to June and below 20 mm per month recorded thereafter, Figure 2. January and February 2019 were also relatively dry with no summer cyclonic events experienced. Therefore both field surveys were conducted in relatively dry seasonal conditions and few annuals were recorded except in low lying moisture gaining sites.

3.2.2. Landforms

The following major landforms were noted within the Study Area:

- Low rounded gabbro or basalt hills and minor drainage lines associated with the Hootanui, Laverton and Leonora Land Systems
- Low ironstone or chert hills and minor drainage lines associated with the Bevon, Violet and Laverton Land Systems
- Low breakaways of weathered granite and associated saline kaolinised slopes of the Sherwood Land System
- Extensive non-saline hardpan wash plains associated with the Monitor and Jundee Land Systems
- Extensive saline plains and low rises associated with the Nubev Land Systems
- Small, discrete areas of paleo groundwater calcrete

3.3. Vegetation

3.3.1. Vegetation Associations

Fifty one vegetation associations at NVIS Level 5 *Association* were recognised within the LGP Study Area, Table 8. This relatively large number of community types is partially due to (i) the detail of mapping, (ii) the interplay between geological, topographic, hydrological and salinity factors within the Study Area and (iii) the elongated linear nature of the Study Area stretching some 36.8 km north-south from the Leonora – Laverton road to the Mertondale deposit area. This complexity builds on that observed in the Land System mapping of the region (DoA 1994), Table 3, Table 4.

It also demonstrates the greater level of differentiation in vegetation associations compared to the relatively broad view taken by DoA in their treatment of Land Systems.

Table 8. Vegetation Associations of the Study Area

Vegetation Group	Final Mapping Numeric Code	Vegetation Association Name	Veg Association Code
1. Mulga Woodlands over Perennial Non-Halophytic Shrubs on hills and plains	1.01	Acacia aneura, A. ramulosa, Eremophila platycalyx subsp. Leonora (Morrisey J. 252), Ptilotus obovatus (Upright form) Shrubland and grasses	AaArEpLPoU, Grasses
	1.02	Acacia aneura (forms), Ptilotus obovatus (Upright form), Maireana triptera Shrubland	AaPoUMt
	1.02 D	Dead vegetation, formerly Acacia aneura (forms), Ptilotus obovatus (Upright form), Maireana triptera Shrubland	Dead AaPoUMt
	1.03	Acacia aneura, Maireana sedifolia, Scaevola spinescens Narrow leaf spiny form Ptilotus obovatus (typical Goldfields form) Shrubland	AaMsSsNPoG
	1.04	Acacia burkittii, Senna artemisioides subsp. filifolia, Maireana spp. Shrubland	AbSafAmpMt
	1.05	Acacia aneura (forms) over Eremophila platycalyx subsp. Leonora (Morrisey J. 252) over Senna spp. over Ptilotus obovatus (Upright form) and Maireana triptera Shrubland	AaEpLSsppPoUMt
	1.06	Acacia aneura (forms) over Eremophila spp. (E. margarethae, E. compacta subsp. compacta, E. simulans subsp. simulans or E. annoscaulis P3) over Ptilotus schwartzii Shrubland	AaEmP
	1.07	Stony Ironstone Mulga Shrubland Acacia aneura, Eremophila latrobei, Sida ectogamma Shrubland on summits of chert, quartz hills and slopes	SIMS AaEiSe
	1.08	Stony Ironstone Mulga Shrubland Acacia aneura, Ptilotus obovatus (Upright form), Ptilotus schwartzii Shrubland on midslopes of chert, quartz hills and slopes	SIMS AaPoUSe
	1.09	Stony Ironstone Mulga Shrubland Acacia aneura (forms) over Eremophila clarkei, Eremophila forrestii Shrubland on summit of low ferricrete hills	SIMS AaEcEf

Vegetation Group	Final Mapping Numeric Code	Vegetation Association Name	Veg Association Code
	1.10	Acacia aneura over Maireana sedifolia over Ptilotus obovatus (Upright form) Shrubland over Maireana triptera Shrubland and grasses	AaMsPoUMt
	1.11	Maireana pyramidata, Maireana sedifolia, Frankenia spp. Open Low Shrubland and grasses	MpMsFsp
	1.12	Acacia aneura (sens. lat.), Eremophila platycalyx subsp. Leonora (Morrisey J. 252) over Eremophila compacta and Ptilotus obovatus (Upright form) Shrubland	AaEpLEm
	1.13	Acacia aneura (sens. lat.), Acacia ramulosa, Acacia quadrimarginea, Eremophila platycalyx subsp. Leonora (Morrisey J. 252) Shrubland	AaArAqEp
	1.14	Stony Acacia - Eremophila Shrubland	SAES
	1.15	Hardpan Plain, deflation zone	HPDS
	1.16	Hardpan Mulga Shrubland	HPMS
	1.17	Acacia aneura, Maireana triptera, Ptilotus obovatus Goldfields Form Shrubland over Aristida contorta	AaPoGMt
2. Mulga Shrublands / Woodlands over Perennial Grasses on Plains	2.01	Mulga-Wanderrie (Acacia aneura, Eragrostis eriopoda) Grassland	MUWA
	2.02	Wanderrie Bank Grassy Shrublands (Eragrostis eriopoda) Grassland	WABS
3. <i>Acacia</i> Woodlands over Shrubs and Grasses in Major Drainage Lines and Groves	3.01	Drainage Line Mulga (Acacia aneura sens. lat.) Woodland	DRMS
	3.02	Drainage line Acacia burkittii Woodland	DRAbS
	3.03	Groved Mulga Woodland	GRMU
4. <i>Acacia</i> (other than Mulga) Shrublands on Stony Hills	4.01	Acacia sp. Marshall Pool (G. Cockerton 3024) Shrubland	Amp

Vegetation Group	Final Mapping Numeric Code	Vegetation Association Name	Veg Association Code
	4.02	Acacia sp. Marshall Pool (G. Cockerton 3024), <i>A. sibirica</i> , <i>Acacia aneura</i> , <i>A. burkittii</i> Shrubland	AmpAsAa
	4.03	<i>Acacia doreta</i> short phyllode form (M. Stone & S. Colwill WB34381), <i>Acacia</i> sp. Marshall Pool (G. Cockerton 3024) Open Woodland <i>Ptilotus obovatus</i> (Goldfields form) Shrubland	AdAspMPPoG
	4.04	<i>Acacia burkittii</i> , <i>Ptilotus obovatus</i> (Goldfields form) Shrubland	AbPoG
5. <i>Acacia papyrocarpa</i> Woodlands	5.01	<i>Acacia papyrocarpa</i> Open Low Woodland, <i>Tecticornia disarticulata</i> Shrubland	ApTdS
	5.02	<i>Acacia papyrocarpa</i> Open Low Woodland, <i>Eremophila scoparia</i> and <i>Maireana</i> spp. Shrubland	ApEsMspp
	5.03	<i>Acacia papyrocarpa</i> Open Low Woodland, <i>Ptilotus obovatus</i> (Upright form), <i>Maireana triptera</i> Shrubland and grasses	ApPoUMt
	5.04	<i>Acacia papyrocarpa</i> Open Low Woodland, <i>Maireana pyramidata</i> Shrubland	ApMt
6. <i>Acacia victoriae</i> Shrubland over Chenopods on Calcrete Plains	6.01	<i>Acacia victoriae</i> Shrubland	AvS
7. Perennial Grasslands	7.01	<i>Eragrostis</i> sp. Yeelirrie Calcrete (S. Regan LCH 26770) Hummock Grassland on Calcrete	EyC
	7.02	<i>Neurachne munroi</i> Hummock Grassland on Mudstone	NmHG
8. <i>Hakea preissii</i> and/or Halophytic Chenopod Shrublands	8.01	<i>Hakea preissii</i> , <i>Maireana pyramidata</i> , <i>Tecticornia disarticulata</i> Shrubland	HpTdMpS
	8.02	<i>Hakea preissii</i> , <i>Maireana pyramidata</i> , <i>Cratystylis subspinescens</i> Shrubland	HpMpCs
	8.03	<i>Hakea preissii</i> , <i>Maireana pyramidata</i> , <i>Eremophila scoparia</i> Shrubland	HpMpEs

Vegetation Group	Final Mapping Numeric Code	Vegetation Association Name	Veg Association Code
	8.04	Hakea preissii, Ptilotus obovatus (Goldfields form), Maireana triptera Shrubland	HpPoGMt
	8.05	Hakea preissii, Maireana pyramidata, Maireana tomentosa (type 1 WB38650) complex Shrubland and grasses	HpMpMsp59
	8.06	Hakea preissii, Eremophila scoparia, Maireana triptera Shrubland	HpEsMt
	8.07	Maireana triptera, Frankenia spp. Low Open Shrubland	MtFsp
	8.08	Maireana pyramidata, M. georgei Shrubland	MpMg
	8.09	Tecticornia disarticulata, Surreya diandra, Frankenia setosa, Maireana tomentosa (type 1 WB38650) complex Shrubland	TdFspMt
	8.10	Maireana tomentosa (type 1 WB38650) Tecticornia disarticulata Shrubland	Mt, Td
	8.11	Frankenia spp. Shrubland	Fspp
	8.12	Acacia masliniana, Cratystylis subspinescens Shrubland	AmCs
	8.13	Bare claypan, no vegetation	Cpn-B
9. <i>Casuarina pauper</i> Woodland on Calcrete Outcrops	9.01	Casuarina pauper Woodland over Chenopods on Calcrete outcrops	CpW
10. Claypans	10.01	Grassy Claypan (<i>Eragrostis xerophila</i> Grassland)	CPN-G
	10.02	Gilgai: <i>Pittosporum angustifolium</i> , <i>Acacia tetragonophylla</i> and <i>A. victoriae</i> Shrubland over Claypan Grasses	Gilgai
11. Breakaway Complex	11.01	<i>Eremophila scoparia</i> , <i>Frankenia</i> spp. Shrubland with <i>Sclerolaena diacantha</i>	EsFsppSpp

In order to discuss the Vegetation Associations, they have been grouped together in 11 logical Vegetation Complexes showing their relatedness to each other. These are:

1. Mulga Woodlands over Perennial Non-Halophytic Shrubs on hills and plains

Seventeen vegetation associations with a diverse range of Mulga species (*Acacia aneura*, *A. aptaneura*, *A. caesaneura*, *A. fuscanaura*, *A. incurvaneura*, *A. macraneura*, *A. mulganeura* and *A. pteraneura*) form the dominant upper stratum as trees and shrubs 4 to 6 m in height. The understorey varies considerably with geological substrate type, soil depth and landscape position, from *Eremophila clarkei*, *E. forrestii*, *E. platycalyx* subsp. Leonora (J. Morrissey 252), *E. simulans* subsp. *simulans*, *E. latrobei* or *E. annoscaulis* P3 on stony hill tops and slopes; to *Eremophila compacta* subsp. *compacta* on loamy wash plains; to *Eremophila galeata* scattered shrublands on skeletal soils on hardpan plains and granite platforms. Some areas of Mulga woodlands have an understorey dominated by two informally recognised species; either *Ptilotus obovatus* Upright form (G Cockerton et al 15206) or *Ptilotus obovatus* Typical Goldfields form (G Cockerton et al 15213) which reflect differing soil types with the former associated with calcareous soils and the latter with non-calcareous soils. Both species are common and widespread in the eastern Goldfields of W.A. and occasionally occur together within a Vegetation Association.

2. Mulga Shrublands / Woodlands over Perennial Grasses on Plains

Two vegetation associations, where silty-sandy soils over hardpan higher in the landscape are present. Here Mulga is associated with a grassy understorey of *Monachather paradoxus* and *Eragrostis eriopoda*, collectively known as Wanderrie grasses.

3. Acacia Woodlands over Shrubs and Grasses in Major Drainage Lines and Groves

Two major drainage tracts and several minor drainage lines occur within the Study Area, draining from the north-east to the south-west. The vegetation of the major drainage line in the west of the Study Area, Cardinia Creek, with its upper reaches draining from the Cardinia deposit areas in the Leonora and Gundockerta Land Systems, is dominated by Mulga species. Bummer Creek, with a small representation within the south-east of the Study Area, drains from the Violet Land System (the site of the Murrin Murrin minesite, east of the Study Area), and is dominated by *Acacia burkittii*. The vegetation of the minor drainage lines within the Study Area reflect on the vegetation adjacent hills and plains, but are denser and with a greater species representation due to the accumulation of resources.

4. *Acacia* (other than Mulga) Shrublands on Stony Hills

Four vegetation associations on stony hills within a large proportion of the Study Area are dominated by *Acacia* trees and shrubs other than Mulga. Here *Acacia* sp. Marshall Pool (G. Cockerton 3024) is the dominant shrub to small tree on the stony gabbro and basalt hills of the Leonora Land System. It may also be co-dominant with *Acacia sibirica* in some locations. *Acacia doreta* short phyllode form (M. Stone & S. Colwill WB34381), being the typical form of the species, is also present in association with *A.* sp. Marshall Pool on one small hill in the central-west of the Study Area. *Acacia burkittii* was found to be dominant in small well defined areas of calcrete platform, higher in the landscape, presumably due to an elevated soil moisture availability in the calcrete.

5. *Acacia papyrocarpa* Woodlands

Four variants of the *Acacia papyrocarpa* woodland were observed. The dominant and defining understorey varies from *Tecticornia disarticulata* in more saline sites; to *Eremophila scoparia* where calcrete is present; to *Ptilotus obovatus* (Upright form), *Maireana triptera* and grasses where there is non-saline but mildly alkaline soil cover over underlying materials; to *Maireana pyramidata* in areas subject to some waterlogging and salinity. *Acacia papyrocarpa* is by far the largest and most prominent tall tree in the landscape within the Study Area and provides refuge and nesting opportunities for some larger birds of prey (Hobbys actively nesting were observed in *Acacia papyrocarpa* woodlands during 2018 and 2019 surveys). Hobbys are not listed as having conservation significance (Stantec, 2017).

6. *Acacia victoriae* Shrubland over Chenopods on Calcrete Plains

The *Acacia victoriae* shrubland occurs on extensive alkaline calcrete plains in the southern part of the Study Area. It has a relatively diverse understorey dominated by chenopods (*Sclerolaena* and *Maireana* spp.) and may support patches of *Eragrostis* sp. Yeelirrie Calcrete (S. Regan LCH26770).

7. Perennial Grasslands

Two perennial grasslands were mapped. These are small, discrete patches of *Eragrostis* sp. Yeelirrie Calcrete (S. Regan LCH26770) on calcrete platforms (relatively low in the landscape); and similarly small, discrete patches of *Neurachne munroi* Hummock Grassland on Mudstone on low rises.

8. *Hakea preissii* and/or Halophytic Chenopod Shrublands

Thirteen topographically controlled variants of Chenopod Shrublands were recognised with a major distinction being those with *Hakea preissii* emergent above the lower shrubs in areas with a deeper soil profile vs. those lacking *H. preissii*, lower in the landscape and more frequently subject to inundation or waterlogging. These environments are all moderately to highly saline and support a largely well known group of *Maireana*, *Atriplex* (less tolerant of waterlogging) and *Tecticornia* (Samphire, more tolerant of waterlogging) species. They may also support species with conservation significance as identified in the Desktop Study, Table 7.

9. *Casuarina pauper* Woodland on Calcrete Outcrops

Casuarina pauper woodland is found in small, isolated and disjunct populations on calcrete platforms high in the landscape and a lower salinity with reliable soil moisture availability of the alkaline soils here is inferred.

10. Claypans

Two types of grassy claypans were recognised: one supporting almost exclusively *Eragrostis xerophila*; while another forms Gilgais (with heaving clay soils) supporting emergent *Pittosporum angustifolium*, *Acacia tetragonophylla* and *A. victoriae* Shrubland over *Eragrostis setifolia*, *Themeda australis* and other claypan grasses. These are both non-saline environments with heavy clay soils and are internally drained sumps in the landscape. By virtue of their clay soils, high moisture retention and internal drainage, they typically provide refuge for burrowing frogs and support some flora that are not generally found outside these environments. These are small in area, disjunct from each other and uncommon in the landscape within the Study Area.

11. Breakaway Complex

The breakaway complex is represented in the northern part of the Study Area south of Mertondale where *Eucalyptus striatocalyx* is present at the leading edge of the low (5 to 10 m high) lateritised breakaway and a range of species tolerant of kaolin clay soils and some salinity are present in a changing mosaic pattern on the mid to lower slopes of the landscape. Groups of species such as *Frankenia* spp., *Eremophila scoparia*, *Maireana* and *Tecticornia disarticulata* are dominant while Stantec reported *Gunniopsis propinqua* P3 in this community type. The Breakaway Complex extends well outside the Study Area near the Mertondale deposit.

3.3.2. Groundwater Dependent Vegetation

Vegetation containing species that are known to be relatively high water users and with low xylem potentials can be used as a guide for determining whether such vegetation associations should be considered Groundwater Dependent Vegetation. Within the north-eastern Goldfields, three vegetation types could be considered as falling into this category: (i) eucalypt dominated vegetation within major drainage lines indicating highly fractured geology and fresh water aquifers; (ii) eucalypt woodlands and mallee shrublands on sandplains accessing perched fresh water aquifers; and (iii) *Melaleuca* shrublands on calcrete accessing perched fresh water aquifers. Conversely, more water efficient and more drought tolerant species with higher xylem potentials are less likely to rely on perched fresh aquifers and are more likely to be accessing non-saturated soil moisture within the upper soil profiles which is readily replenished in rainfall events. This latter group includes Mulga shrublands on hills and hardpan plains, *Acacia* shrublands on stony hills and chenopod shrublands in broad saline valleys.

The vast majority of vegetation within the LGP Study Area is dominated by Mulga, *Acacia* or Chenopods and is considered highly unlikely to be obligately accessing ground water and is therefore unlikely to be Groundwater Dependent. A few *Eucalyptus striatocalyx* are present on the rim of the low breakaway system in the transport corridor from Cardinia to Mertondale, however, these appear to be growing on kaolinitic clay soil (vegetation complex unit 11.1). It is unknown whether there is a suitable perched water table in this area, however, being eucalypts, these trees would have a relatively high transpirational load. These occupy a negligible area within the Study Area and direct impacts can readily be avoided.

Two communities within the Study Area are associated with calcrete platforms with relatively high hydrological transmissivities and suggested elevated infiltration rates. These are: (i) *Acacia victoriae* shrublands on calcrete platforms (vegetation association 6.01); and (ii) *Casuarina pauper* woodlands on calcrete (vegetation association 9.01). Within the Study Area, the *Acacia victoriae* shrublands are associated broadly with the Gundockerta land system in the southern part of the Study Area while the *Casuarina pauper* woodlands are associated with small, isolated and disjunct calcrete outcrops amongst the gabbro hills of the Leonora land system. It is considered unlikely that either of these communities represent Groundwater Dependent Vegetation.

The vegetation of Bummer Creek in the south-east of the Study Area is unusual in that is dominated by *Acacia burkittii*. Most creeklines of this nature and magnitude in the north-eastern Goldfields are dominated by varieties of Mulga. *Acacia burkittii* is most often found in either (i) small internally drained low lying areas with medium clay soils, fed by rainfall; or on calcrete rises with shallow surficial fresh water lenses. The surface soils of Bummer Creek are deep alluvial gravely silty sand or clayey sand soils that have originated from the Leonora land system to the north and east. It is suggested that the depth of this alluvium, the relatively high inferred infiltration rates, the large catchment up-stream and inferred high amounts of plant available non-saturated soil moisture within this alluvium support this vegetation unit.

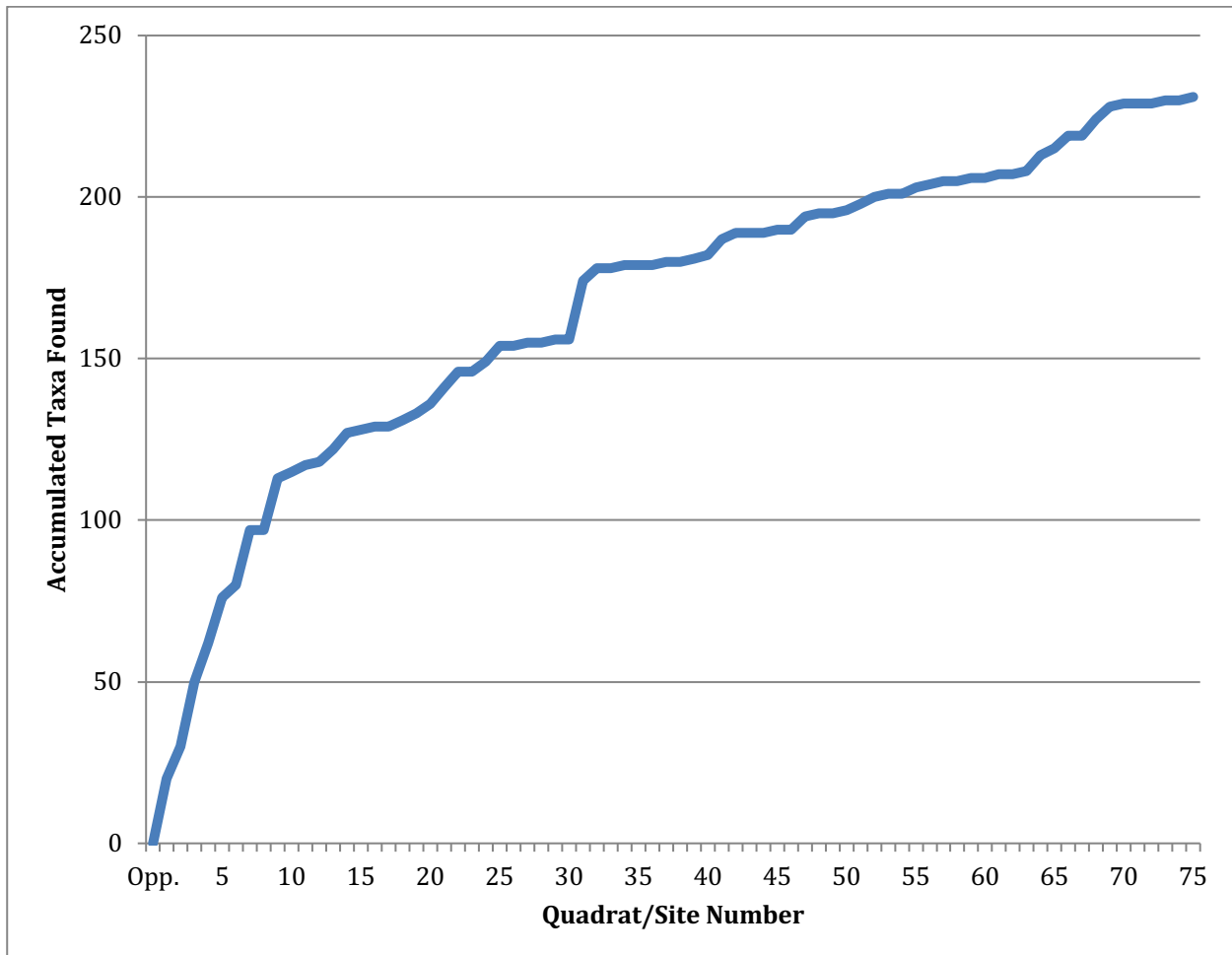
It is considered unlikely therefore that any of the vegetation associations within the Study Area would be considered Groundwater Dependent Vegetation.

3.4. Flora

Two hundred and thirty six species (including subspecies and varieties) from 45 families and 103 genera, inclusive of 224 native endemic species and species 12 weed species were encountered during the 2018-19 studies. The most prevalent family was Poaceae (42 species of grasses) and the most well represented genera were *Acacia* (29 species), *Eremophila* (21 species), *Maireana* (12 species), *Sida* (8 species), *Eragrostis* (8 species) and *Frankenia* (5 species). These statistics are reasonably representative of the flora of similar landforms of the north-eastern Goldfields. With surveys having been conducted in relatively dry seasonal conditions (Oct 2018, Feb 2019), few annuals were present except those in moisture gaining sites. It is likely that a full inventory of flora would include in the order of 50 annual herbs and grasses including the genera *Brachyscome*, *Cyperus*, *Goodenia*, *Gunniopsis*, and various grasses including *Eragrostis* and *Eriachne*. This compares reasonably favourably with the flora statistics reported in Stantec (2017) of 257 species from 37 families and 103 genera in a significantly smaller area but conducted in better seasonal conditions.

Combining the species lists from the Stantec 2017, 2018a and 2018b studies and the current works, the total flora statistics stands at 321 species from 132 genera and 44 families, inclusive of 18 weed species.

Utilising the species list generated in this assessment alone, a Species Accumulation Curve has been generated, Figure 6. This shows an asymptotic approach to the maximum of 236 species (including weeds) and a plateauing within the last ten Releve sites, indicating few new species being added to the species list. Given that both phases of these surveys were conducted in dry seasonal conditions it is anticipated that in the order of 30 to 50 annual species (grasses and herbs) would be expected in addition to this number.

Figure 6. Species Accumulation Curve

3.5. Significant Flora

Significant Flora have been dealt with in the following categories:

- Conservation Significant Flora
 - Threatened Flora
 - Priority Flora
- Species with Taxonomic Interest
- Species at Limit of Range or representing Range Extensions
- Species uncommon in the landscape within the Study Area and the broader NE Goldfields

Locations of these significant flora and also of recorded weed species within the LGP Study Area are presented in the relevant maps (Figure 12, Figure 16, Figure 19, Figure 21, Figure 22 and in Appendix 6.

3.5.1. Conservation Significant (Threatened and Priority) Flora

Threatened Flora

No Threatened Flora were recorded during the cumulative surveys inclusive of Stantec 2017, 2018a, 2018b, Western Botanical 2018 and the current program. Further, no Threatened Flora are known in region nearby the Study Area and therefore no Threatened Species likely to be present.

Priority Flora

Cumulatively, four species with Priority listing were recorded: *Acacia* sp. Marshall Pool (G. Cockerton 3024) P3, *Eremophila annoscaulis* P3, *Cratystylis centralis* P3 (outside the Study Area) and *Gunniopsis propinqua* P3 (Stantec 2017, 2018a). Stantec (2017, 2018a) also reported *Acacia* sp. nov. aff. *resinimarginea*, which was subsequently recognised as *Acacia* sp. Marshall Pool P3. See Figure 12. These species are discussed below.

3.5.2. *Acacia* sp. Marshall Pool (G. Cockerton 3024)

Acacia sp. Marshall Pool (G. Cockerton 3024) is a single trunked small tree 2.5 to 4m high x 2 to 6 m wide, killed by fire and regenerating from soil stored seed. It has rough dark grey bark and long thin dark green glossy phyllodes, 1 mm wide x 15 to 80 mm long which are square in cross section. Flowers are dark yellow, rod shaped and to 15 mm long and fruits are flattened, sickle shaped, raised over seeds with a slightly thickened margin, dark green to brownish-green and with a sticky resinous coating when fresh. Seeds are oval shaped, 5 x 4 mm and black with a thick seed coat. See Plate 1 and Plate 2.

Plate 1. *Acacia* sp. Marshall Pool tree and habitat

Within the Study Area, *Acacia* sp. Marshall Pool is confined to low to high rounded hills of weathered gabbro and basalt with infiltrated paleo groundwater calcrete. This landform is found in the south-eastern part of the Study Area, Figure 12, and has been mapped regionally by DoA as the Leonora Land System.

Plate 2. *Acacia* sp. Marshall Pool flower, foliage and fruit

Flower, about actual size



Fruit, about actual size

During regional surveys for this and related species in May 2017, Western Botanical and Stantec recorded the following summary statistics for the species:

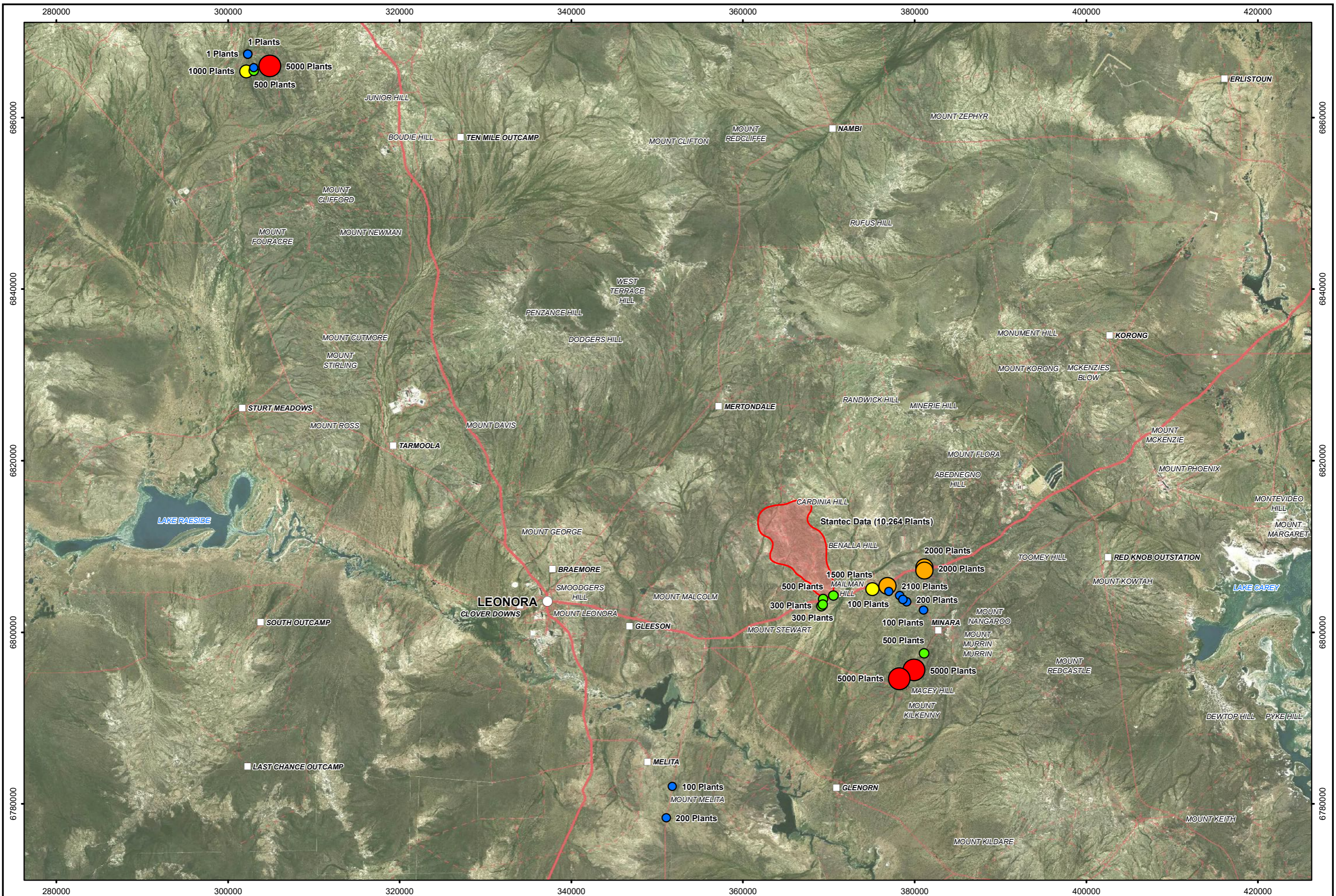
“The Regional Survey Area was defined to capture a significant region inclusive of the known range of *Acacia* sp. Marshall Pool and a range of geologies from Laverton to Menzies and Wiluna, approximately 374 km north-south and 270 km east-west at the widest points and has an area of 69,734 sq. km.

Western Botanical, 2018 estimated 37,266 plants of *Acacia* sp. Marshall Pool at three population centres:

- (i) Major populations on the low basalt ranges both north and south of the Leonora – Laverton road on Minara (26,364+ plants, 70.7% of the overall population) and Glenorn Stations (5,000+ plants, 13.4%);
- (ii) Small occurrences on low basalt hills on Melita Station (300+ plants, 0.8%), some 26 km SE of Leonora, 26 km north of Kookynie; and
- (iii) A major population at the original 1997 collection site, on low basalt hills on Weebo Station (5,602 plants, 15.0%), the former Anaconda Nickel's "Marshall Pool" tenement."

Population (i) above lies within and adjacent to the Study Area while the others are respectively north-west and south of the Study Area, Figure 7.

Figure 7. Regional occurrences of *Acacia* sp. Marshall Pool (G. Cockerton 3024)



Legend

Minimum Plants	501 - 1500	2101 - 5000
1 - 200	1501 - 2100	Stantec Data (10,264 Plants)
201 - 500		

Client:

0 5 10 km

Scale: 1:400,000
MGA94 (Zone 51)

CAD Ref: g2533_F002

Date: May 2018 Rev: A A3

Author: G. Cockerton WB Ref:

Drawn: CAD Resources ~ www.cadresources.com.au

Tel: (08) 9246 3242 ~ Fax (08) 9246 3202

Kin Mining NL

Acacia sp. Marshall Pool (G. Cockerton 3024)

Satellite Imagery

Figure:

2

3.5.3. *Eremophila annoscaulis* P3

Eremophila annoscaulis P3 is a low densely branching shrub to 0.8m high x 1 m wide with small purple flowers, Plate 3. Regionally, it is known from four populations,

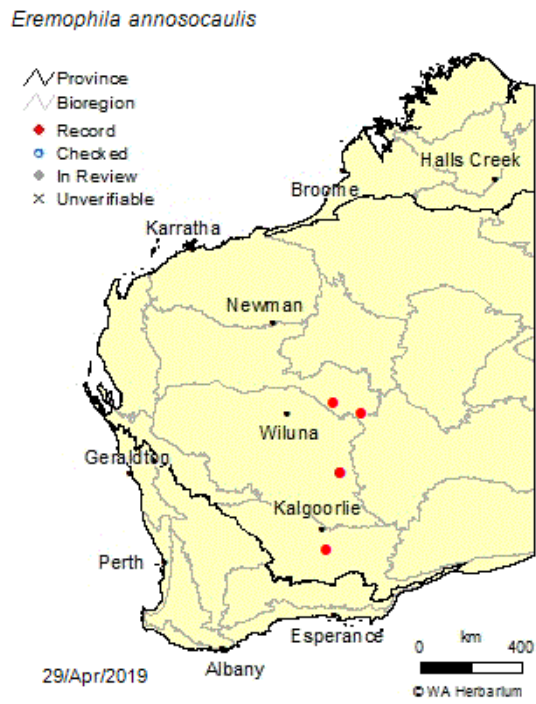
- (i) Two populations, respectively 22 km and 35 km east of the Study Area, adjacent to the Murrin Murrin minesite; and
- (ii) Two populations approximately 280 km north and north-north-east of the Study Area, respectively some 150 km to 250 km east of Wiluna.

