JOHNSTON RANGE GWENDOLYN GOLD PROJECT

NATIVE VEGETATION CLEARING PERMIT APPLICATION

July 2026

Prepared for:

FORRESTANIA RESOURCES

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Executive Summary

Forrestania Resources Limited (Forrestania) Proposes to clear 219.3 ha of native vegetation within a 414.8 ha Purpose Permit Area (PPA) for development of the Johnson Range Gwendolyn Gold Project (the Project).

The Project is located approximately 200 km north of Southern Cross and 150 km west of Menzies within the Eastern Goldfields region Western Australia. Forrestania is proposing to develop the Gwendolyn deposit as an open pit mining, crushing, and trucking operation, with stockpiled ore transported off site for processing. The Project will consist of an open pit and associated infrastructure including waste rock landforms, ore stockpiles, roads, buildings and water storage ponds.

An assessment against the ten clearing principles was undertaken based on information collected from site specific flora and fauna surveys and hydrological studies conducted for the Project. The indicative clearing footprint and mine layout has been developed to ensure impacts to sensitive environmental values are avoided or minimised.

Assessment of the proposed clearing against the ten clearing principles determined that the proposed clearing of 219.3 ha for the Project is not at variance or is unlikely to be at variance with all of the ten clearing principles. Appropriate environmental management measures will be implemented to avoid or minimise potential direct and indirect impacts associated with the clearing, where practicable.

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1. Introduction

Forrestania Resources Ltd (FRS) is proposing to develop the Johnston Range Gwendolyn Gold Project (the Project) as an open pit gold mining operation. The Project comprises the development of an open pit mine, associated waste rock landforms (WRLs), and supporting infrastructure. Ore will be transported off-site for processing.

A substantial amount of historical disturbance is present within the mining tenements, particularly on M 77/1263, as a result of mining and exploration activities undertaken by previous operators during the 1980s. Existing disturbed areas include the historic Gwendolyn open pit, waste rock dumps, processing mill foundations, laydown areas, a former airstrip, access roads, exploration tracks and drill pads. No rehabilitation has been undertaken by previous owners.

The Project will be developed in two stages:

- Stage 1 has been approved under Mining Proposal (MP) Reg ID 38135 and comprises the Gwendolyn East cutback. This stage includes development of an open pit, associated WRLs, and supporting infrastructure, with ore to be crushed on site and transported off-site for processing.
- Stage 2, which will be part of a new Mining Development and Closure Proposal (MDCP) application, involves expansion of the approved open pit footprint and the extension of the existing approved WRLs to facilitate continued mining of the Gwendolyn deposit.

This Native Vegetation Clearing Permit (NVCP) application this application seeks approval to clear native vegetation for the combined disturbance footprint associated with both Stage 1 and Stage 2 of the Project.

2. Background

2.1 Location

The Project is located in the Shire of Menzies approximately 200 km north of Southern Cross and 150 km west of Menzies (Figure 1).

The Project is accessed by Trainers Rock Road (unsealed), approximately 5.4 km west of the Bullfinch-Evanston Road.

2.2 Tenure

The Project is located within Mining Lease M 77/1263, three Miscellaneous Leases (L 77/245, L 77/247 and L 77/248), and one General Purpose Lease (G 77/119). The tenements are held by Aurumin Johnson Range Pty Ltd. On 13 February 2026, Forrestania executed a binding agreement to acquire 100% of the mineral rights (excluding iron ore rights) associated with the Project. Evidence of tenure is provided in Appendix A.

This clearing permit application is being submitted for proposed clearing on M 77/1263, L 77/248 and G 77/119. A summary of the tenements applicable to this Native Vegetation Clearing Permit (NVCP) application is provided in Table 1.

A tenement plan presented in Figure 2. which also shows the proposed Purpose Permit Area (PPA).

Table 1: Project Tenements within PPA

Tenement	Area (ha)	Granted	Expiry
M 77/1263	184.65	15/05/2012	14/05/2033
G 77/119	298.15	21/02/2013	20/02/2034
L 77/248	96	21/02/2013	20/02/2034

2.3 Social Setting

The Project is located within the Shire of Menzies, located on the Diemals' pastoral station.

The Project is not located within any Department of Biodiversity, Conservation and Attractions (DBCA) managed lands or other conservation areas. The nearest conservation areas are the former Mt Elvire Pastoral Lease, proposed for conservation and located approximately 5 km east of the Project, and Mount Manning Range Conservation Park (R48470) and Helena and Aurora Range National Park (R36208), both located approximately 8 km south of the PPA.

The Project does not intersect any recreational reserves.

2.4 Aboriginal Cultural Heritage

There is one determined Native Title claim over the proposed Project - the Marlinyu Ghoorlie Native Title claim (WC2017/007). On 19 December 2025, the Federal Court of Australia recognised the Marlinyu Ghoorlie Native Title Claimant Group's ongoing connection to the land and waters within the claim area, and the claim will progress to determination through case management.

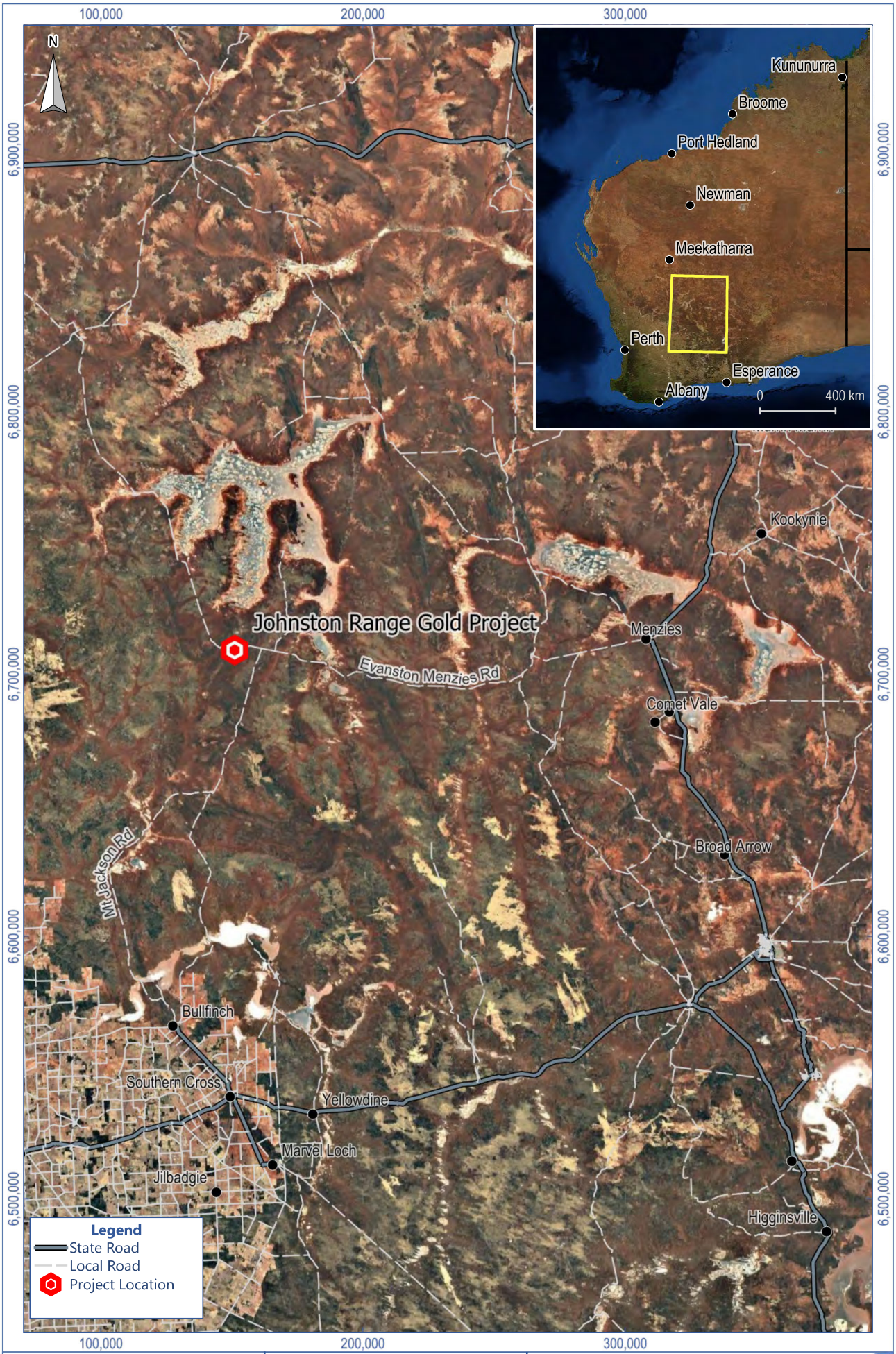
There are no lodged or registered Aboriginal Cultural Heritage sites based on the Department of Planning, Lands and Heritage database (DPLH-099 and DPLH-100).

