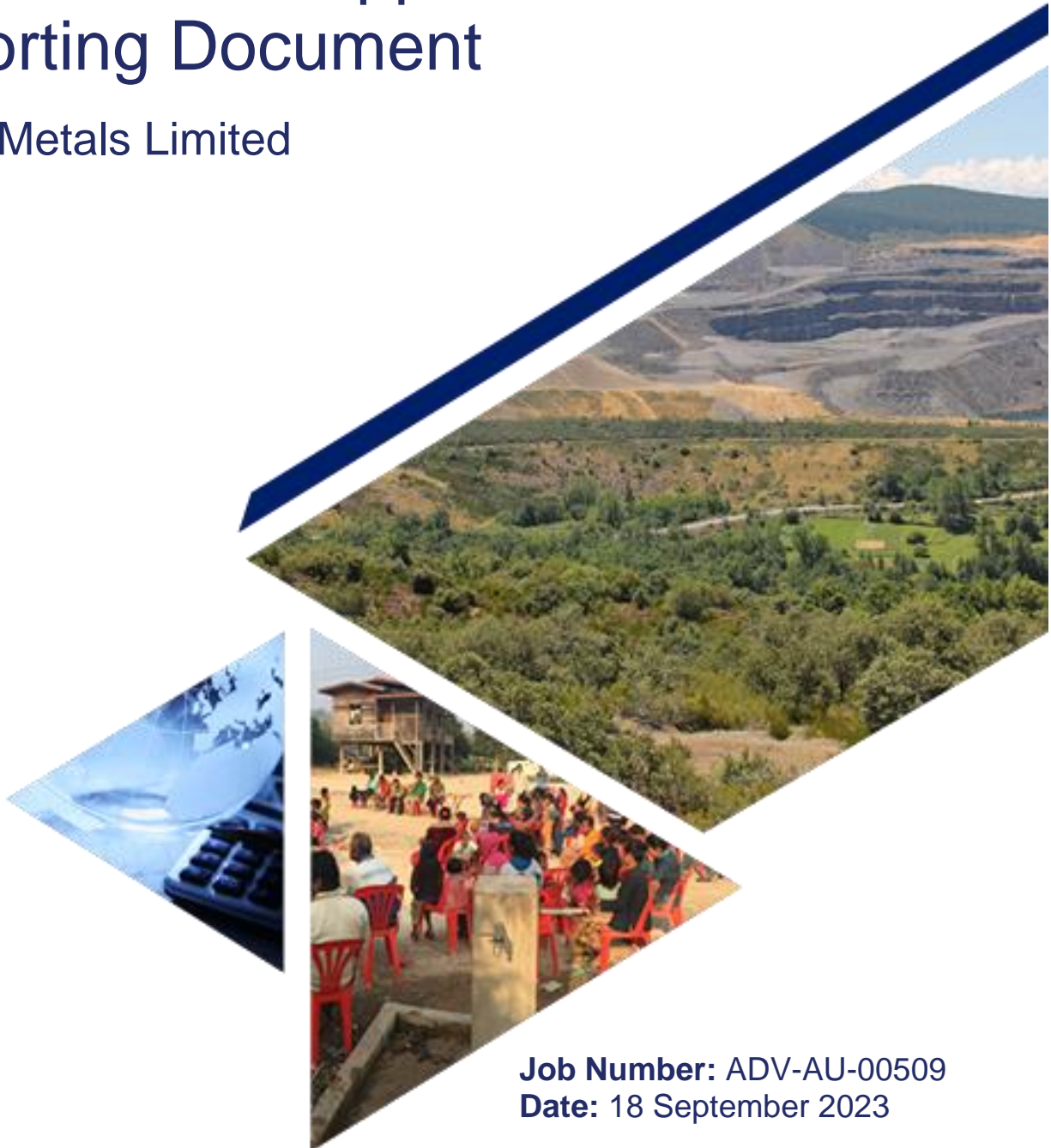


# RPMGLOBAL

## Purpose Permit Application Supporting Document

Catalyst Metals Limited



**Job Number:** ADV-AU-00509  
**Date:** 18 September 2023

## DOCUMENT CONTROL SHEET

<b>Client</b>	
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<b>Report Name</b>	<b>Date</b>
Purpose Permit Application Supporting Document	18 September 2023
<b>Job No.</b>	<b>Revision No.</b>
ADV-AU-00509	Final
<b>File Name:</b>	
230918 Catalyst Trident NVCP Final	

Authorisations				
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## Executive Summary

The Marymia Trident Project (“Trident” or the “Project”) is located approximately 200 kilometres (km) northeast of Meekatharra and 185 km south of Newman in the Peak Hills Goldfields area of the Gascoyne Basin. The Project lies within the Marymia pastoral lease (N050486) within the Shire of Meekatharra. The main access to the Project is via the Plutonic Gold Mine access road between Meekatharra and Newman on the Great Northern Highway. An existing gravel road leaving the Plutonic Gold Mine access road 7 km to the east of the Great Northern Highway intersection between Meekatharra and Newman can also be utilised to access the Project.

The Project has an extensive tenement package comprising of 27 mining leases, as well as several prospecting and exploration leases.

This Supporting Document supports a native vegetation clearing permit (Purpose Permit) application for proposed mining activities. Information is provided to enable assessment of the impacts of the proposed clearing on each of the ten ‘Land Clearing Principles’ described within Schedule 5 of the *Environmental Protection Act 1986* (WA) (EP Act). This document presents the existing ecological information and environmental impact management measures for proposed clearing.

The Clearing Permit Application Area (CPAA) for this Purpose Permit application encompasses 499.2 hectares (ha). Within that, the total project footprint is 80.7 ha, with a total of 27.3 ha of vegetation having been historically cleared, and 53.4 ha of vegetation proposed to be cleared. 45.8 ha (86%) of the area to be cleared covers areas that have been previously cleared and then rehabilitated. Only 7.6 ha of undisturbed native vegetation is therefore proposed to be cleared.

Studies have been undertaken which identified the following:

- Four vegetation communities were recorded in the clearing area; none are considered restricted.
- No Threatened Ecological Communities (TECs) listed under the *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth) (EPBC Act) or *Biodiversity Conservation Act 2016* (WA) (BC Act) were identified.
- No flora species listed under the EPBC Act or BC Act were recorded.
- No Priority flora species were recorded in the proposed clearing area.
- A desktop assessment found that twenty-two vertebrate species of conservation significance may occur in the survey area, with the majority of these being wetland birds classed as Migratory. The majority of significant species recorded from the desktop assessment are unlikely to be present in the project area or occur only irregularly or as vagrants, and as such are not considered likely to be impacted by the clearing.
- Three mammals were considered to reside in the area, being the Kultarr (Locally Significant), Long-tailed Dunnart (Priority 4, Locally Significant) and the Brush-tailed Mulgara (Priority 4). Local habitat loss leading to population decline or fragmentation was found by Bamford *et al.* (2020) to be minor to moderate, however the total percentage loss of that habitat type is 9%, which is not considered significant. Additionally, with the correct management, no significant impacts to terrestrial fauna are expected.
- Three Vegetation and Substrate Associations (VSAs) that provide habitats for fauna across the study area include:
  - Acacia shrubland over spinifex on slightly gravelly rises;
  - Mulga thickets often interspersed with open shrubland on gravelly soils; and
  - Drainage lines with tall and often dense Mulga.

An assessment against the ten clearing principles is provided in **Section 4**. The assessment of the ten clearing principles concludes that the clearing of 53.4 ha of native vegetation within a CPPA of 499.2 ha is unlikely to be at variance with any clearing principles.

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- Appendix A. Important Information about this Document
- Appendix B. Flora and Vegetation Survey
- Appendix C. Fauna and Habitat Survey

## 1. Introduction

RPM Advisory Services Pty Ltd (“RPM”) has been engaged by Catalyst Metals Limited (“Catalyst” or the “Client”) to complete an Purpose Permit Application Supporting Document (hereafter referred to as the “Supporting Document”) for the Trident Underground Mining Project (“Trident” or the “Project”). This Supporting Document provides additional information as referenced in the Native Vegetation Clearing Permit (NVCP) Application form.

### 1.1 Background

The *Environmental Protection Act 1986 (WA) (EP Act)* and *Environmental Protection (Clearing of Native Vegetation) Regulations 2004 (WA)* require that all land clearing related to mining and mineral exploration activities are approved by the Department of Water and Environmental Regulation (DWER). In accordance with Section 20 of the EP Act, applications relating to mineral and petroleum activities are delegated to the Department of Mines, Industry Regulation and Safety (DMIRS) for assessment.

The Supporting Document supports a Native Vegetation Clearing Permit (Purpose Permit) for proposed mining activities as defined in **Section 3**. Information is provided to enable assessment of the impacts of the proposed clearing on each of the ten ‘Land Clearing Principles’ described within Schedule 5 of the EP Act. This document presents the existing ecological information and environmental impact management and mitigation measures for the proposed clearing.

### 1.2 Proponent

All compliance and regulatory requirements regarding this assessment document should be forwarded by email or post to the following address:

**Proponent:** Catalyst Metals Limited  
Level 1, 30 Richardson Street  
West Perth Western Australia 6005

**Contact:** Mr. Paul Quigley  
**Title:** Senior Site Executive  
**Phone:** +61 414 763 883  
**Email:** pquigley@catalystmetals.com.au

### 1.3 Location and Tenure

The Project is located approximately 200 km northeast of Meekatharra and 185 km south of Newman in the Peak Hills Goldfields area of the Gascoyne Basin (**Figure 1-1**). The Project lies within the Marymia pastoral lease (N050486) within the Shire of Meekatharra. The main access to the Project is via the Plutonic Gold Mine access road between Meekatharra and Newman on the Great Northern Highway. An existing gravel road leaving the Plutonic Gold Mine access road 7 km to the east of the Great Northern Highway intersection between Meekatharra and Newman can also be utilised to access the Project.

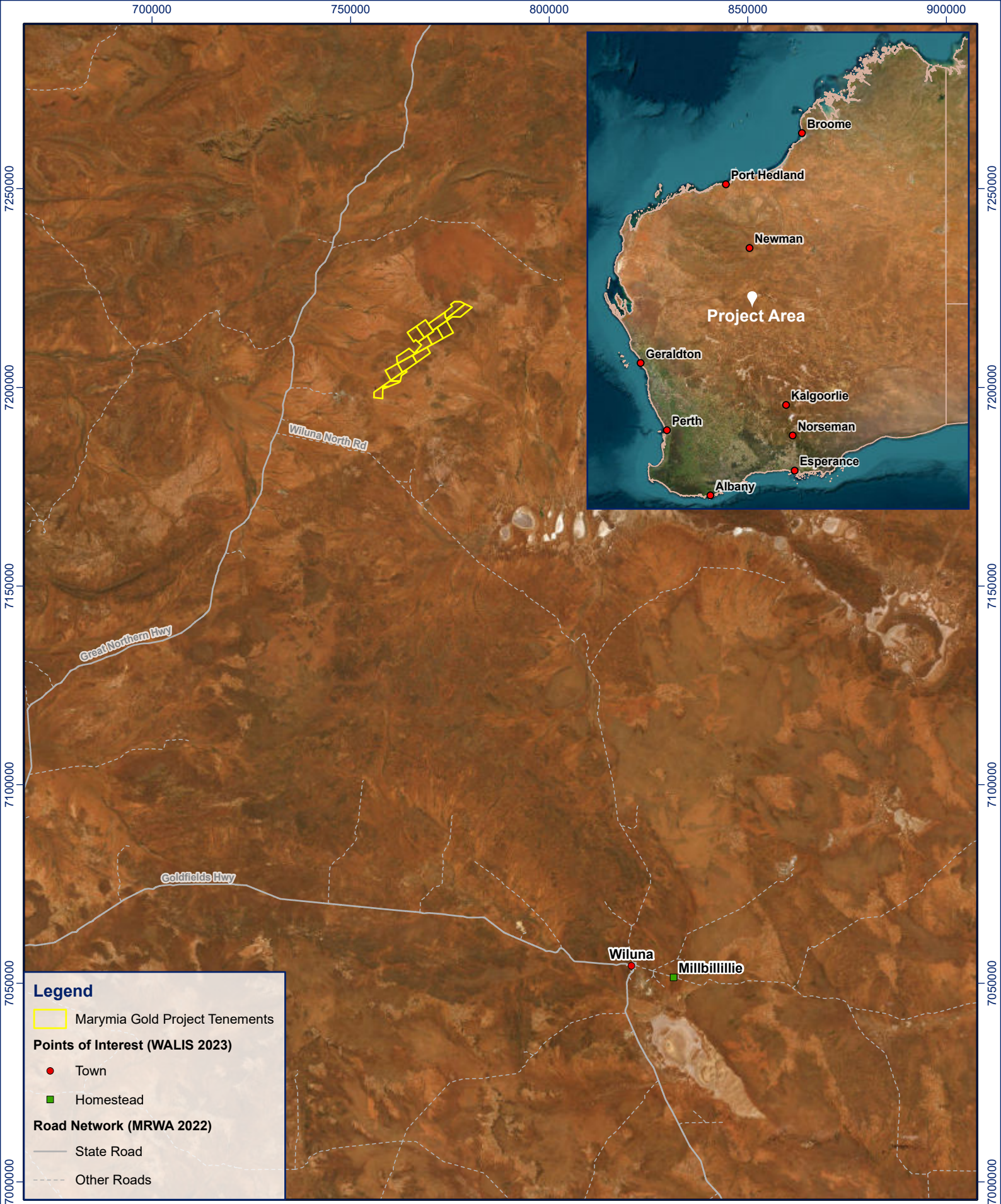
Vango Mining Limited and Dampier (Plutonic) Pty Ltd. (owned by Catalyst Metals Limited.) have an extensive tenement holding in the Project area comprising of 27 mining leases, as well as several prospecting and exploration leases. Project tenements are summarised in **Table 1-1** and presented in **Figure 1-2**.

The 499.2 ha CPAA boundary for this Purpose Permit Application, within which the proposed 53.4 ha of clearing will be undertaken, is outlined in **Figure 1-3**.

**Table 1-1 Project Tenure**

<b>Tenement</b>	<b>Holder</b>	<b>Grant Date</b>	<b>Expiry Date</b>	<b>Size (ha)</b>
M52/183	Vango Mining Limited and Dampier (Plutonic) Pty Ltd.	4/12/1999	03/12/2031	902.70
M52/217	Vango Mining Limited and Dampier (Plutonic) Pty Ltd	20/03/1991	19/03/2033	913.05
M52/218	Vango Mining Limited and Dampier (Plutonic) Pty Ltd	20/03/1991	19/03/2033	988.75
M52/228	Vango Mining Limited and Dampier (Plutonic) Pty Ltd	20/03/1991	20/03/1991	943.20
M52/229	Vango Mining Limited and Dampier (Plutonic) Pty Ltd	20/03/1991	19/03/2033	896.75
M52/230	Vango Mining Limited and Dampier (Plutonic) Pty Ltd	20/03/1991	19/03/2033	743.75
M52/231	Vango Mining Limited and Dampier (Plutonic) Pty Ltd	20/03/1991	19/03/2033	814.80
M52/235	Vango Mining Limited and Dampier (Plutonic) Pty Ltd	04/02/1991	03/02/2033	928.65
M52/257	Vango Mining Limited and Dampier (Plutonic) Pty Ltd	04/11/1991	03/11/2033	947.90
M52/258	Vango Mining Limited and Dampier (Plutonic) Pty Ltd	04/11/1991	03/11/2033	990.95
M52/259	Vango Mining Limited and Dampier (Plutonic) Pty Ltd	04/11/1991	03/11/2033	770.85
M52/269	Vango Mining Limited and Dampier (Plutonic) Pty Ltd	07/11/1991	06/11/2033	863.25
M52/305	Vango Mining Limited and Dampier (Plutonic) Pty Ltd	21/05/1992	20/05/2034	46.61
M52/306	Vango Mining Limited and Dampier (Plutonic) Pty Ltd	21/05/1992	20/05/2034	488.95
M52/369	Vango Mining Limited and Dampier (Plutonic) Pty Ltd	10/06/1993	09/06/2035	345.70
M52/370	Vango Mining Limited and Dampier (Plutonic) Pty Ltd	10/06/1993	09/06/2035	321.05



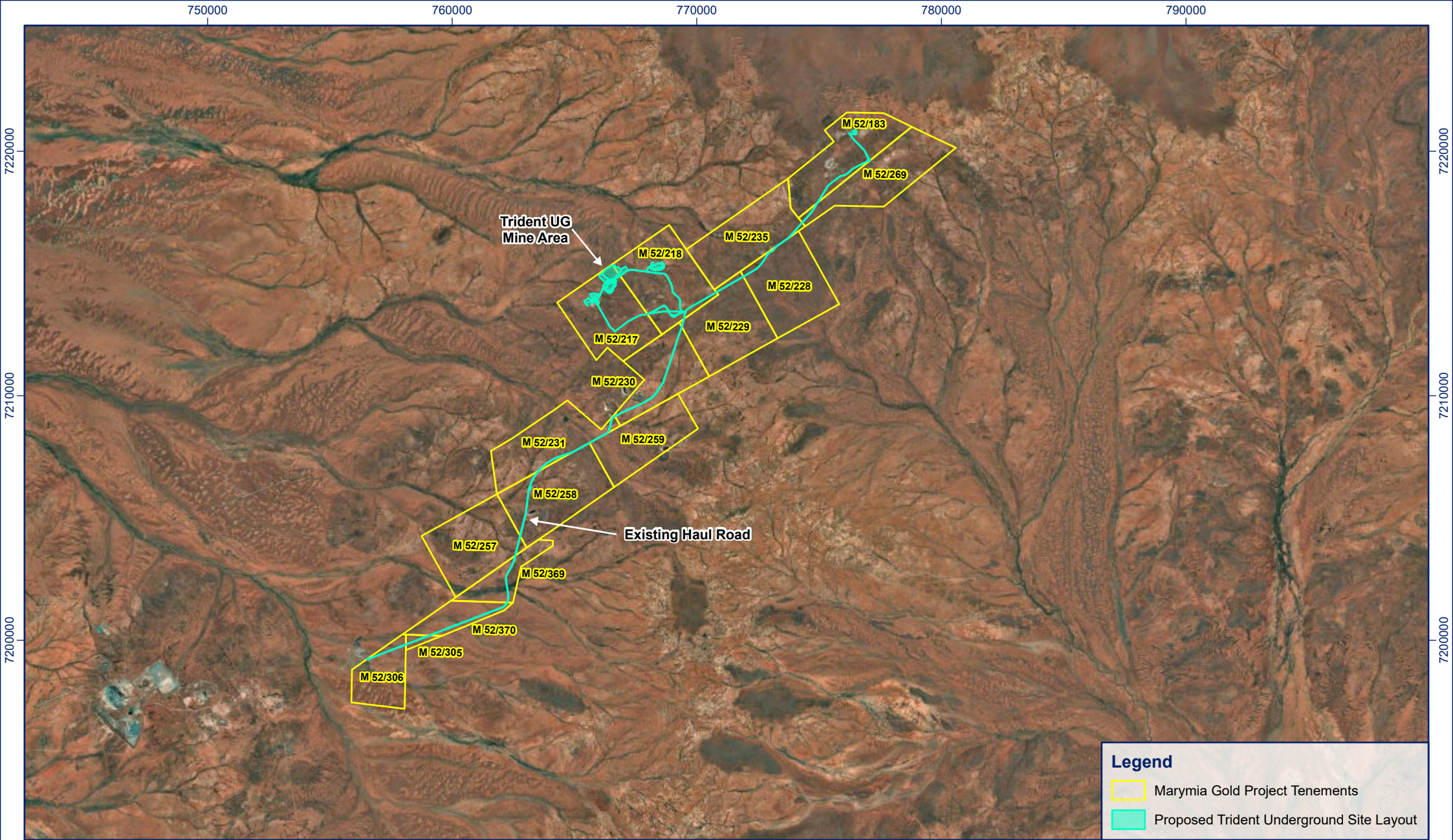


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**Scale:** 1:1,200,000  
**Projection:** GDA2020 MGA Zone 50  
**Created/Reviewed By:** IR/CR  
**Aerial:** Esri, DigitalGlobe, GeoEye, i-cubed, USDA FSA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

PROJECT		CLIENT
<b>Marymia - ESG - Native Vegetation Clearing Permit</b>		
<b>Location</b>		
Figure 1-1	ADV-AU-00509	

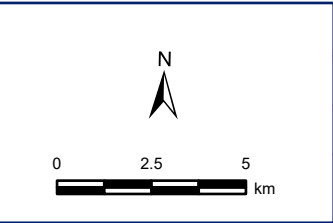




**Legend**

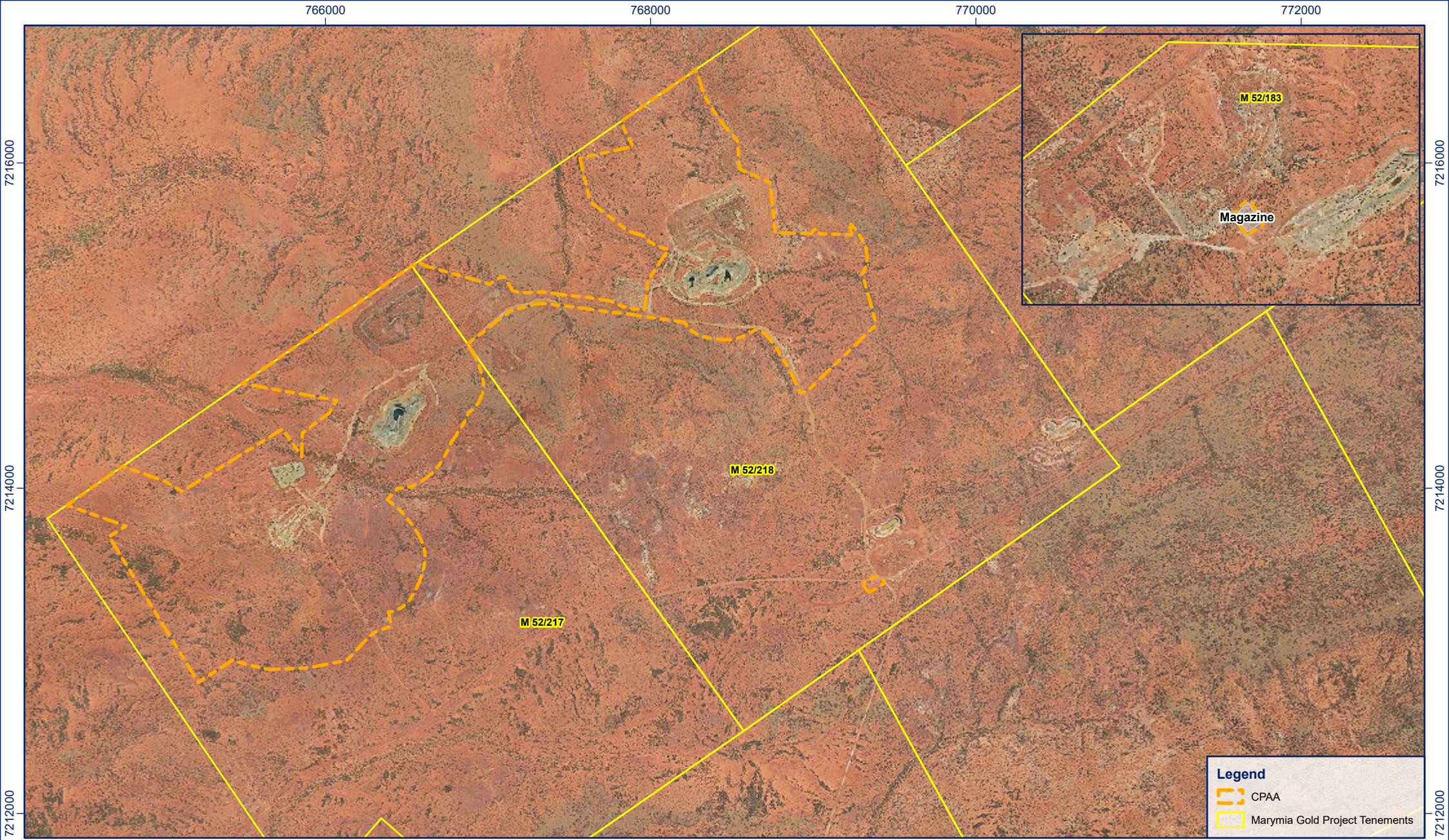
- Marymia Gold Project Tenements
- Proposed Trident Underground Site Layout

Scale: 1:200,000  
 Projection: GDA2020 MGA Zone 50  
 Created/Reviewed By: IR/CR  
 Aerial: Esri, DigitalGlobe, GeoEye, i-cubed, USDA FSA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community





PROJECT		CLIENT
September 2023	<b>Marymia - ESG - Native Vegetation Clearing Permit</b>	
Figure 1-2		
ADV-AU-00509	<b>Tenement Plan</b>	

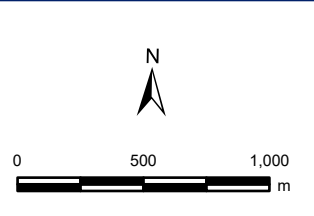




**Legend**

-  CPAA
-  Marymia Gold Project Tenements

Scale: 1:30,000  
 Projection: GDA2020 MGA Zone 50  
 Created/Reviewed By: IR/CR  
 Aerial: 2018



PROJECT		CLIENT
September 2023	<b>Marymia - ESG - Native Vegetation Clearing Permit</b>	
Figure 1-3		
ADV-AU-00509	<b>Purpose Permit Application Area</b>	

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## 2. Environmental Setting

### 2.1 Regional Setting

The project is located in the Augustus subregion (GAS3) of the Gascoyne Interim Biographic Regionalisation for Australia (IBRA) Bioregion. The Augustus subregion is characterised by rugged low Proterozoic sedimentary and granite ranges divided by broad flat valleys. The area also includes the Narryera Complex and the Bryah Basin of the Proterozoic Capricorn Orogen on the northern margin of the Yilgarn Craton, along with the Archaean Marymia and Sylvania Inliers.

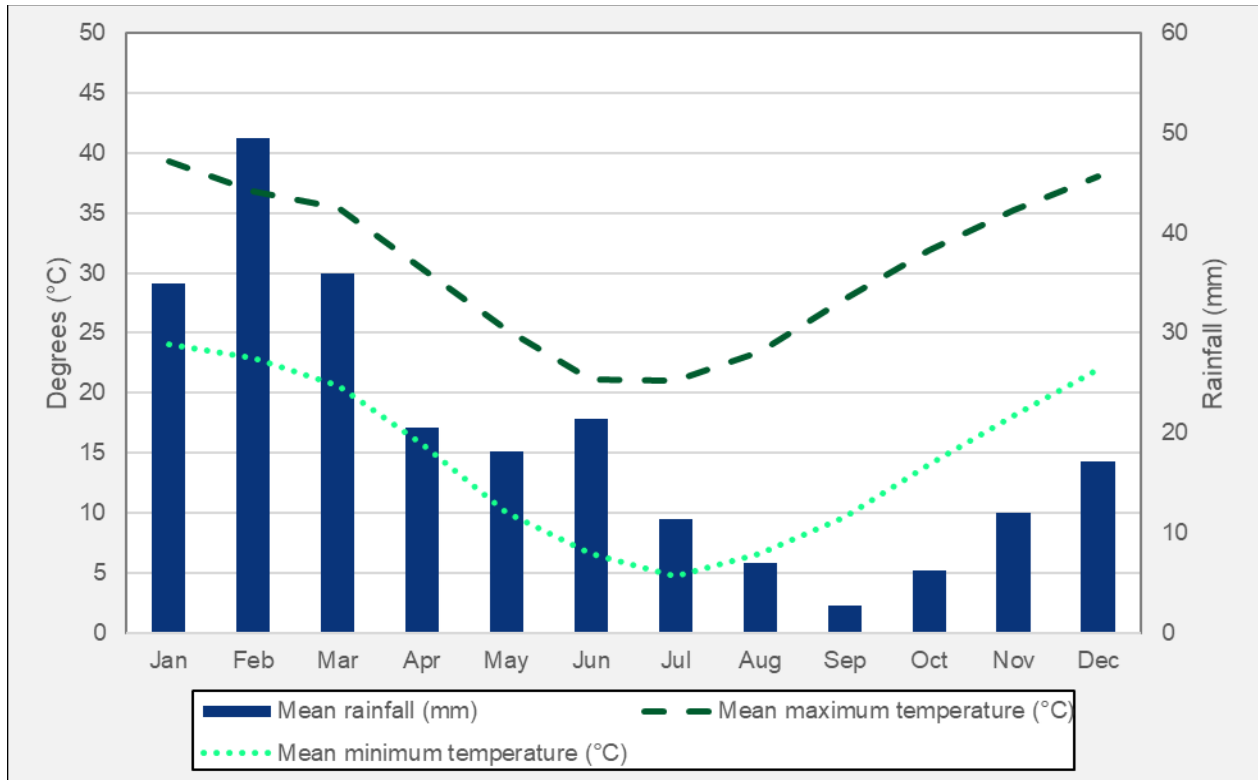
The main drainage through the Augustus subregion is the Gascoyne River System, which is also the headwaters of the Ashburton and Fortescue Rivers. Extensive areas of alluvial valley-fill deposits are found within the subregion. Mulga parkland cover shallow earthy loams over hardpan on the plains, while Mulga woodland with *Triodia* occurring on shallow stony loam rises. The subregion of 10,687,739 ha comprises of mainly native pasture grazing with other land uses including Unallocated Crown Land (UCL) and Crown Reserves, Aboriginal reserves and Conservation Reserves.

### 2.2 Climate

The nearest meteorological station to the Project that records long term temperature statistics is located at Three Rivers (site number 007080), located approximately 50 km from the Project area. Site 007080 readings commenced in 1907 with the latest available data from 13 April 2019. Temperatures range from a mean maximum of 39.3 degrees Celsius (°C) in January to 21°C in July. Minimum mean temperatures range from 24.1°C in January to 4.7°C in July. On average, there are 99.3 days per annum where the temperature is greater than or equal to 35°C, with the highest mean number of days above 30°C per month is January, recording 22.4 days above 35°C. Additionally, there are an average of 31.1 days per annum where the temperature is greater than or equal to 40°C, with 12.6 days per month above 40°C occurring in January (Bureau of Meteorology (BoM), 2023a).

The nearest meteorological station to the Project that records rainfall data is Neds Creek (site number 007103), located approximately 33 km from the Project area. Site 007103 readings commenced in 1947 and the station is still operational, however, quality-controlled data are only available until 2018. The annual rainfall reported at the site is 235 millimetres (mm). The highest rainfall typically occurs in February (49.5 mm) and the lowest rainfall occurs in September (2.7 mm) (Bureau of Meteorology (BoM), 2023b)). Climate data for the Project is presented in **Chart 2-1 Climatic Data for Three Rivers**

**Chart 2-1 Climatic Data for Three Rivers**



## 2.3 Geology, Soils and Landforms

MBS Environmental Pty Ltd (MBS) completed a Baseline Soil and Landform Assessment in 2019 for the Marymia Gold Project area, which included the Project area. The assessment comprised a desktop assessment and a sampling and analysis program.

The Project area was identified as being within the Thomas System (293Th) Land System Unit (LSU). This LSU is characterised by laterised mesas, low hills, foot slopes and lower stony plains on granite and gneiss. Main soil types are expected to be red shallow sandy duplex and stony soil. It represents approximately 51% (18,833 ha) of the total Marymia Gold Project area and covers the Trident, Marwest, and Mareast deposits (MBS, 2019).

The major soil type within the Project area was identified as a red-brown duplex loam over hardpan/saprock (Department of Agriculture and Food Western Australia (DAFWA) / Department of Primary Industry and Regional Development (DPRID) Soils Group 523) as described by Schoknecht and Pathan (2013), or a Duric Red Kandosol, as described in the Australian Soil Classification (Isbell, 2002). Surface soils that contained both red-brown duplex loam and shallow gravel soil types were characterised by the following physical and chemical properties (MBS, 2019).

- Generally high proportions of sand-sized particles with substantial sorting observed in the particle size distribution (60 – 80 % of total).
- Slightly acidic to very strongly acidic pH values ranging from 4.5 to 6.1.
- Low electrical conductivity (EC) values ranging from less than 1 to 24 micro-Siemens per metre ( $\mu\text{S}/\text{m}$ ) (non-saline).
- Low effective cation exchange capacity (ECEC) with values ranging 0.8 to 3.9 centimoles per kilogram ( $\text{cmol}^+/\text{kg}$ ). Acidic exchangeable cations (Aluminium ( $\text{Al}^{3+}$ ) and Manganese ( $\text{Mn}^{2+}$ )) were present in low to moderate concentrations. Potential for phytotoxicity of these species was low given the moderate

to high base status percentage (BS%), contributed by the presence of basic cations (Calcium (Ca<sup>2+</sup>), Magnesium (Mg<sup>2+</sup>), Sodium (Na<sup>+</sup>), and Potassium (K<sup>+</sup>)).

- Non-sodic and non-dispersive soil classifications.
- Low nutrient content as indicated by organic carbon and nitrogen concentrations. Bio-available concentrations of key nutrients were within a range typical of unfertilised Western Australian soils. Despite having elevated concentrations of extractable cobalt, it is not likely to be toxic to native vegetation communities.

## 2.4 Hydrogeology

There are two types of aquifers found in the Marymia area: alluvial and fractured rock. Alluvial aquifers are recharged by direct infiltration of rainfall or by infiltration of surface water during periodic stream-flows. Aquifers in basement rock tend to have a narrow, elongated geometry limiting their storage capacity. Recharge to this type of aquifer occurs predominantly as downwards leakage from overlying alluvial systems.

### 2.4.1 Historical Information

During groundwater exploration drilling undertaken by Woodward-Clyde (1997) it was found that there were significant groundwater flows from the contact shear zone between the granitoid and ultramafic units. This zone hosts a highly transmissive strip-style aquifer which is about 400 m wide at the ground surface. Permeability and storage are enhanced by weathering. The aquifer appears to narrow and reduces in permeability with depth.

Groundwater intersections in the ultramafic sequence away from this contact were limited, with some flows noted in the granitoid units (Woodward-Clyde, 1997).

### 2.4.2 Water Quality

Groundwater quality in the area is relatively fresh, near neutral and dominated by calcium and bicarbonate ions. The aesthetic guideline limits for Total Dissolved Solids (TDS) and hardness and the health guideline for arsenic and nitrate were exceeded. The elevated arsenic levels are characteristic of the localised rock and minerals associated with the gold deposits. Nitrate levels are traditionally elevated in the Gascoyne region.

### 2.4.3 Groundwater Dependent Ecosystems

There are no known groundwater dependent ecosystems (GDEs) within the immediate mine area.

## 2.5 Hydrology

The Project area lies on a drainage divide that separates the headwaters of the westwards-flowing Gascoyne River system from those flowing south in the Lake Gregory inland drainage system. The top of the drainage divide runs approximately along the road between the former Marymia camp and the Trident deposit. That, and other drainage divides are remnants of an extensive plateau surface subject to deep weathering in the early Tertiary. Elevations along the divide decrease to the west to about 600 m Australian Height Datum (AHD) west of Trident. Elevations also decrease to the north and south away from the divide where there are areas of sheet wash and laterite with alluvium along the drainage lines (Rockwater, 2019).

No major streams occur in the vicinity of the Project areas. Given the elevated location of the Marymia Gold Project, no major catchment areas would impact the Marymia Gold Project area. However, several minor natural drainage lines occur in and around the Mareast Pit, Waste Rock Dumps (WRDs), and haul roads (Rockwater, 2019).

Flooding associated with the catchments surrounding the natural drainage lines of the Mareast areas were analysed by Rockwater, which involved assessing the impact of the 1-in-100-year Average Recurrence Interval (ARI) peak flows and Probable Maximum Flood (PMF) on the pits and WRDs.

For the Mareast area (which includes the Mareast pit), a 1-in-100-year flood peak flow and PMF flow would flow into the Mareast pit if a diversion channel was not installed. It was recommended that the existing diversion channel should be extended to divert water around Mareast pit (Rockwater, 2019).

## 2.6 Flora and Vegetation

Onshore Environmental Consultants Pty Ltd were commissioned to conduct a detailed two season flora and vegetation survey, covering nine areas within the Marymia Gold Project tenements and its 50 km radius, including Trident Prospect, Mareast Prospect, and Marwest Prospect (Appendix B). The survey was conducted in accordance with:

- Statement of Environmental Principles, Factors and Objectives (EPA, 2023);
- Environmental Factor Guideline Flora and Vegetation (EPA, 2016a); and
- Technical Guidance Flora and Vegetation Surveys for Environmental Impact Assessment (EPA, 2016b).

The assessment was undertaken over two field mobilisations (November 2018 and May 2019) and involved sampling of the full range of vegetation communities and flora within the survey area. A total of 116 quadrats (50 m x 50 m) were sampled.

### 2.6.1 Regional Vegetation

The study area is located within the Ashburton Valley Botanical District within the Gascoyne IBRA region, which is part of the Eremaen Province.

The original vegetation mapping was undertaken by Beard (1975) and refined by Sheperd et al, (2002). There were three vegetation associations described from the study area. While Pre-European extent for each vegetation association is close to 100%, less than 10 percent of each association occurs within formal or informal reserves (Onshore, 2019) (**Table 2-1**).

**Table 2-1 Pre-European extent of vegetation associations occurring within the study area**

Vegetation Association	Description	Pre-Euro. Extent Remaining (ha)	Remaining area (ha) in IUCN Class 1-IV Reserves	% remaining Other Reserves	% remaining DBCA Managed PL
Carnegie Salient - 18	Low woodland; mulga ( <i>Acacia aneura</i> )	99.9	2	0.3	2.5
Gascoyne Ranges/ Carnegie Salient, 29	Sparse low woodland; mulga, discontinuous in scattered groups	100	0.3	0	2.4
Gascoyne Ranges -111	Hummock grasslands, shrub steppe; <i>Eucalyptus gamophylla</i> over hard s inifex	100	5.8	0.6	0

### 2.6.2 Vegetation Communities

A total of 32 vegetation associations were recorded across the survey area, with 19 occurring in the proposed clearing area as listed in **Table 2-2** and displayed in **Figure 2-1**

Figure 2-1. A total of 497.3 ha was surveyed- of which 52.6 ha is proposed to be cleared within an 80 ha project footprint. 44.8 ha (85%) of the area to be cleared covers areas that have been previously cleared and then rehabilitated. Only 7.6 ha of undisturbed native vegetation is therefore proposed to be cleared.

**Table 2-2 Vegetation Associations and Proposed Clearing Areas**

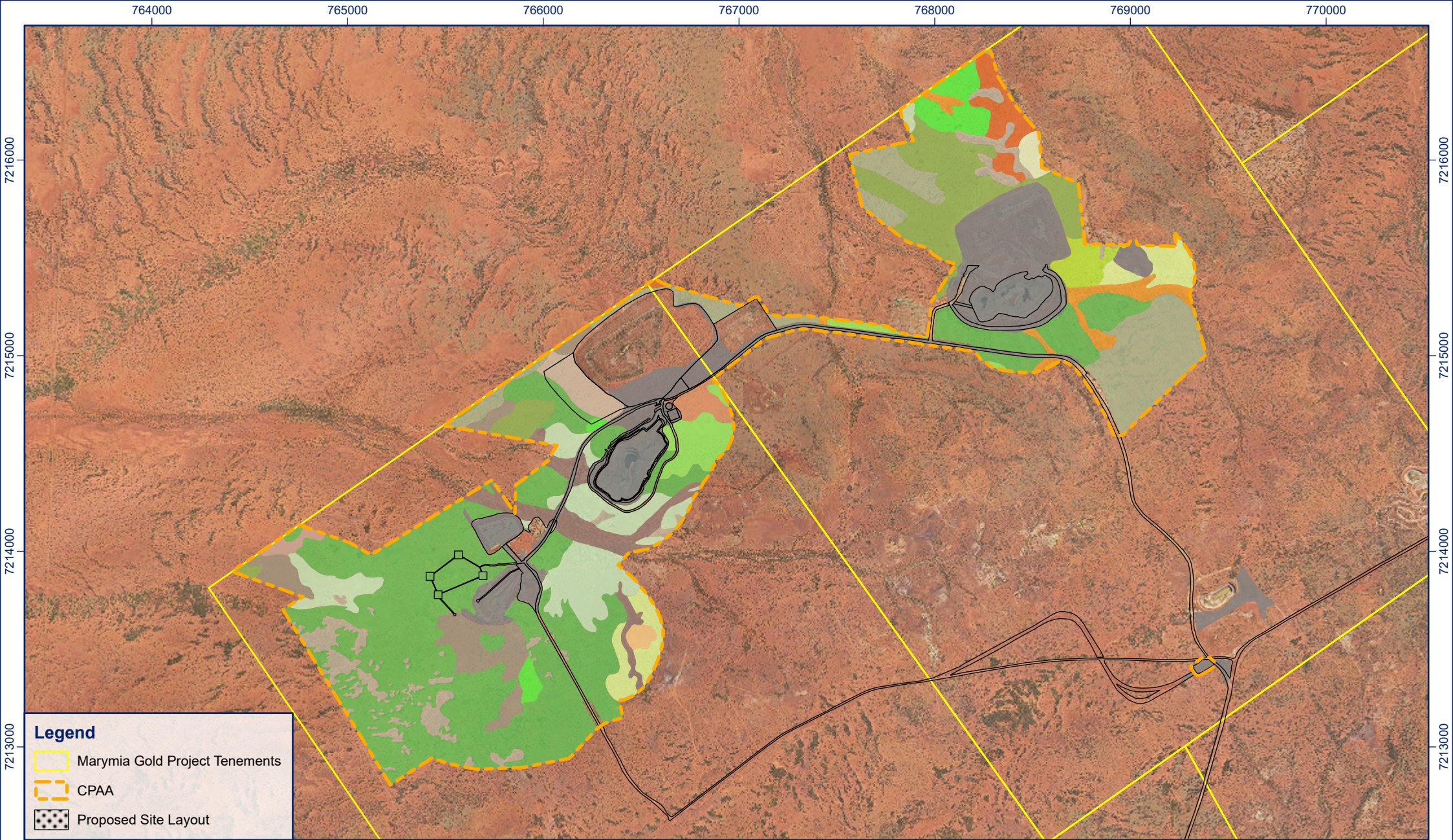
Veg Code	Description	Survey Area (ha)	Project Footprint (ha)	Impact (%)
<b>Hill Crest</b>				
HC AsuAi TslAsu SeEIPs	High Open Shrubland of <i>Acacia subcontorta</i> and <i>Acacia incurvaneura</i> over Open Shrubland of <i>Thryptomene sp. Leinster</i> (B.J. Lepschi & L.A. Craven 4362) and <i>Acacia subcontorta</i> over Low Open Shrubland of <i>Sida cf. ectogama</i> , <i>Eremophila latrobei subsp. latrobei</i> and <i>Ptilotus schwartzii</i> over Very Open Tussock Grassland of <i>Eriachne mucronata</i> , <i>Thyridolepis xerophila</i> and <i>Eragrostis eriopoda</i> on orange sandy loam on weathered ironstone ridges	10.3	0.2	0.2%
<b>Hill Slopes</b>				
HS Apt SglSs Ema	Low Open Woodland of <i>Acacia pteraneura</i> over Open Shrubland of <i>Senna glutinosa subsp. x larcenies</i> and <i>Senna stricta</i> over Low Open Shrubland of <i>Eremophila margarethae</i> on brown sandy loam on hillslopes	13.4	0	0%
HS AptAi EmPrPo Tb	Low Open Woodland (or Low Woodland) of <i>Acacia pteraneura</i> and <i>Acacia incurvaneura</i> over Low Shrubland of <i>Eremophila margarathe</i> , <i>Ptilotus rotundifolius</i> and <i>Ptilotus obovatus</i> and Scattered Hummock Grasses of <i>Triodia basedowii</i> on orange sandy clay loam on hillslopes	5.3	0	0%
HS CdPr EfGbAf	Low Shrubland of <i>Calytrix cf. desolata</i> and <i>Ptilotus rotundifolius</i> with Open Shrubland of <i>Eremophila fraseri</i> , <i>Grevillea berryana</i> and <i>Acacia fuscaneura</i> ( <i>Senna glutinosa subsp. x luerssenii</i> ) on brown sandy loam on hillslopes	1.6	0	0%
<b>Minor Drainage Lines</b>				
MI AptAcGb DpAc SeShSsp	Low Woodland of <i>Acacia pteraneura</i> , <i>Acacia citrinoviridis</i> and <i>Grevillea berryana</i> ( <i>Acacia pruinocarpa</i> ) over High Open Shrubland of <i>Dodonaea pachyneura</i> and <i>Acacia crasepedocarpa</i> (hybrid) over Low Open Shrubland of <i>Sida cf. ectogama</i> , <i>Senna artemisioides subsp. helmsii</i> and <i>Scaevola spinescens</i> (Open Shrubland of <i>Senna glutinosa subsp. x luerssenii</i> ) on brown sandy loam on minor drainage lines	8.2	0	0%
MI Ac DpAtSsp Tb	Low Open Woodland of <i>Acaica citrinoviridis</i> ( <i>Acacia pteraneura</i> ) over Open Shrubland of <i>Dodonaea pachyneura</i> , <i>Acacia tetragonophylla</i> and <i>Scaevola spinescens</i> over Very Open Hummock Grassland of <i>Triodia basedowii</i> on orange silty loam on hillslopes and minor drainage lines	2.3	0	0%
<b>Medium Drainage Lines</b>				
ME AapAan EfEff Tt	Low Open Forest of <i>Acacia aptaneura</i> and <i>Acacia aneura</i> over Open Shrubland of <i>Eremophila fraseri</i> and <i>Eremophila forrestii subsp. forrestii</i> over Very Open Tussock Grassland of <i>Themeda triandra</i> on brown sandy clay loam on medium drainage lines	14.7	0	0%
<b>Floodplains</b>				
FP Ai ArlPIGb EffSeEf TxEe Cs	Low Open Forest (to Low Closed Forest) of <i>Acacia incurvaneura</i> ( <i>Acacia pruinocarpa</i> , <i>Acacia ayersiana</i> , <i>Acacia aptaneura</i> , <i>Acacia aneura</i> , <i>Grevillea berryana</i> ) over High Shrubland of <i>Acacia ramulosa var. linophylla</i> , <i>Psyrax latifolia</i> and <i>Grevillea berryana</i> over Shrubland of <i>Eremophila forrestii subsp. forrestii</i> , <i>Sida cf. ectogama</i>	19.4	0	0%

Veg Code	Description	Survey Area (ha)	Project Footprint (ha)	Impact (%)
	and <i>Eremophila fraseri</i> over Very Open Tussock Grassland of <i>Thyridolepis xerophila</i> and <i>Eragrostis eriopoda</i> and Very Open Herbs of <i>Cheilanthes austrotenuifolia</i> on brown sandy clay loam on floodplains			
<b>Hardpan Plains</b>				
HP AiGbApt AiAth EffPsEsb	Low Open Woodland of <i>Acacia incurvaneura</i> , <i>Grevillea berryana</i> and <i>Acacia pteraneura</i> over High Open Shrubland of <i>Acacia incurvaneura</i> and <i>Acacia thoma</i> and Low Open Shrubland of <i>Eremophila forrestii</i> subsp. <i>forrestii</i> , <i>Ptilotus swartzii</i> and <i>Eremophila spectabilis</i> (Very Open Tussock Grassland of <i>Eragrostis eriopoda</i> ) on brown clay loam on hardpan plains	40.1	0	0%
HP Ai EffEsb	Low Woodland of <i>Acacia incurvaneura</i> over Low Open Shrubland of <i>Eremophila forrestii</i> subsp. <i>forrestii</i> and <i>Eremophila spectabilis</i> subsp. <i>brevis</i> over Very Open Hummock Grassland of <i>Triodia basedowii</i> on brown sandy clay loam on hardpan plains	7.7	0	0%
<b>Stony Plains</b>				
SP AptAiAp AsuAthAi SeEIPs	Low Open Woodland of <i>Acacia pteraneura</i> , <i>Acacia incurvaneura</i> and <i>Acacia pruinocarpa</i> over High Open Shrubland of <i>Acacia subcontorta</i> , <i>Acacia thoma</i> and <i>Acacia incurvaneura</i> over Low Open Shrubland of <i>Sida cf. ectogamma</i> , <i>Eremophila lanata</i> and <i>Ptilotus schwartzii</i> (Scattered Tussock Grassland of <i>Eriachne mucronata</i> and <i>Eragrostis eriopoda</i> ) on brown sandy clay loam on stony plains	34.6	0	0%
SP Ai EfSgEff PsPoSl	High Open Shrubland of <i>Acacia incurvaneura</i> ( <i>Acacia pteraneura</i> , <i>Acacia pruinocarpa</i> ) over Open Shrubland of <i>Eremophila fraseri</i> , <i>Senna glaucifolia</i> and <i>Eremophila forrestii</i> subsp. <i>forrestii</i> ( <i>Eremophila latrobei</i> subsp. <i>latrobei</i> ) over Low Open Shrubland of <i>Ptilotus schwartzii</i> , <i>Ptilotus obovatus</i> and <i>Solanum lasiophyllum</i> on brown sandy loam on stony plains	152.6	1.9	1%
SP AptAi AclSgl EmSsPo	High Open Shrubland of <i>Acacia pteraneura</i> and <i>Acacia incurvaneura</i> ( <i>Acacia macraneura</i> , <i>Hakea preissii</i> ) over Open Shrubland of <i>Acacia cuthbertsonii</i> subsp. <i>linearis</i> and <i>Senna glutinosa</i> subsp. <i>x luerssenii</i> over Low Open Shrubland of <i>Eremophila margarethae</i> , <i>Senna stricta</i> and <i>Ptilotus obovatus</i> on brown sandy loam on stony plains	31.7	0	0%
SP EIPs EmEe GbAiApt	Low Open Shrubland of <i>Eremophila lanata</i> and <i>Ptilotus schwartzii</i> over Very Open Tussock Grassland of <i>Eriachne mucronata</i> and <i>Eragrostis eriopoda</i> with Scattered Tall Shrubs of <i>Grevillea berryana</i> , <i>Acacia incurvaneura</i> and <i>Acacia pteraneura</i> on brown sandy loam on stony plains	18.1	0.1	1%
SP EsEfPo	Low Open Shrubland of <i>Eremophila spathulata</i> , <i>Eremophila fraseri</i> and <i>Ptilotus obovatus</i> on orange sandy clay loam on stony plains	1.9	0	0%
Mosaic of HP Tb AiAth EffEIPs & SP EIPs EmEe GbAiApt	Mosaic of Hummock Grassland of <i>Triodia basedowii</i> with High Open Shrubland of <i>Acacia incurvaneura</i> and <i>Acacia thoma</i> and Low Open Shrubland of <i>Eremophila forrestii</i> subsp. <i>forrestii</i> , <i>Eremophila lanata</i> and <i>Ptilotus schwartzii</i> (Scattered Low Trees of <i>Acacia pruinocarpa</i> and <i>Grevillea berryana</i> ) on orange sandy clay loam on hardpan plains & Low Open Shrubland of <i>Eremophila lanata</i> and <i>Ptilotus schwartzii</i> over Very Open Tussock Grassland of <i>Eriachne mucronata</i> and <i>Eragrostis eriopoda</i> with Scattered Tall Shrubs of <i>Grevillea berryana</i> , <i>Acacia incurvaneura</i> and <i>Acacia pteraneura</i> on brown sandy loam on stony plains	6.6	5.54	85%



Veg Code	Description	Survey Area (ha)	Project Footprint (ha)	Impact (%)
<b>Sandy/ Stony Plains</b>				
SS Tb AanAiAap EffEd	Hummock Grassland of <i>Triodia basedowii</i> with Low Open Woodland of <i>Acacia incurvaneura</i> and <i>Acacia pruinocarpa</i> ( <i>Grevillea berryana</i> , <i>Acacia ayersiana</i> ) and High Open Shrubland of <i>Acacia rhodophloia</i> ( <i>Acacia ramulosa</i> var. <i>linophylla</i> , <i>Acacia thoma</i> ) and Low Open Shrubland of <i>Eremophila</i> cf. <i>citrina</i> and <i>Eremophila spathulata</i> ( <i>Eremophila latrobei</i> subsp. <i>latrobei</i> ) on brown/orange sandy loam on sandy/stony plains and low rises	10	0	0%
SS EffEsEc Tb ApAaApt	Shrubland of <i>Eremophila forrestii</i> subsp. <i>forrestii</i> , <i>Eremophila spathulata</i> and <i>Eremophila</i> cf. <i>citrina</i> ( <i>Eremophila latrobei</i> subsp. <i>latrobei</i> ) over Open Hummock Grassland of <i>Triodia basedowii</i> with Low Open Woodland of <i>Acacia pruinocarpa</i> , <i>Acacia ayersiana</i> and <i>Acacia pteraneura</i> and High Open Shrubland of <i>Acacia incurvaneura</i> and <i>Acacia ramulosa</i> var. <i>linophylla</i> on brown loamy sand on sandy/stony plains	3.7	0	0%
<b>Other</b>				
-	Not Mapped	3.7	0.1	3%
-	Clearing of Rehabilitation	44.57	44.57	100%
<b>Cleared/highly modified</b>				
C/M	Highly modified and cleared areas devoid of native vegetation – include roads, tracks, buildings, mining infrastructure, historical pits, processing areas and camps.	67.9	0.03	1%
<b>Total</b>		<b>499.2</b>	<b>53.4</b>	<b>10.7%</b>





**Legend**

- Marymia Gold Project Tenements
- CPAA
- Proposed Site Layout

Scale: 1:25,000  
 Projection: GDA2020 MGA Zone 50  
 Created/Reviewed By: IR/CR  
 Aerial: 2018

N

0      500      1,000

m

RPMGLOBAL

PROJECT		CLIENT
September 2023	<b>Marymia - ESG - Native Vegetation Clearing Permit</b>	
Figure 2-1		
ADV-AU-00509	<b>Vegetation Units</b>	



**Vegetation Communities (Onshore Environmental 2019)**

High Open Shrubland of <i>Acacia incurvaneura</i> ( <i>Acacia pteraneura</i> , <i>Acacia pruinocarpa</i> ) over Open Shrubland of <i>Eremophila fraseri</i> , <i>Senna glaucifolia</i> and <i>Eremophila forrestii</i> subsp. <i>forrestii</i> ( <i>Eremophila latrobei</i> subsp. <i>latrobei</i> ) over Low Open Shrubland of <i>Ptilotus schwartzii</i> , <i>Ptilotus obovatus</i> and <i>Solanum lasiophyllum</i> on brown sandy loam on stony plains	Low Open Forest of <i>Acacia aptaneura</i> and <i>Acacia aneura</i> over Open Shrubland of <i>Eremophila fraseri</i> and <i>Eremophila forrestii</i> subsp. <i>forrestii</i> over Very Open Tussock Grassland of <i>Themeda triandra</i> on brown sandy clay loam on medium drainage lines	Mosaic of Hummock Grassland of <i>Triodia basedowii</i> with High Open Shrubland of <i>Acacia incurvaneura</i> and <i>Acacia thoma</i> and Low Open Shrubland of <i>Eremophila forrestii</i> subsp. <i>forrestii</i> , <i>Eremophila lanata</i> and <i>Ptilotus schwartzii</i> (Scattered Low Trees of <i>Acacia pruinocarpa</i> and <i>Grevillea berryana</i> ) on orange sandy clay loam on hardpan plains & Low Open Shrubland of <i>Eremophila lanata</i> and <i>Ptilotus schwartzii</i> over Very Open Tussock Grassland of <i>Eriachne mucronata</i> and <i>Eragrostis eriopoda</i> with Scattered Tall Shrubs of <i>Grevillea berryana</i> , <i>Acacia incurvaneura</i> and <i>Acacia pteraneura</i> on brown sandy loam on stony plains
High Open Shrubland of <i>Acacia pteraneura</i> and <i>Acacia incurvaneura</i> ( <i>Acacia macraneura</i> , <i>Hakea preissii</i> ) over Open Shrubland of <i>Acacia cuthbertsonii</i> subsp. <i>linearis</i> and <i>Senna glutinosa</i> subsp. <i>x luerssenii</i> over Low Open Shrubland of <i>Eremophila margarethae</i> , <i>Senna stricta</i> and <i>Ptilotus obovatus</i> on brown sandy loam on stony plains	Low Open Forest of <i>Acacia macraneura</i> and <i>Acacia pteraneura</i> ( <i>Eucalyptus victrix</i> ) over High Open Shrubland of <i>Acacia craspedocarpa</i> , <i>Acacia tetragonophylla</i> and <i>Acacia sclerosperma</i> subsp. <i>sclerosperma</i> over Low Open Shrubland of <i>Senna artemisioides</i> subsp. <i>artemisioides</i> , <i>Eremophila margarethae</i> and <i>Ptilotus obovatus</i> over Very Open Tussock Grassland of <i>Chrysopogon fallax</i> , <i>Themeda triandra</i> and <i>Eragrostis kennedyae</i> on brown sand on major drainage lines	Shrubland of <i>Eremophila forrestii</i> subsp. <i>forrestii</i> , <i>Eremophila spathulata</i> and <i>Eremophila cf. citrina</i> ( <i>Eremophila latrobei</i> subsp. <i>latrobei</i> ) over Open Hummock Grassland of <i>Triodia basedowii</i> with Low Open Woodland of <i>Acacia pruinocarpa</i> , <i>Acacia ayersiana</i> and <i>Acacia pteraneura</i> and High Open Shrubland of <i>Acacia incurvaneura</i> and <i>Acacia ramulosa</i> var. <i>linophylla</i> on brown loamy sand on sandy/stony plains
High Open Shrubland of <i>Acacia subcontorta</i> and <i>Acacia incurvaneura</i> over Open Shrubland of <i>Thryptomene</i> sp. <i>Leinster</i> (B.J. Lepschi & L.A. Craven 4362) and <i>Acacia subcontorta</i> over Low Open Shrubland of <i>Sida cf. ectogama</i> , <i>Eremophila latrobei</i> subsp. <i>latrobei</i> and <i>Ptilotus schwartzii</i> over Very Open Tussock Grassland of <i>Eriachne mucronata</i> , <i>Thyridolepis xerophila</i> and <i>Eragrostis eriopoda</i> on orange sandy loam on weathered ironstone ridges	Low Open Shrubland of <i>Eremophila lanata</i> and <i>Ptilotus schwartzii</i> over Very Open Tussock Grassland of <i>Eriachne mucronata</i> and <i>Eragrostis eriopoda</i> with Scattered Tall Shrubs of <i>Grevillea berryana</i> , <i>Acacia incurvaneura</i> and <i>Acacia pteraneura</i> on brown sandy loam on stony plains	Low Open Woodland (or Low Woodland) of <i>Acacia pteraneura</i> and <i>Acacia incurvaneura</i> over Low Shrubland of <i>Eremophila margarethae</i> , <i>Ptilotus rotundifolius</i> and <i>Ptilotus obovatus</i> and Scattered Hummock Grasses of <i>Triodia basedowii</i> on orange sandy clay loam on hillslopes
Hummock Grassland of <i>Triodia basedowii</i> with High Open Shrubland of <i>Acacia incurvaneura</i> and <i>Acacia thoma</i> and Low Open Shrubland of <i>Eremophila forrestii</i> subsp. <i>forrestii</i> , <i>Eremophila lanata</i> and <i>Ptilotus schwartzii</i> (Scattered Low Trees of <i>Acacia pruinocarpa</i> and <i>Grevillea berryana</i> ) on orange sandy clay loam on hardpan plains	Low Open Shrubland of <i>Eremophila spathulata</i> , <i>Eremophila fraseri</i> and <i>Ptilotus obovatus</i> on orange sandy clay loam on stony plains	Low Open Woodland of <i>Acacia incurvaneura</i> , <i>Grevillea berryana</i> and <i>Acacia pteraneura</i> over High Open Shrubland of <i>Acacia incurvaneura</i> and <i>Acacia thoma</i> and Low Open Shrubland of <i>Eremophila forrestii</i> subsp. <i>forrestii</i> , <i>Ptilotus swartzii</i> and <i>Eremophila spectabilis</i> (Very Open Tussock Grassland of <i>Eragrostis eriopoda</i> ) on brown clay loam on hardpan plains
Hummock Grassland of <i>Triodia basedowii</i> with Low Open Woodland of <i>Acacia incurvaneura</i> and <i>Acacia pruinocarpa</i> ( <i>Grevillea berryana</i> , <i>Acacia ayersiana</i> ) and High Open Shrubland of <i>Acacia rhodophloia</i> ( <i>Acacia ramulosa</i> var. <i>linophylla</i> , <i>Acacia thoma</i> ) and Low Open Shrubland of <i>Eremophila cf. citrina</i> and <i>Eremophila spathulata</i> ( <i>Eremophila latrobei</i> subsp. <i>latrobei</i> ) on brown/orange sandy loam on sandy/stony plains and low rises	Low Woodland of <i>Acacia incurvaneura</i> over Low Open Shrubland of <i>Eremophila forrestii</i> subsp. <i>forrestii</i> and <i>Eremophila spectabilis</i> subsp. <i>brevis</i> over Very Open Hummock Grassland of <i>Triodia basedowii</i> on brown sandy clay loam on hardpan plains	Low Open Woodland of <i>Acacia pteraneura</i> over Open Shrubland of <i>Senna glutinosa</i> subsp. <i>x luerssenii</i> and <i>Senna stricta</i> over Low Open Shrubland of <i>Eremophila margarethae</i> on brown sandy loam on hillslopes
Low Open Forest (to Low Closed Forest) of <i>Acacia incurvaneura</i> ( <i>Acacia pruinocarpa</i> , <i>Acacia ayersiana</i> , <i>Acacia aptaneura</i> , <i>Acacia aneura</i> , <i>Grevillea berryana</i> ) over High Shrubland of <i>Acacia ramulosa</i> var. <i>linophylla</i> , <i>Psyrax latifolia</i> and <i>Grevillea berryana</i> over Shrubland of <i>Eremophila forrestii</i> subsp. <i>forrestii</i> , <i>Sida cf. ectogama</i> and <i>Eremophila fraseri</i> over Very Open Tussock Grassland of <i>Thyridolepis xerophila</i> and <i>Eragrostis eriopoda</i> and Very Open Herbs of <i>Cheilanthes austrotenuifolia</i> on brown sandy clay loam on floodplains	Low Woodland of <i>Acacia pteraneura</i> , <i>Acacia citrinoviridis</i> and <i>Grevillea berryana</i> ( <i>Acacia pruinocarpa</i> ) over High Open Shrubland of <i>Dodonaea pachyneura</i> and <i>Acacia craspedocarpa</i> (hybrid) over Low Open Shrubland of <i>Sida cf. ectogama</i> , <i>Senna artemisioides</i> subsp. <i>helmsii</i> and <i>Scaevola spinescens</i> (Open Shrubland of <i>Senna glutinosa</i> subsp. <i>x luerssenii</i> ) on brown sandy loam on minor drainage lines	Low Open Woodland of <i>Acacia pteraneura</i> , <i>Acacia incurvaneura</i> and <i>Acacia pruinocarpa</i> over High Open Shrubland of <i>Acacia subcontorta</i> , <i>Acacia thoma</i> and <i>Acacia incurvaneura</i> over Low Open Shrubland of <i>Sida cf. ectogama</i> , <i>Eremophila lanata</i> and <i>Ptilotus schwartzii</i> (Scattered Tussock Grassland of <i>Eriachne mucronata</i> and <i>Eragrostis eriopoda</i> ) on brown sandy clay loam on stony plains
		Low Open Woodland of <i>Acacia citrinoviridis</i> ( <i>Acacia pteraneura</i> ) over Open Shrubland of <i>Dodonaea pachyneura</i> , <i>Acacia tetragonophylla</i> and <i>Scaevola spinescens</i> over Very Open Hummock Grassland of <i>Triodia basedowii</i> on orange silty loam on hillslopes and minor drainage lines
		Already Disturbed

<b>PROJECT</b>		<b>CLIENT</b>	
<b>Marymia - ESG - Native Vegetation Clearing Permit</b>			
<b>Vegetation Units Legend</b>			
Figure 2-1	ADV-AU-00509	September 2023	

### 2.6.3 Vegetation Condition

Vegetation condition within the study area ranged from Good to Very Good. Approximately 18% of the study area has previously been disturbed through historical mining and exploration activities. The remaining vegetation has also been impacted by mining and exploration activities with numerous tracks and drill pads present throughout the study area. The vegetation of the study area showed obvious signs of degradation by cattle grazing. Camels were also present within the study area. Weed species were a very minor disturbance within the study area with only two species recorded at low densities. Weed species may be more prevalent within the study area following higher rainfall seasons.