A fifth point shown on the WA Herbarium's Florabase website is erroneously plotted near Widgiemooltha, south of Coolgardie, a geocode error that will be addressed in due course.

Within the Study Area, *E. annoscaulis* was found at 4 loci (9 sites in total), extending from near the Mertondale minesite to the southern-central part of the Study Area, Figure 12. *Eremophila annoscaulis* was not identified until specimens were sorted following the field program, so no estimate of population size or detailed mapping of populations was undertaken at that time. It was found associated with stony hill tops and mid to lower slopes associated with these, growing in association with Mulga.

Plate 3. *Eremophila annoscaulis* images (Florabase)



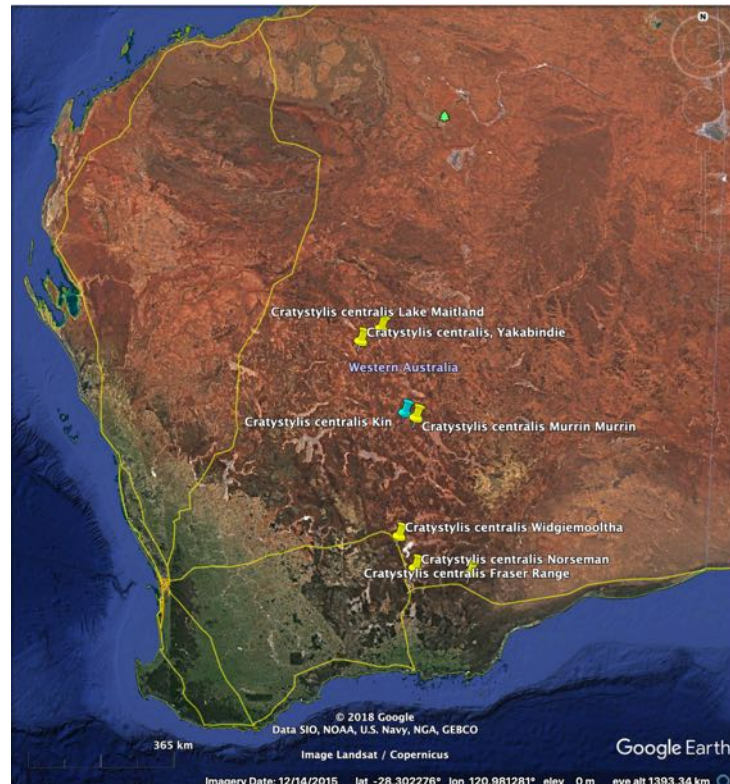
Figure 8. Distribution of *Eremophila annoscaulis* in W.A.

(Note erroneous point south of Kalgoorlie)

3.5.4. *Cratystylis centralis* P3

A population of *Cratystylis centralis* P3 was noted en-route to the Study Area, adjacent to the existing Cardinia access road, within an area previously reported by Stantec, Figure 12. During this survey, the population of 268 plants adjacent to the existing Cardinia access road was mapped and data supplied to Kin. This population represents the seventh population of the species known in W.A, Figure 9.

Figure 9. Regional distribution of *Cratystylis centralis* in W.A. (WA Herbarium and Western Botanical data)



Other than the population reported within the Study Area, six populations of *Cratystylis centralis* are known in W.A.:

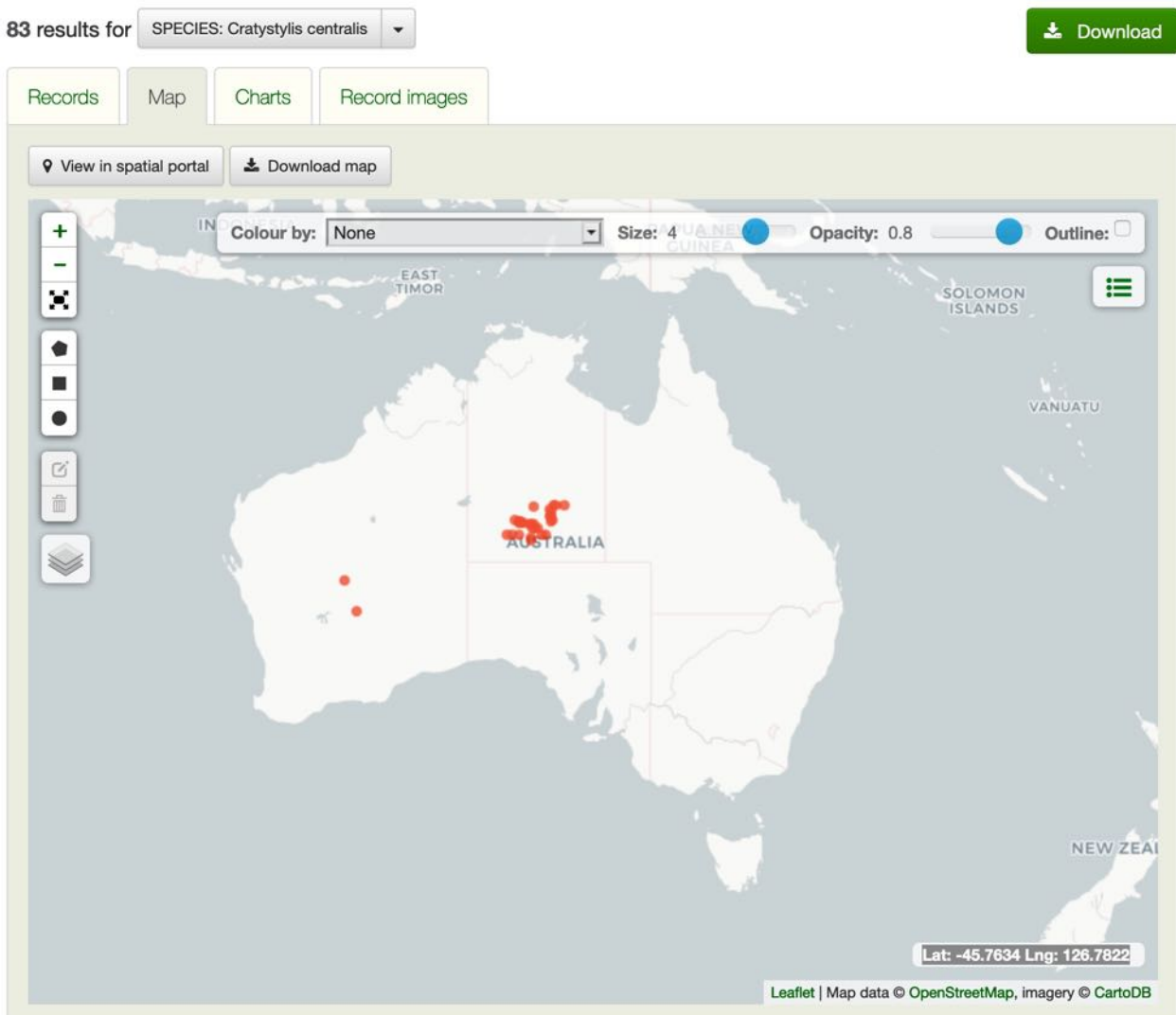
- (i) The closest population known to the Study Area lies some 9.6 km east of the Study Area, south of the Leonora – Laverton Rd, adjacent to the Murrin Murrin minesite, associated with *Mulga* (PERTH 08800936 *et. al.*);
- (ii) A second population (PERTH 08974462) is known near Lake Maitland, some 105 km south-east of Wiluna;
- (iii) A third population of around 500 plants is known by WB to occur on Yakabindie Station, at the abandoned McFarlane’s Find prospect, some 180 km north-north-west of the Study Area, associated with *Eucalyptus striatocalyx* and *Eremophila pantonii* (not yet vouchered at WA Herbarium); and

- (iv) A single plant was recorded by WB in late 2018 on Fraser Range Station some 125 km east of Norseman, north of the Eyre Highway, some 390 km south-east of the Study Area (not yet vouchered at WA Herbarium).
- (v) Five plants are known near Widgiemooltha, on a low breakaway.
- (vi) A single record from near Norseman on the margin of Lake Cowan is also known.

Only two of these have been vouchered at the WA Herbarium, Figure 12 . In W.A. populations of *Cratystylis centralis* known to the author are found in association with calcareous soils with a shallow mantle of red silty sandy soil and ironstone pizolites.

Cratystylis centralis has an enigmatic distribution with the majority of records in the southern Northern Territory and a few scattered populations in the north-eastern Goldfields and one in the eastern Coolgardie bioregion, Figure 10.

Figure 10. Distribution of *Cratystylis centralis* in Australia (AVH) (vouchered specimens)



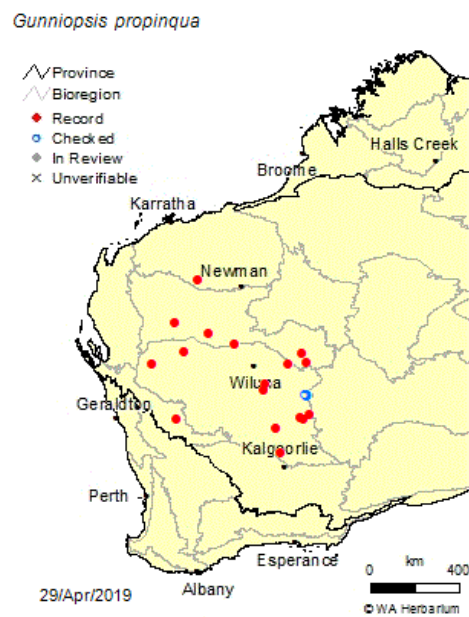
Western Botanical (2017) reported “Wilson & Albrecht (2002) note that the Western Australian specimens differ in the number of florets in the flowering head (capitula) from those in the Northern Territory. However, the lack of good flowering material made it difficult to separate the two groups adequately. They record the species as a putative hybrid between *C. conocephala* and *C. microphylla* with a Western Australian distribution. The species, while currently considered within *C. centralis sens. lat.* and with a P3 conservation listing in W.A. due to the distribution in W.A. and N.T., remains of taxonomic and conservation interest (Mike Hislop, pers. comm.). It is more likely that the Western Australian species is a new taxon and worthy of a revised conservation ranking.

Preliminary investigations undertaken by WB in August 2016 on specimens housed at the WA Herbarium have shown the WA species (Armstrong, P.G. (07/970)) has two flowers per capitula (flower head) while those from the Northern Territory (specimen on loan from NT Herbarium, collected by P.K. Latz) have four. This is considered a significant difference (Paul Wilson pers. comm.) and indicates that the WA taxon requires further taxonomic investigation.”

3.5.5. *Gunniopsis propinqua* P3

Gunniopsis propinqua P3 is a small cryptic succulent annual herb to 5 cm high found growing in association with Samphire species on the margins of saline chenopod dominated plains. It is widespread in W.A. with records in the eastern Gascoyne, throughout the Murchison and one point in the Yalgoo bioregions, Figure 11, Figure 12 . Assuming identifications of all specimens plotted is correct, this distribution suggests a downwards revision of Priority Status is likely warranted. Stantec (2017) reported four sites supporting *Gunniopsis propinqua* within the current Study Area numbers of plants were not provided.

Figure 11. Distribution of *Gunniopsis propinqua* in W.A.



A map showing the distribution of all four Priority 3 species cumulatively reported within the Study Area is presented in Figure 12.

Figure 12. Cumulative Records of Priority Flora within the Study Area

360000

370000

6830000

6830000

6820000

6820000

6810000

6810000

360000

370000

Legend

Western Botanical Flora

- ▲ *Acacia* sp. Marshall Pool (G. Cockerton 3024)
- ▲ *Cratystylis centralis*
- ▲ *Eremophila annoscaulis*

Stantec Flora

- ▼ *Acacia* ? *resinimarginea*
- ▼ *Gunnopsis propinqua*

DBCA TPFL

- DBCA WA *Herberium*

Baseline Survey Limits

- ▭ Baseline Survey Limits
- ▭ Stantec Clip Bdry
- ▭ Mining Area Bdry

Road

- Road
- - Track

WB Vegetation Association

- *Acacia* sp. Marshall Pool (G. Cockerton 3024) Shrubland
- *Acacia* sp. Marshall Pool (G. Cockerton 3024), *A. sibirica*, *Acacia aneura*, *A. burkittii* Shrubland

Source: Land Systems: DPIRD, Tenements: DMIRS, Topography: Landgate

Consultant

Layout

Scale: 1:110,000
MGA94 (Zone 51)

CAD Ref: a2553_Veg_WB_05_01
Date: May 2019 | Rev: A | A3

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Leonora Gold Project
Priority Species
Western Botanical, Stantec and DBCA

***Grevillea inconspicua* P4 and *Hemigenia exilis* P4.** Stantec (2017) reported *Grevillea ?inconspicua* occurring north of the Cardinia development envelope, within the proposed haul road alignment to Mertondale. This site was specifically reviewed in February 2019 and the more common and widespread *Grevillea acuarria* was located at the reported site. The author is very familiar with the distribution and habitat preference of both *Grevillea inconspicua* P4 and *Hemigenia exilis* P4, which are known from the Murrin Murrin, Leinster, Yakabindie and Mt Keith nickeliferous minesites. *G. inconspicua* is associated with basalt and gabbro outcrops and subcrops and *H. exilis* has an obligate association with volcanoclastic sediments associated with nickel bearing basalts and volcanics. It is suggested therefore that *Grevillea inconspicua* and *Hemigenia exilis* do not occur within the Study Area and can safely be discounted.

3.6. Species with Taxonomic Interest

Eight species were considered to have taxonomic interest, Figure 16. These are:

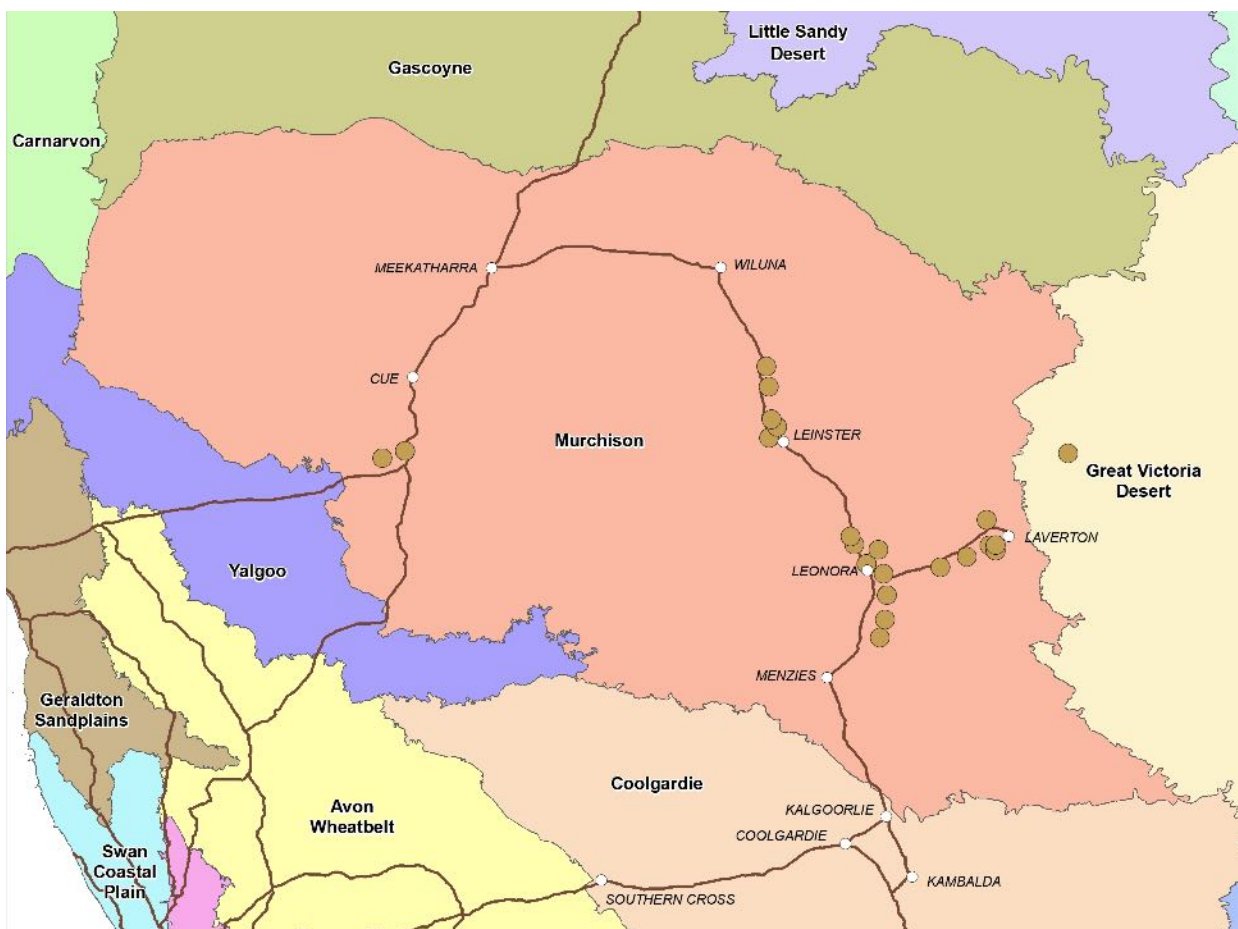
- *Acacia quadrimarginea* narrow phyllode form (G. Cockerton WB38064)
- *Centrolepis* sp. Leonora (G. Cockerton & G. Grigg WB40071)
- *Eremophila platycalyx* subsp. Leonora (J. Morrissey 252)
- *Eriachne mucronata* desert form glabrous (G. Cockerton & S. Cockerton WB40048)
- *Frankenia setosa* type 1
- *Frankenia setosa* type 2
- *Hibiscus* sp. Perrinvale (J. Warden & E. Ager WB10581)
- *Maireana tomentosa* complex (type 1 WB38650)

These are briefly discussed below.

- Two of the seven; *Centrolepis* sp. Leonora (G. Cockerton & G. Grigg WB40071) and *Hibiscus* sp. Perrinvale (J. Warden & E. Ager WB10581), may also have conservation significance and should be flagged for re-collection with flowers and/or fruits and their taxonomy carefully reviewed to confirm whether they represent new species. The other six species are well known and do not require any further investigation. *Acacia quadrimarginea* narrow phyllode form is mapped for reference (Figure 16), however, the other five species are not specifically mapped within the Study Area.

Acacia quadrimarginea narrow phyllode form (G. Cockerton WB38064) is a single stemmed shrub to small tree to 4 m in height with narrow glossy phyllodes held upright and resinous flattened pods. It is always associated with basalt, gabbro or phyllite shale and is widespread in the north-eastern Goldfields between Laverton and Yakabindie Stations with some records near Mt Magnet, Figure 13. It has recently been differentiated from typical *Acacia quadrimarginea* sens. str. It is not considered to warrant conservation ranking. *Acacia quadrimarginea* narrow phyllode form (G. Cockerton WB38064) was reported as *Acacia* sp. East Murchison Basalt in Western Botanical (2018b).

Figure 13. Regional Distribution of *Acacia quadrimarginea* Narrow phyllode form (G. Cockerton WB38064) (Western Botanical 2018b)



***Centrolepis* sp. Leonora (G. Cockerton & G. Grigg WB40071)** is a small herb to 5 cm in height, Plate 4, that was recorded at one point in the Study Area, associated with Mulga, *Ptilotus obovatus* upright form and *Maireana triptera* on a hill slope, Figure 16.

Centrolepis sp. Leonora does not match any known *Centrolepis* species, however, only a tiny specimen was collected and a review of further material is suggested before any determination of taxonomic status can be made. The site at which this species was collected lies just within the north-eastern boundary of the Study Area, north of the Cardinia development area. It requires a review of its taxonomy prior assessing the need for any targeted surveys for the species.

Plate 4. *Centrolepis* sp. Leonora (G. Cockerton & Grigg WB40071) (actual size)



Eremophila platycalyx subsp. **Leonora (J. Morrisey 252)**, Plate 5, is the only form of the complex *E. platycalyx* group known in the Leonora – Laverton area. It is widespread in this region, often associated with granitoid or gabbro geologies, and is currently undergoing taxonomic description by Dr. Bevan Buirchell. It is commonly encountered within the Study Area and not considered to warrant conservation ranking.

Plate 5. *Eremophila platycalyx* subsp. Leonora (J. Morrisey 252), Leinster, July 2016.



A perennial grass, here termed *Eriachne mucronata* desert form glabrous (G. Cockerton & S. Cockerton WB40048), is common and widespread in Western Australia, though often found in small, disjunct occurrences on stony environments. Western Botanical has recorded the species from Warburton in the Gt. Victoria Desert and Central Ranges bioregions to the eastern Murchison bioregion, from Leonora to Wiluna. It was found at seven sites within the Study Area, both on rocky hill tops (either chert or gabbro). It currently is held within the variable *Eriachne mucronata* group, though clearly represents a separate species. It is not considered to have a limited distribution and would not attract conservation listing.

Plate 6. Images of *Eriachne mucronata* desert form glabrous (G. Cockerton & S. Cockerton WB40048), Wanjarri Nature Reserve, 2018



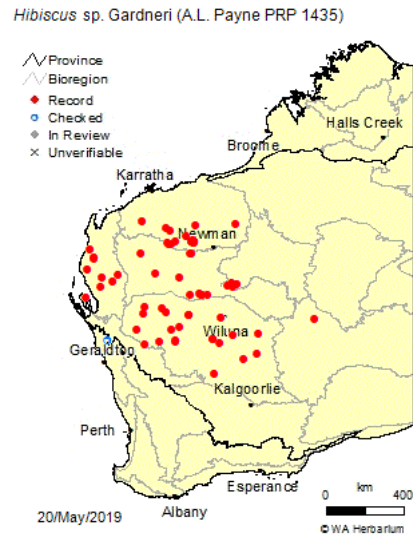
Two *Frankenia* species, both falling within *Frankenia setosa* but having differing flora structures, are uncertain and require review of flowering and fruiting material. The taxonomy of the genus *Frankenia* is well known as being out of date and requiring major revision and it is not surprising there are taxonomic anomalies within this group. The two taxa, *Frankenia setosa* type 1 and *F. setosa* type 2, do not resemble any species with known conservation significance. These are not discussed further.

***Hibiscus* sp. Gardneri (A.L. Payne PRP 1435)**, Plate 7, was recorded at five locations in the Study Area, associated with stony gabbro and basalt hills. It has also been seen more broadly in the NE Goldfields by the author between Leinster and Wiluna, including during surveys in 2018 and is well collected within W.A. from the Pilbara, Carnarvon, Gascoyne and Murchison biogeographic regions, Figure 14. It does not warrant conservation ranking.

Plate 7. *Hibiscus* sp. Gardneri (A.L. Payne PRP 1435), Wanjarrri Nature Reserve, 2018.



The material of *Hibiscus* sp. Gardneri (A.L. Payne PRP 1435) housed at the WA Herbarium has been reviewed by the author and the species is reasonably uniform throughout its range.

Figure 14. Distribution of *Hibiscus* sp. *Gardneri* (A.L. Payne PRP 14325) in W.A.



***Hibiscus* sp. Perrinvale (J. Warden & E. Ager WB10581)**, Table 9 and Plate 8, represents a new species that is not as yet represented within the collection at the WA Herbarium. It was confirmed at five sites within the LGP with a further four sites being possible locations for the species. All sites are on stony ground or hills with either ironstone or basalt rocks prevalent at the surface. Four of these sites occur near the proposed mine infrastructure in north-east of the existing Cardinia development envelope, two in association with Mulga and two in association with *Acacia* sp. Marshall Pool. The remaining five sites, where only vegetative material was observed, occur either on stony chert hills in the south-western part of the Study Area associated with Mulga or on metagabbro hills in association with *Acacia* sp. Marshall in the eastern and central parts of the southern Study Area. The latter group have been fagged as ?*Hibiscus* sp. Perrinvale, Figure 16.

Hibiscus sp. Perrinvale Station has been previously collected once by Western Botanical on a low banded ironstone range on Perrinvale Station, on the eastern shore of Lake Barlee, some 170 km west-south-west of the LGP and 132 km north-west of Menzies. At that time, it was regarded as *Hibiscus* sp. Gardneri and the review of taxonomy has only occurred following this field survey and review of specimens held by Western Botanical.

Hibiscus sp. Perrinvale Station has some superficial similarities to *Hibiscus* sp. Gardneri (A.L. Payne PRP 1435), however, it differs in several characteristics, Table 9. It does not key to any named or as yet un-named species within the Florabase online interactive Malvaceae key (Hollister & Thiele) and does not match any un-named species already held at the WA Herbarium.

Table 9. Features differentiating the two *Hibiscus* species

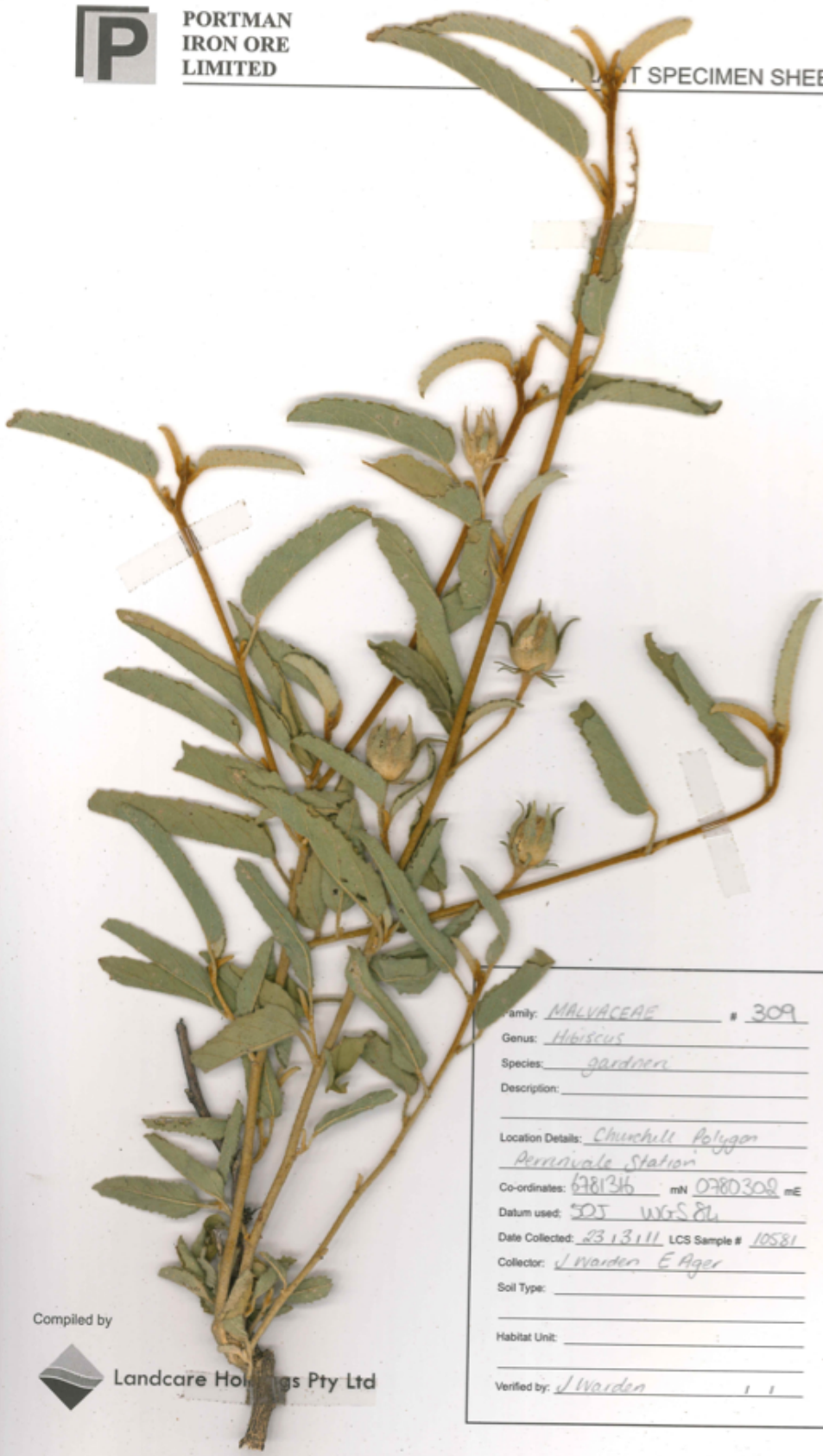
Feature	<i>Hibiscus</i> sp. Gardneri (A.L. Payne PRP 1435),	<i>Hibiscus</i> sp. Perrinvale (J. Warden & E. Ager WB10581)
Hairs on entire plant	Golden stellate hairs covering the entire plant	White stellate hairs covering the entire plant
Leaves	Broadly ovate, acute, dark green colouration, with prominent raised venation on ventral surface, dentate.	Broadly lanceolate, broadly acute, grey-blue colouration, dentate, less prominent raised venation on ventral surface.
Epicalyx	Slender flat oblanceolate epicalyx 10 to 15mm long x 2mm wide, covered in golden stellate hairs.	Slender flat, lanceolate epicalyx 10 mm long x 1.5 mm wide, covered in white stellate hairs.

Feature	<i>Hibiscus</i> sp. <i>Gardneri</i> (A.L. Payne PRP 1435),	<i>Hibiscus</i> sp. <i>Perrinvale</i> (J. Warden & E. Ager WB10581)
Inner Calyx	Broadly triangular, 20 to 40 mm long x 5 to 8 mm wide, with elongated acuminate distal end, dark green, free to base, lobes slightly overlapping at base, prominently ridged, covered in golden stellate hairs.	Broadly triangular, acute, 12 to 15 mm long, co-joined for approximately half the length, lobes not overlapping, surface smooth, covered in white stellate hairs.
Bud and Fruit images		


Hibiscus sp. *Perrinvale* Station (J. Warden & E. Ager WB10581) was not recognised as requiring specific survey whilst in the field and therefore numbers or distribution at each site have not been recorded. Further, the material collected in October 2018 was less than optimal as a reference specimen. It is considered as warranting further collection of flowering and fruiting material and targeted survey within and adjacent to the LGP Study Area .

Plate 8. Specimen of *Hibiscus* sp. Perrinvale Station (J. Warden & E. Ager WB10581), Perrinvale Station, 23rd March 2011.

P PORTMAN IRON ORE LIMITED PLANT SPECIMEN SHEET



Family: MALVACEAE # 309
Genus: Hibiscus
Species: gardneri
Description: _____
Location Details: Churchill Polygon
Perrinvale Station
Co-ordinates: 4781316 mN 0780308 mE
Datum used: SOS WGS 84
Date Collected: 23/3/11 LCS Sample # 10581
Collector: J. Warden E. Ager
Soil Type: _____
Habitat Unit: _____
Verified by: J. Warden 1 1

Compiled by
 Landcare Holdings Pty Ltd

Maireana tomentosa complex (type 1 WB38650) is part of the polymorphic *Maireana tomentosa* complex, widespread and common in arid parts of Australia, Figure 15. The species encountered within the Study Area is widely distributed between Laverton and Wiluna and is not considered to warrant conservation interest.

Figure 15. Distribution of *Maireana tomentosa* within Australia

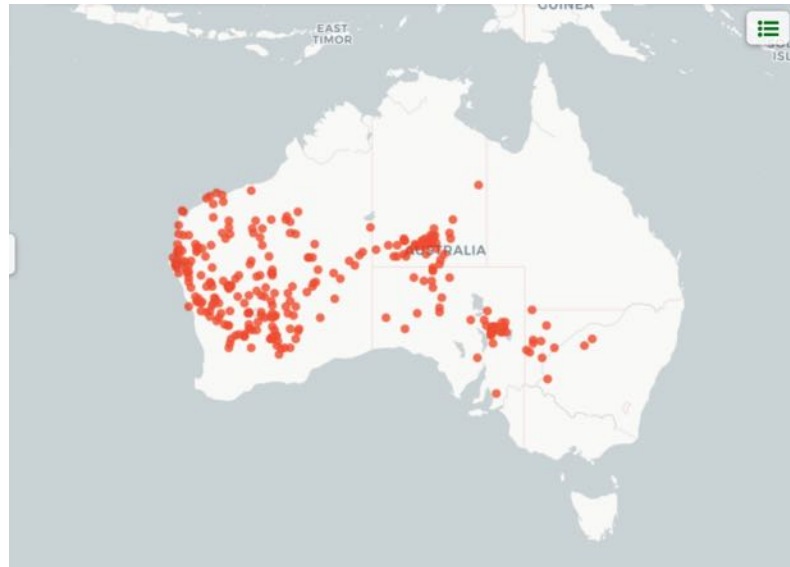
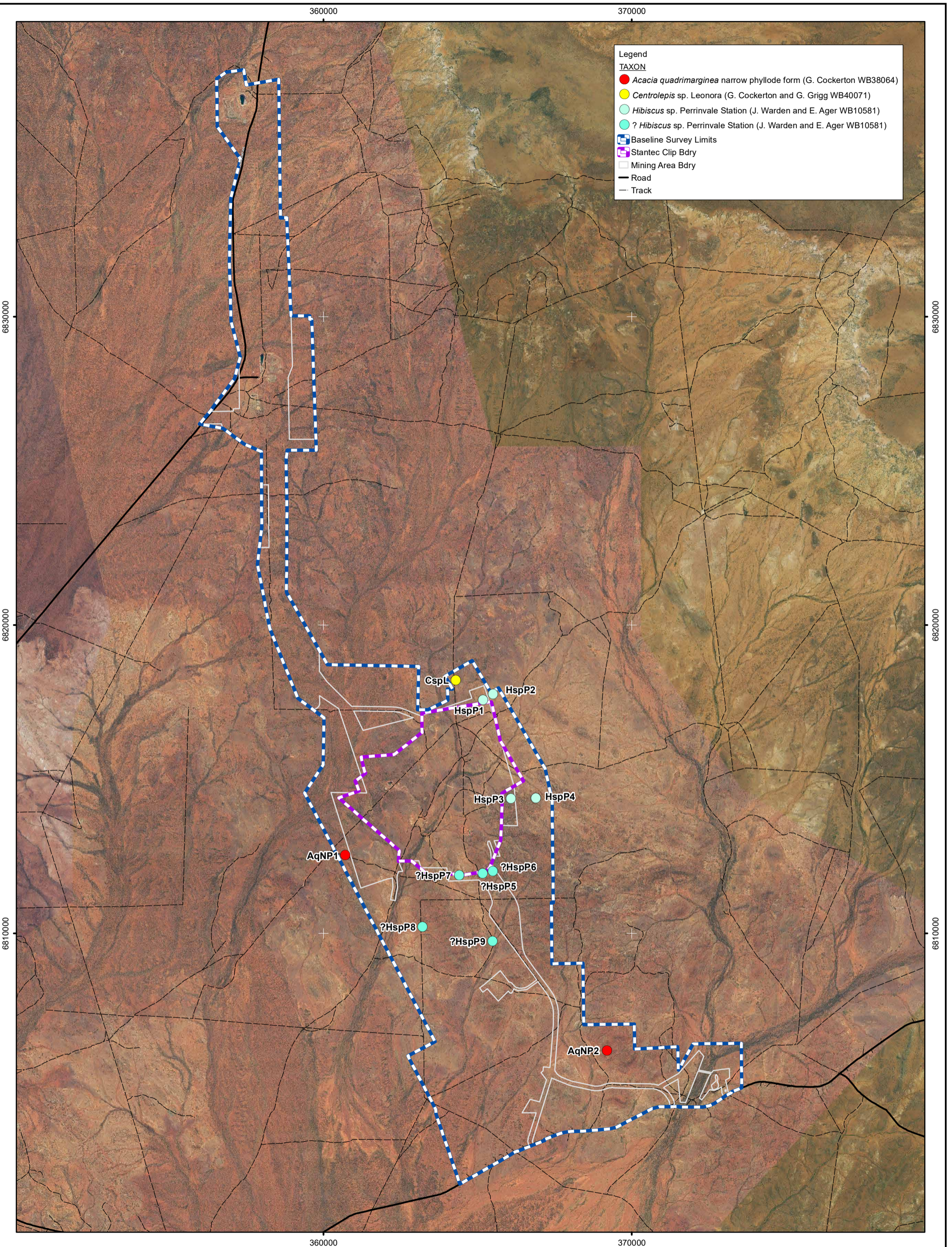


Figure 16. Noteworthy Species with Taxonomic Interest within the Study Area.