An Ethnographic and Archaeological survey was conducted for the Gwendolyn East tenements which indicate that no significant Aboriginal sites are likely to be discovered within the project area (Wayne Glendenning Warranip Pty Ltd, 2012a), (Wayne Glendenning Warranip Pty Ltd, 2012b).

2.5 Previous Native Vegetation Clearing Permit

A previous clearing permit (CPS 5541/1) was approved for the Gwendolyn East Cutback Project (G 77/119, L 77/247, L 77/248 and M 77/1263). CPS 5541/2 was granted by the Department of Mines and Petroleum (DMPE) on 6 June 2013 and was extended on 24 July 2014 (CPS 5541/2) for a five-year period. This permit expired on 31 August 2019.

The expired clearing permit authorised clearing of up to 107.17 ha of native vegetation.

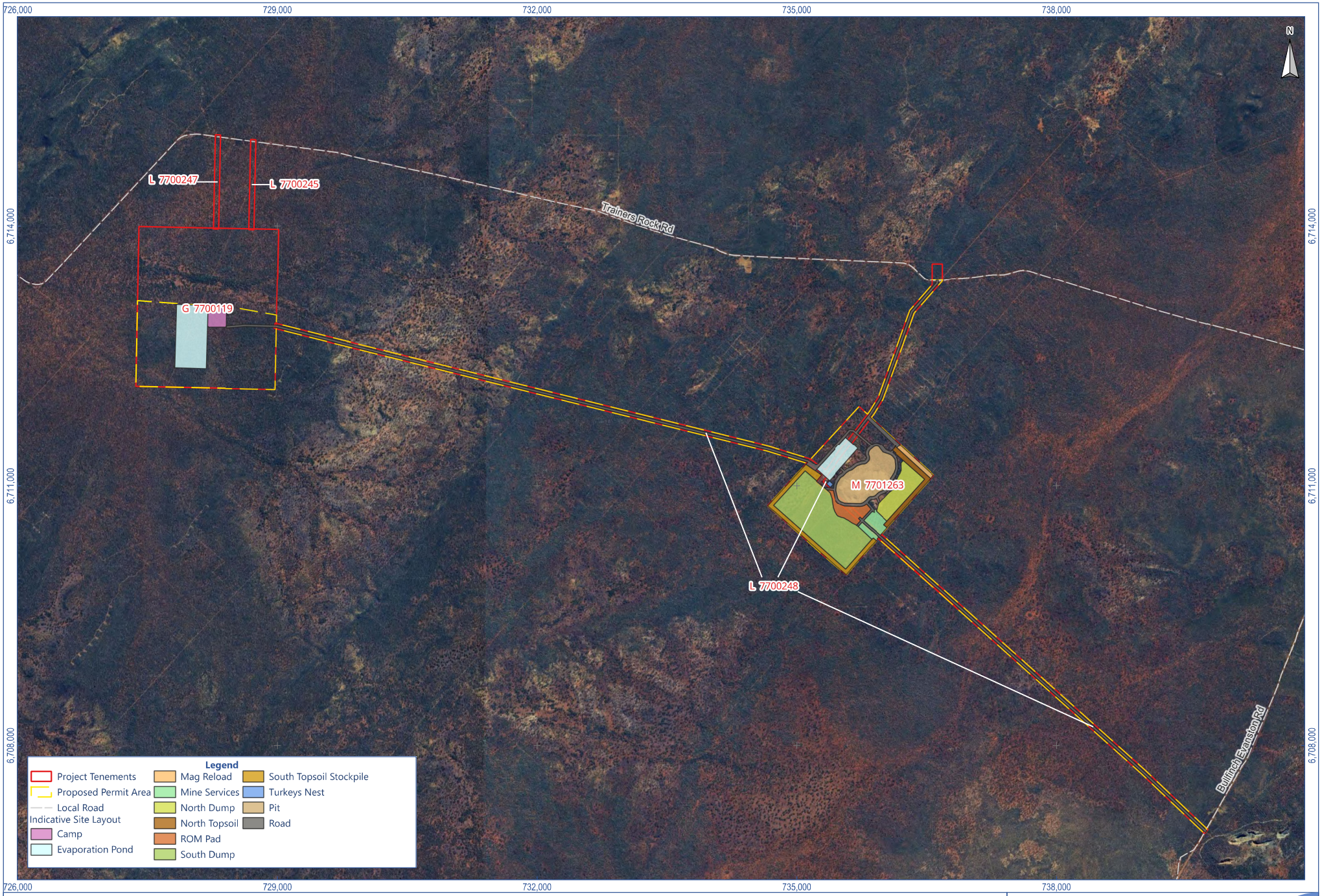


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(EPSG:7851)
0 40 80 km

Forrestania Resources
Johnston Range
Gold Project

Figure 1
Project Location

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Scale: 1: 40,000
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Grid: GDA2020 / MGA zone 50
(EPSG:7850)
0 1 2 km

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Figure 2
Johnston Range Tenement Plan and PPA

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3. Environmental Setting

3.1 Climate

The Project is located within the Northern Goldfields region which experiences a non-seasonal arid climate with hot and dry summers and cool winters. No month in a given year can be considered reliably wet, and zero rainfall can be recorded in any month.

Southern Cross Airport (BoM Station 012320) is the nearest representative Bureau of Meteorology (BoM) weather station, located approximately 114 km southeast of the Project. Mean maximum temperatures range from 16.8°C in July to 34.9°C in January, while mean minimum temperatures range from 3.7°C in July to 18.0°C in January as displayed in Figure 3.

Rainfall averages 302 mm/year with annual rainfall statistics from Southern Cross airport shown in Figure 3. The lowest recorded annual rainfall was 151.4 mm with the highest recorded rainfall at 551.8 mm. The rainfall for all January, March, April, and May has been below average. Rainfall for February 2026 was significantly higher than the average (BoM, 2026).

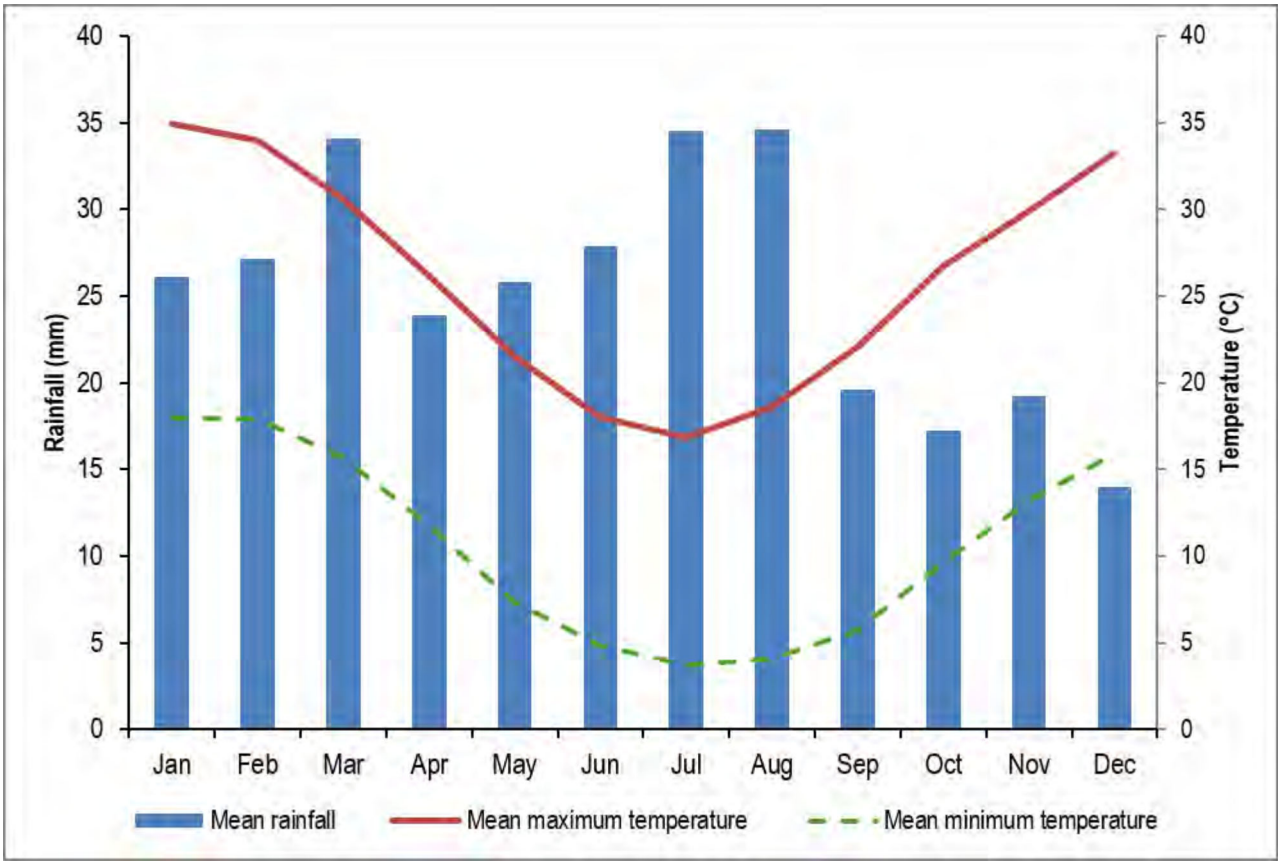


Figure 3: Climatic Conditions

Source: BOM Station 012320

3.2 Soils and Landscape

A desktop review of land systems and soil landscapes was undertaken using publicly available mapping from the Department of Primary Industries and Regional Development (DPIRD, 2022). The Project tenements intersect the following land systems:

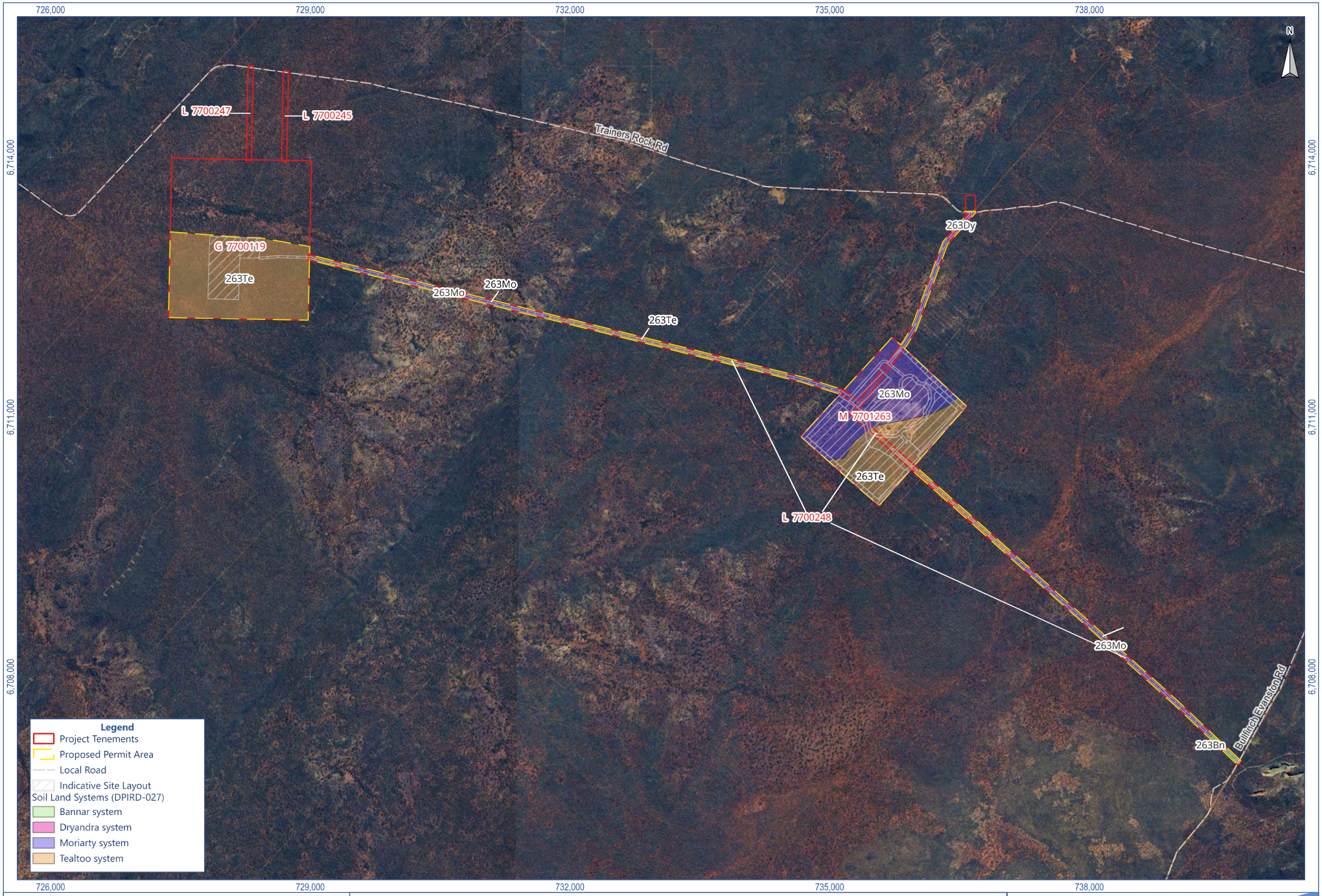
- Tealtoo (263Te), which covers all proposed disturbance on G 77/119, L 77/248, and parts of M 77/1263.
- Moriarty (263Mo), which covers a large portion of the western section of M 77/1263 and sections of the access and transport roads within L 77/248.
- Bannar (263Bn), which covers a small section of the access road on L 77/248 to the southeast.
- Dryandra (263Dy), which covers a small section of the access road on L 77/248 to the north.

The PPA is predominantly situated within the Tealtoo (263Te) and Moriarty (263Mo) land systems. Publicly available mapping indicates that soils within the PPA are predominantly red shallow loams, red loamy earths, red shallow sands, red-brown hardpan shallow loams, calcareous loamy earths, red shallow sandy duplexes and friable non-cracking clays, which are typical of the mapped land systems.

Land system units within the Project area and their characteristics are summarised in Table 2 and displayed in Figure 4.

Table 2: Land Systems Units within the Project Tenements and PPA

Land System	Landforms	Major Soil Types (DAFWA Soil Group)	Infrastructure Within Land System	Mapped Extent (ha)	Area Within PPA (ha)
Bannar (263Bn)	• Gently undulating sandplains, with common areas of plains receiving diffuse run-on. • Breakaways on granite with short moderately inclined footslopes. • Level to gently undulating sandplains consisting of gravelly sand sheets and areas of deep sand. • Minor areas of plain receiving diffuse run-on.	• Red deep sand • Red shallow loam • Red shallow sand • Red loamy earth • Yellow deep sand • Deep sandy gravel • Yellow shallow sand	• Access roads	4,178.8	2.7
Dryandra (263Dy)	• Ridges on banded iron formation. • Moderately inclined to steep slopes and gently inclined lower plain. • Erosional surfaces.	• Stony soil • Red shallow sand • Red shallow loam	• Access roads	785.2	2.8
Moriarty (263Mo)	• Erosional surfaces. • Ferruginous duricrust. • Gently undulating lower plains. • Pebble mantles. • Level to very gently inclined alluvial plains. • Poorly defined, sparse drainage patterns.	• Red shallow loam • Calcareous loamy earth • Red shallow sand • Red shallow sandy duplex • Friable non-cracking clay	• Evaporation pond • Topsoil stockpile • Access roads • Haul roads • ROM pad • Open pit • WRL • Turkeys nest • Magazine	5,555.3	153.1
Tealtoo (263Te)	• Level plains and sandy tracts. • Gravelly mantles. • Alluvial plains. • Level plains. • Infrequent sand sheets. • Level to gently undulating loamy plains. • Fine ironstone gravel mantles.	• Red loamy earth • Red-brown hardpan shallow loam • Red shallow loam • Red shallow sand	• Evaporation pond • Accomodation camp • Topsoil stockpile • Access roads • Haul roads • ROM pad • Open pit • WRL • Laydown • Magazine	22,381.4	256.3



Scale: 1: 40,000
Original Size: A3
Grid: GDA2020 / MGA zone 50
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Forrestania Resources Ltd
Johnston Range Gold Project

Figure 4
Land System Units in the PPA (DPIRD-064)

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W:\Forrestania Resources\GIS\08_JohnsonRange\Jobs\J0004_NVCP\J0004_NVCP_Scoping.qgz 20/07/2026 L4 Land System Units in the PPA (DPIRD-064)

3.3 Environmentally Sensitive Areas and Conservation Reserves

The PPA is not located within an Environmentally Sensitive Area (ESA) or DBCA managed lands.

The nearest conservation areas are the former Mt Elvire Pastoral Lease, proposed for conservation and located approximately 5 km east of the Project, the Mount Manning Range Conservation Park (R48470) and Helena and Aurora Range National Park (R36208), both located approximately 8 km south of the PPA.

There are no wetlands of international importance (Ramsar wetlands) or nationally important wetlands within or in the vicinity of the PPA.

3.4 Surface Water and Groundwater

3.4.1 Groundwater

A Mine Water Balance Study prepared by Aquaterra (2012a) characterises the Project area as being underlain by fractured-rock aquifers comprising greenstone, granitoid and minor intrusive rock units. These aquifers exhibit secondary porosity and permeability, with groundwater storage and flow controlled primarily by the degree of fracturing and weathering.