### 2.6.4 Threatened and Priority Ecological Communities

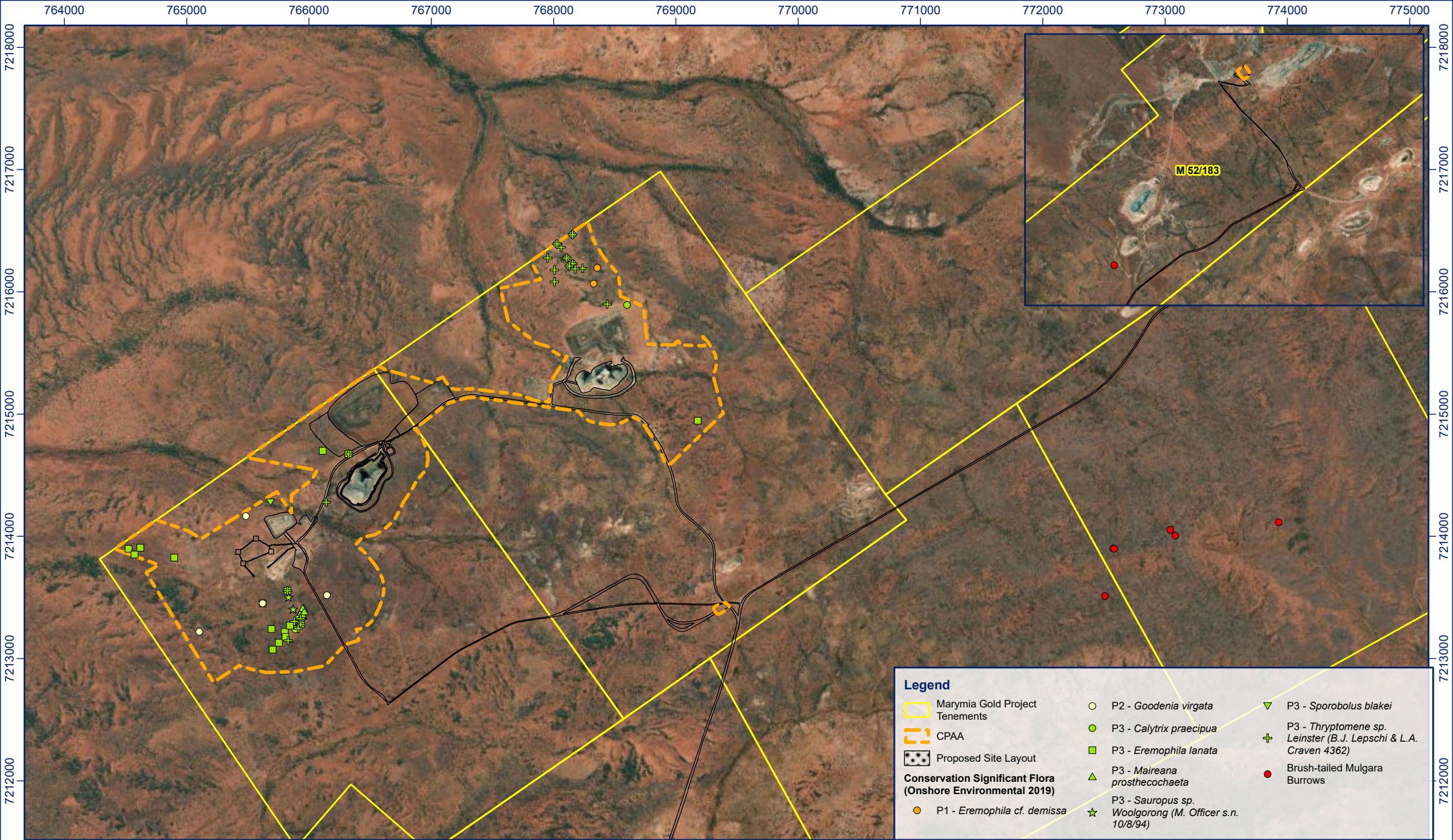
No Threatened Ecological Communities (TECs) or Priority Ecological Communities (PECs) listed under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act), or the *Biodiversity Conservation Act 2016* (WA) (BC Act) were identified during the assessment (Onshore, 2019).

### 2.6.5 Conservation Significant Flora

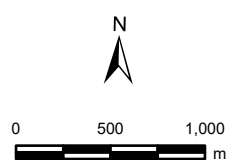
The assessment by Onshore Environmental (2019) found:

- No Flora species listed under the EPBC Act were identified;
- No Flora species listed under the International Union for Conservation of Nature (IUCN) Red List were identified;
- No Flora species listed under the BC Act were identified;
- A total of eight Priority flora species listed by DBCA were recorded inside the Trident survey area, however no species are present in the proposed area for clearing:
  - *Eremophila* cf. *demissa* (Priority 1);
  - *Goodenia virgata* (Priority 2);
  - *Calytrix praecipua* (Priority 3);
  - *Eremophila lanata* (Priority 3);
  - *Maireana prosthocochaeta* (Priority 3);
  - *Sauropus* sp. Woolgorong (M. Officer s.n. 10/8/94) (Priority 3);
  - *Sporobolus blakei* (Priority 3); and
  - *Thryptomene* sp. Leinster (B.J. Lepschi & L.A. Craven 4362) (Priority 3).





Scale: 1:40,000  
 Projection: GDA2020 MGA Zone 50  
 Created/Reviewed By: IR/CR  
 Aerial: Esri, DigitalGlobe, GeoEye, i-cubed, USDA FSA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community



PROJECT		CLIENT
September 2023	<b>Marymia - ESG - Native Vegetation Clearing Permit</b>	
Figure 2-2		
ADV-AU-00509	<b>Conservation Significant Flora and Fauna Records</b>	



## 2.6.6 Weeds

Surveys undertaken by Onshore Environmental in 2019 identified one weed species, *Bidens bipinnata* (Beggar’s Ticks) within the Trident Prospect along a major drainage line and flood plain with a coverage of 1-3%. This taxon is not listed as a Declared Pest under the *Biosecurity and Agriculture Management Act 2007* (BAM Act). Weed species may be more prevalent within the study area following higher rainfall seasons (Onshore, 2019).

Of the species recorded:

- No plant species listed as Declared under the BAM Act 2007 were recorded.
- No plant species listed as a Weed of National Significance (WoNS) under the Australian Weeds Strategy were encountered in the Project area.

## 2.6.7 Dieback

The Project is located outside the mapped dieback prevalence area. However, no dieback was surveyed during the desktop survey or site visit.

## 2.7 Vertebrate Fauna and Habitat

Bamford Consulting Ecologists Pty Ltd (Bamford) were commissioned to conduct a faunal assessment on four areas of the Marymia Gold Project, including Trident (“survey area”) (Appendix C). This assessment included a desktop survey and a field assessment conducted between 6 and 10 November 2018 (Bamford, 2019).

### 2.7.1 Conservation Significant Fauna

A total of 22 vertebrate species of conservation significance was identified as possibly occurring within the project area. An assessment of these species and recordings during the field survey is discussed in **Table 2-3**.

**Table 2-3 Conservation Significant Fauna**

Species	Common Name	Status*	Recorded	Predicted Status
<b>Birds</b>				
<i>Leipoa ocellata</i>	Malleefowl	VU	-	Irregular
<i>Apus pacificus</i>	Fork-tailed Swift	Migratory, S5	-	Visitor
<i>Ardea modesta</i>	Eastern Great Egret	Migratory, S5	-	Irregular
<i>Falco hypoleucos</i>	Grey Falcon	S3	-	Vagrant
<i>Falco peregrinus</i>	Peregrine Falcon	S7	-	Irregular
<i>Caldri acuminata</i>	Sharp-tailed Sandpiper	Migratory	-	Irregular
<i>Calidris ruficollis</i>	Red-necked Stint	Migratory, S5	-	Irregular
<i>Calidris melanotos</i>	Pectoral Sandpiper	Migratory, S5	-	Vagrant
<i>Actitis hypoleucos</i>	Common Sandpiper	Migratory, S5	-	Irregular
<i>Lophochroa leadbeater</i>	Major Mitchell’s Cockatoo	LS	-	Vagrant
<i>Neophema splendida</i>	Scarlet-chested Parrot	LS	-	Vagrant
<i>Polytelis alexandrae</i>	Princess Parrot	Vu, P4	-	Vagrant
<i>Pezoporus occidentalis</i>	Night Parrot	En	-	Vagrant
<i>Ardeotis australis</i>	Australian Bustard	LS	-	Resident
<i>Burhinus grallarius</i>	Bush Stone-curlew	LS	-	Irregular
<i>Amytornis striatus striatus</i>	Inland Striated Grasswren	P4	-	Vagrant



Species	Common Name	Status*	Recorded	Predicted Status
<i>Conopophila whitei</i>	Grey Honeyeater	LS	-	Visitor
<i>Hirundo rustica</i>	Barn Swallow	Migratory, S5	-	Visitor
<b>Mammals</b>				
<i>Dasyercus blythi</i>	Brush-tailed Mulgara	P4	-	Resident
<i>Antechinomys laniger</i>	Kultarr	LS	-	Resident
<i>Sminthopsis longicaudata</i>	Long-tailed Dunnart	LS, P4	-	Resident
<i>Macrotis lagotis</i>	Greater Bilby	Vu	-	Vagrant

\* EPBC Act/BC Act = CE (Critically Endangered) En (Endangered), Vu (Vulnerable), OSPS (Other Specially Protected Species).

\* DBCA = Priority(P)1,2,3,4,5. LS = Locally Significant

\* BC Act Schedules (S1 = Critically Endangered fauna, S2 = Endangered fauna, S3 = Vulnerable Migratory species listed under international treaties, S4 = Presumed extinct fauna, S5 = Migratory birds under international agreement, S6 = Conservation dependent fauna, S7 = Other specially protected fauna).

The majority of conservation significant species identified from the desktop assessment are unlikely to be present in the Project area or occur only irregularly or as vagrants, and as such are not considered likely to be impacted by the proposed clearing. There are four species of bird and two species of mammal that are considered resident or regular visitors and of conservation significance listed under legislation or as Priority species by DBCA, including:

- Kultarr – This small marsupial is rarely-recorded but appears to be widespread. It was detected in the general Marymia area by Ecologia (1991). It is often associated with gravelly and rocky plains with sparse vegetation.
- Long-tailed Dunnart – This species is usually associated with rocky environments and was not included in the database search results, but it was recorded near Wiluna in 2015 (M. Bamford pers. obs.) on a low rocky hill, similar to the small rocky hills present near the Marymia camp and just east of the Apex exploration area. It is therefore considered likely to be resident in the region.
- Brush-tailed Mulgara - It occurs mainly in areas of spinifex on sandy to sandy-loam soils. Inactive Burrows were found during the November site inspection. However, these were at the Cinnamon and K2 Project areas, roughly 7.5 kms away from the proposed clearing area (**Figure 2-2**). All burrows found were inactive, but this is typical of the species that can vary in abundance greatly from year to year.
- Australian Bustard - This large bird is moderately common in the region but is included as locally significant because it is vulnerable to feral predators and vehicle impacts. In addition, while it has declined across southern Australia, the Project area is on the edge of where the species remains common.
- Fork tailed Swift - The Fork-tailed Swift is a non-breeding migrant to Australia and is more or less nomadic; therefore, its occurrence at any one location is unpredictable. Being aerial, it is largely independent of terrestrial ecosystems.
- Barn Swallow - The Barn Swallow is also a non-breeding migrant that occurs regularly around some Pilbara towns in small numbers.
- Grey Honeyeater - This is an infrequently seen honeyeater that has been recorded in Doolgunna and therefore may be present as a visitor if not a resident. It favours tall, dense Mulga so could occur in any of the Project areas.

The natural landscape is largely continuous but fauna that rely on linear VSAs (i.e. drainage lines, bands of Mulga) may be sensitive to habitat fragmentation. Bamford et al. (2019) found the impact of this to be minor to moderate. However, Only 7.6 ha of undisturbed native vegetation is being proposed to be cleared in this area, this is equal to 9% of the proposed clearing area and will have minor effects to habitat fragmentation.

Several migratory waterbird species may occur as irregular visitors or vagrants such as the Eastern Great Egret, sandpipers and Red-necked Stints. Other waterbird species could also occur very infrequently. These might occasionally visit natural wetlands along the drainage lines and could also visit flooded mine pits. Bamford et al. (2019) stated that these numbers would be very low.

## 2.7.2 Vertebrate Fauna Habitat

Three Vegetation and Substrate Associations (VSAs) that provide habitat for fauna have been identified within the Project area:

- Acacia shrubland over spinifex on slightly gravelly rises;
- Mulga thickets often interspersed with open shrubland on gravelly soils; and
- Drainage lines with tall and often dense Mulga.

The Trident Project area comprises extensive areas of gravelly soils and sparse shrublands. Such areas are less likely to have fauna species richness. However, the area is interspersed with Mulga thickets which may provide habitat for Mulgara. The most important ecological processes affecting the fauna assemblage within the Project area are fire, landscape connectivity related to Mulga thickets, impacts of feral predators and local hydrology, with all being identified as having a minor to moderate risk of impact. However, the relatively small impact of 7.6 ha to native vegetation in the project area poses a very minor risk of impacting any priority species.

## 2.7.3 Introduced Species

A number of introduced non-native fauna species were found to have the potential to occur in the Project area. Species were recorded during surveys around the Project area by Bamford Consulting Ecologists in 2018 and included:

- Feral rabbit (*Oryctolagus cuniculus*).
- Feral horse (*Equus caballus*).
- Cattle (*Bos taurus*).
- Cat (*Felis catus*).
- Fox (*Vulpes vulpes*).

## 2.8 Short Range Endemics

Bamford completed a desktop analysis of Short-Range Endemics (SREs) as part of the fauna assessment of the study area in 2018. The database results did not return any range-restrictive invertebrates, though this could be from a lack of sampling in the general area.

One trapdoor spider was collected during the field study and was identified as *Gaius* sp. There were many burrows of adult *Gaius* sp. in the area. This genus is usually widespread although it was currently under review at the time of the report. No previous sampling of potential SREs or subterranean invertebrates had occurred in the Project area. (Bamford, 2019).

The landscape of the study areas was not found to be conducive to the presence of SREs, which are more often associated with relictual landscape features and mesic refugia (Bamford, 2019).

## 2.9 Subterranean Fauna

In 2019, Bennelongia Environmental Consultants (BEC) were commissioned to undertake a desktop assessment to identify the entire Marymia Gold Project's subterranean fauna values, including the Trident Prospect. The survey identified four stygofauna Priority 1 PECs in close proximity to the Project that are rich and unique stygal communities in calcrete aquifers. The buffers of these PECs are shown on **Figure 2-3** and described in **Table 2-4** (BEC, 2019).

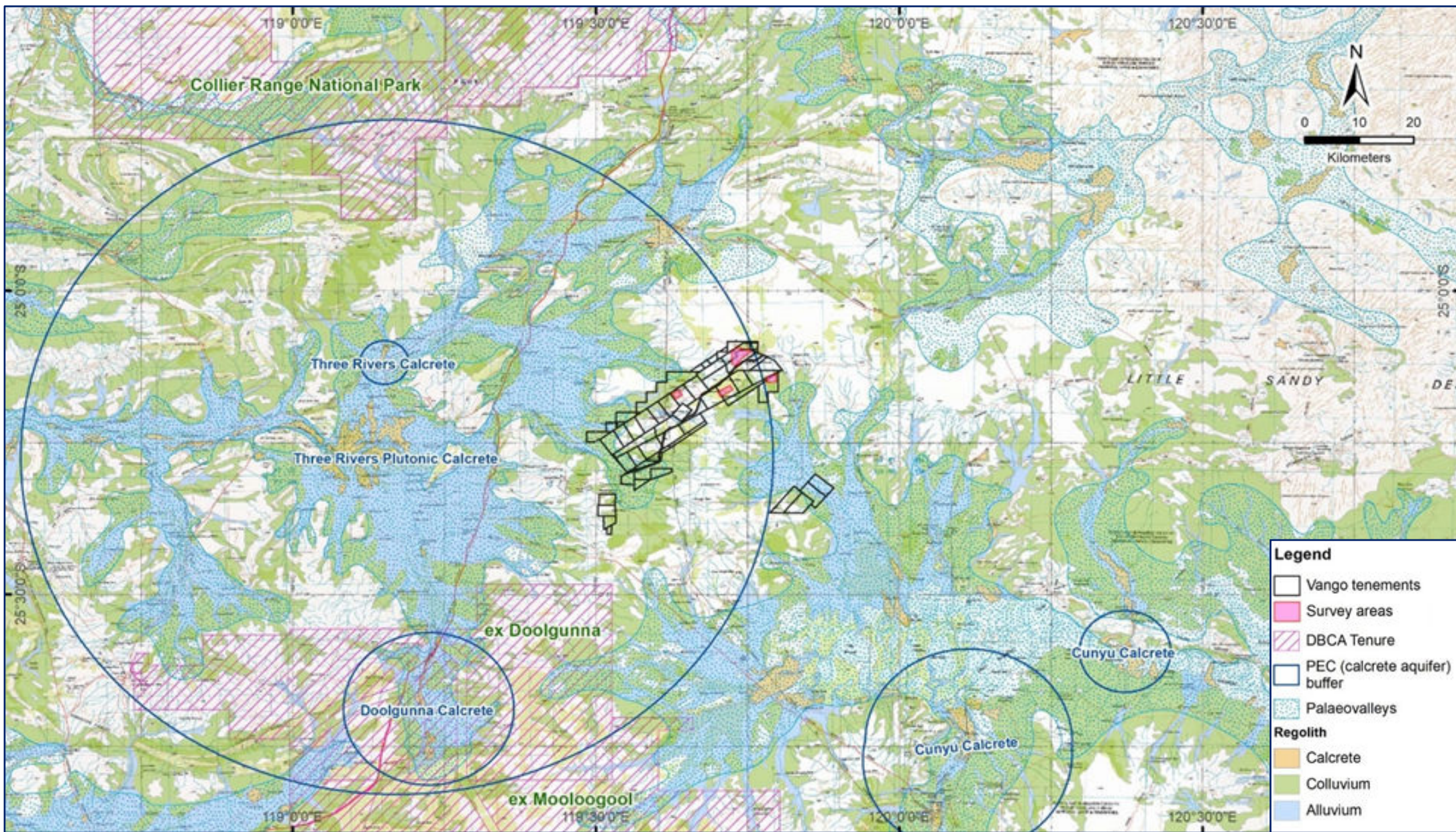
The Trident Project is located in the outer buffer of the Three Rivers Plutonic PEC which comprises a large calcrete deposit and is possibly connected to alluvium and colluvium deposits. The Trident Project is located within a greenstone belt, which is bordered by alluvium and colluvium deposits located within 2 km of Trident (BEC, 2019). The nearest large body of mapped calcrete is located 17 km to the north.

Given the different geology, the Trident Project is not considered to intersect this PEC, or pose a significant risk to it through dewatering given the reasonably shallow workings (245 metres below ground level (mbgl)), limited groundwater anticipated (10 litres per second (L/s)) and short life of mine (5 years).

**Table 2-4 Subterranean Fauna PECs**

PEC	Conservation Code
Three Rivers calcrete groundwater assemblage types on Gascoyne palaeodrainage on Three Rivers Station	P1
Three Rivers Plutonic calcrete groundwater assemblage type on Gascoyne palaeodrainage on Three Rivers Station	P1
Doolgunna calcrete groundwater assemblage type on Gascoyne palaeodrainage on Doolgunna Station	P1
Cunyu SBF and Cunyu Sweetwater calcrete groundwater assemblage types on Nabberu palaeodrainage on Cunyu Station	P1





Not to Scale  
 Source: Bennelongia (2019), *Marymia Gold Project: Desktop Assessment of Subterranean Fauna Values*. Unpublished report prepared for Vango Mining Limited, June 2019.

PROJECT		CLIENT
September	Marymia - ESG - Native Vegetation Clearing Permit	
Figure 2-3		
ADV-AU-00509	Stygofauna Priority Ecological Community Locations	



### 2.9.1 Stygofauna

The desktop assessment conducted by BEC found at least 45 species of stygofauna recorded within 100 km of the Marymia Gold Project area. It is highly unlikely that all the species present in the search area have been recorded due to the low intensity of historic surveys (BEC, 2019).

BEC concluded that the prospect for stygofauna to be located within the Banded Iron Formation (BIF) and granite geologies of the greenstone belt of the Project area is expected to be low given groundwater in the area occurs at 50-60 mbgl and hydrogeology studies at Trident showed groundwater at around 30m the limiting factor for stygal communities in fractured rock is the depth to water and stygal communities in fractured rock, including BIF and granite have not tended to be rich (BEC, 2019).

### 2.9.2 Troglifauna

Surveying for troglifauna in Western Australia (outside of the Pilbara) has been limited compared to stygofauna sampling. BEC relied on habitat information of the Marymia Gold Project area to assess if troglifauna were expected in the area, as there was an absence of species records in the desktop database searches. It is considered likely that a low diversity of troglifaunal species may exist in the alluvial and colluvial deposits adjacent to the Marymia Gold Project area. It is expected that they will have moderately extensive ranges due to the connectivity of the Marymia Gold Project habitats (BEC, 2019). Given the small footprint of the underground workings, no significant impact to troglifauna habitat is anticipated.

### 2.9.3 Summary

Although the Project is in the buffer of the Three Rivers Plutonic Calcrete P1 PEC, the Project's geology is greenstone rather than calcrete, indicating it is not reflective of this PEC. The desktop assessment determined the local greenstone geology shows only low prospectivity for stygofauna and low to moderate prospectivity for troglifauna, which may have extensive ranges. Dewatering inflows are low for the Project, and with the short life of mine (less than 5 years) minimal impact on the PEC and local subterranean fauna is anticipated as a result of clearing and further underground mining.

## 2.10 Heritage and Social Setting

### 2.10.1 Aboriginal Heritage

The Project lies within the Gingirana Native Title Determination (WCD2017/011) and is managed by the Marputu Aboriginal Corporation. The M52/217 mining tenement for Trident is listed on Schedule 4 of the Extract from the Native Title Register as Other Interests – Mining Interest. Other interests are subject to Order 9 of the Determination which has been interpreted that the Project is not required to have an Indigenous Land Use Agreement (ILUA). In any case however, Catalyst will engage with the Marputu People throughout Project development. The planned clearing area does not intersect any Aboriginal Heritage sites with all intersections including the existing pit and existing road, were constructed under previous approvals.

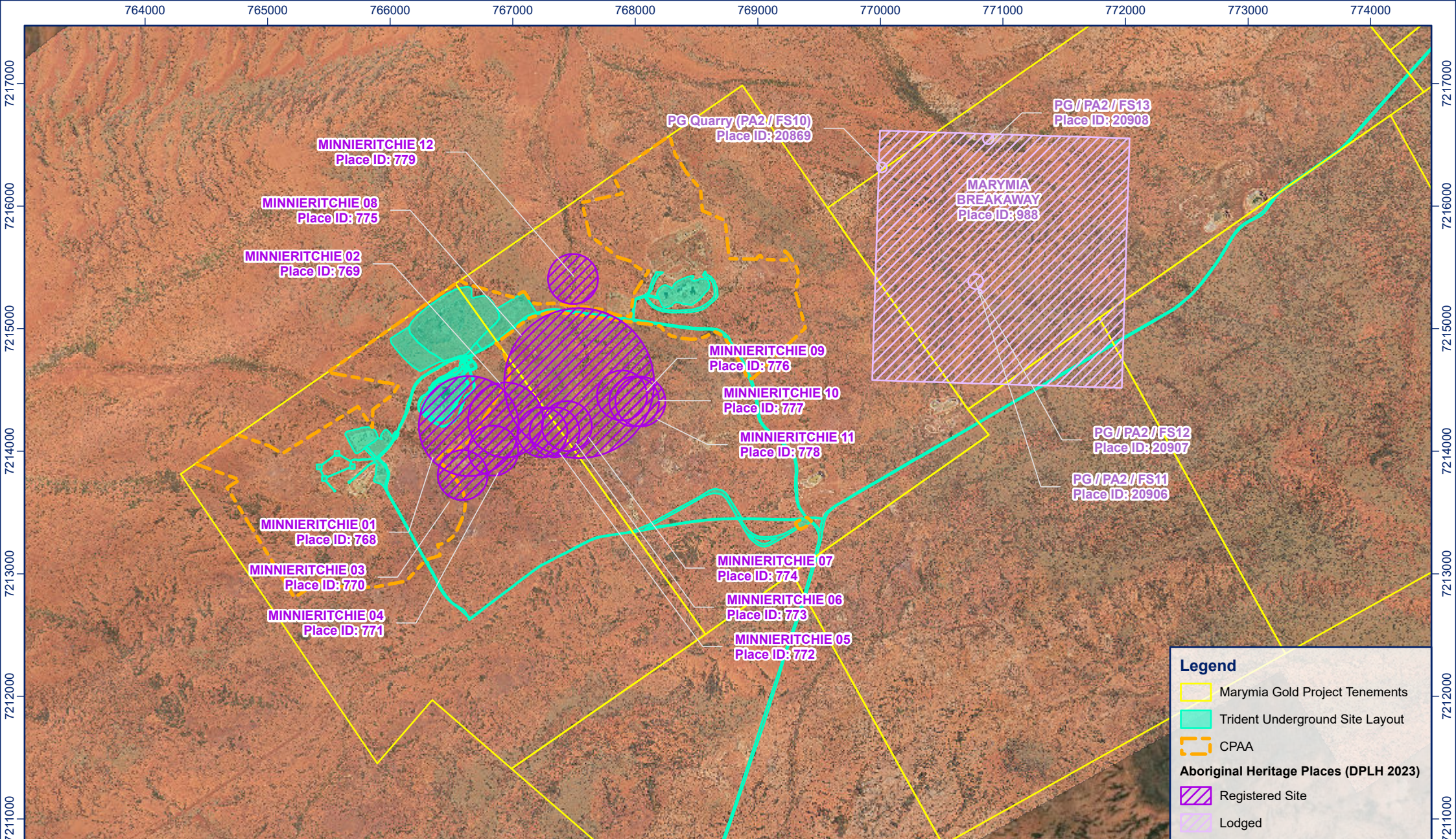
A search of the Department of Planning, Lands and Heritage Aboriginal Heritage Inquiry System (DPLH AHIS) on 21 June 2023 found eight Registered Aboriginal Sites within M52/217 as shown in **Figure 2-4**. Registered Aboriginal Site 768 (Minnieritchie 01) covers the existing Marwest Pit (location of proposed portal to Trident) and is described as Artefacts/Scatter. Consent under Section 18 of the *Aboriginal Heritage Act 1972* was approved to undertake mining activities within M52/217.

An archaeological survey was commissioned by Plutonic Operations Limited and executed in October 2000 by Gary Quartermine (Quartermine, 2000). This survey involved an investigation of previous research in the project area and a field inspection. Four archaeological sites were located because of the field inspection. These comprised of two small artefacts, a sparsely used quarry source and a possible scarred tree. These archaeological finds were found along haulage routes adjacent to the Project site. The registered sites in each tenement are described in **Table 2-5**.

**Table 2-5 Registered Aboriginal Heritage Sites by Tenement**

Tenement	Site ID	Legacy ID	Site Name	Site Type
M52/217	768	P07506	Minnieritchie 01	Artefacts / Scatter, Quarry
	769	P07507	Minnieritchie 02	Artefacts / Scatter, Quarry
	770	P07508	Minnieritchie 03	Artefacts / Scatter, Quarry
	771	P07509	Minnieritchie 04	Artefacts / Scatter
M52/217, M52/218	772	P07510	Minnieritchie 05	Artefacts / Scatter
	773	P07511	Minnieritchie 06	Artefacts / Scatter
	774	P07512	Minnieritchie 07	Artefacts / Scatter, Quarry
	775	P07513	Minnieritchie 08	Artefacts / Scatter, Quarry
M52/218	776	P07514	Minnieritchie 09	Artefacts / Scatter
	777	P07515	Minnieritchie 10	Artefacts / Scatter
	778	P07516	Minnieritchie 11	Artefacts / Scatter
	779	P07517	Minnieritchie 12	Artefacts / Scatter





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Scale: 1:40,000  
 Projection: GDA2020 MGA Zone 50  
 Created/Reviewed By: IR/CR  
 Aerial: 2018 / Esri, DigitalGlobe, GeoEye, i-cubed, USDA FSA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

PROJECT		CLIENT
September 2023	<b>Marymia - ESG - Native Vegetation Clearing Permit</b>	
Figure 2-4		
ADV-AU-00509	<b>Heritage Areas</b>	



### **2.10.2 Non-Aboriginal Heritage**

A search of the Heritage Council of Western Australia's State Register of Heritage Places was undertaken on 3 August 2023. No non-Aboriginal heritage places were found to be registered in the Project area.

### **2.10.3 Pastoral Lease**

The nearest residence is the Marymia pastoral Station located approximately 45 km northeast of the Project. Two pastoral stations cover the Project area, Three Rivers Pastoral Station (N04991) and the Marymia Pastoral Station (N050486). The Pastoralism consists of sheep and cattle grazing. No issues are expected from the Project to impact pastoralism. Annual compensation payments are made to Marymia Pastoral Station to keep livestock out of revegetation/rehabilitated areas of the Marymia project area.

### 3. Proposed Land Clearing

The location for the Project was selected based on geological surveys that showed high-grade gold deposits within the region; the project layout was chosen due to the low area of native vegetation, with the majority of the area required to be cleared being historically disturbed areas. The Project is also proposing to be an underground mine with a smaller footprint than the open-cut method.

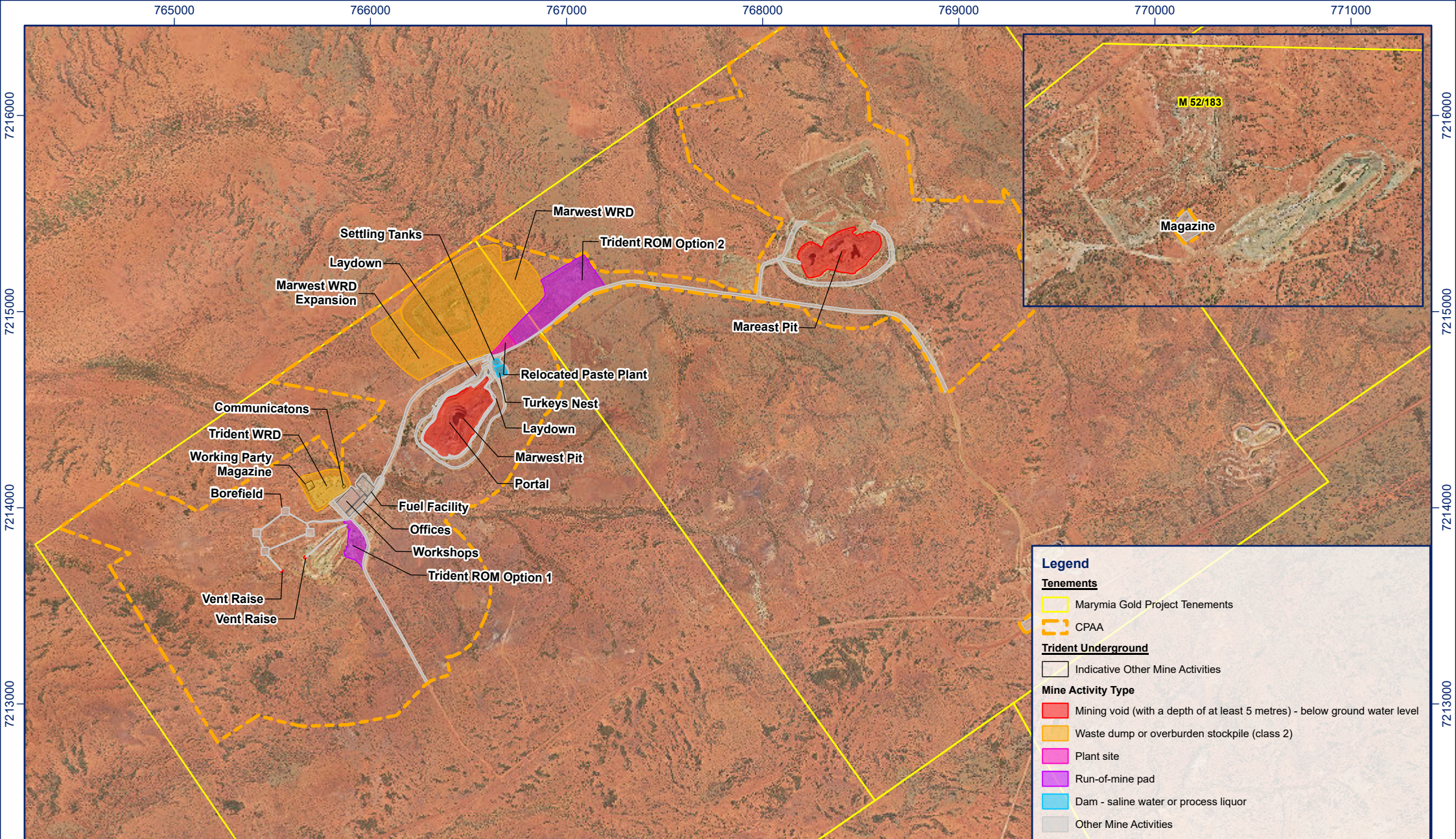
The total clearing of native vegetation proposed under this Purpose Permit application is 52.6 ha within a Purpose Permit boundary of 497.30 ha. As noted previously, A total of 499.2 ha was surveyed- of which 53.4 ha is proposed to be cleared within an 80.7 ha project footprint. 45.8 ha (85%) of the area to be cleared covers areas that have been previously cleared and then rehabilitated. Only 7.6 ha of undisturbed native vegetation is therefore proposed to be cleared this is equal to 9% of the proposed clearing area.

This NVCP Application supports the mining of the Trident Project with mine activity areas and associated footprint outlined in **Table 3-1** and shown in **Figure 3-1**.

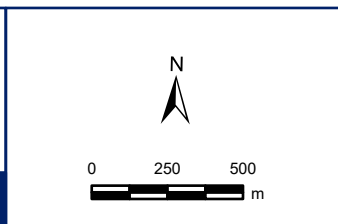
**Table 3-1 Vegetation Disturbance Estimate**


<b>Element</b>	<b>New Clearing (ha)</b>	<b>Existing Disturbance (ha)</b>	<b>Project Footprint (ha)</b>
Dam – Saline water or process liquor	0.34	0	0.34
Mining Void (with a depth of at least 5 m below ground water level)	0.01	14.63	14.64
Other Mine Activities	3.80	12.68	16.49
Plant Site	0.57	0	0.57
Run-of-mine pad	9.52	0	9.52
Waste dump or overburden stockpile (Class 2)	37.90	0	37.90
<b>Total</b>	<b>53.4</b>	<b>27.31</b>	<b>80</b>





Scale: 1:25,000  
 Projection: GDA2020 MGA Zone 50  
 Created/Reviewed By: IR/CR  
 Aerial: 2018



PROJECT		CLIENT
September 2023	Marymia - ESG - Native Vegetation Clearing Permit	
Figure 3-1		
ADV-AU-00509	Site Layout	



## 4. Assessment of Clearing Principles

Clearing applications are to be assessed against 10 principles as outlined in Schedule 5 of the EP Act. These principles aim to ensure that all potential impacts resulting from the removal of native vegetation can be assessed in an integrated way and applied to all lands throughout Western Australia. The principles address the four main environmental areas of biodiversity significance, land degradation, conservation estate and ground and surface water quality.

Information regarding the potential impact of clearing for mining activities on each of these principles for the project area is provided in **Table 4-1**.

**Table 4-1 Native Vegetation Clearing Principles**

Clearing Principle	Assessment	Assessed Outcome
<b>Biodiversity Significance</b>		
a) Native vegetation should not be cleared if it comprises a high level of biological diversity.	The vegetation to be cleared is not considered to support a high level of biological diversity. Vegetation communities and fauna habitats of the Project are considered common and widespread in the subregion and unlikely to function as refugia.	The proposed clearing is unlikely to significantly impact biodiversity at a local or regional level. Therefore, the proposed clearing is not likely to be at variance with this clearing principle
b) Native vegetation should not be cleared if it comprises the whole or part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.	<p>Three fauna habitats were identified in the survey area. These were considered to be common and widespread in the local area and extend well beyond the clearing boundary.</p> <p>Conservation significant fauna – seven fauna species of conservation significance listed under legislation or as Priority species by DBCA were considered residents, regular visitors or were observed during the survey:</p> <ul style="list-style-type: none"> <li>▪ Fork-tailed Swift (Migratory) – The fork-tailed Swift is a aerial, non-breeding migrant to Australia, meaning no habitat will be disturbed. .</li> <li>▪ Barn Swallow (Migratory) – The Barn Swallow is an aerial, non-breeding migrant to Australia, meaning no habitat will be disturbed</li> <li>▪ Australian Bustard (Locally Significant) – Habitat not impacted.</li> <li>▪ Grey Honeyeater (Locally Significant)- Habitat not impacted as it favours tall, dense mulga which appears mainly in Cinnamon and Apex complexes, which are not identified at the trident area.</li> <li>▪ Brush-tailed Mulgara (Priority 4) - Although several burrows recorded in the fauna survey, these were in other deposit areas located at least 7.5km to the south of Trident, and all were inactive. This is typical of the species which can vary in abundance greatly from year to year. No burrows were</li> </ul>	<p>The proposed clearing is unlikely to significantly impact the habitat of fauna at a local or regional level. The fauna impact assessment states that Population decline will be roughly proportional to habitat loss which is a very small part of the overall landscape.</p> <p>Although the fauna report impact assessment found the impacts to be minor to moderate, the clearing of 7.6 ha of native vegetation in a footprint of 80.7 ha for this particular project would result in the impact being minor.</p> <p>Therefore, the proposed clearing is not likely to be at variance with this clearing principle.</p>

Clearing Principle	Assessment	Assessed Outcome
	<p>found in the extensive sandplains in the north of K2 (where Trident is located, but this area had been fairly recently burnt which may have caused animals to migrate.</p> <ul style="list-style-type: none"> <li>▪ Kultarr (Locally Significant) - This small marsupial is rarely recorded but appears to be widespread. It was found in the general Marymia area by ecologia (1991). Clearing is unlikely to impact this species significantly.</li> <li>▪ Long-tailed Dunnart (Priority 4)– Mobile species with widespread distribution and habitat from the Pilbara to the Goldfields. Clearing is unlikely to impact this species significantly from a regional perspective.</li> </ul>	
<p>c) Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora.</p>	<p>No threatened plant taxa protected under state or federal legislation were recorded during flora surveys. No Priority species listed by DBCA: were located within the proposed clearing area.</p>	<p>There is no protected or priority listed flora species within the proposed clearing area. Therefore, the proposed clearing is not likely to be at variance with this clearing principle.</p>
<p>d) Native vegetation should not be cleared if it comprises the whole or a part of or is necessary for the maintenance of a TEC.</p>	<p>No TECs were recorded in the Project area.</p>	<p>The proposed clearing will not impact TECs, therefore, the proposed clearing is not likely to be at variance with this clearing principle.</p>
<p>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.</p>	<p>Vegetation of the area is not considered a remnant, with limited clearing in a vastly uncleared environment.</p>	<p>The proposed clearing is unlikely to significantly impact remnant vegetation at a local or regional level. Therefore, the proposed clearing is not likely to be at variance with this clearing principle.</p>
<p>f) Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.</p>	<p>There are no wetlands or permanent surface water features in the Project area. All drainage lines in the immediate vicinity of the Project are ephemeral and remain dry for most of the year.</p>	<p>The proposed clearing is unlikely to significantly impact watercourses or wetlands at a local or regional level. Therefore, the proposed clearing is not likely to be at variance with this clearing principle.</p>
<p><b>Land Degradation</b></p>		
<p>g) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.</p>	<p>The proposed clearing of 54.3 ha of native vegetation for the development of the Project is not likely to cause any further land degradation. As discussed in section 2.6.1 there will only be 7.6 ha of undisturbed native vegetation being cleared which makes up a total of 9% of the total clearing. The area utilised for the project has a long history of pastoral activities. Further</p>	<p>The proposed clearing is unlikely to significantly impact land degradation at a local or regional level. Therefore, the proposed clearing is not likely to be at variance with this clearing principle.</p>



Clearing Principle	Assessment	Assessed Outcome
	disturbances due to planned mining activities are unlikely to cause significant further land degradation and will be implemented with an approved Mining Proposal which will include management measures for erosion, weeds and disease, and rehabilitation.	
<b>Conservation Estate</b>		
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.	There is no conservation estate in the immediate vicinity.	The proposed clearing will not impact the environmental values of any adjacent or nearby conservation area. Therefore, the proposed clearing is not likely to be at variance with this clearing principle.
<b>Ground and Surface Water Quality</b>		
i) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.	There are minimal watercourses or drainages in the project area. Standard surface water management measures will be implemented within the Project to surface water flows and quality. Clearing will not be interacting with groundwater. No GDEs are identified within the immediate project area.	The proposed clearing is unlikely to significantly impact the quality of surface or underground water on a local or regional level. Therefore, the proposed clearing is not likely to be at variance with this clearing principle.
j) Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence of flooding.	The areas proposed for clearing have relatively flat topographic contours. Sporadic and low rainfall, which is characteristic of the local area. Measures will be taken to prevent the potential impacts of flooding and surface water pooling.	The proposed clearing is unlikely to cause, or increase, the incidence of flooding. Therefore, the proposed clearing is not likely to be at variance with this clearing principle.

## 5. Environmental Management Measures

Environmental management commitments that will be undertaken during and after the completion of the project are summarised in **Table 5-1**.

**Table 5-1 Environmental Management Measures**

Environmental Aspect	Commitment Number	Commitment
Clearing and Topsoil Disturbance	Commitment 1	Conservation significant species avoided during planning.
	Commitment 2	All clearing will be undertaken in accordance with a Native Vegetation Clearing Permit and the Clearing Procedure.
	Commitment 3	Driving only on designated roads and tracks.
	Commitment 4	Clearing boundaries to be marked clearly prior to clearing to prevent over-clearing.
	Commitment 5	10 -20 cm topsoil removed and appropriately stockpiled for use in future rehabilitation. Vegetation cleared will also be appropriately stored for future rehabilitation.
Flora	Commitment 6	All vehicles and equipment arriving on site will be confirmed to be in a clean condition, free of soil, weeds, seeds and vegetative matter.
	Commitment 7	Records will be maintained and made available for internal and external reporting, auditing and improvement.
Fauna	Commitment 8	Vehicles will travel at speeds no greater than 70 km/hr within the tenement areas to protect fauna reduce dust and noise.
Heritage	Commitment 9	Identified Heritage areas will be avoided whilst clearing is undertaken.
Hydrocarbons	Commitment 10	Hydrocarbons or other chemicals will not be stored within 100 m of a drainage line.
	Commitment 11	Spill response kits will be available in all vehicles and the diesel tanker trailer. The spill response kits will be of appropriate type and size, and stock levels will be maintained.
	Commitment 12	All onsite personnel will be trained in spill response.
	Commitment 13	All vehicles and other equipment will be regularly maintained to minimize the chance of leaks and breakdown related spills.
	Commitment 14	As required, any significant spills defined under Section 72 of the <i>Environmental Protection Act 1986</i> and <i>Environmental Protection (Unauthorised Discharges) Regulations 2004</i> will be reported to DWER and DMIRS.
Fire	Commitment 15	There will be no fires onsite, and hot works being undertaken in approved areas that have been identified as having a low risk.
	Commitment 16	All personnel will be trained to use available firefighting equipment and advised on the plan of action in case of a fire.
Compliance with Legislation	Commitment 17	All required environmental approvals will be in place prior to clearing.
	Commitment 18	The Project will be progressively rehabilitated to meet completion criteria.

## 6. Rehabilitation

Rehabilitation is the return of disturbed land to a safe, stable, productive, non-polluting and self-sustaining condition in consideration of beneficial uses of the land. Appropriate rehabilitation will ensure that the long-term impacts of mining in the area are minimised.

Rehabilitation of disturbed areas will generally involve:

- Design of landforms to produce safe and stable slopes.
- Design of landforms to manage water, including construction of water management strategies.
- If required and subject to available material, armouring of final surfaces with cover material to increase surface stability.
- Replacement of available topsoil and vegetation.
- Ripping along contour to break soil compaction and increase water infiltration ability.
- Seeding/planting with local provenance native species and fertilising as required.
- Monitoring to measure progress against meeting closure criteria.

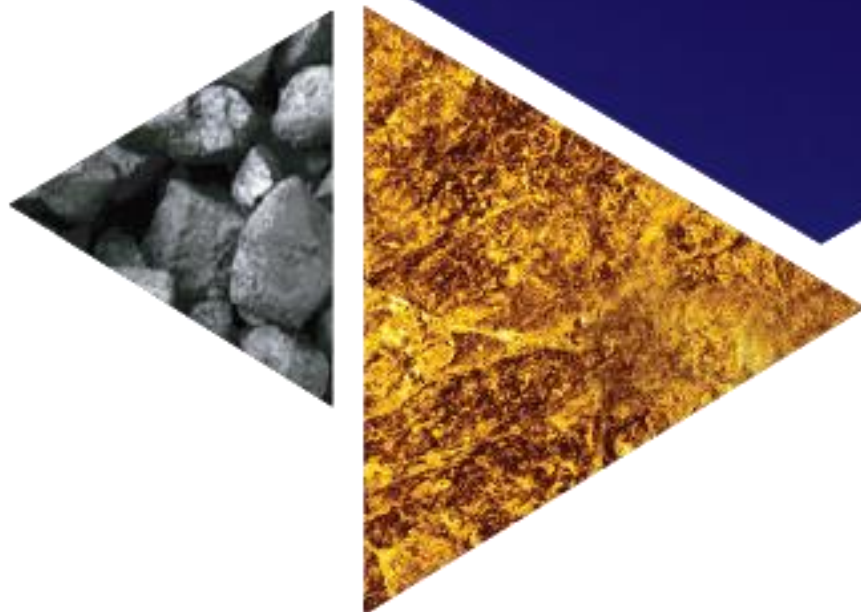
Rehabilitation, closure monitoring and maintenance programs will be undertaken as described in the Mine Closure Plan, with the objectives of ensuring the success of rehabilitation works, identifying the need for any maintenance works and demonstrating achievement of completion criteria.

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# Appendix A. Important Information about this Document



## **IMPORTANT INFORMATION ABOUT THIS DOCUMENT**

### **1. Our Client**

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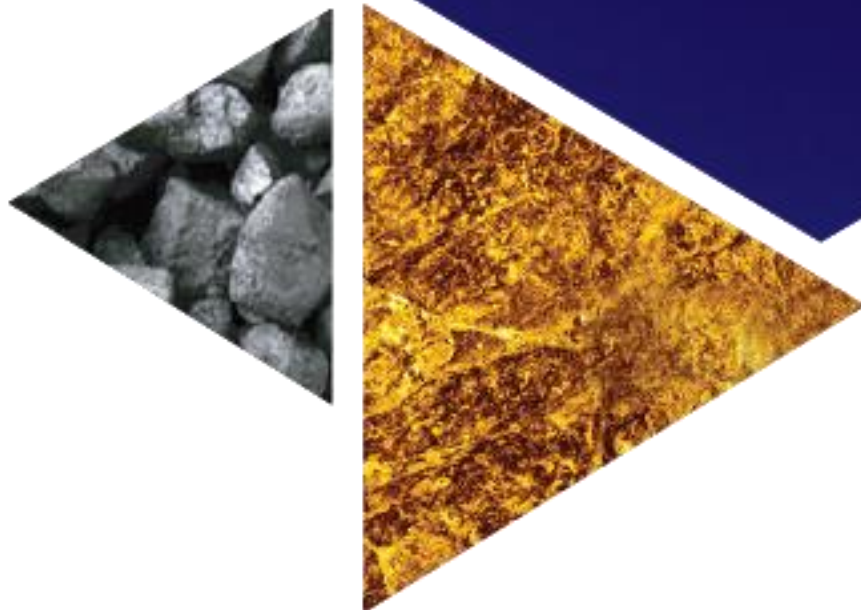
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# Appendix B. Flora and Vegetation Survey





# Marymia Gold Project Detailed Flora and Vegetation Survey

Prepared for Vango Mining  
July 2019



Document Status						
Rev No.	Authors	Reviewer/s	Date	Approved for Issue		
				Name	Distributed To	Date
1	J.Waters, J. Bull	D. Brearley	24/07/19	D. Brearley	G. Povey	30/07/19



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# EXECUTIVE SUMMARY

Onshore Environmental Consultants Pty Ltd (Onshore Environmental) was commissioned by Vango Mining Limited (Vango) to undertake a two season detailed flora and vegetation survey covering nine areas within the Marymia Project tenements (hereafter referred to as the study area):

- K2 Prospect;
- Apex Prospect;
- Cinnamon Prospect;
- Trident Prospect;
- Mar-east Prospect;
- Mill Area Prospect;
- Wedgetail Prospect;
- Mar-west Prospect; and
- Tails Dam Area.

The study area is situated 760 km northeast of Perth, 180 km to the northeast of Meekatharra, and 200 km south of Newman. The first season field survey was conducted between the 16<sup>th</sup> and 20<sup>th</sup> of November 2018 under relatively poor seasonal conditions. A follow-up second season survey was conducted between the 5<sup>th</sup> and 10<sup>th</sup> May 2019, also under poor seasonal conditions. Field work was undertaken by two Principal Botanists, Dr Darren Brearley and Dr Jerome Bull and Senior Botanist Ms Jessica Waters.

A total of 116 quadrats were assessed within the study area, including: 10 quadrats at Apex, 11 quadrats at Cinnamon, 16 quadrats at K2, 7 quadrats at Mar-West, 4 quadrats at Mar-east, 6 quadrats at the Mill Area, 14 quadrats at the Tailings Dam, 15 quadrats at the Tailings Pipeline, 26 quadrats at Trident and 7 quadrats at Wedgetail.

A total of 209 plant taxa (including varieties and subspecies) from 35 families and 89 genera were recorded from the study area. Species representation was greatest among the Fabaceae, Poaceae, Scrophulariaceae, Chenopodiaceae and Malvaceae families. The most speciose genus was *Acacia* (30 taxa), followed by *Eremophila* (21 taxa), *Senna* (11 taxa), *Maireana* (8 taxa), *Sida*, *Hibiscus* and *Ptilotus* (7 taxa each).

There were no plant taxa gazetted as Threatened Flora pursuant to subsection (2) of section 23F of the *Wildlife Conservation Act 1950* (WC Act), or listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) recorded from the study area.

A total of nine Priority listed flora were recorded from the study area; *Eremophila* cf. *demissa* (Priority 1), *Goodenia virgata* (Priority 2), *Calytrix praecipua* (Priority 3); *Eremophila lanata* (Priority 3), *Hemigenia tysonii* (Priority 3), *Maireana prosthochaeta* (Priority 3), *Sauropus* sp. Woolgorong (M. Officer s.n. 10/8/94) (Priority 3), *Sporobolus blakei* (Priority 3) and *Thryptomene* sp. Leinster (B.J. Lepschi & L.A. Craven 4362) (Priority 3). An additional Priority flora species, *Eucalyptus semota* (Priority 1) was recorded just outside the boundary of the study area. A single taxa recorded from the study area is considered a range extension; *Hibiscus brachychlaenus*.

Two introduced species were recorded from the study area; *\*Bidens bipinnata* (Beggar's Ticks) and *\*Portulaca pilosa*. Neither of these taxa are listed as Declared Pests under the *Biosecurity and Agriculture Management Act 2007* (BAM Act).

A total of 32 vegetation associations were recorded within the project area. Vegetation was classified into 15 broad floristic formations on the basis of dominant vegetation stratum. None of the vegetation associations are aligned with Commonwealth or State listed Threatened Ecological Communities (TECs) or Priority Ecological Communities (PECs).

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# 1.0 INTRODUCTION

## 1.1 Preamble

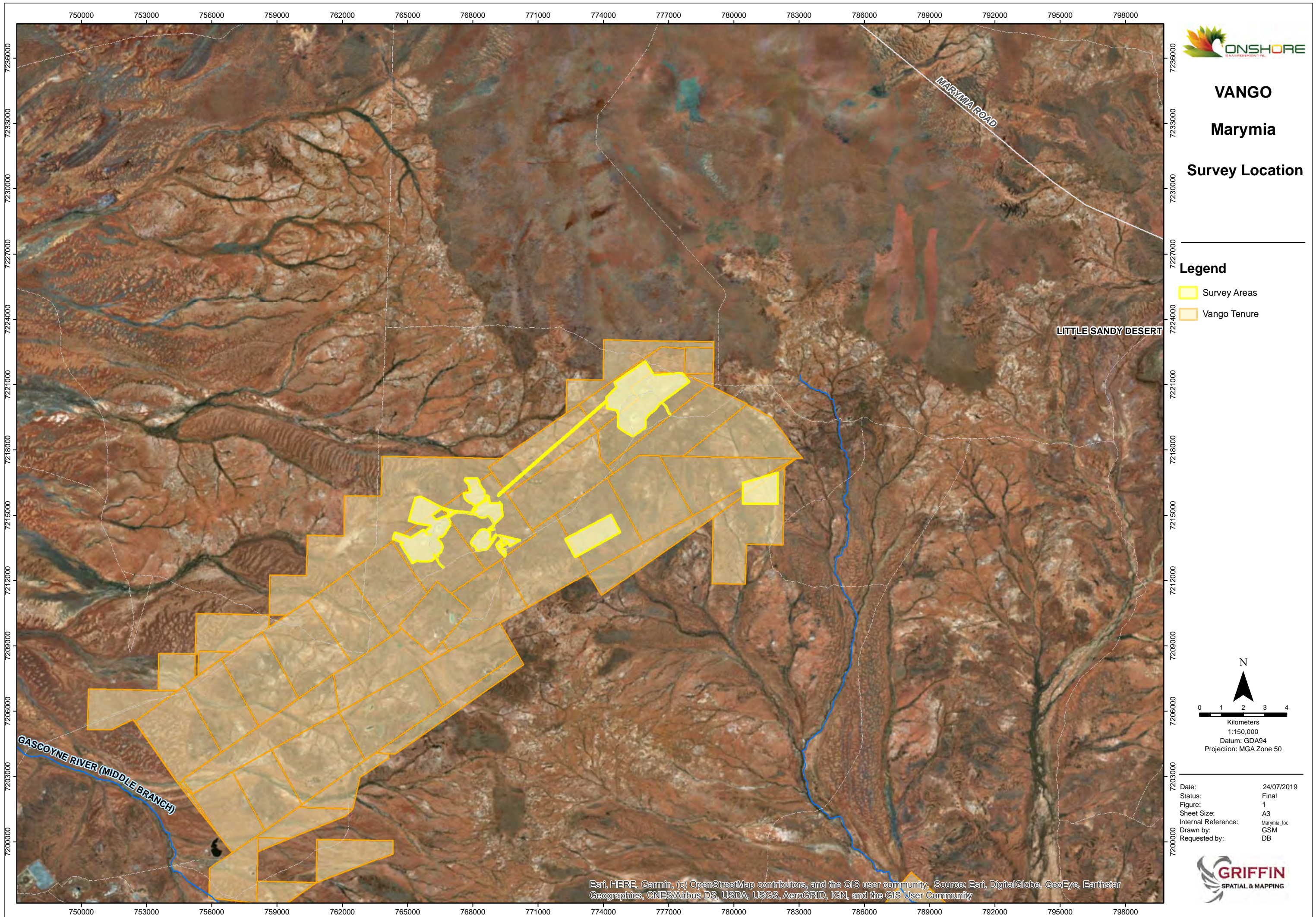
Onshore Environmental was commissioned by Vango Mining Limited WAIO to undertake a detailed two season flora and vegetation survey within the Marymia project area, covering eight prospects and a proposed tails dam. The study area is located 760 km northeast of Perth, 180 km to the northeast of Meekatharra, and 200 km south of Newman. The Project is a brownfields site that was mined during the 1980s, 1990s and 2000s, with numerous open pits and other mine disturbance areas occurring within the Project tenure. The Project has been on care and maintenance for over ten years.

## 1.2 Previous Biological Surveys

There are at least four flora and vegetation surveys that have previously been completed in close proximity of the study area (within a 25 km radius):

- Marymia Hill Gold Project Notice of Intent: Biological Assessment Survey (Ecologia 1991);
- Outline for Biological and Environmental Components of a Notice of Intent – Apollo Deposit (Onshore Environmental Consultants 2002);
- Outline for Biological and Environmental Components of a Notice of Intent – Mar-east Deposit – Plutonic Gold Mine (Onshore Environmental Consultants 2003); and
- Outline for Biological and Environmental Components of a Notice of Intent – K2 Deposit – Plutonic Gold Mine (Onshore Environmental Consultants 2003).





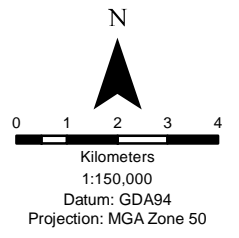
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## Marymia

### Survey Location

#### Legend

- Survey Areas
- Vango Tenure



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 Figure: 1  
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 Drawn by: GSM  
 Requested by: DB



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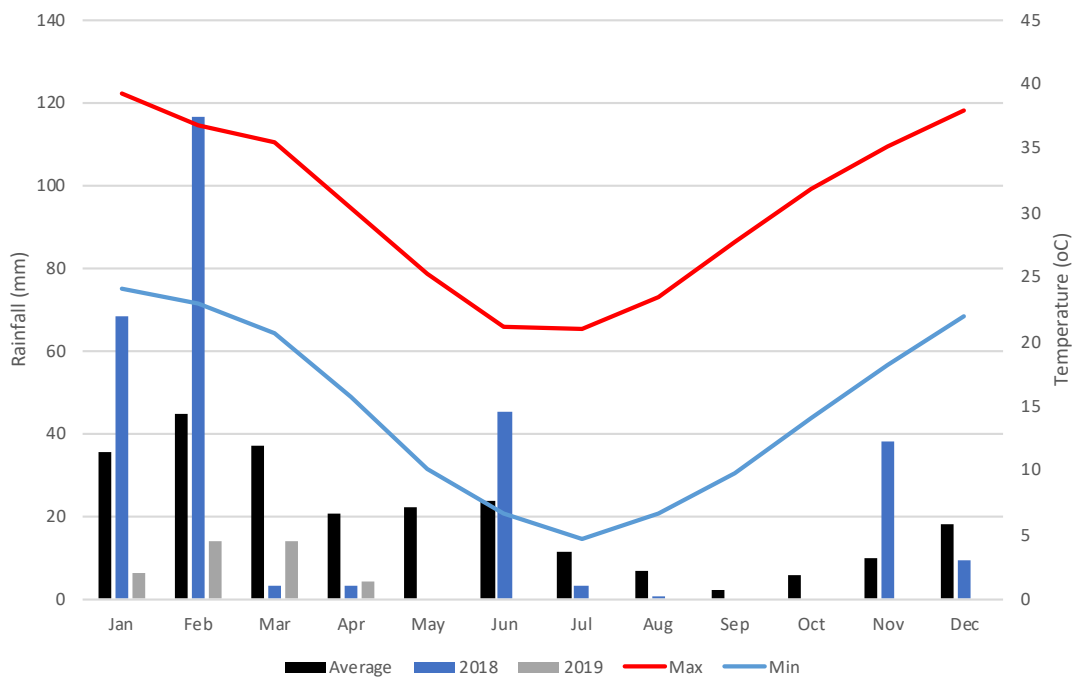
## 1.3 Climate

The climate of the Gascoyne is arid, with hot summers extending from October to April and mild winters from May to September. The climate is dry, and rainfall is variable and unreliable. Winter rainfall is dominant in the west and summer rainfall in the east.

Annual average rainfall for the nearest long term weather station at Three Rivers is 234 mm and occurs predominantly in summer (Bureau of Meteorology, 2019). Average maximum summer temperatures are typically between 37°C to 39°C, and winter maximum temperatures are between 21°C and 23°C. The prevailing wind direction for Three Rivers is east (Bureau of Meteorology 2019).

Rainfall at the Three Rivers station for 2018 was above average with a total of 288.4 mm recorded, compared to the average of 234 mm. However, the majority of this rainfall fell in the summer with over 100 mm recorded in February. Seasonal conditions at the time of the first season survey in November 2018 were poor. It is noted that rainfall is often sporadic throughout the area and that Three Rivers is located 60km west of the study, hence it may not accurately represent conditions at the project area.

Monthly rainfall totals for December 2018 to April 2019 were all below the long term average, with less than 50mm recorded across the 5 months between the two surveys. Hence, seasonal conditions at the time of the second season survey were very poor.



**Figure 2** Climatic data recorded from Three Springs, with long term monthly rainfall compared against monthly rainfall for 2018 and January-April 2019 (BoM 2019).

## 1.4 Biogeographic Regions

The Interim Biogeographic Regionalisation for Australia (IBRA7) divides Australia into 89 bioregions and 419 subregions based on climate, geology, landform, native vegetation and species information (Department of the Environment and Energy [DoEE] 2018). The study area lies within the Gascoyne bioregion and the Augustus subregion (GAS3).

The Augustus subregion has an area 10,687,739 ha. It is described as low rugged ranges of Proterozoic sedimentary and granite ranges interspersed with broad flat valleys. The subregion includes the Narryera Complex and Bryah Basin of the Proterozoic Capricorn Orogen (on the northern margin of the Yilgarn Craton), as well as the Archaean Marymia and Sylvania Inliers. The main drainage in the subregion is to the Gascoyne River System, however the area also contains the headwaters of the Ashburton and Fortescue Rivers. Extensive areas of alluvial valley-fill deposits occur within this subregion. The vegetation on rises consists of Mulga woodland and *Triodia* on shallow stony loams. The hardpan plains of the subregion are dominated by Mulga parkland with shallow earthy loams (Desmond *et al.* 2001).

## 1.5 Existing Land Use

Land tenure in the Gascoyne consists mainly of native pasture grazing with areas of UCL and Crown Reserves, Aboriginal reserves and conservation lands. The Collier Range National Park is the nearest reserve, situated approximately 70 km to the north of the project area.

## 1.6 Soils and Landforms

Tille (2006) collated the most recent and detailed mapping of Western Australia's Rangelands and Arid interior into a hierarchy of soil-landscape mapping units. The study area falls within the Ashburton Province, an area that occupies approximately 188,375 km<sup>2</sup> (7.5% of Western Australia) and is located in the southern Pilbara/Northern Gascoyne. Soils and landforms of the Ashburton Province are described as "Hills and ranges (with stony plains and hardpan wash plains) on the sedimentary and granitic rocks of the Capricorn Orogen. Stony soils with Red loamy earths, Red shallow loams and Red-brown hardpan shallow loams (and some Red deep sands, Red/brown non-cracking clays and Red deep sandy duplexes) (Tille 2006). The Ashburton Province is divided into nine soil-landscape zones:

- Bulloo Plains and Hills Zone;
- South Bangemall Hills Zone;
- Frere Uplands Zone;
- Paroo Uplands Zone;
- Yaragner Hills and Plains Zone;
- Gascoyne Valley Zone;
- Stuart Plains and Hills Zone;
- Ashburton Valley Zone; and
- North Bangemall Hills Zone.

The study area lies within the Paroo Uplands Zone, which covers a total area of 21,175 km<sup>2</sup>. Landforms within this zone include hills, hardpan wash plains and stony plains with some sandplains. Soils in the area are described as red-brown hardpan shallow loams

with red loamy earths and stony soils and some red shallow sands, red shallow loams, red sandy earths and red deep sands. The vegetation is predominantly Mulga shrublands with some spinifex, eucalypts and halophytic shrubs.

## 1.7 Geology

The Ashburton Province lies on several sedimentary basins that separate the Yilgarn and Pilbara Cratons. The area consists of the sandstone, shales and conglomerate of the Ashburton Basins (Tille 2006).

The study area lies on the Peak Hill sheet of the Geological Survey of Western Australia. The following geological features occur in the area (Gee 1986):

- Qs: Reddish eolian sand;
- Qc: Colluvial gravel on scree slopes and sheet wash plains;
- Qa: Alluvial sand and silt in drainages;
- Tl: Tertiary laterite;
- Au: Chlorite-tremolite schist after ultramafic volcanics;
- Ag: Biotite adamellite;
- Ab: Metamorphosed tholeiitic basalt; and
- As: Pelitic metasedimentary rocks, quartzite, banded iron-formation.



## 1.8 Regional Vegetation

The study area is located within the Ashburton Valley Botanical District, within the Gascoyne IBRA region, which is part of the Eremaean Province (Beard 1990).

The original vegetation mapping was undertaken by Beard (1975) and refined by Shepherd *et al.* (2002). There were three vegetation associations described from the study area (Figure 3). While the Pre-European extent for each vegetation association is close to 100 percent, less than 10 percent of each association occurs within formal or informal reserves (Table 1).