Map Legend:

Code	Species Informal Phrase Name
CspL	Centrolepis sp. Leonora (G. Cockerton & G. Grigg WB40071)
HspP	Hibiscus sp. Perrinvale (J. Warden & E. Ager WB10581)
AqNP	Acacia quadrimarginea narrow phyllode form (G. Cockerton WB38064)



Legend

TAXON

- *Acacia quadrimarginea* narrow phyllode form (G. Cockerton WB38064)
- *Centrolepis* sp. Leonora (G. Cockerton and G. Grigg WB40071)
- *Hibiscus* sp. Perrinvale Station (J. Warden and E. Ager WB10581)
- ? *Hibiscus* sp. Perrinvale Station (J. Warden and E. Ager WB10581)

- ▭ Baseline Survey Limits
- ▭ Stantec Clip Bdry
- ▭ Mining Area Bdry
- Road
- Track

Source: Land Systems: DPIRD, Tenements: DMIRS, Topography: Landgate

<p>Consultant</p>	<p>Layout</p>	<p>Scale: 1:110,000 MGA94 (Zone 51)</p> <p>0 1,250 2,500m</p>	<p>KIN MINING NL PO Box 565, Mt Hawthorn, WA 6915 www.kinmining.com.au</p>	<h2 style="margin: 0;">Leonora Gold Project</h2> <h3 style="margin: 0;">Species of Taxonomic Interest</h3>
<p>Author: G Cockerton</p> <p>Drawn: CAD Resources ~ www.cadresources.com.au</p> <p>Date: May 2019 Rev: A A3</p>		<p>KM Ref:</p> <p>Tel: (08) 9246 3242 ~ Fax (08) 9246 3202</p>		

3.7. Species at Limit of Range or Representing Range Extensions

Four endemic species and one weed species are represented at the Limit of their known range or represent range extensions in W.A.:

1. *Alectryon oleifolius* subsp. *canescens*
2. *Eragrostis* sp. Yeelirrie Calcrete (S. Regan LCH 26770)
3. *Sarcozona praecox*; and
4. *Sporobolus actinocladius*
5. *Polycarpon tetraphyllum* * (Weed)

Alectryon oleifolius subsp. *canescens* is a tree to 6m x 8m with foliage that resembles that of an Olive, Plate 9. Its occurrence within and adjacent to the Study Area represents a slight north-westerly range extension of around 100 km from the nearest known occurrence south of Murrin Murrin. It is uncommon in the landscape, and while not considered rare or a Priority species, should be avoided whenever possible when developing infrastructure as the population here represents the northern limit of the range of the species in W.A. Within W.A. it is more widely recorded in the southern Goldfields and Nullarbor regions and is widely distributed in the eastern states.

Plate 9. *Alectryon oleifolius* subsp. *canescens* within the Study Area



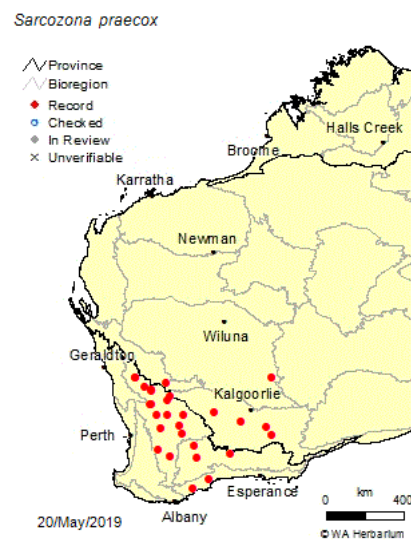
Sarcozona praecox is a succulent prostrate plant with trailing stems and thick, fleshy dark green triangular leaves, Plate 10. Its occurrence in the Study Area represents a minor range extension as the species is more widely known from the Coolgardie and Avon-Wheatbelt bioregions in W.A., Figure 17

The closest record of the species, PERTH 3183149, is on the south-western shore of Lake Carey, some 80 km south-east of the Study Area. Given that the species was not identified until after field works were completed, its distribution within the Study Area was not mapped. It does not warrant conservation focus.

Plate 10. Image of *Sarcozona praecox* (Florabase)



Figure 17. Distribution of *Sarcozona praecox* in W.A.



Sporobolus actinocladus is an annual or perennial grass associated with saline margins of Samphire and *Maireana* dominated chenopod shrublands in low lying seasonally inundated areas. It was commonly recorded within this range of community types in the Study Area. It is widely distributed in northern Australia and its occurrence in the saline Chenopod Plains of the Study Area represent a 292 km southerly range extension for the species from its closest known location north-east of Wiluna (AVH dataset). Given that the species was not identified until after field works were completed, its distribution within the Study Area was not mapped though it is considered to be abundant and widespread in suitable habitats.

Plate 11. Drawing of *Sporobolus actinocladus* (Ausgrass)



Figure 18. Distribution of *Sporobolus actinocladus* within W.A. (AVH)

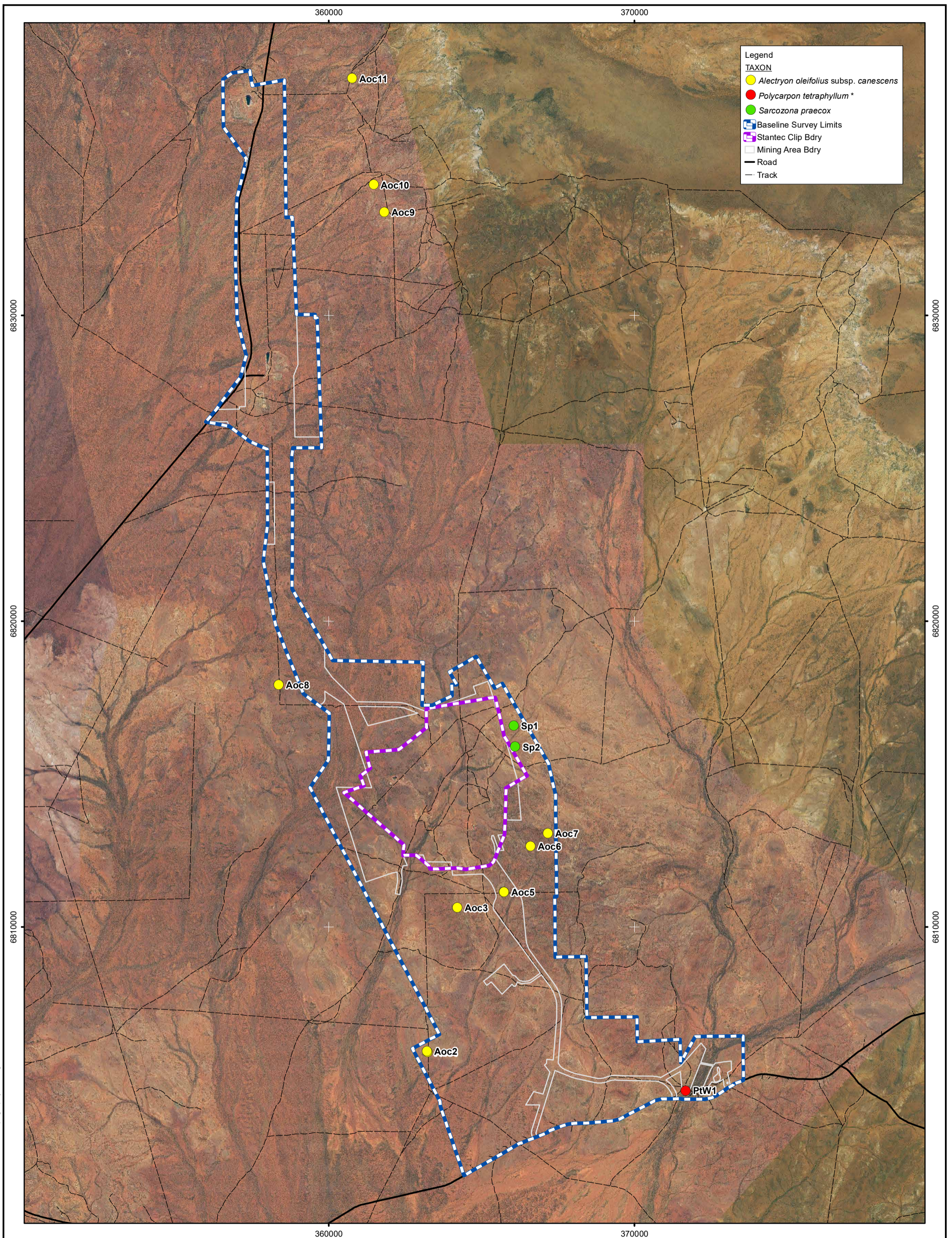


The weed *Polycarpon tetraphyllum*, a small and non-competitive introduced species, represents the first collection of the species in the Murchison bioregion and a range extension of at least 500 km.

Figure 19. Species within the Study Area being at Limit of Range or Representing Range Extensions in W.A.

Map Legend

Code	Species
Aoc	<i>Alectryon oleifolius</i> subsp. <i>canescens</i>
Sp	<i>Sarcozona praecox</i>
PtW	<i>Polycarpon tetraphyllum</i> * (Weed)



Legend

TAXON

- *Alectryon oleifolius* subsp. *canescens*
- *Polycarpon tetraphyllum* *
- *Sarcozona praecox*

- Baseline Survey Limits
- Stantec Clip Bdry
- Mining Area Bdry
- Road
- Track

Source: Land Systems: DPIRD, Tenements: DMIRS, Topography: Landgate

<p>Consultant</p>	<p>Layout</p>		<p>0 1,250 2,500m</p> <p>Scale: 1:110,000 MGA94 (Zone 51)</p>	<p>KIN MINING NL PO Box 565, Mt Hawthorn, WA 6915 www.kinmining.com.au</p>	<p>Leonora Gold Project Species at Limit of Range or Range Extent</p>
		<p>CAD Ref: a2553_Veg_WB_05_04 Date: May 2019 Rev: A A3</p>		<p>Author: G Cockerton KM Ref: Drawn: CAD Resources ~ www.cadresources.com.au Tel: (08) 9246 3242 ~ Fax (08) 9246 3202</p>	

3.8. Species uncommon in the landscape within the Study Area and the broader North-Eastern Goldfields

Santalum acuminatum (Quandong) (2 trees noted); and *Alectryon oleifolius* subsp. *canescens*

Two tree species were markedly uncommon in the landscape within the Study Area: *Santalum acuminatum* (Quandong) (2 trees noted); and *Alectryon oleifolius* subsp. *canescens* (discussed under Range Extensions) with 16 plants at 11 sites (9 x 1 plant, 1 x 2 plants, 1 x 5 plants) observed. Four of these sites, representing eight plants, occur outside the Study Area. Both are medium sized trees and are readily recognised in the field. Only the positions of *Alectryon oleifolius* subsp. *canescens* were recorded using GPS, Figure 19. During development of the LGP, avoidance of impact to these species is recommended due to their scarcity in the landscape as removal of individuals may influence the survival of the local populations.

Acacia doreta Short phyllode form (M. Stone & S. Colwill WB34381) is the typical form of this species and has a widespread distribution in the eastern and northern parts of its range from the southern Pilbara to the eastern Murchison biogeographic regions. It is uncommon in the immediate vicinity of the LGP and this also represents the south-eastern extent of its known distribution, making any occurrences in this area significant. *Acacia doreta* Short phyllode form was found on one gabbro hill on the western margin of the Study Area in association with *Acacia* sp. Marshall Pool, Figure 21. *Acacia doreta* Long phyllode form (G. & S. Cockerton 38632) is prevalent between Leinster and Wiluna.

Eragrostis sp. **Yeelirrie Calcrete (S. Regan LCH 26770)** is a perennial colonial grass forming a dense colony of small individuals to 10 cm high x up to 40 cm across, always associated with calcrete expressions,

Plate 12, Plate 13. It is often heavily grazed by kangaroos and rabbits and is readily overlooked in the field.

Eragrostis sp. Yeelirrie Calcrete was found at 48 sites throughout the south-eastern portion of the Study Area and its distribution was recorded when observed. It is also known from many paleochannels in the Murchison bioregion including the Lake Way, Yeelirrie, Lake Mason and Lake Miranda systems and is not considered as warranting conservation ranking.

Plate 12. *Eragrostis* sp. Yeelirrie Calcrete (S. Regan LCH 26770) habitat.



Plate 13. *Eragrostis* sp. Yeelirrie Calcrete (S. Regan LCH 26770) form of plant.

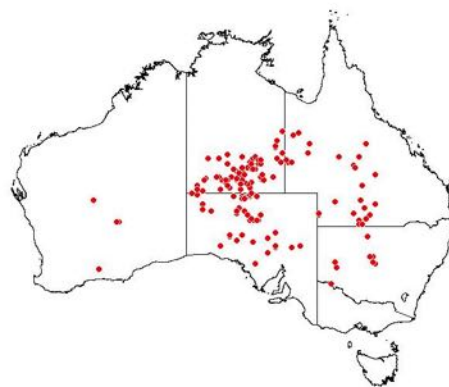


Neurachne munroi is a perennial grass to 0.4m in height which has an enigmatic distribution across central Australia, Plate 14. In WA it is particularly poorly collected, with few specimens vouchered at the WA Herbarium. *Neurachne munroi* was recorded at eight locations within the Study Area, Figure 21, and was always found in association with stony hill slopes on uplifted and weathered mudstone, usually on north and east facing slopes. It has been occasionally recorded by Western Botanical in the Central Ranges, Great Victoria Desert and Murchison bioregions, however, populations area always on similar geology and landscapes, are small in size and highly disjunct. Dr. Terry McFarlane, WA Herbarium, is currently reviewing the taxonomy of this species.

Plate 14. *Neurachne munroi* Within the Study Area



Figure 20. Distribution of *Neurachne munroi* in Australia (AVH)

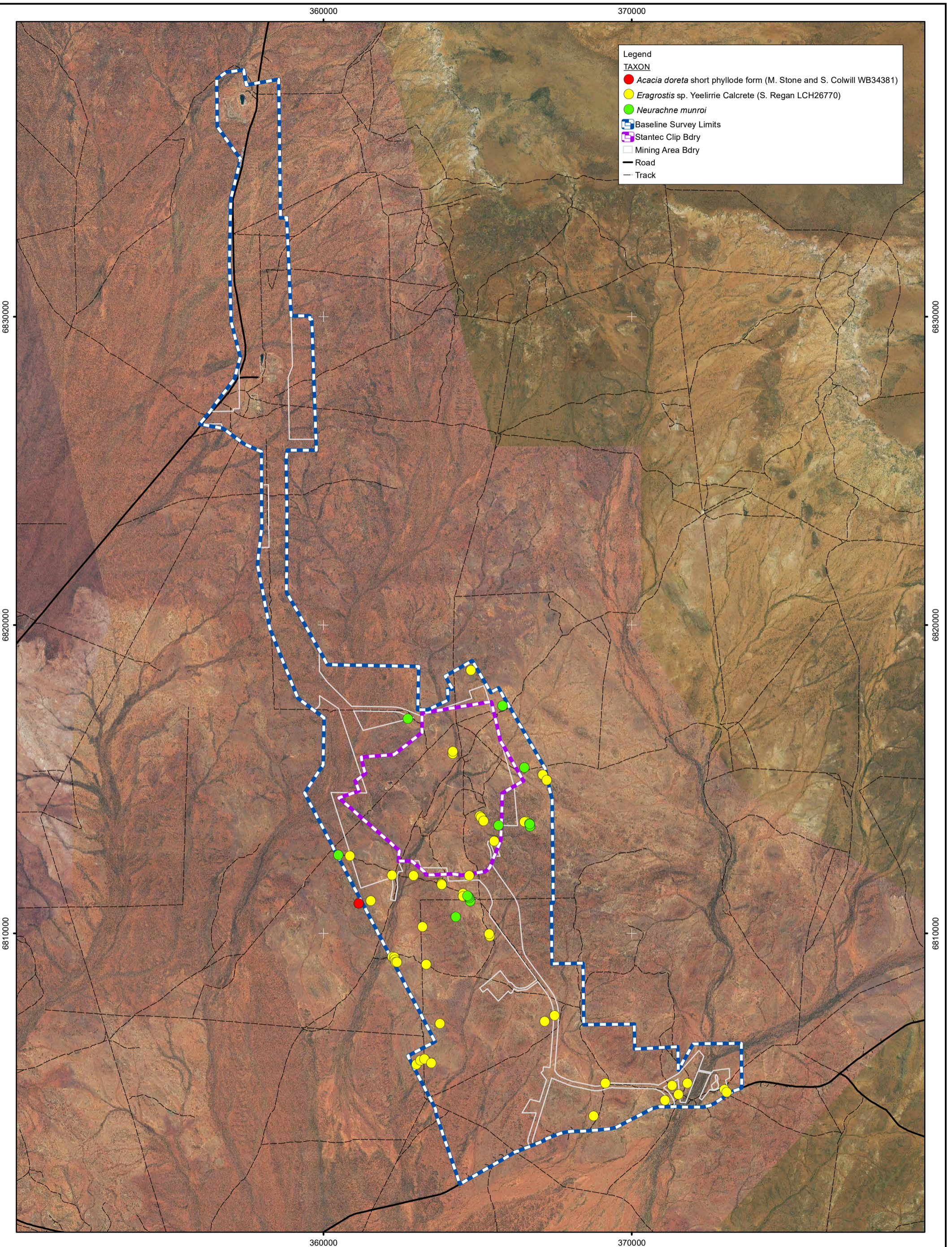


Generated on 20 Jun 2011, copyright Australia's Virtual Herbarium

While *Neurachne munroi* is not a listed Priority species, it is uncommon in the landscape and impacts should be avoided during project development where possible.

Figure 21. Poorly Collected Species

Code	Species
EspYC	Eragrostis sp. Yeelirrie Calcrete (S. Regan LCH26770)
Ad	Acacia doreta Short phyllode form (M. Stone & S. Colwill WB34381)
Nm	Neurachne munroi



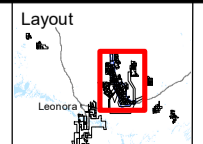
Legend

TAXON

- *Acacia doreta* short phyllode form (M. Stone and S. Colwill WB34381)
- *Eragrostis* sp. Yeelirrie Calcrete (S. Regan LCH26770)
- *Neurachne munroi*

- ▬ Baseline Survey Limits
- ▬ Stantec Clip Bdry
- ▬ Mining Area Bdry
- ▬ Road
- ▬ Track

Source: Land Systems: DPIRD, Tenements: DMIRS, Topography: Landgate



0 1,250 2,500m
Scale: 1:110,000
MGA94 (Zone 51)

CAD Ref: a2553_Veg_WB_05_06
Date: May 2019 | Rev: A | A3

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Leonora Gold Project
Poorly Collected Species
uncommon in area

3.9. Weeds

A cumulative 20 weed species have been recorded during surveys for Kin Mining (Stantec 2017, this survey), Table 10, Figure 22. Of these:

- Seventeen are regarded as introduced minor weed species and not of concern as they are not strongly competitive and are widely naturalised.
- Two species, (*Cenchrus ciliaris* and *Cenchrus setiger*) are widely promoted by the Pastoral industry, however, both are vigorous invasive weed species and their presence within the Study Area lowers the vegetation condition ranking in the habitat in which they occur.
- One species occurring just outside the Study Area, *Cylindropuntia fulgida* var. *mamillata*, Jumping Cholla or Coral Cactus, is listed as a Weed of National Significance (WoNS).
- One species, *Polycarpon tetraphyllum*, a small and non-competitive introduced species, represents the first collection of the species in the Murchison bioregion and a range extension of at least 500 km. It is a small plant and easily overlooked and may be more widespread than data currently indicates.

Cylindropuntia fulgida var. *mamillata* is known at the northern end of the Study Area, around the Mertondale prospect, and is the subject of largely very effective active control measures (G. Grigg pers. comm.). Individual locations of this species were not mapped during field surveys and the location provided is indicative only.

One non-endemic species reported by Stantec (2017), *Carpobrotus aequilaterus*, may have been confused with the native *Sarcozona praecox*. Both species are recorded in the area (Florabase), however, only one record of *C. aequilaterus* is noted in the Murchison bioregion, east of the Study Area, with the bulk of collections being peri-coastal in south-west W.A., indicating there may be confusion in the identification of the species. *Sarcozona praecox* was noted at two sites during the 2018-19 surveys associated with Chenopod Shrublands in saline claypan areas and has a similar leaf morphology to *C. aequilaterus*, affording the chance of confusion. It is suggested that this reported weed be disregarded unless verified in subsequent field survey.

Buffel Grass (*Cenchrus ciliaris*) and Birdwood Grass (*Cenchrus setiger*) are species introduced to WA and often encouraged by Pastoralists for forage value. Both are recognised as environmental risks in that they are vigorous and highly competitive, readily outcompeting native species and pose an elevated fire risk. However, in the north-eastern Goldfields, both species are naturalised and tend to occur in non-saline moisture gaining sites and are therefore restricted in their distribution to roadsides and non-saline creeklines. Neither Buffel Grass nor

Birdwood Grass are listed as Declared Plants in Rangelands in Western Australia and neither require active management. While these species were recorded when observed, locations provided for Buffel Grass and Birdwood Grass are only indicative within the Study Area as no systematic survey for these was conducted during field surveys.

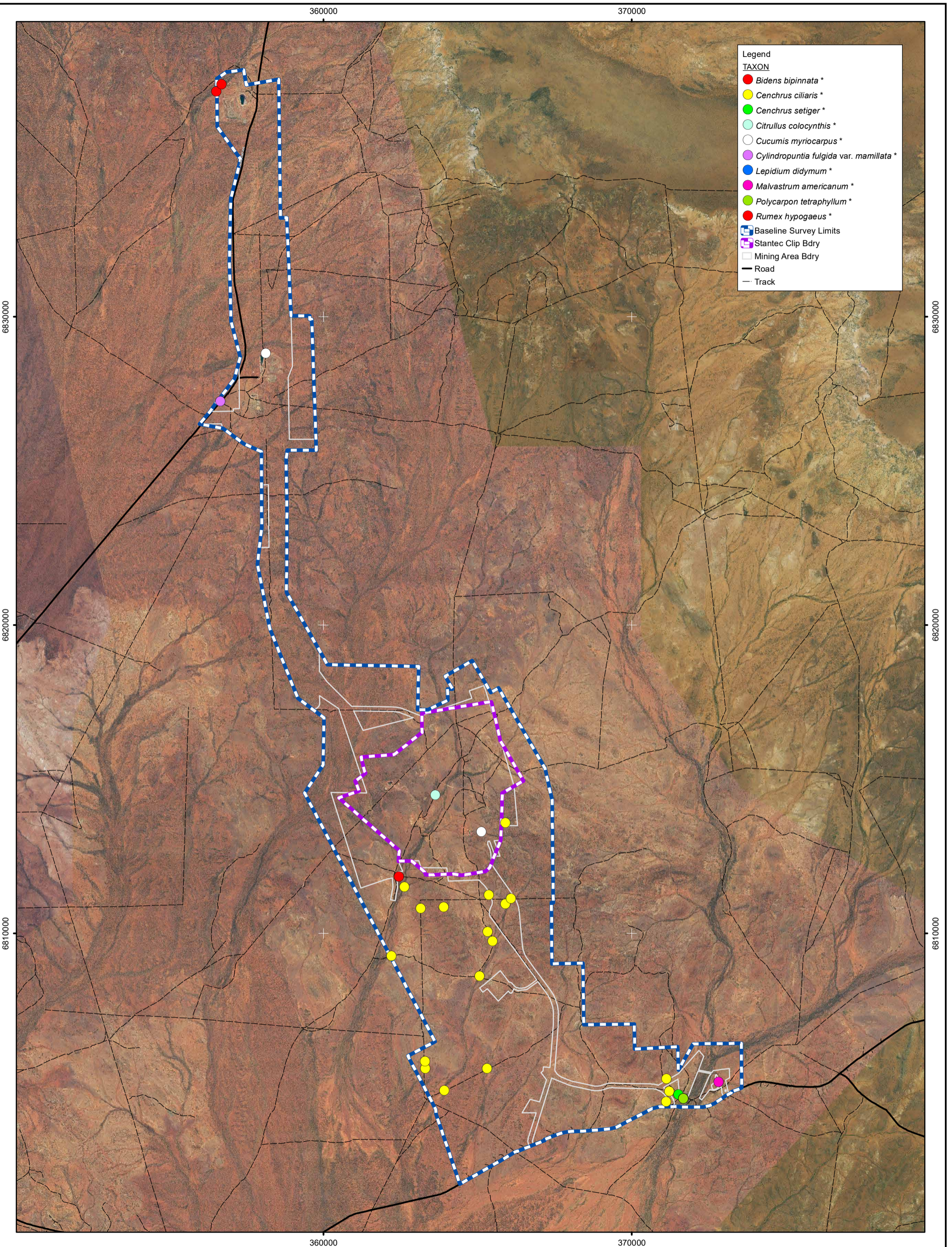
Table 10. Weeds of the Study Area (cumulative list)

Family	Taxon	Common Name	Status	Comment	Source
Aizoaceae	<i>Carpobrotus aequilaterus</i> *	Angular Pigface	Introduced	May have been confused with native species <i>Sarcocolla praecox</i>	Stantec 2017
Anacardiaceae	<i>Schinus terebinthifolia</i> *	Brazilian Pepper Tree	Introduced		WB 2019
Asteraceae	<i>Bidens bipinnata</i> *	Beggars Tick	Introduced		WB 2019
Asteraceae	<i>Sonchus oleraceus</i> *	Common Sowthistle	Introduced		WB 2019
Brassicaceae	<i>Lepidium didymum</i> *	Lesser Swine-Cress	Introduced		WB 2019
Brassicaceae	<i>Sisymbrium erysimoides</i>	Smooth Mustard	Introduced		Stantec 2017
Brassicaceae	<i>Sisymbrium irio</i>	London Rocket	Introduced		Stantec 2017
Convolvulaceae	<i>Cuscuta planiflora</i>	Small Seeded Dodder	Introduced		Stantec 2017
Cucurbitaceae	<i>Citrullus colocynthis</i> *	Bitter Apple	Introduced		WB 2019
Cucurbitaceae	<i>Citrullus myriocarpus</i> *	Prickly Paddy Melon	Introduced		WB 2019
Fabaceae	<i>Medicago</i> sp. Indet. *	A Medic	Introduced		WB 2019
Malvaceae	<i>Malvastrum americanum</i> *	Spiked Malvastrum	Introduced	WB record just outside Study Area but may be present within	WB 2019, Stantec 2017
Poaceae	<i>Cenchrus ciliaris</i> *	Buffel Grass	Environmental risk, naturalised		WB 2019
Poaceae	<i>Cenchrus setiger</i> *	Birdwood Grass	Environmental risk, naturalised		WB 2019
Polygoniaceae	<i>Rumex hypogaeus</i> *	Doublegee			WB 2019, Stantec 2017
Polygalaceae	<i>Rumex vesicarius</i> *	Ruby Dock			WB 2019, Stantec 2017
Primulaceae	<i>Lysimachia arvensis</i> *	Pimpernel			WB 2019, omitted from Stantec 2017
Verbenaceae	<i>Salvia verbenacea</i> *				WB 2019
Caryophyllaceae	<i>Polycarpon tetraphyllum</i> *	Four-leaf Allseed		500 km Range Extension in WA	WB 2019
Cactaceae	<i>Cylindropuntia fulgida</i> var. <i>mamillata</i> *	Jumping Cholla or Coral Cactus	Weed of National Significance (WoNS)	Abundant outside the Study Area near Mertondale prospect	WB 2019, Stantec 2017

Figure 22. Weeds within the Study Area.

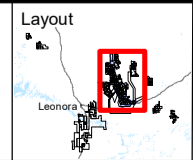
Map Legend:

Code	Weed Species
BpW	<i>Bidens bipinnata</i> *
CcilW	<i>Cenchrus ciliaris</i> *
CsetW	<i>Cenchrus setiger</i> *
CitColW	<i>Citrullus colocynthis</i> *
CucMyrW	<i>Cucumis myriocarpus</i> *
CylFulMamWoNS	<i>Cylindropuntia fulgida</i> var. <i>mamillata</i> * (WoNS)
EmeuW	<i>Rumex hypogaeus</i> *
LdW	<i>Lepidium didymum</i> *
MaW	<i>Malvastrum americanum</i> *
PtW	<i>Polycarpon tetraphyllum</i> *
StW	<i>Schinus terebinthifolia</i>



- Legend**
- TAXON**
- *Bidens bipinnata* *
 - *Cenchrus ciliaris* *
 - *Cenchrus setiger* *
 - *Citrullus colocynthis* *
 - *Cucumis myriocarpus* *
 - *Cyllindropuntia fulgida* var. *mamillata* *
 - *Lepidium didymum* *
 - *Malvastrum americanum* *
 - *Polycarpon tetraphyllum* *
 - *Rumex hypogaeus* *
- Baseline Survey Limits
 - Stantec Clip Bdry
 - Mining Area Bdry
 - Road
 - Track

Source: Land Systems: DPIRD, Tenements: DMIRS, Topography: Landgate



Scale: 1:110,000
MGA94 (Zone 51)

CAD Ref: a2553_Veg_WB_05_05
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Leonora Gold Project Weeds

3.10. Amendments to Previous Flora Records

The following flora previously reported by Stantec were found likely to have been misidentified and corrections are offered. This is undertaken based on field observations of species and not on a review of specimens collected by Stantec. Not all species with uncertain identification reported by Stantec could be addressed in this fashion.

Stantec 2017, 2018a, b Identification	Suggested correct identification	Reason
Acacia assimilis subsp. assimilis	Acacia papyrocarpa	Mis-identification confirmed.
Carpobrotus aequilaterus *	Sarcozona praecox	Likely mis-identification.
Ptilotus sp. Goldfields (R. Davis 10769)	Ptilotus exaltatus	Taxonomic update.
Cynanchum floribundum	Marsdenia australis	Likely mis-identification, Cynanchum floribundum would represent a 400 km range extension.
Vittadinia sp.	Vittadinia eremaea	V. eremaea is prevalent throughout the Study Area.
Enchylaena ?tomentosa	Enchylaena tomentosa	Enchylaena tomentosa confirmed in 2018-19.
Maireana ? platycarpa	Maireana sp. decussate leaves (G. Cockerton & G. Grigg WB 40064)	Specimens reviewed following 2018-19 also keyed to Maireana aff. platycarpa but its taxonomy is uncertain.
Maireana ? tomentosa	Maireana tomentosa (type 1 WB38650) complex	Specimens reviewed following 2018-19 match Maireana tomentosa (type 1 WB38650) complex.
Rhagodia? drummondii	Rhagodia drummondii	Rhagodia drummondii is prevalent in the Study Area.
Duperreya? commixta	Duperreya commixta	Duperreya commixta is prevalent in the Study Area.
Acacia? oswaldii	Acacia oswaldii typical form	Acacia oswaldii typical form is prevalent in the Study Area, as distinct from Acacia oswaldii Calcrete form (BR Maslin 7757) which retains juvenile foliage in adult phase and which is not present in the Study Area.
Baeckea sp. Melita Station (H. Pringle 2738)	Baeckea oclusa	Taxonomic update.
Digitaria ?brownii	Digitaria brownii	Digitaria brownii is prevalent in the Study Area.
Lysimachia arvensis	Lysimachia arvensis *	Lysimachia arvensis is a non-endemic weed species.