Historical resource definition drilling identified groundwater at depths of approximately 35 - 40 m below ground level (mbgl), corresponding to around 420 mRL. More significant groundwater inflows were encountered below approximately 65 - 70 mbgl (390 mRL), indicating increased permeability at depth. Sub-artesian to artesian conditions were recorded between approximately 70 and 140 mbgl (390–320 mRL), suggesting the bedrock aquifer is confined below approximately 390 mRL. Bore G207, located northwest of the proposed pit, intersected artesian conditions, with groundwater flowing to the surface for approximately two weeks following drilling.

Groundwater flow across M 77/1263 is generally from the northwest to the southeast. Groundwater in the vicinity of the Project is saline, with electrical conductivity values typically ranging from 28 to 50 mS/cm (approximately 17,900–31,100 mg/L total dissolved solids (TDS)). Test pumping of the Gwendolyn Bore recorded groundwater salinity of approximately 30,000 mg/L TDS. Groundwater is dominated by sodium and chloride ions and is neutral to slightly alkaline.

The Mine Water Balance Study concluded that pit dewatering requirements are expected to exceed the Project's operational water demand, with excess dewatering discharge proposed to be managed via evaporation ponds (Aquaterra, 2012a).

Groundwater inflows to the proposed Gwendolyn open pit were modelled for both low and high permeability scenarios. Under the low permeability case, inflows are predicted to be up to 780 kL/day (9 L/s) to approximately 25 m below ground level, reducing to approximately 520 kL/day (6 L/s) as mining progresses to the final pit depth of approximately 80 m below ground level. Analytical groundwater modelling predicted that, under the low permeability scenario, the maximum extent of groundwater drawdown (defined by the 0.5 m drawdown contour) would extend up to 3.9 km from the open pit.

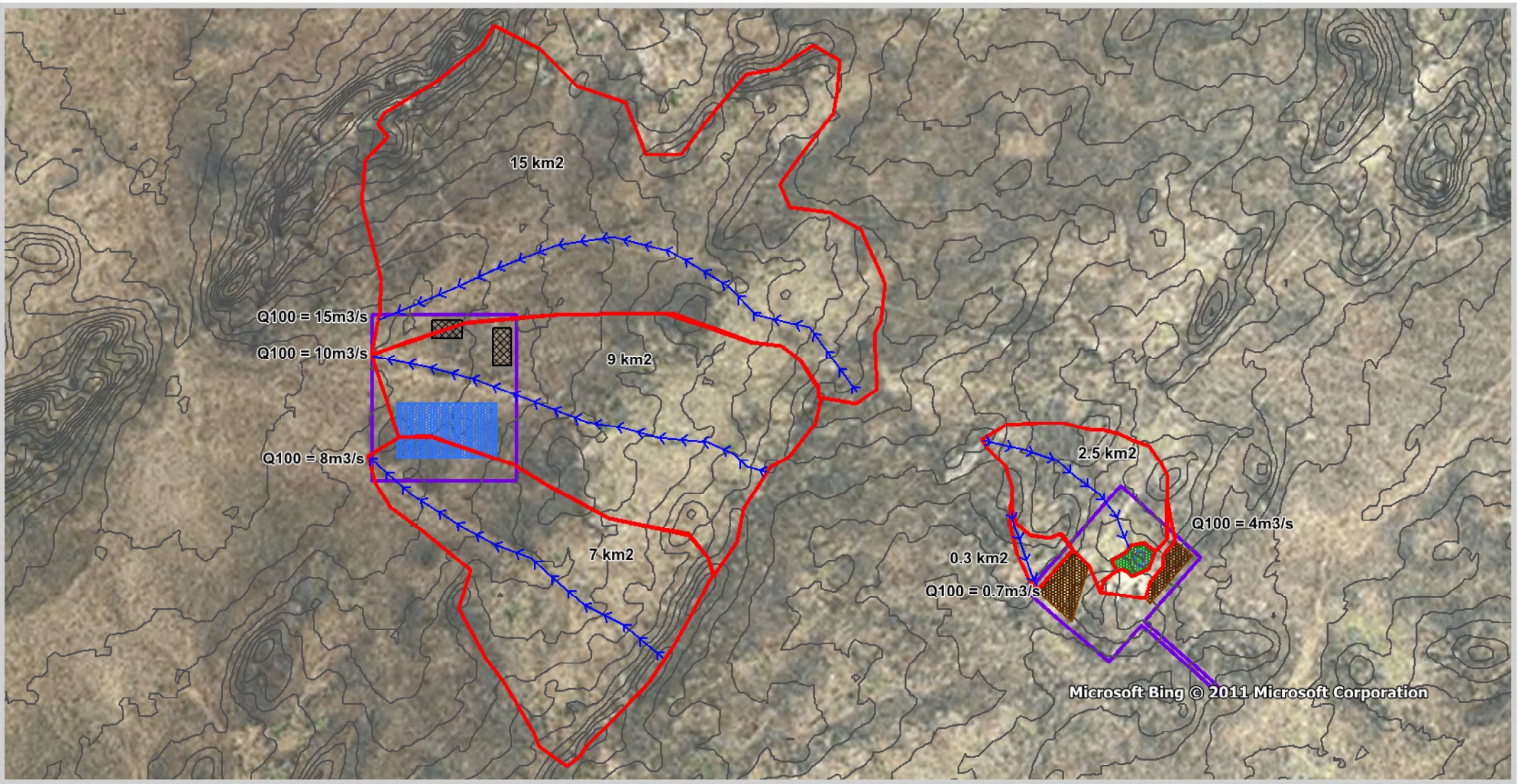
3.4.2 Surface Water

A Surface Water Assessment and Management Plan has been prepared for the Project (Aquaterra, 2012b). The surface water catchments intersected by the Project tenements are displayed in Figure 5. It should be noted that this figure is taken from the 2012 report and the site layout is not current.

The Project is located near a local surface water divide within a small sub-catchment of approximately 2.5 km^2. Consequently, there is limited surface water runoff across the Project area. Surface topography is gently undulating, with drainage generally flowing towards the southeast. Runoff within the Project area originates primarily from low hills to the northwest and follows ephemeral drainage pathways (Aquaterra, 2012b).

A hydrological assessment undertaken by Aquaterra (2012b) identified an ephemeral drainage line traversing the mining lease with a catchment area of approximately 9 km^2. In the absence of stream-flow gauging data, flood estimates were derived using hydrological modelling. The assessment estimated a 1-in-100-year Average Recurrence Interval (ARI) flood flow of approximately 10 m^3/s, with the associated floodplain extending up to 300 m in width. The 1-in-100-year, 24-hour rainfall event was estimated to produce approximately 41 mm of rainfall.

The proposed clearing is not expected to substantially alter regional surface water flow patterns. Any temporary alterations to local drainage associated with mining activities will be managed through the implementation of appropriate surface water management measures, including diversion bunds and drainage channels where required, to maintain the safe conveyance of runoff and minimise erosion.



LOCATION MAP



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GDA 1994 Zone 51

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LEGEND

- Catchment
- Mining Lease
- Camp and Workshop
- Evaporation Pond
- Waste Dump
- Pit
- Catchment Flow Paths
- Contours (5m)

RPS Aquaterra

FIGURE 5

GENERAL LOCATION PLAN AND SURFACE WATER CATCHMENTS

3.5 Flora and Vegetation

3.5.1 Regional Flora and Vegetation Context

The Project is situated predominantly within the Eastern Murchison subregion (MUR01) of the Murchison bioregion, with a small portion of L 77/248 located within the Eastern Goldfields subregion (COO03) of the Coolgardie bioregion. The Project is located near the boundary of these two IBRA subregions and consequently exhibits characteristics of both.

The Eastern Murchison subregion is characterised by an arid climate, broad red-brown plains, red sandplains, breakaway complexes and salt lake systems associated with an occluded palaeodrainage network. Vegetation is dominated by Mulga (*Acacia aneura*) woodlands, hummock grasslands, saltbush shrublands and samphire communities. In contrast, the Eastern Goldfields subregion is characterised by gently undulating plains with Archaean greenstone hills and granitic landforms, supporting mallee communities, Acacia thickets, shrub heaths and diverse Eucalyptus woodlands associated with ranges, valleys and salt lakes.

Owing to the Project's location on the boundary of these subregions, the application area is expected to support vegetation and flora assemblages representative of both the Eastern Murchison and Eastern Goldfields subregions, including Mulga and Eucalypt woodland communities.

A Level 2 (detailed) baseline flora and vegetation survey was completed in 2012 by for tenements M 77/1263, G 77/119, and L 77/248 over an area of 583 ha (Niche Environmental Services, 2012, Appendix B).

An updated flora and vegetation survey has been commissioned and is scheduled to be undertaken in late July/early August 2026 to verify the previously reported flora and vegetation values in the project area.