**Table 1 Pre-European extent of vegetation associations occurring within the study area (Shepherd *et al.* 2002).**

Vegetation Association	Description	Pre-Euro. Extent Remaining (ha)	Remaining area (ha) in IUCN Class I-IV Reserves	% remaining Other Reserves	% remaining DBCA Managed PL
Carnegie Salient - 18	Low woodland; mulga ( <i>Acacia aneura</i> )	99.9	2.0	0.3	2.5
Gascoyne Ranges/ Carnegie Salient, 29	Sparse low woodland; mulga, discontinuous in scattered groups	100	0.3	0	2.4
Gascoyne Ranges -111	Hummock grasslands, shrub steppe; <i>Eucalyptus gamophylla</i> over hard spinifex	100	5.8	0.6	0



# VANGO

## MARYMIA PROJECT

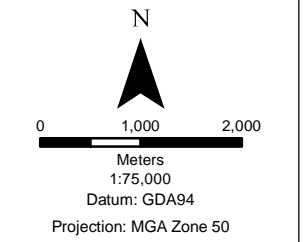
### Beard (1975) vegetation complexes within the study area

#### Legend

Study Area

#### Pre-European Vegetation (Beard 1975)

- CARNEGIE SALIENT, 18
- CARNEGIE SALIENT, 29
- GASCOYNE RANGES, 111
- GASCOYNE RANGES, 18
- GASCOYNE RANGES, 29



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Figure: 3  
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## 1.9 Land Systems

The Department of Agriculture (now the Department of Agriculture and Food) has conducted a number of inventory and condition surveys across the rangelands of Western Australia, using an integrated survey method involving the land system approach to rangeland description evaluation. The primary objective of the surveys was to provide comprehensive descriptions and mapping of the biophysical resources of the region, as well as an evaluation on the condition of soils and vegetation. The mapping is based on patterns in topography, soils and vegetation.

A total of 51 land systems were defined in the Gascoyne catchment at a scale of 1:250,000 (Wilcock and McKinnon 1974). There were 3 land systems represented within the study area (Table 2, Figure 4).

**Table 2 Land systems occurring within the study area (descriptions from Wilcock and McKinnon 1974).**

Land System	Description
Durlacher	Occasional sharp quartz ridges and strike residuals with stony plains and wide drainage sections.
Divide	Sandplains with minor dunes. Gently undulating terrain with predominantly internal drainage.
Thomas	Laterised breakaways and mesas which form a backdrop up to 50 ft high to lower plains and the low rounded rocky hills up to 100 ft high.





# VANGO

## MARYMIA PROJECT

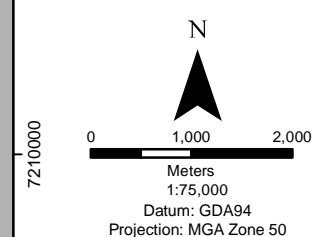
Land systems occurring within the study area (descriptions from Wilcock and McKinnon 1974)

### Legend

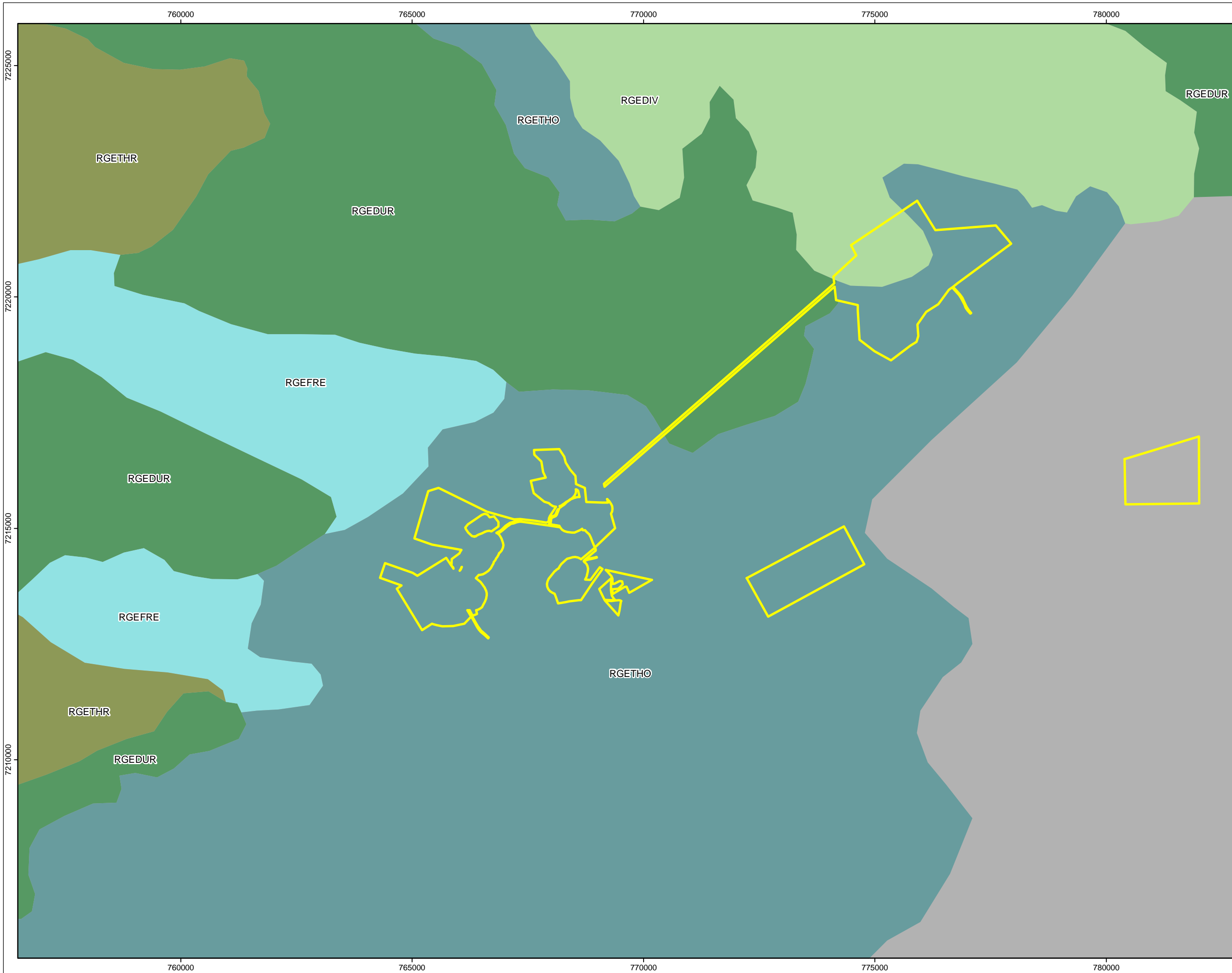
Study Area

#### Land Systems

- RGEDIV, Divide Land System
- RGEDUR, Durlacher Land System
- RGEFRE, Frederick Land System
- RGETHO, Thomas Land System
- RGETHR, Three Rivers Land System
- No Data



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Status: Final  
Figure: 4  
Sheet Size: A3  
Internal Reference: Vango\_LandSys  
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## 2.0 METHODOLOGY

### 2.1 Guidance and Legalisation

#### 2.1.1 Guidance Documents

The survey was carried out in a manner that was compliant with Environmental Protection Authority (EPA) requirements for environmental surveying and reporting in Western Australia:

- Statement of Environmental Principles, Factors and Objectives (EPA 2018);
- Environmental Factor Guideline Flora and Vegetation (EPA 2016a); and
- Technical Guidance Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016b).

#### 2.1.2 Legalisation and Assessment of Conservation Significance

The conservation significance of flora and ecological communities are classified at an International, Commonwealth, State and Local level on the basis of various Acts and Agreements, including:

International Level:

- IUCN: The IUCN 'Red List' lists species at risk under nine categories (status codes) (Appendix 1).

Commonwealth Level:

- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act): The DoEE lists Threatened flora and ecological communities, which are determined by the Threatened Species Scientific Committee according to criteria set out in the Act. The Act lists flora that are considered to be of conservation significance under one of six categories (Appendix 2).

State Level:

- *Biodiversity Conservation Act 2016* (BC Act): At a State level, native flora species are protected under the BC Act. A number of species are assigned an additional level of conservation significance based on a limited number of known populations and the perceived threats to these locations.
- DBCA Priority list: DBCA produces a list of Priority species and ecological communities that have not been assigned statutory protection under the WC Act. Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added under Priorities 1, 2 or 3. Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been removed from the threatened species list for other taxonomic reasons, are placed in Priority 4. These species require regular monitoring (see Appendix 3). The list of PECs identifies those that need further investigation before nomination for TEC status at a State level.

Local Level:

- Species may be considered of local conservation significance because of their patterns of distribution and abundance. Although not formally protected by legislation, such species are acknowledged to be in decline as a result of threatening processes, primarily habitat loss through land clearing.

## 2.2 Desktop Assessment

### 2.2.1 Literature Review

A literature review of relevant surveys previously completed within or in close proximity to the study area was completed, comprising four flora and vegetation surveys.

### 2.2.2 Database Searches

Database searches included databases relating to significant flora, TECs and PECs previously collected or described within, or in close proximity to, the study area. For this report the search was extended beyond the project area to place species and community values into a local and regional context.

The following databases were searched:

- NatureMap: This database represents the most comprehensive source of information on the distribution of Western Australia's flora, comprising records from the Department of Biodiversity, Conservation and Attractions (DBCA) database, and the Western Australian Herbarium (WAH) Specimen Database (40 km radial search) (Department Biodiversity Conservation and Attractions [DBCA] 2019);
- DBCA's Threatened Flora Database was searched to confirm the NatureMap results (50 km radial search) (DBCA 2018a);
- DBCA's TEC, PEC and Environmentally Sensitive Areas (ESAs) database was searched to identify significant communities (50 km radial search, DBCA 2018b);
- EPBC Act Protected Matters database (50 km radial search, DoEE 2019); and
- International Union for Conservation of Nature (IUCN) database (IUCN 2019).

### 2.2.3 Assessment of Likelihood of Occurrence in the Study Area

A list of conservation significant flora species occurring within a 50 km radius of the study area was compiled during the literature review and database searches. The likelihood of each taxon occurring within the study area was assessed using a set of rankings and criteria (as described in Table 3). The criteria are based on the presence of suitable landform (inferred from aerial imagery with contours overlaid) and distance to known records.



**Table 3** Ranking system used to assign the likelihood that a flora species could occur in the study area.

Rank	Criteria
Recorded	The species has been recorded in the study area.
Likely to occur	The species has previously been recorded from a landform/habitat which is present within the study area, and there are previous records within a 20 km radius of the study area.
Possible to occur	The species has previously been recorded from a landform/habitat which is present within the study area, and there are previous records within a 50 km radius of the study area.
Unlikely to occur	The landform/habitat from which the species has previously been recorded is absent within the study area, and/or there are no previous records within a 50 km radius of the study area.

## 2.3 Survey Methodology

### 2.3.1 Timing and Personnel

The first season flora and vegetation survey was completed by Principal Botanists Dr Darren Brearley and Dr Jerome Bull, between the 16<sup>th</sup> and 20<sup>th</sup> of November 2018, under relatively poor seasonal conditions. A follow-up second season survey was conducted between the 5<sup>th</sup> and 10<sup>th</sup> May 2019, also under poor seasonal conditions. Second season field work was completed by Dr Jerome Bull and Senior Botanist Ms Jessica Waters.

All botanists are familiar with the flora and vegetation of the Gascoyne, having undertaken numerous baseline surveys over the past 20 years. The original surveys of the Marymia area between 2001 and 2004 were completed by the Principal Botanists.

### 2.3.2 Sampling of Study Sites

The field survey involved systematic sampling using quadrats (referred to as study sites). Relevé vegetation descriptions were made to increase the accuracy of vegetation mapping and targeted searches were completed in habitats where it was anticipated that significant flora or weeds might occur.

A total of 116 study sites (50 m x 50 m) were assessed during the survey (Figure 5), including 10 quadrats at Apex, 11 quadrats at Cinnamon, 16 quadrats at K2, 7 quadrats at Mar-West, 4 quadrats at Mar-east, 6 quadrats at the Mill area, 14 at the Tailings Dam, 15 quadrats at the Tailings Pipeline, 26 quadrats at Trident and 7 quadrats at Wedgetail.

The study sites were assessed to provide a list of the total flora occurring within the study area and a description of the vegetation structure. Data collected covered a range of environmental parameters including:

- Landform and habitat;
- Aspect;
- Soil colour and soil type;
- Rock type;
- Slope (angle);
- Vegetation condition;
- Disturbance (caused by fire, clearing, grazing etc.);
- Age since fire;
- Broad floristic formation;
- Vegetation association description; and
- Height, number of plants and percentage ground cover provided by conservation

significant and introduced plant taxa.

Other parameters recorded for each study site were:

- Study site number and date of assessment;
- Names of the botanists undertaking the assessment;
- Location description ie a waypoint and GPS coordinate (GDA94) using a handheld GPS; and
- Photograph number.

Vegetation condition for each of the study sites was determined using a recognised rating scale (based on Keighery 1994, see Appendix 4).

### 2.3.3 Targeted Surveys for Conservation Significant Species

Targeted searches were conducted for flora of conservation significance within the project areas. Ground truthing provided an opportunity to record opportunistic locations for Threatened and Priority listed flora and undertake closer examination of specific landforms where conservation significant flora may be expected to occur. Additionally, locations for conservation significant flora previously recorded within or in close proximity to the study area were revisited to confirm their presence and to identify their habitat preference.

### 2.3.4 Weed Survey and Mapping

Introduced weed species were recorded from the 116 study sites assessed within the study area. Opportunistic collections were also made while moving around the study area, with targeted weed searches completed in high moisture habitats of the drainage channels.





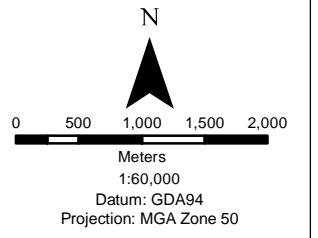
# VANGO

## Marymia

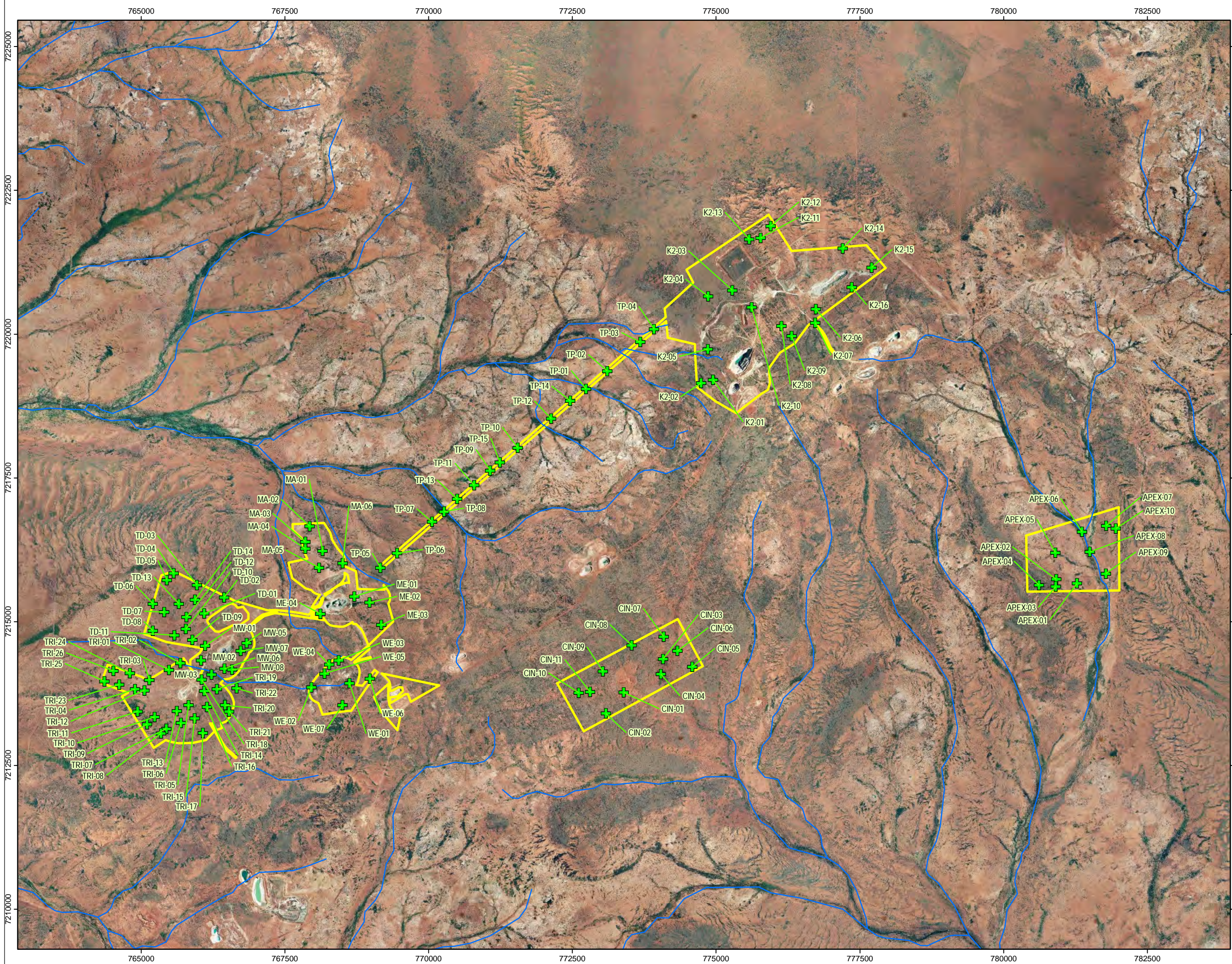
### Study Sites

#### Legend

- Survey Areas
- Sample Locations



Date: 11/06/2019  
Status: Final  
Figure: 5  
Sheet Size: A3  
Internal Reference: Marymia\_Apex\_SS  
Drawn by: GSM  
Requested by: DB





### 2.3.5 Vegetation Association Mapping

The vegetation mapping utilised high-resolution aerial photography of the entire study area at a scale of 1:7,500 with definition of vegetation polygons based on contrasting shading patterns. Ground-truthing of the study area was completed during the survey with vegetation descriptions made within selected vegetation polygons to confirm dominant structural layers and associated plant taxa.

The location of the study sites and additional relevé plots were overlaid on the aerial photography, and associated flora and vegetation data was used to provide vegetation association descriptions for the individual polygons defined. Description of vegetation structure follows the height, life form and density classes of Specht (1970) as modified by Aplin (1979) (see Appendix 5). This is largely a structural classification suitable for broader scale mapping, but taking all ecologically significant strata into account.

### 2.3.6 Vouchering

Voucher specimens were taken for species that could not readily be identified in the field to verify identification. Taxonomy was completed by Dr Jerome Bull, with selected voucher specimens provided to the specialist botanists within the WA Herbarium for further study where required. Use was made of the Western Australian Herbarium (WAH) for confirmation of species identification.

### 2.3.7 Field Survey Constraints

The Environmental Protection Authority (EPA) Technical Guidance (EPA 2016b) list potential limitations that field surveys may encounter. Limitations associated with the flora and vegetation reconnaissance survey are addressed in Table 4. The major limitation for this survey was the extremely dry conditions experienced across the two surveys.

**Table 4**      **Relevance of constraints, as identified by EPA to the flora and vegetation (EPA 2016b).**

<b>Constraint</b>	<b>Relevance</b>
Availability of contextual information at a regional and local scale	There are at least four flora and vegetation surveys that have been previously completed within or in close proximity to the study area, providing an extensive local database.
Proportion of flora recorded and/or collected, any identification issues	The two-season flora and vegetation survey was undertaken under poor seasonal conditions. Hence, a large proportion of the ephemeral taxa occurring within the study area would not have been present at the time of the surveys. Additional survey effort in good seasonal conditions is recommended.
Survey timing, rainfall, season of survey	The survey was completed in November 2018 under poor seasonal conditions and a second season survey was completed in May 2019 after a summer of below average rainfall.
Disturbance that may have affected the results of survey such as fire, flood or clearing	Disturbances within the study area included previous historical mining and exploration activities and grazing of vegetation by domestic stock (cattle). None of the disturbances were a constraint to completing the survey.
Was the appropriate area fully surveyed (effort and extent)	A total of eleven field days over two trips were completed at the site. Quadrats at Cinnamon, Trident and K2 were assessed for a second time during the second field trip. Sites established at the remaining prospects were assessed for the first time at May 2019 and will require a second season survey. Surveying of the Triple P/Albatross, Southern Haul Road and Speckled Hen prospects were not completed during the second season field trip due to time constraints.
Access restrictions within the survey area	There were no access restrictions experienced during the survey with the study area accessible by vehicle and on foot; noting that vegetation mapping was facilitated by high-resolution aerial photography.
Competency/experience of the team carrying out the survey, including experience in the bioregion surveyed	The two Principal Botanist working on the survey have over 20 years' experience in the Gascoyne and Pilbara regions, and have completed numerous surveys in close proximity to the study area.

## 3.0 RESULTS

### 3.1 Literature Review

The flora and vegetation of the Murchison has been assessed at a broad scale by Beard (1975). In addition to the larger broad scale surveys, an increasing number of smaller intensive surveys have been completed in the area associated with resource development projects. These surveys have resulted in the collection of a significant amount of site-specific biological survey data, most of which has been undertaken for formal environmental impact assessment.

There are at least 4 flora and vegetation that have previously been completed in close proximity to or within the study area. These surveys are described in Appendix 6.

### 3.2 Database Searches

#### 3.2.1 Flora Species

##### Threatened Flora listed under the EPBC Act

A search of the EPBC Act Protected Matters Database (DoEE 2019) identified no Threatened Flora or their habitat as occurring within a 40 km radius of the study area.

##### Threatened Flora listed under the IUCN Red List

A search of the International Union for Conservation of Nature (IUCN) database (IUCN 2019) determined that no Threatened Flora taxa were likely to occur within the study area.

##### Threatened Flora listed under the WC Act

The DBCA rare flora database search (DBCA 2018a) did not identify any plant taxon gazetted as Threatened Flora (T) pursuant to subsection (2) of Section 23F of the WC Act from a 50 km radius around the study area.

##### Priority Flora recognised by the DBCA

The DBCA rare flora database search (DBCA 2018a) identified 31 Priority flora taxa as potentially occurring within a 50 km radius of the study area. The NatureMap search (DBCA 2019) identified eight Priority flora as potentially occurring within a 20 km radius.

A total of 33 Priority flora taxa were identified during the desktop assessment. These taxa are detailed in Table 5.

Three of these Priority flora have previously been recorded from within the study area. Based on the known distributions and habitat preferences of Priority flora taxa, and comparison with the habitats identified and mapped for the study area, three taxa were determined as being “likely” to occur within the study area, six as “possible” to occur, and one determined as unknown. The remaining taxa were identified as “unlikely” to occur (Table 5).



**Table 5 Conservation significant flora taxa identified during the desktop assessment.**

Taxon	Cons. Code	Life Form	Habitat Preference	Suitable Habitat Present	Likelihood in the Study Area
<i>Calytrix praecipua</i>	P3	Perennial	Skeletal sandy soils over granite or laterite. Breakaways, outcrops.	Yes	Likely
<i>Comesperma sabulosum</i>	P3	Perennial	Red sand on dunes	No	Unlikely
<i>Comesperma viscidulum</i>	P4	Perennial	Dunes	No	Unlikely
<i>Daviesia arthropoda</i>	P3	Perennial	Dunes	No	Unlikely
<i>Eremophila anomala</i>	P1	Perennial	Basalt outcrop	No	Unlikely
<i>Eremophila appressa</i>	P1	Perennial	Ironstone gravel. Ridge slopes.	Yes	Possible
<i>Eremophila arguta</i>	P1	Perennial	Floodplain in rangeland with brown/red loam soil.	Yes	Possible
<i>Eremophila demissa</i>	P1	Perennial	Silcrete plains	Yes	Possible
<i>Eremophila lanata</i>	P3	Perennial	Stony red clayey sand.	Yes	Unlikely
<i>Eucalyptus semota</i>	P3	Perennial	Quartz outcrops	Yes	Recorded
<i>Fimbristylis sieberiana</i>	P3	Perennial	Mud, skeletal soil pockets. Pool edges, sandstone cliffs	No	Unlikely
<i>Frankenia glomerata</i>	P4	Perennial	White sand.	No	Unlikely
<i>Gonocarpus pycnostachyus</i>	P3	Annual	Sand or clay soils. Wet depressions, granite rocks.	No	Unlikely
<i>Goodenia modesta</i>	P3	Annual	Red loam, sand.	Yes	Possible
<i>Hemigenia tysonii</i>	P3	Perennial	Red sand, sandy clay or lateritic sandy soils on flats, sand dunes and hills	Yes	Likely
<i>Hemigenia virescens</i>	P3	Perennial	Hillside. Rangeland. Brown ironstone gravel.	Yes	Possible
<i>Hibiscus</i> sp. Carnarvon (S. van Leeuwen 5110)	P1	Perennial	Unknown	Unknown	Unknown
<i>Maireana prosthecochoeta</i>	P3	Perennial	Lateritic hills, slopes and saline areas	Yes	Recorded
<i>Micromyrtus mucronulata</i>	P3	Perennial	Hillslopes, brown loam dolerite, sandy soils.	Yes	Likely
<i>Minuria</i> sp. Little Sandy Desert (S. van Leeuwen 4919)	P1	Unknown	Flat around salt lake. Soil pink sand.	No	Unlikely
<i>Ptilotus tetrandrus</i>	P1	Perennial	Loamy sand.	Yes	Unlikely - Nearest record > 50 km
<i>Samolus</i> sp. Fortescue Marsh (A. Markey & R. Coppen FM 9702)	P1	Perennial	Margins of clay pans and salt lakes	No	Unlikely
<i>Sauropus</i> sp. Woolgorong (M. Officer s.n. 10/8/94)	P3	Perennial	Red sandy soils on plains	Yes	Recorded (just outside the study area)
<i>Sida picklesiana</i>	P3	Perennial	Variety of habitats including exposed rocky habitats such as BIF and granite breakaways, footslopes, stony plains and near creek lines	Yes	Possible

<i>Stackhousia clementii</i>	P3	Perennial	Skeletal soils. Sandstone hills.	Yes	Unlikely - Nearest record > 50 km
<i>Stackhousia</i> sp. Lake Mackay (P.K. Latz 12870) PN	P1	Perennial	Red dune near lake.	No	Unlikely
<i>Tecticornia bibenda</i>	P1	Perennial	Red-brown saline sand with some clay over calcrete and gypsum. Near the edges of gypsiferous playas and salt lakes on flat to gently undulating terrain.	No	Unlikely
<i>Tecticornia mellarium</i>	P1	Perennial	Along thin margin between salt lake and foredune. Pale yellow to white sand over clay.	No	Unlikely
<i>Tecticornia</i> sp. Christmas Creek (K.A. Shepherd & T. Colmer et al. KS 1063)	P1	Perennial	Saline flats. Marsh.	No	Unlikely
<i>Tecticornia</i> sp. Sunshine Lake (K.A. Shepherd et al. KS 867)	P1	Perennial	Flats near water line. Red-brown clayey sand.	No	Unlikely
<i>Tecticornia willisii</i>	P1	Perennial	Unknown	No	Unlikely
<i>Thryptomene</i> sp. Leinster (B.J. Lepschi & L.A. Craven 4362)	P3	Perennial	Sandy soils. Sandplains, stony ridges, breakaways	Yes	Unlikely - Nearest record > 50 km
<i>Triodia birriliburu</i>	P3	Perennial	Crest of red sand dune.	No	Unlikely

### 3.2.2 Ecological Communities

#### TECs listed under State and Federal Legislation

A search of the EPBC Act Protected Matters database (DoEE 2019) identified no Federal listed TECs previously recorded within, or adjacent to, the study area.

Search results from the DBCA ecological community database (DBCA 2018b) confirmed there was no State listed TECs known from within a 50 km of the study area.

#### PECs recognised by DBCA

A search of the State database (DBCA 2018b) identified three PECs located in close proximity (Table 6):

- Three Rivers Plutonic calcrete groundwater assemblage types on Gascoyne palaeodrainage on Three Rivers Station (Priority 1);
- Blech Land System (Priority 3iii); and
- Jingle Land System (Priority 3iii).

**Table 6** PECs located in close proximity to the study area.

Name	Description	Distance to study area
Three Rivers Plutonic calcrete groundwater assemblage types on Gascoyne palaeodrainage on Three Rivers Station (Priority 1)	Supports a unique assemblages of invertebrates in the groundwater calcretes. Threatened by mining.	40 km west
Blech Land System (Priority 3iii)	Characterised by large sandy banks up to 1.6 km long and 1 km wide connected by several arcuate bands. Interbanks occur between sandy banks and may coalesce into discernible through drainage plains in some areas. Threatened by overgrazing and erosion.	30km south-west
Jingle Land System (Priority 3iii)	Floodplains with <i>Eucalypt</i> woodlands and variable shrublands marginal to rivers. Threatened by overgrazing and erosion.	40km north-west



## 3.3 Field Survey

### 3.3.1 Flora Species

A total of 209 plant taxa (including varieties and subspecies) from 35 families and 89 genera were recorded from the study area (Table 7, Appendix 7). Species representation was greatest among the Fabaceae (47 taxa), Poaceae (24 taxa), Scrophulariaceae (21 taxa), Chenopodiaceae and Malvaceae families (18 taxa). The most speciose genus was *Acacia* (30 taxa), followed by *Eremophila* (21 taxa), *Senna* (11 taxa), *Maireana* (8 taxa), *Sida*, *Hibiscus* and *Ptilotus* (7 taxa each) (Table 7).

**Table 7 Statistics for total flora recorded from the study area.**

<b>Overview</b>	<b>No. Taxa</b>
Families	35
Genera	89
Taxa (species, subspecies, varieties)	209
Native Taxa	207
Introduced Taxa	2
Threatened Flora	0
Priority Flora	9
Range Extension	1
<b>Speciose Families</b>	<b>No. Taxa</b>
Fabaceae	47
Poaceae	24
Scrophulariaceae	21
Chenopodiaceae	18
Malvaceae	17
Asteraceae	8
Myrtaceae	8
<b>Speciose Genera</b>	<b>No. Taxa</b>
<i>Acacia</i> (Fabaceae)	30
<i>Eremophila</i> (Scrophulariaceae)	21
<i>Senna</i> (Fabaceae)	11
<i>Maireana</i> (Chenopodiaceae)	8
<i>Sida</i> (Malvaceae)	7
<i>Hibiscus</i> (Malvaceae)	7
<i>Ptilotus</i> (Amaranthaceae)	7

#### Threatened Flora listed under the WC Act and EPBC Act

No plant taxon gazetted as Threatened Flora (T) pursuant to subsection (2) of section 23F of the WC Act or listed under the EPBC Act were recorded from the study area.

#### Priority Flora recognised by the DBCA

A total of nine conservation significant flora species were recorded within the study area during the current survey with an additional priority species occurring just outside the study area (Figure 6):

- *Eremophila* cf. *demissa* (Priority 1);
- *Goodenia virgata* (Priority 2);
- *Calytrix praecipua* (Priority 3);
- *Eremophila lanata* (Priority 3);

- *Hemigenia tysonii* (Priority 3);
- *Maireana prosthocochaeta* (Priority 3);
- *Sauropus* sp. Woolgorong (M. Officer s.n. 10/8/94) (Priority 3);
- *Sporobolus blakei* (Priority 3);
- *Thryptomene* sp. Leinster (B.J. Lepschi & L.A. Craven 4362) (Priority 3); and
- *Eucalyptus semota* (Priority 1, recorded just outside the study area boundary).

GPS coordinates of each species are provided in Appendix 8. Descriptions of the conservation codes for Western Australian flora species are detailed in Appendix 3.

Summarised descriptions of each conservation significant flora species recorded from the Marymia Project Area are provided below.

### ***Eremophila* cf. *demissa* Chinnock (Family: Scrophulariaceae), Priority 1**

*Eremophila* cf. *demissa* is a small compact shrub growing to between 0.25-0.50 meters high with small grey to yellowish-grey, felty and narrowly ovate leaves, densely hairy sepals and mauve to blue tubular flowers to 1.5-2.5 cm long (Plate 1, Brown & Buirchell, 2011). It typically grows on silcrete plains in a small region northeast and east of Meekatharra in the Gascoyne and Murchison bioregions of central Western Australia (WAH 2019; Atlas of Living Australia 2019). It is a poorly collected taxon having only been recorded from a small geographical area of the state and has therefore been assigned Priority 1 status.

The taxon collected from the study area was identified as *Eremophila* cf. *demissa* as no flowers were recorded at the time of survey due to poor seasonal conditions. Further surveys during good seasonal conditions would be needed to confirm the identification of this species.

The closest documented populations of *Eremophila demissa* to the study area are located approximately 35km to the southwest near the decommissioned Plutonic Mine site. All of these populations are growing on broad stony plains and upland slopes that form the catchment divide of the headwaters of the Gascoyne River flowing westward and the various unnamed waterways flowing to the east and south.

*Eremophila* cf. *demissa* was recorded at 14 locations during the survey with more than 150 plants recorded. Percentage cover ranged from <1 to 10%. It was recorded from sandy/stony plains and drainage areas/floodplains.

### ***Goodenia virgata* Carolin (Family: Scrophulariaceae), Priority 2**

*Goodenia virgata* is an ascending to erect virgate (wand-shaped) perennial herb growing to 0.4 meters high with thin, glabrous, green leaves and delicate yellow flowers<sup>1</sup>. Due to its thin leaves and stems, it is often difficult to locate in the field and is typically a minor component of the vegetation. It has been found growing on red sandy loam soils, sometimes near salt pans. The majority of collections have been recorded from central Australia with scattered occurrences in the Gascoyne, Gibson Desert, Great Sandy Desert and Little Sandy Desert bioregions of central Western Australia (WAH 2019).

*Goodenia virgata* was only found within the Apex and Trident tenements. It was recorded as scattered plants from six locations. It was recorded from stony plains and hillslopes with mulga woodlands. Additional locations for *Goodenia* sp. indet at the Tailings Dam and along the Tailings Pipeline may also be this species, however seasonal conditions at the time of survey were too poor for these taxa to be identified to species level.

The populations recorded within the study area are a significant range extension for the taxon, being situated approximately 233 km northwest of the closest recorded location near Lorna Glen Homestead Airport in the Murchison bioregion.

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<sup>1</sup> This species was not photographed in the field.

### **Calytrix praecipua Craven (Family: Myrtaceae), Priority 3**

*Calytrix praecipua* is an open twiggy shrub that typically grows to a height between 0.3 - 0.7 metres tall. It has short, thin, glabrous leaves in opposite pairs that are often densely clustered at the ends of branchlets. It produces pink-white star-shaped flowers between June and November (Plate 2, ALA 2019). *Calytrix praecipua* typically grows on skeletal sandy soils on hill crests and breakaways composed of laterite or granite (WAH 2019; Brown & Buirchell 2011). Most populations of *Calytrix praecipua* are found further south of the study area in the Murchison, Little Sandy Desert and Great Victoria Desert bioregions of central Western Australia. The Marymia populations form the northernmost geographic extent of the taxon.

*Calytrix praecipua* was found at 16 locations within the Trident and Wedgetail prospects and the Mill area. A total of 159 plants were recorded from stony plains and hillslopes with coverage ranging between <1 to 3%.

### **Eremophila lanata Chinnock (Family: Scrophulariaceae), Priority 3**

*Eremophila lanata* is a low compact to spreading shrub with small, oblong, shortly hairy and densely clustered leaves, densely hairy sepals and mauve or lilac tubular flowers up to 20 mm long (Plate 3). It grows between 0.1 to 0.3 metres in height and is found growing in red clayey sand soils on stony flats and rocky slopes underlain by quartz (WAH 2019; Brown & Buirchell 2011). The only documented populations of *E. lanata* are located approximately 180 km to the southwest of the study area near Meekatharra in the Gascoyne bioregion (WAH 2019). However, a number of populations have been documented in unpublished reports and via opportunistic observations as occurring within and adjacent to the wider study area (Brown & Buirchell 2011).

*Eremophila lanata* was found at 59 locations within the Trident and Mar-east Prospects and along the proposed tailings pipeline and tails dam areas. Approximately, 2700 plants were recorded from stony plains, hardpan plains, hillslopes and undulating low hills. Coverage ranged from <1% up to 10%.

### **Hemigenia tysonii F.Muell. (Family: Lamiaceae), Priority 3**

*Hemigenia tysonii* is a low, intricately-branching mint bush up to 0.5 metres high and 0.7 metres wide. The leaves are small, grey green in colour, opposite or whorled, scented and up to 11 mm long by 2 mm wide. The flowers are either white or purple/blue/pink with white spots on the inside surface (WAH 2018) (Plate 4). *Hemigenia tysonii* is primarily found growing in red sand, sandy clay or lateritic sandy soils on flats, sand dunes and hills in the Murchison, Carnarvon and Gascoyne bioregions. The main populations occur over 250 km southwest of the study area in the eastern Murchison and southern Carnarvon bioregions, however there is one historical record existing nearby, adjacent to the Apex tenement (DBCA 2018a).

*Hemigenia tysonii* was recorded at ten locations across the Apex prospect.

### **Maireana prosthochaeta (F.Muell.) (Family: Chenopodiaceae), Priority 3**

*Maireana prosthochaeta* is an open, densely-leaved glabrous shrub growing to 0.3-0.6 metres high. It has erect branches with narrow, glabrous, succulent and somewhat terete leaves and fruits that are black, glabrous with a prominent circular wing and 4-6 erect perianth processes (Plate 5). It is known to occur on lateritic hills, slopes and saline areas within the Gascoyne and northern Murchison bioregions of central Western Australia with an outlier collection in the central Kimberley (WAH 2019).



*Maireana prosthochaeta* was collected from 22 locations on hill slopes and undulating low hills in the Wedgetail and Trident prospects. This species occurs as a scattered component of the understorey.

**Sauropus sp. Woolgorong (M. Officer s.n. 10/8/94) (Family: Phyllanthaceae), Priority 3**

*Sauropus* sp. Woolgorong is a low, bright green shrub growing to 0.3-1 metres high with very small, cryptic, yellow flowers and green ovoid capsules. The leaves are glabrous, obovate and generally 10-15mm long and 2-5mm wide whilst the stems are somewhat 'zigzag' and rough in texture (Plate 6). Individuals sometimes appear leafless due to the somewhat caducous nature of the leaves during drier seasons. This taxon primarily inhabits red sandy soils on plains in the northern Murchison and central Yalgoo bioregions, with a northerly outlier in the central Gascoyne.

*Sauropus* sp. Woolgorong was found at 21 locations in the K2, Trident and Apex Prospects. Approximately 20 plants were recorded from breakaways and hillslopes.

**Sporobolus blakei B.K.Simon (Family: Poaceae), Priority 3**

*Sporobolus blakei* is a tufted perennial grass growing to 0.45-0.6 metres high. The inflorescence is elongated, compact and feathery and has very small green to purple flowers<sup>2</sup>. It primarily grows in red sandy clays and loams in creek lines and is widely distributed, though poorly collected, across the state in the Carnarvon, Central Kimberley, Gascoyne, Gibson Desert, Jarrah Forest and Murchison bioregions. Due to paucity of documented collections, the current location at Marymia represents a significant range infill/ extension, the closest recorded location being approximately 250km east southeast near Wongawol Airport on the Carnegie Rd in the eastern Gascoyne (WAH 2019).

*Sporobolus blakei* was restricted to one location within the study area scattered within a rocky creekline in the north-western sector of the Trident prospect. The number of plants was not recorded.

**Thryptomene sp. Leinster (B.J. Lepschi & L.A. Craven 4362) (Family: Myrtaceae), Priority 3**

*Thryptomene* sp. Leinster is a shrub in the family Myrtaceae. It is an erect shrub with a messy habit, growing between 0.6-3 metres high. It has small, circular leaves which are densely clustered along the branches and small, pink to white flowers that are produced between July and November (Plate 7). *Thryptomene* sp. Leinster occurs in a band across the Murchison and Gascoyne bioregions from Leinster in the south to Meekatharra and Marymia in the north. The populations found in the study area are the most north-eastern extent of the currently known distribution of this taxon.

*Thryptomene* sp. Leinster primarily grows in orange to brown sandy loams on weathered ironstone and lateritic ridges, breakaways and stony slopes in the study area. These landforms appear to have a consistent plant assemblage and include species such as *Acacia subcontorta*, *Acacia incurvaneura* (bushy form), *Sida* cf. *ectogama*, *Ptilotus schwartzii*, *Eragrostis eriopoda* and the Priority 3 taxon *Calytrix praecipua*. *Thryptomene* sp. Leinster appears to be an indicator species for this vegetation community.

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<sup>2</sup> This species was not photographed in the field

*Thryptomene* sp. Leinster was recorded at 42 locations during the survey with a total of 438 plants. It was recorded from minor drainage lines, rocky hillslopes and undulating low hills within the Trident, Wedgetail, Ibis and K2 prospects.

***Eucalyptus semota* C.J.Macpherson & Grayling (Family: Myrtaceae), Priority 1 (not within study area boundary)**

*Eucalyptus semota*, commonly known as Marymia Mallee, is a mallee or small tree growing to 2-9 m high. It has smooth pink to cream coloured bark with a stocking of rough, peeling bark below. It has thin, lanceolate, glossy green leaves with small white/cream/yellow flowers and small, cup-shaped gum nuts approximately 6 mm long (Plate 8) (Macpherson & Grayling, 1996). It typically grows on pallid zone clay soils below lateritic mesa caps and quartz outcrops in a small region between Meekatharra and Kumarina in the Gascoyne, Murchison and Little Sandy Desert bioregions of central Western Australia (WAH 2019; Atlas of Living Australia 2019). It is a poorly collected taxon, and most known populations are from the Marymia Hill area. It has therefore been assigned Priority 1 status by DBCA.

This species was recorded at three locations just outside the study area from minor rocky drainage lines. A total of 13 plants were observed ranging from 4-6 metres in height.

**Range Extensions**

One flora species with a significant range extension was recorded within the study area: *Hibiscus brachychlaenus*. This species is a perennial shrub reaching 1.8 meters in height. It produces blue, purple or pink flowers in March to April or August to November and grows on sandy or loamy soils on sandstone, sand plains or dunes.

*Hibiscus brachychlaenus* was recorded from one location within the study area at the K2 prospect. It was recorded from a sandplain with brown sandy loam and was a minor component of the vegetation.

**Introduced Flora**

Two introduced flora were recorded from the study area; *\*Bidens bipinnata* and *\*Portulaca pilosa* (Appendix 9, Figure 7).

*\*Bidens bipinnata* is an erect annual herb that grows up to 1m in height. This species is widespread in the northern parts of WA, from Shark Bay up to the Northern Territory Border. It has three pronged barbs on its seeds, so it is easily spread by livestock and other animals. It is common in moist habitats such as drainage lines, flood plains and gorges, and responds vigorously following rainfall.

Within the study area it was recorded from two locations in the Trident and Apex Prospects. It was recorded from a major drainage line and a floodplain with coverage between 1-3%.

*\*Portulaca pilosa* is a succulent, erect or prostrate annual herb reaching 0.2 meters high. Flowers are yellow or pink and are produced between January to July or November. It grows on sandy, loamy & clayey soils. It has predominantly been recorded throughout the Pilbara and Kimberley with a few scattered records extending into the Gascoyne.

Within the study area *\*Portulaca pilosa* was recorded from one location within the Apex prospect. Scattered plants were recorded from a medium drainage line.



Plate 1 *Eremophila cf. demissa*



Plate 2 *Calytrix praecipua*



Plate 3 *Eremophila lanata*





Plate 4 *Hemigenia tysonii*



Plate 5 *Maireana prosthochaeta*



Plate 6 *Sauropus* sp. Woolgorong (M. Officer s.n. 10/8/94)

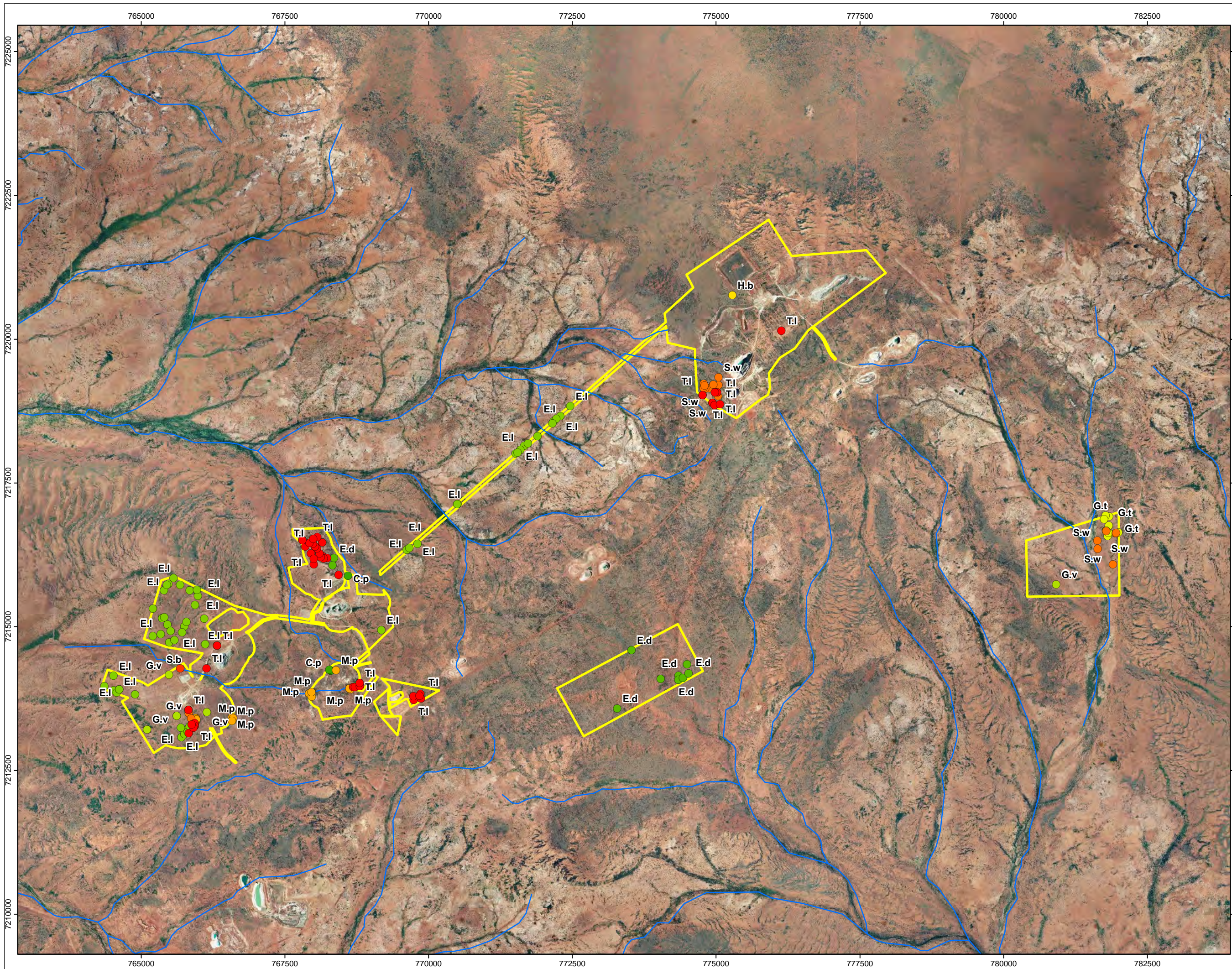


**Plate 7** *Thryptomene* sp. Leinster (B.J. Lepschi & L.A. Craven 4362)



**Plate 8** *Eucalyptus semota*





# VANGO

## Marymia

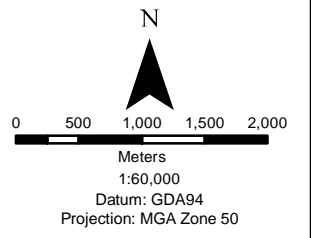
### Significant Flora

#### Legend

Survey Areas

#### Significant Flora

- Calytrix praecipua (C.p)
- Eremophila cf. demissa (E.d)
- Eremophila lanata (E.l)
- Goodenia virgata (G.v)
- Hemigenia tysonii (H.t)
- Hibiscus brachychlaenus (H.b)
- Maireana prosthocochaeta (M.p)
- Sauropus sp.
- Woolgorong (M. Officer s.n. 10/8/94)
- Sporobolus blakei (S.b)
- Thryptomene sp.
- Leinster (B.J. Lepschi & L.A. Craven 4362)



Date: 11/06/2019  
 Status: Final  
 Figure: 6  
 Sheet Size: A3  
 Internal Reference: Marymia\_Apex\_SF  
 Drawn by: GSM  
 Requested by: DB





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# VANGO

## Marymia

### Introduced Flora

#### Legend

- Survey
- Introduced Flora**
- Bidens bipinnata
- Portulaca pilosa



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1:60,000  
Datum: GDA94  
Projection: MGA Zone 50

Date: 11/06/2019  
 Status: Final  
 Figure: 7  
 Sheet Size: A3  
 Internal Reference: Marymia\_Apex\_F  
 Drawn by: GSM  
 Requested by: DB





### 3.3.2 Vegetation

#### Vegetation Associations

A total of 32 vegetation associations were described and mapped within the study area (Figure 8). The vegetation associations have been classified into 15 broad floristic formations on the basis of the dominant vegetation stratum (Table 8).

**Table 8** Vegetation types mapped within the study area.

Vegetation Association Code	Sites	Vegetation Association Description	
<b>Hill Crests</b>			
HC AsuAi TslAsu SeEIPs	IB-01, K2-08, K2-17, MA-01, TRI-15, WE-04	Acacia High Open Shrubland	High Open Shrubland of <i>Acacia subcontorta</i> and <i>Acacia incurvaneura</i> over Open Shrubland of <i>Thryptomene</i> sp. Leinster (B.J. Lepschi & L.A. Craven 4362) and <i>Acacia subcontorta</i> over Low Open Shrubland of <i>Sida</i> cf. <i>ectogama</i> , <i>Eremophila latrobei</i> subsp. <i>latrobei</i> and <i>Ptilotus schwartzii</i> over Very Open Tussock Grassland of <i>Eriachne mucronata</i> , <i>Thyridolepis xerophila</i> and <i>Eragrostis eriopoda</i> on orange sandy loam on weathered ironstone ridges and hill crests
<b>Hill Slopes</b>			
HS Apt SglSs Ema	TRI-21, WE-01, WE-02, WE-05	Acacia Low Open Woodland	Low Open Woodland of <i>Acacia pteraneura</i> over Open Shrubland of <i>Senna glutinosa</i> subsp. <i>x luerssenii</i> and <i>Senna stricta</i> over Low Open Shrubland of <i>Eremophila margarethae</i> on brown sandy loam on hillslopes
HS AptAi EmPrPo Tb	ME-01, TP-15, TP-06	Acacia Low Open Woodland	Low Open Woodland (or Low Woodland) of <i>Acacia pteraneura</i> and <i>Acacia incurvaneura</i> over Low Shrubland of <i>Eremophila margarethae</i> , <i>Ptilotus rotundifolius</i> and <i>Ptilotus obovatus</i> and Scattered Hummock Grasses of <i>Triodia basedowii</i> on orange sandy clay loam on hillslopes
HS CdPr EfGbAf	TRI-20, (TRI-22 outside study area)	<i>Calytrix</i> Low Shrubland	Low Shrubland of <i>Calytrix</i> cf. <i>desolata</i> and <i>Ptilotus rotundifolius</i> with Open Shrubland of <i>Eremophila fraseri</i> , <i>Grevillea berryana</i> and <i>Acacia fuscaneura</i> ( <i>Senna glutinosa</i> subsp. <i>x luerssenii</i> ) on brown sandy loam on hillslopes
<b>Minor Drainage Lines</b>			
MI AptAcGb DpAc SeShSsp	MA-03, ME-02	Acacia Low Open Woodland	Low Woodland of <i>Acacia pteraneura</i> , <i>Acacia citrinoviridis</i> and <i>Grevillea berryana</i> ( <i>Acacia pruinocarpa</i> ) over High Open Shrubland of <i>Dodonaea pachyneura</i> and <i>Acacia craspedocarpa</i> (hybrid) over Low Open Shrubland of <i>Sida</i> cf. <i>ectogamma</i> , <i>Senna artemisioides</i> subsp. <i>helmsii</i> and <i>Scaevola spinescens</i> (with an Open Shrubland of <i>Senna glutinosa</i> subsp. <i>luerssenii</i> ) on brown sandy loam on minor drainage lines
MI AcApt DpAtSsp Tb	MA-06	Acacia Low Open Woodland	Low Open Woodland of <i>Acacia citrinoviridis</i> ( <i>Acacia pteraneura</i> ) over Open Shrubland of <i>Dodonaea pachyneura</i> , <i>Acacia tetragonophylla</i> and <i>Scaevola spinescens</i> over Very Open Hummock Grassland of <i>Triodia basedowii</i> on orange silty loam on hillslopes and minor drainage lines
MI ArlApt As	APEX-10	Acacia Scattered Tall Shrubs	Scattered Tall Shrubs of <i>Acacia ramulosa</i> var. <i>linophylla</i> and <i>Acacia pteraneura</i> over Scattered Low Shrubs of <i>Acacia sibirica</i> on brown sandy loam on minor drainage lines (eroded channels)
<b>Medium Drainage Lines</b>			

ME AapAan EfEff Tt	MW-03, MW-08, TRI-02	<i>Acacia</i> Low Open Forest	Low Open Forest of <i>Acacia aptaneura</i> and <i>Acacia aneura</i> over Open Shrubland of <i>Eremophila fraseri</i> and <i>Eremophila forrestii</i> subsp. <i>forrestii</i> over Very Open Tussock Grassland of <i>Themeda triandra</i> on brown sandy clay loam on medium drainage lines
ME Ai TI Se	APEX-05	<i>Acacia</i> Low Open Forest	Low Open Forest of <i>Acacia incurvaneura</i> over Open Tussock Grassland of <i>Tripogonella loliiformis</i> with Open Shrubland of <i>Sida</i> cf. <i>ectogama</i> ( <i>Eremophila fraseri</i> and <i>Acacia tetragonophylla</i> ) on brown loamy sand on medium drainage lines and floodplains
<b>Major Drainage Lines</b>			
MA AanAcAm PIArIAt Tt	TP-08	<i>Acacia</i> Low Closed Forest	Low Closed Forest of <i>Acacia aneura</i> , <i>Acacia citrinoviridis</i> and <i>Acacia macraneura</i> over High Open Shrubland of <i>Psyrax latifolia</i> , <i>Acacia ramulosa</i> var. <i>linophylla</i> and <i>Acacia tetragonophylla</i> over Very Open Tussock Grassland of <i>Themeda</i> sp. indet on brown loamy sandy on major drainage lines
MA AapAanAi TIEkCf At CsEal	APEX-06	<i>Acacia</i> Low Closed Forest	Low Closed Forest of <i>Acacia aptaneura</i> , <i>Acacia aneura</i> and <i>Acacia incurvaneura</i> over Open Tussock Grassland of <i>Tripogonella loliiformis</i> , <i>Eragrostis kennedyae</i> and <i>Chrysopogon fallax</i> with High Open Shrubland of <i>Acacia tetragonophylla</i> and Very Open Herbs of <i>Cheilanthes sieberi</i> and <i>Evolvulus alsinoides</i> on brown silty clay loam on major drainage lines
MA AmApt AcrAtAss CFTtEk	APEX-08, APEX-09	<i>Acacia</i> Low Open Forest	Low Open Forest of <i>Acacia macraneura</i> and <i>Acacia pteraneura</i> ( <i>Eucalyptus victrix</i> ) over High Open Shrubland of <i>Acacia craspedocarpa</i> , <i>Acacia tetragonophylla</i> and <i>Acacia sclerosperma</i> subsp. <i>sclerosperma</i> over Low Open Shrubland of <i>Senna artemisioides</i> subsp. <i>artemisioides</i> , <i>Eremophila margarethae</i> and <i>Ptilotus obovatus</i> (over Very Open Tussock Grassland of <i>Chrysopogon fallax</i> , <i>Themeda triandra</i> and <i>Eragrostis kennedyae</i> ) on brown sand on major drainage lines
<b>Floodplains</b>			
FP Ai ArIPIGb EffSeEf TxEe Cs	CIN-03, CIN-07, CIN-11, K2-12, TRI-07, TRI-11	<i>Acacia</i> Low Open Forest	Low Open Forest (to Low Closed Forest) of <i>Acacia incurvaneura</i> ( <i>Acacia pruinocarpa</i> , <i>Acacia ayersiana</i> , <i>Acacia aptaneura</i> , <i>Acacia aneura</i> ) over High Shrubland of <i>Acacia ramulosa</i> var. <i>linophylla</i> , <i>Psyrax latifolia</i> and <i>Grevillea berryana</i> over Shrubland of <i>Eremophila forrestii</i> subsp. <i>forrestii</i> , <i>Sida</i> cf. <i>ectogama</i> and <i>Eremophila fraseri</i> over Very Open Tussock Grassland of <i>Thyridolepis xerophila</i> and <i>Eragrostis eriopoda</i> and Very Open Herbs of <i>Cheilanthes sieberi</i> on brown sandy clay loam on floodplains
<b>Hardpan Plains</b>			
HP Ai EffEsb Tb	TD-02	<i>Acacia</i> Low Woodland	Low Woodland of <i>Acacia incurvaneura</i> over Low Open Shrubland of <i>Eremophila forrestii</i> subsp. <i>forrestii</i> and <i>Eremophila spectabilis</i> over Very Open Hummock Grassland of <i>Triodia basedowii</i> on brown sandy clay loam on hardpan plains
HP AiGbApt AiAth EffPsEsb	MA-02, ME-03, ME-21, TD-03, TD-04, TD-06, TD-10	<i>Acacia</i> Low Open Woodland	Low Open Woodland of <i>Acacia incurvaneura</i> , <i>Grevillea berryana</i> and <i>Acacia pteraneura</i> over High Open Shrubland of <i>Acacia incurvaneura</i> and <i>Acacia thoma</i> and Low Open Shrubland of <i>Eremophila forrestii</i> subsp. <i>forrestii</i> , <i>Ptilotus schwartzii</i> and <i>Eremophila spectabilis</i> (over Very Open Tussock Grassland of <i>Eragrostis eriopoda</i> ) on brown clay loam on hardpan plains
HP Tb AiAth EffEIPs	TD-05, TD-07, TD-14	<i>Triodia</i> Hummock Grassland	Hummock Grassland of <i>Triodia basedowii</i> with High Open Shrubland of <i>Acacia incurvaneura</i> and <i>Acacia thoma</i> and Low Open Shrubland of <i>Eremophila forrestii</i> subsp. <i>forrestii</i> , <i>Eremophila lanata</i> and <i>Ptilotus schwartzii</i> (with Scattered Low Trees of <i>Acacia pruinocarpa</i> and <i>Grevillea berryana</i> ) on orange sandy clay loam on hardpan plains
<b>Stony Plains</b>			



SP AptAiAp AsuAthAi SeEIPs	IB-04, MA-05, TD-08, TD-09, TD-11, TRI-25,	Acacia Low Open Woodland	Low Open Woodland of <i>Acacia pteraneura</i> , <i>Acacia incurvaneura</i> and <i>Acacia pruinocarpa</i> over High Open Shrubland of <i>Acacia subcontorta</i> , <i>Acacia thoma</i> and <i>Acacia incurvaneura</i> over Low Open Shrubland of <i>Sida</i> cf. <i>ectogamma</i> , <i>Eremophila lanata</i> and <i>Ptilotus schwartzii</i> (with Scattered Tussock Grassland of <i>Eriachne mucronata</i> and <i>Eragrostis eriopoda</i> ) on brown sandy clay loam on stony plains
SP Ai EffEcEII PsEd	APEX-07	Acacia High Open Shrubland	High Open Shrubland of <i>Acacia incurvaneura</i> ( <i>Acacia pruinocarpa</i> , <i>Grevillea berryana</i> ) over Open Shrubland of <i>Eremophila forrestii</i> subsp. <i>forrestii</i> , <i>Eremophila</i> cf. <i>citrina</i> and <i>Eremophila latrobei</i> subsp. <i>latrobei</i> over Low Open Shrubland of <i>Ptilotus schwartzii</i> and <i>Eremophila</i> cf. <i>demissa</i> (over Very Open Hummock Grassland of <i>Triodia basedowii</i> ) on brown loamy sand on stony plains
SP Ai EfSgEff PsPoSl	APEX-02, K2- 16, ME-04, MW- 02, TP-13, TRI- 01, TRI-03, TRI- 06, TRI-09, TRI- 16, TRI-17, TRI- 18, WE-06, WE- 07, K2-11 (i/g), K2-14 (i/g), TRI- 08 (i/g), TRI-10 (i/g)	Acacia High Open Shrubland	High Open Shrubland of <i>Acacia incurvaneura</i> ( <i>Acacia pteraneura</i> , <i>Acacia pruinocarpa</i> ) over Open Shrubland of <i>Eremophila fraseri</i> , <i>Senna glaucifolia</i> and <i>Eremophila forrestii</i> subsp. <i>forrestii</i> ( <i>Eremophila latrobei</i> subsp. <i>latrobei</i> ) over Low Open Shrubland of <i>Ptilotus schwartzii</i> , <i>Ptilotus obovatus</i> and <i>Solanum lasiophyllum</i> on brown sandy loam on stony plains
SP AptAi AcISgl EmSsPo	IB-02, K2-15, K2-19, MA-04, MW-01, MW-06, TP-04, TRI-04, TRI-12, TRI-14, TRI-19	Acacia Low Closed Forest	High Open Shrubland of <i>Acacia pteraneura</i> and <i>Acacia incurvaneura</i> ( <i>Acacia macraneura</i> , <i>Hakea preissii</i> ) over Open Shrubland of <i>Acacia cuthbertsonii</i> subsp. <i>linearis</i> and <i>Senna glutinosa</i> subsp. <i>x luerssenii</i> over Low Open Shrubland of <i>Eremophila margarethae</i> , <i>Senna stricta</i> and <i>Ptilotus obovatus</i> on brown sandy loam on stony plains
SP AiGbPI EffEII EsEmPs	TP-10	Acacia Low Closed Forest	High Open Shrubland of <i>Acacia incurvaneura</i> , <i>Grevillea berryana</i> and <i>Psydrax latifolia</i> over Open Shrubland of <i>Eremophila forrestii</i> subsp. <i>forrestii</i> and <i>Eremophila latrobei</i> subsp. <i>latrobei</i> over Low Open Shrubland of <i>Eremophila spathulata</i> , <i>Eremophila margarethae</i> and <i>Ptilotus schwartzii</i> on orange sandy clay loam on stony plains
SP AiGb EsEmPs Apt	TP-02, TP-03, TP-10, TP-14	Acacia Low Closed Forest	High Open Shrubland of <i>Acacia incurvaneura</i> and <i>Grevillea berryana</i> over Low Open Shrubland of <i>Eremophila spathulata</i> , <i>Eremophila margarethae</i> and <i>Ptilotus schwartzii</i> ( <i>Eremophila lanata</i> , <i>Ptilotus albidus</i> , <i>Solanum lasiophyllum</i> ) with Scattered Low Trees of <i>Acacia pteraneura</i> on brown sandy clay loam on stony plains
SP EIPs EmEe GbAiApt	TD-01, TD-12, TRI-05, TRI-13, TRI-23	<i>Eremophila</i> Low Open Shrubland	Low Open Shrubland of <i>Eremophila lanata</i> and <i>Ptilotus schwartzii</i> over Very Open Tussock Grassland of <i>Eriachne mucronata</i> and <i>Eragrostis eriopoda</i> with Scattered Tall Shrubs of <i>Grevillea berryana</i> , <i>Acacia incurvaneura</i> and <i>Acacia pteraneura</i> on brown sandy loam on stony plains
SP SmFs Apt HpSm	APEX-01	<i>Senna</i> Low Open Shrubland	Low Open Shrubland of <i>Senna</i> sp. Meekatharra (E. Bailey 1-26), <i>Frankenia setosa</i> and <i>Sclerolaena</i> spp. with Scattered Tall Shrubs of <i>Acacia pteraneura</i> over Scattered Shrubs of <i>Hakea preissii</i> and <i>Senna</i> sp. Meekatharra (E. Bailey 1-26) on brown sandy loam on stony plains

SP EsEfPo	TRI-24, TRI-26	<i>Eremophila</i> Low Open Shrubland	Low Open Shrubland of <i>Eremophila spathulata</i> , <i>Eremophila fraseri</i> and <i>Ptilotus obovatus</i> on orange sandy clay loam on stony plains
SP EexPrEf AfAi	TP-09, TP-11, TP-12	<i>Eremophila</i> Low Open Shrubland	Low Open Shrubland of <i>Eremophila exilifolia</i> , <i>Ptilotus rotundifolius</i> and <i>Eremophila fraseri</i> with Scattered Low Trees of <i>Acacia fuscaneura</i> and <i>Acacia incurvaneura</i> on orange sandy loam on stony plains
<b>Sandy/ Stony Plains</b>			
SS AiApAa Ec Tb	APEX-04	<i>Acacia</i> Low Open Forest	Low Open Forest of <i>Acacia incurvaneura</i> , <i>Acacia pruinocarpa</i> and <i>Acacia ayersiana</i> over Shrubland of <i>Eremophila</i> cf. <i>citrina</i> ( <i>Eremophila forrestii</i> subsp. <i>forrestii</i> ) over Open Hummock Grassland of <i>Triodia basedowii</i> on brown sandy loam on sandy/stony plains
SS AanAa Arl EffArl Tb EeTx	CIN-01, CIN-06, CIN-09, CIN-10	<i>Acacia</i> Low Woodland	Low Woodland of <i>Acacia aneura</i> and <i>Acacia ayersiana</i> ( <i>Acacia incurvaneura</i> , <i>Acacia pteraneura</i> , <i>Acacia pruinocarpa</i> ) over High Open Shrubland of <i>Acacia ramulosa</i> var. <i>linophylla</i> over Open Shrubland of <i>Eremophila forrestii</i> subsp. <i>forrestii</i> and <i>Acacia ramulosa</i> var. <i>linophylla</i> over Very Open Hummock Grassland of <i>Triodia basedowii</i> over Very Open Tussock Grassland of <i>Eragrostis eriopoda</i> and <i>Thyridolepis xerophila</i> on red/orange silty loam on sandy/stony plains
SS EffEsEc Tb ApAaApt AiArl	CIN-02, K2-03, K2-06, K2-07, K2-10, K2-13	<i>Eremophila</i> Shrubland	Shrubland of <i>Eremophila forrestii</i> subsp. <i>forrestii</i> , <i>Eremophila spathulata</i> and <i>Eremophila</i> cf. <i>citrina</i> ( <i>Eremophila latrobei</i> subsp. <i>latrobei</i> ) over Open Hummock Grassland of <i>Triodia basedowii</i> with Low Open Woodland of <i>Acacia pruinocarpa</i> , <i>Acacia ayersiana</i> and <i>Acacia pteraneura</i> and High Open Shrubland of <i>Acacia incurvaneura</i> and <i>Acacia ramulosa</i> var. <i>linophylla</i> on brown loamy sand on sandy/stony plains
SS Tb AiAp Ar EcEs	APEX-03, K2-01, K2-02, K2-05, K2-09, MW-05, TP-18	<i>Triodia</i> Hummock Grassland	Hummock Grassland of <i>Triodia basedowii</i> with Low Open Woodland of <i>Acacia incurvaneura</i> and <i>Acacia pruinocarpa</i> ( <i>Grevillea berryana</i> , <i>Acacia ayersiana</i> ) and High Open Shrubland of <i>Acacia rhodophloia</i> ( <i>Acacia ramulosa</i> var. <i>linophylla</i> , <i>Acacia thoma</i> ) and Low Open Shrubland of <i>Eremophila</i> cf. <i>citrina</i> and <i>Eremophila spathulata</i> ( <i>Eremophila latrobei</i> subsp. <i>latrobei</i> ) on brown/orange sandy loam on sandy/stony plains and low rises
SS Tb AanAiAap EffEd	CIN-04, CIN-05, CIN-08	<i>Triodia</i> Hummock Grassland	Hummock Grassland of <i>Triodia basedowii</i> with Low Open Woodland of <i>Acacia aneura</i> , <i>Acacia incurvaneura</i> and <i>Acacia aptaneura</i> ( <i>Acacia ayersiana</i> ) and Scattered Low Shrubs of <i>Eremophila forrestii</i> subsp. <i>forrestii</i> and <i>Eremophila</i> cf. <i>demissa</i> on orange silty loam on sandy/stony plains
SS Tb ScSe AaAkEff	K2-04, K2-18, K2-20, K2-22	<i>Triodia</i> Hummock Grassland	Hummock Grassland of <i>Triodia basedowii</i> with Low Open Shrubland of <i>Sida cardiophylla</i> and <i>Seringia elliptica</i> with Scattered Shrubs of <i>Acacia ayersiana</i> , <i>Acacia kempeana</i> and <i>Eremophila forrestii</i> subsp. <i>forrestii</i> on brown loamy sand on sandy/stony plains

Ap, *A. pruinocarpa*; Apt, *A. pteraneura*; Aa, *A. ayersiana*; Aap, *A. aptaneura*; Aan, *A. aneura*; Ac, *A. citrinoviridis*; Acr, *A. craspedocarpa* (hybrid); As, *A. subcontorta*; Ass, *A. sclerosperma* subsp. *sclerosperma*; Em, *E. mucronata*; Ema, *E. margarethae*; Ef, *E. fraseri*; Eff, *E. forrestii* subsp. *forrestii*; Es, *E. spathulata*; Esp, *E. spectabilis*; Ee, *E. eriopoda*; Eex, *Eremophila exilifolia*; Se, *Sida* cf. *ectogama*; Sel, *Seringia elliptica*; Ss, *Senna stricta*; Ssp, *Scaevola spinescens*; Sg, *S. glaucifolia*; Sgl, *Senna glutinosa* subsp. *x luerssenii*.  
(i/g)=intergrove site

### Vegetation Significance

None of the vegetation associations recorded within the study area are affiliated with any Federal or State listed TECs or PECs.