Stantec 2017, 2018a, b Identification	Suggested correct identification	Reason
Triodia basedowii	Eriachne mucronata Desert form glabrous	Photographs of habitats containing the species suggest this change

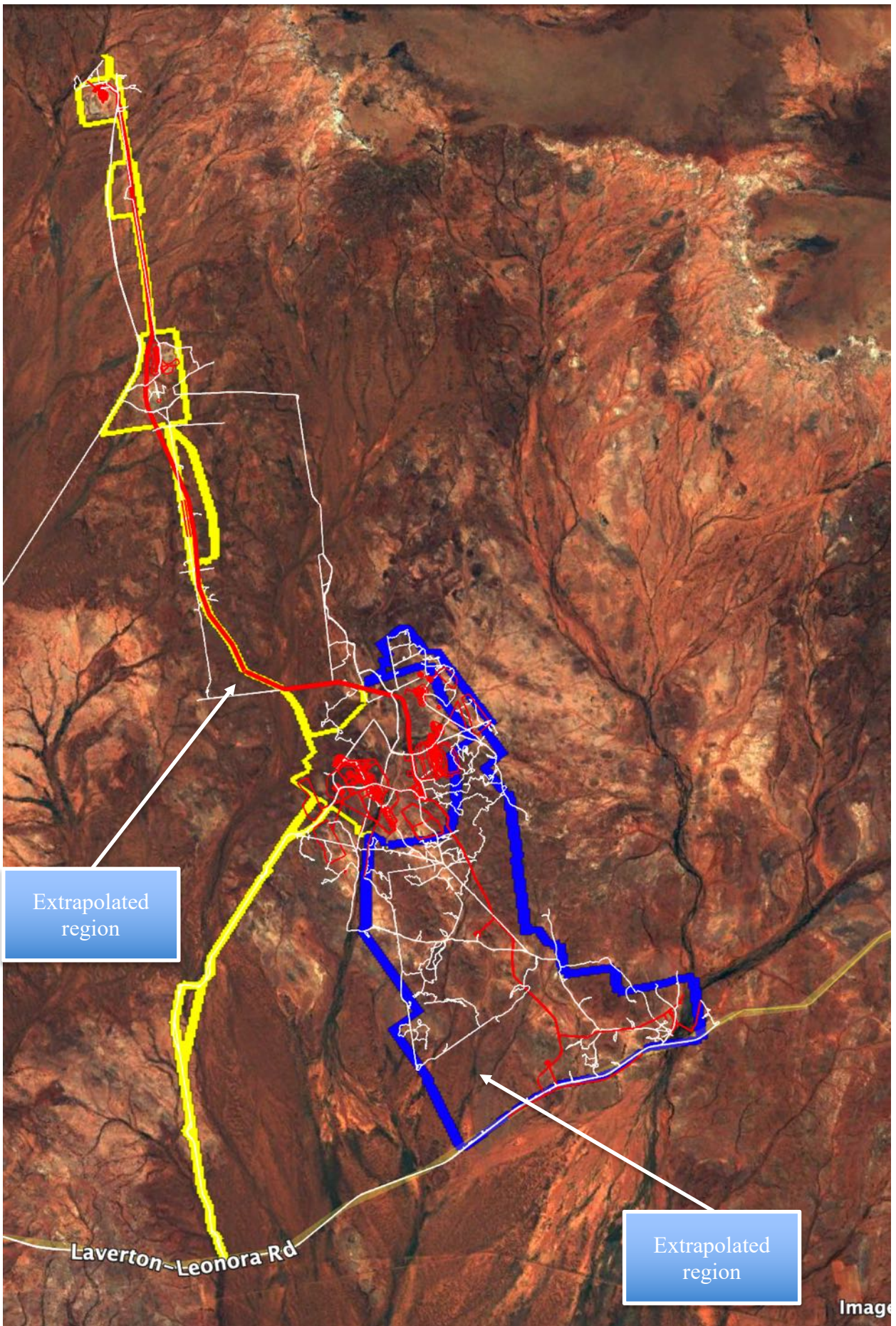
3.11. Survey Effort and Coverage with the Study Area

As access was excellent throughout much of the Study Area, survey coverage was facilitated by numerous existing tracks or fence lines, Figure 23. Where access was limited, but where aerial photography indicated anomalous landscapes, these were accessed on foot where necessary to map the vegetation and develop flora inventories. However, two regions within the Study Area appeared as relatively homogeneous landscapes, were readily access on their perimeters but posed challenges to off-track access within them within the time frame available for survey. The vegetation of these three regions were mapped by extrapolating from the margins at accessible points. These areas were:

- South-western portion of the Study Area north of the Leonora – Laverton Rd – a region of broad drainage lines and broad gently sloping distributary fans.
- Central portion of the Study Area representing the southern 5 km of the proposed haul road from Mertondale to Cardinia, a region with a complex of Hardpan Mulga Shrublands (HPMS), Mulga-Wanderrie Grassy Woodlands (MUWA) and Stony *Acacia* – *Eremophila* Shrublands (SAES) vegetation associations.

The community types in both the extrapolated areas are not particularly complex and all are widely distributed within both the Study Area and the eastern Murchison bioregion. Despite the issue with limited access in the two extrapolated areas, Western Botanical is confident that the vegetation mapping has been conducted effectively and sufficiently accurately given the size of the Study Area and the observed complexity of both flora and vegetation.

Figure 23. GPS Track Logs and Survey Intensity Within the Study Area



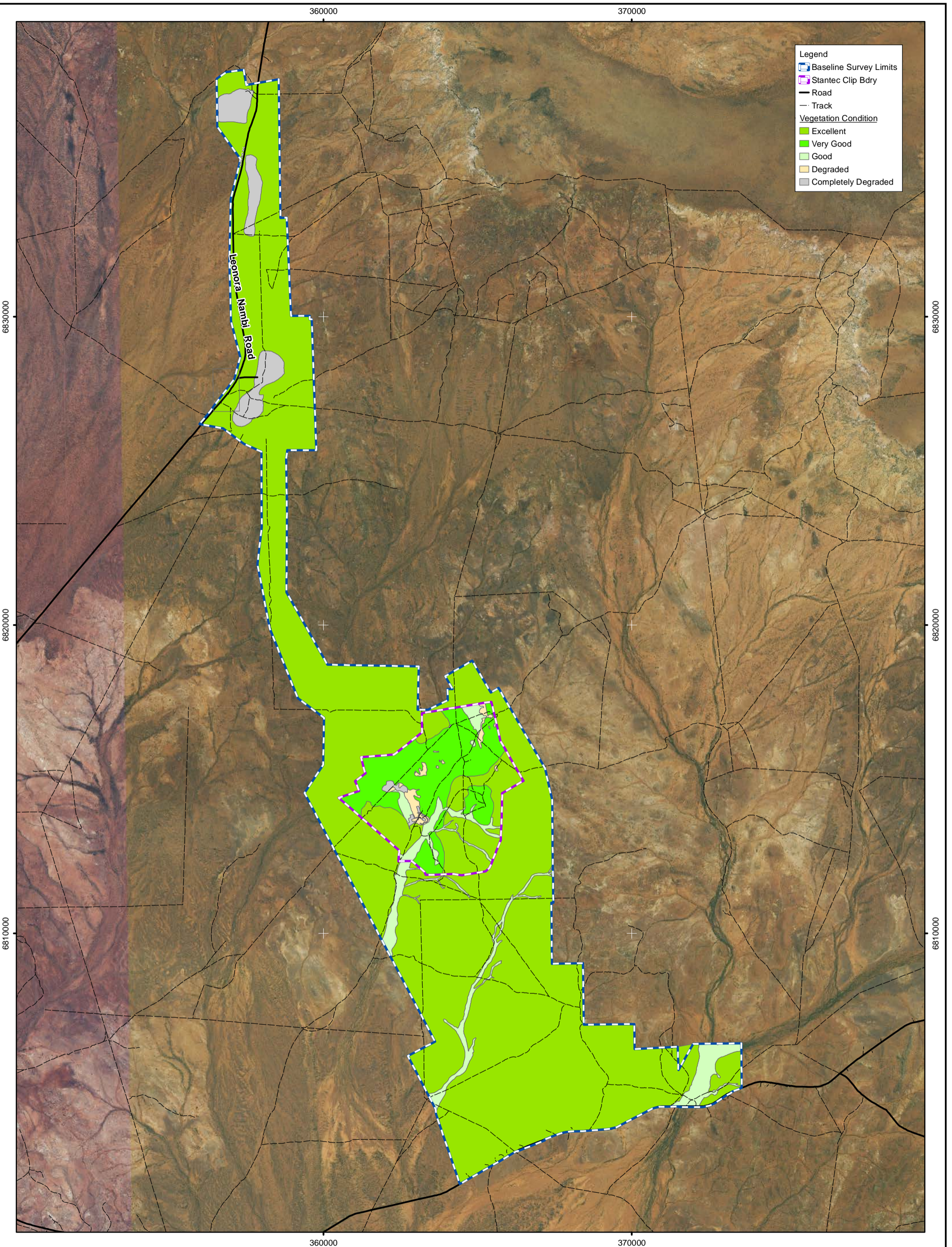
3.12. Vegetation Condition

The bulk of vegetation was observed within the Study Area as being of either Pristine (1) (“Pristine or nearly so, no obvious signs of disturbance”); or Excellent (2) (“Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species”) Condition, utilising the Keighery (1994) scale, Appendix 3.

Exceptions to this were in areas either recently or historically disturbed in exploration, mining or pastoralism (fence lines). The areas of stony hill tops supporting *Acacia* and Mulga were generally Pristine while major drainage lines (Cardinia Creek and Bummer Creek) supported patches of aggressive weed species such as Buffel and Birdwood Grasses that reduced the condition score to Very Good (3) ranking (“Vegetation structure altered, obvious signs of disturbance ... such as the presence of some more aggressive weeds..”).

Little evidence of significant impact from grazing was observed on the bulk of native vegetation, with the exception of cattle tracks nearby and within the major drainage lines where deeper soils and ephemeral surface water is present from time to time.

Figure 24. Vegetation Condition Map



Legend

- Baseline Survey Limits
- Stantec Clip Bdry
- Road
- Track

Vegetation Condition

- Excellent
- Very Good
- Good
- Degraded
- Completely Degraded

Source: Vegetation: Western Botanical, Stantec, Tenements: DMIRS, Topography: Landgate, Image: Outline Imagery (09/07/2018)

Consultant

Coverage

Layout



0 1,250 2,500m

Scale: 1:110,000
MGA94 (Zone 51)

CAD Ref: a2553_Veg_WB_06_01
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**Leonora Gold Project
Vegetation Condition
Western Botanical & Stantec Mapping**

3.13. Statistical Analysis of Vegetation Associations

The statistical analysis of vegetation associations provided insights into the inter-relatedness of vegetation associations, Figure 25. Those communities demonstrating halophytic vegetation components, whether the full suite of *Hakea preissii*, *Maireana* and / or *Tecticornia* species (8.x vegetation unit series) representing the saline chenopod plains prevalent in the central region of the Study Area surrounding the Cardinia development site, or those of the often adjacent *Acacia papyrocarpa* woodlands (5.x vegetation unit series) grouping together due to the influence of the understorey species prevalent in both community groups. While these two differ markedly in vegetation structure, the *A. papyrocarpa* woodlands representing the tallest woodlands in the region, the understorey clearly shows they are closely related in species composition. Interestingly, the Breakaway complex (11.01 vegetation unit) also nests with this group, sharing much of the understorey components of *Maireana* species and *Eremophila scoparia*.

The Mulga woodlands on non-saline soils (1.x vegetation unit series) nest with the *Acacia* spp. (other than Mulga) on stony (gabbro and basalt) hills (4.x vegetation unit series), indicating a shared suite of understorey species among both groups of vegetation associations. The dominant and defining overstorey varies markedly between the two with the suite of Mulga species generally found on neutral or acidic soils (*Acacia aneura*, *A. aptaneura*, *A. caesaneura*, *A. fuscaneura*, *A. incurvaneura*, *A. macraneura* and *A. mulganeura*) not showing habitat specificity in the data set available, but strongly contrasting with the *Acacia* sp. Marshall Pool and/or *A. sibirica* dominated communities, the *Acacia doreta* short phyllode form and the *Acacia burkittii* shrublands on basalt or meta-gabbro geologies which have all been infiltrated with groundwater calcretes, producing alkaline soils. The non-Mulga *Acacia* species prevalent on the greenstone hills are very habitat specific while Mulga seems far more relaxed in its habitat preference.

The calcrete influenced soils of the Gundockerta Land System support the *Acacia victoriae* shrublands (6.01 vegetation unit) along with large patches of *Hakea preissii* over *Eremophila scoparia* (8.06 vegetation unit) and small, isolated, disjunct patches of *Eragrostis* sp. Yeelirrie Calcrete (S. Regan LCH26770) (7.01 vegetation unit). The occurrence of the latter represents a slight range extension for this species which is often encountered on calcrete platforms on the margins of salt lakes and paleochannels in the eastern Murchison biogeographic region.

Low lying non-saline sites subject to waterlogging following heavy rainfall may support either (i) small gilgai with species tolerant of heavy clay soils such as Claypan Grass *Eragrostis setifolia* and tall shrubs such as *Pittosporum angustifolium* (10.02 vegetation unit) or (ii) in the a few cases, support dense *Eragrostis xerophila* (Neverfail) grasslands (10.01 vegetation unit). These are both infrequent in the landscape though the component species of the vegetation associations are very widespread in WA and more broadly in inland Australia.

While the data set available is relatively small (74 Relevés) in relation to the number of community types described (51 vegetation associations) and has little replication is small vegetation units, the PATN analysis has lumped a disparate group of Gilgai (*Pittosporum*

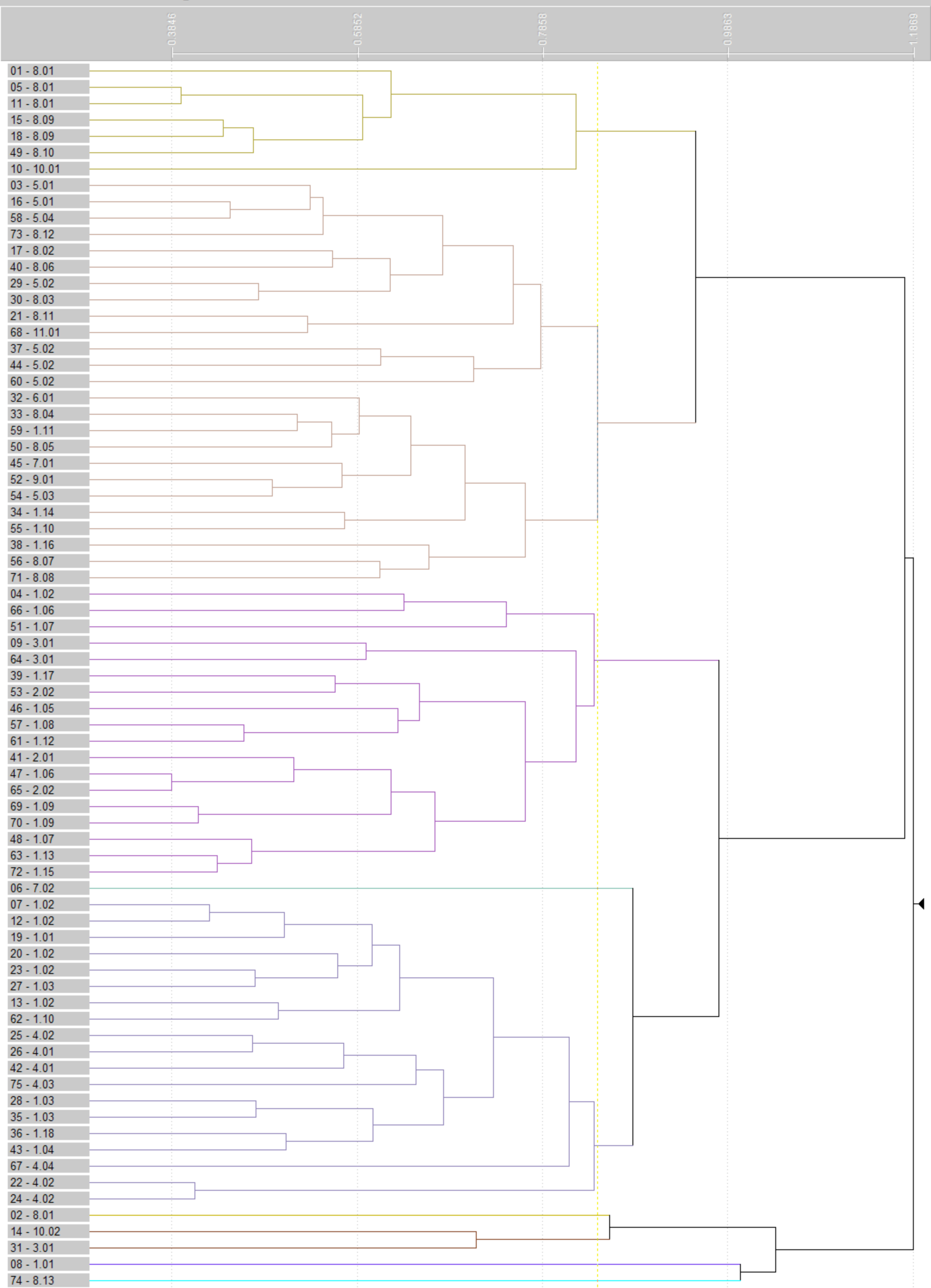
angustifolium, *Acacia tetragonophylla* and *A. victoriae* Shrubland over Claypan Grasses, 10.02), a *Hakea preissii* – *Tecticornia disarticulata* Shrubland (8.01), Mulga Woodland over *Eremophila platycalyx* subsp. Leonora (1.01), drainage line with Mulga (3.01) and a bare claypan (8.13) together. This could be an artefact of one or two species being relatively dominant within these communities or in having a generally low projected foliar cover.

Major drainage lines dominated by Mulga (vegetation unit 3.01 representing Cardinia Creek and similar communities) do not nest together, and are scattered within the dendrogram, likely due to the varying understorey composition at each site, strongly influenced by adjacent community types.

The dendrogram produced on this data set indicates insufficient replication of Relevés to show a strong grouping of community types. However, descriptions of community types were made over relatively large areas within each community and species profiles at each Relevé site were comprehensive, capturing a high proportion of the biodiversity present at the time of survey.

Figure 25. Vegetation Association Row Fusion Dendrogram

Row Fusion Dendrogram



3.14. Regional Context of Vegetation

The vegetation of the Study Area has been mapped at a high level of detail, NVIS Level 5 *Association*. Regional context (outside the Study Area) of vegetation associations is only available at a coarser level of detail, Land Systems as mapped by DoA (1994). However, it is the authors professional judgement that the majority of vegetation associations of the Study Area are broadly representative of those in the immediate region between Leonora and Laverton.

- The vegetation associated with stony hills with limonite, weathered granite Breakaways and the broad colluvial and alluvial plains are well represented;
- The saline lake systems are similarly widely distributed in the numerous paleochannels of the Murchison biogeographic region.

Those vegetation associations that are observed within the Study Area to be small in area, associated with specific geology and disjunct from similar associations include:

- *Eragrostis* sp. Yeelirrie Calcrete grasslands on calcrete. This appears to be associated with occurrences of the Gundockerta Land System within the Study Area. This species is associated with the Cosmo and Melaleuca Land Systems in other paleochannels north of the Study Area.
- *Neurachne munroi* grasslands on mudstone shale on stony hill slopes. It is difficult to draw any meaningful relationship between this species and the relatively broad Land System scale regional mapping available.
- *Acacia doreta* Short phyllode form (M. Stone & S. Colwill WB34381) – *Acacia* sp. Marshall Pool woodland on gabbro and basalt hill. *Acacia doreta* Short phyllode form (M. Stone & S. Colwill WB34381) has a widespread distribution in the eastern and northern parts of its range while *Acacia doreta* Long phyllode form (G. & S. Cockerton 38632) is prevalent between Leinster and Wiluna.

While *Acacia* sp. Marshall Pool Shrublands and *Acacia* sp. Marshall Pool – *Acacia sibirica* Shrublands are common and extensive within the southern part of the Study Area, and they are also common in the region immediately east and south of the Study Area on adjacent occurrences of the Leonora Land System on Minara and Glenorn Stations. They are not known to be widely distributed in the region other than an occurrence at Weebo Station some 70 km NNW of the Study Area (Western Botanical 2018b).

4. Assessment Against the 10 Clearing Principles

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

While the Study Area has a significant diversity of Land Systems and Vegetation Associations (at NVIS 5 *Association*), the diversity of flora within each community type is consistent with that expected respective community types throughout the north-eastern Goldfields.

A total species richness of 236 species is considered typical of a large Study Area though few annuals were observed in the 2018 and 2019 surveys. It is estimated that in the order of 50 annual species could be encountered in more favourable seasons.

The Project is not at variance with this principle.

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

While flora and vegetation are utilised by fauna and for food and habitat, there are no known obligate fauna-flora correlations within the Study Area. Stantec (2017) recorded a range of vertebrate fauna but none that indicated a specific requirement for flora or vegetation within the Study Area. The *Acacia papyrocarpa* woodlands offer nesting sites for birds of prey (active nesting of Australian Hobbys was observed) and areas with active nests should be identified and avoided with significant buffers where possible. Australian Hobbys are not listed as having conservation concern (Stantec, 2017).

Parts of the Study Area may be at variance with this principle with regard to *Acacia papyrocarpa* woodlands and nesting opportunities for some birds of prey.

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

No Threatened (Rare) Flora were recorded in any of the studies conducted within the Study Area and none are known in the immediate area adjacent to the Study Area. Further, while several undescribed species are known within the Study Area, none of these are considered likely to acquire Threatened Flora conservation listing based upon current understanding.

The Project is not at variance with this principle.

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

There are no vegetation related no PECs or TECS within the Study Area and the habitats of the Study Area do not reflect any vegetation related PECs or TECS in the region.

The Project is not at variance with this principle.

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

The region encompassing the Study Area has been subject to significant historical Pastoralism, exploration and mining, however, the bulk of vegetation in the region has not been cleared and is in Excellent to Good condition with many of the hill tops being in a near-Pristine condition.

The Project is not at variance with this principle.

Principle (f) – Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.

Two major and several minor ephemeral Mulga (*Acacia aneura* and its allies) or *Acacia burkittii* dominated creeklines drain from north-east to south-west within the Study Area. Some of the deposit areas lie at or near the heads of these ephemeral creek systems and the proposed borefield lies within a section of Bummer Creek in the south-eastern part of the Study Area. While surface water may pond for periods of time in parts of the major creeklines, these are not permanent water holes. While these are ephemeral water courses, they are not considered wetlands.

The Project may be at variance with this principle.

Principle (g) – Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.

While direct clearing of vegetation for minesite development will directly impact native vegetation, development plans will include measures to minimise and mitigate interruptions to drainage, and the risk of sedimentation down stream.

The Project is not at variance with this principle.

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

No conservation areas lie in close proximity to the Study Area.

The Project is not at variance with this principle.

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

Mine development planning will include measures to minimise and mitigate the risk of increased sedimentation downstream of development envelopes while maintaining surface runoff patterns around infrastructure.

The Project is not at variance with this principle.

Principle (j) – Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence of flooding.

The proposed developments within the Study Area are relatively small and will have measures implemented to maintain surface drainage around infrastructure, maintaining surface flows downstream.

The Project is not at variance with this principle.

5. Limitations

Limitation	Discussion
Available sources of contextual information	Previous reports on the flora and vegetation of areas immediately adjacent to the Study Area were useful references while the regional scale work on Land Systems by DoA provide a broad-scale view of vegetation – landscape – geology patterns in the region. Geoff Cockerton, senior botanist, has had over 30 years' experience working on the flora and vegetation of the north-eastern Goldfields and is familiar with much of the flora of the region. This is not considered a limitation.
The Scope of the survey	The scope of the survey was adequate to gain a good and comprehensive assessment of the perennial flora and vegetation associations of the Study Area. While not incorporating quadrats, the study relied on the implementation of 74 Relevés and development of comprehensive species lists within vegetation associations mapped at NVIS 5 Association level. This is not considered a limitation.
Proportion of flora collected and identified	The perennial flora of the Study Area is considered well assessed. However, the annual and geophytic species were largely not assessed during the 2018-19 surveys due to dry seasonal conditions. Fifteen of the 236 species collected (6.35%) were not able to be identified beyond genus or in some cases family level due to the lack of adequate material and dry seasonal conditions. While Stantec have captured many of the annuals of their Study Areas, these did not overlap with the Study Area for this project. This is considered a limitation in relation to some perennials and the majority of annual and geophytic species that may be present within the Study Area.
Completeness and further work which may be needed	Most of the Study Area was covered adequately to fulfil the scope and to adequately assess the perennial flora and vegetation associations. Two relatively homogeneous regions within the Study Area had vegetation within each extrapolated from accessible tracks on their margins due to limitations of timeframe in the field and the relative inaccessibility of these areas. The author is confident of having assessed perennial species well though annual and geophytic species were not adequately assessed due to the relatively dry seasonal conditions experienced in the months preceding each of the two field surveys.
Mapping reliability	Excellent quality 1:7,500 scale colour aerial photograph field maps were available for the southern portion of the Study area and allowed reasonably accurate mapping of vegetation associations. The field maps available northern portion of the Study Area inclusive of the linear proposed haul road alignment and adjacent old workings, were at 1:12,500 scale and of poorer quality, meaning definition of smaller units on hard copy maps was more challenging in this region. However, CAD Resources provided an electronic tablet with high resolution recent aerial photography of the entire Study Area which was extremely useful in interrogating areas at higher resolution than the hard copy maps allowed. In all cases, community boundaries are presented at +/- 50 to 100m accuracy. Therefore this is not considered a limitation.
Timing: weather, season	The weather immediately preceding both field surveys in late 2018 and early 2019 were during dry seasonal conditions. This meant that few perennial species were in flower, though this was not a limitation in most cases. However, annual species were generally not able to be

Limitation	Discussion
	assessed except in moisture gaining sites. This is considered a limitation for the assessment of annuals.
Disturbances	Substantial historical disturbance and some current and recently completed drilling was evident in some parts of the Study Area. These areas have been mapped as Disturbed. The bulk of the Study Area showed little evidence of historical or recent disturbance. This is not considered a limitation.
Intensity	The surveys relied on traverses and advanced Relevés (where projected foliar cover was estimated for each species encountered at each site) rather than quadrats. Seventy four relevés and many kilometres of traverses were undertaken within the Study Area as access allowed and was deemed necessary to confidently assess the vegetation and flora. The surveys were comprehensive and exceeded the requirements for a Targeted Survey but do not technically meet the requirements for a Detailed Survey as presented in the EPA Technical Guidance (2016). Survey intensity is not considered a limitation.
Resources	Adequate resources were made available by Kin for implementation of the survey at the intensity and survey design undertaken. This is not considered a limitation.
Access	Access to most of the Study Area was excellent and allowed a thorough and comprehensive assessment to be undertaken. Two relatively homogeneous areas with limited access were confidently extrapolated from their respective perimeters. This is not considered a limitation.
Experience levels	Geoff Cockerton, senior botanist, has had over 30 years' experience working with the flora and vegetation of the north-eastern Goldfields and is familiar with much of the flora of the region. He was assisted by Ms Gemma Grigg, an enthusiastic, competent and talented environmental technician with a keen eye for flora. This is not considered a limitation.

6. List of Participants

Staff Member	Field Surveys	Specimen Identification	Data Analysis	Report Preparation
Geoff Cockerton B.Sc. (Biology) <i>License No. – SL011924</i>	1	1	1	1
Gemma Grigg B.Sc.	1			
Dr. David Leach		1		
Mr. Jono Warden		1	1	
Ms Morgan Cockerton, Mr. Steven Cockerton		1		

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8. Bibliography

AVH (2017-) *The Australasian Virtual Herbarium*. Council of Heads of Australasian Herbaria, retrieved from <http://avh.chah.org.au/> (accessed April, May 2019).

Beard, J.S. (1976) *Vegetation survey of Western Australia. Murchison. 1:1000,000 Vegetation Series*. UWA Press, Perth.

Blatant Fabrications Pty Ltd (2004) *PATN (Version 3.12)* [Statistical Analysis Software Package]. Retrieved from <http://www.patn.com.au>.

Brown, B. and B. Buirchell (2011) *A Field Guide to Eremophilas of Western Australia*. Simon Neville Publications, York, Western Australia.

Bureau of Meteorology (2019) *Australian Government, Bureau of Meteorology*. Retrieved from <http://www.bom.gov.au/>.

Cowan, M. (2001). Murchison 1 (MUR1 – East Murchison subregion) In N.L. McKenzie & J.E. May (eds.), *A Biodiversity Audit of Western Australia's 53 Biogeographical Subregions in 2002* (pp. 466-479). Western Australia: Department of Conservation and Land Management.

Department of Biodiversity, Conservation and Attractions. *Threatened and Priority Flora Database, WA Herbarium Database, Threatened and Priority Ecological Communities Databases*, accessed 2018.

Department of the Environment, Water, Heritage and the Arts (2009). *Interim Biogeographic Regionalisation for Australia (IBRA), version 6.1*. Retrieved from <http://www.environment.gov.au/parks/nrs/science/bioregion-framework/ibra/index.html>.

Environmental Protection Authority (EPA) (2004) *Guidance statement 51: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessments in Western Australia*. Retrieved from http://www.epa.wa.gov.au/Policies_guidelines/Pages?ReportPages.aspx

Environmental Protection Authority (EPA) (2016) *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment*, EPA, Western Australia

Hollister, C. and Kevin Thiele *On-line Malvaceae Interactive Key*, <https://florabase.dpaw.wa.gov.au/science/key/malvaceae/>. Accessed May 2019.

Maslin, B.R. & J. E. Reid (2012). *A taxonomic revision of Mulga (Acacia aneura and its close relatives: Fabaceae) in Western Australia*. *Nuytsia* 22 (4): 129-267.

Pringle, H. J. R., A.M.E. Van Vreeswyk & S.A. Gilligan (1994) *Technical Bulletin No.87: An inventory and condition survey of the north-eastern Goldfields, Western Australia*. South Perth, Department of Agriculture Western Australia.

Stantec (2017) *Leonora Gold Project: Level 1 Flora, Vegetation and Fauna Assessment*.
Consultants report to Kin Mining Pty Ltd.

Stantec (2018a) *Leonora Gold Project Proposed Mertondale Haul Road and Pipeline Deviation and Cardinia Access Road Flora, Vegetation and Fauna Report*. Consultant's report to Kin Mining Pty Ltd.

Stantec (2018b) *Leonora Gold Project Flora and Fauna Extrapolation Exercise Report*.
Consultant's report to Kin Mining Pty Ltd.

Western Botanical (2018a) *Flora and Vegetation Assessment for the Mt Keith Satellite Proposal Study Area, October 2017*. Consultant's report for BHP Billiton Nickel West Pty Ltd, report Ref WB867.

Western Botanical (2018b) *Acacias endemic to Greenstones of the north-eastern Goldfields*.
Presentation at the Goldfields Environmental Management Group Conference, Kalgoorlie WA.,
May 2018.

Western Botanical (2018c) *Regional survey for Acacia sp. Marshall Pool (G. Cockerton 3024)*.
Consultant's report to Stantec Pty Ltd and Kin Mining Pty Ltd.

Wilson & Albrecht (2002) *Notes on the genus Cratystylis (Asteraceae)*. *Nuytsia* v14 No 3,
2002, pp. 445 – 452.

Appendix 1. Systematic Flora Species List of Those Collected in the 2018-19 Surveys

Note:

Asterisk * indicates a species reported by Stantec 2017, 2018 a, b has either undergone a name change and is now aligned with that currently accepted or is regarded as having been misidentified and is not aligned with a species currently reported.

Species with uncertain nomenclature or not adequately identified but reported in Stantec 2017-2018 have been omitted.