3.5.2 Pre European Vegetation Communities

The pre-European vegetation spatial mapping dataset identified two vegetation associations as occurring within the Purpose Permit Area (DPIRD, 2023). Proposed infrastructure for mining is located in the Barlee and Jackson vegetation associations. The association description and remaining extent are provided in Table 3. Areas retaining less than 30% of their pre-European vegetation extent generally experience exponentially accelerated species loss, while areas with less than 10% are considered 'endangered' (EPA, 2008). Barlee and Jackson associations retain greater than 99% of their pre-European extent, and development of the Project will not significantly reduce this vegetation community.

Table 3: Pre-European Vegetation Associations Within the PPA

Vegetation Association	Description	Pre-European Extent Remaining (%)
Barlee	Scrub, open scrub, or sparce scrub.	99.57%
Jackson	Thicket, Scrub with open woodland or scattered trees.	99.94%

3.5.3 Vegetation Communities

Niche Environmental conducted a vegetation community assessment for the Project in 2012. A total of 26 vegetation communities were identified, grouped into seven broad vegetation types: Plains, Sandplains, Floodplains, Ephemeral Drainage Lines, Banded Ironstone Formation and Concretionary Weathered Ironstone, Basalt Hills, and Greenstone Hills.

The Plains Vegetation community represented the dominant community within the study area, covering 400 ha of the total mapped spatial extent. The vegetation units described by Niche Environmental are not considered to represent a unique assemblage of species and are widespread in the local region.

Vegetation communities within the PPA are summarised in Table 4 and displayed in Figure 6.

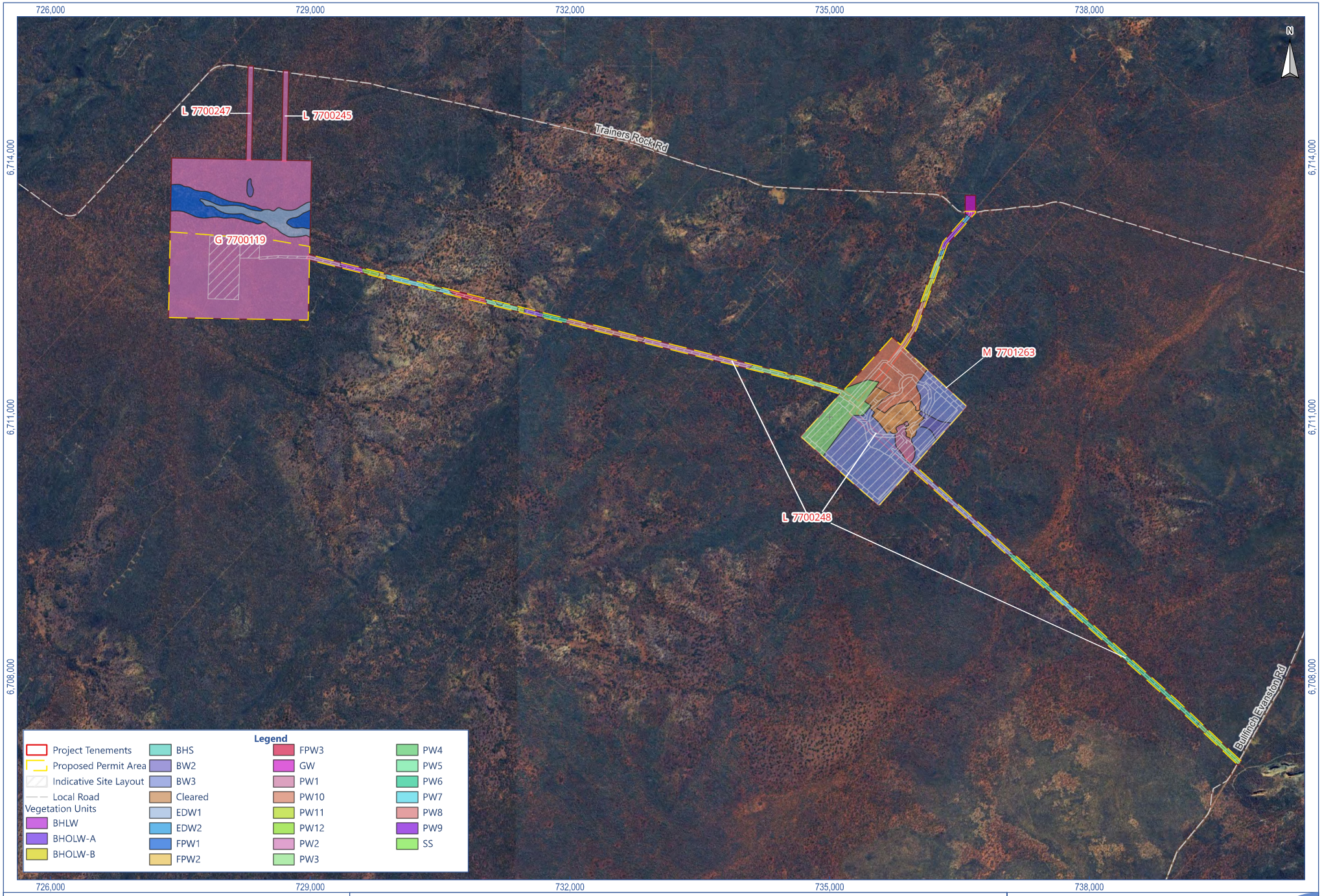
No Threatened of Priority Ecological Communities (TECs/PECs) occur within the project area. The closest TEC is located approximately 180 km north of the Project. The closest PEC is the Priority 1 Johnston Range Banded Iron Formation, located approximately 1 km northwest of the PPA.

Table 4: Mapped Vegetation Communities Within the Project Area

Vegetation Group (Landform)	Vegetation Community Code	Description	Condition	Mapped Extent (ha)	Area in PPA (ha)
Basalt Hills	BHLW	Low Woodland B Acacia species and Allocasuarina dielsiana over Open Low Scrub A of *Dodonaea rigida, Protstanthera alotherferi* subsp. *althoferi* and *Acacia caesanaeura* on red clay with scattered basalt stones and outcropping	Very Good	1.56	1.56
	BHOLW-A	Open Low Woodland A of *Casuarina pauper* over Open Low Scrub B of *Scaevola spinescens, Eremophila decipiens* subsp. *decipiens* and *E. scoparia* on red clay on low hill of basalt	Good to Degraded	1.26	1.26
	BHOLW-B	Open Low Woodland B of *Acacia cockertoniana, A. caesaneura* and *A. aneura* over Low Scrub B of *Baeckea aff. elderiana* on red clay on weathered basalt and ironstone.	Good to Very Good	0.20	0.2
	BHS	Scrub of *Dodonaea lobulata* and *Acacia acuminata* on light red clay on low hill of basalt.	Good to Very Good	0.31	0.31
Banded Ironstone	BW2	Low Woodland B of *Acacia species* and *Grevillea nematophylla* var. *nematophylla*. The vegetation in this unit was characterised by an upper storey to 4 m comprised of Acacia ramulosa var. ramulosa, A. acuminata and A. tetragonophylla with Grevillea nematophylla var. nematophylla recorded as a co-dominant species. Other species recorded in this unit included Hakea recurva, Psydrax linearis, Eremophila latrobei and Westringia rigida.	Good to Very Good	6.36	5.2
	BW3	Open Low Woodland A of *Eucalyptus* species over Low Woodland B of *Acacia ramulosa* var. *ramulosa, A. aneura* and *A. caesaneura* over Open Low Scrub B of *Philotheca brucei* subsp. *brucei, Dodonaea rigida* and *Eremophila decipiens* subsp. *decipiens* on red flat plain to very gently sloping low hills of red clay with ironstone, quartz and basalt gravel and very occasional minor outcroppings of basalt and ironstone.	Good to Degraded	96.17	96.17
Ephemeral Drainage Line	EDW1	Open Low Woodland A of *Eucalyptus loxophleba* and *E. kochii* over Open Low Woodland B of *Acacia ramulosa var. ramulosa, A. aneura* and *A. acuminata* on red clay with sections of exposed, laterised hardcap and calcrete	Very Good	17.47	0
	EDW2	Low Woodland B of *Acacia* species on red clay with exposed hardcap of concretionary laterised ironstone.	Good to Degraded	0.99	0.99