The weathered lateritic and ironstone communities in the study area are of conservation interest due to the propensity for these areas to contain Priority flora in the region. The vegetation is described as HC AsuAi TslAsu SeEIIpS - High Open Shrubland of *Acacia subcontorta* and *Acacia incurvaneura* over Open Shrubland of *Thryptomene* sp. Leinster (B.J. Lepschi & L.A. Craven 4362) and *Acacia subcontorta* over Low Open Shrubland of *Sida* cf. *ectogama*, *Eremophila latrobei* subsp. *latrobei* and *Ptilotus schwartzii* (over Very Open Tussock Grassland of *Eriachne mucronata*, *Thyridolepis xerophila* and *Eragrostis eriopoda*) on orange sandy loam on weathered ironstone ridges and hill crests. Two Priority species occur consistently within this unit: *Thryptomene* sp. Leinster (B.J. Lepschi & L.A. Craven 4362) and *Calytrix praecipua*. *Eremophila lanata* also occurs sporadically within the unit.

This community appears to be poorly represented in the Marymia area, representing approximately 2% of the vegetation area that was assessed in the Project area.

### Vegetation Condition

Vegetation condition within the study area ranged from Good to Very Good (Figure 9). Approximately 18 percent of the study area has previously been disturbed through historical mining and exploration activities. The remaining vegetation has also been impacted by mining and exploration activities with numerous tracks and drill pads present throughout the study area. The vegetation of the study area showed obvious signs of degradation by cattle grazing. Camels were also present within the study area. Weed species were a very minor disturbance within the study area with only two species recorded at low densities. Weed species may be more prevalent within the study area following higher rainfall seasons.



# VANGO

# Marymia

## Vegetation Types Legend

### Legend

Survey Areas

### Vegetation Types

#### Hill Crest

HC AsuAi TslAsu SeEIPs

High Open Shrubland of *Acacia subcontorta* and *Acacia incurvaneura* over Open Shrubland of *Thryptomene* sp. *Leinster* (B.J. Lepschi & L.A. Craven 4362) and *Acacia subcontorta* over Low Open Shrubland of *Sida* cf. *ectogama*, *Eremophila latrobei* subsp. *latrobei* and *Ptilotus schwartzii* over Very Open Tussock Grassland of *Eriachne mucronata*, *Thyridolepis xerophila* and *Eragrostis eriopoda* on orange sandy loam on weathered ironstone ridges

#### Hillslope

HS Apt SglSs Em

Low Open Woodland of *Acacia pteraneura* over Open Shrubland of *Senna glutinosa* subsp. *x luerssenii* and *Senna stricta* over Low Open Shrubland of *Eremophila margarethae* on brown sandy loam on hillslopes

HS CdPr EFGbAf

Low Shrubland of *Calytrix* cf. *desolata* and *Ptilotus rotundifolius* with Open Shrubland of *Eremophila fraseri*, *Grevillea berryana* and *Acacia fuscaneura* (*Senna glutinosa* subsp. *x luerssenii*) on brown sandy loam on hillslopes

HS AptAi EmPrPo

Low Open Woodland (or Low Woodland) of *Acacia pteraneura* and *Acacia incurvaneura* over Low Shrubland of *Eremophila margarathe*, *Ptilotus rotundifolius* and *Ptilotus obovatus* and Scattered Hummock Grasses of *Triodia basedowii* on orange sandy clay loam on hillslopes

#### Hardpan Plains

HP Tb AiAth

Hummock Grassland of *Triodia basedowii* with High Open Shrubland of *Acacia incurvaneura* and *Acacia thoma* and Low Open Shrubland of *Eremophila forrestii* subsp. *forrestii*, *Eremophila lanata* and *Ptilotus schwartzii* (Scattered Low Trees of *Acacia pruinocarpa* and *Grevillea berryana*) on orange sandy clay loam on hardpan plains

HP AiGbApt AiAth

Low Open Woodland of *Acacia incurvaneura*, *Grevillea berryana* and *Acacia pteraneura* over High Open Shrubland of *Acacia incurvaneura* and *Acacia thoma* and Low Open Shrubland of *Eremophila forrestii* subsp. *forrestii*, *Ptilotus swartzii* and *Eremophila spectabilis* (Very Open Tussock Grassland of *Eragrostis eriopoda*) on brown clay loam on hardpan plains

HP Ai EffEsb

Low Woodland of *Acacia incurvaneura* over Low Open Shrubland of *Eremophila forrestii* subsp. *forrestii* and *Eremophila spectabilis* subsp. *brevis* over Very Open Hummock Grassland of *Triodia basedowii* on brown sandy clay loam on hardpan plains

#### Sandy / Stony Plains

SS AanAa Arl EffArI Tb

Low Woodland of *Acacia aneura* and *Acacia ayersiana* (*Acacia incurvaneura*, *Acacia pteraneura*, *Acacia pruinocarpa*) over High Open Shrubland of *Acacia ramulosa* var. *linophylla* over Open Shrubland of *Eremophila forrestii* subsp. *forrestii* and *Acacia ramulosa* var. *linophylla* over Very Open Hummock Grassland of *Triodia basedowii* over Very Open Tussock Grassland of *Eragrostis eriopoda* and *Thyridolepis xerophila* on red/orange silty loam on sandy/stony plains

SS AiApAa Ec

Low Open Forest of *Acacia incurvaneura*, *Acacia pruinocarpa* and *Acacia ayersiana* over Shrubland of *Eremophila* cf. *citrina* (*Eremophila forrestii* subsp. *forrestii*) over Open Hummock Grassland of *Triodia basedowii* on brown sandy loam on sandy/stony plains

SS Tb AanAiAap

Hummock Grassland of *Triodia basedowii* with Low Open Woodland of *Acacia aneura*, *Acacia incurvaneura* and *Acacia aptaneura* (*Acacia ayersiana*) and Scattered Low Shrubs of *Eremophila forrestii* subsp. *forrestii* and *Eremophila* cf. *demissa* on orange silty loam on sandy/stony plains

SS Tb ScSe

Hummock Grassland of *Triodia basedowii* with Low Open Shrubs of *Sida cardiophylla* and *Seringia elliptica* with Scattered Shrubs of *Acacia ayersiana*, *Acacia kempeana* and *Eremophila forrestii* subsp. *forrestii* on brown loamy sand on sandy/stony plains

SS EffEsEc Tb ApAaApt

Shrubland of *Eremophila forrestii* subsp. *forrestii*, *Eremophila spathulata* and *Eremophila* cf. *citrina* (*Eremophila latrobei* subsp. *latrobei*) over Open Hummock Grassland of *Triodia basedowii* with Low Open Woodland of *Acacia pruinocarpa*, *Acacia ayersiana* and *Acacia pteraneura* and High Open Shrubland of *Acacia incurvaneura* and *Acacia ramulosa* var. *linophylla* on brown loamy sand on sandy/stony plains

SS Tb AiAp Ar

Humock Grassland of *Triodia basedowii* with Low Open Woodland of *Acacia incurvaneura* and *Acacia pruinocarpa* (*Grevillea berryana*, *Acacia ayersiana*) and High Open Shrubland of *Acacia rhodophloia* (*Acacia ramulosa* var. *linophylla*, *Acacia thoma*) and Low Open Shrubland of *Eremophila* cf. *citrina* and *Eremophila spathulata* (*Eremophila latrobei* subsp. *latrobei*) on brown/orange sandy loam on sandy/stony plains and low rises

#### Stony Plains

SP Ai EISgEff PsPoSI

High Open Shrubland of *Acacia incurvaneura* (*Acacia pteraneura*, *Acacia pruinocarpa*) over Open Shrubland of *Eremophila fraseri*, *Senna glaucifolia* and *Eremophila forrestii* subsp. *forrestii* (*Eremophila latrobei* subsp. *latrobei*) over Low Open Shrubland of *Ptilotus schwartzii*, *Ptilotus obovatus* and *Solanum lasiophyllum* on brown sandy loam on stony plains

SP AiGbPI EffEII EsEmPs

High Open Shrubland of *Acacia incurvaneura*, *Grevillea berryana* and *Psydrax latifolia* over Open Shrubland of *Eremophila forrestii* subsp. *forrestii* and *Eremophila latrobei* subsp. *latrobei* over Low Open Shrubland of *Eremophila spathulata*, *Eremophila margarathe* and *Ptilotus schwartzii* on orange sandy clay loam on stony plains

SP EexPrEf AiAi

Low Open Shrubland of *Eremophila exilifolia*, *Ptilotus rotundifolius* and *Eremophila fraseri* with Scattered Low Trees of *Acacia fuscaneura* and *Acacia incurvaneura* on orange sandy loam on stony plains

SP Ai EffEcEII PsEd Tb

High Open Shrubland of *Acacia incurvaneura* (*Acacia pruinocarpa*, *Grevillea berryana*) over Open Shrubland of *Eremophila forrestii* subsp. *forrestii*, *Eremophila* cf. *citrina* and *Eremophila latrobei* subsp. *latrobei* over Low Open Shrubland *Ptilotus schwartzii* and *Eremophila* cf. *demissa* over Very Open Hummock Grassland of *Triodia basedowii* on brown loamy sand on stony plains

SP AptAiAp AsuAthAi

Low Open Woodland of *Acacia pteraneura*, *Acacia incurvaneura* and *Acacia pruinocarpa* over High Open Shrubland of *Acacia subcontorta*, *Acacia thoma* and *Acacia incurvaneura* over Low Open Shrubland of *Sida* cf. *ectogama*, *Eremophila lanata* and *Ptilotus schwartzii* (Scattered Tussock Grassland of *Eriachne mucronata* and *Eragrostis eriopoda*) on brown sandy clay loam on stony plains

SP EIPs EmEe GbAiApt

Low Open Shrubland of *Eremophila lanata* and *Ptilotus schwartzii* over Very Open Tussock Grassland of *Eriachne mucronata* and *Eragrostis eriopoda* with Scattered Tall Shrubs of *Grevillea berryana*, *Acacia incurvaneura* and *Acacia pteraneura* on brown sandy loam on stony plains

SP AiGb EsEmPs

High Open Shrubland of *Acacia incurvaneura* and *Grevillea berryana* over Low Open Shrubland of *Eremophila spathulata*, *Eremophila margarathe* and *Ptilotus schwartzii* (*Eremophila lanata*, *Ptilotus albidus*, *Solanum lasiophyllum*) with Scattered Low Trees of *Acacia pteraneura* on brown sandy clay loam on stony plains

SP EsEPo

Low Open Shrubland of *Eremophila spathulata*, *Eremophila fraseri* and *Ptilotus obovatus* on orange sandy clay loam on stony plains

SP AptAi AcISgl

High Open Shrubland of *Acacia pteraneura* and *Acacia incurvaneura* (*Acacia macraneura*, *Hakea preissii*) over Open Shrubland of *Acacia cultbertsonii* subsp. *linearis* and *Senna glutinosa* subsp. *x luerssenii* over Low Open Shrubland of *Eremophila margarethae*, *Senna stricta* and *Ptilotus obovatus* on brown sandy loam on stony plains

SP SmFs Apt HpSm

Low Open Shrubland of *Senna* sp. *Meekatharra* (E. Bailey 1-26), *Frankenia setosa* and *Sclerolaena* ssp. with Scattered Tall Shrubs of *Acacia pteraneura* over Scattered Shrubs of *Hakea preissii* and *Senna* sp. *Meekatharra* (E. Bailey 1-26) on brown sandy loam on stony plains

#### Flood Plain

FP Ai ArIPIGb EffSeEf

Low Open Forest (to Low Closed Forest) of *Acacia incurvaneura* (*Acacia pruinocarpa*, *Acacia ayersiana*, *Acacia aptaneura*, *Acacia aneura*, *Grevillea berryana*) over High Shrubland of *Acacia ramulosa* var. *linophylla*, *Psydrax latifolia* and *Grevillea berryana* over Shrubland of *Eremophila forrestii* subsp. *forrestii*, *Sida* cf. *ectogama* and *Eremophila fraseri* over Very Open Tussock Grassland of *Thyridolepis xerophila* and *Eragrostis eriopoda* and Very Open Herbs of *Cheilanthes austrotenuifolia* on brown sandy clay loam on floodplains

#### Major Drainage Line

MA AapAanAi TIEkCf

Low Closed Forest of *Acacia aptaneura*, *Acacia aneura* and *Acacia incurvaneura* over Open Tussock Grassland of *Tripogonella loliformis*, *Eragrostis kennedyae* and *Chrysopogon fallax* with High Open Shrubland of *Acacia tetragonophylla* and Very Open Herbs of *Cheilanthes austrotenuifolia* and *Evolvulus alsinoides* on brown silty clay loam on major drainage lines

MA AanAcAm PIARiAT Tt

Low Closed Forest of *Acacia aneura*, *Acacia citrinoviridis* and *Acacia macraneura* over High Open Shrubland of *Psydrax latifolia*, *Acacia ramulosa* var. *linophylla* and *Acacia tetragonophylla* over Very Open Tussock Grassland of *Themeda triandra* on brown loamy sandy on major drainage lines

MA AmApt AcrAIAss

Low Open Forest of *Acacia macraneura* and *Acacia pteraneura* (*Eucalyptus victrix*) over High Open Shrubland of *Acacia craspedocarpa*, *Acacia tetragonophylla* and *Acacia sclerosperma* subsp. *sclerosperma* over Low Open Shrubland of *Senna artemisioides* subsp. *artemisioides*, *Eremophila margarethae* and *Ptilotus obovatus* over Very Open Tussock Grassland of *Chrysopogon fallax*, *Themeda triandra* and *Eragrostis kennedyae* on brown sand on major drainage lines

#### Medium Drainage Line

ME AapAan EFEff

Low Open Forest of *Acacia aptaneura* and *Acacia aneura* over Open Shrubland of *Eremophila fraseri* and *Eremophila forrestii* subsp. *forrestii* over Very Open Tussock Grassland of *Themeda triandra* on brown sandy clay loam on medium drainage lines

ME Ai TI

Low Open Forest of *Acacia incurvaneura* over Open Tussock Grassland of *Tripogonella loliformis* with Open Shrubland of *Sida* cf. *ectogama* (*Eremophila fraseri* and *Acacia tetragonophylla*) on brown loamy sand on medium drainage lines and floodplains

#### Minor Drainage Line

MI ArI Apt

Scattered Tall Shrubs of *Acacia ramulosa* var. *linophylla* and *Acacia pteraneura* over Scattered Low Shrubs of *Acacia sibirica* on brown sandy loam on minor drainage lines (eroded channels)

MI AptAcGb DpAc SeShSsp

Low Woodland of *Acacia pteraneura*, *Acacia citrinoviridis* and *Grevillea berryana* (*Acacia pruinocarpa*) over High Open Shrubland of *Dodonaea pachyneura* and *Acacia craspedocarpa* (hybrid) over Low Open Shrubland of *Sida* cf. *ectogama*, *Senna artemisioides* subsp. *helmsii* and *Scaevola spinescens* (Open Shrubland of *Senna glutinosa* subsp. *x luerssenii*) on brown sandy loam on minor drainage lines

MI Ac DpAISsp

Low Open Woodland of *Acacia citrinoviridis* (*Acacia pteraneura*) over Open Shrubland of *Dodonaea pachyneura*, *Acacia tetragonophylla* and *Scaevola spinescens* over Very Open Hummock Grassland of *Triodia basedowii* on orange silty loam on hillslopes and minor drainage lines

#### Other

Disturbed

Mosaic of HP Tb AiAth EffEIPs & SP EIPs EmEe GbAiApt

Mosaic of Hummock Grassland of *Triodia basedowii* with High Open Shrubland of *Acacia incurvaneura* and *Acacia thoma* and Low Open Shrubland of *Eremophila forrestii* subsp. *forrestii*, *Eremophila lanata* and *Ptilotus schwartzii* (Scattered Low Trees of *Acacia pruinocarpa* and *Grevillea berryana*) on orange sandy clay loam on hardpan plains & Low Open Shrubland of *Eremophila lanata* and *Ptilotus schwartzii* over Very Open Tussock Grassland of *Eriachne mucronata* and *Eragrostis eriopoda* with Scattered Tall Shrubs of *Grevillea berryana*, *Acacia incurvaneura* and *Acacia pteraneura* on brown sandy loam on stony plains

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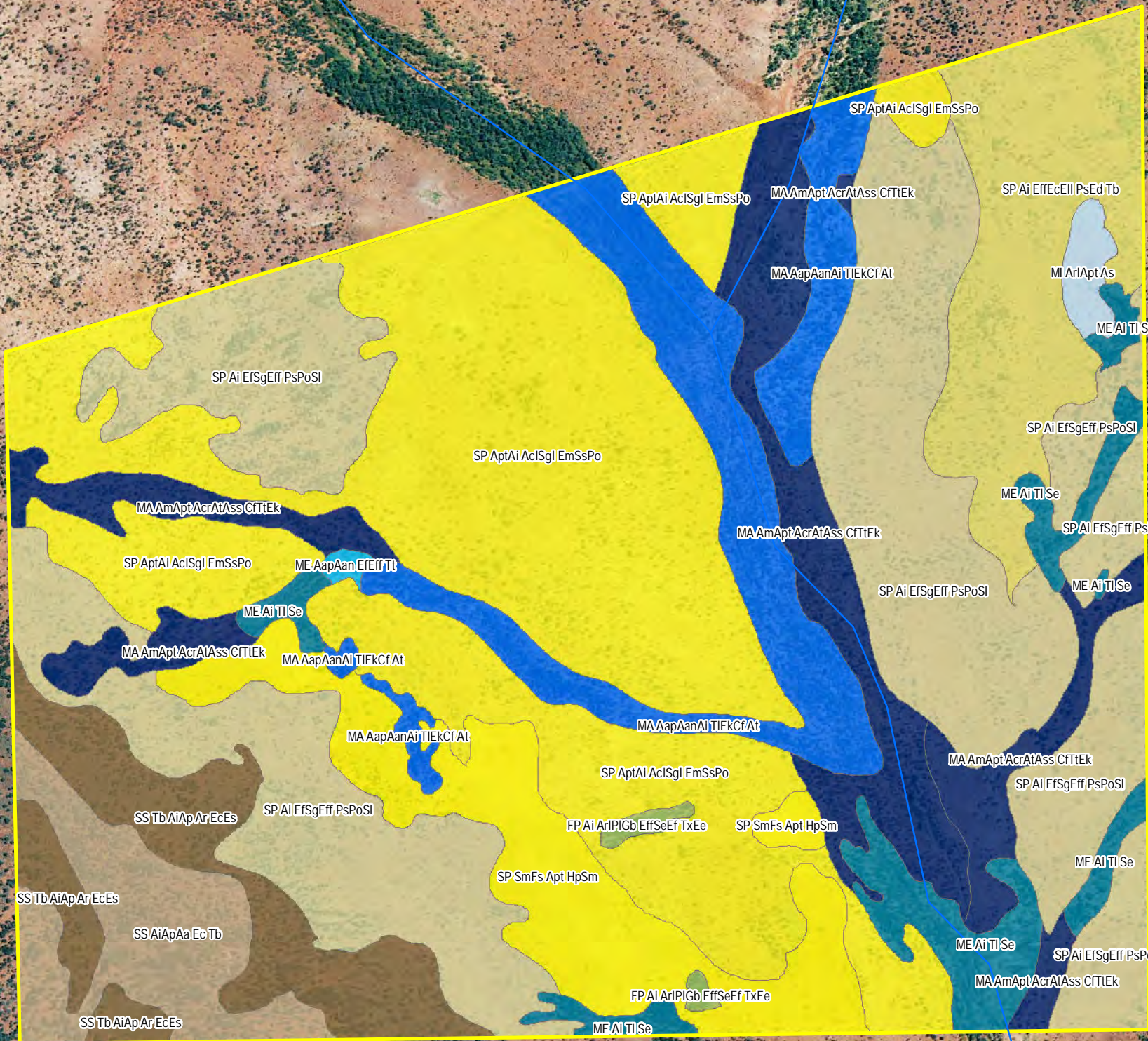
# VANGO

## Marymia

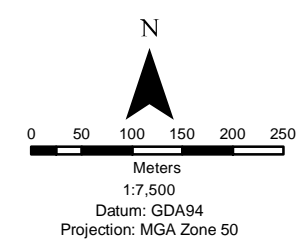
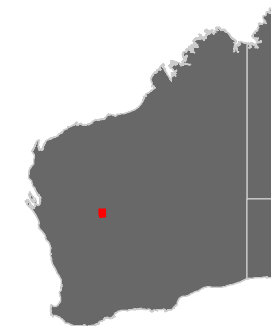
### Apex Vegetation Types

#### Legend

Survey Areas



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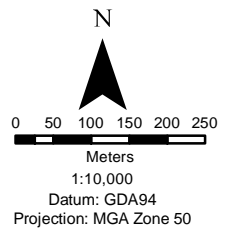
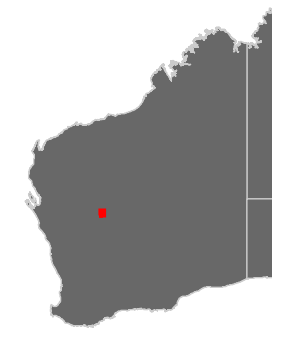
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## Marymia

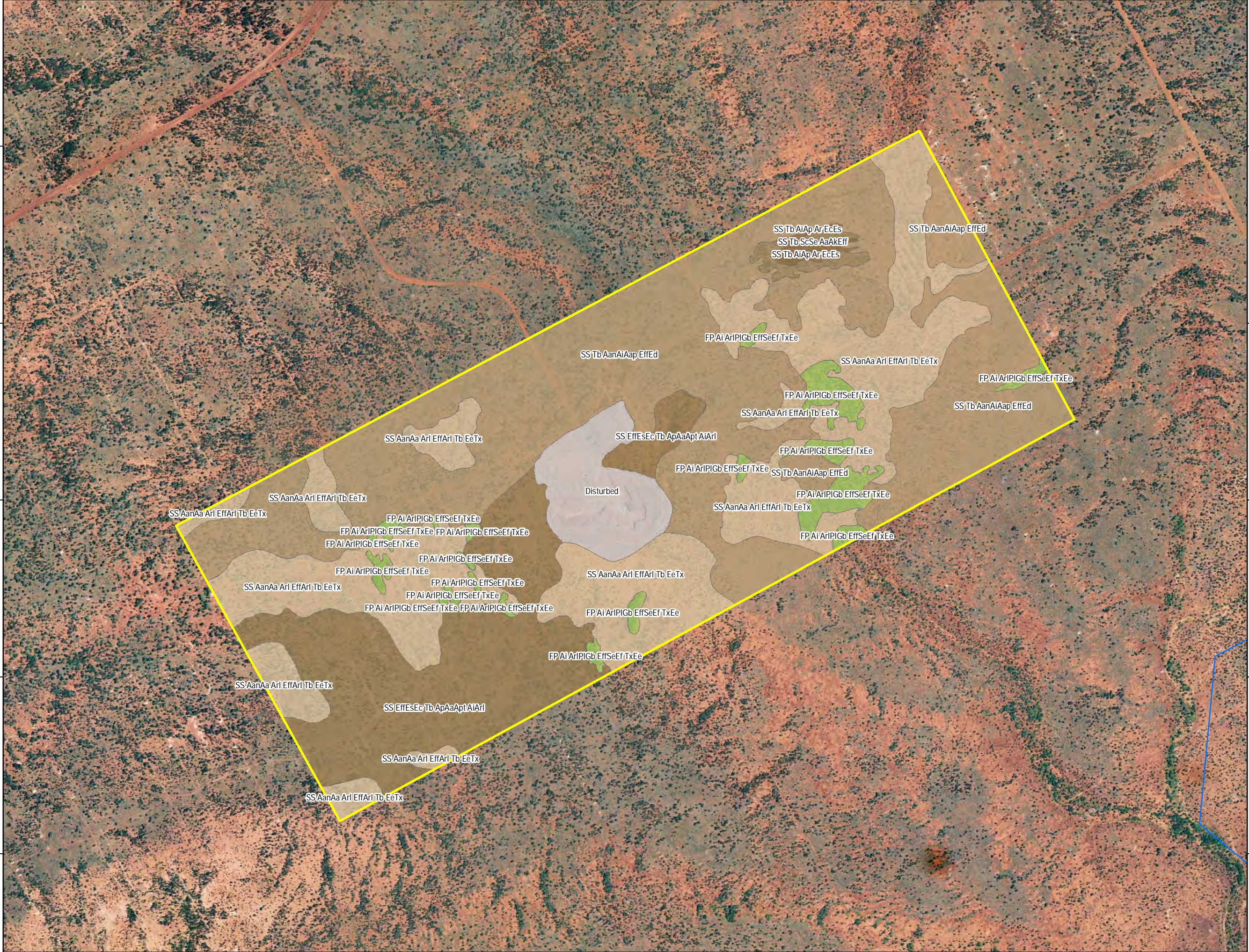
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#### Legend

Survey Areas

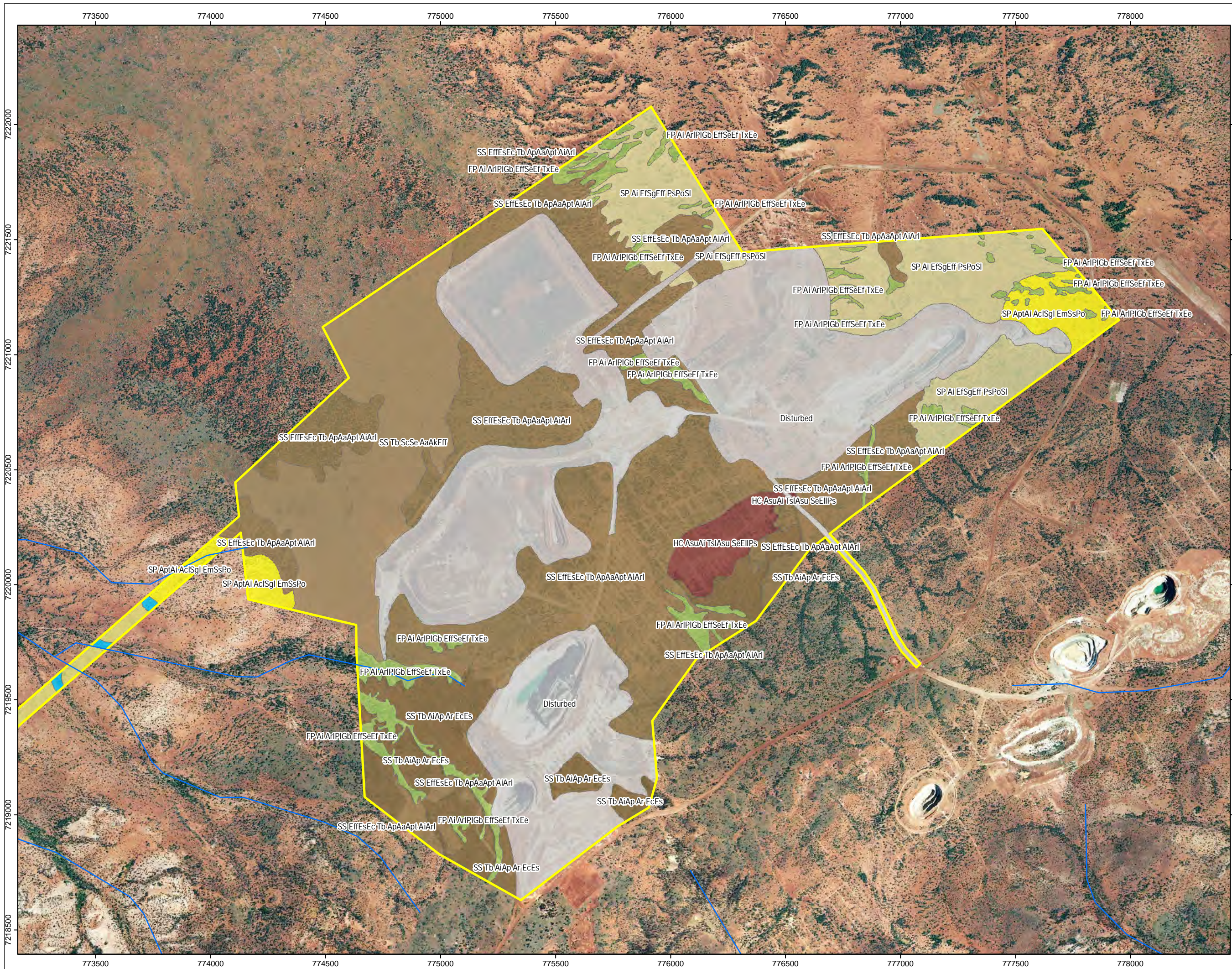


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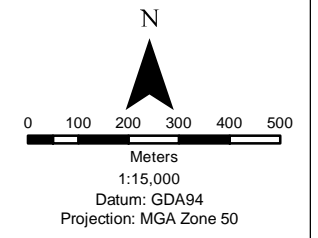
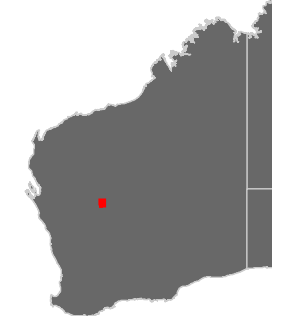
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**VANGO**  
**Marymia**  
**K2**  
**Vegetation Types**

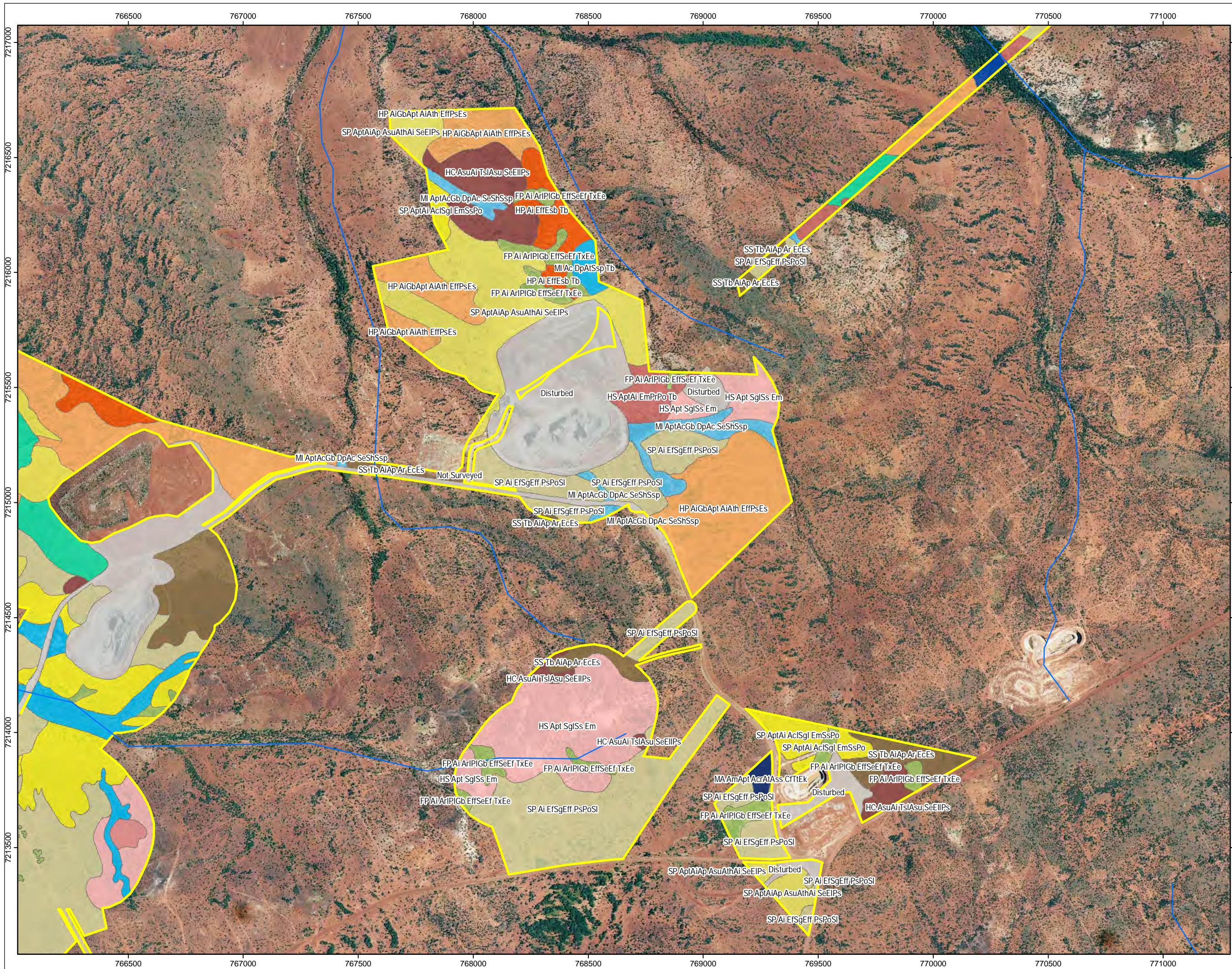
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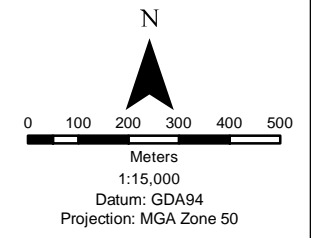
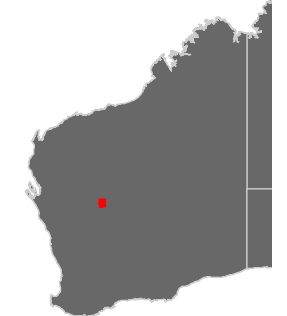


**VANGO**  
**Marymia**

**Wedgetail, Mareast & Ibis Area**  
**Vegetation Types**

**Legend**

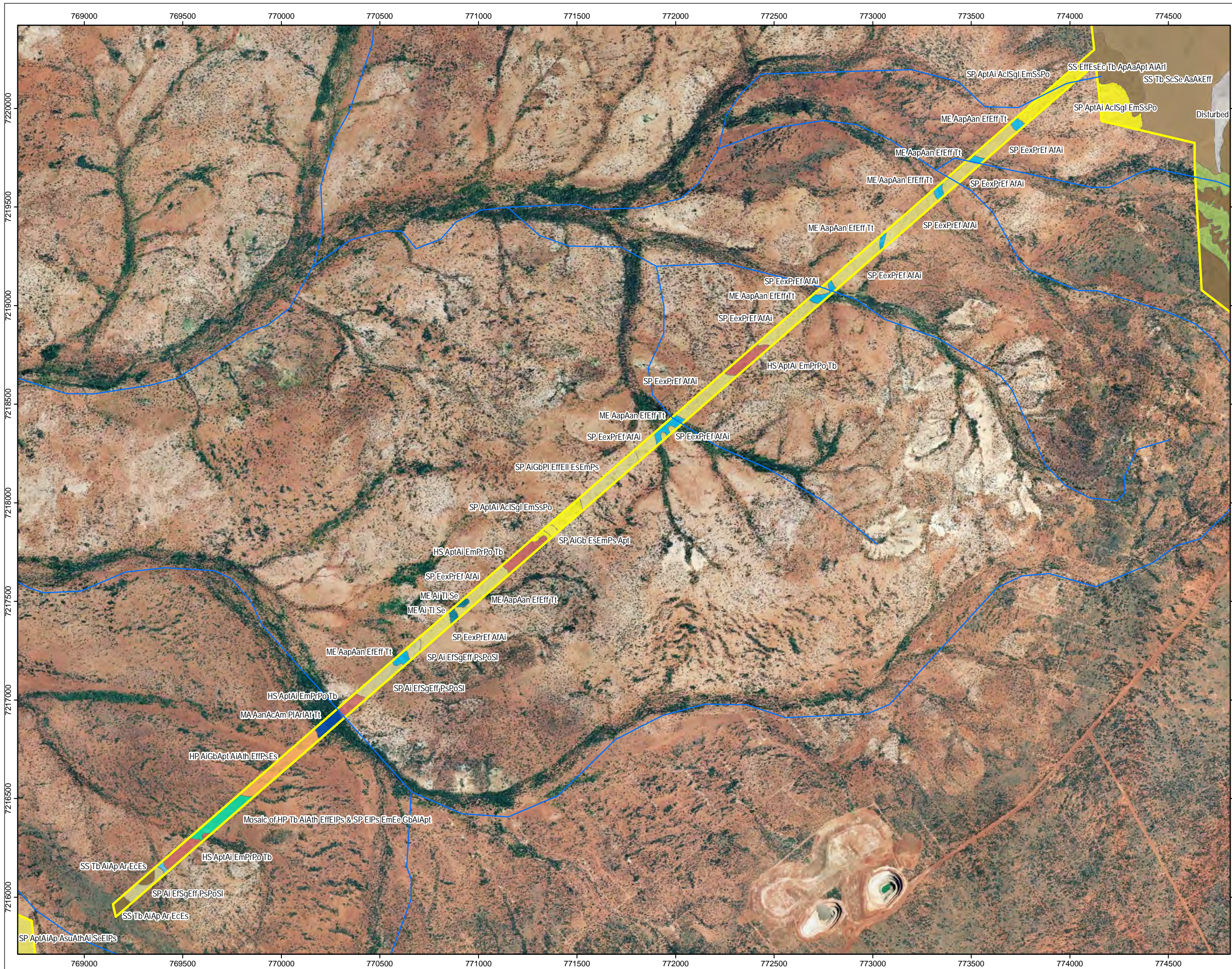
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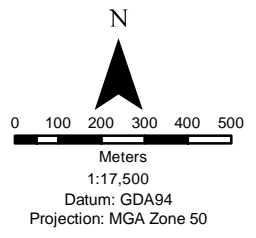
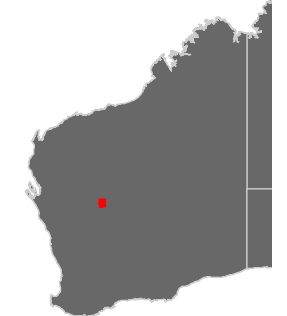


**VANGO**  
**Marymia**

**Access Road**  
**Vegetation Types**

**Legend**

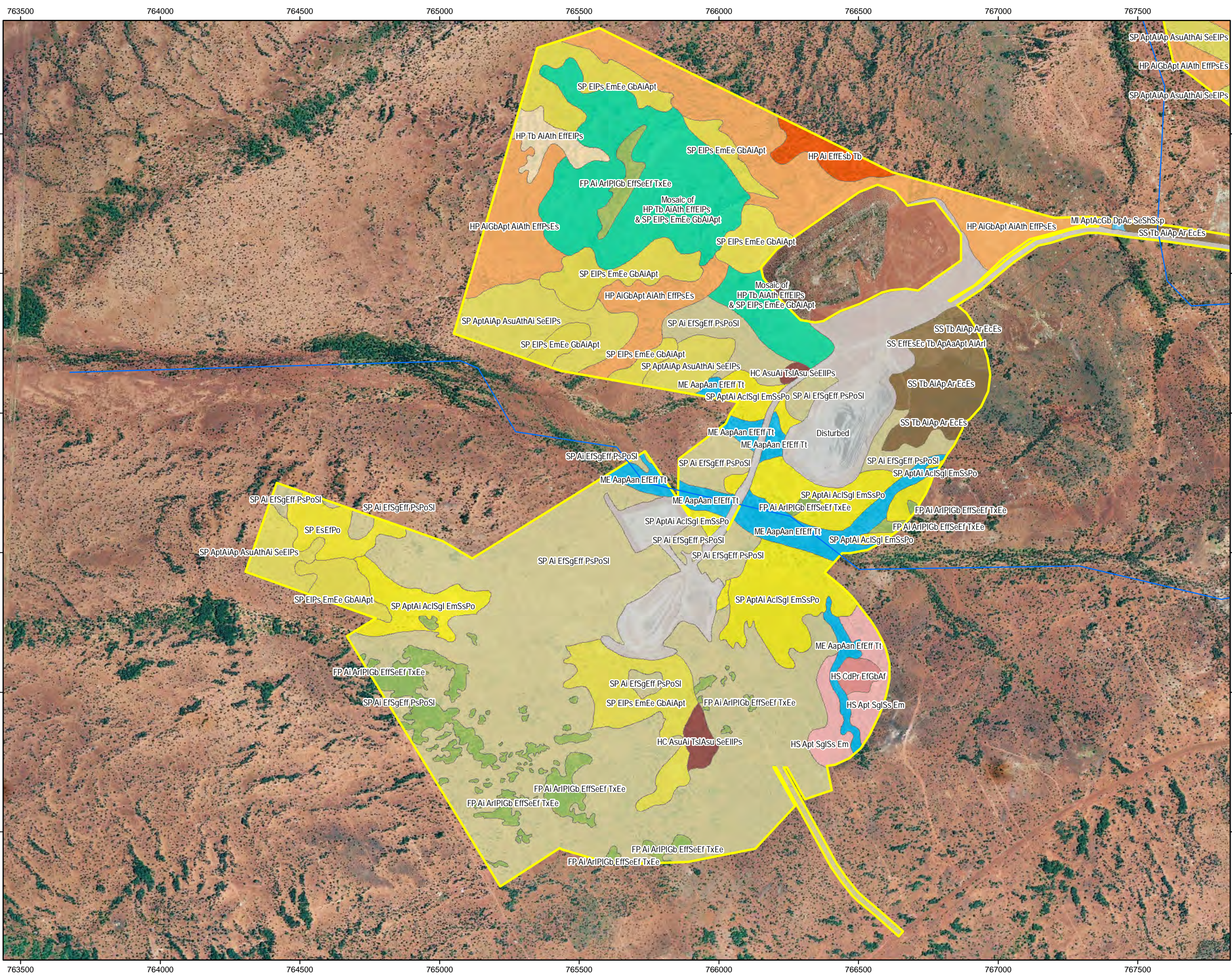
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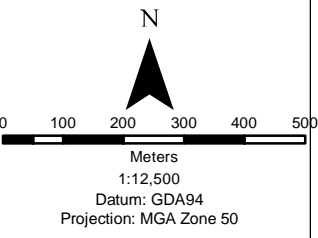
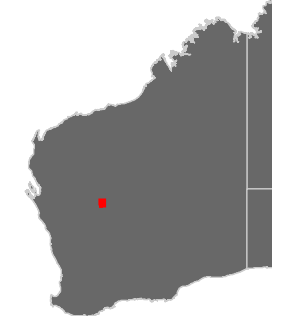






**VANGO**  
**Marymia**  
**Trident Area**  
**Vegetation Types**

**Legend**  
 Survey Areas



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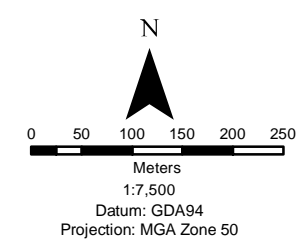
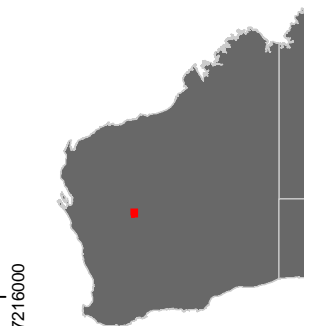
# VANGO

## Marymia

### Apex Vegetation Condition

#### Legend

- Survey Areas
- Vegetation Condition**
- Disturbed
- Good
- Very Good



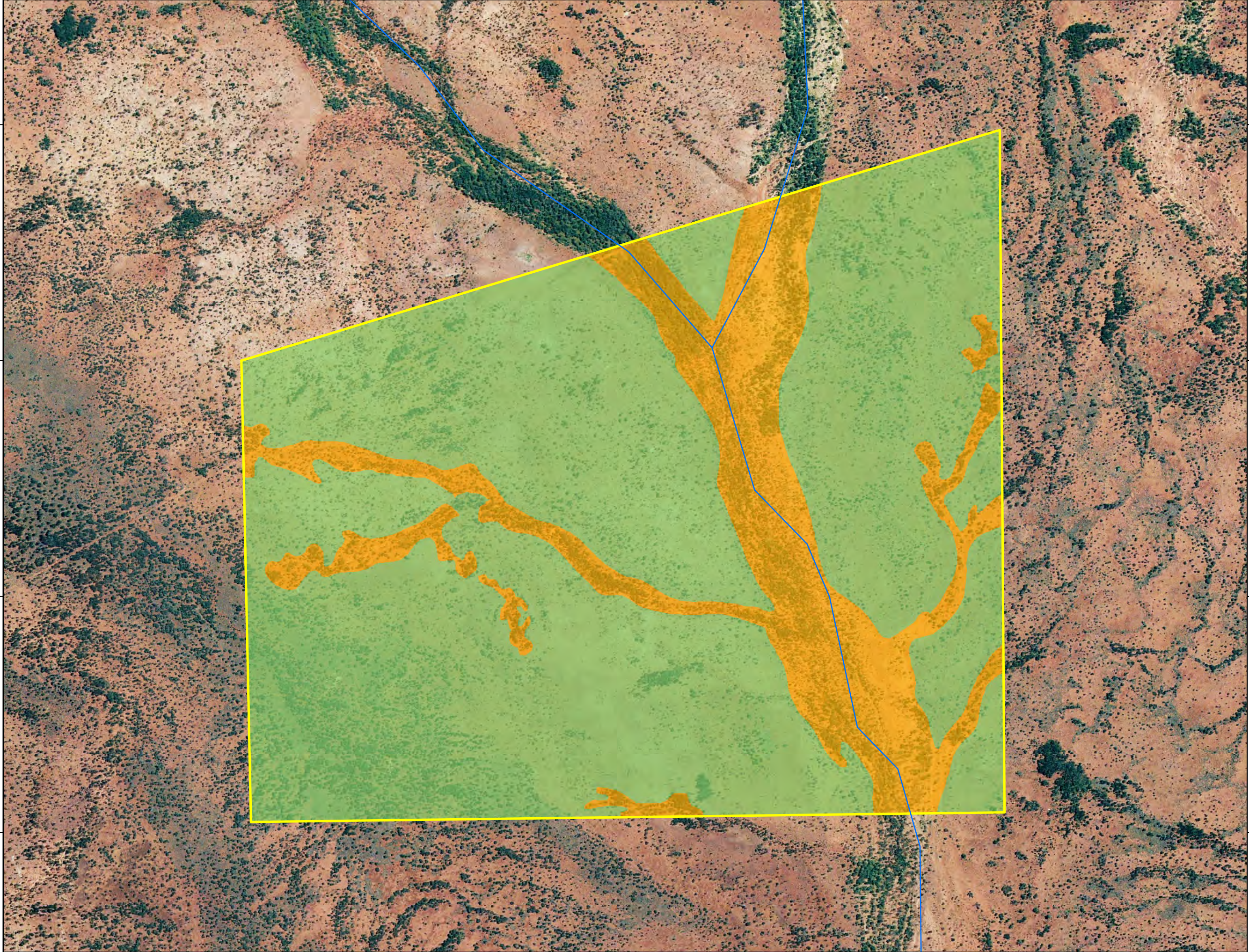
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# VANGO

## Marymia

### Cinnamon Vegetation Condition

#### Legend

- Survey Areas
- Vegetation Condition**
- Disturbed
- Good
- Very Good

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# VANGO

## Marymia

### K2 Vegetation Condition

#### Legend

Survey Areas

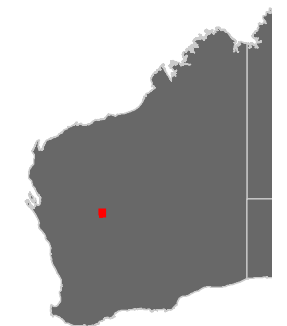
#### Vegetation Condition

Disturbed

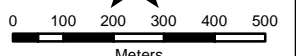
Good

Very Good

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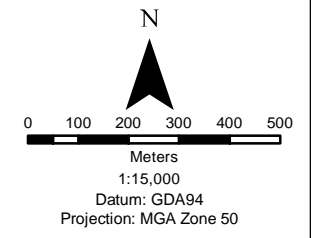
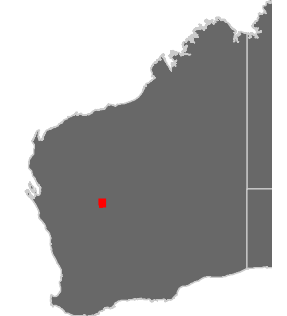
**VANGO**

**Marymia**

**Wedgetail, Mareast  
& Ibis Area  
Vegetation  
Condition**

**Legend**

- Survey Areas
- Vegetation Condition**
- Disturbed
- Good
- Very Good



Date: 11/06/2019  
 Status: Final  
 Figure: 9  
 Sheet Size: A3  
 Internal Reference: Marymia\_MarE\_VC  
 Drawn by: GSM  
 Requested by: DB







# VANGO

## Marymia

### Access Road Vegetation Condition

#### Legend

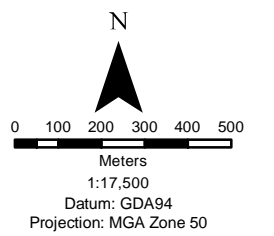
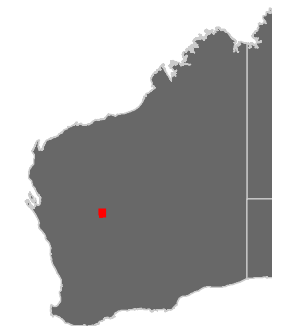
Survey Areas

#### Vegetation Condition

Disturbed

Good

Very Good



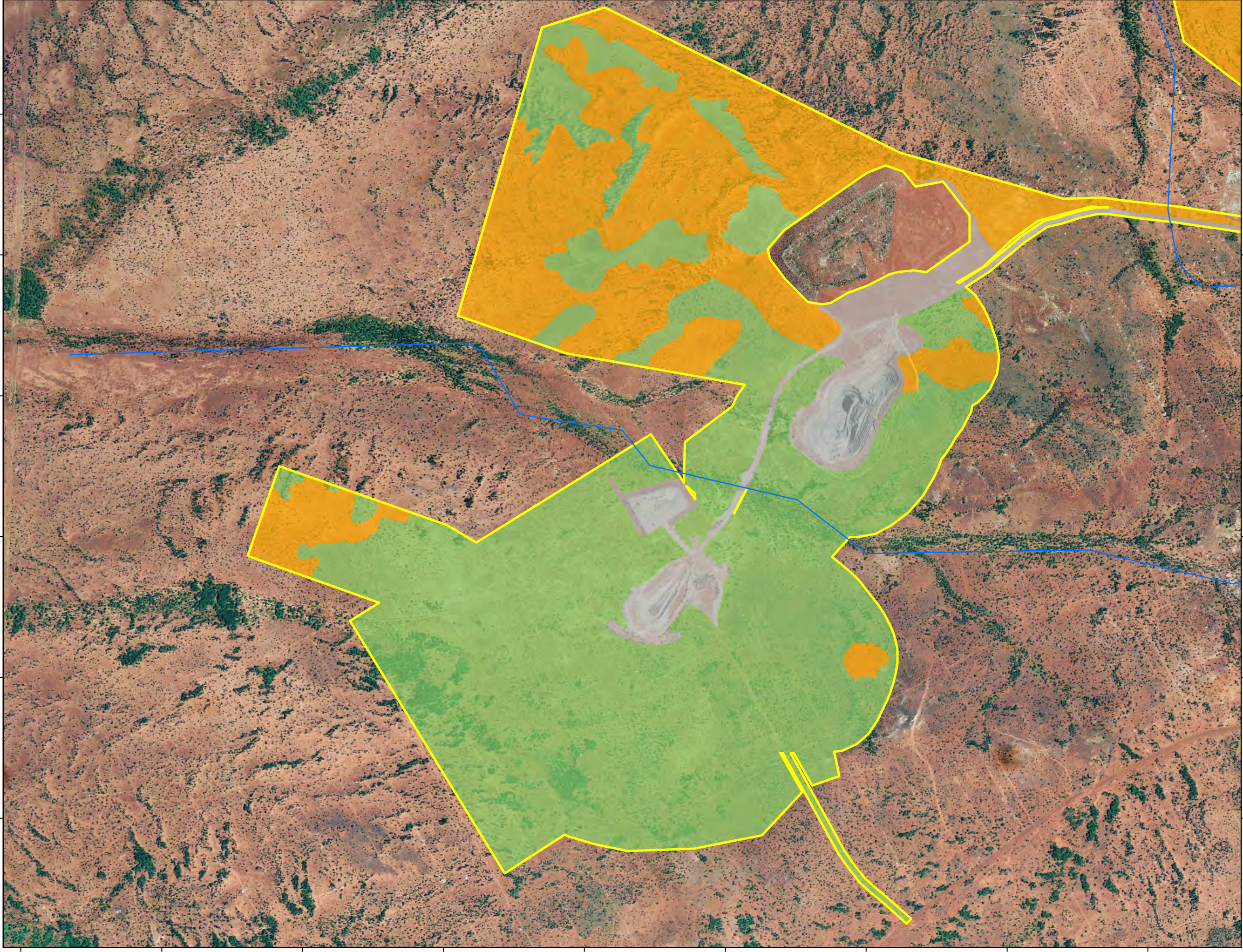
Date: 11/06/2019  
Status: Final  
Figure: 9  
Sheet Size: A3  
Internal Reference: Marymia\_road\_VC  
Drawn by: GSM  
Requested by: DB





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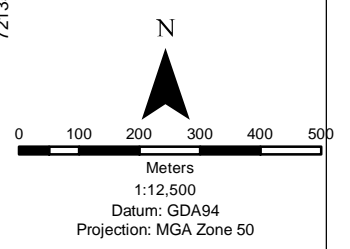
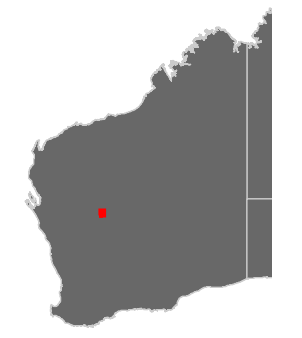
**VANGO**

**Marymia**

**K2  
Vegetation  
Condition**

**Legend**

- Survey Areas
- Vegetation Condition**
- Disturbed
- Good
- Very Good



Date: 11/06/2019  
 Status: Final  
 Figure: 9  
 Sheet Size: A3  
 Internal Reference: Marymia\_K2\_VC  
 Drawn by: GSM  
 Requested by: DB



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**Broad Floristic Formation** *Acacia* High Open Shrubland  
**Vegetation Association** HC AsuAi TslAsu SeEllPs - High Open Shrubland of *Acacia subcontorta* and *Acacia incurvaneura* over Open Shrubland of *Thryptomene* sp. Leinster (B.J. Lepschi & L.A. Craven 4362) and *Acacia subcontorta* over Low Open Shrubland of *Sida* cf. *ectogama*, *Eremophila latrobei* subsp. *latrobei* and *Ptilotus schwartzii* (over Very Open Tussock Grassland of *Eriachne mucronata*, *Thyridolepis xerophila* and *Eragrostis eriopoda*) on orange sandy loam on weathered ironstone ridges and hill crests



Area Mapped	30.74 ha
Quadrats Sampled	IB-01, K2-08, K2-17, MA-01, TRI-15, WE-04
Soils	Orange Sandy Loam
Land Form	Hill crest/ Upper Hill slopes of weathered ironstone ridges
Priority Ecological Community	No
Conservation Significant Flora	<i>Eremophila lanata</i> (P3) <i>Thryptomene</i> sp. Leinster (B.J. Lepschi & L.A. Craven 4362) (P3) <i>Calytrix praecipua</i> (P3)
Introduced Species	None recorded
Vegetation Condition	Very Good
Disturbances	Road/access track, cattle grazing
Average Fire Age	Old (6+ years)
<b>Vegetation Structure &amp; Floristics</b>	
Shrubs >2 m	<i>Acacia subcontorta</i> , <i>Acacia incurvaneura</i> , <i>Acacia ramulosa</i> var. <i>linophylla</i> , <i>Acacia mulganeura</i> , <i>Grevillea berryana</i> , <i>Acacia pteraneura</i>
Shrubs 1-2 m	<i>Thryptomene</i> sp. Leinster (B.J. Lepschi & L.A. Craven 4362), <i>Acacia subcontorta</i>
Shrubs 0-1 m	<i>Sida</i> cf. <i>ectogama</i> , <i>Eremophila latrobei</i> subsp. <i>latrobei</i> , <i>Ptilotus schwartzii</i> , <i>Calytrix praecipua</i>
Tussock Grasses	<i>Eriachne mucronata</i> , <i>Thyridolepis xerophila</i> , <i>Eragrostis eriopoda</i>




**Broad Floristic Formation** *Acacia* High Open Shrubland  
**Vegetation Association** SP Ai EffEcEII PsEd - High Open Shrubland of *Acacia incurvaneura* (*Acacia pruinocarpa*, *Grevillea berryana*) over Open Shrubland of *Eremophila forrestii* subsp. *forrestii*, *Eremophila* cf. *citrina* and *Eremophila latrobei* subsp. *latrobei* over Low Open Shrubland *Ptilotus schwartzii* and *Eremophila* cf. *demissa* on brown loamy sand on stony plains



Area Mapped	14.34 ha
Quadrats Sampled	APEX-07
Soils	Brown Loamy Sand
Land Form	Stony Plain
Priority Ecological Community	No
Conservation Significant Flora	<i>Eremophila</i> cf. <i>demissa</i> (P1) <i>Goodenia virgata</i> (P2) <i>Hemigenia tysonii</i> (P3)
Introduced Species	None recorded
Vegetation Condition	Very Good
Disturbances	Cattle Grazing
Average Fire Age	Old (6+ years)
<b>Vegetation Structure &amp; Floristics</b>	
Shrubs >2 m	<i>Acacia incurvaneura</i> , <i>Acacia pruinocarpa</i> , <i>Grevillea berryana</i>
Shrubs 1-2 m	<i>Eremophila forrestii</i> subsp. <i>forrestii</i> , <i>Eremophila</i> cf. <i>citrina</i> , <i>Eremophila latrobei</i> subsp. <i>latrobei</i>
Shrubs 0-1 m	<i>Ptilotus schwartzii</i> , <i>Eremophila</i> cf. <i>demissa</i>
Hummock Grasses	<i>Triodia basedowii</i>



Broad Floristic Formation	<i>Acacia</i> High Open Shrubland
Vegetation Association	SP Ai EfSgEff PsPoSl - High Open Shrubland of <i>Acacia incurvaneura</i> ( <i>Acacia pteraneura</i> , <i>Acacia pruinocarpa</i> ) over Open Shrubland of <i>Eremophila fraseri</i> , <i>Senna glaucifolia</i> and <i>Eremophila forrestii</i> subsp. <i>forrestii</i> ( <i>Eremophila latrobei</i> subsp. <i>latrobei</i> ) over Low Open Shrubland of <i>Ptilotus schwartzii</i> , <i>Ptilotus obovatus</i> and <i>Solanum lasiophyllum</i> on brown sandy loam on stony plains
	
Area Mapped	311.18 ha
Quadrats Sampled	APEX-02, K2-16, ME-04, MW-02, TP-13, TRI-01, TRI-03, TRI-06, TRI-09, TRI-16, TRI-17, TRI-18, WE-06, WE-07, K2-11 (i/g), K2-14 (i/g), TRI-08 (i/g), TRI-10 (i/g)
Soils	Brown Sandy Loam
Land Form	Stony Plain (ironstone/quartz)
Priority Ecological Community	No
Conservation Significant Flora	<i>Goodenia virgata</i> (P2) <i>Eremophila lanata</i> (P3)
Introduced Species	None recorded
Vegetation Condition	Very Good
Disturbances	Cattle Grazing, Mining Exploration, Road/Access Track
Average Fire Age	Old (6+ years)
Vegetation Structure & Floristics	
Trees <10m	<i>Acacia pteraneura</i> , <i>Acacia pruinocarpa</i> , <i>Grevillea berryana</i> , <i>Acacia paraneura</i> , <i>Acacia aptaneura</i> , <i>Acacia ayersiana</i>
Shrubs >2 m	<i>Acacia incurvaneura</i> , <i>Acacia pteraneura</i> , <i>Acacia pruinocarpa</i> , <i>Acacia ramulosa</i> var. <i>linophylla</i> , <i>Acacia thoma</i> , <i>Psydrax latifolia</i> , <i>Acacia rhodophloia</i> , <i>Acacia aneura</i> , <i>Acacia cuthbertsonii</i> subsp. <i>linearis</i>
Shrubs 1-2 m	<i>Eremophila fraseri</i> , <i>Senna glaucifolia</i> , <i>Eremophila forrestii</i> subsp. <i>forrestii</i> , <i>Eremophila latrobei</i> subsp. <i>latrobei</i> , <i>Acacia thoma</i> , <i>Eremophila forrestii</i> subsp. <i>forrestii</i> , <i>Senna glutinosa</i> subsp. <i>x luerssenii</i> , <i>Senna artemisioides</i> subsp. <i>helmsii</i> , <i>Scaevola spinescens</i> , <i>Acacia tetragonophylla</i>
Shrubs 0-1 m	<i>Ptilotus schwartzii</i> , <i>Ptilotus obovatus</i> , <i>Solanum lasiophyllum</i> , <i>Senna glaucifolia</i> , <i>Senna artemisioides</i> subsp. <i>oligophylla</i> , <i>Eremophila margarathe</i> , <i>Ptilotus rotundifolius</i> , <i>Eremophila spathulata</i> , <i>Maireana georgei</i> , <i>Eremophila punctate</i> , <i>Sida</i> cf. <i>ectogama</i> , <i>Eremophila spectabilis</i> , <i>Senna</i> sp. Meekatharra (E. Bailey 1-26)
Hummock Grassland	<i>Triodia basedowii</i>
Tussock Grassland	<i>Eragrostis eriopoda</i> , <i>Eriachne mucronata</i>



Broad Floristic Formation *Acacia* High Open Shrubland  
Vegetation Association SP EIPs EmEe GbAiApt - Low Open Shrubland of *Eremophila lanata* and *Ptilotus schwartzii* over Very Open Tussock Grassland of *Eriachne mucronata* and *Eragrostis eriopoda* with Scattered Tall Shrubs of *Grevillea berryana*, *Acacia incurvaneura* and *Acacia pteraneura* on brown sandy loam on stony plains



Area Mapped	38.82 ha
Quadrats Sampled	TD-01, TD-12, TRI-05, TRI-13, TRI-23
Soils	Brown Sandy Loam
Land Form	Stony Plain
Priority Ecological Community	No
Conservation Significant Flora	<i>Goodenia virgata</i> (P3) <i>Eremophila lanata</i> (P3) <i>Thryptomene</i> sp. Leinster (B.J. Lepschi & L.A. Craven 4362) (P3)
Introduced Species	None recorded
Vegetation Condition	Very Good
Disturbances	Cattle Grazing, Mining Exploration, Road/Access Track
Average Fire Age	Old (6+ years)
<b>Vegetation Structure &amp; Floristics</b>	
Shrubs >2 m	<i>Grevillea berryana</i> , <i>Acacia incurvaneura</i> , <i>Acacia pteraneura</i> , <i>Acacia thoma</i> , <i>Acacia aptaneura</i> , <i>Acacia ramulosa</i> var. <i>linophylla</i>
Shrubs 0-1 m	<i>Eremophila lanata</i> , <i>Ptilotus schwartzii</i> , <i>Solanum lasiophyllum</i> , <i>Senna glaucifolia</i>
Tussock Grasses	<i>Eriachne mucronata</i> , <i>Eragrostis eriopoda</i> , <i>Amphipogon</i> sp. indet
Hummock Grasses	<i>Triodia basedowii</i>



**Broad Floristic Formation** *Acacia* High Open Shrubland  
**Vegetation Association** SP AptAi AclSgl EmSsPo - High Open Shrubland of *Acacia pteraneura* and *Acacia incurvaneura* (*Acacia macraneura*, *Hakea preissii*) over Open Shrubland of *Acacia cuthbertsonii* subsp. *linearis* and *Senna glutinosa* subsp. *x luerssenii* over Low Open Shrubland of *Eremophila margarethae*, *Senna stricta* and *Ptilotus obovatus* on brown sandy loam on stony plains



Area Mapped	110.16 ha
Quadrats Sampled	IB-02, K2-15, K2-19, MA-04, MW-01, MW-06, TP-04, TRI-04, TRI-12, TRI-14, TRI-19
Soils	Brown Sandy Loam
Land Form	Stony plain
Priority Ecological Community	No
Conservation Significant Flora	<i>Eremophila lanata</i> (P3)
Introduced Species	None recorded
Vegetation Condition	Very Good
Disturbances	Cattle Grazing; Mining Exploration; Road/Access Track; Rubbish
Average Fire Age	Old (6+ years)
<b>Vegetation Structure &amp; Floristics</b>	
Shrubs >2 m	<i>Acacia pteraneura</i> , <i>Acacia incurvaneura</i> , <i>Acacia macraneura</i> , <i>Hakea preissii</i>
Shrubs 1-2 m	<i>Acacia cuthbertsonii</i> subsp. <i>linearis</i> , <i>Senna glutinosa</i> subsp. <i>x luerssenii</i>
Shrubs 0-1 m	<i>Eremophila margarethae</i> , <i>Senna stricta</i> , <i>Ptilotus obovatus</i> , <i>Ptilotus albidus</i> , <i>Senna</i> sp. Meekatharra (E. Bailey 1-26), <i>Senna artemisioides</i> subsp. <i>helsmii</i>



Broad Floristic Formation *Senna* Low Open Shrubland  
Vegetation Association SP SmFs Apt HpSm - Low Open Shrubland of *Senna* sp. Meekatharra (E. Bailey 1-26), *Frankenia setosa* and *Sclerolaena* spp. with Scattered Tall Shrubs of *Acacia pteraneura* over Scattered Shrubs of *Hakea preissii* and *Senna* sp. Meekatharra (E. Bailey 1-26) on brown sandy loam on stony plains



Area Mapped	13.73 ha
Quadrats Sampled	APEX-01
Soils	Brown Sandy Loam
Land Form	Stony plain
Priority Ecological Community	No
Conservation Significant Flora	None recorded
Introduced Species	None recorded
Vegetation Condition	Very Good
Disturbances	Cattle Grazing
Average Fire Age	Old (6+ years)
<b>Vegetation Structure &amp; Floristics</b>	
Shrubs >2 m	<i>Acacia pteraneura</i>
Shrubs 1-2 m	<i>Hakea preissii</i> , <i>Senna</i> sp. Meekatharra (E. Bailey 1-26)
Shrubs 0-1 m	<i>Senna</i> sp. Meekatharra (E. Bailey 1-26), <i>Frankenia setosa</i> , <i>Sclerolaena</i> spp.