Family	Taxon	Status	Source	
			Western Botanical	Stantec
Aizoaceae	Sarcozona praecox	Range Extension	1	1*
Aizoaceae	Gunnipopsis propinqua	Priority 3		1
Amaranthaceae	Alternanthera nodiflora		1	1
Amaranthaceae	Ptilotus aevroides			1
Amaranthaceae	Ptilotus divaricatus		1	1
Amaranthaceae	Ptilotus drummondii			1
Amaranthaceae	Ptilotus exaltatus		1	1*
Amaranthaceae	Ptilotus gaudichaudii subsp. gaudichaudii			1
Amaranthaceae	Ptilotus helipteroides			1
Amaranthaceae	Ptilotus macrocephalus		1	1
Amaranthaceae	Ptilotus obovatus (Typical Goldfields form) (G Cockerton et al 15213)	Undescribed, widespread	1	1
Amaranthaceae	Ptilotus obovatus (Upright form) (G Cockerton et al 15206)	Undescribed, widespread	1	
Amaranthaceae	Ptilotus roei		1	1
Amaranthaceae	Ptilotus schwartzii		1	
Amaranthaceae	Surreya diandra		1	1
Anacardiaceae	Schinus terebinthifolia *	Weed	1	
Apocynaceae	Marsdenia australis		1	1*
Asteraceae	Bidens bipinnata *	Weed	1	
Asteraceae	Brachyscome ciliaris sens. lat.	Indeterminate	1	1
Asteraceae	Calocephalus multiflorus			1
Asteraceae	Calotis hispidula			1
Asteraceae	Calotis multicaulis			1
Asteraceae	Centipeda minima			1
Asteraceae	Centipeda thespidioides		1	1
Asteraceae	Cephalipterum drummondii			1
Asteraceae	Chrysocephalum puteale		1	1
Asteraceae	Chthonocephalus pseudevax			1
Asteraceae	Cratystylis centralis	Priority 3	1	
Asteraceae	Cratystylis microphylla			1
Asteraceae	Cratystylis subspinescens		1	1

Family	Taxon	Status	Source	
			Western Botanical	Stantec
Asteraceae	Gnephosis arachnoidea			1
Asteraceae	Lemooria burkittii			1
Asteraceae	Minuria cunninghamii			1
Asteraceae	Myriocephalus pygmaeus			1
Asteraceae	Olearia muelleri		1	1
Asteraceae	Podolepis capillaris		1	
Asteraceae	Podolepis ?kendalii			1
Asteraceae	Podolepis lessonii			1
Asteraceae	Pterocaulon sphacelatum		1	
Asteraceae	Rhodanthe ?charsleyae			1
Asteraceae	Rhodanthe maryonii			1
Asteraceae	Rhodanthe propinqua			1
Asteraceae	Roebuckiella oncocarpa			1
Asteraceae	Senecio magnificus		1	1
Asteraceae	Sonchus oleraceus *	Weed	1	
Asteraceae	Streptoglossa liatroides		1	1
Asteraceae	Vittadinia eremaea		1	1*
Asteraceae	Vittadinia sulcata			1
Asteraceae	Waitzia acuminata			1
Brassicaceae	Brassicaceae sp. INDET	Indeterminate	1	
Brassicaceae	Lepidium didymum *	Weed	1	
Brassicaceae	Lepidium oxytrichum			1
Brassicaceae	Lepidium platypetalum		1	1
Brassicaceae	Sisymbrium erysimoides			1
Brassicaceae	Sisymbrium irio			1
Cactaceae	Cylindropuntia fulgida car. mamillata		1	1
Campanulaceae	Wahlenbergia queenslandica		1	1
Campanulaceae	Wahlenbergia tumidifructa			1
Caryophyllaceae	Polycarpon tetraphyllum *	Weed, Range Extension	1	
Casuarinaceae	Casuarina pauper		1	1
Chenopodiaceae	Atriplex bunburyana		1	1
Chenopodiaceae	Atriplex codonocarpa		1	1
Chenopodiaceae	Atriplex nummularia			1

Family	Taxon	Status	Source	
			Western Botanical	Stantec
Chenopodiaceae	<i>Atriplex quinii</i>		1	1
Chenopodiaceae	<i>Atriplex vesicaria</i>			1
Chenopodiaceae	<i>Chenopodium curvispicatum</i>		1	1
Chenopodiaceae	<i>Dissocarpus paradoxus</i>		1	1
Chenopodiaceae	<i>Dysphania melanocarpa</i>			1
Chenopodiaceae	<i>Dysphania saxatilis</i>			1
Chenopodiaceae	<i>Einadia nutans</i> subsp. <i>eremaea</i>		1	1
Chenopodiaceae	<i>Enchylaena tomentosa</i>		1	1
Chenopodiaceae	<i>Eriochiton sclerolaenoides</i>			1
Chenopodiaceae	Indet ? Chenopod, need more material	Indeterminate	1	
Chenopodiaceae	<i>Maireana carnososa</i>		1	1
Chenopodiaceae	<i>Maireana convexa</i>		1	1
Chenopodiaceae	<i>Maireana georgei</i>		1	1
Chenopodiaceae	<i>Maireana glomerifolia</i>		1	1
Chenopodiaceae	<i>Maireana planifolia</i>		1	
Chenopodiaceae	<i>Maireana platycarpa</i> sens. lat.		1	1
Chenopodiaceae	<i>Maireana pyramidata</i>		1	1
Chenopodiaceae	<i>Maireana sedifolia</i>		1	1
Chenopodiaceae	<i>Maireana thesioides</i>		1	
Chenopodiaceae	<i>Maireana tomentosa</i> (type 1 WB38650) complex	Taxonomic Interest	1	1
Chenopodiaceae	<i>Maireana trichoptera</i>		1	
Chenopodiaceae	<i>Maireana triptera</i>		1	1
Chenopodiaceae	<i>Maireana villosa</i>			1
Chenopodiaceae	<i>Rhagodia drummondii</i>		1	1
Chenopodiaceae	<i>Salsola australis</i>		1	1
Chenopodiaceae	<i>Sclerolaena</i> aff. <i>cuneata</i>	Indeterminate	1	
Chenopodiaceae	<i>Sclerolaena cuneata</i>		1	1
Chenopodiaceae	<i>Sclerolaena densiflora</i>		1	1
Chenopodiaceae	<i>Sclerolaena diacantha</i>		1	1
Chenopodiaceae	<i>Sclerolaena drummondii</i>			1
Chenopodiaceae	<i>Sclerolaena eriacantha</i>		1	1
Chenopodiaceae	<i>Sclerolaena eurotioides</i>		1	

Family	Taxon	Status	Source	
			Western Botanical	Stantec
Chenopodiaceae	Sclerolaena fusiformis			1
Chenopodiaceae	Sclerolaena lanicuspis			1
Chenopodiaceae	Sclerolaena patenticuspis		1	
Chenopodiaceae	Tecticornia disarticulata		1	1
Chenopodiaceae	Tecticornia indica			1
Chenopodiaceae	Tecticornia pergranulata subsp. pergranulata		1	1
Chenopodiaceae	Tecticornia pruinosa			1
Convolvulaceae	Cuscuta planiflora			1
Convolvulaceae	Convolvulus remotus		1	
Convolvulaceae	Duperreya commixta		1	1
Crassulaceae	Crassula colorata			1
Cucurbitaceae	Citrullus colocynthis *	Weed	1	
Cucurbitaceae	Citrullus myriocarpus *	Weed	1	
Cyperaceae	Bulbostylis / Fimbristylis sp. #202	Indeterminate	1	
Cyperaceae	Bulbostylis / Fimbristylis sp. #258	Indeterminate	1	
Cyperaceae	Centrolepis sp. Leonora (G. Cockerton & G. Grigg WB40071)	Taxonomic Interest	1	
Cyperaceae	Cyperus iria			1
Cyperaceae	Eleocharis pallens			1*
Cyperaceae	Isolepis congrua			1
Euphorbiaceae	Euphorbia drummondii		1	1
Fabaceae	Acacia aneura		1	1
Fabaceae	Acacia aptaneura		1	1
Fabaceae	Acacia ayersiana			1
Fabaceae	Acacia brachystachya		1	
Fabaceae	Acacia burkittii		1	1
Fabaceae	Acacia caesaneura		1	1
Fabaceae	Acacia coolgardiensis (doubtful)			1
Fabaceae	Acacia craspedocarpa (lanceolate phyllode form)		1	
Fabaceae	Acacia craspedocarpa (ovate phyllode form)		1	

Family	Taxon	Status	Source	
			Western Botanical	Stantec
Fabaceae	Acacia doreta (short phyllode form)	Typical form of the species	1	1
Fabaceae	Acacia duriuscula			1
Fabaceae	Acacia erinaceae (grey leaf form)		1	
Fabaceae	Acacia fuscaneura		1	
Fabaceae	Acacia incurvaneura		1	1
Fabaceae	Acacia kalgoorliensis			1
Fabaceae	Acacia kempeana		1	1
Fabaceae	Acacia macraneura		1	1
Fabaceae	Acacia masliniana		1	
Fabaceae	Acacia mulganeura		1	
Fabaceae	Acacia oswaldii typical form		1	1
Fabaceae	Acacia papyrocarpa		1	1*
Fabaceae	Acacia pteraneura		1	1
Fabaceae	Acacia quadrimarginea Narrow phyllode form (G. Cockerton WB38064)	Undescribed, widespread	1	
Fabaceae	Acacia quadrimarginea sens. str.	Typical form of the species	1	1
Fabaceae	Acacia ramulosa var. linophylla			1
Fabaceae	Acacia ramulosa var. ramulosa		1	
Fabaceae	Acacia sibirica		1	1
Fabaceae	Acacia sp. Marshall Pool (G. Cockerton 3024)	Priority 3, Undescribed, limited in distribution	1	1
Fabaceae	Acacia tetragonophylla		1	1
Fabaceae	Acacia victoriae		1	1
Fabaceae	Glycine canescens		1	1
Fabaceae	Indigofera georgei		1	
Fabaceae	Medicago sp. Indet. *	Weed	1	
Fabaceae	Senna artemisioides subsp. artemisioides		1	1
Fabaceae	Senna artemisioides subsp. filifolia		1	1
Fabaceae	Senna artemisioides subsp. helmsii		1	1

Family	Taxon	Status	Source	
			Western Botanical	Stantec
Fabaceae	<i>Senna artemisioides</i> subsp. <i>X sturtii</i>			1
Fabaceae	<i>Senna cardiosperma</i>		1	1
Fabaceae	<i>Senna charlesiana</i>			1
Fabaceae	<i>Senna chatelainiana</i>		1	
Fabaceae	<i>Senna glaucophylla</i>		1	
Fabaceae	<i>Senna manicula</i>		1	1
Fabaceae	<i>Senna stowardii</i>			1
Fabaceae	<i>Senna</i> sp. Meekatharra (E. Bailey 1-26)	Undescribed, widespread	1	1
Fabaceae	<i>Templetonia incrassata</i>		1	
Frankeniaceae	<i>Frankenia cinerea</i>		1	
Frankeniaceae	<i>Frankenia fecunda</i>		1	
Frankeniaceae	<i>Frankenia laxiflora</i>		1	
Frankeniaceae	<i>Frankenia setosa</i> (type 1)	Taxonomic Interest	1	1
Frankeniaceae	<i>Frankenia setosa</i> (type 2)	Taxonomic Interest	1	
Geraniaceae	<i>Erodium</i> sp.			1
Goodeniaceae	<i>Brunonia australis</i>			1
Goodeniaceae	<i>Goodenia havilandii</i>			1
Goodeniaceae	<i>Goodenia triodiophila</i>			1
Goodeniaceae	<i>Goodenia</i> sp. (? <i>G. occidentalis</i>)	Indeterminate	1	1
Goodeniaceae	<i>Scaevola densiflora</i>			1
Goodeniaceae	<i>Scaevola spinescens</i> (broad leaf non-spiny form)	Undescribed, widespread	1	1
Goodeniaceae	<i>Scaevola spinescens</i> (narrow leaved spiny form)	Undescribed, widespread	1	
Goodeniaceae	<i>Velleia glabrata</i>			1
Juncaceae	<i>Juncus aridicola</i>		1	1
Lamiaceae	<i>Prostanthera albiflora</i>		1	
Lamiaceae	<i>Prostanthera althoferi</i> subsp. <i>althoferi</i>		1	
Lamiaceae	<i>Teucrium teucriflora</i>		1	1
Lobeliaceae	<i>Isotoma hypocrateriformis</i>		1	

Family	Taxon	Status	Source	
			Western Botanical	Stantec
Loranthaceae	<i>Amyema fitzgeraldii</i>		1	1
Loranthaceae	<i>Amyema miquellii</i>			1
Loranthaceae	<i>Amyema preissii</i>			1
Loranthaceae	<i>Lysiana</i> aff. <i>murrayi</i>	Indeterminate	1	1
Malvaceae	<i>Abutilon cryptopetalum</i>		1	1
Malvaceae	<i>Abutilon oxycarpum</i> subsp. Prostrate (A.A. Mitchell PRP 1266)		1	1
Malvaceae	<i>Brachychiton gregorii</i>		1	1
Malvaceae	<i>Hibiscus burtonii</i>		1	1
Malvaceae	<i>Hibiscus</i> sp. <i>Gardneri</i> (A.L. Payne PRP 1435)	Undescribed, widespread	1	
Malvaceae	<i>Hibiscus</i> sp. <i>Perrinvale</i> (J. Warden & E. Ager WB10581)	Taxonomic and Conservation Interest	1	
Malvaceae	<i>Lawrenzia densiflora</i>			1
Malvaceae	<i>Malvastrum americanum</i> *	Weed	1	1
Malvaceae	<i>Sida</i> aff. <i>fibulifera</i>	Indeterminate	1	
Malvaceae	<i>Sida calyxhymenia</i>		1	1
Malvaceae	<i>Sida ectogamma</i>		1	1
Malvaceae	<i>Sida intricata</i>		1	1
Malvaceae	<i>Sida</i> sp. dark green fruits (S. van Leeuwen 2260)	Undescribed, widespread	1	
Malvaceae	<i>Sida</i> sp. <i>Excedentifolia</i> (J.L. Egan 1925)	Undescribed, widespread	1	1
Malvaceae	<i>Sida</i> sp. Indet	Indeterminate	1	1
Malvaceae	<i>Sida</i> sp. Indet #12	Indeterminate	1	
Marsileaceae	<i>Marsilea drummondii</i>		1	1*
Marsileaceae	<i>Marsilea hirsuta</i>		1	
Myrtaceae	<i>Calytrix desolata</i>		1	
Myrtaceae	<i>Eucalyptus gypsophila</i>		1	1*
Myrtaceae	<i>Eucalyptus lucasii</i>		1	
Myrtaceae	<i>Hysterobaeckea occlusa</i>		1	
Nyctaginaceae	<i>Boerhavia coccinea</i>			1
Nyctaginaceae	<i>Boerhavia repleta</i>		1	1
Phyllanthaceae	<i>Phyllanthus irwinii</i>			1

Family	Taxon	Status	Source	
			Western Botanical	Stantec
Pittosporaceae	Pittosporum angustifolium		1	1
Poaceae	Aristida contorta		1	1
Poaceae	Aristida holathera		1	1
Poaceae	Aristida inaequiglumis		1	
Poaceae	Aristida obscura		1	1
Poaceae	Austrostipa elegantissima		1	1
Poaceae	Austrostipa scabra		1	
Poaceae	Austrostipa nitida			1
Poaceae	Austrostipa trichophylla			1
Poaceae	Austrostipa sp. #224 INDET	Indeterminate	1	
Poaceae	Cenchrus ciliaris *	Weed	1	
Poaceae	Cenchrus setiger *	Weed	1	
Poaceae	Cymbopogon ambiguus		1	1*
Poaceae	Cynodon prostratus			1
Poaceae	Dactyloctenium radulans		1	1
Poaceae	Dichanthium sericeum		1	
Poaceae	Digitaria brownii		1	1
Poaceae	Enneapogon avenaceus		1	1
Poaceae	Enneapogon caeruleus		1	1
Poaceae	Enneapogon cylindricus		1	
Poaceae	Enneapogon polyphyllus		1	1
Poaceae	Enteropogon ramosus		1	1
Poaceae	Eragrostis aff. kennedyae	Indeterminate	1	1
Poaceae	Eragrostis dielsii		1	1
Poaceae	Eragrostis eriopoda		1	1
Poaceae	Eragrostis lancunaria		1	1
Poaceae	Eragrostis leptocarpa		1	1
Poaceae	Eragrostis pergracilis			1
Poaceae	Eragrostis setifolia		1	1
Poaceae	Eragrostis sp. Yeelirrie Calcrete (S. Regan LCH 26770)	Taxonomic Interest, Range Extension, Undescribed, widespread	1	

Family	Taxon	Status	Source	
			Western Botanical	Stantec
Poaceae	<i>Eragrostis xerophila</i>		1	
Poaceae	<i>Eriachne flaccida</i>			1
Poaceae	<i>Eriachne helmsii</i>		1	1
Poaceae	<i>Eriachne mucronata</i> desert form glabrous (G. Cockerton & S. Cockerton WB40048)	Taxonomic Interest, Undescribed, widespread	1	
Poaceae	<i>Eriachne ovata</i>		1	
Poaceae	<i>Eriachne pulchella</i> subsp. <i>pulchella</i>		1	1
Poaceae	<i>Iseilema eremaea</i>		1	1
Poaceae	<i>Monachather paradoxus</i>		1	1
Poaceae	<i>Neurachne munroi</i>	Poorly Collected	1	
Poaceae	<i>Paspalidium basicladum</i>		1	
Poaceae	Poaceae sp. #197 INDET	Indeterminate	1	
Poaceae	<i>Sporobolus actinocladus</i>	Range Extension	1	1
Poaceae	<i>Sporobolus caroli</i>		1	1*
Poaceae	<i>Themeda triandra</i>		1	1
Poaceae	<i>Thyridolepis multiculmis</i>		1	1
Poaceae	<i>Triodia basedowii</i> (doubtful)			1
Poaceae	<i>Tripogonella loliiformis</i>		1	
Polygalaceae	<i>Polygala isingii</i>		1	
Polygalaceae	<i>Rumex vesicarius</i> *	Weed	1	
Polygoniaceae	<i>Rumex hypogaeus</i> *	Weed	1	
Portulacaceae	<i>Calandrinia creethiae</i>			1
Portulacaceae	<i>Calandrinia eremaea</i>			1
Portulacaceae	<i>Calandrinia porifera</i>			1
Portulacaceae	<i>Calandrinia ptychosperma</i>			1
Portulacaceae	<i>Calandrinia</i> sp. Black angular seeds (A.A. Mitchell PRP 1661)			1
Portulacaceae	<i>Calandrinia translucens</i>			1
Portulacaceae	<i>Portulaca oleracea</i>		1	1
Primulaceae	<i>Lysimachia arvensis</i> *	Weed	1	1
Proteaceae	<i>Grevillea acuaria</i>		1	1
Proteaceae	<i>Grevillea berryana</i>		1	1

Family	Taxon	Status	Source	
			Western Botanical	Stantec
Proteaceae	<i>Grevillea extorris</i>		1	1
Proteaceae	<i>Hakea arida</i> subsp. <i>recurva</i>		1	
Proteaceae	<i>Hakea leucoptera</i> subsp. <i>sericipes</i>		1	
Proteaceae	<i>Hakea lorea</i> subsp. <i>lorea</i>		1	1
Proteaceae	<i>Hakea preissii</i>		1	1
Pteridaceae	<i>Cheilanthes lasiophyllum</i>		1	
Pteridaceae	<i>Cheilanthes sieberi</i>		1	1
Rubiaceae	<i>Alectryon oleifolius</i> subsp. <i>canescens</i>	Limit of Range, Range Extension	1	
Rubiaceae	<i>Psydrax latifolium</i>		1	
Rubiaceae	<i>Psydrax rigidula</i>		1	1
Rubiaceae	<i>Psydrax suaveolens</i>		1	1
Rutaceae	<i>Philotheca brucei</i> subsp. <i>brucei</i>		1	
Santalaceae	<i>Exocarpos aphyllus</i>		1	1
Santalaceae	<i>Santalum acuminatum</i>		1	
Santalaceae	<i>Santalum lanceolatum</i>		1	1
Santalaceae	<i>Santalum spicatum</i>		1	1
Sapindaceae	<i>Dodonaea lobulata</i>		1	1
Sapindaceae	<i>Dodonaea rigida</i>		1	1
Scrophulariaceae	<i>Eremophila alternifolia</i>		1	1
Scrophulariaceae	<i>Eremophila annoscaulis</i>	Priority 3	1	
Scrophulariaceae	<i>Eremophila clarkei</i>		1	
Scrophulariaceae	<i>Eremophila compacta</i> subsp. <i>compacta</i>		1	
Scrophulariaceae	<i>Eremophila exilifolia</i>			1*
Scrophulariaceae	<i>Eremophila forrestii</i>		1	1
Scrophulariaceae	<i>Eremophila georgei</i>		1	1
Scrophulariaceae	<i>Eremophila gilesii</i> subsp. <i>variabilis</i>			1
Scrophulariaceae	<i>Eremophila glabra</i> subsp. <i>glabra</i>			1
Scrophulariaceae	<i>Eremophila glandulifera</i>			1
Scrophulariaceae	<i>Eremophila granitica</i>		1	
Scrophulariaceae	<i>Eremophila hygrophana</i>		1	
Scrophulariaceae	<i>Eremophila homoplastica</i>			1
Scrophulariaceae	<i>Eremophila latrobei</i> subsp. <i>latrobei</i>		1	1

Family	Taxon	Status	Source	
			Western Botanical	Stantec
			1	
Scrophulariaceae	<i>Eremophila latrobei</i> var. <i>tuberculosa</i>		1	
Scrophulariaceae	<i>Eremophila longifolia</i>		1	1
Scrophulariaceae	<i>Eremophila mackinlayi</i> subsp. <i>spathulata</i>		1	1
Scrophulariaceae	<i>Eremophila margarethae</i>		1	1
Scrophulariaceae	<i>Eremophila oldfieldii</i> subsp. <i>angustifolia</i>		1	1
Scrophulariaceae	<i>Eremophila oppositifolia</i> var. <i>angustifolia</i>		1	
Scrophulariaceae	<i>Eremophila platycalyx</i> subsp. <i>Leonora</i> (Morrisey J. 252)	Taxonomic Interest, Undescribed, Widespread in Leonora area	1	1*
Scrophulariaceae	<i>Eremophila scoparia</i>		1	1*
Scrophulariaceae	<i>Eremophila serrulata</i>		1	1
Scrophulariaceae	<i>Eremophila simulans</i> subsp. <i>simulans</i>		1	1
Scrophulariaceae	<i>Eremophila</i> sp. aff. <i>simulans</i> subsp. <i>simulans</i> INDET	Indeterminate	1	
Scrophulariaceae	<i>Eremophila youngii</i> subsp. <i>youngii</i>		1	1
Solanaceae	<i>Nicotiana rosulata</i> subsp. <i>rosulata</i>			1
Solanaceae	<i>Solanum cleistogamum</i>		1	1
Solanaceae	<i>Solanum lasiophyllum</i>		1	1
Solanaceae	<i>Solanum nigrum</i> *			1
Thymelaeaceae	<i>Pimelea microcephala</i> subsp. <i>microcephala</i>		1	
Verbenaceae	<i>Salvia verbenacea</i> *	Weed	1	
Zygophyllaceae	<i>Roepera</i> ? <i>compressa</i>			1*
Zygophyllaceae	<i>Roepera eichleri</i>			1*
Zygophyllaceae	<i>Tribulus asterocarpus</i>			1

Appendix 2. Vegetation Maps of the Study Area

Vegetation Group	Final Mapping Numeric Code	Vegetation Association Name	Veg Assoc Code
Mulga Woodlands over Perennial Non-Halophytic Shrubs on hills and plains	1.01	<i>Acacia aneura</i> , <i>A. ramulosa</i> , <i>Eremophila platycalyx</i> subsp. <i>Leonora</i> (Morrisey J. 252), <i>Ptilotus obovatus</i> (Upright form) Shrubland and grasses	AaArEpLPoU, Grasses
	1.02	<i>Acacia aneura</i> (forms), <i>Ptilotus obovatus</i> (Upright form), <i>Maireana triptera</i> Shrubland	AaPoUMt
	1.02D	Dead vegetation, formerly <i>Acacia aneura</i> (forms), <i>Ptilotus obovatus</i> (Upright form), <i>Maireana triptera</i> Shrubland	Dead AaPoUMt
	1.03	<i>Acacia aneura</i> , <i>Maireana sedifolia</i> , <i>Scaevola spinescens</i> Narrow leaf spiny form <i>Ptilotus obovatus</i> (typical Goldfields form) Shrubland	AaMsSsNPoG
	1.04	<i>Acacia burkittii</i> , <i>Senna artemisioides</i> subsp. <i>filifolia</i> , <i>Maireana</i> spp. Shrubland	AbSafAmpMt
	1.05	<i>Acacia aneura</i> (forms) over <i>Eremophila platycalyx</i> subsp. <i>Leonora</i> (Morrisey J. 252) over <i>Senna</i> spp. over <i>Ptilotus obovatus</i> (Upright form) and <i>Maireana triptera</i> Shrubland	AaEpLSpPpPoUMt
	1.06	<i>Acacia aneura</i> (forms) over <i>Eremophila</i> spp. (<i>E. margarethae</i> , <i>E. compacta</i> subsp. <i>compacta</i> , <i>E. simulans</i> subsp. <i>simulans</i> or <i>E. annoscaulis</i> P3 over <i>Ptilotus schwartzii</i> Shrubland	AaEmP
	1.07	Stony Ironstone Mulga Shrubland <i>Acacia aneura</i> , <i>Eremophila latrobei</i> , <i>Sida ectogamma</i> Shrubland on summits of chert, quartz hills and slopes	SIMS AaEISe
	1.08	Stony Ironstone Mulga Shrubland <i>Acacia aneura</i> , <i>Ptilotus obovatus</i> (Upright form), <i>Ptilotus schwartzii</i> Shrubland on midslopes of chert, quartz hills and slopes	SIMS AaPoUSe
	1.09	Stony Ironstone Mulga Shrubland <i>Acacia aneura</i> (forms) over <i>Eremophila clarkei</i> , <i>Eremophila forrestii</i> Shrubland on summit of low ferricrete hills	SIMS AaEcEf
	1.10	<i>Acacia aneura</i> over <i>Maireana sedifolia</i> over <i>Ptilotus obovatus</i> (Upright form) Shrubland over <i>Maireana triptera</i> Shrubland and grasses	AaMsPoUMt
	1.11	<i>Maireana pyramidata</i> , <i>Maireana sedifolia</i> , <i>Frankenia</i> spp. Open Low Shrubland and grasses	MpMsFspp
	1.12	<i>Acacia aneura</i> (sens. lat.), <i>Eremophila platycalyx</i> subsp. <i>Leonora</i> (Morrisey J. 252) over <i>Eremophila compacta</i> subsp. <i>compacta</i> and <i>Ptilotus obovatus</i> (Upright form) Shrubland	AaEpLEm
	1.13	<i>Acacia aneura</i> (sens. lat.), <i>Acacia ramulosa</i> , <i>Acacia quadrimarginea</i> (sens. str.), <i>Eremophila platycalyx</i> subsp. <i>Leonora</i> (Morrisey J. 252) Shrubland	AaArAqEp
	1.14	Stony <i>Acacia</i> - <i>Eremophila</i> Shrubland	SAES
	1.15	Hardpan Plain, deflation zone	HPDS
	1.16	Hardpan Mulga Shrubland	HPMS
1.17	<i>Acacia aneura</i> , <i>Maireana triptera</i> , <i>Ptilotus obovatus</i> (Goldfields Form) Shrubland over <i>Aristida contorta</i>	AaPoGMt	
Mulga Shrublands / Woodlands over Perennial Grasses on Plains	2.01	Mulga-Wanderrie (<i>Acacia aneura</i> , <i>Eragrostis eriopoda</i>) Grassland	MUWA
	2.02	Wanderrie Bank Grassy Shrublands (<i>Eragrostis eriopoda</i>) Grassland	WABS
<i>Acacia</i> Woodlands over Shrubs and Grasses in Major Drainage Lines and Groves	3.01	Drainage Line Mulga <i>Acacia aneura</i> (sens. lat.) Woodland	DRMS
	3.02	Drainage line <i>Acacia burkittii</i> Woodland	DRAbS
	3.03	Groved Mulga Woodland	GRMU
<i>Acacia</i> (other than Mulga) Shrublands on Stony Hills	4.01	<i>Acacia</i> sp. Marshall Pool (G. Cockerton 3024) Shrubland	Amp
	4.02	<i>Acacia</i> sp. Marshall Pool (G. Cockerton 3024), <i>A. sibirica</i> , <i>Acacia aneura</i> , <i>A. burkittii</i> Shrubland	AmpAsAa
	4.03	<i>Acacia doreta</i> short phyllode form, <i>Acacia</i> sp. Marshall Pool (G. Cockerton 3024) Open Woodland <i>Ptilotus obovatus</i> (Goldfields form) Shrubland	AdAspMPPoG
	4.04	<i>Acacia burkittii</i> , <i>Ptilotus obovatus</i> (Goldfields form) Shrubland	AbPoG
<i>Acacia papyrocarpa</i> Woodlands	5.01	<i>Acacia papyrocarpa</i> Open Low Woodland, <i>Tecticornia disarticulata</i> Shrubland	ApTdS
	5.02	<i>Acacia papyrocarpa</i> Open Low Woodland, <i>Eremophila scoparia</i> and <i>Maireana</i> spp. Shrubland	ApEsMssp
	5.03	<i>Acacia papyrocarpa</i> Open Low Woodland, <i>Ptilotus obovatus</i> (Upright form), <i>Maireana triptera</i> Shrubland and grasses	ApPoUMt
	5.04	<i>Acacia papyrocarpa</i> Open Low Woodland, <i>Maireana pyramidata</i> Shrubland	ApMt
<i>Acacia victoria</i> Shrubland over Chenopods on Calcrete Plains	6.01	<i>Acacia victoriae</i> Shrubland	AvS
Perennial Grasslands	7.01	<i>Eragrostis</i> sp. Yeelirrie Calcrete (S. Regan LCH 26770) Hummock Grassland on Calcrete	EyC
	7.02	<i>Neurachne munroi</i> Hummock Grassland on Mudstone	NmHG
<i>Hakea preissii</i> and/or Halophytic Chenopod Shrublands	8.01	<i>Hakea preissii</i> , <i>Maireana pyramidata</i> , <i>Tecticornia disarticulata</i> Shrubland	HpTdMpS
	8.02	<i>Hakea preissii</i> , <i>Maireana pyramidata</i> , <i>Cratystylis subspinescens</i> Shrubland	HpMpCs
	8.03	<i>Hakea preissii</i> , <i>Maireana pyramidata</i> , <i>Eremophila scoparia</i> Shrubland	HpMpEs
	8.04	<i>Hakea preissii</i> , <i>Ptilotus obovatus</i> (Goldfields form), <i>Maireana triptera</i> Shrubland	HpPoGMt
	8.05	<i>Hakea preissii</i> , <i>Maireana pyramidata</i> , <i>Maireana</i> sp. decussate leaves. (G. Cockerton & G. Grigg WB40064) Shrubland and grasses	HpMpMsp59
	8.06	<i>Hakea preissii</i> , <i>Eremophila scoparia</i> , <i>Maireana triptera</i> Shrubland	HpEsMt
	8.07	<i>Maireana triptera</i> , <i>Frankenia</i> spp. Low Open Shrubland	MtFsp
	8.08	<i>Maireana pyramidata</i> , <i>M. georgei</i> Shrubland	MpMg
	8.09	<i>Tecticornia disarticulata</i> , <i>Surreya diandra</i> , <i>Frankenia setosa</i> , <i>Maireana</i> sp. decussate leaves. (G. Cockerton & G. Grigg WB40064) Shrubland	TdFsspMsp#59
	8.10	<i>Maireana</i> sp. decussate leaves. (G. Cockerton & G. Grigg WB40064), <i>Tecticornia disarticulata</i> Shrubland	Msp59, Td
	8.11	<i>Frankenia</i> spp. Shrubland	Fspp
	8.12	<i>Acacia masliniana</i> , <i>Cratystylis subspinescens</i> Shrubland	AmCs
	8.13	Bare claypan, no vegetation	Cpn-B
<i>Casuarina pauper</i> Woodland on Calcrete Outcrops	9.01	<i>Casuarina pauper</i> Woodland over Chenopods on Calcrete outcrops	CpW
Claypans	10.01	Grassy Claypan (<i>Eragrostis xerophila</i> Grassland)	CPN-G
	10.02	Gilgai: <i>Pittosporum angustifolium</i> , <i>Acacia tetragonophylla</i> and <i>A. victoriae</i> Shrubland over Claypan Grasses	Gilgai
Breakaway Complex	11.01	<i>Eremophila scoparia</i> , <i>Frankenia</i> spp. Shrubland with <i>Sclerolaena diacantha</i>	EsFsppSspp
	M1	4.02+1.10 mosaic	
Mosaics	M2	1.06+2.01+1.15 mosaic	
	M3	1.06+2.01 mosaic	
	M4	8.09+7.01 mosaic	
Other	d	Dead Vegetation	
	dist	Disturbed	

Note:



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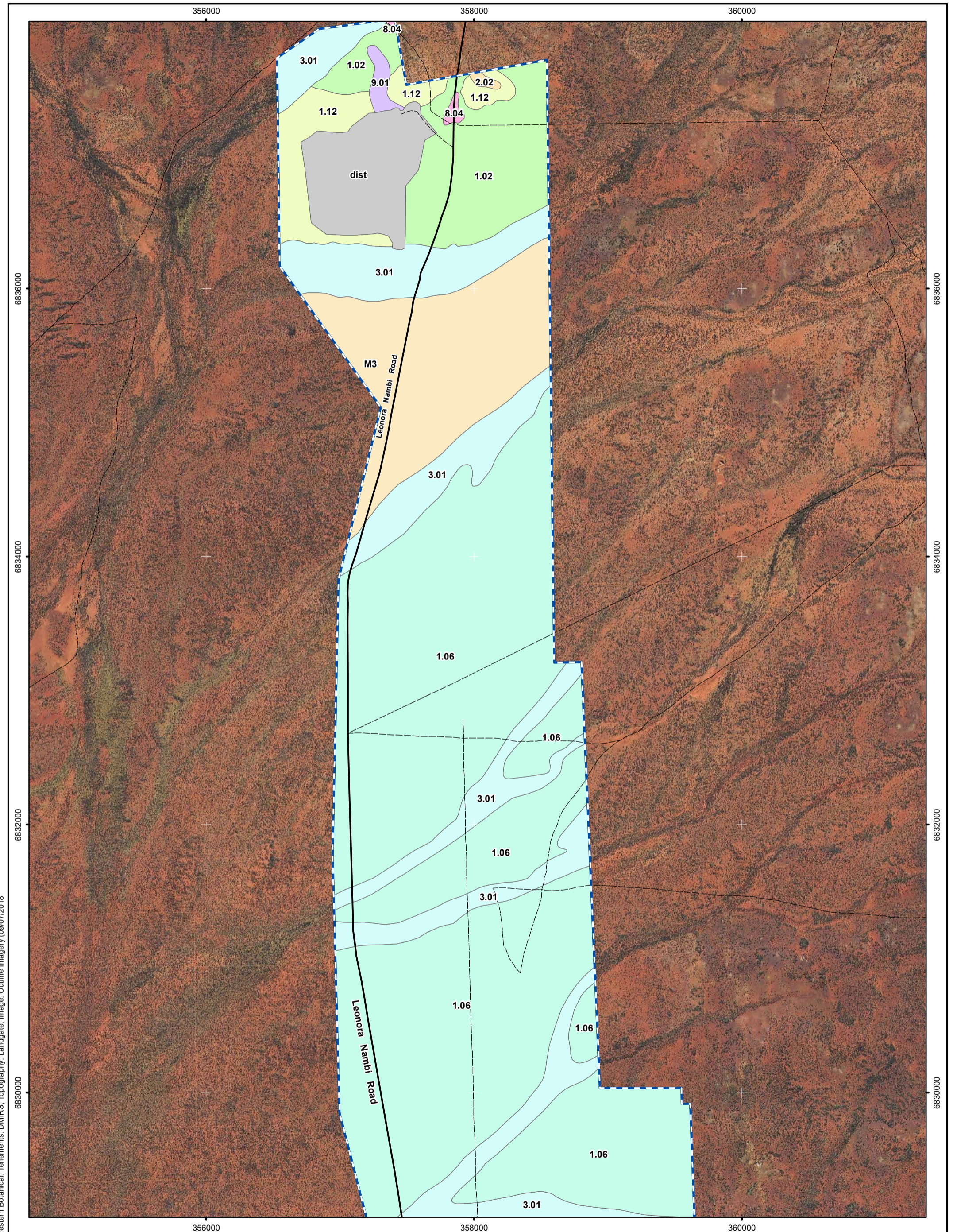
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KM Ref:

CAD Ref: a2553_Veg_WB_04_01
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**Leonora Gold Project
Vegetation Associations
Legend**



Source: Vegetation: Western Botanical, Tenements: DMIRS, Topography: Landgate, Image: Outline Imagery (09/07/2018)

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Sheet Layout

Layout



0 310 620m

Scale: 1:25,000
MGA94 (Zone 51)

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**Leonora Gold Project
Vegetation Associations
Sheet 1 of 6**



Source: Vegetation: Western Botanical, Tenements: DMIRS, Topography: Landgate, Image: Outline Imagery (09/07/2018)