Vegetation Group (Landform)	Vegetation Community Code	Description	Condition	Mapped Extent (ha)	Area in PPA (ha)
Floodplains	FPW1	Low Woodland of *Acacia aneura*, *A. ramulosa* var. *ramulosa* and *A. acuminata* with occasional emergent *Eucalyptus loxophleba* on red clay.	Good	24.26	0
	FPW2	Open Woodland of *Eucalyptus griffithsii* over Open Low Woodland B of *Acacia* species and *Eremophila scoparia* on red clay with occasional sections of exposed hardcap of weather basalt.	Good	0.49	0.48
	FPW3	Open Woodland of *Eucalyptus kochii* and *E. loxophleba* over Open Low Woodland B of *Acacia acuminata* and *Eremophila oppositifolia* subsp. *angustifolia* on red clay with occasional scattered outcropping of weathered basalt.	Good	2.47	2.47
Greenstone Hills	GW	Low Woodland B of *Acacia* species and *Eremophila oldfieldii* subsp. *angustifolia* on red clay on low greenstone hill.	Good to Degraded	2.76	0.60
Plains	PW1	Low Woodland B of *Acacia cockertoniana, A, burkittii* and *Eremophila oldfieldii* with an emergent canopy of *Allocasuarina acutivalvis* subsp. *acutivalvis* over Low Scrub B of *Philotheca brucei* subsp. *brucei, Dodonaea rigida* and *Leucopogon* sp. Clyde Hill (M.A. Burgman 1207) over Open Dwarf Scrub D of *Prostanthera althoferi* subsp. *althoferi* and *Dianella revoluta* var. *divaricata* over Very Open Low Grasses of *Monachather paradoxus* and *Amphipogon caricinus* var. *caricinus* on red clay on low ridge of basalt with ironstone intrusions.	Good	6.43	6.43
	PW2	Low Woodland B of *Acacia ramulosa* var. *ramulosa, A. aneura* and *A. caesaneura* on red clay.	Good to Degraded	277.68	161.85
	PW3	Woodland of *Eucalyptus salubris* and *E. clelandii* over Open Low Scrub B of *Atriplex nummularia, Eremophila pantonii* and *Senna artemisioides* subsp. x *artemisioides* over Open Dwarf Scrub D of chenopods on plains with red clay and scattered gravel of ironstone and quartz.	Good to Degraded	37.74	37.74
	PW4	Open Low Woodland A of *Callitris columellaris* over Open Low Woodland B of *Acacia ramulosa* var. *ramulosa, A. acuminata* and *Grevillea obliqiostigma* subsp. *obliquistigma* on red clay.	Good to Degraded	0.73	0.73
	PW5	Open Low Woodland A of *Eucalyptus clelandii* over Open Dwarf Scrub C of *Atriplex nummularia* on red clay with scattered pebbles and stones of basalt.	Good to Very Good	2.80	2.8
	PW6	Open Low Woodland A of *Eucalyptus griffithsii* and *Casuarina pauper* over Low Woodland B of *Acacia* species on red clay with scattered ironstone and basalt pebbles.	Good to Degraded	16.97	16.96

Vegetation Group (Landform)	Vegetation Community Code	Description	Condition	Mapped Extent (ha)	Area in PPA (ha)
	PW7	Open Low Woodland A of *Eucalyptus griffithsii* over Open Low Scrub A of *Eremophila scoparia* and *Atriplex nummularia* on red clay with very scattered ironstone and basalt pebbles.	Good to Degraded	6.17	6.17
	PW8	Open Low Woodland A of Eucalyptus kochii and Casuarina pauper over Low Woodland B of Acacia species on red clay with scattered ironstone pebbles and stones.	Good to Very Good	5.46	5.46
	PW9	Open Low Woodland A of Eucalyptus kochii over Low Woodland B of Acacia species on red clay with ironstone pebbles.	Good to Degraded	2.35	2.35
	PW10	Low Woodland A of *Eucalyptus* species over Low Woodland B of *Acacia ramulosa* tvar. *ramulosa, A. aneura* and *A. caesaneura* over red clay with scattered gravel of ironstone and quartz.	Good to Degraded	40.50	40.5
	PW11	Open Low Woodland of *Eucalyptus salubris* over Open Scrub B of *Eremophila scoparia, Exocarpos aphyllus* and mixed species on red clay with ironstone and quartz pebbles and stones.	Good to Degraded	2.22	2.21
	PW12	Open Woodland of *Eucalyptus oleosa* over Low Woodland B of *Acacia ramulosa* var. *ramulosa, A. aneura* and *A. acuminata* on red clay with basalt and ironstone pebbles.	Good	1.16	1.16
Sandplains	SS	Sandplain Scrub of *Acacia ramulosa* var. *ramulosa, A. aneura* and *Grevillea obliquistigma* subsp. *obliquistigma* Parker Range form on shallow light orange sandy loam over concretionary gravel.	Very Good	3.20	3.2
Cleared	Cleared	Land cleared of native vegetation.		17.96	17.96
		Total		**575.67**	**414.76**



Scale: 1: 40,000
Original Size: A3
Grid: GDA2020 / MGA zone 50
(EPSG:7850)
0 1 2 km

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Figure 6
Mapped Vegetation Communities Within the PPA (Niche Environmental Services, 2012)

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W:\Forrestania Resources\GIS\08_JohnsonRange\Jobs\J0004_NVCP\J0004_NVCP_Scoping.qgz 20/07/2026 L5 Mapped Vegetation Communities Within the PPA (Niche Environmental Services, 2012)

3.5.4 Groundwater Dependant Ecosystems

Groundwater Dependent Ecosystems (GDEs) include biological assemblages of species such as wetlands or woodlands that use groundwater either opportunistically or as their primary water source.

The BoM Atlas of GDE database does not identify any aquatic GDEs with the project area (BoM, 2026). However, there are six potential terrestrial GDEs within the project area including three with low potential and three with moderate potential in regard to supporting GDEs.

The groundwater aquifer beneath the Project is approximately 70 m thick and is confined below 390 mRL. Development of the open pit will require groundwater dewatering. Aquaterra (2012a) assessed the mine water balance, predicted groundwater inflows and dewatering requirements, and modelled the extent of groundwater drawdown. Groundwater inflows during Stage 3 mining are estimated to range from approximately 520 kL/day to 1,300 kL/day, with groundwater drawdown predicted to extend between approximately 2 km and 4 km from the open pit.

Groundwater within the regional aquifer is saline, with a TDS concentration of approximately 30,000 mg/L which substantially reduces the likelihood that vegetation within the Project area is reliant on groundwater from the regional aquifer.

3.5.5 Significant Flora

No Threatened flora listed under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) or the Biodiversity Conservation Act 2016 (BC Act) were identified during the 2012 baseline flora survey undertaken by Niche Environmental Services.

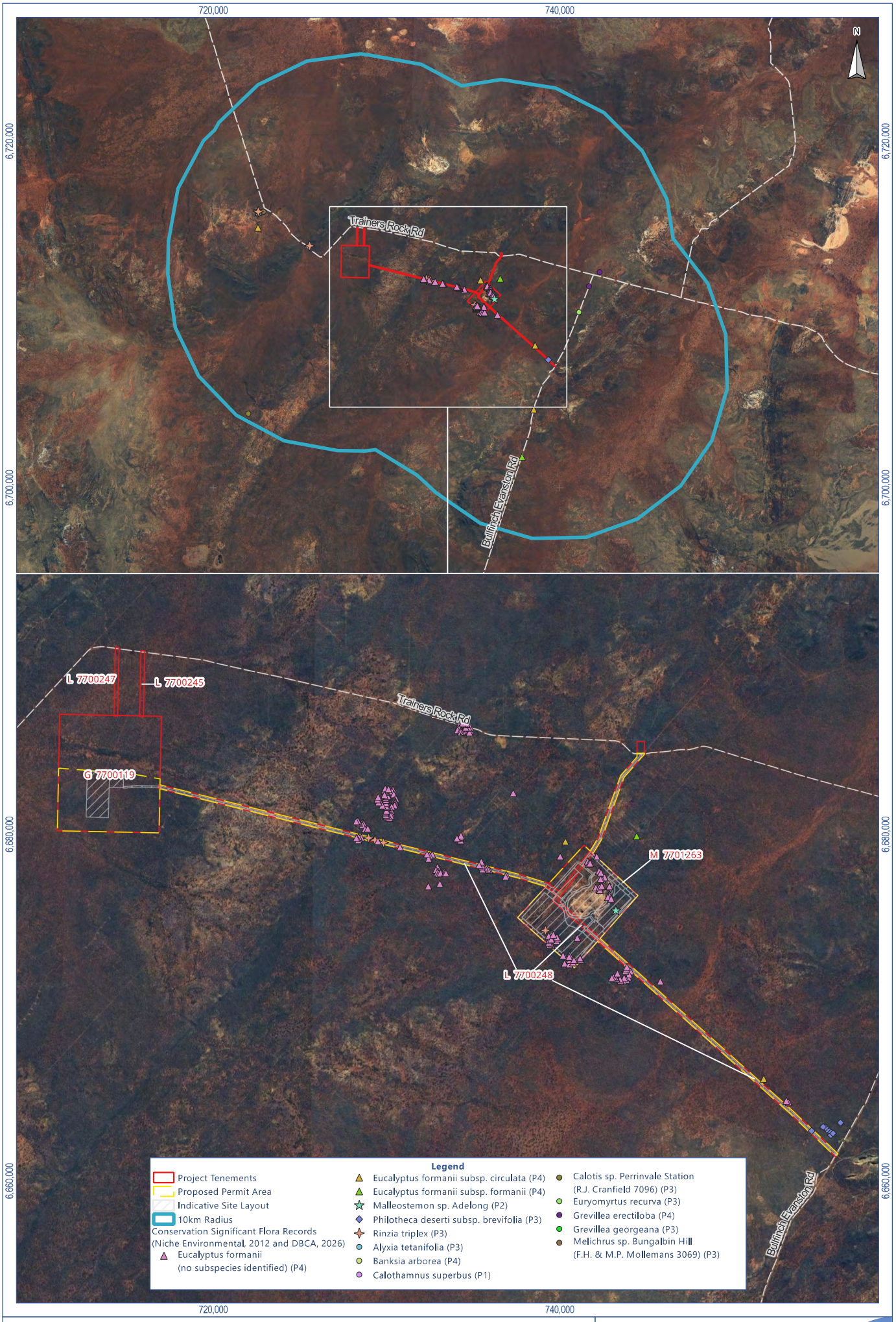
To supplement the baseline assessment, a paid DBCA Threatened and Priority Flora database search was completed in June 2026. The search identified 13 Priority flora species within a 10 km radius of the Project, comprising one Priority 2 species, two Priority 3 species and ten Priority 4 species. No Threatened flora listed under the EPBC Act or BC Act were identified, and no records of Threatened or Priority flora were located within the proposed PPA.