**Broad Floristic Formation** *Acacia* Low Woodland  
**Vegetation Association** SS AanAa Arl EffArl Tb EeTx - Low Woodland of *Acacia aneura* and *Acacia ayersiana* (*Acacia incurvaneura*, *Acacia pteraneura*, *Acacia pruinocarpa*) over High Open Shrubland of *Acacia ramulosa* var. *linophylla* over Open Shrubland of *Eremophila forrestii* subsp. *forrestii* and *Acacia ramulosa* var. *linophylla* (over Very Open Hummock Grassland of *Triodia basedowii* over Very Open Tussock Grassland of *Eragrostis eriopoda* and *Thyridolepis xerophila*) on red/orange silty loam on sandy/stony plains



Area Mapped	66.64 ha
Quadrats Sampled	CIN-01, CIN-06, CIN-09, CIN-10
Soils	Orange Silty Loam
Land Form	Sandy/ Stony plain
Priority Ecological Community	No
Conservation Significant Flora	None recorded
Introduced Species	None recorded
Vegetation Condition	Very Good
Disturbances	Cattle Grazing; Mining Exploration
Average Fire Age	Old (6+ years)
<b>Vegetation Structure &amp; Floristics</b>	
Trees <10 m	<i>Acacia aneura</i> , <i>Acacia ayersiana</i> , <i>Acacia incurvaneura</i> , <i>Acacia pteraneura</i> , <i>Acacia pruinocarpa</i>
Shrubs >2 m	<i>Acacia ramulosa</i> var. <i>linophylla</i>
Shrubs 1-2 m	<i>Eremophila forrestii</i> subsp. <i>forrestii</i> , <i>Acacia ramulosa</i> var. <i>linophylla</i>
Hummock Grasses	<i>Triodia basedowii</i>
Tussock Grasses	<i>Eragrostis eriopoda</i> , <i>Thyridolepis xerophila</i>



**Broad Floristic Formation** *Acacia* Low Open Forest  
**Vegetation Association** SS AiApAa Ec Tb - Low Open Forest of *Acacia incurvaneura*, *Acacia pruinocarpa* and *Acacia ayersiana* over Shrubland of *Eremophila* cf. *citrina* (*Eremophila forrestii* subsp. *forrestii*) over Open Hummock Grassland of *Triodia basedowii* on brown sandy loam on sandy/stony plains



Area Mapped	8.21 ha
Quadrats Sampled	APEX-04
Soils	Brown Sandy Loam
Land Form	Sandy/ Stony plain
Priority Ecological Community	No
Conservation Significant Flora	None recorded
Introduced Species	None recorded
Vegetation Condition	Very Good
Disturbances	Cattle Grazing
Average Fire Age	Old (6+ years)
<b>Vegetation Structure &amp; Floristics</b>	
Trees <10 m	<i>Acacia incurvaneura</i> , <i>Acacia pruinocarpa</i> , <i>Acacia ayersiana</i>
Shrubs 1-2 m	<i>Eremophila</i> cf. <i>citrina</i> , <i>Eremophila forrestii</i> subsp. <i>forrestii</i>
Hummock Grasses	<i>Triodia basedowii</i>



Broad Floristic Formation *Acacia* Low Open Forest  
Vegetation Association SS EffEsEc Tb ApAaApt AiArI - Shrubland of *Eremophila forrestii* subsp. *forrestii*, *Eremophila spathulata* and *Eremophila* cf. *citrina* (*Eremophila latrobei* subsp. *latrobei*) over Open Hummock Grassland of *Triodia basedowii* with Low Open Woodland of *Acacia pruinocarpa*, *Acacia ayersiana* and *Acacia pteraneura* (and High Open Shrubland of *Acacia incurvaneura* and *Acacia ramulosa* var. *linophylla*) on brown loamy sand on sandy/ stony plains



Area Mapped	221.92 ha
Quadrats Sampled	CIN-02, K2-03, K2-06, K2-07, K2-10, K2-13
Soils	Orange Clay Loam, Sandy
Land Form	Sandy/ Stony plain
Priority Ecological Community	No
Conservation Significant Flora	<i>Hibiscus brachychlaenus</i> (Range extension)
Introduced Species	None recorded
Vegetation Condition	Very Good
Disturbances	Cattle Grazing; Mining Exploration; Road/Access Track; Rubbish; Old Mine nearby
Average Fire Age	Old (6+ years)
<b>Vegetation Structure &amp; Floristics</b>	
Trees <10 m	<i>Acacia pruinocarpa</i> , <i>Acacia ayersiana</i> , <i>Acacia pteraneura</i> , <i>Acacia aneura</i> , <i>Acacia paraneura</i> , <i>Acacia incurvaneura</i> , <i>Grevillea berryana</i>
Shrubs >2 m	<i>Acacia ramulosa</i> var. <i>linophylla</i> , <i>Acacia incurvaneura</i> , <i>Hakea lorea</i> subsp. <i>lorea</i> , <i>Psyrdrax latifolia</i> , <i>Acacia thoma</i> , <i>Acacia subcontorta</i>
Shrubs 1-2 m	<i>Eremophila forrestii</i> subsp. <i>forrestii</i> , <i>Eremophila</i> cf. <i>citrina</i> , <i>Eremophila latrobei</i> subsp. <i>latrobei</i> , <i>Senna glaucifolia</i>
Shrubs <1m	<i>Sida</i> sp. Golden calyces glabrous (H.N. Foote 32), <i>Seringia elliptica</i> , <i>Eremophila punctata</i>
Hummock Grasses	<i>Triodia basedowii</i>
Tussock Grasses	<i>Eragrostis eriopoda</i>



**Broad Floristic Formation** *Acacia* Low Open Forest  
**Vegetation Association** SS Tb AanAiAap EffEd - Hummock Grassland of *Triodia basedowii* with Low Open Woodland of *Acacia aneura*, *Acacia incurvaneura* and *Acacia aptaneura* (*Acacia ayersiana*) and Scattered Low Shrubs of *Eremophila forrestii* subsp. *forrestii* and *Eremophila* cf. *demissa* on orange silty loam on sandy/ stony plains



Area Mapped	94.59 ha
Quadrats Sampled	CIN-04, CIN-05, CIN-08
Soils	Orange Silty Loam
Land Form	Sandy/ Stony plain
Priority Ecological Community	No
Conservation Significant Flora	<i>Eremophila</i> cf. <i>demissa</i> (P1)
Introduced Species	None recorded
Vegetation Condition	Very Good
Disturbances	Cattle Grazing
Average Fire Age	Old (6+ years)
<b>Vegetation Structure &amp; Floristics</b>	
Trees <10 m	<i>Acacia aneura</i> , <i>Acacia incurvaneura</i> , <i>Acacia aptaneura</i> , <i>Acacia ayersiana</i>
Shrubs <1 m	<i>Eremophila forrestii</i> subsp. <i>forrestii</i> , <i>Eremophila</i> cf. <i>demissa</i> , <i>Eremophila granitica</i>
Hummock Grasses	<i>Triodia basedowii</i>



Broad Floristic Formation Triodia Hummock Grassland  
Vegetation Association SS Tb AiAp Ar EcEs - Hummock Grassland of *Triodia basedowii* with Low Open Woodland of *Acacia incurvaneura* and *Acacia pruinocarpa* (*Grevillea berryana*, *Acacia ayersiana*) and High Open Shrubland of *Acacia rhodophloia* (*Acacia ramulosa* var. *linophylla*, *Acacia thoma*) and Low Open Shrubland of *Eremophila* cf. *citrina* and *Eremophila spathulata* (*Eremophila latrobei* subsp. *latrobei*) on brown/orange sandy loam on sandy/ stony plains and low rises



Area Mapped	72.86 ha
Quadrats Sampled	APEX-03, K2-01, K2-02, K2-05, K2-09, MW-05, TP-18
Soils	Brown Sandy Loam
Land Form	Sandy/ Stony plain
Priority Ecological Community	No
Conservation Significant Flora	<i>Sauropus</i> sp. Woolgorong (M. Officer s.n. 10/8/94) (P3)
Introduced Species	None recorded
Vegetation Condition	Very Good
Disturbances	Cattle Grazing; Mining Exploration; Road/ Access Track
Average Fire Age	Old (6+ years)
<b>Vegetation Structure &amp; Floristics</b>	
Trees <10 m	<i>Acacia incurvaneura</i> , <i>Acacia pruinocarpa</i> , <i>Acacia ayersiana</i> , <i>Grevillea berryana</i> , <i>Acacia citrinoviridis</i>
Shrubs >2 m	<i>Acacia rhodophloia</i> , <i>Acacia ramulosa</i> var. <i>linophylla</i> , <i>Acacia thoma</i> , <i>Acacia subcontorta</i> , <i>Acacia mulganeura</i>
Shrubs <1 m	<i>Eremophila</i> cf. <i>citrina</i> , <i>Eremophila spathulata</i> , <i>Eremophila latrobei</i> subsp. <i>latrobei</i> , <i>Ptilotus obovatus</i> , <i>Ptilotus rotundifolius</i> , <i>Senna glaucifolia</i>
Hummock Grasses	<i>Triodia basedowii</i>



Broad Floristic Formation *Triodia* Hummock Grassland  
Vegetation Association SS Tb ScSe AaAKeff - Hummock Grassland of *Triodia basedowii* with Low Open Shrubland of *Sida cardiophylla* and *Seringia elliptica* with Scattered Shrubs of *Acacia ayersiana*, *Acacia kempeana* and *Eremophila forrestii* subsp. *forrestii* on brown loamy sand on sandy/stony plains



Area Mapped	72.97 ha
Quadrats Sampled	K2-04, K2-20, K2-18, K2-22
Soils	Brown Loamy Sand
Land Form	Sandplain
Priority Ecological Community	No
Conservation Significant Flora	None recorded
Introduced Species	None recorded
Vegetation Condition	Very Good
Disturbances	Cattle Grazing; Frequent Fire; Mining Exploration
Average Fire Age	Recent (0 to 2 yr)
<b>Vegetation Structure &amp; Floristics</b>	
Shrubs 1-2 m	<i>Acacia ayersiana</i> , <i>Acacia kempeana</i> , <i>Eremophila forrestii</i> subsp. <i>forrestii</i>
Shrubs <1 m	<i>Sida cardiophylla</i> , <i>Seringia elliptica</i>
Hummock Grasses	<i>Triodia basedowii</i>



**Broad Floristic Formation** *Acacia* Low Open Forest  
**Vegetation Association** FP Ai ArlPIGb EffSeEf TxEe - Low Open Forest (to Low Closed Forest) of *Acacia incurvaneura* (*Acacia pruinocarpa*, *Acacia ayersiana*, *Acacia aptaneura*, *Acacia aneura*) over High Shrubland of *Acacia ramulosa* var. *linophylla*, *Psyrax latifolia* and *Grevillea berryana* over Shrubland of *Eremophila forrestii* subsp. *forrestii*, *Sida* cf. *ectogama* and *Eremophila fraseri* (over Very Open Tussock Grassland of *Thyridolepis xerophila* and *Eragrostis eriopoda* and Very Open Herbs of *Cheilanthes sieberi*) on brown sandy clay loam on floodplains



Area Mapped	64.49 ha
Quadrats Sampled	CIN-03, CIN-07, CIN-11, K2-12, TRI-07, TRI-11, TD-13
Soils	Brown Sandy Clay Loam
Land Form	Drainage Area/ Floodplain, Stony Plain, Sandy/ Stony Plain
Priority Ecological Community	No
Conservation Significant Flora	None recorded
Introduced Species	* <i>Bidens bipinnata</i>
Vegetation Condition	Very Good
Disturbances	Cattle Grazing
Average Fire Age	Old (6+ years)
<b>Vegetation Structure &amp; Floristics</b>	
Trees <10 m	<i>Acacia incurvaneura</i> , <i>Acacia pruinocarpa</i> , <i>Acacia ayersiana</i> , <i>Acacia aptaneura</i> , <i>Acacia aneura</i> , <i>Acacia pteraneura</i> , <i>Acacia citrinoviridis</i>
Shrubs >2 m	<i>Acacia ramulosa</i> var. <i>linophylla</i> , <i>Psyrax latifolia</i> , <i>Grevillea berryana</i> , <i>Acacia minyura</i> , <i>Psyrax suaveolens</i> , <i>Acacia tetragonophylla</i>
Shrubs 1-2 m	<i>Eremophila forrestii</i> subsp. <i>forrestii</i> , <i>Sida ectogama</i> , <i>Eremophila fraseri</i> , <i>Ptilotus obovatus</i> , <i>Eremophila spectabilis</i> , <i>Enchylaena tomentosa</i> , <i>Eremophila latrobei</i> subsp. <i>latrobei</i> , <i>Abutilon cryptopetalum</i>
Shrubs <1m	<i>Sida fibulifera</i>
Hummock Grasses	<i>Triodia basedowii</i>
Tussock Grasses	<i>Thyridolepis xerophila</i> , <i>Eragrostis eriopoda</i> , <i>Eriachne helmsii</i> , <i>Paspalidium</i> sp. Indet, <i>Tripogonella loliiformis</i>
Herbs	<i>Cheilanthes austrotenuifolia</i>



Broad Floristic Formation *Acacia* Scattered Tall Shrubs  
Vegetation Association MI ArlApt As - Scattered Tall Shrubs of *Acacia ramulosa* var. *linophylla* and *Acacia pteraneura* over Scattered Low Shrubs of *Acacia sibirica* on brown sandy loam on minor drainage lines (eroded channels)



Area Mapped	1.09 ha
Quadrats Sampled	APEX-10
Soils	Brown Sandy Loam
Land Form	Drainage Area/ Floodplain
Priority Ecological Community	No
Conservation Significant Flora	<i>Eremophila</i> cf. <i>demissa</i> (P1), <i>Sauropus</i> sp. Woolgorong (M.Officer s.n.10/8/94) (P3)
Introduced Species	None recorded
Vegetation Condition	None Discernible
Disturbances	Cattle Grazing
Average Fire Age	Old (6+ years)
<b>Vegetation Structure &amp; Floristics</b>	
Shrubs >2 m	<i>Acacia ramulosa</i> var. <i>linophylla</i> , <i>Acacia pteraneura</i>
Shrubs <1 m	<i>Acacia sibirica</i>



Broad Floristic Formation *Acacia* Low Open Forest  
Vegetation Association ME AapAan EfEff Tt - Low Open Forest of *Acacia aptaneura* and *Acacia aneura* over Open Shrubland of *Eremophila fraseri* and *Eremophila forrestii* subsp. *forrestii* over Very Open Tussock Grassland of *Themeda triandra* on brown sandy clay loam on medium drainage lines



Area Mapped	17.80 ha
Quadrats Sampled	TRI-02, MW-03, MW-08
Soils	Brown Sandy Clay Loam
Land Form	Medium Drainage Line
Priority Ecological Community	No
Conservation Significant Flora	<i>Sporobolus blakei</i> (P3)
Introduced Species	None recorded
Vegetation Condition	Very Good
Disturbances	Cattle Grazing
Average Fire Age	Old (6+ years)
<b>Vegetation Structure &amp; Floristics</b>	
Trees <10 m	<i>Acacia aptaneura</i> , <i>Acacia aneura</i> , <i>Acacia incurvaneura</i> , <i>Acacia craspedocarpa</i> , <i>Acacia pteraneura</i> , <i>Acacia pruinocarpa</i> ,
Shrubs <2m	<i>Acacia sibirica</i>
Shrubs 1-2 m	<i>Eremophila fraseri</i> , <i>Eremophila forrestii</i> subsp. <i>forrestii</i> , <i>Sida</i> cf. <i>ectogamma</i>
	<i>Ptilotus obovatus</i> , <i>Indigofera monophyla</i>
Tussock Grasses	<i>Themeda triandra</i>



**Broad Floristic Formation** *Acacia* Low Open Forest  
**Vegetation Association** ME Ai TI Se - Low Open Forest of *Acacia incurvaneura* over Open Tussock Grassland of *Tripogonella loliiformis* with Open Shrubland of *Sida ectogama* (*Eremophila fraseri* and *Acacia tetragonophylla*) on brown loamy sand on medium drainage lines and floodplains



Area Mapped	8.12 ha
Quadrats Sampled	APEX-05
Soils	Brown Loamy Sand
Land Form	Drainage Area/ Floodplain
Priority Ecological Community	No
Conservation Significant Flora	None recorded
Introduced Species	None recorded
Vegetation Condition	Good
Disturbances	Cattle Grazing
Average Fire Age	Old (6+ years)
<b>Vegetation Structure &amp; Floristics</b>	
Trees <10 m	<i>Acacia incurvaneura</i>
Shrubs 1-2 m	<i>Sida</i> cf. <i>ectogama</i> , <i>Eremophila fraseri</i> , <i>Acacia tetragonophylla</i>
Tussock Grasses	<i>Tripogonella loliiformis</i>



Broad Floristic Formation *Acacia* Low Closed Forest  
Vegetation Association MA AapAanAi TIEkCf At - Low Closed Forest of *Acacia aptaneura*, *Acacia aneura* and *Acacia incurvaneura* over Open Tussock Grassland of *Tripogonella loliiformis*, *Eragrostis kennedyae* and *Chrysopogon fallax* with High Open Shrubland of *Acacia tetragonophylla* (and Very Open Herbs of *Cheilanthes sieberi* and *Evolvulus alsinoides*) on brown silty clay loam on major drainage lines



Area Mapped	15.55 ha
Quadrats Sampled	APEX-06
Soils	Brown Silty Clay Loam
Land Form	Major Drainage Line
Priority Ecological Community	No
Conservation Significant Flora	None recorded
Introduced Species	* <i>Bidens bipinnata</i>
Vegetation Condition	Good
Disturbances	Cattle Grazing
Average Fire Age	Old (6+ years)
<b>Vegetation Structure &amp; Floristics</b>	
Trees <10 m	<i>Acacia aptaneura</i> , <i>Acacia aneura</i> , <i>Acacia incurvaneura</i>
Shrubs >2 m	<i>Acacia tetragonophylla</i>
Tussock Grasses	<i>Tripogonella loliiformis</i> , <i>Eragrostis kennedyae</i> , <i>Chrysopogon fallax</i>
Herbs	<i>Cheilanthes sieberi</i> , <i>Evolvulus alsinoides</i>



**Broad Floristic Formation** *Acacia* Low Open Forest  
**Vegetation Association** MA AmApt AcrAtAss CfttEk - Low Open Forest of *Acacia macraneura* and *Acacia pteraneura* (*Eucalyptus victrix*) over High Open Shrubland of *Acacia craspedocarpa*, *Acacia tetragonophylla* and *Acacia sclerosperma* subsp. *sclerosperma* over Low Open Shrubland of *Senna artemisioides* subsp. *artemisioides*, *Eremophila margarethae* and *Ptilotus obovatus* over Very Open Tussock Grassland of *Chrysopogon fallax*, *Themeda triandra* and *Eragrostis kennedyae* on brown sand on major drainage lines



Area Mapped	19.92 ha
Quadrats Sampled	APEX-08, APEX-09
Soils	Brown Sand
Land Form	Major / Medium Drainage Line
Priority Ecological Community	No
Conservation Significant Flora	None recorded
Introduced Species	* <i>Portulaca pilosa</i>
Vegetation Condition	Very Good to Degraded
Disturbances	Cattle Grazing; Erosion
Average Fire Age	Old (6+ years)
<b>Vegetation Structure &amp; Floristics</b>	
Trees <10 m	<i>Acacia macraneura</i> , <i>Acacia pteraneura</i> , <i>Eucalyptus victrix</i>
Shrubs >2 m	<i>Acacia craspedocarpa</i> , <i>Acacia tetragonophylla</i> , <i>Acacia sclerosperma</i> subsp. <i>sclerosperma</i>
Shrubs <1 m	<i>Senna artemisioides</i> subsp. <i>artemisioides</i> , <i>Eremophila margarethae</i> , <i>Ptilotus obovatus</i>
Tussock Grasses	<i>Chrysopogon fallax</i> , <i>Themeda triandra</i> , <i>Eragrostis kennedyae</i>



**Broad Floristic Formation** *Acacia* Low Open Woodland  
**Vegetation Association** HS Apt SglSs Em- Low Open Woodland of *Acacia pteraneura* over Open Shrubland of *Senna glutinosa* subsp. *x luerssenii* and *Senna stricta* over Low Open Shrubland of *Eremophila margarethae* on brown sandy loam on hillslopes



Area Mapped	44.23 ha
Quadrats Sampled	TRI-21, WE-01, WE-02, WE-05
Soils	Brown Sandy Loam
Land Form	Hill slopes
Priority Ecological Community	No
Conservation Significant Flora	<i>Maireana prosthecochoeta</i> (P3)
Introduced Species	None recorded
Vegetation Condition	Very Good
Disturbances	Cattle Grazing; Mining Exploration; Road/ Access Track
Average Fire Age	Old (6+ years)
<b>Vegetation Structure &amp; Floristics</b>	
Trees <10 m	<i>Acacia pteraneura</i> , <i>Acacia pruinocarpa</i> , <i>Acacia fuscaneura</i> , <i>Eucalyptus gypsophila</i>
Shrubs <2m	<i>Hakea leucoptera</i> subsp. <i>sericipes</i>
Shrubs 1-2 m	<i>Senna glutinosa</i> subsp. <i>luerssenii</i> , <i>Senna stricta</i> , <i>Senna</i> sp. <i>Meekatharra</i> (E. Bailey 1-26), <i>Ptilotus albidus</i>
Shrubs <1 m	<i>Eremophila margarethae</i> , <i>Maireana prosthecochoeta</i>



**Broad Floristic Formation** *Acacia* Low Open Woodland or Low Woodland  
**Vegetation Association** HS AptAi EmPrPo Tb - Low Open Woodland (or Low Woodland) of *Acacia pteraneura* and *Acacia incurvaneura* over Low Shrubland of *Eremophila margarethae*, *Ptilotus rotundifolius* and *Ptilotus obovatus* and Scattered Hummock Grasses of *Triodia basedowii* on orange sandy clay loam on hillslopes



Area Mapped	10.05 ha
Quadrats Sampled	ME-01, TP-15, TP-06
Soils	Orange Sandy Clay Loam
Land Form	Hill slopes
Priority Ecological Community	No
Conservation Significant Flora	None recorded
Introduced Species	None recorded
Vegetation Condition	Very Good
Disturbances	Cattle Grazing; Mining Exploration; Road/ Access Track
Average Fire Age	Old (6+ years)
<b>Vegetation Structure &amp; Floristics</b>	
Trees <10 m	<i>Acacia pteraneura</i> , <i>Acacia incurvaneura</i>
Shrubs <2 m	<i>Acacia incurvaneura</i> , <i>Acacia ramulosa</i> var. <i>linophylla</i> , <i>Acacia craspeocarpa</i>
Shrubs <1 m	<i>Eremophila margarethae</i> , <i>Ptilotus rotundifolius</i> , <i>Ptilotus obovatus</i> , <i>Senna glutinosa</i> subsp. <i>x luerssenii</i>
Hummock Grasses	<i>Triodia basedowii</i>



**Broad Floristic Formation** *Calytrix* Low Shrubland  
**Vegetation Association** HS CdPr EfGbAf – Low Shrubland of *Calytrix* cf. *desolata* and *Ptilotus rotundifolius* with Open Shrubland of *Eremophila fraseri*, *Grevillea berryana* and *Acacia fuscaneura* (*Senna glutinosa* subsp. *luerssenii*) on brown sandy loam on hillslopes



Area Mapped	1.54 ha
Quadrats Sampled	TRI-20, TRI-22 (outside study area)
Soils	Brown Sandy Loam
Land Form	Hill slopes
Priority Ecological Community	No
Conservation Significant Flora	None recorded
Introduced Species	None recorded
Vegetation Condition	Good
Disturbances	Cattle Grazing; Mining Exploration
Average Fire Age	Old (6+ years)
<b>Vegetation Structure &amp; Floristics</b>	
Shrubs <2 m	<i>Acacia sibirica</i> , <i>Acacia fuscaneura</i>
Shrubs 1-2 m	<i>Eremophila fraseri</i> , <i>Grevillea berryana</i> , <i>Acacia fuscaneura</i> , <i>Senna glutinosa</i> subsp. <i>x luerssenii</i>
Shrubs <1 m	<i>Calytrix</i> cf. <i>desolata</i> , <i>Ptilotus rotundifolius</i>



**Broad Floristic Formation** *Acacia* Low Woodland  
**Vegetation Association** MI AptAcGb DpAc SeShSsp - Low Woodland of *Acacia pteraneura*, *Acacia citrinoviridis* and *Grevillea berryana* (*Acacia pruinocarpa*) over High Open Shrubland of *Dodonaea pachyneura* and *Acacia craspedocarpa* (hybrid) over Low Open Shrubland of *Sida* cf. *ectogama*, *Senna artemisioides* subsp. *helmsii* and *Scaevola spinescens* (with an Open Shrubland of *Senna glutinosa* subsp. *luerssenii*) on brown sandy loam on minor drainage lines



Area Mapped	9.05 ha
Quadrats Sampled	MA-03, ME-02
Soils	Brown Sandy Loam
Land Form	Minor Drainage Line
Priority Ecological Community	No
Conservation Significant Flora	<i>Thryptomene</i> sp. Leinster (B.J. Lepschi & L.A. Craven 4362) (P3)
Introduced Species	None recorded
Vegetation Condition	Good
Disturbances	Cattle Grazing, mining Exploration, road/ access track
Average Fire Age	Old (6+ years)
<b>Vegetation Structure &amp; Floristics</b>	
Trees <10 m	<i>Acacia pteraneura</i> , <i>Acacia citrinoviridis</i> , <i>Grevillea berryana</i> , <i>Acacia pruinocarpa</i>
Shrubs >2 m	<i>Dodonaea pachyneura</i> , <i>Acacia craspedocarpa</i> (hybrid)
Shrubs 1-2 m	<i>Senna glutinosa</i> subsp. x <i>luerssenii</i>
Shrubs <1 m	<i>Sida</i> cf. <i>ectogama</i> , <i>Senna artemisioides</i> subsp. <i>helmsii</i> , <i>Scaevola spinescens</i>



**Broad Floristic Formation** *Acacia* Low Open Woodland  
**Vegetation Association** MI Ac DpAtSsp Tb - Low Open Woodland of *Acacia citrinoviridis* (*Acacia pteraneura*) over Open Shrubland of *Dodonaea pachyneura*, *Acacia tetragonophylla* and *Scaevola spinescens* over Very Open Hummock Grassland of *Triodia basedowii* on orange silty loam on hillslopes and minor drainage lines



Area Mapped	2.22 ha
Quadrats Sampled	MA-06
Soils	Orange Silty Loam
Land Form	Hill slopes and Minor Drainage Lines
Priority Ecological Community	No
Conservation Significant Flora	None recorded
Introduced Species	None recorded
Vegetation Condition	Very Good
Disturbances	Mining Exploration; Road/Access Track
Average Fire Age	Old (6+ years)
<b>Vegetation Structure &amp; Floristics</b>	
Trees <10 m	<i>Acacia citrinoviridis</i> , <i>Acacia pteraneura</i>
Shrubs 1-2 m	<i>Dodonaea pachyneura</i> , <i>Acacia tetragonophylla</i> , <i>Scaevola spinescens</i>
Hummock Grasses	<i>Triodia basedowii</i>



**Broad Floristic Formation** *Acacia* Low Closed Forest  
**Vegetation Association** MA AanAcAm PlArlAt Tt - Low Closed Forest of *Acacia aneura*, *Acacia citrinoviridis* and *Acacia macraneura* over High Open Shrubland of *Psydrax latifolia*, *Acacia ramulosa* var. *linophylla* and *Acacia tetragonophylla* over Very Open Tussock Grassland of *Themeda* sp. indet. on brown loamy sandy on major drainage lines



Area Mapped	0.91 ha
Quadrats Sampled	TP-08
Soils	Brown Loamy Sand
Land Form	Major / Medium Drainage Line
Priority Ecological Community	No
Conservation Significant Flora	None recorded
Introduced Species	None recorded
Vegetation Condition	Good
Disturbances	Cattle grazing
Average Fire Age	Old (6+ years)
<b>Vegetation Structure &amp; Floristics</b>	
Trees <10 m	<i>Acacia aneura</i> , <i>Acacia citrinoviridis</i> , <i>Acacia macraneura</i>
Shrubs >2 m	<i>Psydrax latifolia</i> , <i>Acacia ramulosa</i> var. <i>linophylla</i> , <i>Acacia tetragonophylla</i>
Tussock Grasses	<i>Themeda triandra</i>



**Broad Floristic Formation** *Acacia* Low Woodland  
**Vegetation Association** HP Ai EffEsb Tb – Low Woodland of *Acacia incurvaneura* over Low Open Shrubland of *Eremophila forrestii* subsp. *forrestii* and *Eremophila spectabilis* over Very Open Hummock Grassland of *Triodia basedowii* on brown sandy clay loam on hardpan plains



Area Mapped	11.09 ha
Quadrats Sampled	TD-02
Soils	Brown Sandy Clay Loam
Land Form	Hardpan Plain
Priority Ecological Community	No
Conservation Significant Flora	None recorded
Introduced Species	None recorded
Vegetation Condition	Good
Disturbances	Cattle Grazing
Average Fire Age	Old (6+ years)
<b>Vegetation Structure &amp; Floristics</b>	
Trees <10 m	<i>Acacia incurvaneura</i>
Shrubs <1 m	<i>Eremophila forrestii</i> subsp. <i>forrestii</i> , <i>Eremophila spectabilis</i>
Hummock Grasses	<i>Triodia basedowii</i>



**Broad Floristic Formation** *Acacia* Low Open Woodland  
**Vegetation Association** HP AiGbApt AiAth EffPsEsb - Low Open Woodland of *Acacia incurvaneura*, *Grevillea berryana* and *Acacia pteraneura* over High Open Shrubland of *Acacia incurvaneura* and *Acacia thoma* and Low Open Shrubland of *Eremophila forrestii* subsp. *forrestii*, *Ptilotus schwartzii* and *Eremophila spectabilis* (over Very Open Tussock Grassland of *Eragrostis eriopoda*) on brown clay loam on hardpan plains



Area Mapped	85.1 ha
Quadrats Sampled	MA-02, ME-03, ME-21, TD-03, TD-04, TD-06, TD-07, TD-10
Soils	Clay Loam
Land Form	Hardpan Plain
Priority Ecological Community	No
Conservation Significant Flora	<i>Eremophila lanata</i> (P3)
Introduced Species	None recorded
Vegetation Condition	Good
Disturbances	Cattle grazing
Average Fire Age	Old (6+ years)
<b>Vegetation Structure &amp; Floristics</b>	
Trees <10 m	<i>Acacia incurvaneura</i> , <i>Grevillea berryana</i> , <i>Acacia pteraneura</i> , <i>Acacia ayersiana</i> , <i>Acacia pruinocarpa</i>
Shrubs >2 m	<i>Acacia incurvaneura</i> , <i>Acacia thoma</i> , <i>Psyrax latifolia</i> , <i>Acacia ramulosa</i> var. <i>linophylla</i> , <i>Acacia rhodophloia</i> , <i>Anthobolus leptomerioides</i>
Shrubs <1 m	<i>Eremophila forrestii</i> subsp. <i>forrestii</i> , <i>Ptilotus schwartzii</i> , <i>Eremophila spectabilis</i> , <i>Eremophila latrobei</i> subsp. <i>latrobei</i> , <i>Senna glaucifolia</i> , <i>Eremophila spectabilis</i> subsp. <i>brevis</i> , <i>Sida</i> cf. <i>ectogama</i> , <i>Ptilotus schwartzii</i>
Hummock Grasses	<i>Triodia basedowii</i>
Tussock Grasses	<i>Eragrostis eriopoda</i>



**Broad Floristic Formation** *Triodia* Hummock Grassland  
**Vegetation Association** HP Tb AiAth EffEIPs – Hummock Grassland of *Triodia basedowii* with High Open Shrubland of *Acacia incurvaneura* and *Acacia thoma* and Low Open Shrubland of *Eremophila forrestii* subsp. *forrestii*, *Eremophila lanata* and *Ptilotus schwartzii* (with Scattered Low Trees of *Acacia pruinocarpa* and *Grevillea berryana*) on orange sandy clay loam on hardpan plains



Area Mapped	3.53 ha
Quadrats Sampled	TD-05, TD-07, TD-14
Soils	Orange Sandy Clay Loam
Land Form	Hardpan Plain
Priority Ecological Community	No
Conservation Significant Flora	<i>Eremophila lanata</i> (P3)
Introduced Species	None recorded
Vegetation Condition	Very Good
Disturbances	Cattle grazing, road/ access track, mining exploration
Average Fire Age	Old (6+ years)
<b>Vegetation Structure &amp; Floristics</b>	
Trees <10 m	<i>Acacia pruinocarpa</i> , <i>Grevillea berryana</i>
Shrubs >2 m	<i>Acacia incurvaneura</i> , <i>Acacia thoma</i>
Shrubs <1 m	<i>Eremophila forrestii</i> subsp. <i>forrestii</i> , <i>Eremophila lanata</i> , <i>Ptilotus schwartzii</i> , <i>Senna glaucifolia</i>
Hummock Grasses	<i>Triodia basedowii</i>



**Broad Floristic Formation** *Acacia* Low Open Woodland  
**Vegetation Association** SP AptAiAp AsuAthAi SeEIPs - Low Open Woodland of *Acacia pteraneura*, *Acacia incurvaneura* and *Acacia pruinocarpa* over High Open Shrubland of *Acacia subcontorta*, *Acacia thoma* and *Acacia incurvaneura* over Low Open Shrubland of *Sida* cf. *ectogama*, *Eremophila lanata* and *Ptilotus schwartzii* (with Scattered Tussock Grassland of *Eriachne mucronata* and *Eragrostis eriopoda* on brown sandy clay loam on stony plains



Area Mapped	56.77 ha
Quadrats Sampled	IB-04, MA-05, TD-08, TD-09, TD-11, TRI-25
Soils	Brown Sandy Clay Loam
Land Form	Stony Plains
Priority Ecological Community	No
Conservation Significant Flora	<i>Eremophila lanata</i> (P3)
Introduced Species	None recorded
Vegetation Condition	Good
Disturbances	Cattle grazing, mining exploration, road/access track
Average Fire Age	Old (6+ years)
<b>Vegetation Structure &amp; Floristics</b>	
Trees <10 m	<i>Acacia pteraneura</i> , <i>Acacia incurvaneura</i> , <i>Acacia pruinocarpa</i> , <i>Grevillea berryana</i>
Shrubs >2 m	<i>Acacia subcontorta</i> , <i>Acacia thoma</i> , <i>Acacia incurvaneura</i>
Shrubs 1-2m	<i>Acacia cuthbertsonii</i> subsp. <i>linearis</i> , <i>Eremophila fraseri</i>
Shrubs <1 m	<i>Sida</i> cf. <i>ectogama</i> , <i>Eremophila lanata</i> , <i>Ptilotus schwartzii</i> , <i>Eremophila margarethae</i>
Tussock Grasses	<i>Eriachne mucronata</i> , <i>Eragrostis eriopoda</i>



**Broad Floristic Formation** *Acacia* High Open Shrubland  
**Vegetation Association** SP AiGbPI EffEII EsEmPs - High Open Shrubland of *Acacia incurvaneura*, *Grevillea berryana* and *Psyrdrax latifolia* over Open Shrubland of *Eremophila forrestii* subsp. *forrestii* and *Eremophila latrobei* subsp. *latrobei* over Low Open Shrubland of *Eremophila spathulata*, *Eremophila margarethae* and *Ptilotus schwartzii* on orange sandy clay loam on stony plains



Area Mapped	2.17 ha
Quadrats Sampled	TP-10
Soils	Orange Sandy Clay Loam
Land Form	Stony Plain
Priority Ecological Community	No
Conservation Significant Flora	<i>Eremophila lanata</i> (P3)
Introduced Species	None recorded
Vegetation Condition	Good
Disturbances	Cattle grazing, road/ access track
Average Fire Age	Old (6+ years)
<b>Vegetation Structure &amp; Floristics</b>	
Trees <10 m	<i>Acacia incurvaneura</i> , <i>Grevillea berryana</i> , <i>Psyrdrax latifolia</i>
Shrubs 1-2 m	<i>Eremophila forrestii</i> subsp. <i>forrestii</i> , <i>Eremophila latrobei</i> subsp. <i>latrobei</i>
Shrubs <1 m	<i>Eremophila spathulata</i> , <i>Eremophila margarethae</i> , <i>Ptilotus schwartzii</i>



**Broad Floristic Formation** *Acacia* High Open Shrubland  
**Vegetation Association** SP AiGb EsEmPs Apt - High Open Shrubland of *Acacia incurvaneura* and *Grevillea berryana* over Low Open Shrubland of *Eremophila spathulata*, *Eremophila margarethae* and *Ptilotus schwartzii* (*Eremophila lanata*, *Ptilotus albidus*, *Solanum lasiophyllum*) with Scattered Low Trees of *Acacia pteranaeura* on brown sandy clay loam on stony plains



Area Mapped	0.27 ha
Quadrats Sampled	TP-02, TP-03, TP-10, TP-14
Soils	Brown Sandy Clay Loam
Land Form	Stony Plains
Priority Ecological Community	No
Conservation Significant Flora	<i>Eremophila lanata</i> (P3)
Introduced Species	None recorded
Vegetation Condition	Very Good
Disturbances	Cattle grazing, mining exploration, road/access track
Average Fire Age	Old (6+ years)
<b>Vegetation Structure &amp; Floristics</b>	
Trees <10 m	<i>Acacia pteranaeura</i>
Shrubs >2 m	<i>Acacia incurvaneura</i> , <i>Grevillea berryana</i>
Shrubs 1-2m	<i>Eremophila latrobei</i> subsp. <i>latrobei</i> , <i>Acacia thoma</i>
Shrubs <1 m	<i>Eremophila spathulata</i> , <i>Eremophila margarethae</i> , <i>Ptilotus schwartzii</i> , <i>Eremophila lanata</i> , <i>Ptilotus albidus</i> , <i>Solanum lasiophyllum</i>
Hummock Grasses	<i>Triodia basedowii</i>



Broad Floristic Formation *Eremophila* Low Open Shrubland  
Vegetation Association SP EsEfPo - Low Open Shrubland of *Eremophila spathulata*, *Eremophila fraseri* and *Ptilotus obovatus* on orange sandy clay loam on stony plains



Area Mapped	4.98 ha
Quadrats Sampled	TRI-24, TRI-26
Soils	Orange Sandy Clay Loam
Land Form	Stony Plain
Priority Ecological Community	No
Conservation Significant Flora	<i>Eremophila lanata</i> (P3)
Introduced Species	None recorded
Vegetation Condition	Good
Disturbances	Cattle grazing, mining exploration, Road/Access track
Average Fire Age	Old (6+ years)
<b>Vegetation Structure &amp; Floristics</b>	
Trees <10 m	<i>Acacia pteraneura</i>
Shrubs <1 m	<i>Eremophila spathulata</i> , <i>Eremophila fraseri</i> , <i>Ptilotus obovatus</i> , <i>Ptilotus schwartzii</i>



**Broad Floristic Formation** *Eremophila* Low Open Shrubland  
**Vegetation Association** SP EexPrEf AfAi - Low Open Shrubland of *Eremophila exilifolia*, *Ptilotus rotundifolius* and *Eremophila fraseri* with Scattered Low Trees of *Acacia fuscaneura* and *Acacia incurvaneura* on orange sandy loam on stony plains



Area Mapped	14.31ha
Quadrats Sampled	TP-09, TP-11, TP-12
Soils	Orange Sandy Loam
Land Form	Stony Plains
Priority Ecological Community	No
Conservation Significant Flora	None recorded
Introduced Species	None recorded
Vegetation Condition	Very Good
Disturbances	Cattle grazing, mining exploration
Average Fire Age	Old (6+ years)
<b>Vegetation Structure &amp; Floristics</b>	
Trees <10 m	<i>Acacia fuscaneura</i> , <i>Acacia incurvaneura</i> , <i>Grevillea berryana</i>
Shrubs <1 m	<i>Eremophila exilifolia</i> , <i>Ptilotus rotundifolius</i> , <i>Eremophila fraseri</i> , <i>Solanum lasiophyllum</i> , <i>Senna artemisioides</i> subsp. <i>helmsii</i> , <i>Eremophila spathulata</i>
Tussock Grassland	<i>Eragrostis eriopoda</i> , <i>Eriachne mucronata</i>



## 4.0 SUMMARY

A two season detailed flora and vegetation survey covering prospects within the Marymia Project tenements was completed in November 2018 and May 2018.

A total of 209 plant taxa (including varieties and subspecies) from 35 families and 89 genera were recorded from the study area. Species representation was greatest among the Fabaceae, Poaceae, Scrophulariaceae, Chenopodiaceae and Malvaceae families. The most speciose genus was *Acacia* (30 taxa), followed by *Eremophila* (21 taxa), *Senna* (11 taxa), *Maireana* (8 taxa), *Sida* (7 taxa), *Hibiscus* (7 taxa) and *Ptilotus* (7 taxa).

There were no plant taxa gazetted as Threatened Flora pursuant to subsection (2) of section 23F of the *Wildlife Conservation Act 1950* (WC Act), or listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) recorded from the study area.

Nine priority listed flora were recorded from the study area; *Eremophila* cf. *demissa* (Priority 1), *Goodenia virgata* (Priority 2), *Calytrix praecipua* (Priority 3); *Eremophila lanata* (Priority 3), *Hemigenia tysonii* (Priority 3), *Maireana prosthocochaeta* (Priority 3), *Sauropus* sp. Woolgorong (M. Officer s.n. 10/8/94) (Priority 3), *Sporobolus blakei* (Priority 3) and *Thryptomene* sp. Leinster (B.J. Lepschi & L.A. Craven 4362) (Priority 3). Additionally, *Eucalyptus semota* (Priority 1) was recorded just outside the boundary of the study area. One taxa recorded from the study area is considered a range extension; *Hibiscus brachychlaenus*.

Two introduced species were recorded from the study area; *\*Bidens bipinnata* (Beggar's Ticks) and *\*Portulaca pilosa*. Neither of these taxa are listed as Declared Pests under the *Biosecurity and Agriculture Management Act 2007* (BAM Act).

A total of 32 vegetation associations were recorded within the project area. Vegetation was classified into 15 broad floristic formations on the basis of dominant vegetation stratum. None of the vegetation associations are aligned with Commonwealth or State listed Threatened Ecological Communities (TECs) or Priority Ecological Communities (PECs).



## 5.0 STUDY TEAM

The detailed flora and vegetation survey was planned, co-ordinated and executed by the following personnel:

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### *Project Staff*

Dr Darren Brearley	PhD	Project Manager and Principal Botanist
Dr Jerome Bull	PhD	Principal Botanist
Ms Jessica Waters	BSc	Senior Botanist
Ms Breanne Menezies	BSc	Senior Environmental Advisor
Mrs Kerry Keenan		Data Analyst
Mr Todd Griffin	BSc	GIS and Mapping Specialist

### *Licences*

The field survey was conducted under the authorisation of the following licences issued by DBCA:

- Jerome Bull, Onshore Environmental Consultants 'Licence to take flora for scientific & other prescribed purposes' Licence No. SL012079; and



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# APPENDIX 1

Status codes for species listed on the IUCN 'Red List'



Category	Description
Extinct (EX)	A taxon is Extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.
Extinct in the Wild (EW)	A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range. A taxon is presumed Extinct in the Wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.
Critically Endangered (CR)	A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered, and it is therefore considered to be facing an extremely high risk of extinction in the wild.
Endangered (EN)	A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered, and it is therefore considered to be facing a very high risk of extinction in the wild.
Vulnerable (VU)	A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable, and it is therefore considered to be facing a high risk of extinction in the wild.
Near Threatened (NT)	A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.
Least Concern (LC)	A taxon is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.
Data Deficient (DD)	A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases great care should be exercised in choosing between DD and a threatened status. If the range of a taxon is suspected to be relatively circumscribed, and a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.
Not Evaluated (NE)	A taxon is Not Evaluated when it has not yet been evaluated against the criteria.



# APPENDIX 2

**Conservation categories for species listed under the EPBC Act**



Category	Description
Extinct	A species is extinct if there is no reasonable doubt that the last member of the species has died.
Extinct in the Wild	A species is categorised as extinct in the wild if it is only known to survive in cultivations, in captivity, or as a naturalised population well outside its past range; or if it has not been recorded in its known/expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
Critically Endangered	The species is facing an extremely high risk of extinction in the wild and in the immediate future.
Endangered	The species is likely to become extinct unless the circumstances and factors threatening its abundance, survival, or evolutionary development cease to operate; or its numbers have been reduced to such a critical level, or its habitats have been so drastically reduced, that it is in immediate danger of extinction.
Vulnerable	Within the next 25 years, the species is likely to become endangered unless the circumstances and factors threatening its abundance, survival or evolutionary development cease to operate.
Conservation Dependent	The species is the focus of a specific conservation program, the cessation of which would result in the species becoming vulnerable, endangered or critically endangered within a period of 5 years.



# APPENDIX 3

## Conservation codes for Western Australian flora



## Threatened Species

Published as Specially Protected under the *Wildlife Conservation Act 1950*, and listed under Schedules 1 to 4 of the *Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora* (which may also be referred to as Declared Rare Flora).

**Threatened fauna** is that subset of 'Specially Protected Fauna' declared to be 'likely to become extinct' pursuant to section 14(4) of the *Wildlife Conservation Act*.

**Threatened flora** is flora that has been declared to be 'likely to become extinct or is rare, or otherwise in need of special protection', pursuant to section 23F(2) of the *Wildlife Conservation Act*.

The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria.

### Priority One: Poorly-known species

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

### Priority Two: Poorly-known species

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

### Priority Three: Poorly-known species

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

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

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

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

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



# APPENDIX 4

**Vegetation condition scale  
(as developed by Keighery 1994)**



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

# APPENDIX 5

**Vegetation classifications for the Pilbara  
(based on Specht 1970 as modified by Aplin 1979 and Trudgen 2002)**



Height Class	Canopy Cover				
	100 - 70%	70 - 30%	30 - 10%	10 - 2%	< 2%
Trees > 30 m	High Closed Forest	High Open Forest	High Woodland	High Open Woodland	Scattered Tall Trees
Trees 10-30m	Closed Forest	Open Forest	Woodland	Open Woodland	Scattered Trees
Trees < 10 m	Low Closed Woodland	Low Open Forest	Low Woodland	Low Open Woodland	Scattered Low Trees
Mallee	Closed Mallee	Mallee	Open Mallee	Very Open Mallee	Scattered Mallees
Shrubs > 2 m	Closed Scrub	Open Scrub	High Shrubland	High Open Shrubland	Scattered Tall Shrubs
Shrubs 1-2 m	Closed Heath	Open Heath	Shrubland	Open Shrubland	Scattered Shrubs
Shrubs < 1 m	Low Closed Heath	Low Open Heath	Low Shrubland	Low Open Shrubland	Low Scattered Shrubs
Hummock Grass	Closed Hummock Grassland	Hummock Grassland	Open Hummock Grassland	Very Open Hummock Grassland	Scattered Hummock Grass
Tussock Grass	Closed Tussock Grassland	Tussock Grassland	Open Tussock Grassland	Very Open Tussock Grassland	Scattered Tussock Grass
Bunch Grass	Closed Bunch Grassland	Bunch Grassland	Open Bunch Grassland	Very Open Bunch Grassland	Scattered Bunch Grass
Sedges	Closed Sedges	Sedges	Open Sedges	Very Open Sedges	Scattered Sedges
Herbs	Closed Herbs	Herbs	Open Herbs	Very Open Herbs	Scattered Herbs

# APPENDIX 6

**Summary of background and results for previous flora and vegetation surveys**



Project	Survey Timing	Season	Survey Type	Area (ha)	No. Sites	No. Taxa	Significant Flora	Introduced Flora
Surveys completed within, or partly within, the study area								
Marymia Hill Gold Proect Notice of Intent: Biological Assessment Survey (Ecologia 1991)	6-10 July 1991	Poor	Biological survey	-	12	84	Undescribed <i>Eucalyptus</i> sp.	None
Outline for Biological and Envionmental Components of a Notice of Intent – Apollo Deposit (Onshore Environmental Consultants 2002)	5-8 August 2002	-	Biological survey	-	-	68	<i>Micromyrtus mucronulata</i> <sup>3</sup> (P1), <i>Maireana prosthocochaeta</i> (P3), <i>Calytrix praecipua</i> (P3)	None
Outline for Biological and Envionmental Components of a Notice of Intent – Mareast Deposit – Plutonic Gold Mine (Onshore Environmental Consultants 2003a)	11 March 2003	-	Biological survey	-	-	60	<i>Maireana prosthocochaeta</i> (P3), <i>Calytrix praecipua</i> (P3)	* <i>Solanum nigrum</i> (Blackberry Nightshade)
Outline for Biological and Envionmental Components of a Notice of Intent – K2 Deposit – Plutonic Gold Mine (Onshore Environmental Consultants 2003b)	14-15 <sup>th</sup> March 2003	-	Flora and vegetation survey	12 km <sup>2</sup>	-	93	<i>Eucalyptus semota</i> (P3), <i>Micromyrtus mucronulata</i> <sup>4</sup> (P1), <i>Maireana prosthocochaeta</i> (P3), <i>Calytrix praecipua</i> (P3)	None

<sup>3</sup> Previously known as *Micromyrtus racemosa* var. *mucronata*<sup>4</sup> Previously known as *Micromyrtus racemosa* var. *mucronata*

# APPENDIX 7

Species list recorded from the study area



Family	Genus	Species	Rank	Name
Acanthaceae	<i>Harnieria</i>	<i>kempeana</i>	subsp.	<i>muelleri</i>
Adiantaceae	<i>Cheilanthes</i>		cf.	<i>brownii</i>
Adiantaceae	<i>Cheilanthes</i>	<i>austrotenuifolia</i>		
Adiantaceae	<i>Cheilanthes</i>	<i>sieberi</i>	subsp.	<i>sieberi</i>
Adiantaceae	<i>Marsilea</i>	<i>exarata</i>		
Adiantaceae	<i>Marsilea</i>	<i>hirsuta</i>		
Amaranthaceae	<i>Ptilotus</i>		sp.	indet
Amaranthaceae	<i>Ptilotus</i>	<i>albidus</i>		
Amaranthaceae	<i>Ptilotus</i>	<i>exaltatus</i>		
Amaranthaceae	<i>Ptilotus</i>	<i>obovatus</i>		
Amaranthaceae	<i>Ptilotus</i>	<i>roei</i>		
Amaranthaceae	<i>Ptilotus</i>	<i>rotundifolius</i>		
Amaranthaceae	<i>Ptilotus</i>	<i>schwartzii</i>	var.	<i>schwartzii</i>
Apocynaceae	<i>Apocynaceae</i>		sp.	indet. (white hairy climber)
Apocynaceae	<i>Cynanchum</i>	<i>viminale</i>	subsp.	<i>australe</i>
Apocynaceae	<i>Marsdenia</i>	<i>australis</i>		
Apocynaceae	<i>Rhyncharrhena</i>	<i>linearis</i>		
Apocynaceae	<i>Vincetoxicum</i>	<i>lineare</i>		
Asteraceae	* <i>Bidens</i>	<i>bipinnata</i>		
Asteraceae	<i>Calocephalus</i>	<i>beardii</i>		
Asteraceae	<i>Centipeda</i>		cf.	<i>thespedioides</i>
Asteraceae	<i>Chrysocephalum</i>		cf.	<i>puteale</i>
Asteraceae	<i>Chrysocephalum</i>		cf.	<i>pterochaetum</i>
Asteraceae	<i>Chthonocephalus</i>		sp.	indet
Asteraceae	<i>Olearia</i>	<i>stuartii</i>		
Asteraceae	<i>Streptoglossa</i>		sp.	indet
Boraginaceae	<i>Heliotropium</i>	<i>moorei</i>		
Brassicaceae	<i>Lepidium</i>	<i>phlebopetalum</i>		
Campanulaceae	<i>Wahlenbergia</i>	<i>tumidifructa</i>		
Chenopodiaceae	<i>Atriplex</i>	<i>semilunaris</i>		
Chenopodiaceae	<i>Enchylaena</i>	<i>tomentosa</i>		
Chenopodiaceae	<i>Maireana</i>		sp.	indet
Chenopodiaceae	<i>Maireana</i>	<i>georgei</i>		
Chenopodiaceae	<i>Maireana</i>	<i>glomerifolia</i>		
Chenopodiaceae	<i>Maireana</i>	<i>prosthecochaeta</i>		
Chenopodiaceae	<i>Maireana</i>	<i>thesioides</i>		
Chenopodiaceae	<i>Maireana</i>	<i>tomentosa</i>		
Chenopodiaceae	<i>Maireana</i>	<i>triptera</i>		
Chenopodiaceae	<i>Maireana</i>	<i>villosa</i>		
Chenopodiaceae	<i>Rhagodia</i>	<i>eremaea</i>		
Chenopodiaceae	<i>Salsola</i>	<i>australis</i>		
Chenopodiaceae	<i>Sclerolaena</i>		sp.	indet
Chenopodiaceae	<i>Sclerolaena</i>	<i>convexula</i>		
Chenopodiaceae	<i>Sclerolaena</i>	<i>cuneata</i>		
Chenopodiaceae	<i>Sclerolaena</i>	<i>diacantha</i>		
Chenopodiaceae	<i>Sclerolaena</i>	<i>eriacantha</i>		
Chenopodiaceae	<i>Sclerolaena</i>	<i>fusiformis</i>		
Convolvulaceae	<i>Convolvulus</i>		sp.	indet
Convolvulaceae	<i>Convolvulus</i>	<i>clementii</i>		
Convolvulaceae	<i>Duperreya</i>	<i>commixta</i>		
Convolvulaceae	<i>Evolvulus</i>	<i>alsinoides</i>	var.	<i>villosicalyx</i>
Convolvulaceae	<i>Ipomoea</i>	<i>calobra</i>		
Cyperaceae	<i>Cyperus</i>	<i>bifax</i>		
Cyperaceae	<i>Cyperus</i>	<i>cf. betchei</i>	subsp.	<i>commiscens</i>
Cyperaceae	<i>Fimbristylis</i>	<i>dichotoma</i>		
Euphorbiaceae	<i>Euphorbia</i>		sp.	indet
Euphorbiaceae	<i>Euphorbia</i>	<i>porcata</i>		
Euphorbiaceae	<i>Euphorbia</i>	<i>tannensis</i>	subsp.	<i>eremophila</i>
Fabaceae	<i>Acacia</i>		aff.	<i>sibirica</i> (thin robust yellow phyllodes)
Fabaceae	<i>Acacia</i>		cf.	<i>clelandii</i>
Fabaceae	<i>Acacia</i>		cf.	<i>macraneura</i>
Fabaceae	<i>Acacia</i>		cf.	<i>incurvaneura</i> x <i>mulganeura</i> (probable hybrid)
Fabaceae	<i>Acacia</i>		cf.	<i>quadrilmarginea</i>
Fabaceae	<i>Acacia</i>	<i>aneura</i>		
Fabaceae	<i>Acacia</i>	<i>aptaneura</i>		
Fabaceae	<i>Acacia</i>	<i>ayersiana</i>		
Fabaceae	<i>Acacia</i>	<i>balsamea</i>		
Fabaceae	<i>Acacia</i>	<i>citrinoviridis</i>		
Fabaceae	<i>Acacia</i>	<i>craspedocarpa</i>		
Fabaceae	<i>Acacia</i>	<i>cuthbertsonii</i>	subsp.	<i>linearis</i>
Fabaceae	<i>Acacia</i>	<i>fuscaneura</i>		

Fabaceae	<i>Acacia</i>	<i>incurvaneura</i>		
Fabaceae	<i>Acacia</i>	<i>kempeana</i>		
Fabaceae	<i>Acacia</i>	<i>macraneura</i>		
Fabaceae	<i>Acacia</i>	<i>minyura</i>		
Fabaceae	<i>Acacia</i>	<i>mulganeura</i>		
Fabaceae	<i>Acacia</i>	<i>pachyacra</i>		
Fabaceae	<i>Acacia</i>	<i>paraneura</i>		
Fabaceae	<i>Acacia</i>	<i>pruinocarpa</i>		
Fabaceae	<i>Acacia</i>	<i>pteraneura</i>		
Fabaceae	<i>Acacia</i>	<i>pyrifolia</i>		
Fabaceae	<i>Acacia</i>	<i>ramulosa</i>	var.	<i>linophylla</i>
Fabaceae	<i>Acacia</i>	<i>rhodophloia</i>		
Fabaceae	<i>Acacia</i>	<i>sclerosperma</i>	subsp.	<i>sclerosperma</i>
Fabaceae	<i>Acacia</i>	<i>sibirica</i>		
Fabaceae	<i>Acacia</i>	<i>subcontorta</i>		
Fabaceae	<i>Acacia</i>	<i>tetragonophylla</i>		
Fabaceae	<i>Acacia</i>	<i>thoma</i>		
Fabaceae	<i>Glycine</i>	<i>canescens</i>		
Fabaceae	<i>Indigofera</i>		sp.	indet
Fabaceae	<i>Indigofera</i>	<i>georgei</i>		
Fabaceae	<i>Indigofera</i>	<i>monophylla</i>		
Fabaceae	<i>Isotropis</i>		sp.	Arid zone (G. Byrne 2775)
Fabaceae	<i>Leptosema</i>	<i>chambersii</i>		
Fabaceae	<i>Mirbelia</i>	<i>rhagodioides</i>		
Fabaceae	<i>Senna</i>		sp.	Meekatharra (E. Bailey 1-26)
Fabaceae	<i>Senna</i>	<i>artemisioides</i>	subsp.	<i>helmsii</i>
Fabaceae	<i>Senna</i>	<i>artemisioides</i>	subsp.	<i>oligophylla</i> x <i>helmsii</i>
Fabaceae	<i>Senna</i>	<i>artemisioides</i>	subsp.	<i>petiolaris</i>
Fabaceae	<i>Senna</i>	<i>artemisioides</i>	subsp.	x <i>artemisioides</i>
Fabaceae	<i>Senna</i>	<i>artemisioides</i>	subsp.	x <i>sturtii</i>
Fabaceae	<i>Senna</i>	<i>artemisioides</i>	subsp.	<i>helmsii</i> x <i>glaucifolia</i> (hybrid)
Fabaceae	<i>Senna</i>	<i>glaucifolia</i>		
Fabaceae	<i>Senna</i>	<i>glutinosa</i>	subsp.	x <i>luerssenii</i>
Fabaceae	<i>Senna</i>	<i>stricta</i>		
Frankenia	<i>Frankenia</i>	<i>setosa</i>		
Goodenia	<i>Goodenia</i>		sp.	indet
Goodenia	^ <i>Goodenia</i>	<i>virgata</i>		
Goodeniaceae	<i>Scaevola</i>	<i>parvifolia</i>	subsp.	indet
Goodeniaceae	<i>Scaevola</i>	<i>spinescens</i>		
Gyrostemonaceae	<i>Codonocarpus</i>	<i>cotinifolius</i>		
Lamiaceae	<i>Dicrastylis</i>	<i>brunnea</i>		
Lamiaceae	^ <i>Hemigenia</i>	<i>tysonii</i>		
Lamiaceae	<i>Prostanthera</i>	<i>albiflora</i>		
Lamiaceae	<i>Teucrium</i>	<i>teucriiflorum</i>		
Loranthaceae	<i>Amyema</i>	<i>fitzgeraldii</i>		
Loranthaceae	<i>Lysiana</i>	<i>murrayi</i>		
Malvaceae	<i>Abutilon</i>		sp.	indet
Malvaceae	<i>Abutilon</i>	<i>cryptopetalum</i>		
Malvaceae	<i>Abutilon</i>	<i>otocarpum</i>		
Malvaceae	<i>Hibiscus</i>		sp.	indet
Malvaceae	<i>Hibiscus</i>	<i>brachychlaenus</i>		
Malvaceae	<i>Hibiscus</i>	<i>burtonii</i>		
Malvaceae	<i>Hibiscus</i>	<i>coatesii</i>		
Malvaceae	<i>Hibiscus</i>	<i>sturtii</i>	var.	<i>campylochlamys</i>
Malvaceae	<i>Hibiscus</i>	<i>sturtii</i>	var.	indet
Malvaceae	<i>Hibiscus</i>	<i>sturtii</i>	var.	<i>truncatus</i>
Malvaceae	<i>Senna</i>	<i>elliptica</i>		
Malvaceae	<i>Sida</i>		cf.	<i>ectogama</i>
Malvaceae	<i>Sida</i>		sp.	Golden calyces glabrous (H.N. Foote 32)
Malvaceae	<i>Sida</i>		sp.	indet
Malvaceae	<i>Sida</i>		sp.	L (A.M. Ashby 4202)
Malvaceae	<i>Sida</i>		sp.	dark green fruits (S. van Leeuwen 2260)
Malvaceae	<i>Sida</i>	<i>cardiophylla</i>		
Malvaceae	<i>Sida</i>	<i>fibulifera</i>		
Myrtaceae	<i>Calytrix</i>		cf.	<i>desolata</i>
Myrtaceae	^ <i>Calytrix</i>	<i>praecipua</i>		
Myrtaceae	<i>Corymbia</i>	<i>deserticola</i>	subsp.	<i>deserticola</i>
Myrtaceae	<i>Corymbia</i>	<i>opaca</i>		
Myrtaceae	<i>Eucalyptus</i>	<i>gypsophila</i>		
Myrtaceae	<i>Eucalyptus</i>	<i>victrix</i>		
Myrtaceae	^ <i>Thryptomene</i>		sp.	Leinster (B.J. Lepschi & L.A. Craven 4362)
Nyctaginaceae	<i>Boerhavia</i>	<i>repleta</i>		