Consultant

Sheet Layout

Layout



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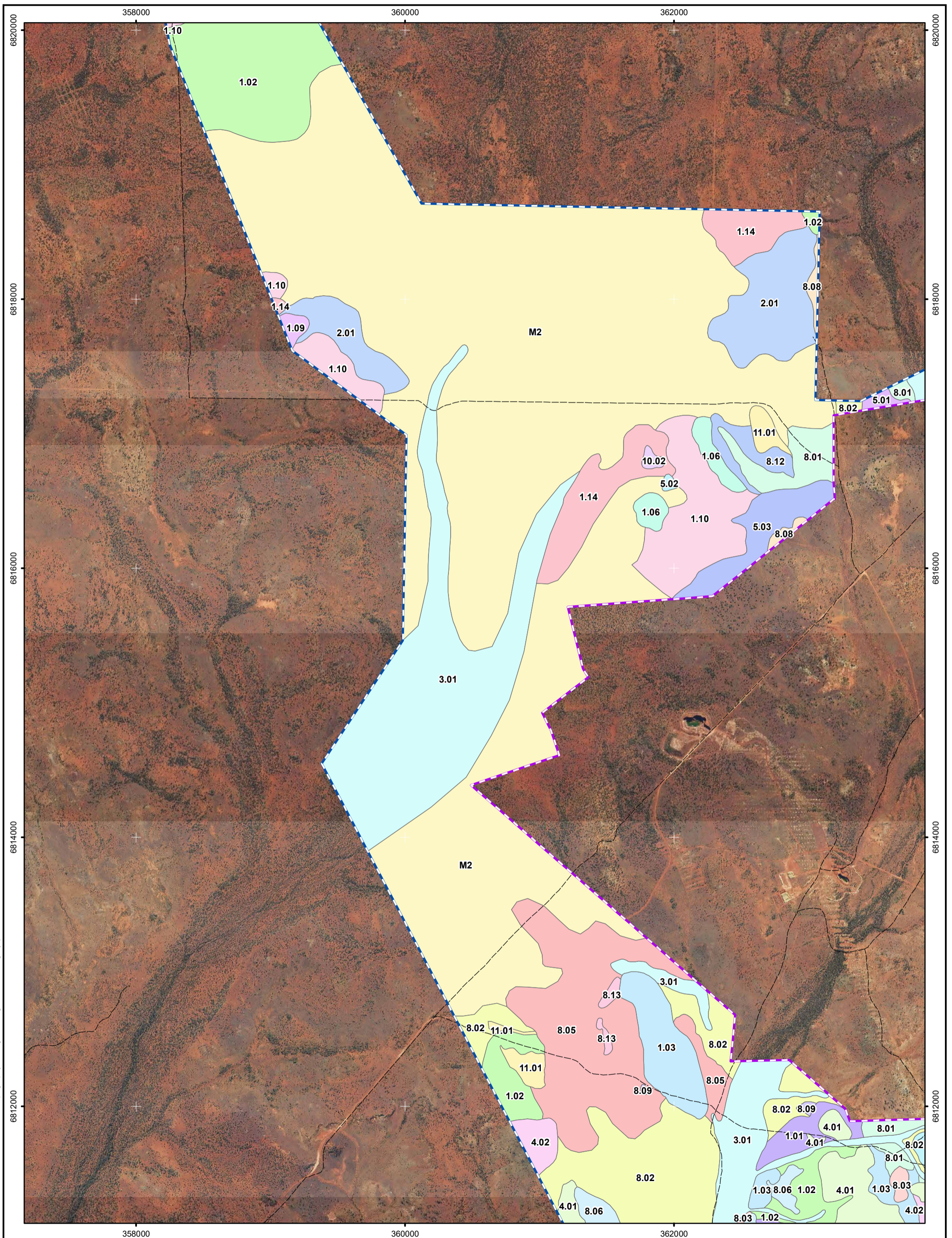
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Leonora Gold Project
Vegetation Associations
Sheet 2 of 6



Source: Vegetation: Western Botanical, Tenements: DMIRS, Topography: Landgate, Image: Outline Imagery (09/07/2018)

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Sheet Layout

Layout



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Scale: 1:25,000
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CAD Ref: a2553_Veg_WB_04_02
Date: May 2019 | Rev: A | A3

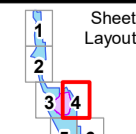
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Leonora Gold Project
Vegetation Associations
Sheet 3 of 6



Source: Vegetation: Western Botanical, Tenements: DMIRS, Topography: Landgate, Image: Outline Imagery (09/07/2018)

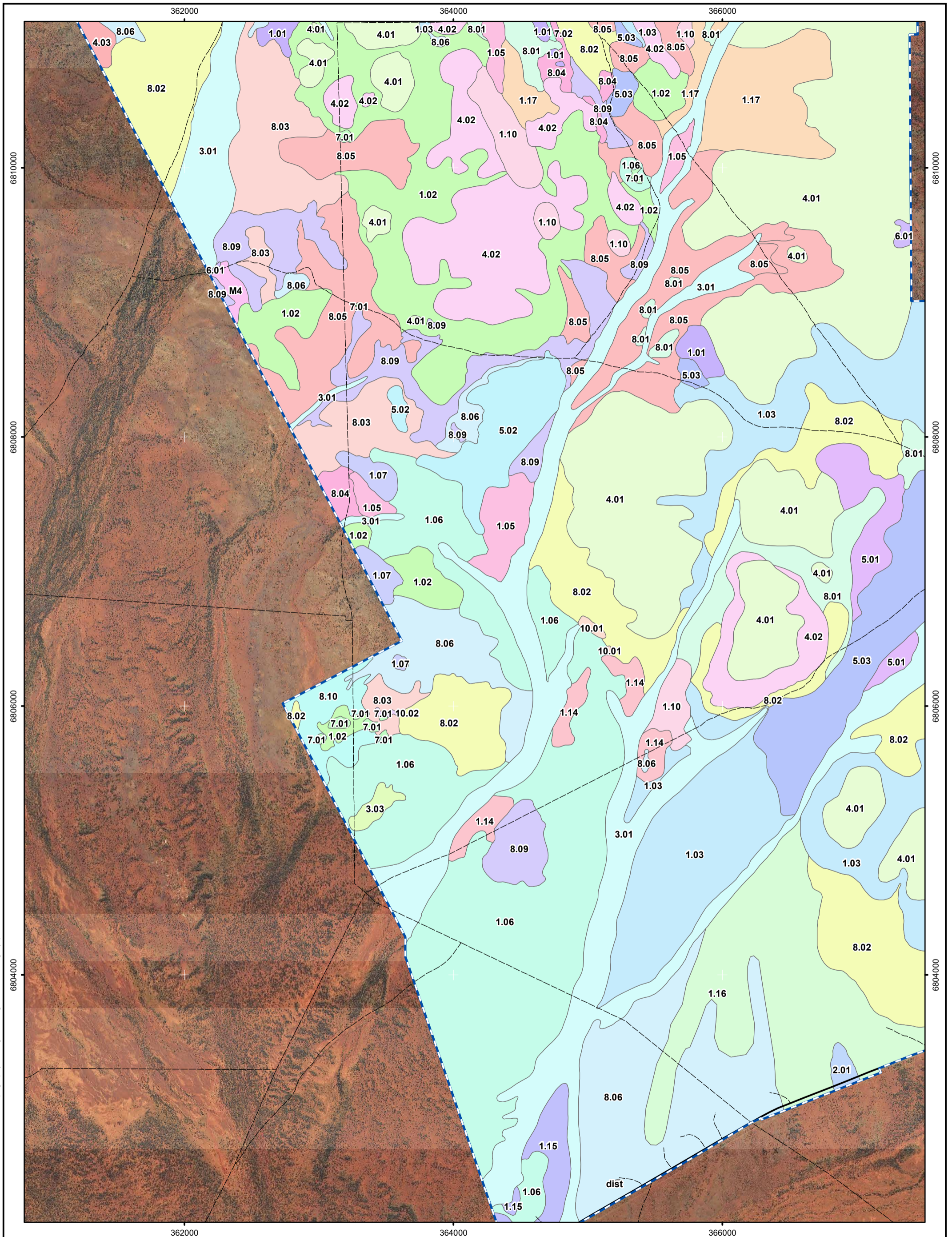


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 CAD Ref: a2553_Veg_WB_04_02
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**Leonora Gold Project
 Vegetation Associations
 Sheet 4 of 6**



Source: Vegetation: Western Botanical, Tenements: DMIRS, Topography: Landgate, Image: Outline Imagery (09/07/2018)

Consultant

Sheet Layout

Layout



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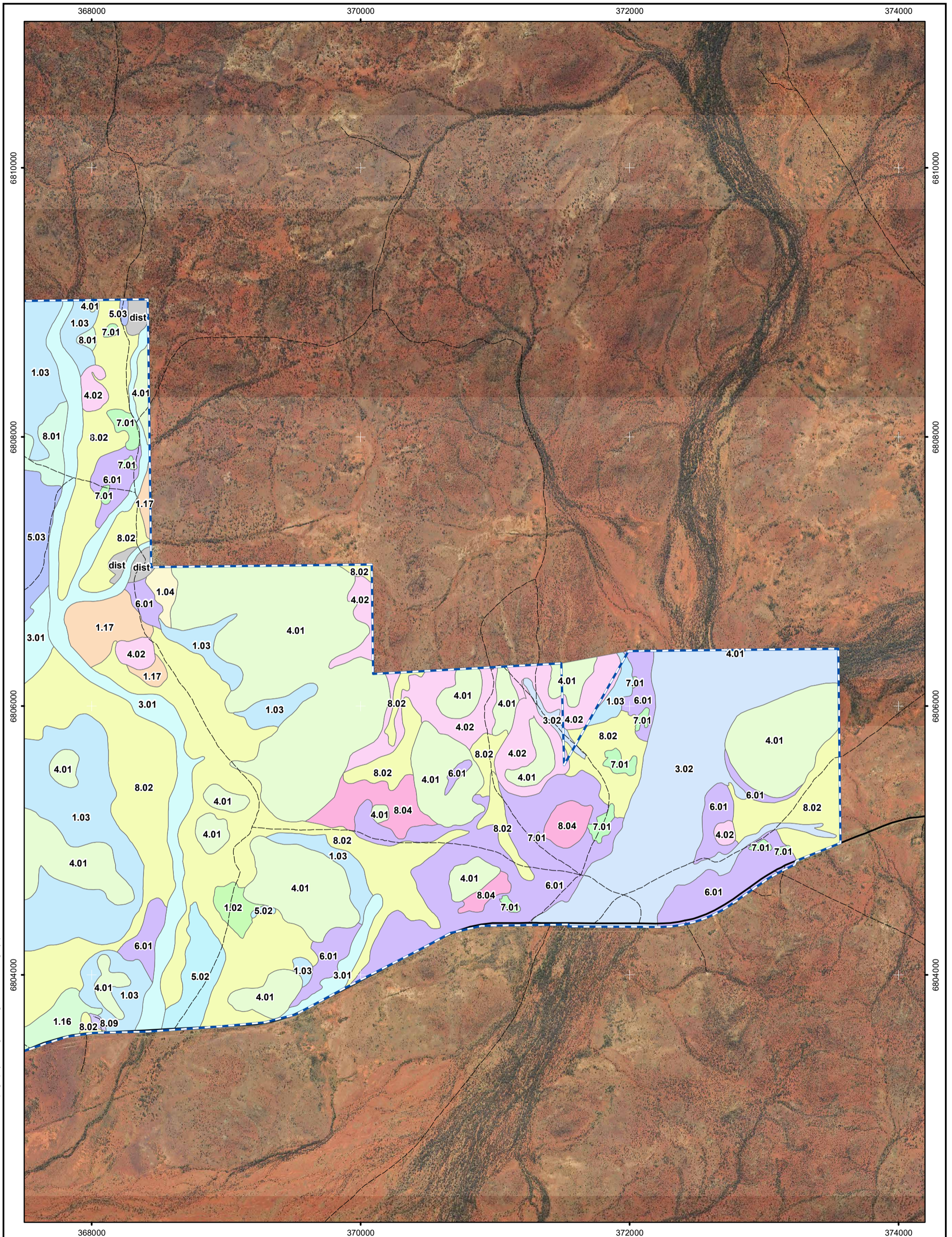
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CAD Ref: a2553_Veg_WB_04_02
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Leonora Gold Project
Vegetation Associations
Sheet 5 of 6



Source: Vegetation: Western Botanical, Tenements: DMIRS, Topography: Landgate, Image: Outline Imagery (09/07/2018)

Consultant
 Western Botanical

Sheet Layout

Layout



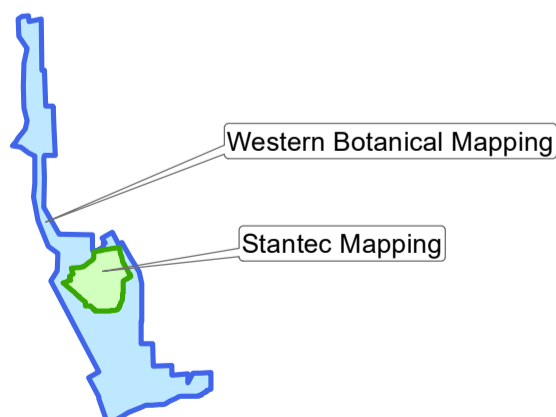
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 CAD Ref: a2553_Veg_WB_04_02
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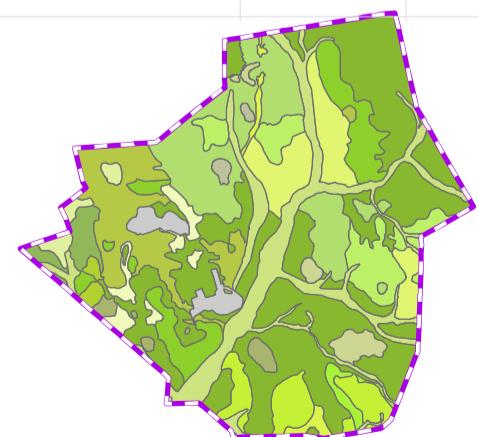
**Leonora Gold Project
 Vegetation Associations
 Sheet 6 of 6**

Habitat	MU	Code	Description (Table 5-2)	Sig Unit (Table 5-3)	Locally Restricted Distribution (Table 5-4)
Acacia Shrublands on Plains	S02	AaArAq	Acacia quadrimarginea, Acacia incurvaneura and Acacia aneura low woodland over Acacia ramulosa var. ramulosa and Acacia tetragonophylla tall to mid sparse shrubland over Eremophila spp. low isolated shrubs over Eragrostis eriopoda and Monachather paradoxus isolated tussock grasses		Yes
	S03	AaArEsp.	Acacia aneura, Acacia incurvaneura and Acacia caesaneura low open forest over Acacia ramulosa var. ramulosa tall isolated shrubs over Eremophila spp. mid isolated shrubs over low isolated mixed shrubs, herbs and grasses,		
	S04	AaAtEp	Acacia aneura, Acacia aptaneura and Acacia caesaneura low open woodland over Eremophila platycalyx subsp. platycalyx, Acacia ramulosa subsp. ramulosa and Acacia tetragonophylla tall to mid isolated shrubs over Ptilotus obovatus, Eremophila metallicorum and Eremophila margarethae low isolated shrubs, over mixed low grasses.		
	S05	AaAtEsp.	Acacia aneura, Acacia caesaneura and Acacia pteraneura low woodland over Acacia tetragonophylla tall isolated shrubs over mixed low isolated shrubs		
	S08	AcAtEo	Acacia craspedocarpa, Acacia aneura and Acacia caesaneura low woodland over Acacia tetragonophylla, Scaevola spinescens and Eremophila oldfieldii subsp. angustifolia mid isolated shrubs over Ptilotus obovatus and Maireana tomentosa subsp. tomentosa low isolated shrubs, over Ptilotus sp. Goldfields (R. Davis 10796), Enneapogon caerulescens and Aristida contorta low isolated forbs and grasses		
	S09	AcHpEp	Acacia craspedocarpa, Acacia aneura and Acacia incurvaneura low open woodland over Acacia oswaldii, Hakea preissii and Rhagodia drummondii mid isolated shrubs, over Eremophila pantonii, Maireana georgei and Atriplex nummularia subsp. spathulata low isolated shrubs over Sclerolaena densiflora, Enneapogon caerulescens and Ptilotus aevoides low isolated forbs and grasses		Yes
	S10	AiEIEc	Acacia incurvaneura low open woodland over Eremophila latrobei subsp. latrobei, Solanum lasiophyllum and Ptilotus obovatus low sparse shrubland, over Enneapogon caerulescens low grassland over Sclerolaena diacantha isolated dwarf chenopod shrubs		Yes
	S11	AiMsTd	Acacia inceana subsp. conformis low woodland over Maireana sedifolia mid isolated shrubs over Maireana pyramidata and Tecticornia disarticulata low isolated chenopod shrubs	Yes	Yes
	S13	AkHpEs	Acacia kalgoorliensis, Acacia oswaldii and Hakea preissii low open woodland over Eremophila scoparia, Senna stowardii and Acacia craspedocarpa mid isolated shrubs over Ptilotus obovatus, Maireana triptera and Cratystylis subspinescens low isolated shrubs over Sclerolaena eriantha, Sclerolaena densiflora and Ptilotus sp. Goldfields (R. Davis 10796) low isolated forbs on rocky plains		Yes
	S14	Asp.MsEs	Acacia sp. low open woodland over Maireana sedifolia and Eremophila scoparia mid open shrubland, over Sclerolaena diacantha sparse isolated dwarf chenopod shrubland		Yes
Chenopod Shrublands	S16	HpCsMp	Hakea preissii low isolated trees over Cratystylis subspinescens and Maireana pyramidata mid open shrubland over Tecticornia pruinosa, Tecticornia disarticulata and Tecticornia pergranulata subsp. pergranulata low open chenopod shrubland over Enneapogon caerulescens low isolated grasses	Yes	
	S17	MpTdSd	Maireana pyramidata and Tecticornia disarticulata low chenopod shrubland over Sclerolaena densiflora isolated dwarf chenopod shrubs with Aristida contorta, Enteropogon ramosus and Sporobolus actinocladius isolated tussock grasses		Yes
Drainage Line	S07	AbAtTt	Acacia burkittii and Acacia aptaneura low open woodland over Acacia tetragonophylla and Acacia burkittii mid sparse shrubland over Themeda triandra, Eriachne flaccida and Enteropogon ramosus low tussock grasses on sandy drainage line		Yes
Low Hills	S01	A?rSaMs	Acacia sp. nov. aff. resinimarginea, Acacia aneura and Acacia caesaneura tall open shrubland, over Senna artemisioides subsp. filifolia, Scaevola spinescens and Acacia tetragonophylla mid isolated shrubs over Ptilotus obovatus, Maireana sedifolia and Solanum lasiophyllum low isolated shrubs over Ptilotus helipteroides and Enneapogon caerulescens low isolated forbs and grasses on rocky hills	Yes	Yes
	S06	AaSaMs	Acacia aneura and Acacia caesaneura tall open woodland over Senna artemisioides subsp. filifolia, Maireana sedifolia and Ptilotus obovatus low open shrubland over low mixed chenopod shrubland on rocky hills		Yes
	S12	AkAbMs	Acacia kempeana low open woodland over Acacia burkittii, Maireana sedifolia and Eremophila scoparia mid open shrubland, over Ptilotus obovatus, Sida ectogama and Solanum lasiophyllum low isolated shrubs, over Enneapogon caerulescens and Sclerolaena eriantha low isolated forbs and grasses on rocky hills		Yes
	S15	CpArEo	Casuarina pauper, Acacia caesaneura and Acacia aneura low woodland over Acacia ramulosa var. ramulosa and Acacia tetragonophylla tall isolated shrubs over Eremophila oldfieldii subsp. angustifolia mid isolated shrubs over Maireana triptera, Sclerolaena eriantha and Sclerolaena densiflora low isolated forbs		Yes
Disturbed	dist	Disturbed	Areas of disturbance including historical and recent mining activities.		

Table reference from Stantec report LEVEL 1 FLORA, VEGETATION AND FAUNA ASSESSMENT dated Aug 2017



Legend	
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	S13, AkHpEs
	S07, AbAtTt
	S14, Asp.MsEs
	S01, A?rSaMs
	S08, AcAtEo
	S15, CpArEo
	S02, AaArAq
	S09, AcHpEp
	S16, HpCsMp
	S03, AaArEsp.
	S10, AiEIEc
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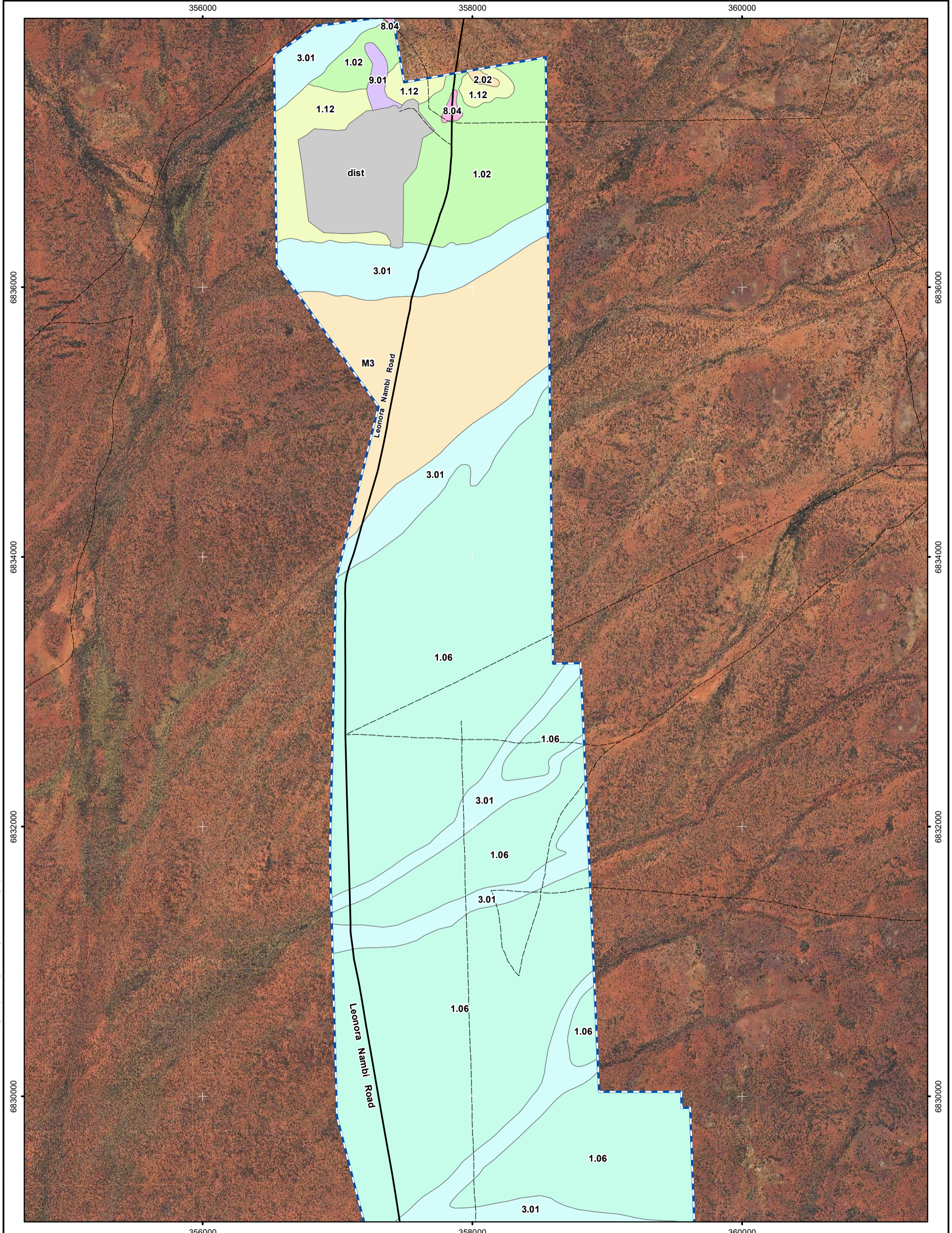
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**Leonora Gold Project
 Vegetation Associations
 Stantec Legend**



Source: Vegetation: Western Botanical (S codes Stantec), Tenements: DMIRS, Topography: Landgate, Image: Outline Imagery (09/07/2018)

Consultant

Sheet Layout

Layout

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Scale: 1:25,000
MGA94 (Zone 51)

CAD Ref: a2553_Veg_WB_04_04
Date: May 2019 | Rev: B | A3

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Leonora Gold Project
Vegetation Associations

Western Botanical & Stantec Mapping - Sheet 1 of 6



Source: Vegetation: Western Botanical (S codes Stantec), Tenements: DMIRS, Topography: Landgate, Image: Outline Imagery (09/07/2018)

Consultant

Sheet Layout

Layout

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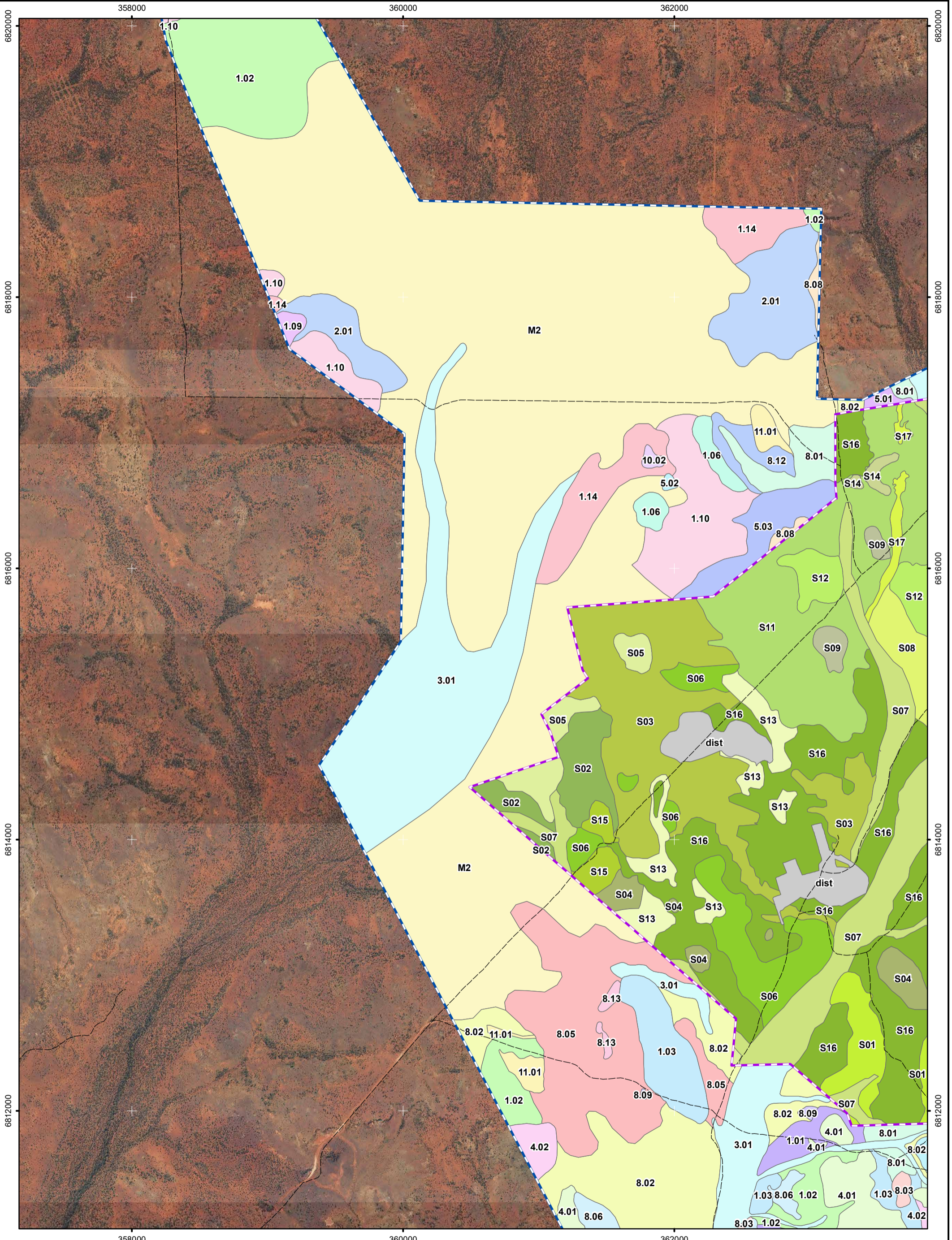
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CAD Ref: a2553_Veg_WB_04_04
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Leonora Gold Project
Vegetation Associations
Western Botanical & Stantec Mapping - Sheet 2 of 6



Source: Vegetation: Western Botanical (S codes Stantec), Tenements: DMIRS, Topography: Landgate, Image: Outline Imagery (09/07/2018)

Consultant

Sheet Layout

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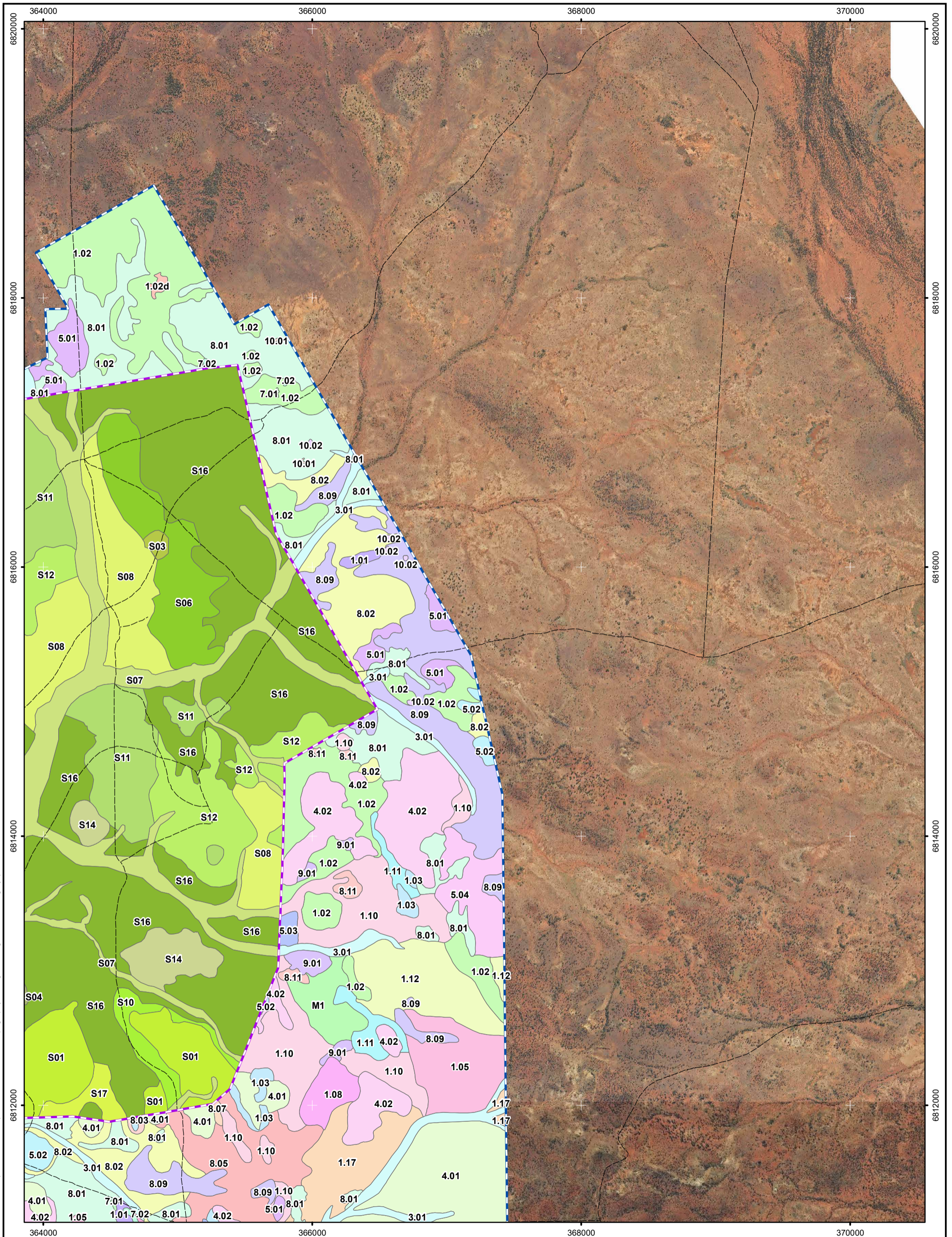
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Leonora Gold Project Vegetation Associations

Western Botanical & Stantec Mapping - Sheet 3 of 6



Source: Vegetation: Western Botanical (S codes Stantec), Tenements: DMIRS, Topography: Landgate, Image: Outline Imagery (09/07/2018)