A likelihood of occurrence assessment was undertaken for all conservation significant flora species identified within the desktop search area, considering species distribution, habitat preferences and the presence of suitable habitat within the Project. Habitat descriptions and distribution information were sourced from the Atlas of Living Australia (ALA) and FloraBase. The results of the assessment are summarised in Table 5.

The locations of conservation significant flora records identified from the June 2026 DBCA database search and the 2012 Niche Environmental Services survey are shown in Figure 7.

Table 5: Likelihood of Occurrence Assessment of Conservation Significant Flora Within 10 km of the Project

Species	BC Act	Habitat Description	Likelihood of Occurrence
Alyxia tetanifolia	P3	Sand over hardpan. Sandy clay, loam, concretionary gravel and located in drainage lines near lakes.	Unlikely. Not recorded in 2012 assessment. Closest DBCA occurrence is 5.2 km west.
Banksia arborea	P4	Grows among ironstone rocks in open shrubland hills and stony loam.	Unlikely. Not recorded in 2012 assessment. Closest DBCA occurrence is 4.9 km northwest.
Calothamnus superbus	P1	Grows in yellow/brown sand with pebbles located on sandplains.	Unlikely. Not recorded in 2012 assessment. Closest occurrence is 4.9 km east.
Calotis sp. Perrinvale Station (R.J. Cranfield 7096)	P3	Loamy clay plain associated with Eucalyptus salubris (Gimlet) woodland.	Unlikely. Not recorded in 2012 assessment. Closest occurrence is 9.5 km southwest.
Eucalyptus formanii subsp. circulata	P4	Habitat located on dry shrubland and ironstone slopes.	*Eucalyptus formani* recorded in 2012 assessment prior to delineation onto 2 subspecies. DBCA record occurring 250 m from tenement boundary.
Eucalyptus formanii C.A. Gardner	P4	Grows in lateritic or rocky sand, in low woodland and scrubland. Grows on level terrain in orange to red sandy loam, or on stony hillslopes and ridges, in open mallee shrubland or mixed mallee woodland.	Recorded within Project area.
Euryomyrtus recurva	P3	Catchment slopes and gravel pits in sandy clay. Also occurs often in yellow sand or in red sand; also recorded on a breakaway.	Unlikely. Not recorded in 2012 assessment. Closest DBCA occurrence is 3.5 km Northeast.
Grevillea erectiloba	P4	Grows in semi-arid tall shrubland in gravelly loam soil on lateritic rises.	Unlikely. Not recorded in 2012 assessment. Closest DBCA occurrence is 5 km east.
Grevillea georgeana	P3	Grows in open shrub associations in well-drained situations in shallow stony soils on ironstone.	Unlikely. Not recorded in 2012 assessment. Closest DBCA occurrence is 5.2 km west.
Malleostemon sp. Adelong (G.J. Keighery 11825)	P2	Grows in sandplain, mallee shrubland and red sand.	Recorded within project area.
Philotheca deserti subsp. *brevifolia* Paul G. Wilson	P3	Grows in red sandy clay.	Recorded within project area.
Melichrus sp. Bungalbin Hill (F.H. & M.P. Mollemans 3069)	P3	Grows in sandplain among clayey sand and open scrub.	Unlikely. Not recorded in 2012 assessment. Closest DBCA occurrence is 5.3 km west.
Rinzia triplex	P3	Grows in sand or sandy loam, often with lateritic gravel, on plains, hillslopes and banded ironstone outcrops. Favours shrubland or woodland dominated by *Acacia*, *Eucalyptus* or *Allocasuarina*, often growing with *Baeckea elderiana*.	Recorded within project area.



Scale: 1: 55,000
Original Size: A3
Grid: GDA2020 / MGA zone 50
(EPSG:7850)

0 4,000 8,000 m

Figure 7
Conservation Significant Flora Records Within 10 km of the Project

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3.5.6 Weeds

Seven non-native weed species were recorded during the 2012 survey. The weed species recorded in the survey were included in the DBCA Weed Assessment for the Goldfields region. The species recorded in the survey area were:

- *Brassica tournefortii.*
- *Carrichtera annua.*
- *Centaurea melitensis.*
- *Cucumis myriocarpus.*
- *Solanum hoplopetalum.*
- *Sisymbrium orientale.*
- *Salvia verbenaca.*

In addition to the non-native weed species, there was one native weed species recorded in the Project area, *Solanum hoplopetalum.* This is known to occur in the region, but it has the potential to be a weed in disturbed areas.

3.6 Terrestrial Fauna

3.6.1 Fauna Habitat

A Level 1 Fauna Investigation was conducted for the Project in 2012 by Bamford Consulting Ecologists (Appendix C). The assessment identified 10 major Vegetation Substrate Associations (VSAs), broadly representing habitat types which are displayed in Table 6. Areas of previous clearing and disturbance are also present, particularly within M 77/1263, where historical mining and exploration activities have occurred.

Bamford stated that:

- Most VSAs are regionally widespread and well represented. However, Acacia shrublands on ironstone ridges and pockets of eucalypt woodland, which represent the northern extent of the Great Western Woodlands, are more restricted in distribution.
- Biodiversity values are likely distributed across the VSAs and the broader landscape. However, the eucalypt woodlands are considered to have relatively higher ecological significance, as they support a number of conservation significant fauna species and declining woodland birds. Historical clearing and disturbance within these woodlands have reduced the availability of large, mature eucalypt trees. The remaining mature trees often contain hollows, which provide important roosting and breeding habitat for conservation significant birds and bats.

An updated fauna survey has been commissioned for July/August 2026 to verify the 2012 findings for fauna values in the project area.

Table 6: Fauna Habitats (VSAs) Within the Project (ha)

Fauna Habitat Code	Habitat Type	Corresponding Vegetation Unit	Description	Mapped Extent	Extent in PPA	Extent in Clearing Area
VSA01	Acacia shrublands	BW2, PW2, SS	Dominated by *Acacia ramulosa* and *A. aneura* with some scattered *Casuarina pauper* on Ironstone Ridges.	287.23	170.25	42.55
VSA02	Mixed Acacia shrublands	BW3, PW1, PW10, BHLW, BHOLW-B	Including *Acacia aneura, Acacia ramulosa, Acacia cockertoniana, A. burkittii, A.caesaneura, A. burkittii* and *A. tetragonophylla* with scattered Eucalypts on gravelly ironstone slopes and rises.	144.86	144.86	113.05
VSA03	Mixed Eucalypt Woodlands	PW3	Dominated by *Eucalyptus salubris* and *E. clelandii* over *Atriplex nummularia, Eremophila pantonii* and *Senna artemisioides* on plains with red clay and scattered gravel of ironstone and quartz.	37.74	37.74	29.91
VSA04	Low Woodland	FPW3, PW9, PW12	Dominated by *E. loxophleba* and *E. formanii* with scattered *Callitris columellaris* over *Acacia ramulosa, A. aneura* and *A. caesaneura* over red sandy clay loam with scattered gravel of ironstone and quartz.	5.98	5.98	2.53
VSA05	Mixed shrublands	BHOLW-A, BHS	Containing *Acacia aneura* and *Acacia ramulosa* on clay flat.	1.57	1.57	0.70
VSA06	Minor drainage lines	EDW1, EDW2, FPW1	Supporting dense *Acacia aneura* shrublands with *A. burkittii* and scattered Eucalypts.	42.72	0.99	0.41
VSA07	*Eucalyptus clelandii* woodlands	PW5, GW	Supporting chenopod shrublands on low greenstone rises and stony plains.	5.56	3.40	1.35
VSA08	*Eucalyptus salubris* woodlands	FPW2, PW6, PW7, PW8, PW11	On loam flats and drainage valleys.	31.30	31.28	12.93
VSA09	Dense *Acacia ramulosa* shrubland	PW4	With scattered Mallee, *Callitris columellaris* and Grevillea sp. on level to gently undulating sandy / gravelly plains.	0.73	0.73	0.30
			Total Vegetation	**557.71**	**234.92**	**203.73**
VSA10	Cleared/previously disturbed land	Cleared or previously disturbed land	Cleared or previously disturbed land.	17.96	17.96	15.53
			Grand Total	**575.67**	**252.88**	**219.26**

3.6.2 Significant Fauna

The Level 1 Fauna Investigation comprised of a desktop assessment and fauna reconnaissance survey (Appendix C). The field survey was undertaken in September 2012. A total of 83 fauna species were recorded during the survey, comprising 11 reptile, 60 bird, 7 native mammal and 5 introduced mammal species.