Ophioglossaceae	<i>Ophioglossum</i>	<i>lusitanicum</i>		
Phyllanthaceae	<sup>^</sup> <i>Sauropus</i>		sp.	Woolgorong (M. Officer s.n. 10/8/94)
Poaceae	<i>Amphipogon</i>		sp.	indet
Poaceae	<i>Aristida</i>	<i>contorta</i>		
Poaceae	<i>Chrysopogon</i>	<i>fallax</i>		
Poaceae	<i>Digitaria</i>	<i>brownii</i>		
Poaceae	<i>Enteropogon</i>	<i>ramosus</i>		
Poaceae	<i>Eragrostis</i>	<i>eriopoda</i>		
Poaceae	<i>Eragrostis</i>	<i>kennedyae</i>		
Poaceae	<i>Eragrostis</i>	<i>xerophila</i>		
Poaceae	<i>Eriachne</i>	<i>helmsii</i>		
Poaceae	<i>Eriachne</i>	<i>mucronata</i>		
Poaceae	<i>Eriachne</i>	<i>pulchella</i>	subsp.	<i>pulchella</i>
Poaceae	<i>Monachather</i>	<i>paradoxus</i>		
Poaceae	<i>Panicum</i>	<i>effusum</i>		
Poaceae	<i>Paraneurachne</i>	<i>muelleri</i>		
Poaceae	<i>Paspalidium</i>		sp.	indet
Poaceae	Poaceae		sp.	indet
Poaceae	<sup>^</sup> <i>Sporobolus</i>	<i>blakei</i>		
Poaceae	<i>Themeda</i>		sp.	indet
Poaceae	<i>Themeda</i>	<i>triandra</i>		
Poaceae	<i>Thyridolepis</i>	<i>xerophila</i>		
Poaceae	<i>Triodia</i>		cf.	<i>pungens</i>
Poaceae	<i>Triodia</i>	<i>basedowii</i>		
Poaceae	<i>Triodia</i>	<i>wiseana</i>		
Poaceae	<i>Tripogonella</i>	<i>loliiformis</i>		
Portulacaceae	<i>Portulaca</i>		sp.	indet
Portulacaceae	<sup>*</sup> <i>Portulaca</i>	<i>pilosa</i>		
Proteaceae	<i>Grevillea</i>	<i>berryana</i>		
Proteaceae	<i>Hakea</i>	<i>leucoptera</i>	subsp.	<i>sericipes</i>
Proteaceae	<i>Hakea</i>	<i>lorea</i>	subsp.	<i>lorea</i>
Proteaceae	<i>Hakea</i>	<i>preissii</i>		
Rubiaceae	<i>Psyrax</i>	<i>latifolia</i>		
Rubiaceae	<i>Psyrax</i>	<i>rigidula</i>		
Rubiaceae	<i>Psyrax</i>	<i>suaveolens</i>		
Santalaceae	<i>Anthobolus</i>	<i>leptomerioides</i>		
Santalaceae	<i>Santalum</i>	<i>lanceolatum</i>		
Santalaceae	<i>Santalum</i>	<i>spicatum</i>		
Sapindaceae	<i>Dodonaea</i>	<i>pachyneura</i>		
Sapindaceae	<i>Dodonaea</i>	<i>petiolaris</i>		
Scrophulariaceae	<i>Eremophila</i>		cf.	<i>citrina</i>
Scrophulariaceae	<sup>^</sup> <i>Eremophila</i>		cf.	<i>demissa</i>
Scrophulariaceae	<i>Eremophila</i>		cf.	<i>granitica</i>
Scrophulariaceae	<i>Eremophila</i>		cf.	<i>incisa</i>
Scrophulariaceae	<i>Eremophila</i>	<i>exillifolia</i>		
Scrophulariaceae	<i>Eremophila</i>	<i>forrestii</i>	subsp.	<i>forrestii</i>
Scrophulariaceae	<i>Eremophila</i>	<i>fraseri</i>		
Scrophulariaceae	<i>Eremophila</i>	<i>georgei</i>		
Scrophulariaceae	<i>Eremophila</i>	<i>granitica</i>		
Scrophulariaceae	<sup>^</sup> <i>Eremophila</i>	<i>lanata</i>		
Scrophulariaceae	<i>Eremophila</i>	<i>latrobei</i>	subsp.	<i>latrobei</i>
Scrophulariaceae	<i>Eremophila</i>	<i>longifolia</i>		
Scrophulariaceae	<i>Eremophila</i>	<i>margarethae</i>		
Scrophulariaceae	<i>Eremophila</i>	<i>micrantha</i>		
Scrophulariaceae	<i>Eremophila</i>	<i>oppositifolia</i>	subsp.	<i>angustifolia</i>
Scrophulariaceae	<i>Eremophila</i>	<i>platycalyx</i>	subsp.	indet
Scrophulariaceae	<i>Eremophila</i>	<i>punctata</i>		
Scrophulariaceae	<i>Eremophila</i>	<i>spathulata</i>		
Scrophulariaceae	<i>Eremophila</i>	<i>spectabilis</i>	subsp.	<i>brevis</i>
Scrophulariaceae	<i>Eremophila</i>	<i>spinosa</i>		
Scrophulariaceae	<i>Eremophila</i>	<i>spuria</i>		
Solanaceae	<i>Solanum</i>	<i>centrale</i>		
Solanaceae	<i>Solanum</i>	<i>lasiophyllum</i>		
Tecticornia	<i>Tecticornia</i>	<i>disarticulata</i>		
Zygophyllaceae	<i>Tribulus</i>		cf.	<i>hirsutus</i>
Zygophyllaceae	<i>Tribulus</i>	<i>suberosus</i>		

# APPENDIX 8

**Locations for conservation significant flora species recorded from the study area**



GENUS	SPECIES	INF_RANK	INF_NAME	EASTING	NORTHING
<i>Calytrix</i>	<i>praecipua</i>			768156	7216228
<i>Calytrix</i>	<i>praecipua</i>			768690	7213946
<i>Calytrix</i>	<i>praecipua</i>			768719	7213955
<i>Calytrix</i>	<i>praecipua</i>			768748	7213974
<i>Calytrix</i>	<i>praecipua</i>			768804	7213965
<i>Calytrix</i>	<i>praecipua</i>			768300	7214231
<i>Calytrix</i>	<i>praecipua</i>			768599	7215891
<i>Calytrix</i>	<i>praecipua</i>			768127	7216210
<i>Calytrix</i>	<i>praecipua</i>			768107	7216274
<i>Calytrix</i>	<i>praecipua</i>			768026	7216390
<i>Calytrix</i>	<i>praecipua</i>			767988	7216442
<i>Calytrix</i>	<i>praecipua</i>			767925	7216456
<i>Calytrix</i>	<i>praecipua</i>			768153	7216467
<i>Calytrix</i>	<i>praecipua</i>			767804	7216509
<i>Calytrix</i>	<i>praecipua</i>			768652	7215979
<i>Calytrix</i>	<i>praecipua</i>			765887	7213237
<i>Calytrix</i>	<i>praecipua</i>			768274	7214255
<i>Eremophila</i>	<i>lanata</i>			764524	7213897
<i>Eremophila</i>	<i>lanata</i>			764573	7213850
<i>Eremophila</i>	<i>lanata</i>			764620	7213905
<i>Eremophila</i>	<i>lanata</i>			769178	7214944
<i>Eremophila</i>	<i>lanata</i>			765801	7213217
<i>Eremophila</i>	<i>lanata</i>			772171	7218569
<i>Eremophila</i>	<i>lanata</i>			772294	7218665
<i>Eremophila</i>	<i>lanata</i>			772222	7218613
<i>Eremophila</i>	<i>lanata</i>			771662	7218148
<i>Eremophila</i>	<i>lanata</i>			771598	7218077
<i>Eremophila</i>	<i>lanata</i>			764554	7211013
<i>Eremophila</i>	<i>lanata</i>			764627	7211043
<i>Eremophila</i>	<i>lanata</i>			764587	7210951
<i>Eremophila</i>	<i>lanata</i>			764617	7210982
<i>Eremophila</i>	<i>lanata</i>			765518	7209860
<i>Eremophila</i>	<i>lanata</i>			765702	7213072
<i>Eremophila</i>	<i>lanata</i>			765753	7213128
<i>Eremophila</i>	<i>lanata</i>			765807	7213176
<i>Eremophila</i>	<i>lanata</i>			765989	7215538
<i>Eremophila</i>	<i>lanata</i>			765843	7215636
<i>Eremophila</i>	<i>lanata</i>			765675	7215734
<i>Eremophila</i>	<i>lanata</i>			765474	7215742
<i>Eremophila</i>	<i>lanata</i>			765399	7215634
<i>Eremophila</i>	<i>lanata</i>			765370	7215148
<i>Eremophila</i>	<i>lanata</i>			765370	7215148
<i>Eremophila</i>	<i>lanata</i>			765458	7215041
<i>Eremophila</i>	<i>lanata</i>			765341	7214868
<i>Eremophila</i>	<i>lanata</i>			765514	7214931
<i>Eremophila</i>	<i>lanata</i>			765753	7215006
<i>Eremophila</i>	<i>lanata</i>			766112	7214698
<i>Eremophila</i>	<i>lanata</i>			765713	7214905
<i>Eremophila</i>	<i>lanata</i>			765488	7214727
<i>Eremophila</i>	<i>lanata</i>			766321	7214672
<i>Eremophila</i>	<i>lanata</i>			769619	7216335
<i>Eremophila</i>	<i>lanata</i>			770503	7217135
<i>Eremophila</i>	<i>lanata</i>			769806	7216445
<i>Eremophila</i>	<i>lanata</i>			769665	7216365
<i>Eremophila</i>	<i>lanata</i>			771517	7218012
<i>Eremophila</i>	<i>lanata</i>			771729	7218185
<i>Eremophila</i>	<i>lanata</i>			771894	7218311
<i>Eremophila</i>	<i>lanata</i>			772155	7218536
<i>Eremophila</i>	<i>lanata</i>			766099	7215142
<i>Eremophila</i>	<i>lanata</i>			765970	7215640
<i>Eremophila</i>	<i>lanata</i>			765566	7215842
<i>Eremophila</i>	<i>lanata</i>			765449	7215726
<i>Eremophila</i>	<i>lanata</i>			765205	7215313
<i>Eremophila</i>	<i>lanata</i>			765404	7215166
<i>Eremophila</i>	<i>lanata</i>			765204	7214841

<i>Eremophila</i>	<i>lanata</i>			765581	7214767
<i>Eremophila</i>	<i>lanata</i>			765787	7215081
<i>Eremophila</i>	<i>lanata</i>			765937	7215382
<i>Eremophila</i>	<i>lanata</i>			771548	7218027
<i>Eremophila</i>	<i>lanata</i>			770498	7217133
<i>Eremophila</i>	<i>lanata</i>			772466	7218839
<i>Eremophila</i>	<i>lanata</i>			764897	7213824
<i>Eremophila</i>	<i>lanata</i>			765824	7213554
<i>Eremophila</i>	<i>lanata</i>			765693	7213240
<i>Eremophila</i>	<i>lanata</i>			765620	7213450
<i>Eremophila</i>	<i>lanata</i>			765930	7213324
<i>Eremophila</i>	<i>lanata</i>			765932	7213278
<i>Eremophila</i>	<i>lanata</i>			765843	7213267
<i>Eremophila</i>	<i>lanata</i>			764620	7213905
<i>Eremophila</i>	<i>lanata</i>			764360	7213965
<i>Eremophila</i>	<i>lanata</i>			764518	7214148
<i>Eremophila</i>		cf.	demissa	782786	7216669
<i>Eremophila</i>		cf.	demissa	781953	7216618
<i>Eremophila</i>		cf.	demissa	774039	7214090
<i>Eremophila</i>		cf.	demissa	773531	7214592
<i>Eremophila</i>		cf.	demissa	773282	7213579
<i>Eremophila</i>		cf.	demissa	774347	7214151
<i>Eremophila</i>		cf.	demissa	781787	7216665
<i>Eremophila</i>		cf.	demissa	774342	7214076
<i>Eremophila</i>		cf.	demissa	774425	7214103
<i>Eremophila</i>		cf.	demissa	774520	7214190
<i>Eremophila</i>		cf.	demissa	774498	7214342
<i>Eremophila</i>		cf.	demissa	766794	7209181
<i>Eremophila</i>		cf.	demissa	767995	7216530
<i>Eremophila</i>		cf.	demissa	768326	7216066
<i>Eremophila</i>		cf.	demissa	768356	7216194
<i>Eucalyptus</i>	<i>semota</i>			766702	7213377
<i>Eucalyptus</i>	<i>semota</i>			766733	7213424
<i>Eucalyptus</i>	<i>semota</i>			766721	7213416
<i>Goodenia</i>	<i>virgata</i>			780917	7215736
<i>Goodenia</i>	<i>virgata</i>			782786	7216669
<i>Goodenia</i>	<i>virgata</i>			765483	7214164
<i>Goodenia</i>	<i>virgata</i>			765102	7213218
<i>Goodenia</i>	<i>virgata</i>			765620	7213450
<i>Goodenia</i>	<i>virgata</i>			766146	7213516
<i>Hemigenia</i>	<i>tysonii</i>			781849	7216626
<i>Hemigenia</i>	<i>tysonii</i>			781999	7216642
<i>Hemigenia</i>	<i>tysonii</i>			781787	7216665
<i>Hemigenia</i>	<i>tysonii</i>			781812	7216580
<i>Hemigenia</i>	<i>tysonii</i>			781828	7216634
<i>Hemigenia</i>	<i>tysonii</i>			781830	7216760
<i>Hemigenia</i>	<i>tysonii</i>			781835	7216917
<i>Hemigenia</i>	<i>tysonii</i>			781775	7216929
<i>Hemigenia</i>	<i>tysonii</i>			781752	7216867
<i>Hemigenia</i>	<i>tysonii</i>			782786	7216669
<i>Maireana</i>	<i>prosthecochaeta</i>			765921	7213361
<i>Maireana</i>	<i>prosthecochaeta</i>			778174	7220129
<i>Maireana</i>	<i>prosthecochaeta</i>			778215	7220337
<i>Maireana</i>	<i>prosthecochaeta</i>			765909	7213346
<i>Maireana</i>	<i>prosthecochaeta</i>			765935	7213382
<i>Maireana</i>	<i>prosthecochaeta</i>			765958	7213411
<i>Maireana</i>	<i>prosthecochaeta</i>			765950	7213349
<i>Maireana</i>	<i>prosthecochaeta</i>			765942	7213351
<i>Maireana</i>	<i>prosthecochaeta</i>			765946	7213362
<i>Maireana</i>	<i>prosthecochaeta</i>			765948	7213412
<i>Maireana</i>	<i>prosthecochaeta</i>			778208	7220297
<i>Maireana</i>	<i>prosthecochaeta</i>			765961	7213384
<i>Maireana</i>	<i>prosthecochaeta</i>			766581	7213429
<i>Maireana</i>	<i>prosthecochaeta</i>			766599	7213409
<i>Maireana</i>	<i>prosthecochaeta</i>			766583	7213364
<i>Maireana</i>	<i>prosthecochaeta</i>			766662	7213380
<i>Maireana</i>	<i>prosthecochaeta</i>			768641	7213908
<i>Maireana</i>	<i>prosthecochaeta</i>			768391	7214243



<i>Maireana</i>	<i>prosthecochaeta</i>			767923	7213839
<i>Maireana</i>	<i>prosthecochaeta</i>			767967	7213785
<i>Maireana</i>	<i>prosthecochaeta</i>			768626	7213928
<i>Maireana</i>	<i>prosthecochaeta</i>			767962	7213864
<i>Sauropus</i>		sp.	Woolgorong (M. Officer s.n. 10/8/94)	781953	7216618
<i>Sauropus</i>		sp.	Woolgorong (M. Officer s.n. 10/8/94)	781787	7216665
<i>Sauropus</i>		sp.	Woolgorong (M. Officer s.n. 10/8/94)	774948	7219208
<i>Sauropus</i>		sp.	Woolgorong (M. Officer s.n. 10/8/94)	774877	7219147
<i>Sauropus</i>		sp.	Woolgorong (M. Officer s.n. 10/8/94)	774765	7219027
<i>Sauropus</i>		sp.	Woolgorong (M. Officer s.n. 10/8/94)	774938	7218899
<i>Sauropus</i>		sp.	Woolgorong (M. Officer s.n. 10/8/94)	775033	7219014
<i>Sauropus</i>		sp.	Woolgorong (M. Officer s.n. 10/8/94)	775018	7219074
<i>Sauropus</i>		sp.	Woolgorong (M. Officer s.n. 10/8/94)	775047	7219208
<i>Sauropus</i>		sp.	Woolgorong (M. Officer s.n. 10/8/94)	778208	7220295
<i>Sauropus</i>		sp.	Woolgorong (M. Officer s.n. 10/8/94)	778481	7220483
<i>Sauropus</i>		sp.	Woolgorong (M. Officer s.n. 10/8/94)	781961	7216629
<i>Sauropus</i>		sp.	Woolgorong (M. Officer s.n. 10/8/94)	765832	7213502
<i>Sauropus</i>		sp.	Woolgorong (M. Officer s.n. 10/8/94)	765870	7213403
<i>Sauropus</i>		sp.	Woolgorong (M. Officer s.n. 10/8/94)	781906	7216089
<i>Sauropus</i>		sp.	Woolgorong (M. Officer s.n. 10/8/94)	781639	7216355
<i>Sauropus</i>		sp.	Woolgorong (M. Officer s.n. 10/8/94)	781635	7216494
<i>Sauropus</i>		sp.	Woolgorong (M. Officer s.n. 10/8/94)	775047	7219338
<i>Sauropus</i>		sp.	Woolgorong (M. Officer s.n. 10/8/94)	774952	7219212
<i>Sauropus</i>		sp.	Woolgorong (M. Officer s.n. 10/8/94)	774813	7219137
<i>Sauropus</i>		sp.	Woolgorong (M. Officer s.n. 10/8/94)	774782	7219157
<i>Sauropus</i>		sp.	Woolgorong (M. Officer s.n. 10/8/94)	774787	7219226
<i>Sauropus</i>		sp.	Woolgorong (M. Officer s.n. 10/8/94)	774800	7219192
<i>Sporobolus</i>	<i>blakei</i>			765684	7214276
<i>Thryptomene</i>		sp.	Leinster (B.J. Lepschi & L.A. Craven 4362)	776137	7220146
<i>Thryptomene</i>		sp.	Leinster (B.J. Lepschi & L.A. Craven 4362)	768156	7216228
<i>Thryptomene</i>		sp.	Leinster (B.J. Lepschi & L.A. Craven 4362)	767854	7216394
<i>Thryptomene</i>		sp.	Leinster (B.J. Lepschi & L.A. Craven 4362)	774765	7219027
<i>Thryptomene</i>		sp.	Leinster (B.J. Lepschi & L.A. Craven 4362)	767092	7208527
<i>Thryptomene</i>		sp.	Leinster (B.J. Lepschi & L.A. Craven 4362)	774938	7218899
<i>Thryptomene</i>		sp.	Leinster (B.J. Lepschi & L.A. Craven 4362)	774976	7218858
<i>Thryptomene</i>		sp.	Leinster (B.J. Lepschi & L.A. Craven 4362)	775071	7218866
<i>Thryptomene</i>		sp.	Leinster (B.J. Lepschi & L.A. Craven 4362)	775018	7219074
<i>Thryptomene</i>		sp.	Leinster (B.J. Lepschi & L.A. Craven 4362)	774980	7219075
<i>Thryptomene</i>		sp.	Leinster (B.J. Lepschi & L.A. Craven 4362)	765829	7213146
<i>Thryptomene</i>		sp.	Leinster (B.J. Lepschi & L.A. Craven 4362)	769856	7213830
<i>Thryptomene</i>		sp.	Leinster (B.J. Lepschi & L.A. Craven 4362)	769870	7213752
<i>Thryptomene</i>		sp.	Leinster (B.J. Lepschi & L.A. Craven 4362)	769741	7213723
<i>Thryptomene</i>		sp.	Leinster (B.J. Lepschi & L.A. Craven 4362)	769737	7213789
<i>Thryptomene</i>		sp.	Leinster (B.J. Lepschi & L.A. Craven 4362)	768690	7213946
<i>Thryptomene</i>		sp.	Leinster (B.J. Lepschi & L.A. Craven 4362)	768719	7213955
<i>Thryptomene</i>		sp.	Leinster (B.J. Lepschi & L.A. Craven 4362)	768804	7213965
<i>Thryptomene</i>		sp.	Leinster (B.J. Lepschi & L.A. Craven 4362)	768803	7214018
<i>Thryptomene</i>		sp.	Leinster (B.J. Lepschi & L.A. Craven 4362)	766321	7214672
<i>Thryptomene</i>		sp.	Leinster (B.J. Lepschi & L.A. Craven 4362)	766140	7214278
<i>Thryptomene</i>		sp.	Leinster (B.J. Lepschi & L.A. Craven 4362)	768236	7216192
<i>Thryptomene</i>		sp.	Leinster (B.J. Lepschi & L.A. Craven 4362)	768175	7216186
<i>Thryptomene</i>		sp.	Leinster (B.J. Lepschi & L.A. Craven 4362)	768127	7216210
<i>Thryptomene</i>		sp.	Leinster (B.J. Lepschi & L.A. Craven 4362)	768107	7216274
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<i>Thryptomene</i>		sp.	Leinster (B.J. Lepschi & L.A. Craven 4362)	768026	7216390
<i>Thryptomene</i>		sp.	Leinster (B.J. Lepschi & L.A. Craven 4362)	767988	7216442
<i>Thryptomene</i>		sp.	Leinster (B.J. Lepschi & L.A. Craven 4362)	767925	7216456
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<i>Thryptomene</i>		sp.	Leinster (B.J. Lepschi & L.A. Craven 4362)	768067	7216558
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<i>Thryptomene</i>		sp.	Leinster (B.J. Lepschi & L.A. Craven 4362)	765930	7213324

<i>Thryptomene</i>		sp.	Leinster (B.J. Lepschi & L.A. Craven 4362)	765932	7213278
<i>Thryptomene</i>		sp.	Leinster (B.J. Lepschi & L.A. Craven 4362)	765910	7213246
<i>Thryptomene</i>		sp.	Leinster (B.J. Lepschi & L.A. Craven 4362)	765880	7213303
<i>Hibiscus</i>	<i>brachychlaenus</i>		(Range extension)	775283	7220764



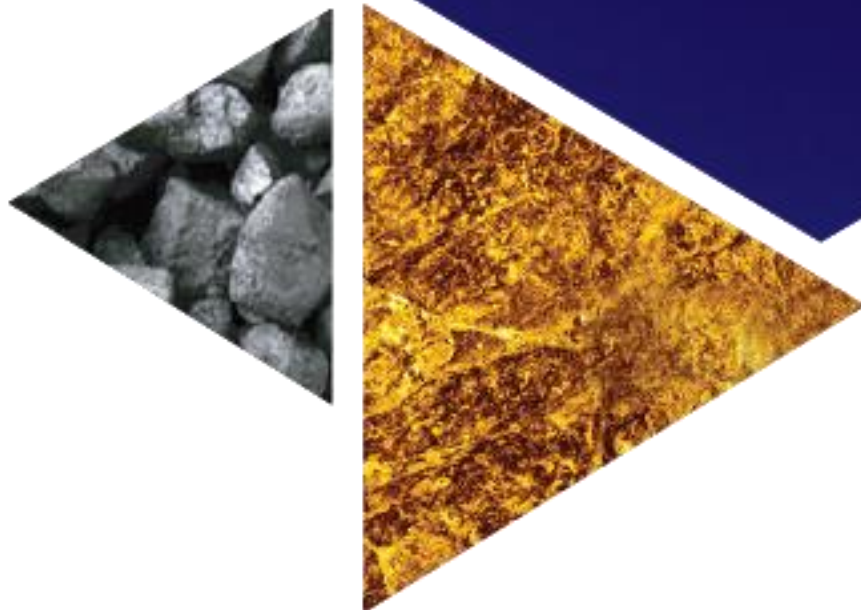
# APPENDIX 9

**Locations for introduced flora species recorded from the study area**

<b>GENUS</b>	<b>SPECIES</b>	<b>EASTING</b>	<b>NORTHING</b>
<i>Bidens</i>	<i>bipinnata</i>	781363	7216564
<i>Bidens</i>	<i>bipinnata</i>	765440	7213141
<i>Portulaca</i>	<i>pilosa</i>	781779	7215833



# Appendix C. Fauna and Habitat Survey



**Vango Mining Pty Ltd**

**Marymia Project Fauna Assessment of exploration areas**



Banded Knob-tailed Gecko (Pilbara sub-species) (photo: M. Bamford)

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Prepared by: Mike Bamford and Natalia Huang

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6<sup>th</sup> November 2019



## Executive Summary

### Introduction

Vango Mining Pty Ltd (Vango) is conducting exploration in the Marymia Project area where mining has previously been conducted, most recently (up to about 2010) by Barrick Gold. As part of the process for seeking approval of future mining, Bamford Consulting Ecologists (BCE) was commissioned in 2018 and 2019 to provide information on the fauna values of a suite of exploration leases in the project area. The focus of these investigations was on significant species, and the provision of discussion on the interaction of the proposal with fauna values and functions.

### Methods

Fauna studies have previously been conducted in the area by *ecologia environment* and BCE, including monitoring of the Brush-tailed Mulgara. Therefore the 2018/2019 studies involved a review of existing data and detailed site inspections comprising: 1) identifying Vegetation and Substrate Associations present; 2) targeted searches for conservation significant fauna including the Malleefowl and Brush-tailed Mulgara; 3) bird censusing; and 4) operation of autonomous recording units such as motion-sensitive cameras, audio recording units and bat detectors. In addition, general fauna lists were produced based upon opportunistic observations. The exploration areas K2, Cinnamon, Apex and Trident were visited in November 2018, while the exploration areas K2 (east), Mareast, Marwest, Wedgetail, Ibis, Trident, Triple P, Speckled Hen and the Pipeline Corridor were visited in August 2019.

BCE uses a 'values and impacts' assessment process with the following components:

- The identification of fauna values:
  - Assemblage characteristics: uniqueness, completeness and richness;
  - Species of conservation significance;
  - Recognition of ecotypes or vegetation/substrate associations (VSAs) that provide habitat for fauna, particularly those that are rare, unusual and/or support significant fauna;
  - Patterns of biodiversity across the landscape;
  - Ecological processes upon which the fauna depend.
- The review of impacting processes such as:
  - Habitat loss leading to population decline;
  - Habitat loss leading to population fragmentation;
  - Degradation of habitat due to weed invasion leading to population decline;
  - Ongoing mortality from operations;
  - Species interactions including feral and overabundant native species;
  - Hydrological change;
  - Altered fire regimes; and
  - Disturbance (dust, light, noise).

### Results - Key fauna values

Vegetation and Substrate Associations (VSAs) that provide habitat for fauna. The exploration areas are broadly similar in vegetation and substrates with representatives of each VSA throughout the project area. The vegetation can be summarised as being mostly open Acacia or Mulga shrubland

over sparse to dense vegetation with many areas of spinifex. These occur over red loam to sandy loam on the flat areas and gravelly loam and rocky soil on the higher ground, with some gravelly areas overlaid with quartz/ironstone cobbles or pebbles. Drainage lines with Acacia or Mulga thickets on clayey loams occur throughout the exploration areas in varying sizes. VSAs can only be broadly defined in the absence of detailed vegetation surveys, but six VSAs can be recognised and they occur across the exploration areas in varying extent:

1. Acacia shrubland on gravelly loam with quartz/ironstone cobbles on flats and slight rises. This is very extensive and variable, with some areas of acacia thickets, but other areas that are very open and the quartz forms a veneer over open ground.
2. Open Acacia on rocky/gravelly soil, on high ground, sometimes with Miniritchi and sometimes over Spinifex.
3. Mulga over shrubs and spinifex on loam to sandy loam flats.
4. Drainage line with Acacia/Mulga thickets on clayey loam. On some drainage lines the acacia are a tall Miniritchi.
5. Old mine pits, stockpiles with partial rehabilitation; areas of good rehabilitation are similar to VSA 1. Some of these old pits contain water.

Environments of most interest with respect to fauna are the drainage lines, Mulga thickets and the mulga over spinifex on sandy loam. This is because they support some significant species and are restricted in extent. The mine portal in K2, and possibly other shafts in other mine pits, may be locally important (fauna discussed below). The general landscape is very extensive in the region with only small areas of development (past and current mines) and some grazing impacts.

Fauna assemblage. The desktop study identified 259 vertebrate fauna species as potentially occurring in the survey area: 9 frogs, 66 reptiles, 148 birds, 26 native mammals and 10 introduced mammals. This does not include several locally extinct mammal species. Except for these extinct mammals the assemblage is intact, and it is only moderately rich because the landscape is fairly uniform and lacks features such as large hills and major rivers. The assemblage appears to include elements of both the Pilbara and Murchison. Over half of the expected species (58%) were recorded across the present and previous surveys. It is noted that the August 2019 survey recorded a markedly lower abundance of birds than the November 2018 survey which is likely due to the poor long-term rainfall across the region in 2019, resulting in dry conditions, low productivity and therefore low fauna activity.

Species of conservation significance. The project area potentially supports about 20 conservation significant fauna species. The most notable is the Brush-tailed Mulgara (listed as Priority 3), which is locally common in the general region and was the subject of a research and monitoring project in the past. It favours sandy to sandy loam soils, usually with spinifex, and may be temporarily displaced by fire. Such soils occur in patches throughout the project area and are more widespread to the south, although inactive burrows were recorded in Cinnamon and K2 and extensive suitable habitat in K2 was recently burnt. The Mulgara is also sensitive to Fox and Cat predation. A pair of Peregrine Falcons (listed as Schedule 3 under the WA Biodiversity Conservation Act 2016) was present in Flamingo Pit in August 2019. It is likely they were breeding on a ledge on the side of the pit.

Patterns of biodiversity. Across the exploration areas, Mulga over spinifex on sandy loam and Mulga thickets along drainage lines are likely to be richest in fauna, while gravelly and rocky soils with sparse



vegetation are likely to be lowest in fauna species richness. Mulga over spinifex on sandy loam is also where the Brush-tailed Mulgara can occur. This VSA is widespread in the north of K2, across much of Cinnamon, in the north of Triple P and along the southern Haul Road. Mulga thickets along drainage lines is well-developed in Apex but also occurs in patches across Trident, Cinnamon, K2, Triple P and Speckled Hen. Trident has the most extensive areas of gravelly soils and sparse shrublands.

Key ecological processes. The most important ecological processes affecting the fauna assemblage are fire, landscape connectivity related to Mulga thickets, impacts of feral predators and local hydrology.

Overall, the project area has a fauna species assemblage that has suffered some species loss. It is a moderately rich assemblage, and includes some species of conservation significance, although only the Brush-tailed Mulgara is of concern. The assemblage is sensitive to landscape connectivity, introduced species and fire, while the most important environments for fauna richness are Mulga over spinifex on sandy loam, and Mulga thickets along drainage lines or in slightly lower areas of the landscape. K2 has the widest range of environments and extensive habitat for the Brush-tailed Mulgara. Cinnamon also has extensive Mulgara habitat. Cinnamon is also likely to be richest in bird species due to the extensive Mulga with understorey present. Apex has a major drainage line with associated tall Mulga thickets important for fauna. Trident has the most extensive areas of gravelly and rocky soils that are probably less rich in fauna, but even this is interspersed with Mulga thickets. The Triple P area is large with a complex array of VSAs and several moderately large water courses. It also has some Mulgara habitat and an apparently nesting pair of Peregrine Falcons (in Flamingo Pit).

### **Potential impacts upon fauna and recommendations**

Potential impacts to fauna can come from a range of sources, but key concerns are:

- Mortality of Brush-tailed Mulgara during clearing;
- Loss of Peregrine Falcon nest in Flamingo Pit;
- Changes in abundance of feral predators;
- Altered fire regimes;
- Disturbance of birds from noise, dust and light, potentially leading to changes in the bird assemblage away from direct impact areas;
- Hydrological change, and in particular changes to surface hydrology which can affect Mulga;
- Impacts of feral species; and
- Altered fire regimes.

Recommendations to manage potential impacts include:

- Minimise clearing footprint and rehabilitate where possible;
- Pre-clearing surveys and displacement of Mulgara; this would be limited to activities in the Mulga and spinifex on sand VSA in parts of K2, Cinnamon and Triple P;
- Monitor the pair of Peregrine Falcons to see if they move to an alternative nesting site. Could consider constructing a ledge on the side of a pit that is not going to be disturbed to give the birds an alternative nesting site.
- Hydrological management in particular to ensure surface hydrology is not altered near Mulga areas;

- Feral fauna management and monitoring;
- Fire management measures; and
- Minimise noise, dust and light.



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## 1 Introduction

Vango Mining Pty Ltd (Vango) is conducting exploration in the Marymia Project area where mining has previously been conducted, most recently (up to about 2010) by Barrick Gold. As part of the process for seeking approval of future mining, Bamford Consulting Ecologists (BCE) was initially commissioned in 2018 to provide information on the fauna values of four exploration areas that form part of the Marymia Project: Trident, K2, Cinnamon and Apex (Figure 1-1). In 2019, BCE was requested to provide information on additional exploration areas in the project area: a smaller area of K2, the tailings pipeline corridor, Trident/Mareast, Wedgetail, Ibis, Marwest, Triple P and Speckled Hen (Figure 1-2). Fauna studies have previously been conducted in the general Marymia Project area by *ecologia environment* and BCE, including monitoring of the Brush-tailed Mulgara. Therefore, the 2018 to 2019 studies presented in this report involved a review of existing data and detailed site inspections of the exploration areas, including targeted searching for the Brush-tailed Mulgara. The aim of these investigations is to broadly outline the fauna assemblage and its values, particularly for significant species, and to provide discussion on the interaction of the proposal with these fauna values and functions.

### 1.1 General Approach to Fauna Impact Assessment

The purpose of impact assessment is to provide government agencies with the information they need to decide upon the significance of impacts of a proposed development. BCE uses an impact assessment process with the following 'values and impacts' components:

- The identification of fauna values:
  - Assemblage characteristics: uniqueness, completeness and richness;
  - Species of conservation significance;
  - Recognition of ecotypes or vegetation/substrate associations (VSAs) that provide habitat for fauna, particularly those that are rare, unusual and/or support significant fauna;
  - Patterns of biodiversity across the landscape; and
  - Ecological processes upon which the fauna depend.
- The review of impacting processes such as:
  - Habitat loss leading to population decline;
  - Habitat loss leading to population fragmentation;
  - Degradation of habitat due to weed invasion leading to population decline;
  - Ongoing mortality from operations;
  - Species interactions including feral and overabundant native species;
  - Hydrological change;
  - Altered fire regimes; and
  - Disturbance (dust, light, noise).
- The recommendation of actions to mitigate impacts.

Descriptions and background information on these values and processes can be found in Appendices 1 to 4. In particular, Appendix 1 explains and defines the fauna values, including the recognition of three classes of species of conservation significance (CS): those listed under legislation (CS1), those listed as priority by the Department of Biodiversity, Conservation and Attractions (CS2), and those that



can be considered of local or other significance, but which have no formal listing (CS3). Appendix 2 describes threatening processes, while Appendix 3 outlines the legal definitions and classes of conservation significance, and Appendix 4 presents the threatening processes recognised under legislation. Based on this impact assessment process, the objectives of investigations are to: identify fauna values; review impacting processes with respect to these values and the proposed activity; and provide recommendations to mitigate these impacts.

## **1.2 Description of Project Area**

The Marymia Project area lies on Marymia station about 150km north-east of Meekatharra and 150km north-west of Wiluna. It lies in the south of the Augustus Subregion of the Gascoyne Bioregion (Figure 1-3), identified as part of the Interim Biogeographic Regionalisation of Australia (IBRA) that has identified 26 bioregions in Western Australia which are further divided into subregions (DSEWPac 2013, Environment Australia 2000). Bioregions are classified on the basis of climate, geology, landforms, vegetation and fauna (Thackway and Cresswell, 1995). IBRA Bioregions are affected by a range of different threatening processes and have varying levels of sensitivity to impact (EPA 2004).

The Augustus subregion is characterised by Mulga woodlands on hard pan and stony rises and *Triodia* hummock grasslands on sandy soils. The climate is arid with bimodal rainfall, and the dominant land use is grazing (based on native pastures), with small areas of mining, UCL and Crown Reserves (Desmond *et al.* 2001).

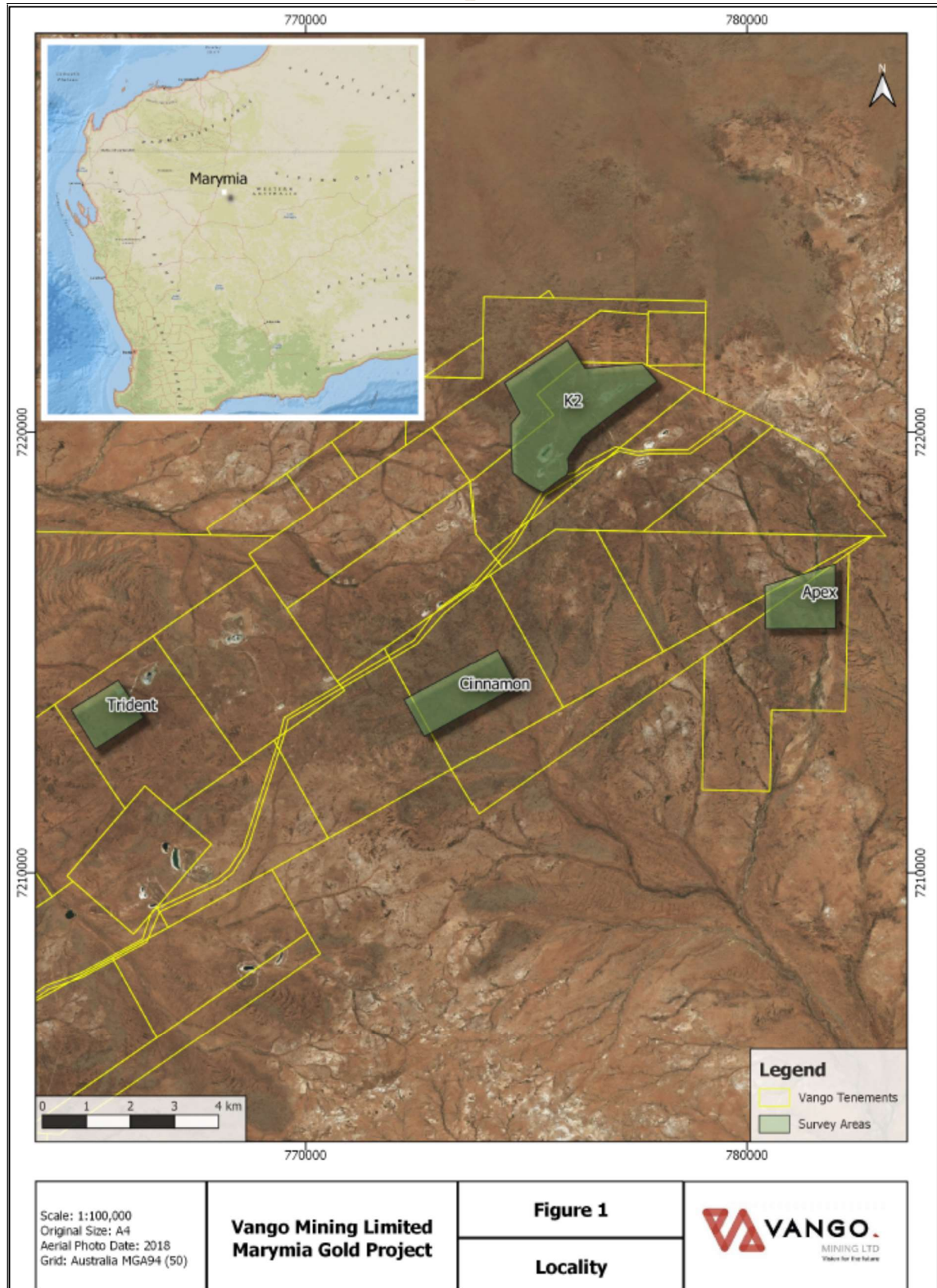


Figure 1-1. Location of Marymia Project area and 2018 exploration areas.



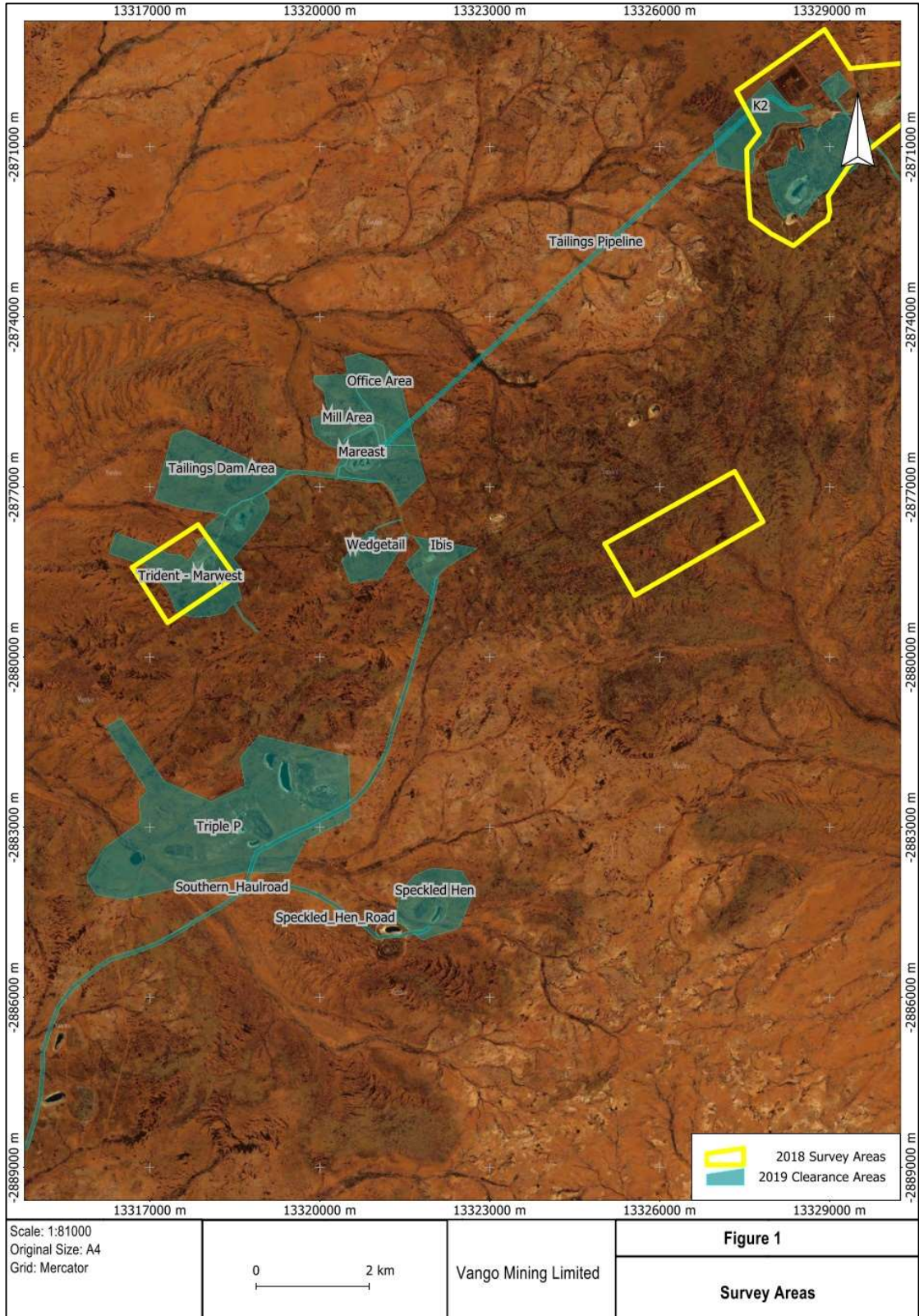


Figure 1-2. Locations of 2019 survey areas (blue boundaries); 2018 survey areas are indicated in yellow, see preceding figure for detail.

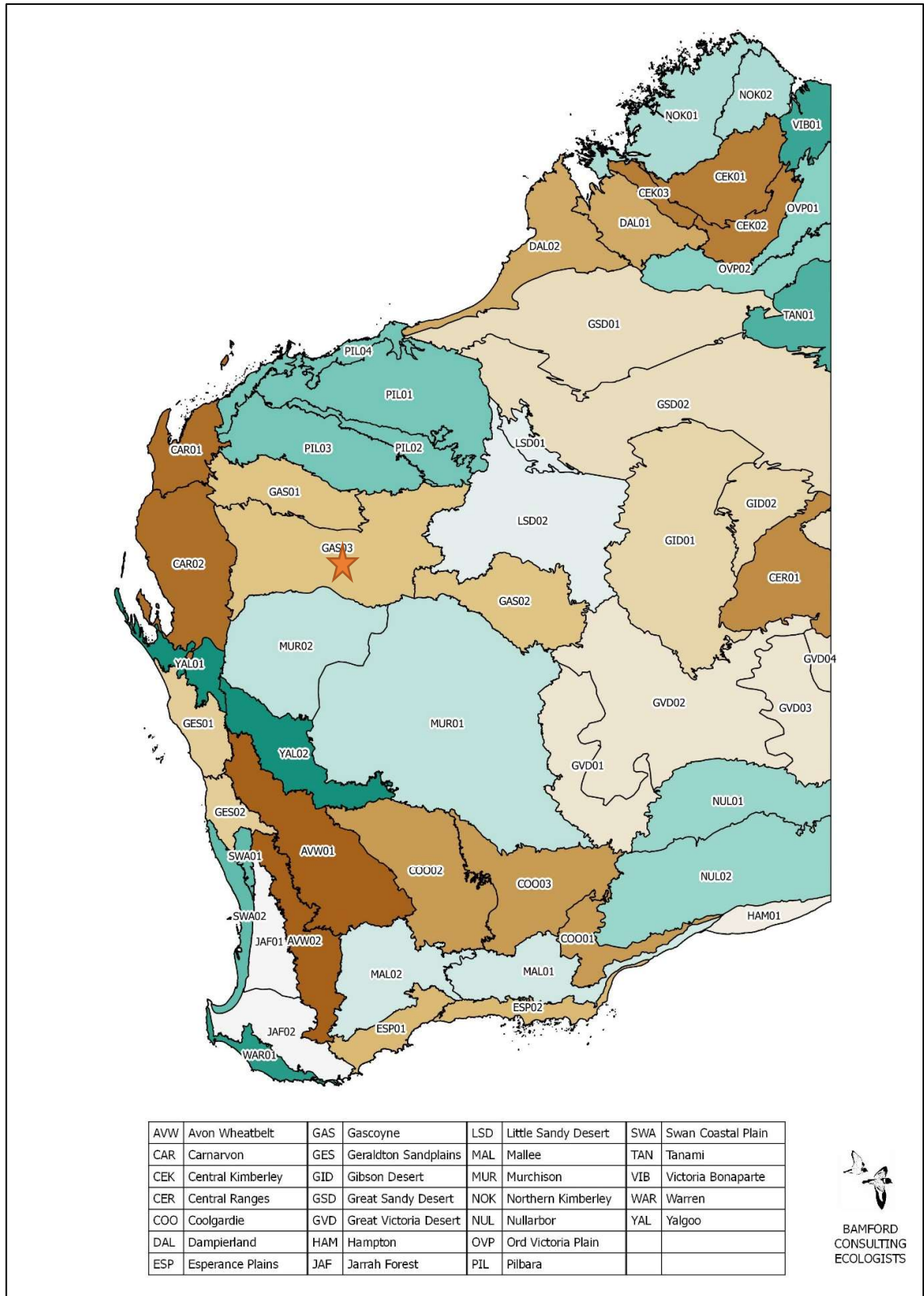


Figure 1-3. Bioregions across Western Australia, indicating the approximate location of the Marymia Project area (orange star).



## 2 Methods

### 2.1 Overview

The methods used for this assessment are based upon the general approach to fauna investigations for impact assessment as outlined in Section 1.1 and with reference to Appendices 1 to 4. Thus, the impact assessment process involves the identification of fauna values, review of impacting processes and, where possible, preparation of mitigation recommendations.

This approach to fauna impact assessment has been developed with reference to guidelines and recommendations set out by the Western Australian Environmental Protection Authority (EPA) on fauna surveys and environmental protection, and Commonwealth biodiversity legislation (EPA 2002; EPA 2004, EPA and Department of Environment and Conservation 2010). The EPA proposes two levels of investigation that differ in the approach to field investigations, Level 1 (this assessment) being a review of data and a site reconnaissance to place data into the perspective of the site, and Level 2 being a literature review and intensive field investigations (e.g. trapping and other intensive sampling). The level of assessment recommended by the EPA is determined by the size and location of the proposed disturbance, the sensitivity of the surrounding environment in which the disturbance is planned, and the availability of pre-existing data.

The following approach and methods is divided into three groupings that relate to the stages and the objectives of impact assessment:

- **Desktop assessment.** The purpose of the desktop review is to produce a species list that can be considered to represent the vertebrate fauna assemblage of the project area based on unpublished and published data using a precautionary approach.
- **Field investigations.** The purpose of the field investigations is to gather information on this assemblage: confirm the presence of as many species as possible (with an emphasis on species of conservation significance), place the list generated by the desktop review into the context of the environment of the project area, collect information on the distribution and abundance of this assemblage, and develop an understanding of the project area's ecological processes that maintain the fauna. Note that field investigations cannot confirm the presence of an entire assemblage, or confirm the absence of a species. This requires far more work than is possible in the EIA process. For example, in an intensive trapping survey, How and Dell (1990) recorded in any one year only about 70% of the vertebrate species found over three years. In a study spanning over two decades, Bamford *et al.* (2010) has found that the vertebrate assemblage varies over time and space, meaning that even complete sampling at a set of sites only defines the assemblage of those sites at the time of sampling.
- **Impact assessment.** Determine how the fauna assemblage may be affected by the proposed development based on the interaction of the project with a suite of ecological and threatening processes.

## 2.2 Desktop Assessment

### 2.2.1 Sources of information

Information on the fauna assemblage of the survey area was drawn from a wide range of sources (Table 2-1). These included state and federal government databases and results of regional studies. Databases accessed were the Atlas of Living Australia (ALA), the WA Department of Biodiversity, Conservation and Attractions (DBCA) NatureMap (incorporating the Western Australian Museum's FaunaBase and the DBCA Threatened and Priority Fauna Database), BirdLife Australia's Birdata (Atlas) Database, the EPBC Protected Matters Search Tool managed by the Department of Energy and the Environment (DEE). There were also some records from the Bamford Consulting Database from studies within c. 50km, but these will be captured in NatureMap. Information from the above sources was supplemented with species expected in the area based on general patterns of distribution. Sources of information used for these general patterns were:

- Frogs: Tyler *et al.* (2000) and Anstis (2013);
- Reptiles: Storr *et al.* (1983, 1990, 1999 and 2002) and Wilson and Swan (2013);
- Birds: Blakers *et al.* (1984); Johnstone and Storr (1998, 2004), Barrett *et al.* (2003) and Menkhorst *et al.* (2017);
- Mammals: Menkhorst & Knight (2004); Churchill (2008); and Van Dyck and Strahan (2008).

Table 2-1. Sources of information used for the desktop assessment.

Database / Survey	Comment	Area searched
NatureMap (DBCA, December 2018)	Records in the WAM and DPaW databases. Includes historical data and records on Threatened and Priority species in WA.	Project area – plus 40 km buffer
BirdLife Australia Atlas Database (BirdLife Australia, December 2018)	Records of bird observations in Australia, 1998-2018.	Species list for one degree cell containing project area
EPBC Protected Matters (DEE, December 2018)	Records on matters of national environmental significance protected under the EPBC Act.	Project area – plus 40 km buffer
ALA (December 2018)	Fauna records submitted to the Atlas of Living Australia	Project area – plus 40 km buffer

In addition to the databases, some fauna studies have previously been carried out as part of the Marymia Project (*ecologia* 1991, 2005; Mulgara surveys by Rodda and Bamford 2007, 2008; Zosky and Bamford 2009), and on the nearby (20km south-west) Doolgunna Station, owned by the DBCA (Bell *et al.* 2013, Ninox 2011, Turpin and Bamford 2016). The earlier studies on Marymia Station included general fauna observations and targeted research on the Brush-tailed Mulgara (referred to as *Dasyercus cristicauda* in earlier studies, but now identified as *D. blythi*). All previous studies conducted in Marymia were targeted Mulgara surveys, except for the 1991 *ecologia* survey which was a level 2 survey. Species recorded in the *ecologia* (1991) survey and in previous BCE surveys (2007 to 2009) are included in species totals in the results of this report.



### 2.2.2 *Nomenclature and taxonomy*

As per the recommendations of EPA (2004), the nomenclature and taxonomic order presented in this report are based on the Western Australian Museum's (WAM) Checklist of the Fauna of Western Australia 2016. The authorities used for each vertebrate group were: amphibians (Doughty *et al.* 2016a), reptiles (Doughty *et al.* 2016b), birds (Johnstone and Darnell 2016), and mammals (Travouillon 2016). In some cases, more widely-recognised names and naming conventions have been followed, particularly for birds where there are national and international naming conventions in place (e.g. the BirdLife Australia working list of names for Australian Birds). English names of species where available are used throughout the text; Latin species names are presented with corresponding English names in tables in the appendices.

### 2.2.3 *Interpretation of species lists*

Species lists generated from the review of sources of information are generous as they include records drawn from a large region and possibly from environments not represented in the survey area. Therefore, some species that were returned by one or more of the data searches have been excluded because their ecology, or the environment within the survey area, meant that it is highly unlikely that these species will be present. Such species can include, for example, seabirds that might occur as extremely rare vagrants at a terrestrial, inland site, but for which the site is of no importance. Species returned from databases but excluded from species lists are presented in Appendix 6. Databases can also include species that are locally or completely extinct; where a species would have occurred at the site but is now considered extinct at that site, it is listed separately (Appendix 6).

Species returned from the databases and not excluded on the basis of ecology, environment or extinction, are therefore considered potentially present or expected to be present in the survey area at least occasionally, whether or not they were recorded during field surveys, and whether or not the survey area is likely to be important for them. This list of expected species is therefore subject to interpretation by assigning each a predicted status in the survey area. The status categories used are:

- Resident (Res): species with a population permanently present in the survey area;
- Migrant or regular visitor (Vis): species that occur within the survey area regularly in at least moderate numbers, such as part of annual cycle;
- Irregular Visitor (IrrVis): species that occur within the survey area irregularly such as nomadic and irruptive species. The length of time between visitations could be decades but when the species is present, it uses the survey area in at least moderate numbers and for some time;
- Vagrant (Vag): species that occur within the survey area unpredictably, in small numbers and/or for very brief periods. Therefore, the survey area is unlikely to be of importance for the species; and
- Locally extinct: species that would have been present but has not been recently recorded in the local area and therefore is almost certainly no longer present in the survey area.

These status categories make it possible to distinguish between vagrant species, which may be recorded at any time but for which the site is not important in a conservation sense, and species which use the site in other ways but for which the site is important at least occasionally. This is particularly

useful for birds that may naturally be migratory or nomadic, and for some mammals that can also be mobile or irruptive, and further recognises that even the most detailed field survey can fail to record species which will be present at times, or may have been previously confirmed as present. The status categories are assigned conservatively. For example, a lizard known from the general area is assumed to be a resident unless there is very good evidence that the site will not support it, and even then it may be classed as a vagrant rather than assumed to be absent if the site might support dispersing individuals.

### **2.3 Field Investigation Methodology**

The field assessment incorporated a range of survey techniques so as to maximise developing an understanding of the exploration areas, their fauna and the potential impacts of exploration upon that fauna. Survey techniques utilised are outlined in the following sections.

#### *2.3.1 Dates and Personnel*

The initial four exploration areas (K2, Cinnamon, Trident and Apex) were visited from 6<sup>th</sup> to 10<sup>th</sup> November 2018. Personnel involved in the 2018 survey were: Dr Michael Bamford (B.Sc. Hons. Ph.D.), Mr Peter Smith (Assoc. Dip. Ag. (Farm Management)) and Mrs Sarah Smith (B.Sc.). The additional exploration areas (a smaller area of K2, the tailings pipeline corridor, Trident/Mareast, Wedgetail, Ibis, Marwest, Triple P and Speckled Hen) were visited from 6<sup>th</sup> to 9<sup>th</sup> August 2019. Personnel involved in the 2019 survey were: Dr Michael Bamford and Mrs Amanda Bamford (B.Sc. Hons.). This report was prepared by Dr Michael Bamford and Ms Natalia Huang (B.Sc. Hons.).

#### *2.3.2 Vegetation and Substrate Associations*

The Vegetation and Substrate Associations (VSAs) present in all areas were identified. These provide the habitat for fauna and inform the fauna assemblage expected in each area. Details on methodology are provided in Appendix 1.

#### *2.3.3 Targeted searches for conservation significant fauna*

Targeted searches for conservation significant fauna, including an assessment of their likelihood of occurrence, were conducted in November 2018 and August 2019. In November 2018, targeted searching was undertaken by the personnel spaced at 25-50m intervals and walking transects across each exploration area. In August 2019, exploration areas were examined by driving (an all-terrain vehicle) and walking through as much of the area as possible and considered necessary. Notes were made on the environment; searching was undertaken for Malleefowl mounds and Mulgara burrows; and general fauna observations were recorded. The tracks taken in each exploration area are given in Figures Figure 2-1 to Figure 2-5. Details on dates and locations of surveys are given in Table 2-2.



**Table 2-2. Details of surveys at each exploration area.**

Location	Date	Details
Trident	7 <sup>th</sup> November 2018	Team of three walked around the lease area from about 08:00 to 12:30.
K2	7 <sup>th</sup> and 8 <sup>th</sup> November 2018	Team of three walked across much of the east of the area 14:45 to 16:30 (7/11/2018). Team of three walked across much of the area in north and west from 06:30 to 12:30 (8/11/2018).
Cinnamon	9 <sup>th</sup> November 2018	Team of three walked across much of the area from 06:30 to 12:00.
Apex	9 <sup>th</sup> November 2018	Team of three walked across much of the area from 14:00 to 17:30.
Pipeline corridor	7 <sup>th</sup> August 2019	Team of two drove length of pipeline corridor using Can-Am as there was no access for a regular vehicle. Stopped regularly to look for evidence of fauna, including birds.
K2 (east)	7 <sup>th</sup> August 2019	Team of two drove and walked through much of the area.
Mareast (west)	7 <sup>th</sup> August 2019	Team of two drove and walked through much of the area.
Ibis	7 <sup>th</sup> August 2019	Team of two drove and walked through much of the area.
Wedgetail	7 <sup>th</sup> August 2019	Team of two drove and walked through much of the area.
Tailings Dam	8 <sup>th</sup> August 2019	Team of two drove and walked through much of the area.
Marwest	8 <sup>th</sup> August 2019	Team of two drove and walked through much of the area.
Trident	9 <sup>th</sup> August 2019	Team of two drove and walked through much of the area.
Triple P	9 <sup>th</sup> August 2019	Team of two drove and walked through much of the area.
Speckled Hen	9 <sup>th</sup> August 2019	Team of two drove and walked through much of the area although not covered completely.



**Figure 2-1. Walked transects in Trident (left) and Cinnamon (right) exploration areas (November 2018).**



Figure 2-2. Walked transects in Apex (left) and K2 (right) exploration areas (November 2018).

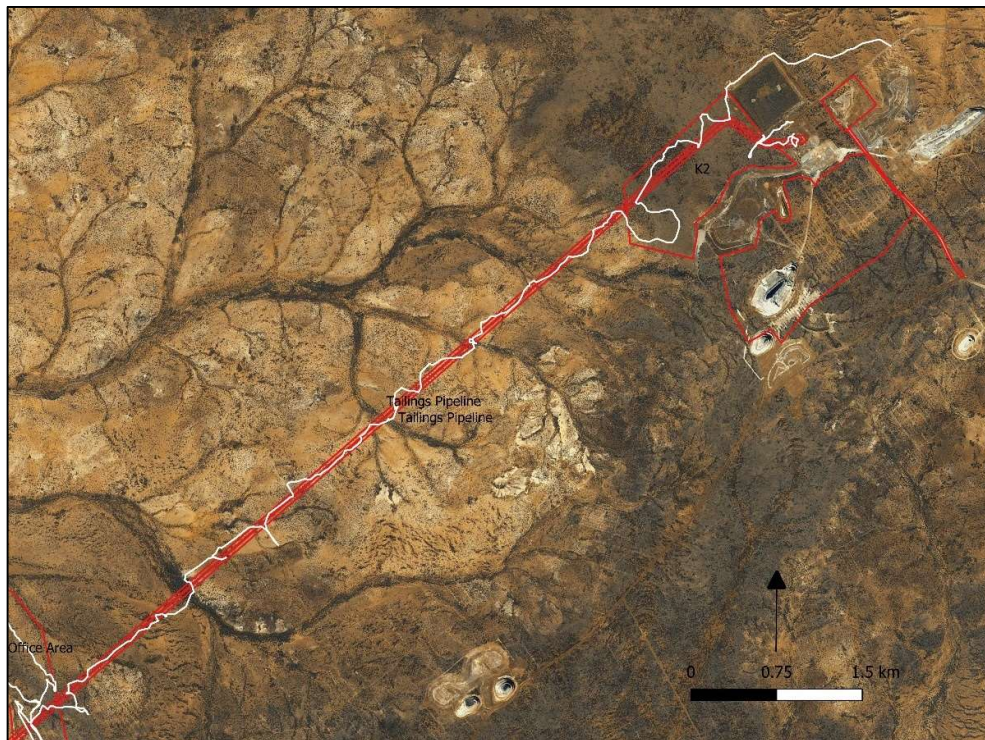


Figure 2-3. Driven or walked transects in K2 exploration area and along Pipeline Corridor (August 2019).