Consultant

Sheet Layout

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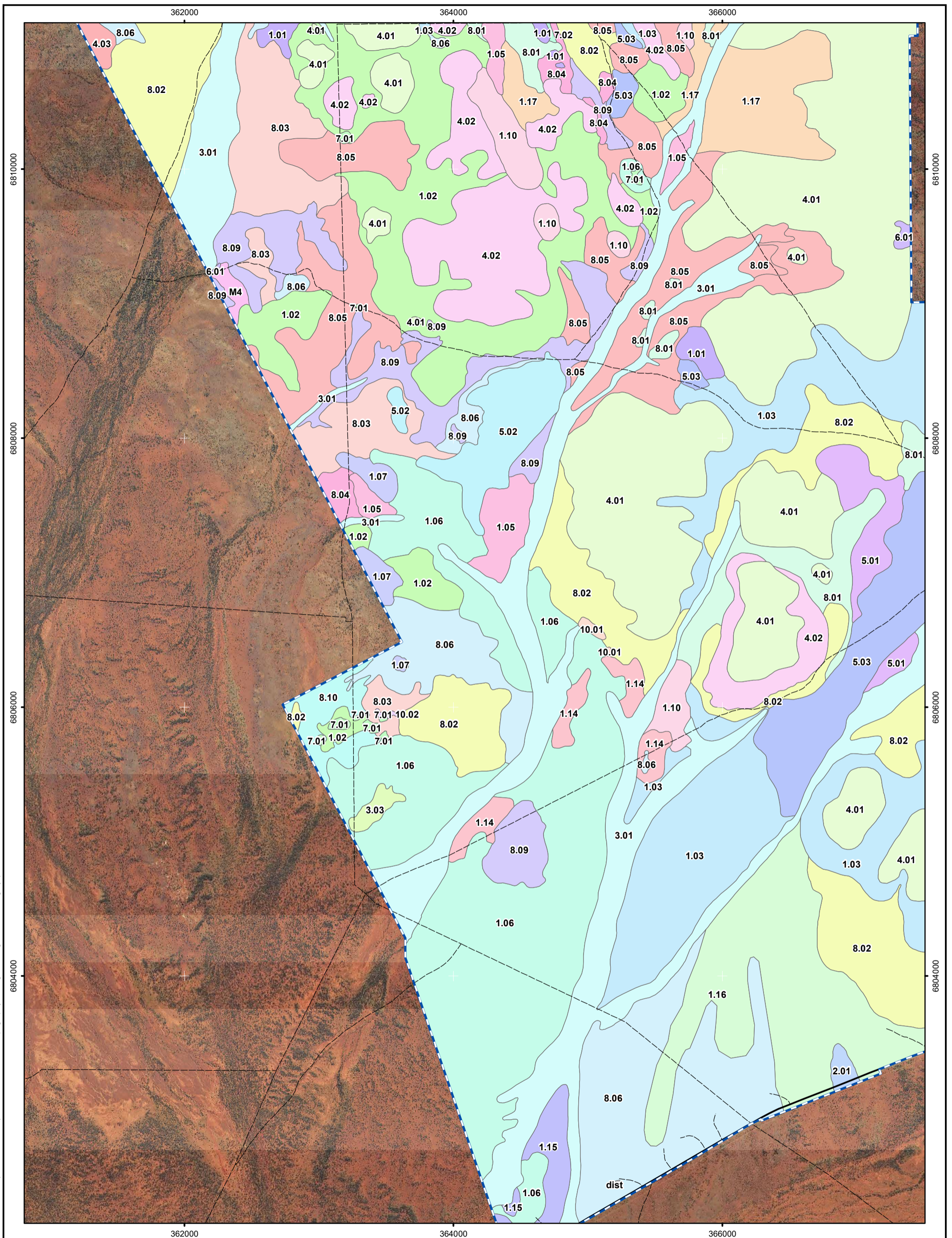
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**Leonora Gold Project
Vegetation Associations**

Western Botanical & Stantec Mapping - Sheet 4 of 6



Source: Vegetation: Western Botanical (S codes Stantec), Tenements: DMIRS, Topography: Landgate, Image: Outline Imagery (09/07/2018)

Consultant

Sheet Layout

Layout



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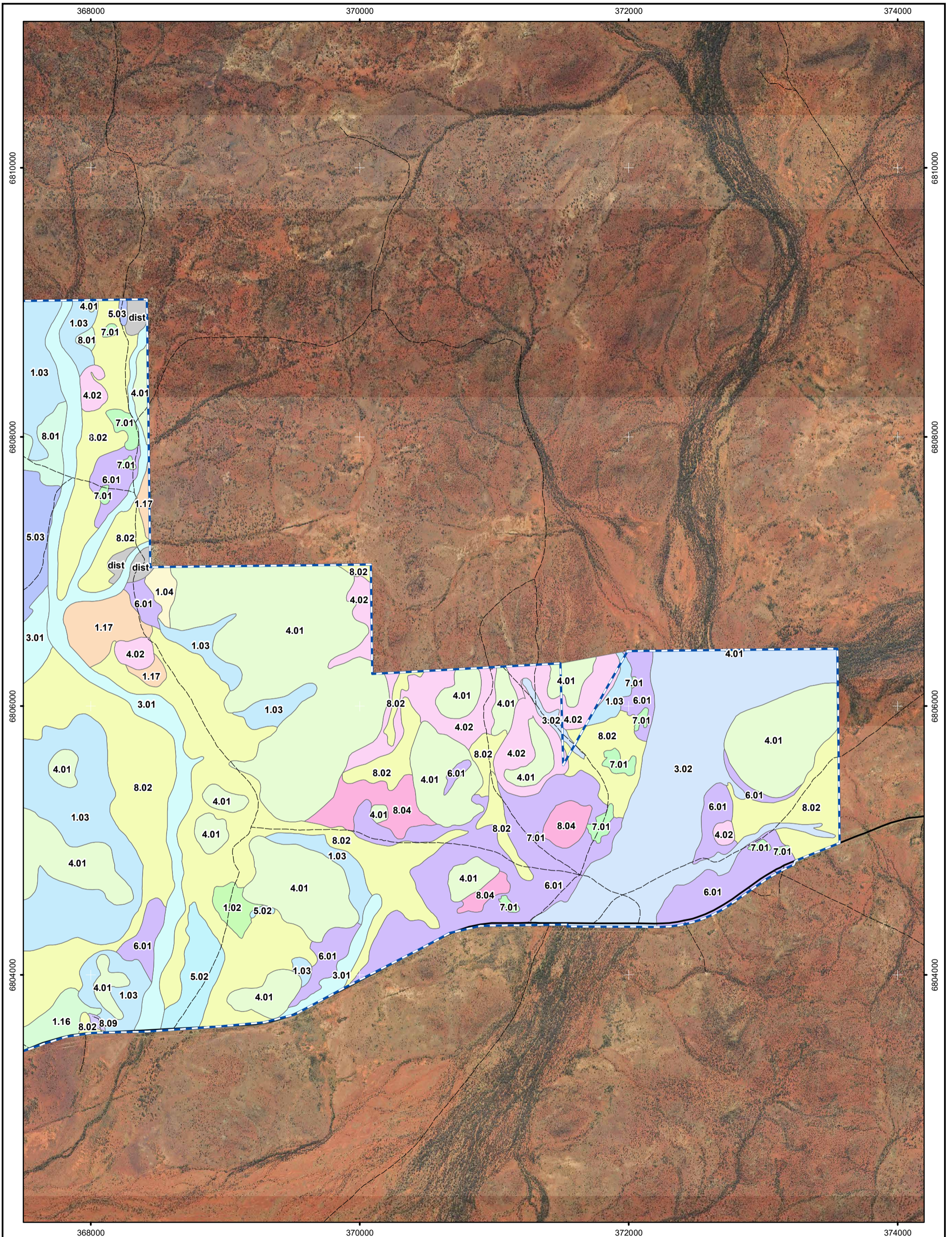
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Leonora Gold Project
Vegetation Associations

Western Botanical & Stantec Mapping - Sheet 5 of 6



Source: Vegetation: Western Botanical (S codes Stantec), Tenements: DMIRS, Topography: Landgate, Image: Outline Imagery (09/07/2018)

Consultant

Sheet Layout

Layout

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Scale: 1:25,000
MGA94 (Zone 51)

CAD Ref: a2553_Veg_WB_04_04
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Vegetation Associations
Western Botanical & Stantec Mapping - Sheet 6 of 6

Appendix 3. Keighery (1994) Vegetation Condition Scale

Summary of Vegetation Condition Scale as developed by Keighery (1994) and as summarized in Bush Forever (Government of Western Australia 2000) Condition Scale Description

Code	Description
Pristine (1)	Pristine or nearly so, no obvious signs of disturbance.
Excellent (2)	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
Very Good (3)	Vegetation structure altered, obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback , logging and grazing.
Good (4)	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.
Degraded (5)	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing
Completely Degraded (6)	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as “parkland cleared’ with the flora comprising weed or crop species with isolated native trees or shrubs.

Appendix 4. DBCA Conservation Codes and Their Meanings

T: Threatened Flora (Declared Rare Flora — Extant)

Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such (Schedule 1 under the Wildlife Conservation Act 1950).

Threatened Flora (Schedule 1) are further ranked by the Department according to their level of threat using IUCN Red List criteria:

CR: Critically Endangered – considered to be facing an extremely high risk of extinction in the wild

EN: Endangered – considered to be facing a very high risk of extinction in the wild

VU: Vulnerable – considered to be facing a high risk of extinction in the wild.

X: Presumed Extinct Flora (Declared Rare Flora — Extinct)

Taxa which have been adequately searched for and there is no reasonable doubt that the last individual has died, and have been gazetted as such (Schedule 2 under the Wildlife Conservation Act 1950).

Taxa that have not yet been adequately surveyed to be listed under Schedule 1 or 2 are added to the Priority Flora List 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 flora or fauna. Taxa that are adequately known, are rare but not threatened, or meet criteria for Near Threatened, or that have been recently removed from the threatened list for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring. Conservation Dependent species are placed in Priority 5.

1: Priority One: Poorly-known taxa

Taxa that are known from one or a few collections or sight records (generally less than five), all on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, Shire, Westrail and Main Roads WA road, gravel and soil reserves, and active mineral leases and under threat of habitat destruction or degradation. Taxa may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes.

2: Priority Two: Poorly-known taxa

Taxa that are known from one or a few collections or sight records, some of which are on lands not under imminent threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc. Taxa may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes.

3: Priority Three: Poorly-known taxa

Taxa that are known from collections or sight records from several localities not under imminent threat, or from few but widespread localities with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Taxa may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and known threatening processes exist that could affect them.

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

Rare. Taxa 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 taxa are usually represented on conservation lands.

Near Threatened. Taxa that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.

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

5: Priority Five: Conservation Dependent taxa

Taxa that are not threatened but are subject to a specific conservation program, the cessation of which would result in the taxon becoming threatened within five years.

Appendix 5. Vegetation Association Descriptions and Representative Photographs

Mulga Woodlands over Perennial Non-Halophytic Shrubs on hills and plains

Seventeen vegetation associations with a diverse range of Mulga species (*Acacia aneura*, *A. aptaneura*, *A. caesaneura*, *A. fuscaneura*, *A. incurvaneura*, *A. macraneura*, *A. mulganeura* and *A. pteraneura*) form the dominant upper stratum as trees and shrubs 4 to 6 m in height. The understorey varies considerably with geological substrate type, soil depth and landscape position, from *Eremophila clarkei*, *E. forrestii*, *E. platycalyx* subsp. Leonora (J. Morrisey 252), *E. simulans* subsp. *simulans*, *E. latrobei* or *E. annoscaulis* P3 on stony hill tops and slopes; to *Eremophila compacta* subsp. *compacta* on loamy wash plains; to *Eremophila galeata* scattered shrublands on skeletal soils on hardpan plains and granite platforms. Some areas of Mulga woodlands have an understorey dominated by two informally recognised species; either *Ptilotus obovatus* Upright form (G Cockerton et al 15206) or *Ptilotus obovatus* Typical Goldfields form (G Cockerton et al 15213) which reflect differing soil types with the former associated with calcareous soils and the latter with non-calcareous soils. Both species are common and widespread in the eastern Goldfields of W.A. and occasionally occur together within a Vegetation Association.

1.01	<i>Acacia aneura</i> , <i>A. ramulosa</i> , <i>Eremophila platycalyx</i> subsp. Leonora (Morrisey J. 252), <i>Ptilotus obovatus</i> (Upright form) Shrubland and grasses	AaArEpLPoU, Grasses
------	--	---------------------

Small conical basalt outcrop supporting *Eremophila platycalyx* subsp. Leonora shrubland over *Digitaria brownii* grasses and occasional *Cheilanthes lasiophyllum* ferns between rocks on the southern side. Too small an area to map.



1.02	<i>Acacia aneura</i> (forms), <i>Ptilotus obovatus</i> (Upright form), <i>Maireana triptera</i> Shrubland	AaPoUMt
------	---	---------

Low basalt hill supporting scattered *Acacia aneura* (2 varieties), *A. ramulosa* to 3.5m, PFC 15% over *Eremophila platycalyx* subsp. Leonora (J. Morrissey 252) 1.5m, PFC 5% over *Ptilotus obovatus* (both Upright and Typical Goldfields forms) 0.3 to 0.7m, PFC 3% over grasses dominated by *Digitaria brownii* 0.4m, *Aristida contorta* 0.2m, PFC 1.5 to 2%. Basalt is uniform fine grained dark grey)



1.02 D	Dead vegetation, formerly <i>Acacia aneura</i> (forms), <i>Ptilotus obovatus</i> (Upright form), <i>Maireana triptera</i> Shrubland	Dead AaPoUMt
--------	---	--------------

No image. A small, well defined area that may have been burnt following a lightning strike or killed in a hail storm, no live Mulga and few live shrubs present.

1.03	<i>Acacia aneura</i> , <i>Maireana sedifolia</i> , <i>Scaevola spinescens</i> Narrow leaf spiny form <i>Ptilotus obovatus</i> (typical Goldfields form) Shrubland	AaMsSsNPoG
------	---	------------

Mulga woodland on low rocky sandstone shale hill. *Acacia incurvaneura* 4m, *Acacia caesaneura* 4m, PFC 10% over *Sida calyxhymenia* 1m, *Scaevola spinescens* (narrow leaf spiny form) 1m, PFC 10%. Note, differs from adjacent Mulga woodland on plains in having fewer chenopods and *Sida* and *Scaevola* understorey.



1.04 *Acacia burkittii*, *Senna artemisioides* subsp. *filifolia*, *Maireana* spp. Shrubland
AbSafAmpMt

No Image

1.05	<i>Acacia aneura</i> (forms) over <i>Eremophila platycalyx</i> subsp. Leonora (Morrisey J. 252) over <i>Senna</i> spp. over <i>Ptilotus obovatus</i> (Upright form) and <i>Maireana triptera</i> Shrubland	AaEpLSsppPoUMt
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Acacia aneura forms 4 to 5m, PFC 10% over *Eremophila platycalyx* subsp. Leonora 1 to 2.5m, PFC 2% over *Senna* sp. Meekatharra (E. Bailey 1-26) 1.5m, *Senna artemisioides* subsp. *helmsii* 1.2m, *Maireana sedifolia* 1m, *Senna artemisioides* subsp. *filifolia* 1m, *Scaevola spinescens* (narrow leaf spiny form), PFC 7%, over *Ptilotus obovatus* (upright form) 0.8m, *Solanum lasiophyllum* 0.7m, *Atriplex bunburyana* 0.8m, PFC 2% over *Maireana triptera* 0.3m, *Sclerolaena cuneata* 0.2m, PFC 0.5%. Site is gently sloping to the east, ~ 2 degrees, and has a continuous mantle of ironstone, basalt and quartz stones 0.5 to 10 cm diameter over a red silty sand soil.



1.06	<i>Acacia aneura</i> (forms) over <i>Eremophila</i> spp. (<i>E. margarethae</i> , <i>E. compacta</i> subsp. <i>compacta</i> , <i>E. simulans</i> subsp. <i>simulans</i> or <i>E. annoscaulis</i> P3 over <i>Ptilotus schwartzii</i> Shrubland	AaEmP
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Mulga Shrubland over *Eremophila margarethae*. *Acacia aneura* 3 to 4m, PFC 15% over *Eremophila margarethae* 0.8m, PFC 5% over *Ptilotus schwartzii* 0.4m, PFC 4%. In moisture gaining sites, small groves of Mulga are present between sheet wash areas and support *Eremophila annoscaulis* P3 and denser vegetation to 6m high, PFC 70%. This community has been broadened to include a mid story of either/or *Eremophila margarethae*, *E. compacta*, *E. simulans* subsp. *simulans* or *E. annoscaulis* P3.



1.07	Stony Ironstone Mulga Shrubland <i>Acacia aneura</i> , <i>Eremophila latrobei</i> , <i>Sida ectogamma</i> Shrubland on summits of chert, quartz hills and slopes	SIMS AaEISe
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Acacia burkittii 2.1m, PFC 5 to 15% over *Senna artemisioides* subsp. *filifolia* 0.5 to 1m, PFC 5% with a minor component of *Acacia* sp. Marshall Pool (G. Cockerton 3024) 1 to 3m, PFC 1% and *Scaevola spinescens* (narrow leaf spiny form) 1 to 2m, PFC 2% over *Maireana trichoptera*, *M. triptera*, *M. georgei*, *M. sedifolia* PFC 1 to 2%. Soil is a pale creamy carbonate-rich silty sand. Site is a stony hill with abundant tabular calcrete stones and subangular quartz stones to 10 cm diameter. Abundant dark algal soil crust is a prominent feature of this site.



1.08	Stony Ironstone Mulga Shrubland <i>Acacia aneura</i> , <i>Ptilotus obovatus</i> (Upright form), <i>Ptilotus schwartzii</i> Shrubland on midslopes of chert, quartz hills and slopes	SIMS AaPoUSe
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Acacia caesaneura, *A. incurvaneura*, *A. pteraneura* 4 to 5m, PFC 10 to 15% over scattered shrubs of *Ptilotus obovatus* Upright form (G Cockerton et al 15206) 0.7m, *Sida ectogamma* 1m, PFC 3 to 5% over *Ptilotus schwartzii* 0.5m, PFC 2%. A mid slope position with much bare ground between plants. Site has a discontinuous mantle of subangular chert, ironstone and some gabbro rocks to 15 cm diameter. An unusual site with a chert and gabbro hill upslope, the SIMS community influenced by weathering of the quartz-rich rocks overlaying the gabbro, hence minor inclusion of *Acacia* sp. Marshall Pool (G. Cockerton 3024).



1.09	Stony Ironstone Mulga Shrubland <i>Acacia aneura</i> (forms) over <i>Eremophila clarkei</i> , <i>Eremophila forrestii</i> Shrubland on summit of low ferricrete hills	SIMS AaEcEf
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Acacia aneura (forms), *Acacia caesaneura*, *Acacia mulganeura* 1.5 to 4m, PFC 5 to 15% over *Eremophila clarkei*, *Eremophila forrestii* 1.2m, PFC 5 to 6% over scattered *Eragrostis eriopoda* 0.3m, *Ptilotus schwartzii*, *Monachather paradoxus* 0.2m, PFC 1 to 2%. Outcropping geology is ferricrete capping. Site is similar to much SIMS in the area north of Leonora.



1.10	<i>Acacia aneura</i> over <i>Maireana sedifolia</i> over <i>Ptilotus obovatus</i> (Upright form) Shrubland over <i>Maireana triptera</i> Shrubland and grasses	AaMsPoUMt
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Acacia incurvaneura 4m, PFC 1 to 5% over *Maireana sedifolia* 1.5m, PFC 10 to 15% over *Ptilotus obovatus* (Upright form) (G Cockerton et al 15206) over *Maireana triptera* and grasses dominated by *Enneapogon caerulescens*. Soil is a red-brown silty sand surface has a continuous mantle of subrounded ironstone, gabbro; angular quartz gravel and stones to 10 cm diameter. Southerly aspect at 1 to 2 degrees.



1.11	<i>Maireana pyramidata</i> , <i>Maireana sedifolia</i> , <i>Frankenia</i> spp. Open Low Shrubland and grasses	MpMsFsp
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Chenopod shrubland of *Maireana pyramidata* 1.2m, *Maireana sedifolia* 1.2m, PFC 10 to 15% over *Frankenia cinerea* 0.2m, *Surreya diandra* 0.4m, PFC 1 to 5% with grasses dominated by *Enneapogon cylindricus* 0.3m, *Cymbopogon ambiguus* 0.5m, *Enneapogon caerulescens* 0.25m, PFC 2 to 10%. Occasional emergent *Hakea preissii*, *Eremophila oldfieldii* subsp. *angustifolia* to 3m, PFC < 1%. Level site where soil is red-brown silty sand with abundant quartz, ironstone, silcrete, sandstone fragments to 10 cm.



1.12	<i>Acacia aneura</i> (<i>sens. lat.</i>), <i>Eremophila platycalyx</i> subsp. <i>Leonora</i> (Morrisey J. 252) over <i>Eremophila compacta</i> subsp. <i>compacta</i> and <i>Ptilotus obovatus</i> (Upright form) Shrubland	AaEpLEm
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Acacia pteraneura, *A. caesaneura* 4 to 6m, PFC 15 to 20% over *Eremophila platycalyx* subsp. *Leonora* (J. Morrissey 252) 1 to 2.4m, PFC 5% over *Eremophila compacta* subsp. *compacta* 0.8m PFC 10% and *Ptilotus obovatus* (upright form) 0.6m PFC 1%. North facing slope at 3 to 4 degrees with a discontinuous mantle of subangular quartz (chert) stones to 20 cm. Few grasses, mostly Mulga over *Eremophila* shrubs.



1.13	<i>Acacia aneura</i> (sens. lat.), <i>Acacia ramulosa</i> , <i>Acacia quadrimarginea</i> (sens. str.), <i>Eremophila platycalyx</i> subsp. Leonora (Morrissey J. 252) Shrubland	AaArAqEp
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Acacia aneura (sens. lat.) 2 to 5m PFC 5%, *Acacia ramulosa* 2m PFC 0.5%, *Acacia quadrimarginea* 4 to 6m PFC 2 to 3% over *Eremophila platycalyx* subsp. Leonora 2m PFC 1.5% over *Sida ectogamma* 1m, *Eremophila margarethae* 0.5m, *Ptilotus obovatus* (Goldfields form) 0.4m, *Ptilotus obovatus* (Upright form) 0.7m, PFC 5%. Site represents a stony granitic plain, gently inclined, dipping to the north-west at 1 to 2 degrees. Soil is a coarse gritty sand and has a discontinuous mantle of subangular quartz and granite rocks and gravel to 8 cm diameter.



1.14	Stony <i>Acacia</i> - <i>Eremophila</i> Shrubland	SAES
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Acacia aptaneura, *A. caesaneura*, *A. incurvaneura* to 3m, *Eremophila platycalyx* subsp. Leonora 1.5m, PFC 1% over *Sida ectogamma* 0.8m, PFC < 1%, *Eremophila margarethae* 0.5m, PFC 3%, *Ptilotus schwartzii* 0.4m, PFC 1%. A stony plain gently inclined to the north-west at 0.5 degrees, with hardpan red-brown silty sandy soil and a continuous mantle of subangular to subrounded ironstone, quartz gravels and stones to 7 cm diameter.



1.15	Hardpan Plain, deflation zone	HPDS
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Acacia incurvaneura, *Acacia pteraneura* to 6m, PFC 10 to 30% with a tall shrub stratum of *Eremophila platycalyx* subsp. Leonora 3m, *Santalum lanceolatum* 3m, and younger Mulga to 3m, PFC 5 to 15% over low shrubs *Ptilotus obovatus* Typical Goldfields form (G Cockerton et al 15213) 0.6m, *Maireana triptera* 0.5m, *Teucrium teucriflora* 1m, PFC 1% over scattered grasses *Eriachne ovata*, *Enteropogon ramosus* and occasional *Austrostipa elegantissima* 1m, PFC 0.5%.

A relatively level site representing a broad distributary fan subject to sheet flow (adjacent to the HPP community) with hardpan red silty sand soil and abundant but discontinuous lag quartz and basalt gravel with evidence of conglomerate Wiluna hardpan below the surface. Large amount of bare ground, > 80%.



1.16	Hardpan Mulga Shrubland	HPMS
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Acacia aneura 4 to 6m, PFC 5% over scattered *Maireana pyramidata* 1m, PFC 1% over *Ptilotus obovatus* (Goldfields form) 0.5m, PFC 5% over *Aristida contorta* 0.3m, PFC 15%. A level broad valley floor, non-saline at surface, red silty sand with subrounded to subangular basalt tocks to 20 cm and quartz fragments.



1.17	<i>Acacia aneura</i> , <i>Maireana triptera</i> , <i>Ptilotus obovatus</i> (Goldfields Form) Shrubland over <i>Aristida contorta</i>	AaPoGMt
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No photo taken

Mulga Shrublands / Woodlands over Perennial Grasses on Plains

Two vegetation associations, where silty-sandy soils over hardpan higher in the landscape are present. Here Mulga is associated with a grassy understorey of *Monachather paradoxus* and *Eragrostis eriopoda*, collectively known as Wanderrie grasses.

2.01	Mulga-Wanderrie (<i>Acacia aneura</i> , <i>Eragrostis eriopoda</i>) Grassland	MUWA
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Acacia caesaneura, *Acacia incurvaneura* 4 to 8m, PFC 15% over shrubs *Eremophila compacta* subsp. *compacta* 0.8m, PFC 3% over *Ptilotus schwartzii* 0.5m, PFC < 1% and *Eragrostis eriopoda* 0.5M, PFC 5 to 15%. Site has a discontinuous mantle of quartz, chert, ironstone and basalt gravel and rocks to 5 cm diameter with a red silty sandy soil.



2.02	Wanderrie Bank Grassy Shrublands (<i>Eragrostis eriopoda</i>) Grassland	WABS
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Acacia incurvaneura, *A. pteraneura* 4 to 5m, PFC 1 to 7% over *Eragrostis eriopoda* 0.4m, *Monachather paradoxus* 0.4m, PFC 1 to 10% with *Maireana triptera*, *Eremophila platycalyx* subsp. Leonora (J. Morrissey 252), *Solanum lasiophyllum*, *Maireana convexa*, *Ptilotus obovatus* (Goldfields form), *Scaevola spinescens* (narrow leaf, spiny form), PFC 1%.



***Acacia* Woodlands over Shrubs and Grasses in Major Drainage Lines and Groves**

Two major drainage tracts and several minor drainage lines occur within the Study Area, draining from the north-east to the south-west. The vegetation of the major drainage line in the west of the Study Area, Cardinia Creek, with its upper reaches draining from the Cardinia deposit areas in the Leonora and Gundockerta Land Systems, is dominated by Mulga species. Bummer Creek, with a small representation within the south-east of the Study Area, drains from the Violet Land System (the site of the Murrin Murrin minesite, east of the Study Area), and is dominated by *Acacia burkittii*. The vegetation of the minor drainage lines within the Study Area reflect on the vegetation adjacent hills and plains, but are denser and with a greater species representation due to the accumulation of resources.

3.01	Drainage Line Mulga <i>Acacia aneura</i> (sens. lat.) Woodland	DRMS
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Major incised multi channelled braided Drainage Line supporting Mulga Woodland of *Acacia aneura* varieties 4 to 8m, PFC 10 to 20% over *Acacia burkittii* 3m, *A. tetragonophylla* 2.5m, PFC 10% over Shrubs of *Sida ectogamma* 1.5m, *Senna artemisioides* subsp. *artemisioides* 1.2m, *Maireana pyramidata* 1.2m, PFC 3 to 4% over grasses including *Digitaria brownii* 0.8m, *Enteropogon ramosus* 0.5m, PFC 25% and *Ptilotus obovatus* Typical Goldfields form (G Cockerton et al 15213) 0.5m, PFC 5 to 10%. Soils are colluvial sands, gravel and some clay with areas of exposed Wiluna Hardpan conglomerate in deeper channels with sandy slugs present.



3.02	Drainage line <i>Acacia burkittii</i> Woodland	DRAbS
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A broad (500m) wide drainage line with numerous braided incised channels to 2m deep x 5 m wide. Vegetation is a dense Mulga Woodland with grassy understorey. *Acacia pteraneura*, 6 to 8m high, *Acacia tetragonophylla* 3m, *Acacia burkittii* 3 to 6m, PFC 50% to 75% over Buffel Grass (*Cenchrus ciliaris**) 1m, PFC 30 to 80%, *Themeda australis* 1m, PFC 1%, *Juncus aridicola* (only on margins of incised channels), *Enneapogon avenaceus* 0.3m, *Eragrostis setifolia* 0.4m, PFC 10% Occasional Ruby Dock (*Rumex vesicarius**) and Brazilian Pepper Tree (*Schinus terebinthifolia**) noted. The surface alluvium of red silty sand ranges from 0.4 to 1.5m in depth in the channels viewed with exposed Wiluna Hardpan conglomerate exposed on the margins and coarse sandy within the channel.



3.03	Groved Mulga Woodland	GRMU
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An internally drained depression in the landscape, within a broad hardpan Mulga shrubland dense grove. No photograph taken.

***Acacia* (other than Mulga) Shrublands on Stony Hills**

Four vegetation associations on stony hills within a large proportion of the Study Area are dominated by *Acacia* trees and shrubs other than Mulga. Here *Acacia* sp. Marshall Pool (G. Cockerton 3024) is the dominant shrub to small tree on the stony gabbro and basalt hills of the Leonora Land System. It may also be co-dominant with *Acacia sibirica* in some locations. *Acacia doreta* short phyllode form (M. Stone & S. Colwill WB34381), being the typical form of the species), is also present in association with *A.* sp. Marshall Pool on one small hill in the central-west of the Study Area. *Acacia burkittii* was found to be dominant in small, well defined areas of calcrete platform, higher in the landscape, presumably due to an elevated soil moisture availability in the calcrete.

4.01	<i>Acacia</i> sp. Marshall Pool (G. Cockerton 3024) Shrubland	Amp
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Acacia sp. Marshall Pool (G. Cockerton 3024) 1.5 to 2m with occasional trees to 3.5m, PFC 25% with occasional *Acacia burkittii* 3 to 4m, PFC 3 %, *A. caesaneura* 0.1%, *Acacia quadrimarginea* narrow phyllode form 1.5m, PFC 0.1% over *Eremophila georgei* 0.4 to 1.8m, PFC 1% and *Senna cardiosperma* 1m, PFC 0.5%. A large and extensive stony gabbro range with a substantial population of *Acacia* sp. Marshall Pool (G. Cockerton 3024). Soil is a red silty sand amongst a continuous cover of rounded (occasionally freshly fractured) gabbro rocks.



4.02	Acacia sp. Marshall Pool (G. Cockerton 3024), <i>A. sibirica</i> , <i>Acacia aneura</i> , <i>A. burkittii</i> Shrubland	AmpAsAa
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Acacia ramulosa subsp. *ramulosa*, *A. sp.* Marshall Pool to 3m, PFC 10% over *Acacia sibirica* to 1.2m, *Philotheca brucei* subsp. *brucei* to 1.2m, *Dodonaea lobulata* 1m, *Eremophila forrestii* 1m, PFC 15% over *Prostanthera albiflora* 0.7m, *Ptilotus obovatus* Upright form (G Cockerton et al 15206) 0.8m, *Ptilotus obovatus* Typical Goldfields form (G Cockerton et al 15213) 0.4m, *Cymbopogon ambiguus* 0.6m, PFC 10%. Stony basalt (fine grain) hilltop with fine red silty sandy soil, continuous mantle of subangular to subrounded basalt rocks and boulders.



4.03	Acacia doreta short phyllode form, Acacia sp. Marshall Pool (G. Cockerton 3024) Open Woodland Ptilotus obovatus (Goldfields form) Shrubland	AdAspMPPoG
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Acacia doreta (short phyllode form) 1.5m to 6m, *Acacia* sp. Marshall Pool (G. Cockerton 3024) 0.5 to 3m, PFC 3 to 7%, *Ptilotus obovatus* Typical Goldfields form (G Cockerton et al 15213) 0.4m, PFC 5 to 10% over grasses *Enneapogon caerulescens* 0.15m, PFC 5 to 10%. A low basalt hill with subangular fragments to 20 cm diameter and extensive calcrete



4.04	Acacia burkittii, Ptilotus obovatus (Goldfields form) Shrubland	AbPoG
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Low and isolated basalt hill supporting *Acacia burkittii* 2.4m, PFC 5 to 10% over scattered *Senna artemisioides* subsp. *filifolia*, *S. artemisioides* subsp. *artemisioides*, *Senna* sp. Meekatharra (E. Bailey 1-26) 0.5 to 1.2m, PFC 1 to 2% over *Ptilotus obovatus* Typical Goldfields form (G Cockerton et al 15213) 0.4m, PFC 5 to 10% over scattered grasses *Enneapogon caerulescens* 0.2m, PFC 1%. Entire surface of the hill is covered in outcropping basalt rocks with patches of tabular calcrete. Very similar to community 1.04, however, lacks occasional *Acacia* sp. Marshall Pool (G. Cockerton 3024).



Acacia papyrocarpa Woodlands

Four variants of the *Acacia papyrocarpa* woodland were observed. The dominant and defining understorey varies from *Tecticornia disarticulata* in more saline sites; to *Eremophila scoparia* where calcrete is present; to *Ptilotus obovatus* (Upright form), *Maireana triptera* and grasses where there is non-saline but mildly alkaline soil cover over underlying materials; to *Maireana pyramidata* in areas subject to some waterlogging and salinity. *Acacia papyrocarpa* is by far the largest and most prominent tall tree in the landscape within the Study Area.

5.01	<i>Acacia papyrocarpa</i> Open Low Woodland, <i>Tecticornia disarticulata</i> Shrubland	ApTdS
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Low rise supporting *Acacia papyrocarpa* 5 to 7m, PFC 10% with occasional *Acacia sibirica* 2.5m, *A. aneura* (3 forms) 2 to 5m, PFC 1% total over medium shrubs *Tecticornia disarticulata* 1m, *Maireana sedifolia* 1.5m, *Lepidium platypetalum* 0.8m, PFC 5% over scattered low shrubs *Maireana georgei* 0.25m, *M. triptera* 0.25m, PFC < 1%. Site slopes at 2 to 3 degrees and has a continuous lateritic gravel mantle, 0.5cm to 6 cm diameter with conglomerate ferricrete boulders present, soil is a fine red silty sand.



5.02	Acacia papyrocarpa Open Low Woodland, Eremophila scoparia and Maireana spp. Shrubland	ApEsMspp
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Acacia papyrocarpa 8 to 10m, PFC 7% over *Eremophila scoparia* 0.5 to 2.1m, PFC 5% over *Maireana georgei* 0.3m, *M. triptera* 0.3m, *M. glomerifolia* 0.4m, *Maireana tomentosa* (type 1 WB38650) complex 0.3m, PFC 5 to 10%. A low rounded hill with an extensive, continuous mantle of angular to subangular quartz, weathered gabbro gravel and stones to 15 cm diameter.



5.03	Acacia papyrocarpa Open Low Woodland, Ptilotus obovatus (Upright form), Maireana triptera Shrubland and grasses	ApPoUMt
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Acacia papyrocarpa 3.5 to 5m with occasional *Casuarina pauper* 4m, PFC 5% over *Ptilotus obovatus* Upright form (G Cockerton et al 15206) 0.4 to 0.8m, PFC 7% with occasional *Maireana sedifolia* 1.2m, *Eremophila oldfieldii* (young plants) 1m and *Senna artemisioides* subsp. *filifolia* 1.5m, PFC 1% over *Maireana triptera* 0.3m, PFC 4% and grasses dominated by *Enneapogon caerulescens*, *E. polyphyllus* 0.25m, PFC 2%. Soil at surface is a red - brown silty sand with abundant but discontinuous subangular quartz sub rounded gabbro and subangular silcrete fragments to 8 cm diameter.