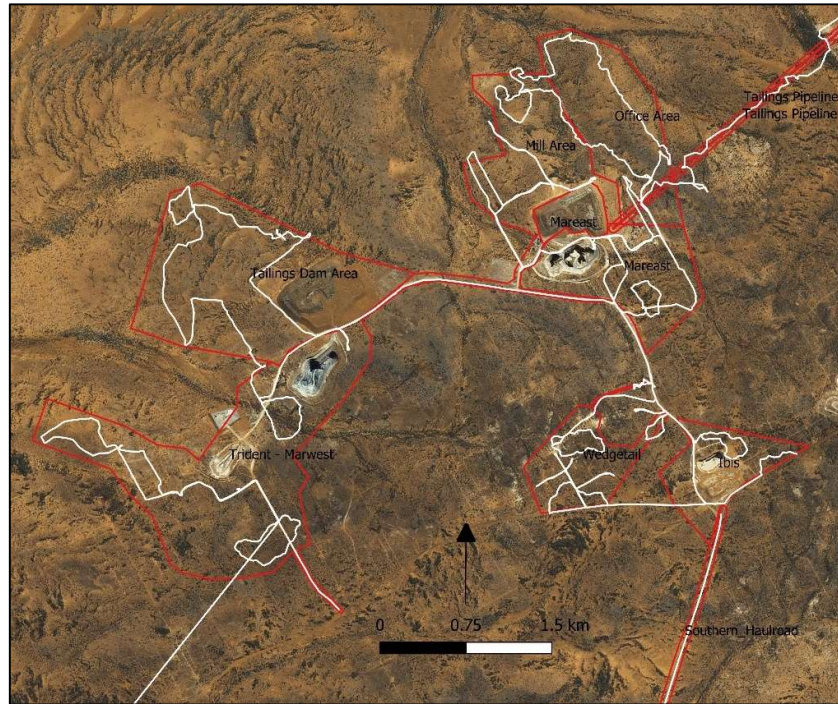


Figure 2-4. Driven and walked transects in Mareeast, Trident, Marwest, Wedgetail and Ibis exploration areas (August 2019).

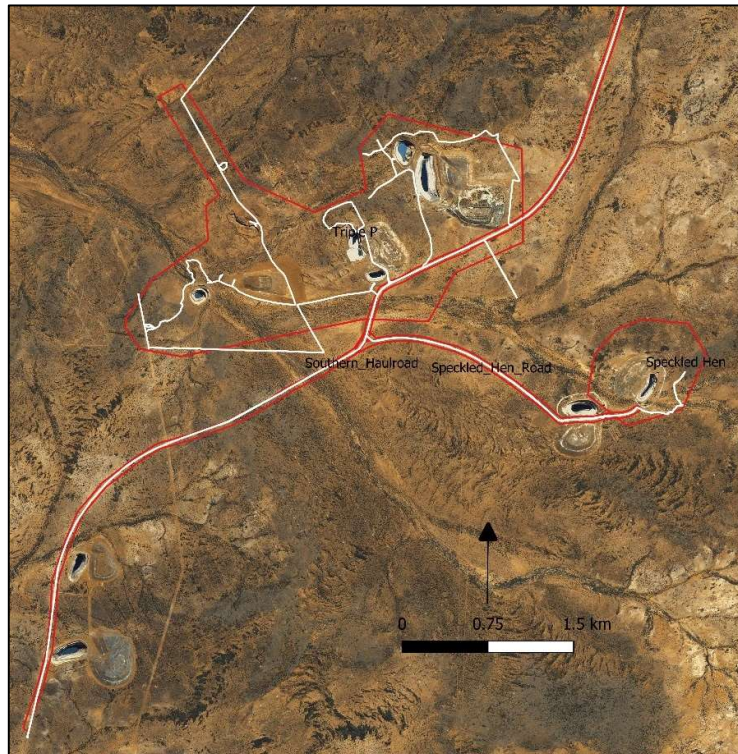


Figure 2-5. Driven and walked transects in Triple P and Speckled Hen exploration areas (August 2019).

### 2.3.4 Bird censusing

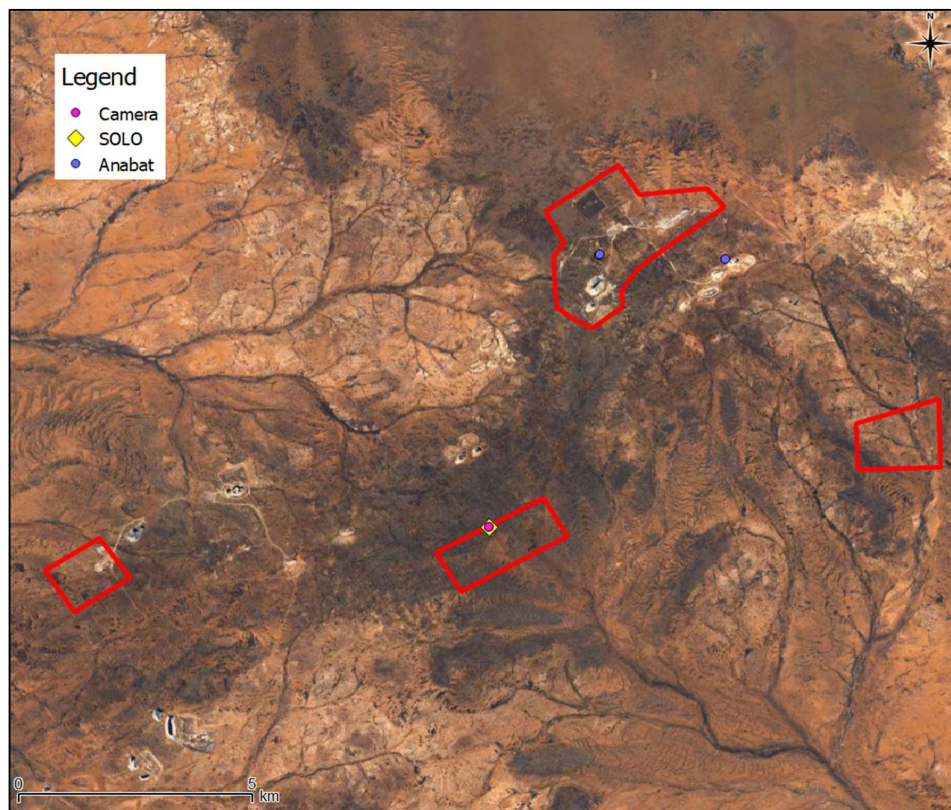
During all walks through the exploration areas in November 2018 and August 2019, birds were identified and counted, giving a measure of abundance of each species in each area.

### 2.3.5 Head-torching and Spotlighting

Head-torching was conducted in each exploration area in November 2018 by three personnel for at least half an hour. In addition, spotlighting was carried out when driving to and from the areas. Head-torching and spotlighting were not conducted in August 2019 as conditions were considered too cold for reptiles to be active.

### 2.3.6 Motion-sensitive cameras

A single motion-sensitive camera (baited with bait confined in a tube) was set in the Cinnamon exploration area at 25.16120°S, 119.71083°E on the night of 8<sup>th</sup> November 2018 (Figure 2-6). This was at a location that appeared to be frequented by a Fox. Cameras were not set in August 2019.



**Figure 2-6. Locations of recording devices (November 2018 survey). Note: A bat detector (“Anabat”) was also deployed in August 2019 at the same location within the K2 boundary (western purple dot).**

### 2.3.7 Audio recording unit

An Autonomous Recording Unit (ARU), a SOLO, was set in the Cinnamon exploration area at 25.16120°S, 119.71083°E on the night of 8<sup>th</sup> November 2018 (Figure 2-6). This is a high definition audio recorder for acoustic monitoring of the environment. The audio recording unit was not set in August 2019.



### 2.3.8 Bat detectors

A bat detector (Anabat Swift, Titley) was deployed in a large mining portal in the K2 exploration area (Figure 2-7) for one night on 7<sup>th</sup> November 2018 and 8<sup>th</sup> August 2019. A detector was also deployed at the exploration camp (Figure 2-8) for one night on 8<sup>th</sup> November 2018. The locations of the bat detectors are shown in Figure 2-6. Details of the bat detector locations and dates are given in Table 2-3. These were the first bat survey work to be undertaken at the site.

**Table 2-3. Details of bat detector deployment in November 2018 and August 2019 surveys.**

<b>Date</b>	<b>GPS coordinates</b>	<b>Description of location and features of interest</b>
7 <sup>th</sup> – 8 <sup>th</sup> November 2018	25.10907°S, 119.73203°E	Detector set outside a large mining “portal” – vehicle entrance to underground system in K2 area. Portal was set in excavated hollow as shown in Figure 2-7.
8 <sup>th</sup> – 9 <sup>th</sup> November 2018	25.11009°S, 119.75627°E	Detector set near the camp in a sparsely vegetated area (Figure 2-8). Some small breakaways nearby and also some old open cut pits.
8 <sup>th</sup> – 9 <sup>th</sup> August 2019	25.10907°S, 119.73203°E	Detector set in excavated hollow outside mining portal as on 7 <sup>th</sup> November 2018 and Figure 2-7.

The detectors were set to record from 30 minutes before sunset to 30 minutes after sunrise. Calls were assessed using Wildlife Acoustics Kaleidoscope software (v4.5.4) and compared against previously collected calls using the following characteristics:

- Fmax (kHz): Average maximum frequency of call pulses within each call sequence;
- Fpeak (kHz): Average frequency of peak energy within call pulses, within each call sequence;
- Fmin (kHz): Average minimum frequency of call pulses within each call sequence;
- Dur (ms): Average duration of call pulses.



Figure 2-7. Underground mine portal entrance outside which a bat detector was set on night of 7<sup>th</sup> November 2018 and 8<sup>th</sup> August 2019.



Figure 2-8. View of bat detector at exploration camp on night of 8<sup>th</sup> November 2018.



### 2.3.9 Opportunistic observations

At all times, opportunistic observations of fauna were recorded with all individuals identified to species level.

## 2.4 Survey Limitations

The EPA Guidance Statement 56 (EPA 2004, now EPA 2016) outlines a number of limitations that may arise during surveying. These survey limitations are discussed in the context of the BCE investigation of the survey area in Table 2-4. One issue was restrictions on movement due to Dingo activity in the area. As a result of very dry conditions and lack of food, Dingoes were travelling in packs and there was concern with being on-foot away from a vehicle.

**Table 2-4. Survey limitations as outlined by EPA.**

<b>EPA Limitation</b>	<b>BCE Comment</b>
Level of survey.	Level 1 (desktop study and site inspection). Survey intensity was deemed adequate due to the scale of the project and the amount of data available in the region.
Competency/experience of the consultant(s) carrying out the survey.	The ecologists have had extensive experience in conducting fauna surveys and have conducted several fauna studies within the immediate region.
Scope. (What faunal groups were sampled and were some sampling methods not able to be employed because of constraints?)	The survey focussed on vertebrate fauna and fauna values.
Proportion of fauna identified, recorded and/or collected.	All vertebrate fauna observed were identified.
Sources of information e.g. previously available information (whether historic or recent) as distinct from new data.	Abundant information from databases and previous studies.
The proportion of the task achieved and further work which might be needed.	The survey was completed and the report provides fauna values for the project area.
Timing/weather/season/cycle.	Timing is not of great importance for level 1 investigations.
Disturbances (e.g. fire, flood, accidental human intervention etc.) that affected results of survey.	None
Intensity. (In retrospect, was the intensity adequate?)	All major VSAs were visited and significant species habitat and traces were identified.

EPA Limitation	BCE Comment
Completeness (e.g. was relevant area fully surveyed).	Site was fully surveyed to the level appropriate for a level 1 assessment and for the proposed impact. Fauna database searches covered a 40 km radius beyond the survey area boundary. Detailed field investigations covered the VSAs present.
Resources (e.g. degree of expertise available in animal identification to taxon level).	Field personnel have extensive experience with fauna and habitat in the region.
Remoteness and/or access problems.	There were no serious remoteness/access problems encountered. In August 2019, walking long distances away from the vehicle was avoided due to concern with Dingoes present in packs in the area. The all-terrain vehicle (ATV) corrected for this to a great degree. Speckled Hen was not completely searched due to failing light on the last day and poor access (dense vegetation restricted access by the ATV).
Availability of contextual (e.g. biogeographic) information on the region.	Regional information was available and was consulted.

## 2.5 Presentation of Results for Impact Assessment

While some impacts are unavoidable during a development, of concern are long-term, deleterious impacts upon biodiversity. This is reflected in documents such as the Significant Impact Guidelines provided by DSEWPaC (2012) (see Appendix 4). Significant impacts may occur if:

- There is direct impact upon a VSA and the VSA is rare, a large proportion of the VSA is affected and/or the VSA supports significant fauna.
- There is direct impact upon conservation significant fauna.
- Ecological processes are altered and this affects large numbers of species or large proportions of populations, including significant species.

The impact assessment process therefore involves reviewing the fauna values identified through the desktop assessment and field investigations with respect to the project and impacting processes. The severity of impacts on the fauna assemblage and conservation significant fauna can then be quantified on the basis of predicted population change.

The presentation of this assessment follows the general approach to impact assessment as given in Section 1.1), but modified to suit the characteristics of the site. Key components to the general approach to impact assessment are addressed as follows:



### Fauna values

This section presents the results of the desktop and field investigations in terms of key fauna values (described in detail in Appendix 1) and includes:

- Recognition of ecotypes or vegetation/substrate associations (VSAs);
- Assemblage characteristics (uniqueness, completeness and richness);
- Species of conservation significance;
- Patterns of biodiversity across the landscape; and
- Ecological processes upon which the fauna depend.

### Impact assessment

This section reviews impacting processes (as described in detail in Appendix 2) with respect to the proposed development and examines the potential effect these impacts may have on the faunal biodiversity of the survey area. It thus expands upon Section 3) and discusses the contribution of the project to impacting processes, and the consequences of this with respect to biodiversity. A major component of impact assessment is consideration of threats to species of conservation significance as these are a major and sensitive element of biodiversity. Therefore, the impact assessment section includes the following:

- Review of impacting processes; will the proposal result in:
  - Habitat loss leading to population decline, especially for significant species;
  - Habitat loss leading to population fragmentation, especially for significant species;
  - Weed invasion that leads to habitat degradation;
  - Ongoing mortality;
  - Species interactions that adversely affect native fauna, particularly significant species;
  - Hydrological change;
  - Altered fire regimes; or
  - Disturbance (dust, light, noise).
- Summary of impacts upon significant species, and other fauna values.

The impact assessment concludes with recommendations for impact mitigation, based upon predicted impacts.

#### *2.5.1 Criteria for impact assessment*

Impact assessment criteria are based on the severity of impacts on the fauna assemblage and conservation significant fauna, and quantified on the basis of predicted population change (Table 2-5). Population change can be the result of direct habitat loss and/or impacts upon ecological processes.

The significance of population change is contextual. The EPA (2004) suggests that the availability of fauna habitats within a radius of 15 km can be used as a basis to predict low, moderate or high impacts. In this case, a high impact is where the impacted environment and its component fauna are rare (less than 5% of the landscape within a 15 km radius or within the Bioregion), whereas a low impact is where the environment is widespread (e.g. >10% of the local landscape). Under the Ramsar Convention, a wetland that regularly supports 1% of a population of a waterbird species is considered to be significant. These provide some guidance for impact assessment criteria. In the following criteria (Table 2-5), the significance of impacts is based upon percentage population decline within a 15 km

radius (effectively local impact) and upon the effect of the decline upon the conservation status of a recognised taxon (recognisably discrete genetic population, sub-species or species). Note that percentage declines can usually only be estimated on the basis of the distribution of a species derived from the extent of available habitat.

The impact assessment concludes with recommendations based upon predicted impacts and designed to mitigate these.

**Table 2-5. Assessment criteria for impacts upon fauna.**

<b>Impact Category</b>	<b>Observed Impact</b>
Negligible	Effectively no population decline; at most few individuals impacted and any decline in population size within the normal range of annual variability.
Minor	Population decline temporary (recovery after end of project such as through rehabilitation) or permanent, but <1% within 15 km radius of centre-point of impact area (or within bioregion if this is smaller). No change in viability or conservation status of taxon.
Moderate	Permanent population decline 1-10% within 15 km radius. No change in viability or conservation status of taxon.
Major	Permanent population decline >10% within 15 km radius. No change in viability or conservation status of taxon.
Critical	Taxon extinction within 15 km and/or change in viability or conservation status of taxon.



### 3 Results: Fauna Values

#### 3.1 Vegetation and Substrate Associations (VSAs)

The exploration areas are broadly similar in vegetation and substrates with representatives of each VSA throughout the project area. The vegetation can be summarised as being mostly open Acacia or Mulga shrubland over sparse to dense vegetation with many areas of spinifex. These occur over red loam to sandy loam on the flat areas and gravelly loam and rocky soil on the higher ground, with some gravelly areas overlain with quartz/ironstone cobbles or pebbles. Drainage lines with Acacia or Mulga thickets on clayey loams occur throughout the exploration areas in varying sizes. VSAs can only be broadly defined in the absence of detailed vegetation surveys, but key VSAs are listed in Table 3-1 and shown in Figures Figure 3-1 to Figure 3-9.

Table 3-1. Main VSAs across project area

VSA No.	VSA	Exploration areas with VSA
VSA 1	Acacia shrubland on gravelly loam with quartz/ironstone cobbles on flats and slight rises. This is very extensive and variable, with some areas of acacia thickets, but other areas that are very open and the quartz forms a veneer over open ground.	Trident, Mareast, Cinnamon, Triple P, Apex, K2, Marwest, Speckled Hen, Tailings Pipeline
VSA 2	Open Acacia on rocky/gravelly soil, on high ground, sometimes with Miniritchi and sometimes over Spinifex.	Tailings Pipeline, Mareast, East Ibis, Wedgetail, Speckled Hen
VSA 3	Mulga over shrubs and spinifex on loam to sandy loam flats.	Significant for Mulgara. Apex, north K2, east K2, pipeline, Triple P, Cinnamon
VSA 4	Drainage line with Acacia/Mulga thickets on clayey loam. On some drainage lines the acacia are a tall Miniritchi.	Trident, Apex, Tailings Pipeline, Ibis, Wedgetail, Mareast, Triple P, Marwest. Largest drainage lines are along the Tailings Pipeline and in Apex and Triple P.
VSA 5	Old mine pits, stockpiles with partial rehabilitation; areas of good rehabilitation are similar to VSA 1.	K2, Trident, Cinnamon, Ibis, Mareast, Triple P.

Detailed descriptions of the VSAs within each exploration area are given here:

**K2.** Several old mine workings, open-cuts and access to a portal at K2. Also large overburden stockpiles with some Acacia regeneration but a lot of bare ground and erosion channels. An old TSF to the north has impressively dense Acacia regrowth. In north, vegetation is Mulga over Spinifex on gravelly loam, over half burnt c. 3 years previously.

Notable for: Large areas of Mulga over Spinifex on gravelly loam.

**Apex.** Encompasses a major drainage system running north-south. Some small pools along drainage line were present in November 2018, with drainage system supporting a corridor of Acacia thickets

over dense patches of understorey on clayey loam. Some areas are clearly flooded to a shallow depth seasonally. Most of project area is Acacia open tall shrubland over sparse shrubs on quartz and ironstone cobbles/gravel veneer flats and slight rises.

Notable for: Large drainage line whereas most other areas have smaller drainage lines. No previous mining but some recent exploration so low levels of disturbance.

**Cinnamon.** Some mine workings but mostly undisturbed. More uniform than other areas, with tall Mulga over Spinifex on loam plain, slightly gravelly in north. Some areas of Mulga thicket with dense understorey.

Notable for: Large areas of Mulga over Spinifex on loam and low level of existing mine activity.

**Trident/Marwest.** Lower relief than in more easterly areas. Extensive low open Acacia woodland with sparse understorey on gravelly loam flats, some areas with quartz and ironstone cobbles/gravel veneer. In west and northwest, some minor drainage lines with dense and tall acacia over dense shrubs forming tall thickets. Similar thickets in slight depressions throughout. Moderately large drainage line in south supports dense belt of tall Acacia thicket over mixed understorey. Some areas of Spinifex and areas of open Acacia woodland on loam to clayey-loam flats. Shrub-steppe of low, sparse shrubs may be natural or the product of grazing. Old mine workings in east with a deep open pit, overburden stockpiles and generally disturbed ground. Active drilling in centre has resulted in a lot of loss of understorey but most taller shrubs retained.

Notable for: Large areas of Acacia woodland on gravelly loam and moderately large drainage line in south supporting Acacia thickets.

**Pipeline Corridor.** In east (K2 area), passes through open Mulga over Spinifex on loam plain, much of it burnt in 2016. Central section of corridor passes over a raised area dissected by several drainage lines. High ground supports Mulga and scattered shrubs on gravelly loam with a distinct veneer of quartz pebbles. A few small rocky hills are also present. Crosses several drainage lines, some large and supporting dense corridors of tall Mulga on loam soil. In west, near Mareast, high ground supports open woodland of Acacia, including Mimiritchi, over Spinifex on rocky/gravelly soil.

Notable for: Diversity of vegetation over variety of soils on low and high ground, and major drainage lines.

**Mareast.** Part of area taken up with mine pit and overburden stockpile which is partly rehabilitated. Most of intact area supports Acacia open low woodland with little understorey on gravelly rises and plains. There are also some areas of Acacia thickets along drainage lines and slight depressions. In the east, there are areas of gravelly/rocky hills with Spinifex and Acacia. In the north, drainage lines have distinctive patches of a tall Mimiritchi.

Notable for: Rocky hills with Acacia over Spinifex.

**Wedgetail.** Subject to exploration but no previous mining, so level of disturbance is low. Mostly Acacia low woodland on undulating rocky/gravelly hills. Small area (<1ha) of Mallee with little understorey also present. Dense thickets of Mulga in minor drainage lines between hills.

Notable for: Low level of disturbance, Acacia woodland on gravelly hills, and only area of Mallee in project area.



**Ibis.** Much of area taken up with old mine pit and overburden stockpiles which are partly rehabilitated. Intact areas mostly Acacia woodland on undulating rocky/gravelly hills with dense Mulga thickets in minor drainage lines. In far east, hills have Acacia over Spinifex on rocky/gravelly substrate. Notable for: Acacia woodland on gravelly hills.

**Haul road from Ibis to south of Exocet.** Most notable feature is it passes through Mulgara conservation area. This has VSA of Mulga over Spinifex on loamy sand which seems to be more widespread in the south. Also passes through two major drainage lines. Notable for: Mulgara conservation area of Mulga over Spinifex on loam.

**Triple P.** Relief of natural landscape low, but project area has several large pits and overburden stockpiles. Extensive areas in north and through centre of area of Mulga with shrubby understorey and occasional Spinifex on loam flats; this vegetation generally in good condition. Some of the Mulga over spinifex on loam is signposted as a conservation area (presumably for Mulgara). In far west, undulating gravelly hills supporting open Acacia low woodland over Spinifex. In south-east, areas of gravelly/rocky plain, including quartz veneer, supporting Acacia tall open shrubland. Several large drainage lines present. In north, these contain dense thickets of tall Mulga. In west, passing through Exocet pit, a drainage line with a distinctive woodland of tall Miniritchi is present. Notable for: Large areas of Mulga over shrubby understorey on a range of soil types; several large drainage lines and belts of Miniritchi woodland.

**Speckled Hen.** Most of Speckled Hen is Mulga on loam; some of this is associated with drainage line or low-lying, sometimes damp areas. There is a Spinifex on a gravel rise in the east. Notable for: Large areas of Mulga on loam.

Environments of most interest with respect to fauna are the drainage lines, Mulga thickets and the mulga over spinifex on sandy loam. This is because they support some significant species and are restricted in extent. The mine portal in K2, and possibly other shafts in other mine pits, may be locally important (fauna discussed below). The general landscape is very extensive in the region with only small areas of development (past and current mines) and some grazing impacts.



**Figure 3-1. Example of VSA 1 – Acacia shrubland over gravelly loam (Trident).**



**Figure 3-2. Example of VSA 1 - Acacia tall shrubland on slight gravelly rise (Trident).**





Figure 3-3. Example of VSA 1 – Acacia over dense shrubs on slightly gravelly loam (Apex).



Figure 3-4. Example of VSA 2 – Open Acacia over gravelly rise with Miniritchi over Spinifex (Tailings Pipeline Corridor).





Figure 3-5. Example of VSA 2 – Open Acacia shrubland and woodland over Spinifex on loam Cinnamon).



Figure 3-6. Example of VSA 3 - Mulga over Spinifex on loam to sandy loam (north of K2).





**Figure 3-7. Example of VSA 4 - Drainage line with Acacia thickets (Apex, showing temporary pool).**



**Figure 3-8. Example of VSA 4 - Acacia along a drainage line, where the acacias are a tall Miniritchi and there is little understorey (Triple P).**





**Figure 3-9. Example of VSA 5. Flamingo Pit in Triple P. This was the location where a pair of Peregrine Falcons appeared to be nesting.**



**Figure 3-10. Example of moderately good rehabilitation on an old tailings storage facility in K2. This is effectively VSA 1.**



### 3.2 Fauna assemblage

#### 3.2.1 Overview of fauna assemblage

The desktop study identified 259 vertebrate fauna species as potentially occurring in the Marymia area: 9 frogs, 66 reptiles, 148 birds and 36 mammals. These species are listed in Appendix 5. Over half (150; 58%) of these species have been confirmed across multiple surveys, but many cannot be expected to be present all of the time. Species are considered recorded in the project area if they were recorded during the 2009 level 2 survey by *ecologia*, and during either of the BCE surveys conducted in the area, including the Mulgara surveys conducted between 2007 and 2009, and the present November 2018 and August 2019 surveys.

A further 10 species (1 bird and 9 mammals) are considered to be locally extinct, and 26 species returned from databases have been excluded on the basis that they are not known to occur in the area (Appendix 6). An annotated species list for fauna recorded during the November 2018 and August 2019 surveys is presented in Appendix 7.

The composition of the vertebrate fauna is summarised in Table 3-2. Differences in the fauna assemblage between the exploration areas are likely to be subtle and cannot be investigated without massive sampling effort, but potential differences are discussed below.

**Table 3-2. Composition of vertebrate fauna assemblage of the project area.**

The number of non-native mammals is shown in parentheses. Locally extinct species are not included in totals.

Taxon	Expected Species	Recorded Species	Number of species in each status category				
			Resident	Migrant or regular visitor	Irregular visitor	Vagrant	Locally extinct
Frogs	9	3	9	-	-	-	-
Reptiles	66	29	65	1	-	-	-
Birds	148	91	60	40	37	11	1
Mammals	36 (10)	27 (10)	30 (6)	2 (1)	2 (2)	2	9
Total	259	150	164	43	39	13	10

The key features of the fauna assemblage expected in the survey area are:

- **Uniqueness:** The fauna assemblage is probably widespread across similar soils and vegetation in the region, and these soils and vegetation are widespread with localised disturbance from mining and extensive impacts from grazing. The assemblage appears to include at least some outlying populations of Pilbara sub-species, but extensive sampling would be required to document this.

- **Completeness:** The assemblage is likely to be substantially complete except for the mammal fauna, with at least nine species locally extinct. This is typical of a broad part of Australia.
- **Richness:** The assemblage is only moderately rich as the project area has a limited range of VSAs to provide habitat for fauna. For example, it lacks permanent water or very large river systems, and lacks major rocky landscapes.

As a fauna value, the most important features of the project area's assemblage are that it is substantially complete except for some mammals, and it contains elements of the Pilbara as well as the Murchison regions.

### 3.2.2 Frogs

The nine frog species are all considered to be residents and are likely to breed in seasonal freshwater pools such as along the major drainage lines such as in Apex and Triple P, but may also utilize temporary pools where-ever they occur. They may also breed in flooded mine pits if the water is fresh. Outside the breeding season, the frogs are likely to be widespread and not restricted to the margins of seasonal wetlands. The presence of only three frog species has been confirmed, probably because they can only be detected when active, with activity periods limited to rainy periods. All of the frog species are widespread and are not of conservation significance.

### 3.2.3 Reptiles

The 66 reptile species are all considered to be residents except for the Flat-shelled Tortoise which has been recorded but may only be present as a visitor along major drainage lines. However, it could possibly aestivate in the river bed when this system is dry. Studies have confirmed fewer than half the expected reptile assemblage which may reflect difficulty of detection of many species; for example the November 2018 site visit recorded two snake species that are almost certainly resident and common throughout the general area, but which had not previously been found and had not come up from the database search (but were considered to be expected based on known patterns of distribution). One of these, the Pygmy Python, was found when spotlighting at K2 and Cinnamon, and in both cases animals were using piles of rocks created by mining. One of the geckoes recorded, the Banded Knob-tailed Gecko (see cover photograph), was of interest as it represents the Pilbara sub-species (*Nephrurus wheeleri cinctus*) rather than the Murchison sub-species (*N. wheeleri wheeleri*), whereas the latter would have been expected given the project area's location. The results of spotlighting and head-torching are included in the annotated species list in Appendix 7. There were no reptiles recorded in the August 2019 survey due to unsuitable conditions for observing this fauna group (temperatures being too low). All of the reptile species are widespread and are not of conservation significance.

### 3.2.4 Birds

The bird assemblage of 148 species includes a suite of about 20 wetland-dependent species that are only likely to occur as irregular visitors when suitable conditions (i.e. flooding of drainage lines and mine pits) occur within the survey area. Several of these waterbird species were present in August 2019, possibly because dry conditions over large areas were forcing birds to retreat to remnant water bodies such as flooded mine pits. Such water bodies are generally unproductive and thus do not support large numbers of waterbirds, and the numbers present were low (given in Appendix 7).



A high proportion (59%) of species are considered to be visitors, irregular visitors or vagrants; this is to be expected of a strongly seasonal environment with unpredictable rainfall. The majority (49 of 60 species) of bird species considered to be resident have been recorded, suggesting that this group of fauna has been well-covered in surveys. A smaller proportion (18 of 40) of species expected to be visitors have been confirmed.

Results of the bird census conducted in each exploration area in November 2018 and August 2019 are presented in Table 3-3. Comparisons between areas can only be made cautiously, as sampling effort was not strictly standardised and results have not been adjusted for sampling effort, but some trends are apparent. For example, there was higher bird activity in November 2018 surveys than in August 2019 surveys with the average number of species per site being ~17 in 2018 compared with ~5 in 2019. This can be attributed to the poor long-term rainfall across the region in 2018/2019 resulting in dry conditions, low productivity and therefore low fauna activity and abundance. The exception was at Triple P where bird activity was similar to November 2018 levels and much higher than in other sites in August 2019 (n=23 species compared with n<5 in other sites, Table 3-3), but most of the birds were recorded around a pile of horse carcasses where they were foraging on invertebrates attracted to the carcasses. It is interesting to speculate that the survival of some sedentary insectivorous birds may be reliant on such a resource. In November 2018, the rehabilitation area in K2 had fewer bird species than other areas, was missing a suite of thornbills that are associated with medium to tall Mulga, and was also missing the otherwise widespread Spiny-cheeked Honeyeater. The Cinnamon and Apex exploration areas were notable for the abundance of the Red-capped and Hooded Robins, both of which were associated with dense, tall mulga that in Apex occurred along a major drainage line, but in Cinnamon similar vegetation was widespread on sandy loam soils. The majority of species recorded were classed as residents.

The bird assemblage includes 17 species of conservation significance, but most are expected only as irregular visitors or vagrants. These are discussed further below. One bird species is considered to be locally extinct.

**Table 3-3. Raw data of bird surveys in each exploration area in November 2018 and August 2019 surveys.**

Numbers are approximate number of each species counted in each area. K2 records from November 2018 are divided between rehabilitation area and native vegetation.

Species	November 2018 survey					August 2019 survey							
	Trident	K2 rehab	K2 native	Cinnamon	Apex	Pipeline corridor	K2 (west)	Ibis	Wedge-tail	Mareast	Marwest/ Trident	Triple P	Speckled Hen
Little Eagle	1												
Whistling Kite			1										
Nankeen Kestrel	1		1										
Peregrine Falcon												2	
Brown Falcon		1			1	1							
Common Bronzewing	1		2										
Crested Pigeon		2											
Diamond Dove			1										
Galah												2	
Australian Ringneck	2											1	
Red-backed Kingfisher	1												
Rainbow Bee-eater			2										
Western Quail-thrush	5				4	1						3	
Chestnut-rumped Thornbill	14		7	2	8			2	1	3	2	2	
Slaty-backed Thornbill	4		6	6					2				
Yellow-rumped Thornbill												2	
Inland Thornbill	2		2	2	4							2	
Southern Whiteface												2	
Redthroat				1	1							1	
Variigated Fairy-wren	3	3			7				3			3	
Splendid Fairy-wren	2			5	3								
Yellow-throated Miner	2			1	6								
Spiny-cheeked Honeyeater	2		8	8	5	1			2				
Singing Honeyeater	5	2	9	4	6					1			



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Species	November 2018 survey					August 2019 survey							
	Trident	K2 rehab	K2 native	Cinnamon	Apex	Pipeline corridor	K2 (west)	Ibis	Wedge-tail	Mareast	Marwest/Trident	Triple P	Speckled Hen
Mistletoebird					2								
Willie Wagtail	2	1	8	6	6			1	1			4	1
Red-capped Robin	1			2	2							2	
Hooded Robin				2	5	2				1		2	
Grey Shrike-thrush	1	2	6	3	3							1	
Rufous Whistler	5		6	8	4								
Crested Bellbird		1	3	2	3							1	
Grey-crowned Babbler	3			5	5							3	
White-browed Babbler		8	3	2	14								
Welcome Swallow												7	
White-backed Swallow		1											
Little Woodswallow	2		2					1				2	
Black-faced Woodswallow			2	3								30	12
Dusky Woodswallow												1	
Varied Sittella													6
White-winged Triller			1										
Magpie-lark												2	
Pied Butcherbird												1	
Grey Butcherbird			1	2									
Torresian Crow	3									1		1	1
<b>Total Number of Species</b>	<b>21</b>	<b>9</b>	<b>19</b>	<b>18</b>	<b>19</b>	<b>4</b>	<b>0</b>	<b>3</b>	<b>5</b>	<b>4</b>	<b>1</b>	<b>23</b>	<b>4</b>
<b>Average in 2018/2019</b>	<b>17</b>					<b>5</b>							

### 3.2.4.1 Audio Recording Unit

There were no significant findings recorded from the audio recording unit with only common bird species recorded.

### 3.2.5 Mammals

Most of the 37 mammal species are considered to be resident (n=31), with six of these being introduced species. The remaining six mammals are visitors, irregular visitors or vagrants, with three of these introduced. The two vagrant species are native and are probably locally extinct; one of these, the Bilby, is discussed below among significant species. The two irregular visitors are introduced, while the one native regular visitor is the White-striped Bat, which is a migrant in the region, visiting over winter but moving south over summer. Nine mammals are considered to be locally extinct (Appendix 6); these include several of conservation significance. The mammal assemblage includes four species of conservation significance that are discussed below. One of these, the Brush-tailed Mulgara (referred to as the Crest-tailed Mulgara in earlier studies), has been the subject of a major research project in the Marymia area.

#### 3.2.5.1 Motion-sensitive cameras

There were no images recorded from motion-sensitive cameras.

#### 3.2.5.2 Bat detectors

Six bat species were recorded on bat detectors in November 2018 and August 2019 surveys, and all are classed as residents in the project area (Table 3-4). Call charts from each species recorded on bat detectors are shown in Appendix 8. There were three bat species recorded at the K2 portal, with the same species recorded in November 2018 and August 2019 (Table 3-4). The large number of call sequences of *Taphozous georgianus* and *Vespadelus finlaysoni* recorded at the K2 portal contained social calls and feeding buzzes, suggesting these species were roosting in the portal. Similarly, a number of calls from *Saccolaimus flaviventris*, *V. finlaysoni* and *Scotorepens balstoni* in November 2018 contained social calls and feeding buzzes, suggesting these species were roosting in pits close to the exploration camp.

Of the nine bat species expected in the project area, seven have been recorded in previous and present surveys, and all except for one visitor are considered residents (Appendix 5). None is of conservation significance.

**Table 3-4. Species recorded on bat detectors in November 2018 and August 2019. Relative abundance of calls indicated in parentheses.**

Date/Location	Species					
	<i>C. gouldii</i>	<i>N. geoffroyi</i>	<i>S. balstoni</i>	<i>V. finlaysoni</i>	<i>S. flaviventris</i>	<i>T. georgianus</i>
7 Nov 2018 (K2 portal)	X (low)			X (high)		X (high)
8 Nov 2018 (camp)	X (low)	X (low)	X (moderate)	X (high)	X (high)	X (low)
8 Aug 2019 (K2 portal)	X (low)			X (high)		X (high)



### 3.2.6 Species of conservation significance

Of the 259 species of vertebrate fauna that are expected to occur in the survey area, 20 are considered to be of conservation significance (12 CS1, three CS2 and five CS3). The number of conservation significant species in each vertebrate class is given in Table 3-5 and the list of conservation significant species is given in Table 3-6. See Appendix 1 for descriptions of these CS (conservation significance) levels. The majority of conservation significant species are expected as irregular visitors or vagrants; only one bird is considered to be a Visitor, and one bird and three mammals are considered to be Resident. Significant species are discussed below, with the focus on species considered to be Visitors or Residents, but with some discussion on species of high (CS1) significance whatever their expected status.

**Table 3-5. Number of conservation significant species in each vertebrate class.**

See Appendix 1 for full explanation of Conservation Significance (CS) levels: CS1 = listed under WA State and/or Commonwealth legislation; CS2 = listed as Priority by DBCA; CS3 = considered locally significant.

CLASS	CONSERVATION SIGNIFICANCE			
	CS1	CS2	CS3	Total
Frogs	0	0	0	0
Reptiles	0	0	0	0
Birds	11	1	5	17
Mammals	1	2	0	3
<b>Total</b>	<b>12</b>	<b>3</b>	<b>5</b>	<b>20</b>

**Table 3-6. Conservation significant fauna species expected to occur within the project area.**

Species are listed in taxonomic order.

CS1, CS2, CS3 = (summary) levels of conservation significance. See Appendix 1 for full explanation.

EPBC Act listings: E = Endangered, V = Vulnerable, M = Migratory (see Appendix 3).

WA Biodiversity Conservation Act 2018 listings: S1 to S7 = Schedules 1 to 7 (see Appendix 3).

DBCA Priority species: P1 to P4 = Priority 1 to 4 (see Appendix 3).

LS = considered by BCE to be of local significance (see Appendix 3).

SPECIES	COMMON NAME	STATUS	EXPECTED OCCURRENCE
<i>Leiopoa ocellata</i>	Malleefowl	CS1 (V, S3)	Irregular visitor
<i>Apus pacificus</i>	Fork-tailed Swift	CS1 (M, S5)	Visitor
<i>Ardea modesta</i>	Eastern Great Egret	CS1 (M, S5)	Irregular visitor
<i>Falco hypoleucos</i>	Grey Falcon	CS1 (S3)	Vagrant
<i>Falco peregrinus</i>	Peregrine Falcon	CS1 (S7)	Resident
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	CS1 (M, S5)	Irregular Visitor
<i>Calidris ruficollis</i>	Red-necked Stint	CS1 (M, S5)	Irregular Visitor
<i>Calidris melanotos</i>	Pectoral Sandpiper	CS1 (M, S5)	Vagrant
<i>Actitis hypoleucos</i>	Common Sandpiper	CS1 (M, S5)	Irregular Visitor
<i>Lophochroa leadbeateri</i>	Major Mitchell's Cockatoo	CS3 (LS)	Vagrant
<i>Neophema splendida</i>	Scarlet-chested Parrot	CS3 (LS)	Vagrant

SPECIES	COMMON NAME	STATUS	EXPECTED OCCURRENCE
<i>Polytelis alexandrae</i>	Princess Parrot	CS1 (V, P4)	Vagrant
<i>Pezoporus occidentalis</i>	Night Parrot	CS1 (E, S1)	Vagrant
<i>Ardeotis australis</i>	Australian Bustard	CS3 (LS)	Resident
<i>Burhinus grallarius</i>	Bush Stone-curlew	CS3 (LS)	Irregular visitor
<i>Amytornis striatus striatus</i>	Inland Striated Grasswren	CS2 (P4)	Vagrant
<i>Conopophila whitei</i>	Grey Honeyeater	CS3 (LS)	Visitor
<i>Hirundo rustica</i>	Barn Swallow	CS1 (M, S5)	Visitor
<i>Dasycercus blythi</i>	Brush-tailed Mulgara	CS2 (P4)	Resident
<i>Antechinomys laniger</i>	Kultarr	CS3 (LS)	Resident
<i>Sminthopsis longicaudata</i>	Long-tailed Dunnart	CS2 (P4)	Resident
<i>Macrotis lagotis</i>	Greater Bilby	CS1 (V, S3)	Vagrant

### 3.2.6.1 Conservation Significance 1

#### Malleefowl

This species has been recorded to the south on Doolgunna (Turpin and Bamford 2015), but its distinctive mounds were not found in the exploration areas so it is very unlikely that it is a breeding resident. However, individual birds may visit the project area. They are likely to favour Mulga thickets and other dense vegetation that are found in all exploration areas.

#### Peregrine Falcon

A pair of Peregrine Falcons was present in Flamingo Pit in the Triple P area in August 2019. It is likely they were nesting on a ledge on the pit wall, although this could not be confirmed. Peregrine Falcon pairs are usually site-faithful, so these birds are likely to be long-term residents with a feeding range that encompasses several hundred square kilometres. The pair may have alternative nest sites in nearby mine pits; Marchant and Higgins (1993) report on studies that indicate most breeding territories have two or three alternative nesting sites.

#### Fork-tailed Swift and Barn Swallow

The Fork-tailed Swift is a non-breeding migrant to Australia and is more or less nomadic; therefore its occurrence at any one location is unpredictable. Being aerial, it is largely independent of terrestrial ecosystems. The Barn Swallow is also a non-breeding migrant that occurs regularly around some Pilbara towns in small numbers.

#### Significant waterbirds

Several migratory waterbird species may occur as irregular visitors or vagrants, including the Eastern Great Egret, sandpipers and stints. Other waterbird species could also occur very infrequently. These might occasionally visit natural wetlands along the drainage lines throughout the exploration areas, and could also visit flooded mine pits, although numbers would be very low.



### Night Parrot

The Night Parrot is expected only as a vagrant, if at all. Its biology is poorly understood but there is some evidence that it favours the spinifex/samphire ecotone, such as the vegetation which occurs around the margins of salt lakes, but it is also known from rocky hills, particularly with spinifex. There are reports of the species around salt lake systems over 100km to the east of the project area.

### Greater Bilby

There is a re-introduced population of the Greater Bilby over 100km to the east (Matawa/Lorna Glen Station) and as this is a mobile species there is a slight possibility of the occasional animal passing through the project area. In time, and given Fox control, the species could even colonise drainage lines in sandplain environments which exist throughout the exploration areas. However, the likelihood of such colonisation realistically is low.

#### 3.2.6.2 Conservation Significance 2

### Brush-tailed Mulgara

This species is locally common in suitable environments in the Marymia area and was subject to a long-term research project monitoring its numbers in the mid to late 2000s (*ecologia* 2005; Rodda and Bamford 2007, 2008; Zosky and Bamford 2009). At that time, the species was thought to be the Crest-tailed Mulgara *Dasyercus cristicauda*, which has a high level of conservation significance (CS1; listed under legislation). A subsequent taxonomic review determined the species to be the Brush-tailed Mulgara, which is of lower significance (CS2; listed as priority by DBCA). It occurs mainly in areas of spinifex on sandy to sandy-loam soils, with this environment best represented in the K2 and Cinnamon exploration areas, in part of Triple P and along the haul road to the south. Burrows were found in K2 and Cinnamon during the November 2018 survey (Figure 3-11; GPS coordinates given in Appendix 8). All burrows found were inactive, but this is typical of the species that can vary in abundance greatly from year to year. No burrows were found in the extensive sandplains in the north of K2, but this area had been fairly recently burnt which may have caused animals to emigrate. No burrows were found in the other exploration areas surveyed in August 2019, most of which had no suitable (sandy) substrate. Suitable habitat in Triple P and along the southern Haul Road have already been identified as significant for the species.



Figure 3-11. Locations of Brush-tailed Mulgara burrows found in November 2018.

#### Long-tailed Dunnart

This species is usually associated with rocky environments and was not included in the database search results, but it was recorded near Wiluna in 2015 (M. Bamford pers. obs.) on a low rocky hill, similar to the small rocky hills present near the Marymia camp and just east of the Apex exploration area. It is therefore considered likely to be resident in the region although it might only occasionally visit the actual exploration areas. However, rocky landscapes created by mining may provide habitat for it.

#### 3.2.6.3 *Conservation Significance 3*

#### Australian Bustard

This large bird is moderately common in the region but is included as locally significant because it is vulnerable to feral predators and roadkill. In addition, it has declined across southern Australia and the project area is on the edge of where the species remains common.

#### Bush Stone-curlew

This ground-nesting bird has disappeared from southern Australia and remains in small numbers across the Murchison and Gascoyne. It remains common only in the Pilbara and further north. While not recorded in the project area, it may be present occasionally. It is often associated with dense thickets along drainage lines, such as found throughout the exploration areas.



### Grey Honeyeater

This is an infrequently seen honeyeater that has been recorded in Doolgunna and therefore may be present as a visitor if not a resident. It favours tall, dense Mulga so could occur in any of the exploration areas, although this vegetation is most extensive in Cinnamon and Apex.

### Kultarr

This small marsupial is rarely-recorded but appears to be widespread. It was detected in the general Marymia area by ecologia (1991). It is often associated with gravelly and rocky plains with sparse vegetation, so could occur in any of the exploration areas.

### Short Range Endemic (SRE) invertebrates

No range-restricted invertebrates were returned from databases; though this is not to say there are no such species in the general area, but just that they have not been detected. The landscape of the study area is not conducive to the presence of SRE invertebrates, which are often associated with relictual landscape features and mesic refugia, whereas the study area supports an environment typical of the region. However, speciation in invertebrates is complex and where groups have been studied in detail, species with restricted ranges that are not linked to relictual landscape features have been found (M. Heath, pers. comm.). One trapdoor spider was collected during the November 2018 survey and was identified as a juvenile *Gaius* sp., and there were many burrows of adult *Gaius* in the area. Members of this genus are generally widespread although it is currently under review (V. Framinau, pers. comm.). There has been no past sampling of potential SRE invertebrates, and no sampling of subterranean invertebrates.

#### *3.2.7 Patterns of biodiversity*

Investigating patterns of biodiversity can be complex and are often beyond the scope even of level 2 investigations, but it is possible to draw some general conclusions based upon the patterns of soils and vegetation across the landscape. Of particular interest are environments likely to be rich in species or that support species of conservation significance. These include:

- Mulga over spinifex on sandy loam. Spinifex tends to support a rich assemblage of reptiles and this VSA is also favoured by the Brush-tailed Mulgara. Mulga in general is rich in birds. This VSA is widespread in the north of K2, across much of Cinnamon, in the north of Triple P and along the southern Haul Road.
- Mulga thickets along drainage lines. This is well-developed in Apex but also occurs in patches across Trident, Cinnamon, K2, Triple P and Speckled Hen. Mulga thickets often have a well-developed understorey of *Eremophila* spp. and there was a high richness and abundance of birds in this vegetation.

In general, gravelly and rocky soils with open shrublands and occasionally spinifex are likely to be lower in fauna richness.

#### *3.2.8 Ecological processes*

The nature of the landscape and the fauna assemblage indicate some of the ecological processes that may be important for ecosystem function (see Appendix 4 for descriptions and other ecological processes). These include:

Fire. As is the case throughout most of Western Australia, the vegetation of the region is fire-adapted to some degree, but the flora and fauna assemblages can be altered by too-frequent fires; and even by fire exclusion. Some species are particularly sensitive to wildfires and altered fire regimes. Fire season may also be important in seed germination. It appeared that a recent extensive fire across the north of K2 had resulted in the disappearance of the Brush-tailed Mulgara; K2 had been one of the monitoring areas for earlier studies on the species.

Feral species and interactions with over-abundant native species. Feral species occur throughout Western Australia, with the Fox, Rabbit, Cat, Cattle (domestic?), Donkey, Horse (apparently feral) and Camel recorded during the 2018/2019 surveys. These species have an impact on native fauna species through competition and predation. Cats and Foxes may also benefit from the control of Dingo/wild Dogs by nearby pastoralists, thereby removing one of their main predators. On Lorna Glen (Matawa) Station where Foxes and Cats are controlled, the Brush-tailed Mulgara has become abundant (N. Hamilton, pers. comm.)

Connectivity and landscape permeability. The native vegetation is mostly continuous with only small areas of clearing relative to a large landscape. However, there is linear connectivity along drainage lines containing dense Mulga which act as natural corridors for fauna, particularly birds and possibly also some mammals, to move through the landscape.

Hydrology. Mulga thickets are often associated with very slight changes in topography and can be sensitive to hydrological change, including surface flows. The extensive areas of Mulga in all exploration areas mean that local patterns of hydrology are important in maintaining vegetation that provides habitat for fauna.

### 3.2.9 Summary of fauna values

The desktop study identified 259 vertebrate fauna species as potentially occurring in the survey area (Appendix 5): 9 frogs, 66 reptiles, 148 birds, 26 native mammals and 10 introduced mammals. This does not include several locally extinct mammal species. The assemblage includes 20 species of conservation significance that may occur in the survey area. Fauna values within the survey area can be summarised as follows:

Fauna assemblage. Some species loss has occurred, affecting particularly mammals, but the remainder of the vertebrate assemblage is more or less intact. The assemblage appears to include elements of both the Pilbara and Murchison and is only moderately rich, reflecting a fairly uniform landscape lacking in dramatic features such as large hills and major rivers.

Species of conservation significance. The project area potentially supports about 20 conservation significant fauna species, but very few are likely to be residents or regular visitors. The most notable is the Brush-tailed Mulgara, which is locally common in the general region and was the subject of a research and monitoring project in the past (mid to late 2000s). It favours sandy to sandy loam soils, usually with spinifex, and may be temporarily displaced by fire. It is also sensitive to Fox and Cat predation. Such soils occur in patches throughout the project area and are more widespread to the south, although inactive burrows were recorded in Cinnamon and K2 and extensive suitable habitat in K2 was recently burnt. Also of importance is the pair of Peregrine Falcons in Flamingo Pit (Triple P).



Patterns of biodiversity. Across the exploration areas, Mulga over spinifex on sandy loam and Mulga thickets along drainage lines are likely to be richest in fauna, while gravelly and rocky soils with sparse vegetation are likely to be lowest in fauna species richness. Mulga over spinifex on sandy loam is also where Brush-tailed Mulgara can occur. This VSA is widespread in the north of K2 and across much of Cinnamon, in the north of Triple P and along the southern Haul Road, while Mulga thickets along drainage lines are best developed in Apex but can be found in all areas. Trident/MarEast/MarWest have the most extensive areas of gravelly soils and sparse shrublands.

Key ecological processes. The most important ecological processes affecting the fauna assemblage are fire, impacts of feral predators and local hydrology. Landscape connectivity related to the distribution of Mulga thickets may also be important for some species.

Overall, the project area has a fauna species assemblage that has suffered some species loss. It is a moderately rich assemblage, although it may not provide core habitat for many of the fauna species listed. The assemblage does include some species of conservation significance. The assemblage is sensitive to landscape connectivity, introduced species and fire, while the most important environments for fauna richness are Mulga over spinifex on sandy loam, and Mulga thickets along drainage lines or in slightly lower areas of the landscape. K2 has a wide range of environments and extensive habitat for the Brush-tailed Mulgara, albeit currently of limited suitability for the species due to a recent fire. Cinnamon also has extensive Mulgara habitat and several records of currently inactive burrows. Cinnamon is also likely to be richest in bird species due to the extensive Mulga with understorey present. Apex has a major drainage line with associated tall Mulga thickets important for fauna. Trident has the most extensive areas of gravelly and rocky soils that are probably less rich in fauna, but even this is interspersed with Mulga thickets. Triple P is notable for being large with a wide range of environments, and for the presence of a pair of Peregrine Falcons (probably breeding).

## 4 Impact Assessment

Impacting processes have to be considered in the context of fauna values and the nature of the proposed development, which in this case involves exploration, leading to some temporary clearing, and could ultimately lead to the development of open mine pits across a portion of the exploration areas. Predicted impacts are examined below; impacting processes are outlined in Appendix 2 and definitions of levels of impact significance are given in Table 3.

### Habitat loss leading to population decline.

Exploration leads to some habitat loss that should be temporary, and impacts understorey vegetation in particular. Mining leads to permanent habitat loss and the creation of what are effectively novel environments (rehabilitated stockpiles and rockpiles). Population decline will be roughly proportional to habitat loss which is a very small part of the overall landscape. Impact generally Minor, but of concern are the Peregrine Falcons at Flamingo Pit (Triple P), which could lose their nesting site and with a possibility of mortality of chicks if development occurred when the nest was occupied.

### Habitat loss leading to population fragmentation.

The natural landscape is largely continuous but fauna of linear VSAs (drainage lines, bands of Mulga) may be sensitive to fragmentation. This would only occur where mine pits or major infrastructure occurs across the VSA, and the fragmentation would be partial, such as reduced dispersal rather than a complete end to movement. This is because the landscape in general remains intact. Impact Minor to Moderate.

### Degradation of habitat due to weed invasion.

The site appears relatively weed free. There is some potential for the development to increase the number of weed species within the study area; basic hygiene measures such as cleaning the underside of vehicles should reduce the chances of this occurring. Impact Minor.

### Direct mortality of fauna during operations.

Some mortality is inevitable during clearing and operation, such as from vehicle movements and entrapment of fauna in drilling sumps, trenches and the like. Mortality can be managed and reduced (see recommendations below), and in a conservation sense mortality of small numbers of common animals at sites that represent a very small proportion of the total landscape is not significant. In Mulgara habitat, direct mortality during clearing should be avoided where possible. Impact Minor.

### Species interactions.

There is potential for the project to aid Cats and Foxes to more easily move through the landscape, such as along exploration lines, and this poses an increased risk to species such as the Brush-tailed Mulgara. Cats and Foxes can also increase in abundance close to centres of human activity. The Mulgara population in the area probably fluctuates in size and distribution with annual conditions and the impact of fire, and therefore a change in predation pressure could lead to the disappearance of sub-populations. Impact Minor to Moderate.



Hydrological change.

Some of the most important vegetation for fauna, Mulga thickets, may be sensitive to subtle changes in surface hydrology. This can occur through alterations of surface flow and through sub-surface hydrological change around deep pits. At least some of these effects can be managed as outlined below. Impact Minor to Moderate.

Altered fire regimes.

Altered fire regimes are a risk in particular to species in spinifex on sandy loam such as the Brush-tailed Mulgara. There may be an increase in the chance of fire due to exploration and mining activity, not least because of the presence of increased numbers of personnel on the site. Impact Minor to Moderate.

Disturbance (dust, noise, light).

Impacts from dust, noise and light are difficult to predict but are likely to be localised around the development areas that are a small part of the overall landscape. However, there is some concern that fauna are affected at some distance from mining activity in remote locations. This has been documented for birds, where in one study larger predatory species increased in abundance, while small insectivores declined or disappeared (Read *et al.* 2017). Such an effect is presumably temporary (across the life of mine). Such an effect may already be occurring around the exploration camp, where Grey Butcherbirds have become resident, feeding mainly on insects attracted to lights. Impact considered to be Minor to Moderate.

Overall, impacts of greatest concern are related to effects of feral species, hydrological change, altered fire regimes and possibly disturbance affecting bird assemblages. Direct impact upon the Peregrine Falcons of Flamingo Pit may also be a concern. At least some impacts can be ameliorated as discussed in recommendations below.

## 5 Recommendations

Recommendations for the minimisation of impacts can be drawn from the review of impacting processes. Many of these recommendations are standard procedures for exploration and mining in these sorts of landscapes.

- Habitat loss leading to population decline. Habitat loss should be minimised by clearly delineating clearing boundaries during any activities. Driving 'off road' should be prohibited except when establishing exploration lines. Exploration areas should be rehabilitated immediately, and there should be a rehabilitation program for long-term or permanent stockpiles.
- Habitat loss leading to population fragmentation. Clearing areas should be minimised, particularly in areas of linear VSAs (e.g. drainage lines and lines of Mulga) that may be used as corridors for fauna movement. Options may exist where such vegetation types can be avoided during operations. In general, avoiding impacting drainage lines is recommended.
- Degradation of habitat due to weed invasion. Vehicle hygiene should be practised to minimise transport of weeds into uncontaminated areas.
- Direct and indirect mortality of fauna during exploration and operation. Standard procedures for installing egress points in drill sumps and trenches, and for capping drill-holes, should be followed. Personnel should be made aware of the roadkill risk to wildlife. In Mulgara habitat, pre-clearing surveys should take place to identify locations where animals are present. These should be avoided if possible, or options for displacing the animals before clearing be investigated. In the special case of the Peregrine Falcons at Flamingo Pit, the location of the nest needs to be established and it needs to be determined if the birds have alternative nests (possibly in other pits). If or when development of Flamingo Pit is proposed, the nest needs to be checked to ensure chicks are not present.
- Species interactions. Changes in the abundance of feral predators and the vulnerability of some species, in particular the Brush-tailed Mulgara, are the main concern. Drill lines should be rehabilitated as quickly as possible so as not to provide access into undisturbed vegetation by feral predators. Feral species should not be encouraged, either deliberately or inadvertently, through the provision of food and water.
- Hydrological change. Surface flow should not be altered, particularly in areas of Mulga. It may be necessary to investigate the impact of mine pits on local hydrology.
- Altered fire regimes. Some fire management may be required to ensure that areas are not impacted by too frequent fires.
- Disturbance. As a precaution, light, noise and dust should be minimised during exploration, construction and operation. Unnecessary lighting should be avoided. For example, 'bug zappers' kill insects indiscriminately and do little if anything to control nuisance or pest species.



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## 7 Appendices

### 7.1 Appendix 1. Explanation of fauna values.

Fauna values are the features of a site and its fauna that contribute to biodiversity, and it is these values that are potentially at threat from a development proposal. Fauna values can be examined under the five headings outlined below. It must be stressed that these values are interdependent and should not be considered equal, but rather contribute to an understanding of the biodiversity of a site. Understanding fauna values provides opportunities to predict and therefore mitigate impacts.

#### **Assemblage characteristics**

Uniqueness. This refers to the combination of species present at a site. For example, a site may support an unusual assemblage that has elements from adjacent biogeographic zones, it may have species present or absent that might be otherwise expected, or it may have an assemblage that is typical of a very large region. For the purposes of impact assessment, an unusual assemblage has greater value for biodiversity than a typical assemblage.

Completeness. An assemblage may be complete (i.e., has all the species that would have been present at the time of European settlement) or it may have lost species due to a variety of factors. Note that a complete assemblage, such as on an island, may have fewer species than an incomplete assemblage (such as in a species-rich but degraded site on the mainland).

Richness. This is a measure of the number of species at a site. At a simple level, a species-rich site is more valuable than a species-poor site, but value is also determined by other factors, for example, by the sorts of species present.

#### **Vegetation and Substrate Associations**

Vegetation and Substrate Associations (VSAs) combine broad vegetation types, the soils or other substrate with which they are associated, and the landform. In the context of fauna assessment, VSAs are the environments that provide habitats for fauna. The term habitat is widely used in this context, but by definition an animal's habitat is the environment that it utilises (Calver *et al.* 2009), not the environment as a whole. Habitat is a function of the animal and its ecology, rather than being a function of the environment. For example, a species may occur in eucalypt canopy or in leaf-litter on sand, and that habitat may be found in only one or in several VSAs. VSAs are not the same as vegetation types since these may not incorporate soil and landform, and recognise floristics to a degree that VSAs do not. Vegetation types may also not recognise minor but often significant (for fauna) structural differences in the environment, which VSAs will recognise. VSAs also do not necessarily correspond with soil types, but may reflect some of these elements.

Because VSAs provide the habitat for fauna, they are important in determining assemblage characteristics. For the purposes of impact assessment, VSAs can also provide a surrogate for detailed information on the fauna assemblage. For example, rare, relictual or restricted VSAs should automatically be considered a significant fauna value. Impacts may be significant if the VSA is rare, a large proportion of the VSA is affected and/or the VSA supports significant fauna. The disturbance of even small amounts of habitat in a localised area can have significant impacts to fauna if rare or unusual habitats are disturbed.



### **Patterns of biodiversity across the landscape**

This fauna value relates to how the assemblage is organised across the landscape. Generally, the fauna assemblage is not distributed evenly across the landscape or even within one VSA. There may be zones of high biodiversity, such as particular environments or ecotones (transitions between VSAs). There may also be zones of low biodiversity. Impacts may be significant if a wide range of species is affected even if most of those species are not significant per se.

### **Species of conservation significance**

Species of conservation significance are of special importance in impact assessment. The conservation status of fauna species in Australia is assessed under Commonwealth and State Acts such as the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the *Western Australian Biodiversity Conservation Act 2016* (Biodiversity Conservation Act). In addition, the Western Australian Department of Biodiversity, Conservation and Attractions (DBCA) recognises priority levels, while local populations of some species may be significant even if the species as a whole has no formal recognition. Therefore, three broad levels of conservation significance can be recognised and are used for the purposes of this report and are outlined below. A full description of the conservation significance levels, schedules and priority levels mentioned below is provided in Appendix 3.

#### *Conservation Significance (CS) level 1: Species listed under State or Commonwealth Acts.*

Species listed under the EPBC Act are assigned to categories recommended by the International Union for the Conservation of Nature and Natural Resources (IUCN) and reviewed by Mace and Stuart (1994), or are listed as migratory. Migratory species are recognised under international treaties such as the China Australia Migratory Bird Agreement (CAMBA), the Japan Australia Migratory Bird Agreement (JAMBA), the Republic of South Korea Australia Migratory Bird Agreement (ROKAMBA), and/or the Convention on the Conservation of Migratory Species of Wild Animals (CMS; also referred to as the Bonn Convention). The Biodiversity Conservation Act uses a series of Schedules to classify status, but also recognizes the IUCN categories and ranks species within the Schedules using the categories of Mace and Stuart (1994).

#### *Conservation Significance (CS) level 2: Species listed as Priority by the DBCA but not listed under State or Commonwealth Acts.*

In Western Australia, the DBCA has produced a supplementary list of Priority Fauna, being species that are not considered threatened under the Biodiversity Conservation Act but for which the DBCA believes there is cause for concern. Some Priority species are also assigned to the Conservation Dependent category of the IUCN.

#### *Conservation Significance (CS) level 3: Species not listed under Acts or in publications, but considered of at least local significance because of their pattern of distribution.*

This level of significance has no legislative or published recognition and is based on interpretation of distribution information and expert judgment, but is used here as it may have links to preserving biodiversity at the genetic level (EPA 2002). If a population is isolated but a subset of a widespread (common) species, then it may not be recognised as threatened, but may have unique genetic characteristics. Conservation significance is applied to allow for the preservation of genetic richness at a population level, and not just at a species level. Species on the edge of their range,

or that are sensitive to impacts such as habitat fragmentation, may also be classed as CS3, as may colonies of waterbirds. The Western Australian Department of Environmental Protection, now DBCA, used this sort of interpretation to identify significant bird species in the Perth metropolitan area as part of the Perth Bushplan (DEP 2000).

Invertebrate species considered to be short range endemics (SREs) also fall within the CS3 category, as they have no legislative or published recognition and their significance is based on interpretation of distribution information. Harvey (2002) notes that the majority of species that have been classified as short-range endemics have common life history characteristics such as poor powers of dispersal or confinement to discontinuous habitats. Several groups, therefore, have particularly high instances of short-range endemic species: Gastropoda (snails and slugs), Oligochaeta (earthworms), Onychophora (velvet worms), Araneae (mygalomorph spiders), Pseudoscorpionida (pseudoscorpions), Schizomida (schizomids), Diplopoda (millipedes), Phreatoicidea (phreatoicidean crustaceans), and Decapoda (freshwater crayfish). The poor understanding of the taxonomy of many of the short-range endemic species hinders their conservation (Harvey 2002).

#### Introduced species

In addition to these conservation levels, species that have been introduced (INT) are indicated throughout the report. Introduced species may be important to the native fauna assemblage through effects by predation and/or competition.

#### **Ecological processes upon which the fauna depend**

These are the processes that affect and maintain fauna populations in an area and as such are very complex; for example, populations are maintained through the dynamic of mortality, survival and recruitment being more or less in balance, and these are affected by a myriad of factors. The dynamics of fauna populations in a project may be affected by processes such as fire regime, landscape patterns (such as fragmentation and/or linkage), the presence of feral species and hydrology. Impacts may be significant if processes are altered such that fauna populations are adversely affected, resulting in declines and even localised loss of species. Threatening processes as outlined below are effectively the ecological processes that can be altered to result in impacts upon fauna.



## **7.2 Appendix 2. Explanation of threatening processes.**

Potential impacts of proposed developments upon fauna values can be related to threatening processes. This is recognised in the literature (e.g. Gleeson and Gleeson 2012) and under the EPBC Act, in which threatening processes are listed. Processes that may impact fauna values are discussed below. Rather than being independent of one another, processes are complex and often interrelated. They are the mechanisms by which fauna can be affected by development. Impacts may be significant if large numbers of species or large proportions of populations are affected.

### **Loss of habitat affecting population survival**

Clearing for a development can lead to habitat loss for a species with a consequent decline in population size. This may be significant if the smaller population has reduced viability. Conservation significant species or species that already occur at low densities may be particularly sensitive to habitat loss affecting population survival.

### **Loss of habitat leading to population fragmentation**

Loss of habitat can affect population movements by limiting movement of individuals throughout the landscape as a result of fragmentation (Gleeson and Gleeson 2012, Soule *et al.* 2004). Obstructions associated with the development, such as roads, pipes and drainage channels, may also affect movement of small, terrestrial species. Fragmented populations may not be sustainable and may be sensitive to effects such as reduced gene flow.

### **Degradation of habitat due to weed invasion leading to population decline**

Weed invasion, such as through introduction by human boots or vehicle tyres, can occur as a result of development and if this alters habitat quality, can lead to effects similar to habitat loss.

### **Increased mortality**

Increased mortality can occur during project operations; for example, roadkill, animals striking infrastructure, and entrapment in trenches. Roadkill as a cause of population decline has been documented for several medium-sized mammals in eastern Australia (Dufty 1989, Jones 2000). Increased mortality due to roadkill is often more prevalent in habitats that have been fragmented (Scheick and Jones 1999, Clevenger and Waltho 2000, Jackson and Griffin 2000). Increased mortality of common species during development is unavoidable and may not be significant for a population. However, the cumulative impacts of increased mortality of conservation significant species or species that already occur at low densities may have a significant impact on the population.

### **Species interactions, including predation and competition**

Changes in species interactions often occur with development. Introduced species, including the feral Cat, Red Fox and Rabbit, may have adverse impacts upon native species and development can alter their abundance. In particular, some mammal species are very sensitive to introduced predators and the decline of many mammals in Australia has been linked to predation by the Red Fox, and to a lesser extent, the feral Cat (Burbidge and McKenzie 1989). Introduced grazing species, such as the Rabbit, Goat, Camel and domestic livestock, can also degrade habitats and deplete vegetation that may be a food source for other species.

Changes in the abundance of some native species at the expense of others, due to the provision of fresh watering points, can also be a concern. Harrington (2002) found the presence of artificial fresh waterpoints in the semi-arid mallee rangelands to influence the abundance and distribution of certain bird species. Common, water-dependent birds were found to out-compete some less common, water-independent species. Over-abundant native herbivores, such as kangaroos, can also adversely affect less abundant native species through competition and displacement.

### **Hydroecology**

Interruptions of hydroecological processes can have major effects because they underpin primary production in ecosystems and there are specific, generally rare habitats that are hydrology-dependent. Fauna may be impacted by potential changes to groundwater level and chemistry and altered flow regime. These changes may alter vegetation across large areas and may lead to habitat degradation or loss. Impacts upon fauna can be widespread and major. Changes to flow regime across the landscape may alter vegetation and may lead to habitat degradation or loss, affecting fauna. For example, Mulga has a shallow root system and relies on surface sheet flow during flood events. If surface sheet flow is impeded, Mulga can die (Kofoed 1998), which may impact on a range of fauna associated with this vegetation type.

### **Fire**

The role of fire in the Australian environment and its importance to vertebrate fauna has been widely acknowledged (Gill et al. 1981, Fox 1982, Bamford and Roberts 2003). It is also one of the factors that has contributed to the decline and local extinction of some mammal and bird species (Burbidge and McKenzie 1989). Fire is a natural feature of the environment but frequent, extensive fires may adversely impact some fauna, particularly mammals and short-range endemic species. Changes in fire regime, whether to more frequent or less frequent fires, may be significant to some fauna. Impacts of severe fire may be devastating to species already occurring at low densities or to species requiring long unburnt habitats to survive. In terms of conservation management, it is not fire *per se* but the fire regime that is important, with evidence that infrequent, extensive and intense fires adversely affect biodiversity, whereas frequent fires that cover small areas and are variable in both season and intensity can enhance biodiversity. Fire management may be considered the responsibility of managers of large tracts of land, including managers of mining tenements.

### **Dust, light, noise and vibration**

Impacts of dust, light, noise and vibration upon fauna are difficult to predict. Some studies have demonstrated the impact of artificial night lighting on fauna, with lighting affecting fauna behaviour more than noise (Rich and Longcore 2006). Effects can include impacts on predator-prey interactions, changes to mating and nesting behaviour, and increased competition and predation within and between invertebrates, frogs, birds and mammals. The death of very large numbers of insects has been observed around some remote mine sites and attracts other fauna, notably native and introduced predators (M. Bamford, pers. obs). The abundance of some insects can decline due to mortality around lights, although this has previously been recorded in fragmented landscapes where populations are already under stress (Rich and Longcore 2006). Artificial night lighting may also lead to disorientation of migratory birds. Aquatic habitats and open habitats such as grasslands and dunes may be vulnerable to light spill.



### 7.3 Appendix 3. Categories used in the assessment of conservation status.

IUCN categories (based on review by Mace and Stuart 1994) as used for the *Environment Protection and Biodiversity Conservation Act 1999* and the *Western Australian Biodiversity Conservation Act 2016*.

<b>Extinct</b>	Taxa not definitely located in the wild during the past 50 years.
<b>Extinct in the Wild (Ex)</b>	Taxa known to survive only in captivity.
<b>Critically Endangered (CR)</b>	Taxa facing an extremely high risk of extinction in the wild in the immediate future.
<b>Endangered (E)</b>	Taxa facing a very high risk of extinction in the wild in the near future.
<b>Vulnerable (V)</b>	Taxa facing a high risk of extinction in the wild in the medium-term future.
<b>Near Threatened</b>	Taxa that risk becoming Vulnerable in the wild.
<b>Conservation Dependent</b>	Taxa whose survival depends upon ongoing conservation measures. Without these measures, a conservation dependent taxon would be classed as Vulnerable or more severely threatened.
<b>Data Deficient (Insufficiently Known)</b>	Taxa suspected of being Rare, Vulnerable or Endangered, but whose true status cannot be determined without more information.
<b>Least Concern</b>	Taxa that are not Threatened.

Schedules used in the *WA Biodiversity Conservation Act 2016*.

<b>Schedule 1 (S1)</b>	Critically Endangered fauna
<b>Schedule 2 (S2)</b>	Endangered fauna
<b>Schedule 3 (S3)</b>	Vulnerable Migratory species listed under international treaties
<b>Schedule 4 (S4)</b>	Presumed extinct fauna
<b>Schedule 5 (S5)</b>	Migratory birds under international agreement
<b>Schedule 6 (S6)</b>	Conservation dependent fauna
<b>Schedule 7 (S7)</b>	Other specially protected fauna

WA Department of Biodiversity, Conservation and Attractions Priority species (species not listed under the *Biodiversity Conservation Act 2016*, but for which there is some concern).

<b>Priority (P1)</b>	<b>1</b>	Taxa with few, poorly known populations on threatened lands.
<b>Priority (P2)</b>	<b>2</b>	Taxa with few, poorly known populations on conservation lands; or taxa with several, poorly known populations not on conservation lands.
<b>Priority (P3)</b>	<b>3</b>	Taxa with several, poorly known populations, some on conservation lands.

		Taxa in need of monitoring.
<b>Priority (P4)</b>	<b>4</b>	Taxa which are considered to have been adequately surveyed, or for which sufficient knowledge is available, and which are considered not currently threatened or in need of special protection, but could be if present circumstances change.
<b>Priority (P5)</b>	<b>5</b>	Taxa in need of monitoring. Taxa which are not considered threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years (IUCN Conservation Dependent).



#### **7.4 Appendix 4. Ecological and threatening processes identified under legislation and in the literature.**

Ecological processes are processes that maintain ecosystems and biodiversity. They are important for the assessment of impacts of development proposals because ecological processes make ecosystems sensitive to change. The interaction of ecological processes with impacts and conservation of biodiversity has an extensive literature. Following are examples of the sorts of ecological processes that need to be considered.

##### **Ecological processes relevant to the conservation of biodiversity in Australia (Soule *et al.* 2004):**

- Critical species interactions (highly interactive species);
- Long distance biological movement;
- Disturbance at local and regional scales;
- Global climate change;
- Hydroecology;
- Coastal zone fluxes;
- Spatially-dependent evolutionary processes (range expansion and gene flow); and
- Geographic and temporal variation of plant productivity across Australia.

##### **Threatening processes (EPBC Act)**

Under the EPBC Act, a key threatening process is an ecological interaction that threatens or may threaten the survival, abundance or evolutionary development of a threatened species or ecological community. There are currently 20 key threatening processes listed by the federal Department of the Environment and Energy (DoEE 2018c):

- Competition and land degradation by rabbits.
- Competition and land degradation by unmanaged goats.
- Dieback caused by the root-rot fungus (*Phytophthora cinnamomi*).
- Incidental catch (bycatch) of Sea Turtle during coastal otter-trawling operations within Australian waters north of 28 degrees South.
- Incidental catch (or bycatch) of seabirds during oceanic longline fishing operations.
- Infection of amphibians with chytrid fungus resulting in chytridiomycosis.
- Injury and fatality to vertebrate marine life caused by ingestion of, or entanglement in, harmful marine debris.
- Invasion of northern Australia by Gamba Grass and other introduced grasses.
- Land clearance.
- Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants.
- Loss of biodiversity and ecosystem integrity following invasion by the Yellow Crazy Ant (*Anoplolepis gracilipes*) on Christmas Island, Indian Ocean.
- Loss of climatic habitat caused by anthropogenic emissions of greenhouse gases.
- Novel biota and their impact on biodiversity.
- Predation by European red fox.

- Predation by exotic rats on Australian offshore islands of less than 1000 km<sup>2</sup> (100,000 ha).
- Predation by feral cats.
- Predation, Habitat Degradation, Competition and Disease Transmission by Feral Pigs.
- Psittacine Circoviral (beak and feather) Disease affecting endangered psittacine species.
- The biological effects, including lethal toxic ingestion, caused by Cane Toads (*Bufo marinus*).
- The reduction in the biodiversity of Australian native fauna and flora due to the red imported fire ant, *Solenopsis invicta* (fire ant).

**General processes that threaten biodiversity across Australia** (Department of Environment, Water, Heritage and the Arts 2009):

- Vegetation clearing;
- Increasing fragmentation, loss of remnants and lack of recruitment;
- Firewood collection;
- Grazing pressure;
- Feral animals;
- Exotic weeds;
- Changed fire regimes;
- Pathogens;
- Changed hydrology—dryland salinity and salt water intrusion;
- Changed hydrology— such as altered flow regimes affecting riparian vegetation; and
- Pollution.

In addition to the above processes, DSEWPac (2013) (now DoEE) has produced **Significant Impact Guidelines** that provide criteria for the assessment of the significance of impacts. These criteria provide a framework for the assessment of significant impacts. The criteria are:

- Will the proposed action lead to a long-term decrease in the size of a population?
- Will the proposed action reduce the area of occupancy of the species?
- Will the proposed action fragment an existing population?
- Will the proposed action adversely affect habitat critical to the survival of a species?
- Will the proposed action disrupt the breeding cycle of a population?
- Will the proposed action modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?
- Will the proposed action result in introducing invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat?
- Will the proposed action introduce disease that may cause the species to decline?
- Will the proposed action interfere with the recovery of the species?



## 7.5 Appendix 5. Vertebrate fauna assemblage of the study area.

Levels of Conservation Significance (Cons Signif) are discussed in the “Assessment of Conservation Significance” section. Expected status categories are outlined in Methods. Data sources include:

- Databases: Naturemap, Atlas of Living Australia, Birddata and EPBC Search Engine
- Dool: Species recorded on Doolgunna Station and nearby by Ninnox (2011), Bell *et al* 2013 and/or Turpin and Bamford (2015).
- Ecol 1991: Species recorded in the level 2 survey of the Marymia project area by *ecologia* (1991).
- BCE 07-09: Species recorded by Bamford Consulting Ecologists in the Marymia Project area during targeted Mulgara surveys across 2007 to 2009.
- BCE 18-19: Species recorded during the current Bamford Consulting Ecologists survey (November 2018 and August 2019).
- Recorded species totals include species recorded in Ecol. 1991, BCE 07-09 and BCE 18-19.

### FROGS

Species	Cons Signif	Data bases	Dool	Ecol 1991	BCE 07-09	BCE 18-19	Expected status
<b>HYLIDAE (Tree frogs)</b>							
<i>Cyclorana maini</i> Main's Frog		X					Res
<i>Cyclorana platycephala</i> Water-holding Frog		X					Res
<i>Litoria rubella</i> Desert Tree Frog		X	X		X	X	Res
<b>LIMNODYNASTIDAE (Burrowing frogs)</b>							
<i>Platyplectrum spenceri</i> Spencer's Frog		X			X		Res
<i>Neobatrachus aquilonius</i> Northern Burrowing Frog		X					Res
<i>Neobatrachus sudellae</i> Trilling Frog		X			X?		Res
<i>Neobatrachus sutor</i> Shoemaker Frog							Res
<i>Neobatrachus wilsmorei</i> Wilsmore's Frog							Res
<i>Notaden nichollsi</i> Desert Spadefoot		X					Res
<b>Total Species Expected: 9</b>							
<b>Total Species Recorded: 3</b>							

**REPTILES**

Species	Cons signif	Data bases	Dool	Ecol 1991	BCE 07-09	BCE 18-19	Expected status
<b>CHELUIDAE</b> (freshwater tortoise)							
<i>Chelodina steindachneri</i> Flat-shelled Tortoise			X		X		Vis
<b>CARPHODACTYLIDAE</b> (knob-tailed geckoes)							
<i>Nephrurus wheeleri</i> Banded Knob-tailed Gecko		X	X			X	Res
<b>DIPLODACTYLIDAE</b> (ground geckoes)							
<i>Amalosia lesueurii</i> Lesueur's Velvet Gecko		X	X				Res
<i>Diplodactylus granariensis</i> Goldfields Stone Gecko							Res
<i>Diplodactylus pulcher</i> Western Saddled Ground Gecko		X		X			Res
<i>Lucasium stenodactylum</i> Pale-snouted Ground Gecko			X				Res
<i>Rhynchoedura ornata</i> Beaked Gecko			X				Res
<i>Strophurus elderi</i> Jewelled Gecko							Res
<i>Strophurus strophurus</i> Western Ring-tailed Gecko							Res
<i>Strophurus wellingtonae</i> Western Shield Spiny-tailed Gecko		X	X		X		Res
<b>GEKKONIDAE</b> (geckoes)							
<i>Gehyra purpurascens</i> Purple Arid Dtella							Res
<i>Gehyra variegata</i> Variegated Dtella		X	X	X	X	X	Res
<i>Heteronotia binoei</i> Bynoe's Gecko		X		X	X	X	Res
<b>PYGOPODIDAE</b> (legless lizards)							
<i>Delma butleri</i> Unbanded Delma							Res
<i>Delma nasuta</i> Long-nosed Delma							Res
<i>Delma haroldi</i>		X					Res
<i>Lialis burtonis</i> Burton's Legless Lizard		X	X		X		Res
<i>Pygopus nigriceps</i> Hooded Scaly-Foot		X					Res



Species	Cons signif	Data bases	Dool	Ecol 1991	BCE 07-09	BCE 18-19	Expected status
<b>AGAMIDAE (dragon lizards)</b>							
<i>Ctenophorus caudicinctus</i> Ring-tailed Dragon		X	X	X		X	Res
<i>Ctenophorus isolepis</i> Military Dragon		X			X	X	Res
<i>Ctenophorus nuchalis</i> Central Netted Dragon							Res
<i>Ctenophorus reticulatus</i> Western Netted Dragon		X		X			Res
<i>Ctenophorus scutulatus</i> Lozenge-marked Dragon			X			X	Res
<i>Diporiphora (Caimanops) amphiboluroides</i> Mulga Dragon		X				X	Res
<i>Gowidon longirostris</i> Long-nosed Dragon		X					Res
<i>Moloch horridus</i> Thorny Devil		X					Res
<i>Pogona minor</i> Western Bearded Dragon			X	X	X	X	Res
<i>Tympanocryptis cephalus</i> Earless Pebble Dragon		X	X		X		Res
<b>VARANIDAE (monitors or goannas)</b>							
<i>Varanus brevicauda</i> Short-tailed Monitor							Res
<i>Varanus caudolineatus</i> Stripe-tailed Monitor			X				Res
<i>Varanus eremius</i> Desert Pygmy Monitor							Res
<i>Varanus giganteus</i> Perentie							Res
<i>Varanus gouldii</i> Sand Goanna		X		X			Res
<i>Varanus panoptes</i> Yellow-spotted Monitor		X	X	X	X	X	Res
<i>Varanus tristis</i> Black-headed Monitor					X		Res
<b>SCINCIDAE (skinks)</b>							
<i>Egernia depressa</i> Pygmy Spiny-tailed Skink		X	X	X	X		Res
<i>Egernia formosa</i> Goldfields Crevice Skink							Res
<i>Cryptoblepharus australis</i> Inland Snake-eyed Skink		X					Res
<i>Cryptoblepharus plagiocephalus</i> Fence Skink				X			Res
<i>Eremiascincus isolepsis</i> Northern Bar-lipped Skink		X					Res

Species		Cons signif	Data bases	Dool	Ecol 1991	BCE 07-09	BCE 18-19	Expected status
<i>Eremiascincus richardsonii</i>	Broad-banded Sand-swimmer		X					Res
<i>Menetia greyii</i>	Common Dwarf Skink		X		X	X		Res
<i>Ctenotus dux</i>			X					Res
<i>Ctenotus grandis</i>								Res
<i>Ctenotus inornatus</i>			X					Res
<i>Ctenotus leonhardii</i>	Leonhardi's Ctenotus		X	X			X	Res
<i>Ctenotus pantherinus</i>	Leopard Skink		X		X	X		Res
<i>Ctenotus schomburgkii</i>	Barred Wedge-snout Ctenotus				X			Res
<i>Ctenotus severus</i>						X		
<i>Lerista timida</i>			X		X			Res
<i>Tiliqua multifasciata</i>	Desert Bluetongue				X			Res
<b>TYPHLOPIDAE (blind snakes)</b>								
<i>Anilius bicolor</i>	Dark-spined Blind Snake							Res
<i>Anilius hamatus</i>	Northern Hook-snouted Blind Snake							Res
<i>Anilius waitii</i>	Beaked Blind Snake							Res
<b>BOIDAE (pythons)</b>								
<i>Antaresia perthensis</i>	Pygmy Python						X	Res
<i>Antaresia stimsoni</i>	Stimson's Python							Res
<b>ELAPIDAE (front-fanged snakes)</b>								
<i>Acanthophis pyrrhus</i>	Desert Death Adder							Res
<i>Brachyuropsis approximans</i>	Northern Shovel-nosed Snake							Res
<i>Demansia psammophis</i>	Yellow-faced Whip-Snake		X			X		Res
<i>Parasuta monachus</i>	Monk Snake		X					Res
<i>Pseudechis australis</i>	Mulga Snake		X		X	X		Res
<i>Pseudonaja modesta</i>	Ringed Brown Snake		X					Res



Species	Cons signif	Data bases	Dool	Ecol 1991	BCE 07-09	BCE 18-19	Expected status
<i>Pseudonaja mengdeni</i> Gwardar							Res
<i>Simoselaps bertholdi</i> Jan's Banded Snake		X					Res
<i>Furina ornata</i> Moon Snake						X	Res
<i>Suta fasciata</i> Rosen's Snake							Res
<b>Total Species Expected: 66</b>							
<b>Total Species Recorded: 29</b>							

## BIRDS

Species	Cons signif	Data bases	Dool	Ecol 1991	BCE 07-09	BCE 18-19	Expected status
<b>CASUARIIDAE (Cassowaries and emus)</b>							
<i>Dromaius novaehollandiae</i> Emu		X	X	X	X	X	Res
<b>MEGAPODIIDAE (Megapodes)</b>							
<i>Leipoa ocellata</i> Malleefowl	CS1		X				IrrVis
<b>PHASIANIDAE (Pheasants and allies)</b>							
<i>Coturnix ypsilophora</i> Brown Quail			X				IrrVis
<b>ANATIDAE (swans and ducks)</b>							
<i>Cygnus atratus</i> Black Swan			X				IrrVis
<i>Tadorna tadornoides</i> Australian Shelduck		X					IrrVis
<i>Anas superciliosa</i> Pacific Black Duck		X	X		X		IrrVis
<i>Anas rhynchotis</i> Australasian Shoveler		X					Vag
<i>Anas gracilis</i> Grey Teal		X	X		X		IrrVis
<i>Chenonetta jubata</i> Australian Wood Duck		X	X		X		IrrVis
<i>Malacorhynchus membranaceus</i> Pink-eared Duck						X	IrrVis
<b>PODICIPEDIDAE (grebes)</b>							
<i>Tachybaptus novaehollandiae</i> Australasian Grebe		X	X		X	X	IrrVis

Species	Cons signif	Data bases	Dool	Ecol 1991	BCE 07-09	BCE 18-19	Expected status
<i>Poliocephalus poliocephalus</i> Hoary-headed Grebe		X	X				IrrVis
<b>COLUMBIDAE (Pigeons and doves)</b>							
<i>Phaps chalcoptera</i> Common Bronzewing		X	X	X		X	Res
<i>Geophaps plumifera</i> Spinifex Pigeon		X			X		Vis
<i>Ocyphaps lophotes</i> Crested Pigeon		X	X	X	X	X	Res
<i>Geopelia cuneata</i> Diamond Dove		X	X				Vis
<b>PODARGIDAE (Australian frogmouths)</b>							
<i>Podargus strigoides</i> Tawny Frogmouth		X	X	X	X		Res
<b>CAPRIMULGIDAE (Nightjars and allies)</b>							
<i>Eurostopodus argus</i> Spotted Nightjar		X	X		X	X	Vis
<b>AEGOTHELIDAE (Owlet-nightjars)</b>							
<i>Aegotheles cristatus</i> Australian Owlet-nightjar		X	X			X	Res
<b>APODIDAE (Typical swifts)</b>							
<i>Apus pacificus</i> Fork-tailed Swift	CS1						Vis
<b>PHALACROCORACIDAE (cormorants)</b>							
<i>Microcarbo melanoleucos</i> Little Pied Cormorant		X	X				Vag
<b>ARDEIDAE (herons and egrets)</b>							
<i>Egretta novaehollandiae</i> White-faced Heron		X	X				IrrVis
<i>Ardea pacifica</i> White-necked Heron		X	X		X		IrrVis
<i>Ardea modesta (alba)</i> Eastern Great Egret	CS1	X					IrrVis
<i>Nycticorax caledonicus</i> Nankeen Night Heron		X					IrrVis
<b>THRESKIORNITHIDAE (ibis and spoonbills)</b>							
<i>Threskiornis molucca</i> Australian White Ibis			X				IrrVis
<i>Threskiornis spinicollis</i> Straw-necked Ibis		X			X		IrrVis
<i>Platalea flavipes</i> Yellow-billed Spoonbill		X					IrrVis
<b>ACCIPITRIDAE (Osprey, hawks and eagles)</b>							



Species		Cons signif	Data bases	Dool	Ecol 1991	BCE 07-09	BCE 18-19	Expected status
<i>Elanus axillaris</i>	Black-shouldered Kite		X	X		X		Vis
<i>Lophoictinia isura</i>	Square-tailed Kite							IrrVis
<i>Hamirostra melanosternon</i>	Black-breasted Buzzard		X	X			X	Vis
<i>Milvus migrans</i>	Black Kite		X	X				Vis
<i>Haliastur sphenurus</i>	Whistling Kite		X	X		X	X	Res
<i>Circus assimilis</i>	Spotted Harrier							Vis
<i>Accipiter fasciatus</i>	Brown Goshawk		X	X				Res
<i>Accipiter cirrhocephalus</i>	Collared Sparrowhawk		X	X				Res
<i>Aquila audax</i>	Wedge-tailed Eagle		X	X	X	X	X	Res
<i>Hieraetus morphnoides</i>	Little Eagle		X				X	Vis
<b>FALCONIDAE (Falcons)</b>								
<i>Falco berigora</i>	Brown Falcon		X	X	X	X	X	Res
<i>Falco longipennis</i>	Australian Hobby		X	X				Res
<i>Falco hypoleucos</i>	Grey Falcon	CS1	X					IrrVis
<i>Falco peregrinus</i>	Peregrine Falcon	CS1	X	X			X	Res
<i>Falco cenchroides</i>	Nankeen Kestrel		X	X		X	X	Res
<b>RALLIDAE (Rails, gallinules and coots)</b>								
<i>Tribonyx ventralis</i>	Black-tailed Native-hen		X					IrrVis
<i>Fulica atra</i>	Eurasian Coot		X	X			X	IrrVis
<b>OTIDIDAE (bustards)</b>								
<i>Ardeotis australis</i>	Australian Bustard	CS3	X	X		X	X	Res
<b>BURHINIDAE (stone-curlews)</b>								
<i>Burhinus grallarius</i>	Bush Stone-curlew	CS3	X					IrrVis
<b>RECURVIROSTRIDAE (stilts and avocets)</b>								
<i>Himantopus himantopus</i>	Black-winged Stilt		X					IrrVis
<b>CHARADRIIDAE (Lapwings, plovers and dotterels)</b>								

Species		Cons signif	Data bases	Dool	Ecol 1991	BCE 07-09	BCE 18-19	Expected status
<i>Erythrogonys cinctus</i>	Red-kneed Dotterel							IrrVis
<i>Charadrius ruficapillus</i>	Red-capped Plover		X					IrrVis
<i>Euseyornis melanops</i>	Black-fronted Dotterel		X	X		X		IrrVis
<i>Charadrius australis</i>	Inland Dotterel							IrrVis
<i>Vanellus tricolor</i>	Banded Lapwing			X				IrrVis
<b>SCOLOPACIDAE (sandpipers)</b>								
<i>Actitis hypoleucos</i>	Common Sandpiper	CS1	X					IrrVis
<i>Calidris ruficollis</i>	Red-necked Stint	CS1	X					IrrVis
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	CS1	X					IrrVis
<i>Calidris melanotos</i>	Pectoral Sandpiper	CS1	X					Vag
<b>GLAREOLIDAE (pratincoles)</b>								
<i>Stiltia Isabella</i>	Australian Pratincole		X					Vag
<b>TURNICIDAE (Button-quails)</b>								
<i>Turnix velox</i>	Little Button-quail		X	X		X		Vis
<b>CACATUIDAE (Cockatoos)</b>								
<i>Nymphicus hollandicus</i>	Cockatiel		X	X		X		Vis
<i>Calyptorhynchus banksii</i>	Red-tailed Black-Cockatoo		X					IrrVis
<i>Eolophus roseicapilla</i>	Galah		X	X		X		Vis
<i>Cacatua sanguinea</i>	Little Corella		X	X				IrrVis
<i>Lophochroa leadbeateri</i>	Major Mitchell's Cockatoo	CS3						Vag
<b>PSITTACIDAE (Parrots)</b>								
<i>Barnardius zonarius</i>	Australian Ringneck		X	X	X	X	X	Res
<i>Psephotus varius</i>	Mulga Parrot		X	X	X	X	X	Res
<i>Melopsittacus undulatus</i>	Budgerigar		X	X	X	X		Vis
<i>Neosephotus bourkii</i>	Bourke's Parrot		X	X				Res
<i>Neophema elegans</i>	Elegant Parrot			X				Vag



Species		Cons signif	Data bases	Dool	Ecol 1991	BCE 07-09	BCE 18-19	Expected status
<i>Neophema splendida</i>	Scarlet-chested Parrot	CS3						Vag
<i>Polytelis alexandrae</i>	Princess Parrot	CS1	X					Vag
<i>Pezoporus occidentalis</i>	Night Parrot	CS1	X					Vag
<b>CUCULIDAE (Old world cuckoos)</b>								
<i>Cacomantis pallidus</i>	Pallid Cuckoo		X	X				Vis
<i>Chalcites osculans</i>	Black-eared Cuckoo		X	X	X	X		Vis
<i>Chalcites basalis</i>	Horsfield's Bronze-Cuckoo		X	X	X	X		Vis
<b>STRIGIDAE (Hawk owls)</b>								
<i>Ninox novaeseelandiae</i>	Southern Boobook		X	X	X			Res
<b>TYTONIDAE (Barn owls)</b>								
<i>Tyto alba</i>	Eastern Barn Owl		X	X				Vis
<b>ALCEDINIDAE (Kingfishers)</b>								
<i>Dacelo leachii</i>	Blue-winged Kookaburra		X					IrrVis
<i>Todiramphus pyrrhopygia</i>	Red-backed Kingfisher		X	X		X	X	Res
<i>Todiramphus sanctus</i>	Sacred Kingfisher		X	X				Vis
<b>MEROPIDAE (Bee-eaters)</b>								
<i>Merops ornatus</i>	Rainbow Bee-eater		X				X	Vis
<b>CLIMACTERIDAE (Australo-Papuan treecreepers)</b>								
<i>Climacteris affinis</i>	White-browed Treecreeper		X	X	X			Vis
<b>PTILONORHYNCHIDAE (Bowerbirds)</b>								
<i>Ptilonorhynchus guttatus</i>	Western Bowerbird		X	X	X	X		Res
<b>MALURIDAE (Fairy-, emu- and grasswrens)</b>								
<i>Malurus splendens</i>	Splendid Fairy-wren		X	X		X	X	Res
<i>Malurus lamberti</i>	Variiegated Fairy-wren		X	X		X	X	Res
<i>Malurus leucopterus</i>	White-winged Fairy-wren		X	X		X		Res
<i>Amytornis striatus striatus</i>	Inland Striated Grasswren	CS2	X					Vag

Species	Cons signif	Data bases	Dool	Ecol 1991	BCE 07-09	BCE 18-19	Expected status
<b>ACANTHIZIDAE (Thornbills and allies)</b>							
<i>Pyrrholaemus brunneus</i> Redthroat		X	X		X	X	Res
<i>Smicronis brevirostris</i> Weebill		X	X	X			Res
<i>Gerygone fusca</i> Western Gerygone		X	X		X		Res
<i>Acanthiza apicalis</i> Inland Thornbill		X	X	X	X	X	Res
<i>Acanthiza uropygialis</i> Chestnut-rumped Thornbill		X	X	X	X	X	Res
<i>Acanthiza robustirostris</i> Slaty-backed Thornbill		X	X		X	X	Res
<i>Acanthiza chrysorrhoa</i> Yellow-rumped Thornbill		X	X			X	Res
<i>Aphelocephala nigricincta</i> Banded Whiteface		X	X				Res
<i>Aphelocephala leucopsis</i> Southern Whiteface		X	X		X	X	Res
<b>PARDALOTIDAE (Pardalotes, thornbills and allies)</b>							
<i>Pardalotus rubricatus</i> Red-browed Pardalote		X					Res
<i>Pardalotus striatus</i> Striated Pardalote		X	X				Res
<b>MELIPHAGIDAE (Honeyeaters)</b>							
<i>Certhionyx variegatus</i> Pied Honeyeater		X			X		Vis
<i>Lichenostomus virescens</i> Singing Honeyeater		X	X	X	X	X	Res
<i>Ptilotula plumula</i> Grey-fronted Honeyeater		X		X			Res
<i>Ptilotula penicillata</i> White-plumed Honeyeater		X	X				Vis
<i>Purnella albifrons</i> White-fronted Honeyeater		X	X		X		Vis
<i>Manorina flavigula</i> Yellow-throated Miner		X	X		X	X	Res
<i>Acanthagenys rufogularis</i> Spiny-cheeked Honeyeater		X	X		X	X	Res
<i>Conopophila whitei</i> Grey Honeyeater	CS3		X				Vis
<i>Epthianura tricolor</i> Crimson Chat		X	X		X		Vis
<i>Epthianura aurifrons</i> Orange Chat		X					IrrVis
<i>Certhionyx niger</i> Black Honeyeater		X			X		Vis
<i>Lichmera indistincta</i> Brown Honeyeater		X	X		X		Res



Species	Cons signif	Data bases	Dool	Ecol 1991	BCE 07-09	BCE 18-19	Expected status
<b>POMATOSTOMIDAE (Babblers)</b>							
<i>Pomatostomus temporalis</i> Grey-crowned Babbler		X	X	X	X	X	Res
<i>Pomatostomus superciliosus</i> White-browed Babbler		X	X		X	X	Res
<b>PSOPHODIDAE (Quail-thrushes and allies)</b>							
<i>Psophodes occidentalis</i> Chiming Wedgebill		X					Vis
<i>Cinclosoma castaneothorax</i> Chestnut-breasted Quail-thrush		X	X		X	X	Res
<b>NEOSITTIDAE (Sitellas)</b>							
<i>Daphoenositta chrysoptera</i> Varied Sittella		X	X	X	X	X	Res
<b>CAMPEPHAGIDAE (Cuckoo-shrikes and trillers)</b>							
<i>Coracina novaehollandiae</i> Black-faced Cuckoo-shrike		X	X		X		Res
<i>Coracina maxima</i> Ground Cuckoo-shrike		X	X				Vis
<i>Lalage tricolor</i> White-winged Triller		X	X			X	Vis
<b>PACHYCEPHALIDAE (Whistlers and allies)</b>							
<i>Oreoica gutturalis</i> Crested Bellbird		X	X	X	X	X	Res
<i>Pachycephala rufiventris</i> Rufous Whistler		X	X	X	X	X	Res
<i>Colluricincla harmonica</i> Grey Shrike-thrush		X	X		X	X	Res
<b>ARTAMIDAE (Woodswallows and allies)</b>							
<i>Artamus personatus</i> Masked Woodswallow		X	X		X		Vis
<i>Artamus cinereus</i> Black-faced Woodswallow		X	X	X	X	X	Res
<i>Artamus cyanopterus</i> Dusky Woodswallow						X	Vag
<i>Artamus minor</i> Little Woodswallow		X	X		X	X	Res
<i>Artamus superciliosus</i> White-browed Woodswallow		X					IrrVis
<i>Cracticus torquatus</i> Grey Butcherbird		X	X	X	X	X	Res
<i>Cracticus nigrogularis</i> Pied Butcherbird		X	X		X	X	Res
<i>Cracticus tibicen</i> Australian Magpie		X	X				Res

Species		Cons signif	Data bases	Dool	Ecol 1991	BCE 07-09	BCE 18-19	Expected status
<i>Strepera versicolor</i>	Grey Currawong			X				IrrVis
<b>RHIPIDURIDAE (Fantails)</b>								
<i>Rhipidura fuliginosa</i>	Grey Fantail			X				Vis
<i>Rhipidura f. albicauda</i>	White-tailed Fantail							Vis
<i>Rhipidura leucophrys</i>	Willie Wagtail		X	X		X	X	Res
<b>CORVIDAE (Crows and allies)</b>								
<i>Corvus bennetti</i>	Little Crow		X	X		X		Res
<i>Corvus orru</i>	Torresian Crow		X	X		X	X	Res
<b>MONARCHIDAE (Monarchs and allies)</b>								
<i>Grallina cyanoleuca</i>	Magpie-lark		X	X		X	X	Res
<b>PETROICIDAE (Robins)</b>								
<i>Microeca leucophaea</i>	Jacky Winter			X				Vis
<i>Petroica goodenovii</i>	Red-capped Robin		X	X		X	X	Res
<i>Melanodryas cucullata</i>	Hooded Robin		X	X	X	X	X	Res
<b>MEGALURIDAE (grassbirds)</b>								
<i>Cinclorhamphus mathewsi</i>	Rufous Songlark		X	X				Vis
<i>Cinclorhamphus cruralis</i>	Brown Songlark			X				Vis
<b>HIRUNDINIDAE (Swallows and martins)</b>								
<i>Cheramoeca leucosternum</i>	White-backed Swallow		X			X	X	Vis
<i>Hirundo neoxena</i>	Welcome Swallow		X	X		X	X	Vis
<i>Petrochelidon nigricans</i>	Tree Martin		X	X		X		Vis
<i>Petrochelidon ariel</i>	Fairy Martin		X	X		X	X	Vis
<b>DICAEIDAE (Flowerpeckers)</b>								
<i>Dicaeum hirundinaceum</i>	Mistletoebird		X	X		X	X	Res
<b>ESTRILDIDAE (Sparrows, weaverbirds and allies)</b>								
<i>Emblema pictum</i>	Painted Finch		X					Vag



Species	Cons signif	Data bases	Dool	Ecol 1991	BCE 07-09	BCE 18-19	Expected status
<i>Taeniopygia guttata</i> Zebra Finch		X	X		X		Res
<b>MOTACILLIDAE (Old world wagtails and pipits)</b>							
<i>Anthus novaeseelandiae</i> Australasian Pipit		X	X	X	X		Res
<b>Total Species Expected: 148</b>							
<b>Total species Recorded: 91</b>							

**MAMMALS**

Species	Cons signif	Data bases	Dool	Ecol 1991	BCE 07-09	BCE 18-19	Expected status
<b>TACHYGLOSSIDAE (Echidnas)</b>							
<i>Tachyglossus aculeatus</i> Echidna			X	X	X	X	Res
<b>DASYURIDAE (Dasyurids)</b>							
<i>Dasyercus blythi</i> Brush-tailed Mulgara	CS2	X			X	X	Res
<i>Antechinomys laniger</i> Kultarr	CS3	X		X			Res
<i>Ningauai ridei</i> Wongai Ningauai		X					Res
<i>Pseudantechinus woolleyae</i> Woolley's Pseudantechinus		X	X	X	X		Res
<i>Sminthopsis crassicaudata</i> Fat-tailed Dunnart							Res
<i>Sminthopsis dolichura</i> Little Long-tailed Dunnart							Res
<i>Sminthopsis longicaudata</i> Long-tailed Dunnart	CS2						Res
<i>Sminthopsis macruora</i> Stripe-faced Dunnart		X		X			Res
<i>Sminthopsis youngsoni</i> Lesser Hairy-footed Dunnart		X					Res
<b>PERAMELIDAE (Bandicoots)</b>							
<i>Macrotis lagotis</i> Greater Bilby	CS1	X					Vag
<b>MACROPODIDAE (Kangaroos, wallabies)</b>							
<i>Macropus robustus</i> Euro, Biggada			X	X	X	X	Res

Species		Cons signif	Data bases	Dool	Ecol 1991	BCE 07-09	BCE 18-19	Expected status
<i>Macropus rufus</i>	Red Kangaroo, Marlu			X		X	X	Res
<b>MURIDAE (Rats and mice)</b>								
<i>Mus musculus</i>	House Mouse	INT			X			Res
<i>Notomys alexis</i>	Spinifex Hopping-Mouse			X	X	X	X	Res
<i>Pseudomys desertor</i>	Desert Mouse		X			X		Res
<i>Pseudomys hermannsburgensis</i>	Sandy Inland Mouse		X		X			Res
<i>Zyomys argurus</i>	Common Rock-rat		X					Vag
<b>EMBALLONURIDAE (Sheathtail bats)</b>								
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheathtail-Bat						X	Res
<i>Taphozous georgianus</i>	Sheathtail-Bat						X	Res
<b>VESPERTILIONIDAE (Vespertilionid bats)</b>								
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat						X	Res
<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat						X	Res
<i>Scotorepens balstoni</i>	Inland Broad-nosed Bat						X	Res
<i>Vespadelus baverstocki</i>	Inland Forest Bat							Res
<i>Vespadelus finlaysoni</i>	Finlayson's Cave Bat		X				X	Res
<b>MOLOSSIDAE (Freetail bats)</b>								
<i>Ozimops planiceps</i>	Inland Freetail-bat							Res
<i>Austronomus saustralis</i>	White-striped Freetail-bat					X		Vis
<b>LEPORIDAE (Rabbits and hares)</b>								
<i>Oryctolagus cuniculus</i>	Rabbit	INT		X		X	X	Res
<b>CANIDAE (Dogs and foxes)</b>								
<i>Canis lupus</i>	Dog/Dingo	INT	X	X	X	X	X	Res
<i>Vulpes vulpes</i>	Red Fox	INT					X	Res



Species	Cons signif	Data bases	Dool	Ecol 1991	BCE 07-09	BCE 18-19	Expected status
<b>FELIDAE (Cats)</b>							
<i>Felis catus</i> Cat	INT		X	X	X	X	Res
<b>BOVIDAE (Horned ruminants)</b>							
<i>Bos taurus</i> Cattle	INT		X		X	X	Res
<i>Capra hircus</i> Goat	INT						Vis
<b>EQUIDAE (horses)</b>							
<i>Equus asinus</i> Donkey	INT					X	IrrVis
<i>Equus caballus</i> Horse	INT					X	Res
<b>CAMELIDAE (camels)</b>							
<i>Camelus dromedarius</i> Camel	INT		X	X	X	X	IrrVis
<b>Total Species Expected: 36</b>							
<b>Total Species Recorded: 28 (10 introduced)</b>							

## 7.6 Appendix 6.

### 6a. Species considered extinct in the Marymia region

English Name	Latin Name
Thick-billed Grasswren	<i>Amytornis textilis</i>
Chuditch	<i>Dasyurus geoffroii</i>
Boodie	<i>Bettongia lesueur</i>
Rufous Hare-Wallaby	<i>Lagorchestes hirsutus</i>
Ghost Bat	<i>Macroderma gigas</i>
Golden Bandicoot	<i>Isodon auratus</i>
Pig-footed Bandicoot	<i>Chaeropus ecaudatus</i>
Lesser Stick-nest Rat	<i>Leporillus apicalis</i>
Pebble-mound Moue	<i>Pseudomys chapmani</i>
Pilbara Leaf-nosed Bat	<i>Rhinonictis aurantia</i>

Note that this list is probably incomplete and the past status of some of these species in the area is uncertain. With the exception of the Lesser Stick-nest Rat and the Pig-footed Bandicoot, all species are extant elsewhere. Old Boodie mounds were recorded in the Cinnamon area.

### 6b. Species returned from databases but for which the project area is outside the known range; the birds in this list could all occur as extremely rare vagrants.

Latin Name	English Name
<i>Litoria adelaidensis</i>	Slender Tree Frog
<i>Litoria ewingii</i>	Brown Tree Frog
<i>Heleioporus albopunctatus</i>	Western Spotted Frog
<i>Heleioporus psammophilus</i>	Sand Frog
<i>Crinia georgiana</i>	Tschudi's Froglet
<i>Pseudophryne bibronii</i>	Brown Toadlet
<i>Neobatrachus kunapalari</i>	Kunapalari Frog
<i>Pseudophryne occidentalis</i>	Western Toadlet
<i>Liopholis whitii</i>	White's Skink
<i>Tiliqua nigrolutea</i>	Blotched Blue-Tongue
<i>Tiliqua rugosa rugosa</i>	Bobtail
<i>Hemiergis peronii</i>	Lowlands Earless Skink
<i>Notechis scutatus scutatus</i>	Tiger Snake
<i>Ctenotus labillardieri</i>	Red-legged Ctenotus
<i>Amphibolurus muricatus</i>	Jacky Lizard
<i>Charadrius veredus</i>	Oriental Plover
<i>Geopelia placida</i>	Peaceful Dove
<i>Motacilla flava</i>	Yellow Wagtail
<i>Motacilla cinerea</i>	Grey Wagtail
<i>Circus approximans</i>	Swamp Harrier
<i>Platalea regia</i>	Royal Spoonbill
<i>Anhinga novaehollandiae</i>	Australian Darter
<i>Pelecanus conspicillatus</i>	Australian Pelican
<i>Phalacrocorax sulcirostris</i>	Little Black Cormorant
<i>Phalacrocorax carbo</i>	Great Cormorant
<i>Dasyercus cristicauda</i>	Crest-tailed Mulgara



## 7.7 Appendix 7. Annotated species list from November 2018 and August 2019 surveys.

### Frogs and Reptiles

*Litoria rubella*. Nov. 2018. One active at night at Cinnamon and reported in ablutions at old camp. Also several at night in puddle at Apex.

*Gehyra variagata*. Nov. 2018. One found around camp (form with reticulum forming lines down dorsum). Also one at night at Apex.

*Heteronotia binoei*. Nov. 18. One on road at night.

*Nephrurus wheeleri cinctus*. Nov. 18. Several on road at night including gravid female.

*Ctenotus leonhardi*. Nov. 18. One seen in Apex.

*Caimanops amphioluroides*. Nov. 18. Large female found at night perched in acacia at about 1.5m in Apex.

*Ctenophorus caudicinctus*. Nov. 18. Several seen in Trident and Apex areas.

*Ctenophorus isolepis*. Nov. 18. Several seen in gravelly loam flats of K2. Include males in breeding colour. Also on gravelly loam flat in west of apex and in Cinnamon.

*Ctenophorus scutullatus*. Nov. 18. Several seen in Cinnamon area and one near Apex.

*Pogona minor*. Nov. 18. One along track in K2.

*Varanus panoptes*. Nov. 18. Two males filmed fighting. Foraging holes and burrows throughout.

*Antaresia perthensis*. Nov. 18. Adult of 500mm found at night in K2, and one at night at Cinnamon.

*Furina ornata*. Nov. 18. One active at night at Cinnamon.

### Birds

1. Emu. Nov 18. Tracks in north of K2 and east of Cinnamon. Aug. 19. Dead bird in fence at Triple P.
2. Australasian Grebe. Aug 19.
3. Pink-eared Duck. Aug 19: B Zone pit: 1.
4. Black-breasted Buzzard. Nov. 18. One flew over K2 area (8/11).
5. Whistling Kite. Nov. 18. One over K2 and one near camp.
6. Little Eagle. Nov. 18. One over Trident.
7. Wedge-tailed Eagle. Nov. 18. Adult and juvenile near Apex and old nest.
8. Nankeen Kestrel. Nov. 18. Single birds seen in open cuts at Trident and K1.
9. Peregrine Falcon. Aug. 19. Pair in Flamingo Pit in Triple P area.
10. Brown Falcon. Nov. 18. A pair around K2 and one seen in apex. Aug. 19. One on drive in south of the loader tyre and one along pipeline corridor.
11. Common Bronzewing. Nov. 18. Few in Trident and K2. Bird on nest in K2.
12. Crested Pigeon. Nov. 18. Small flocks along drive in from highway.
13. Diamond Dove. Nov. 18. One seen in K2.
14. Eurasian Coot. Aug. 19. Six in flooded Mareast pit. Exocet Pit: 1. Flamingo pit: 7. B Zone Pit: 4. PPP pit: 28.
15. Australian Ringneck. Nov. 18. Seen in Trident. Aug. 19. One in Triple P area.

16. Australian Bustard. Nov. 18. One drinking from puddle on edge of Apex.
17. Spotted Nightjar. Nov. 18. Several foraging in evenings around camp and along roads. Heard occasionally. Aug 19. Two flushed at far eastern end of corridor.
18. Owlet-nightjar. Nov. 18. One flew from K2 portal.
19. Red-backed Kingfisher. Nov. 18. One in Trident.
20. Rainbow Bee-eater. Nov. 18. Few in north of K2.
21. Variegated Fairy-wren. Nov. 18. Parties in Trident, Apex and in K2. Coloured males present. Aug 19. Party in Wedgetail and party in rehab at Triple p..
22. Splendid Fairy-wren. Nov. 18. Parties in Trident, Apex and in Cinnamon. Coloured males present.
23. Chestnut-rumped Thornbill. Nov. 18. Parties in Trident, Apex, Cinnamon and K2. Aug 19. Single bird in Wedgetail. Few in Mareast and Marwest/Trident. Several amongst other small birds in rehab at Triple p.
24. Slaty-backed Thornbill. Nov. 18. Parties in Trident, K2 and Cinnamon. May be the more abundant thornbill but difficult to be sure. Aug 19. Two in mulga thicket in Wedgetail.
25. Inland Thornbill. Nov. 18. Few in Trident, Apex, Cinnamon and K2. Aug 19. Several amongst other small birds in rehab at Triple P.
26. Yellow-rumped Thornbill. Aug 19. Two in Triple P area.
27. Southern Whiteface. Aug 19. Teo near dead horse in Triple p.
28. Redthroat. Nov. 18. One in Apex, calling and seen; also in Cinnamon. Inland Thornbills copying Redthroat throughout suggesting they hear the species regularly. Aug 19. One heard near group of small birds in rehab at Triple p.
29. Spiny-cheeked Honeyeater. Nov. 18. Heard Trident and K2. Seen and heard in Cinnamon and Apex. Aug. 19. Few seen in Corridor and Wedgetail.
30. Yellow-throated Miner. Nov. 18. Heard in Trident and seen and heard in Apex and Cinnamon.
31. Singing Honeyeater. Nov. 18. Small numbers in all areas. Aug. 19. One in Mareast.
32. Mistletoebird. Nov. 18. Pair in Apex.
33. Willie Wagtail. Nov. 18. Pairs seen occasionally throughout. Aug. 19. Occasional single birds seen.
34. Red-capped Robin. Nov. 18. Seen in Trident, Apex, Cinnamon and K2. Aug 19. Pair in north of Triple p along drainage line.
35. Hooded Robin. Nov. 18. Pair in Cinnamon and family party in Apex. Aug. 19. Pair along corridor. Female in Mareast and pair flew across main road near K2 turnoff. Pair near dead horse in triple p.
36. Rufous Whistler. Nov. 18. Small numbers throughout.
37. Grey Shrike-thrush. Nov. 18. Few throughout. Aug 19. One near dead horses at Triple p.
38. Crested Bellbird. Nov. 18. Few throughout. Aug. 19. Unconfirmed sighting in Mareast. One near dead horses at Triple p.
39. Varied Sittella. Aug 19. Party of about 6 along road to Speckled Hen.
40. Grey-crowned Babbler. Nov. 18. Parties in Trident, Apex and Cinnamon. Aug 19. Three near dead horses in Triple P.
41. White-browed Babbler. Nov. 18. Several parties in rehab at K2. Also seen in native acacia shrubland nearby, and in Apex and Cinnamon.
42. Western Quail-thrush. Nov. 18. Parties in Trident and Apex. Aug. 19. Single bird along corridor. Male and two females on K2 ROM (8/08). Three birds near dead horse in Triple P.
43. White-winged Triller. Nov. 18. Single bird (female) see near K1 pit in K2.



44. Welcome Swallow. Aug 19. Seen around pits in Triple P, and seven birds around dead horses.
45. White-backed Swallow. Nov. 18. Few around most pits and breeding burrows present.
46. Fairy Martin. Nov. 18. Nests in K2 portal.
47. Little Woodswallow. Nov. 18. Few around pits. Aug. 19. Single bird in Ibis pit.
48. Black-faced Woodswallow. Nov. 18. Group of three in west of K2 and group of three in Cinnamon. Up to 10 near camp.
49. Dusky Woodswallow. Aug 19. One near dead horse in triple P. Seen from about 15m and white edges to primaries clearly seen. This represents an extension to the known range of the species but was probably a vagrant individual.
50. Magpielark. Aug 19. Several in triple p area, including two feeding around dead horses.
51. Pied Butcherbird. Aug 19. One near dead horse in triple P.
52. Grey Butcherbird. Nov. 18. One seen in K2 and one at camp. Aug. 19. Several birds around camp, where they regularly forage on insects under lights.
53. Torresian Crow. Nov. 18. Three birds seen in Trident and group of about 6 in Cinnamon. Aug. 19. Single bird in Mareast.

### **Mammals**

- Echidna. Nov. 18. Fairly recent diggings in rehab at K2.
- Dasyercus blythi*. Nov. 18. Group of disused burrows in west of K2. Few old burrows in Cinnamon.
- Boodie. Nov. 18. Old warrens in Cinnamon.
- Red Kangaroo. Nov. 18. Seen occasionally. Aug 19. One seen in north of Triple p.
- Euro. Nov. 18. Few seen in K2. Aug. 19. Occasional tracks.
- Notomys alexis*. Nov. 18. Burrow system in sandy loam soils in west and north of K2 and in Cinnamon.
- Taphozous georgianus*. One seen before dawn along Marymia road on 9/11 and recorded on bat detectors.
- Nyctophilus geoffroyii*. Recorded on bat detectors.
- Scotorepens bsalstoni*. Recorded on bat detectors.
- Vespadelus finlaysoni*. Recorded on bat detectors.
- Saccolaimus flaviventris*. Recorded on bat detectors.
- Rabbit. Nov. 18. Tracks, scats and burrows in Trident and K2. Aug. 19. Fresh tracks in MarEast.
- Feral Horse. Nov. 18. Group of three in K2 and lots of tracks and scats in Apex (where one seen) and Cinnamon. Aug. 19. Group of four at Wedgetail.
- Donkey. Aug. 19. Fresh tracks at Marwest.
- Cattle. Nov. 18. Evidence throughout. Aug. 19. Evidence throughout.
- Dingo. Nov. 18. Tracks in K2. Aug. 19. Fresh tracks around car at Mareast. Old tracks on edge of Marwest it.
- Cat. Nov. 18. Tracks in K2.
- Fox. Nov. 18. One reported by staff.
- Camel. Aug. 19. Fresh tracks at Marwest.

### 7.8 Appendix 8. Call charts of bat species recorded on bat detectors.

Sample calls for each of the bats recorded are provided in Figures 1 to 6 with grey-scale full spectrum data and zero crossing overlay. All calls are time expanded and time between calls has been compressed.

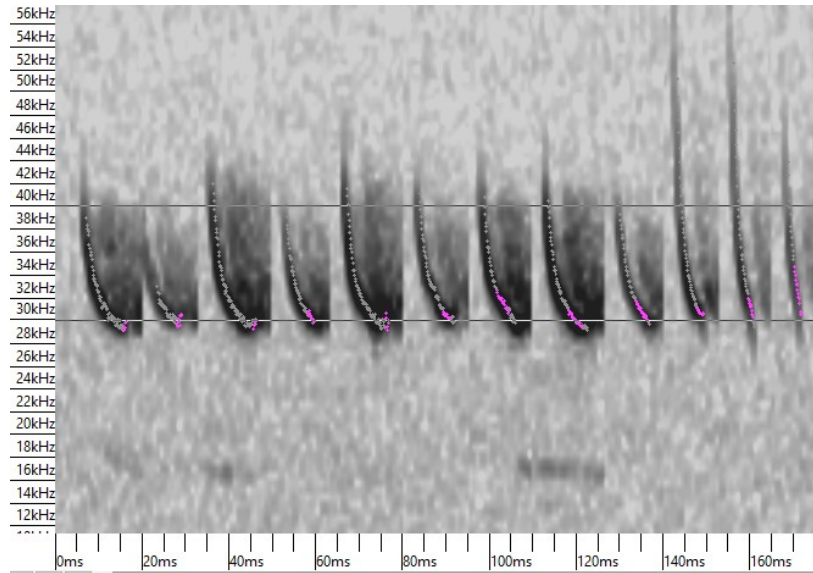


Figure 1: Sonogram of *C. gouldii* showing characteristic alternation in frequency in first nine calls.

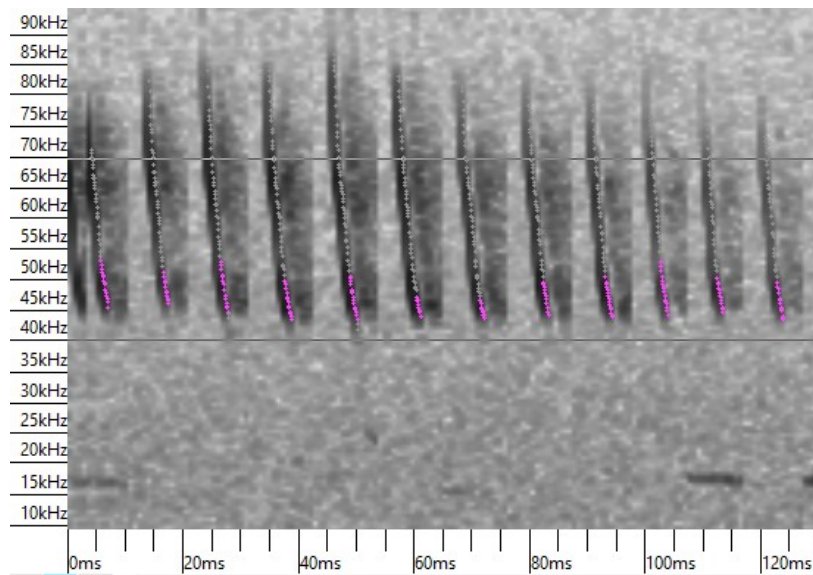


Figure 2: Sonogram of suspected *N. geoffroyi* showing relatively straight and near-vertical call structure.



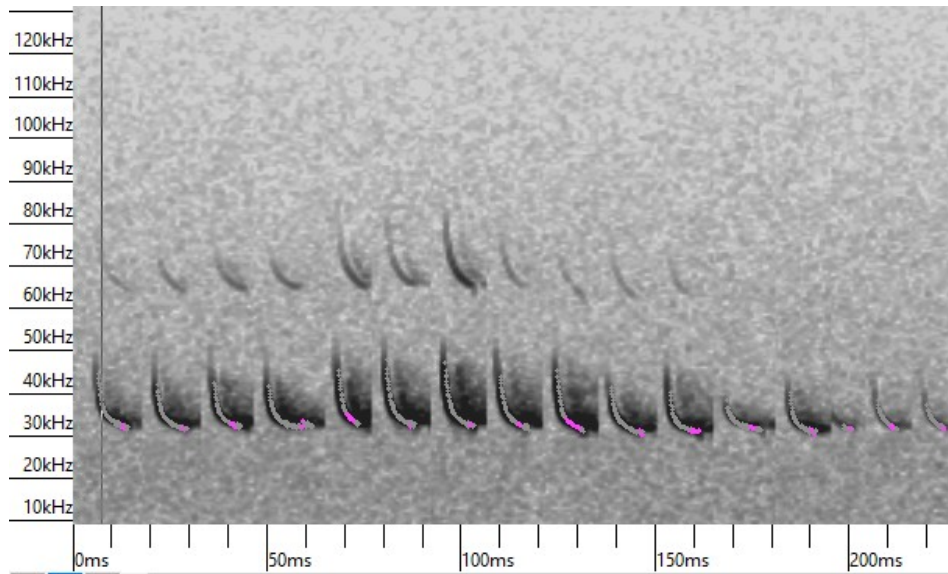


Figure 3: Sonogram of *S. balstoni* echolocation sequence.

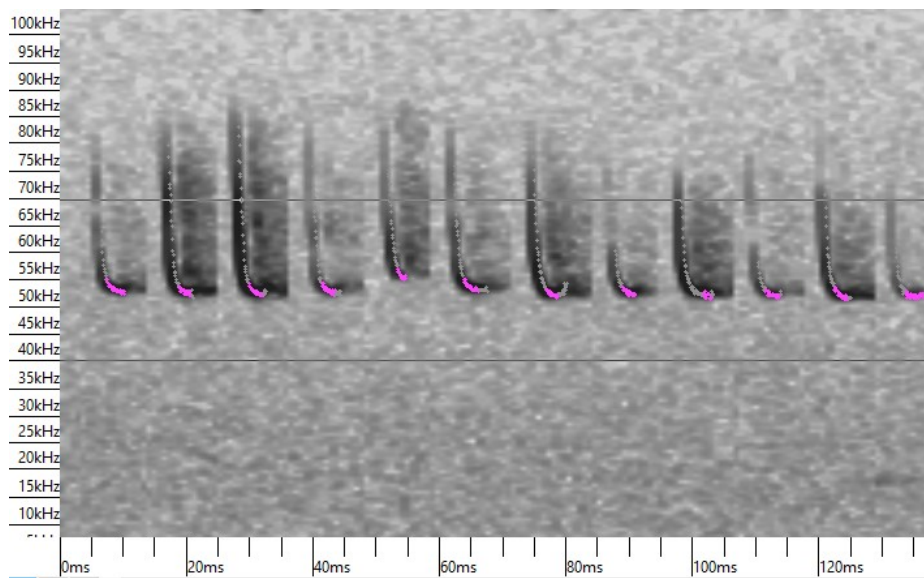


Figure 4: Sonogram of *V. finlaysoni*.

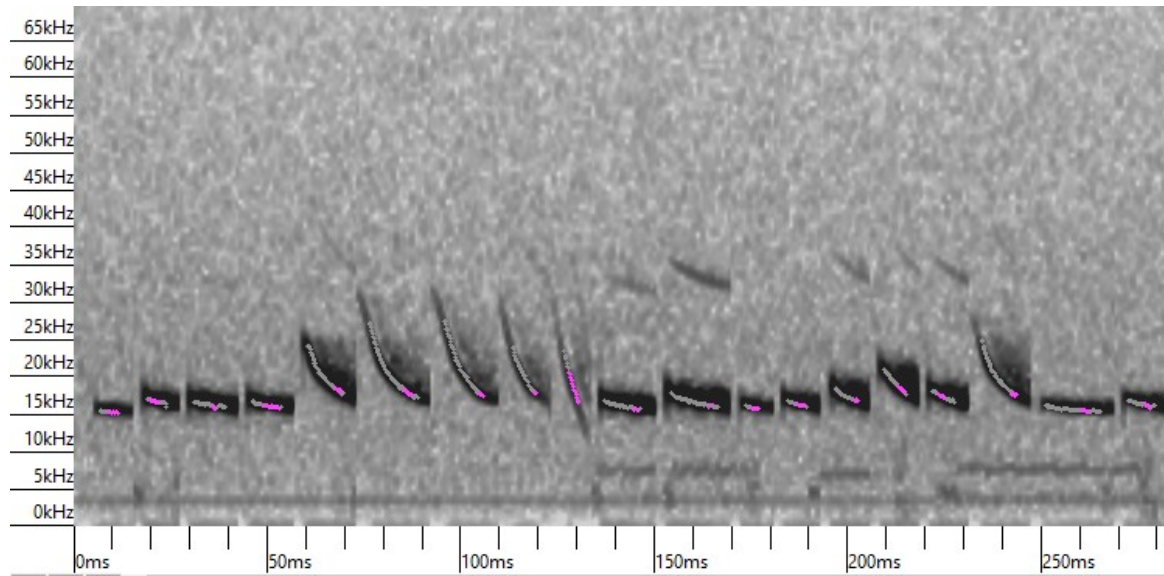


Figure 5: Sonogram of suspected *S. flaviventris* showing characteristic flat calls.

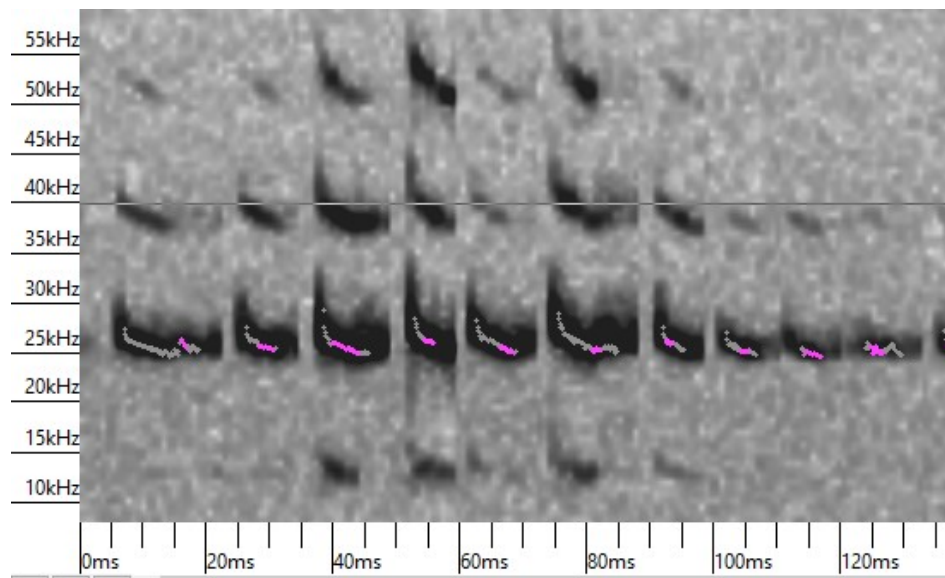


Figure 6: Sonogram of *T. georgianus* with characteristic weaker harmonic at circa 13 kHz.



**7.9 Appendix 9. GPS coordinates of inactive Mulgara burrows and Boodie warrens recorded in November 2018 (none were recorded in August 2019).**

<b>Record of Interest</b>	<b>Easting</b>	<b>Northing</b>
Boodie warren	772545	7213893
Boodie warren	772812.1	7213930
Boodie warren	780598.4	7215862
Mulgara burrow	772574.8	7213901
Mulgara burrow	773042.5	7214052
Mulgara burrow	773083.1	7214005
Mulgara burrow	775153.3	7218859
Mulgara burrow	773927.8	7214115
Mulgara burrow	772507.4	7213511
Mulgara burrow	772585.6	7213899



– END OF REPORT –

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