5.04	<i>Acacia papyrocarpa</i> Open Low Woodland, <i>Maireana pyramidata</i> Shrubland	ApMt
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Open woodland of *Acacia papyrocarpa* 4 to 6m, PFC 10 to 15% over predominantly *Maireana pyramidata* 1m, PFC 10 to 15% with occasional patches of *Maireana sedifolia* 1m, *Tecticornia disarticulata* 0.4m, *Eremophila scoparia* 1.5m, occasional individuals of *Acacia aneura* (sens. lat.) 4m, *Hakea preissii* 3.5m on a level plain with abundant but discontinuous subangular quartz stones to 10 cm diameter over dark red-brown silty clay soil. A community subject to ecotonal inclusions from adjacent communities.



Acacia victoriae Shrubland over Chenopods on Calcrete Plains

The *Acacia victoriae* shrubland occurs on extensive alkaline calcrete plains in the southern part of the Study Area. It has a relatively diverse understorey dominated by chenopods (*Sclerolaena* and *Maireana* spp.) and may support patches of *Eragrostis* sp. Yeelirrie Calcrete (S. Regan LCH26770).

6.01	<i>Acacia victoriae</i> Shrubland	AvS
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Acacia victoriae 2 to 4m, PFC 10% over scattered *Maireana pyramidata* 1m, *M. triptera* 0.4m, *M. georgei* 0.4m, PFC 1.5%, over perennial grasses *Enneapogon caerulescens*, *E. cylindricus* 0.4m PFC 15% and *Eragrostis* sp. Yeelirrie Calcrete (S. Regan LCH 26770) 0.2m, PFC 20%. Soil is a pale red brown silty sand with abundant carbonate subangular nodules to 10mm. Site has a discontinuous stony mantle of quartz, basalt stones 2 to 30cm. Site slopes at approximately 3 to 4 degrees to the east.



Perennial Grasslands

Two perennial grasslands were mapped. These are small, discrete patches of *Eragrostis* sp. Yeelirrie Calcrete (S. Regan LCH26770) on calcrete platforms (relatively low in the landscape); and similarly small, discrete patches of *Neurachne munroi* Hummock Grassland on Mudstone on low rises.

7.01	Eragrostis sp. Yeelirrie Calcrete (S. Regan LCH 26770) Hummock Grassland on Calcrete	EyC
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Hakea preissii 3.5m, *Acacia caesaneura* and *A. incurvaneura* 6m, PFC < 1%, *Eremophila scoparia* 1 to 2m, PFC 1% over *Maireana pyramidata* 0.8m, *Maireana sedifolia*, *Solanum lasiophyllum* 0.4m, *Maireana triptera* 0.3m, *M. georgei* 0.4m, PFC 2% over *Eragrostis* sp. Yeelirrie Calcrete (S. Regan LCH26770) 0.15m, PFC 20%. Foot slope of a low gabbro hill with a southerly aspect, slope 1 to 2 degrees. Outcropping gabbro immediately north of this point and soil surface has a discontinuous lag of subrounded gabbro stones and subangular calcrete nodules.



7.02	Neurachne munroi Hummock Grassland on Mudstone	NmHG
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Neurachne munroi 0.2 to 0.3m, PFC 15% hummock grassland with occasional emergent *Hakea preissii* 1m, *Maireana sedifolia* 1m, *Ptilotus obovatus* Typical Goldfields form (G Cockerton et al 15213) 0.5m, *Ptilotus obovatus* Upright form (G Cockerton et al 15206) 1m, PFC shrubs 1%. An east facing mid slope of a low stony rise with outcropping pale yellow-brown fine sandstone.



Hakea preissii and/or Halophytic Chenopod Shrublands

Thirteen topographically controlled variants of Chenopod Shrublands were recognised with a major distinction being those with *Hakea preissii* emergent above the lower shrubs in areas with a deeper soil profile vs. those lacking *H. preissii*, lower in the landscape and more frequently subject to inundation or waterlogging. These environments are all moderately to highly saline and support a largely well known group of *Maireana*, *Atriplex* (less tolerant of waterlogging) and *Tecticornia* (Samphire, more tolerant of waterlogging) species. They may also support species with conservation significance as identified in the Desktop Study, Table 7.

8.01	Hakea preissii, Maireana pyramidata, Tecticornia disarticulata Shrubland	HpTdMpS
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Chenopod Shrubland of *Tecticornia disarticulata* 1m, *Maireana pyramidata* 1m, PFC 2 to 15% over *Maireana georgei* 0.2m, *Sclerolaena* spp. 0.2m, PFC 3% with occasional grasses *Enneapogon caerulescens*, *E. polyphyllus*, *Enteropogon ramosus* 0.4m, PFC 1%. Gently sloping site (1 deg) with a continuous mantle of ironstone and quartz pebbles to 5 cm over a hard setting fine sandy clay soil.



8.02	Hakea preissii, Maireana pyramidata, Cratystylis subspinescens Shrubland	HpMpCs
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Hakea preissii 3m, occasional emergent *Pittosporum angustifolium* 4m, PFC 5% over chenopod shrubs *Maireana pyramidata* 1m, PFC 5%, *Cratystylis subspinescens* 1m, 1%, *Maireana georgei* and *M. triptera* 0.2m, PFC 4% with patches of grasses *Aristida contorta* 0.2m, PFC 1%. A upland site with red silty sand soil and a continuous mantle of subangular to subrounded ironstone and quartz gravel and stones to 10 cm with occasional chert outcrop to 1.5m above landscape supporting a few *Acacia aneura* (varieties).



8.03	Hakea preissii, Maireana pyramidata, Eremophila scoparia Shrubland	HpMpEs
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Hakea preissii to 3m, PFC 1% over *Eremophila scoparia* 1.2m (2.1m), PFC 20% over scattered *Maireana tomentosa* (type 1 WB38650) complex, *M. triptera* 0.25m, *M. glomerifolia*, PFC < 1%. Site is the footslope of a low basalt range (with *Acacia* sp. Marshall Pool) and has angular to subangular basalt fragments to 10 cm diameter with abundant carbonates evident at surface.



8.04	Hakea preissii, Ptilotus obovatus (Goldfields form), Maireana triptera Shrubland	HpPoGMt
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Hakea preissii 3m, PFC 7.5% over scattered mid shrubs *Maireana pyramidata* 1m, *Sida calyxhymenia* 1m, PFC 1, over *Maireana triptera* 0.2m, *Ptilotus obovatus* Typical Goldfields form (G Cockerton et al 15213) 0.3m, PFC 30 with *Enneapogon caerulescens* 0.3m, *E. cylindricus* 0.3m PFC 20% and occasional patches of *Eragrostis* sp. Yeelirrie Calcrete (S. Regan LCH 26770) PFC 1%. Site represents a low hill with a continuous gravelly to stony mantle of subangular weathered basalt, quartz and sandstone mantle to 15 cm with some calcrete evident. Soil profile as observed in drill spoil indicates kaolin clay at depth.



8.05	Hakea preissii, Maireana pyramidata, Maireana tomentosa (type 1 WB38650) complex Shrubland and grasses	HpMpMpl
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Chenopod shrubland with occasional emergent *Hakea preissii* and *Acacia aneura* (sens. alt.). *Hakea preissii* 3m, PFC 1 to 2% over *Maireana pyramidata* 1.2m, PFC 10 to 15% over *Maireana tomentosa* (type 1 WB38650) complex 0.3m, PFC 10 to 15%. A wide range of annuals and herbaceous perennials also present with grasses prominent. May also include *Maireana sedifolia*.



8.06	Hakea preissii, Eremophila scoparia, Maireana triptera Shrubland	HpEsMt
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Hakea preissii 3.5m, PFC 4% over *Eremophila scoparia* 0.7 to 2.5m, PFC 5 to 7% over *Atriplex bunburyana* 1m, *Maireana triptera* 0.4m or *Maireana tomentosa* (type 1 WB38650) complex PFC 5%. A relatively level site with red silty sandy soil and a discontinuous lag gravel of ironstone, basalt and quartz gravel and stones to 10 cm. Where drainage is concentrated within this community, *Eremophila scoparia* can assume a high density and cover of 50% with *Maireana triptera* 1.5m and *Tecticornia disarticulata* 0.8m, PFC 10%. This denser community not mapped separately.



8.07	Maireana triptera, Frankenia spp. Low Open Shrubland	MtFsp
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Low Chenopod Shrubland of *Maireana triptera*, *M. georgei*, includes patches of *Frankenia* spp., occasional *Hakea preissii* shrubs, dead Mulga. Soil is a red-brown clayey sand with abundant discontinuous subangular quartz stones to 15 cm diameter.



8.08	Maireana pyramidata, M. georgei Shrubland	MpMg
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Maireana pyramidata 1m, PFC 20% over *Maireana triptera* 0.3m, PFC 5% with scattered *Solanum lasiophyllum* 0.4m, *Ptilotus obovatus* Upright form (G Cockerton et al 15206) 0.9m, *Ptilotus obovatus* Typical Goldfields form (G Cockerton et al 15213) 0.4m, PFC 2% over grasses *Enneapogon caeruleus* 0.2m, PFC 2%. Occasional emergent *Acacia aneura* (sens. lat.) 3 to 6m, *A. craspedocarpa* 2m, *Hakea preissii* 2.5m, PFC < 1%. A level site with red clayey silty soil with a discontinuous mantle of ironstone pisolites.



8.09	<i>Tecticornia disarticulata</i> , <i>Surreya diandra</i> , <i>Frankenia setosa</i> , <i>Maireana tomentosa</i> (type 1 WB38650) complex Shrubland	TdF sppMt
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Low lying stony plain supporting a low chenopod shrubland of *Tecticornia disarticulata* 0.3m, *Frankenia setosa* Type 1 0.25m, *Surreya diandra* 0.25m, PFC 25% with occasional emergent *Maireana pyramidata*, *Cratystylis subspinescens* and *Hakea preissii* 2m, PFC < 1%. A highly saline site where plants are small in comparison to other less stressful sites. Soil is a fine red silty sand and the surface is covered in a discontinuous mantle of subangular to subrounded quartz and ironstone gravel and stones to 10 cm diameter.



8.10	Maireana tomentosa (type 1 WB38650) complex), Tecticornia disarticulata Shrubland	Mt, Td
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Low chenopod shrubland of *Maireana tomentosa* (type 1 WB38650) complex 0.3m, PFC 5 to 15% and *Tecticornia disarticulata* 0.4m, PFC 2 to 5%. A level site with clayey soil and a discontinuous lag gravel mantle of quartz and ironstone.



8.11	Frankenia spp. Shrubland	Fspp
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Low shrubland of *Frankenia* sp. #145 0.15m, *Frankenia* sp. #65 0.3m, *Frankenia setosa* 0.3m , PFC 10 to 15%, with occasional *Maireana pyramidata* 1m, PFC < 1%. Site represents the breakaway footslope of a low (6 to 8m high) breakaway with quartz, ?basalt and sandstone shale rubble producing a kaolinitic soil, likely highly saline.



8.12	<i>Acacia masliniana</i> , <i>Cratystylis subspinescens</i> Shrubland	AmCs
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Acacia masliniana 2.5m, PFC 10% over *Cratystylis subspinescens* 0.8m to 1.2m, PFC 10% with occasional *Maireana sedifolia* 1m, *M. georgei* 0.3m, PFC 1%. Site is downslope of a low granitic breakaway.



8.13	Bare claypan, no vegetation	Cpn-B
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No perennial vegetation, no photo taken.

***Casuarina pauper* Woodland on Calcrete Outcrops**

Casuarina pauper woodland is found in small, isolated and disjunct populations on calcrete platforms high in the landscape and a lower salinity with reliable soil moisture availability of the alkaline soils here is inferred.

9.01	<i>Casuarina pauper</i> Woodland over Chenopods on Calcrete outcrops	CpW
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Casuarina pauper 6 to 8m, PFC 10 to 20% over *Hakea preissii* 1.5 to 2.5m and chenopods including *Maireana pyramidata* 1m, *Maireana sedifolia* 1.2m, *Maireana tomentosa* (type 1 WB38650) complex 0.3m, *Maireana. georgei* 0.4m, PFC 15 % over grasses including a prominent component of *Eragrostis* sp. Yeelirrie Calcrete 0.1m (S. Regan LCH26770), *Enneapogon caerulescens* 0.25m, PFC 5%. Site is the lower footslope of a gabbro hill, eastwards facing at slope of 2 to 3 degrees. Soil surface covered in discontinuous lag gravel and stones of basalt, gabbro, quartz



Claypans

Two types of grassy claypans were recognised: one supporting almost exclusively *Eragrostis xerophila*; while another forms Gilgais (with heaving clay soils) supporting emergent *Pittosporum angustifolium*, *Acacia tetragonophylla* and *A. victoriae* Shrubland over *Eragrostis setifolia*, *Themeda australis* and other claypan grasses. These are both non-saline environments with heavy clay soils and are internally drained sumps in the landscape. By virtue of their clay soils, high moisture retention and internal drainage, they typically provide refuge for burrowing frogs and support some flora that are not generally found outside these environments. These are small in area, disjunct from each other and uncommon in the landscape within the Study Area.

10.01	Grassy Claypan (<i>Eragrostis xerophila</i> Grassland)	CPN-G
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A small, well defined and distinct Claypan with a grass dominant vegetation of *Eragrostis xerophila* to 0.3m, PFC 90% with occasional *Eremophila youngii* 1.6m, PFC 5%, occasional *Maireana pyramidata* and *Cratystylis subspinescens* margin of this site from adjacent community. Soil is a pale red-brown medium to heavy heaving clay with numerous small deep cracks present when dry.



10.02	Gilgai: <i>Pittosporum angustifolium</i> , <i>Acacia tetragonophylla</i> and <i>A. victoriae</i> Shrubland over Claypan Grasses	Gilgai
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An internally drained non-saline claypan supporting a dense grove of *Pittosporum angustifolium* 8m, PFC 10% and *Acacia tetragonophylla* 2 to 3m and *Acacia victoriae* 2.5m, PFC 10% over grasses of *Dichanthium sericeum* to 1m, *Enteropogon ramosus* 0.3m. May also contain *Casuarina pauper*.



Breakaway Complex

The breakaway complex is represented in the northern part of the Study Area south of Mertondale where *Eucalyptus striaticalyx* is present at the leading edge of the low (5 to 10 m high) lateritised breakaway and a range of species tolerant of kaolin clay soils and some salinity are present in a changing mosaic pattern on the mid to lower slopes of the landscape. Groups of species such as *Frankenia* spp., *Eremophila scoparia*, *Maireana* and *Tecticornia disarticulata* are dominant while Stantec reported *Gunniopsis propinqua* P3 in this community type. The Breakaway Complex extends well outside the Study Area near the Mertondale deposit.

11.01	Eremophila scoparia, Frankenia spp. Shrubland with Sclerolaena diacantha	EsFsppSspp
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A complex of (i) Breakaway slopes and saline plains and (ii) Breakaway Plateaux. Breakaway slopes and saline plains supporting a Chenopod dominated low shrublands of *Maireana triptera*, *Sclerolaena diacantha*, and *Frankenia setosa* (type 2), PFC 10 to 15%. Breakaway Plateaux and upper slopes with *Eremophila scoparia* PFC 5%, occasional tall *Eucalyptus gypsophila* to 8m, PFC < 1% on the upper slopes at the eastern side of the large eroded gully. Highly eroded gully system below low breakaways, ca 5 to 10m relief, with kaolinitic slopes and soils and with abundant continuous mantle of angular metamorphosed mudstone, ironstone, quartz gravel and stones to 10 cm diameter. Slopes form vertical to 15 - 20 degrees and a near-level valley floor with narrow unincised drainage channels. Breakaways on the margin have lateritised rocks and support *Acacia sibirica*, *A. craspedocarpa* (lanceolate phyllode form), *A. aneura* sens. lat., *Dodonaea viscosa* subsp. *mucronata* 2m, *Eremophila annoscaulis* P3 1m, *Senna manicula* 1.2m, *Ptilotus obovatus* Typical Goldfields form (G Cockerton et al 15213) 0.5m, PFC 5 to 10%, and occasional *Philothea brucei* subsp. *brucei* and *Eragrostis lancunaria*.



Appendix 6. Records of Significant Flora Species Generated in this Study

Name	Taxon	Status	Zone	Zone	Easting	Northing	# Plants
Priority Flora							
Ea1	Eremophila annoscaulis	P3	51	J	364060	6807367	
Ea2	Eremophila annoscaulis	P3	51	J	363668	6807699	
Ea3	Eremophila annoscaulis	P3	51	J	363463	6807686	
Ea4	Eremophila annoscaulis	P3	51	J	356524	6837303	
Ea5	Eremophila annoscaulis	P3	51	J	358103	6837547	
Ea6	Eremophila annoscaulis	P3	51	J	358748	6827590	
Ea7	Eremophila annoscaulis	P3	51	J	359400	6826083	
Ea8	Eremophila annoscaulis	P3	51	J	364831	6818548	
Ea9	Eremophila annoscaulis	P3	51	J	358076	6837472	
AspMP1	Acacia sp. Marshall Pool (G. Cockerton 3024)	P3	51	J	365990	6814583	17
AspMP2	Acacia sp. Marshall Pool (G. Cockerton 3024)	P3	51	J	366019	6814442	10
AspMP3	Acacia sp. Marshall Pool (G. Cockerton 3024)	P3	51	J	366128	6814262	20
AspMP4	Acacia sp. Marshall Pool (G. Cockerton 3024)	P3	51	J	366148	6814350	12
AspMP5	Acacia sp. Marshall Pool (G. Cockerton 3024)	P3	51	J	366304	6814427	30
AspMP6	Acacia sp. Marshall Pool (G. Cockerton 3024)	P3	51	J	366273	6814130	20
AspMP7	Acacia sp. Marshall Pool (G. Cockerton 3024)	P3	51	J	366295	6814049	40
AspMP8	Acacia sp. Marshall Pool (G. Cockerton 3024)	P3	51	J	366333	6813884	20
AspMP9	Acacia sp. Marshall Pool (G. Cockerton 3024)	P3	51	J	367032	6814517	2
AspMP10	Acacia sp. Marshall Pool (G. Cockerton 3024)	P3	51	J	367074	6814468	2
AspMP11	Acacia sp. Marshall Pool (G. Cockerton 3024)	P3	51	J	367008	6814300	20
AspMP12	Acacia sp. Marshall Pool (G. Cockerton 3024)	P3	51	J	366977	6814310	20
AspMP13	Acacia sp. Marshall Pool (G. Cockerton 3024)	P3	51	J	366948	6814320	20
AspMP14	Acacia sp. Marshall Pool (G. Cockerton 3024)	P3	51	J	366926	6814339	20
AspMP15	Acacia sp. Marshall Pool (G. Cockerton 3024)	P3	51	J	366892	6814375	500

Name	Taxon	Status	Zone	Zone	Easting	Northing	# Plants
AspMP16	Acacia sp. Marshall Pool (G. Cockerton 3024)	P3	51	J	365167	6811933	400
AspMP17	Acacia sp. Marshall Pool (G. Cockerton 3024)	P3	51	J	365645	6812063	1000
AspMP18	Acacia sp. Marshall Pool (G. Cockerton 3024)	P3	51	J	363394	6811615	500
AspMP19	Acacia sp. Marshall Pool (G. Cockerton 3024)	P3	51	J	363191	6811868	50
AspMP20	Acacia sp. Marshall Pool (G. Cockerton 3024)	P3	51	J	370805	6804665	500
AspMP21	Acacia sp. Marshall Pool (G. Cockerton 3024)	P3	51	J	370578	6805286	2000
AspMP22	Acacia sp. Marshall Pool (G. Cockerton 3024)	P3	51	J	360181	6805123	150
AspMP23	Acacia sp. Marshall Pool (G. Cockerton 3024)	P3	51	J	369761	6804764	5000
AspMP24	Acacia sp. Marshall Pool (G. Cockerton 3024)	P3	51	J	368209	6803927	50
AspMP25	Acacia sp. Marshall Pool (G. Cockerton 3024)	P3	51	J	369296	6804669	150
AspMP26	Acacia sp. Marshall Pool (G. Cockerton 3024)	P3	51	J	369202	6806191	5000
AspMP27	Acacia sp. Marshall Pool (G. Cockerton 3024)	P3	51	J	366620	6808946	100+
AspMP28	Acacia sp. Marshall Pool (G. Cockerton 3024)	P3	51	J	363003	6811036	10
AspMP29	Acacia sp. Marshall Pool (G. Cockerton 3024)	P3	51	J	362999	6810824	50
AspMP30	Acacia sp. Marshall Pool (G. Cockerton 3024)	P3	51	J	363242	6810653	100
AspMP31	Acacia sp. Marshall Pool (G. Cockerton 3024)	P3	51	J	363302	6809819	10
AspMP32	Acacia sp. Marshall Pool (G. Cockerton 3024)	P3	51	J	363332	6806633	100
AspMP33	Acacia sp. Marshall Pool (G. Cockerton 3024)	P3	51	J	363942	6811028	50
AspMP34	Acacia sp. Marshall Pool (G. Cockerton 3024)	P3	51	J	364227	6810687	1
AspMP35	Acacia sp. Marshall Pool (G. Cockerton 3024)	P3	51	J	361069	6810949	200
AspMP36	Acacia sp. Marshall Pool (G. Cockerton 3024)	P3	51	J	370685	6806175	
Cc1	Cratystylis centralis	P3	51	J	359190	6811436	268

Name	Taxon	Status	Zone	Zone	Easting	Northing	# Plants
Range Extensions or Limits of Range							
Aoc1	Alectryon oleifolius subsp. canescens	RE	51	J	363227	6805904	1
Aoc2	Alectryon oleifolius subsp. canescens	RE	51	J	363211	6805932	1
Aoc3	Alectryon oleifolius subsp. canescens	RE	51	J	364205	6810623	1
Aoc4	Alectryon oleifolius subsp. canescens	RE	51	J	365725	6811135	1
Aoc5	Alectryon oleifolius subsp. canescens	RE	51	J	365731	6811137	1
Aoc6	Alectryon oleifolius subsp. canescens	RE	51	J	366598	6812635	2
Aoc7	Alectryon oleifolius subsp. canescens	RE	51	J	367165	6813054	1
Aoc8	Alectryon oleifolius subsp. canescens	RE	51	J	358360	6817917	5
Aoc9	Alectryon oleifolius subsp. canescens	RE	51	J	361814	6833380	1
Aoc10	Alectryon oleifolius subsp. canescens	RE	51	J	361463	6834273	1
Aoc11	Alectryon oleifolius subsp. canescens	RE	51	J	360760	6837749	1
Sp1	Sarcozona praecox	RE	51	J	366046	6816576	
Sp2	Sarcozona praecox	RE	51	J	366098	6815885	
PtW1	Polycarpon tetraphyllum *	W, RE	51	J	371679	6804641	
Species with Taxonomic Interest							
AqNP1	Acacia quadrimarginea narrow phyllode form (G. Cockerton WB38064)	TI	51	J	360704	6812526	3
AqNP2	Acacia quadrimarginea narrow phyllode form (G. Cockerton WB38064)	TI	51	J	369202	6806191	1
CspL	Centrolepis sp. Leonora (G. Cockerton & G. Grigg WB40071)	TI	51	J	364291	6818208	
HspP1	Hibiscus sp. Perrinvale Station (J. Warden & E. Ager WB10581)	TI	51	J	365172	6817562	

Name	Taxon	Status	Zone	Zone	Easting	Northing	# Plants
HspP2	Hibiscus sp. Perrinvale Station (J. Warden & E. Ager WB10581)	TI	51	J	365503	6817750	
HspP3	Hibiscus sp. Perrinvale Station (J. Warden & E. Ager WB10581)	TI	51	J	366082	6814363	
HspP4	Hibiscus sp. Perrinvale Station (J. Warden & E. Ager WB10581)	TI	51	J	366892	6814375	
?HspP5	? Hibiscus sp. Perrinvale Station (J. Warden & E. Ager WB10581)	TI	51	J	365167	6811933	
?HspP6	? Hibiscus sp. Perrinvale Station (J. Warden & E. Ager WB10581)	TI	51	J	365490	6812007	
?HspP7	? Hibiscus sp. Perrinvale Station (J. Warden & E. Ager WB10581)	TI	51	J	364400	6811875	
?HspP8	? Hibiscus sp. Perrinvale Station (J. Warden & E. Ager WB10581)	TI	51	J	363211	6810207	
?HspP9	? Hibiscus sp. Perrinvale Station (J. Warden & E. Ager WB10581)	TI	51	J	365478	6809735	
Poorly Collected Species							
Add1	Acacia doreta short phyllode form (M. Stone & S. Colwill WB34381)		51	J	361137	6810957	500
EspYC1	Eragrostis sp. Yeelirrie Calcrete (S. Regan LCH26770)		51	J	363780	6807066	5
EspYC2	Eragrostis sp. Yeelirrie Calcrete (S. Regan LCH26770)		51	J	364191	6815823	
EspYC3	Eragrostis sp. Yeelirrie Calcrete (S. Regan LCH26770)		51	J	364782	6818525	
EspYC4	Eragrostis sp. Yeelirrie Calcrete (S. Regan LCH26770)		51	J	362220	6811882	50
EspYC5	Eragrostis sp. Yeelirrie Calcrete (S. Regan LCH26770)		51	J	363838	6811569	200
EspYC6	Eragrostis sp. Yeelirrie Calcrete (S. Regan LCH26770)		51	J	363835	6811584	

Name	Taxon	Status	Zone	Zone	Easting	Northing	# Plants
EspYC7	Eragrostis sp. Yeelirrie Calcrete (S. Regan LCH26770)		51	J	363820	6811607	
EspYC8	Eragrostis sp. Yeelirrie Calcrete (S. Regan LCH26770)		51	J	363823	6811598	
EspYC9	Eragrostis sp. Yeelirrie Calcrete (S. Regan LCH26770)		51	J	363835	6811562	
EspYC10	Eragrostis sp. Yeelirrie Calcrete (S. Regan LCH26770)		51	J	363211	6810207	
EspYC11	Eragrostis sp. Yeelirrie Calcrete (S. Regan LCH26770)		51	J	362226	6809226	
EspYC12	Eragrostis sp. Yeelirrie Calcrete (S. Regan LCH26770)		51	J	362300	6809208	
EspYC13	Eragrostis sp. Yeelirrie Calcrete (S. Regan LCH26770)		51	J	362319	6809124	
EspYC14	Eragrostis sp. Yeelirrie Calcrete (S. Regan LCH26770)		51	J	362341	6809055	
EspYC15	Eragrostis sp. Yeelirrie Calcrete (S. Regan LCH26770)		51	J	362376	6809061	
EspYC16	Eragrostis sp. Yeelirrie Calcrete (S. Regan LCH26770)		51	J	363328	6808986	
EspYC17	Eragrostis sp. Yeelirrie Calcrete (S. Regan LCH26770)		51	J	363017	6805732	
EspYC18	Eragrostis sp. Yeelirrie Calcrete (S. Regan LCH26770)		51	J	363144	6805876	
EspYC19	Eragrostis sp. Yeelirrie Calcrete (S. Regan LCH26770)		51	J	363274	6805914	
EspYC20	Eragrostis sp. Yeelirrie Calcrete (S. Regan LCH26770)		51	J	363497	6805784	
EspYC21	Eragrostis sp. Yeelirrie Calcrete (S. Regan LCH26770)		51	J	364523	6811283	

Name	Taxon	Status	Zone	Zone	Easting	Northing	# Plants
EspYC22	Eragrostis sp. Yeelirrie Calcrete (S. Regan LCH26770)		51	J	364522	6811198	
EspYC23	Eragrostis sp. Yeelirrie Calcrete (S. Regan LCH26770)		51	J	363333	6808984	
EspYC24	Eragrostis sp. Yeelirrie Calcrete (S. Regan LCH26770)		51	J	365397	6809896	
EspYC25	Eragrostis sp. Yeelirrie Calcrete (S. Regan LCH26770)		51	J	365369	6809978	
EspYC26	Eragrostis sp. Yeelirrie Calcrete (S. Regan LCH26770)		51	J	364727	6811862	lots
EspYC27	Eragrostis sp. Yeelirrie Calcrete (S. Regan LCH26770)		51	J	364195	6815899	
EspYC28	Eragrostis sp. Yeelirrie Calcrete (S. Regan LCH26770)		51	J	366561	6813615	
EspYC29	Eragrostis sp. Yeelirrie Calcrete (S. Regan LCH26770)		51	J	366515	6813604	
EspYC30	Eragrostis sp. Yeelirrie Calcrete (S. Regan LCH26770)		51	J	365536	6812983	
EspYC31	Eragrostis sp. Yeelirrie Calcrete (S. Regan LCH26770)		51	J	367115	6815130	1
EspYC32	Eragrostis sp. Yeelirrie Calcrete (S. Regan LCH26770)		51	J	367243	6814955	5
EspYC33	Eragrostis sp. Yeelirrie Calcrete (S. Regan LCH26770)		51	J	365073	6813798	
EspYC34	Eragrostis sp. Yeelirrie Calcrete (S. Regan LCH26770)		51	J	365109	6813744	
EspYC35	Eragrostis sp. Yeelirrie Calcrete (S. Regan LCH26770)		51	J	365190	6813630	
EspYC36	Eragrostis sp. Yeelirrie Calcrete (S. Regan LCH26770)		51	J	360848	6812506	2

Name	Taxon	Status	Zone	Zone	Easting	Northing	# Plants
EspYC37	Eragrostis sp. Yeelirrie Calcrete (S. Regan LCH26770)		51	J	361532	6811051	20
EspYC38	Eragrostis sp. Yeelirrie Calcrete (S. Regan LCH26770)		51	J	371080	6804571	
EspYC39	Eragrostis sp. Yeelirrie Calcrete (S. Regan LCH26770)		51	J	373008	6804930	
EspYC40	Eragrostis sp. Yeelirrie Calcrete (S. Regan LCH26770)		51	J	371810	6805127	
EspYC41	Eragrostis sp. Yeelirrie Calcrete (S. Regan LCH26770)		51	J	371312	6805042	
EspYC42	Eragrostis sp. Yeelirrie Calcrete (S. Regan LCH26770)		51	J	367494	6807329	
EspYC43	Eragrostis sp. Yeelirrie Calcrete (S. Regan LCH26770)		51	J	367173	6807131	
EspYC44	Eragrostis sp. Yeelirrie Calcrete (S. Regan LCH26770)		51	J	362918	6811865	20
EspYC45	Eragrostis sp. Yeelirrie Calcrete (S. Regan LCH26770)		51	J	371519	6804771	10,000
EspYC46	Eragrostis sp. Yeelirrie Calcrete (S. Regan LCH26770)		51	J	373082	6804834	10,000
EspYC47	Eragrostis sp. Yeelirrie Calcrete (S. Regan LCH26770)		51	J	368764	6804058	10
EspYC48	Eragrostis sp. Yeelirrie Calcrete (S. Regan LCH26770)		51	J	369140	6805120	1000
Nm1	Neurachne munroi		51	J	365806	6817370	
Nm2	Neurachne munroi		51	J	366511	6815363	
Nm3	Neurachne munroi		51	J	364756	6811024	125
Nm4	Neurachne munroi		51	J	364724	6811138	125
Nm5	Neurachne munroi		51	J	364696	6811187	125
Nm6	Neurachne munroi		51	J	364670	6811204	125
Nm7	Neurachne munroi		51	J	364289	6810527	100

Name	Taxon	Status	Zone	Zone	Easting	Northing	# Plants
Nm8	Neurachne munroi		51	J	366699	6813459	30
Nm9	Neurachne munroi		51	J	366685	6813555	50
Nm10	Neurachne munroi		51	J	366695	6813540	50
Nm11	Neurachne munroi		51	J	365679	6813481	300
Nm12	Neurachne munroi		51	J	362737	6816962	50
Nm13	Neurachne munroi		51	J	360482	6812523	20
Weeds							
BpW1	Bidens bipinnata *	W	51	J	371679	6804641	
BpW2	Bidens bipinnata *	W	51	J	356524	6837303	
BpW3	Bidens bipinnata *	W	51	J	356691	6837541	
BpW4	Bidens bipinnata *	W	51	J	362447	6811835	
CcilW1	Cenchrus ciliaris *	W	51	J	363151	6810803	
CcilW2	Cenchrus ciliaris *	W	51	J	362619	6811489	
CcilW3	Cenchrus ciliaris *	W	51	J	362200	6809254	
CcilW4	Cenchrus ciliaris *	W	51	J	363300	6805602	
CcilW5	Cenchrus ciliaris *	W	51	J	363293	6805838	
CcilW6	Cenchrus ciliaris *	W	51	J	365066	6808600	
CcilW7	Cenchrus ciliaris *	W	51	J	365478	6809735	
CcilW8	Cenchrus ciliaris *	W	51	J	365323	6810046	
CcilW9	Cenchrus ciliaris *	W	51	J	363898	6810845	4
CcilW10	Cenchrus ciliaris *	W	51	J	365362	6811234	10
CcilW11	Cenchrus ciliaris *	W	51	J	365900	6810952	
CcilW12	Cenchrus ciliaris *	W	51	J	366074	6811123	
CcilW13	Cenchrus ciliaris *	W	51	J	365898	6813576	
CcilW14	Cenchrus ciliaris *	W	51	J	371118	6804529	
CcilW15	Cenchrus ciliaris *	W	51	J	371220	6804866	
CcilW16	Cenchrus ciliaris *	W	51	J	371126	6805268	
CcilW17	Cenchrus ciliaris *	W	51	J	365307	6805602	
CcilW18	Cenchrus ciliaris *	W	51	J	363913	6804890	
CsetW1	Cenchrus setiger *	W	51	J	371679	6804641	
CsetW2	Cenchrus setiger *	W	51	J	371519	6804771	

Name	Taxon	Status	Zone	Zone	Easting	Northing	# Plants
CitColW1	<i>Citrullus colocynthis</i> *	W	51	J	363628	6814478	1
CucMyrW1	<i>Cucumis myriocarpus</i> *	W	51	J	365114	6813282	1
CucMyrW2	<i>Cucumis myriocarpus</i> *	W	51	J	358123	6828819	
CylFulMamWoNS1	<i>Cylindropuntia fulgida</i> var. <i>mamillata</i> *	W, WoNS	51	J	356653	6827254	
EmeuW1	<i>Rumex hypogaeus</i> *	W	51	J	371679	6804641	
LdW1	<i>Lepidium didymum</i> *	W	51	J	371679	6804641	
MaW1	<i>Malvastrum americanum</i> *	W	51	J	372821	6805171	10+
PtW1	<i>Polycarpon tetraphyllum</i> *	W, RE	51	J	371679	6804641	



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