Targeted surveys were undertaken for conservation significant fauna and associated habitat features, including Malleefowl (*Leipoa ocellata*) through searches for distinctive mounds and tracks, Tree-stem Trapdoor Spider (*Aganippe castellum*) through searches for characteristic burrows, and the ant *Camponotus terebrans* due to its association with habitat features that may support the conservation significant Arid Bronze Azure Butterfly (*Ogyris subterrestris petrina*).

Bamford recorded two conservation significant fauna species within the project area that remain listed under current conservation frameworks:

- Malleefowl (*Leipoa ocellata*) – Vulnerable under the EPBC Act and Vulnerable under the BC Act.
- Tree-stem Trapdoor Spider (*Aganippe castellum*) – Priority 4 under the DBCA Priority Fauna List.

In 2012, nine Malleefowl mounds were recorded within dense Acacia shrublands and fresh tracks were recorded near the proposed camp. Of the mounds recorded, one was active, one mound had been recently excavated and seven were considered inactive without any evidence of recent use.

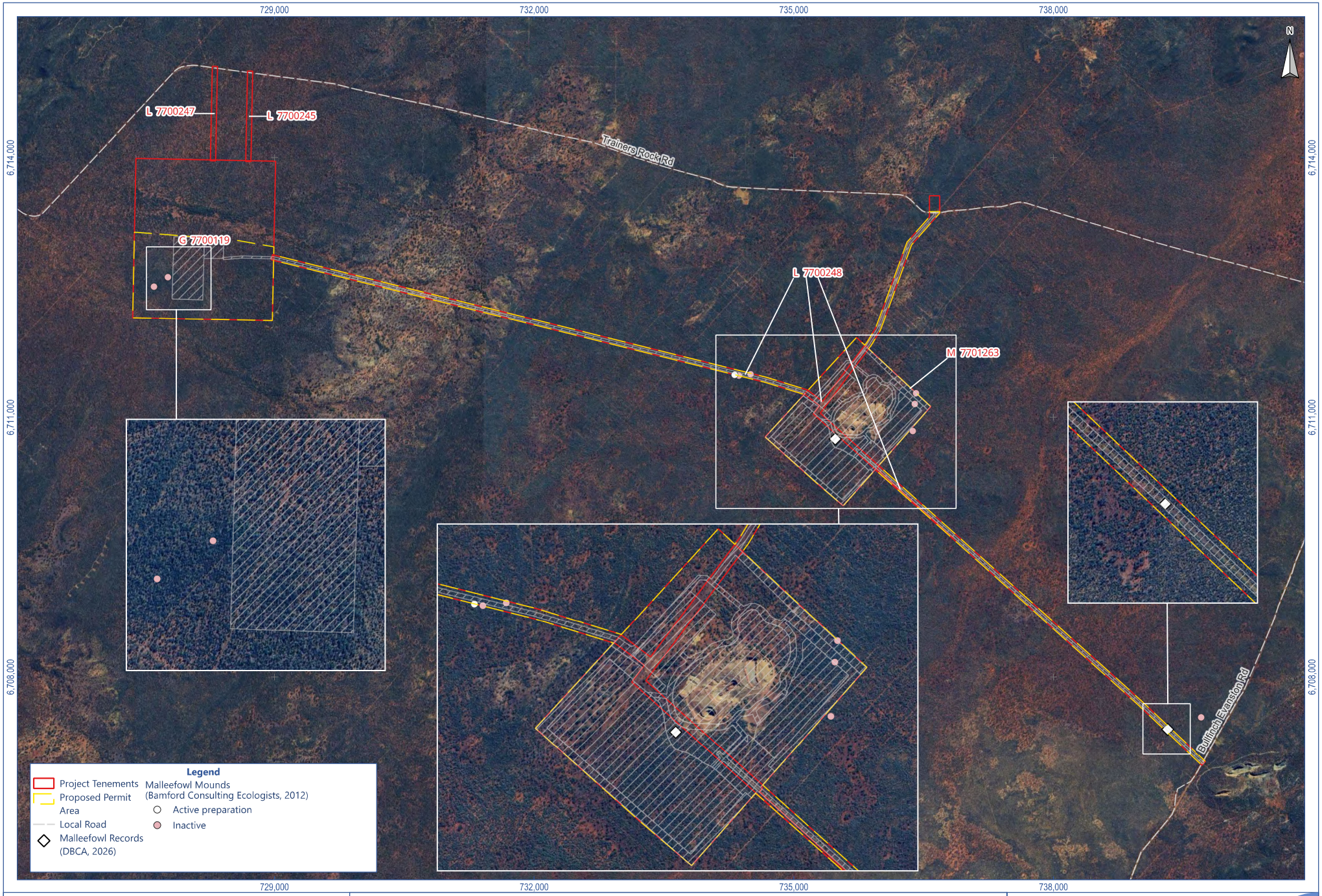
The desktop assessment undertaken by Bamford Consulting Ecologists (2012) also identified a further six conservation significant fauna species with potential to occur within the project area. The likelihood of occurrence assessment for these species is summarised in Table 7.

A paid DBCA Threatened and Priority Fauna database search was undertaken in June 2026 to support this assessment and identify conservation significant fauna records within a 10 km radius of the project area. The search identified two conservation significant fauna species, Malleefowl (*Leipoa ocellata*) and Tree-stem Trapdoor Spider (*Aganippe castellum*), both of which had previously been recorded by Bamford Consulting Ecologists (2012). No additional conservation significant fauna species were identified.

The DBCA database search identified two more recent records of Malleefowl (*Leipoa ocellata*) within the Project tenements, indicating that the species continues to occur in the vicinity of the Project area following the original 2012 survey.

Table 7: Conservation Significant Fauna Potentially Occurring in Project Area

Common Name	Species Name	EPBC Act	BC Act	Habitat Type	Habitat in Survey Area	Expected Status in Survey Area	Recorded in Survey Area
Carpet Python	*Morelia spilota imbricata*	-	P3	Eucalypt woodland	Yes	Potential Resident	–
Western Spiny-Tailed Skink	*Egernia stokesii badia*	EN	VU	Eucalypt woodland	Yes	Unlikely to occur	–
Malleefowl	*Leipoa ocellata*	VU	VU	Acacia shrublands, dense woodlands	Yes	Visitor / Resident	Recorded
Peregrine Falcon	*Falco peregrinus*	-	OS	Rocky ridges, major drainage lines, woodland	Yes	Visitor / Resident	–
Major Mitchell's Cockatoo	*Lophochroa leadbeateri*	EN	-	Eucalypt woodland	Yes	Visitor / Resident	–
Western Rosella	*Platycercus icterotis xanthogenys*	-	P4	Eucalypt and sheoak woodlands	Yes	Unlikely Visitor	–
Rainbow Bee-Eater	*Merops ornatus*	MI	-	Watercourses, woodland	Yes	Regular Migrant	–
Fork-tailed Swift	*Apus pacificus*	MI	-	Aerial	Yes	Irregular Visitor	–
Chuditch	*Dasyurus geoffroyii*	VU	VU	Woodland, forest, mallee	Yes	Locally extinct	–
Tree-Stem Trapdoor Spider	*Aganippe castellum*	-	P4	Ironstone ridges, slopes, stony plains	Yes	Resident	Recorded
Arid Bronze Azure	*Ogyris subterrestris petrina*	CR	CR	Eucalypt woodland, smooth-barked eucalypts	Yes	Potential Resident	–
Inland Hairstreak Butterfly	*Jalmenus aridus*	-	P2	*Acacia tetragonophylla* and *Senna nemophila*	Yes	Unlikely to occur	–



Scale: 1: 40,000
Original Size: A3
Grid: GDA2020 / MGA zone 50 (EPSG:7850)
0 1 2 km

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Johnston Range Gold Project

Figure 8

Conservation Significant Fauna Within the PPA

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4. Proposed Land Clearing

The Project will require clearing of 219.3 ha of native vegetation within a PPA of 414.8 ha.

Clearing is anticipated to commence in Q4 2026 to facilitate construction of proposed infrastructure.

A shapefile is provided for the PPA.

5. Assessment of Clearing Principals

5.1 Native Vegetation Clearing Principals

Clearing applications are assessed against the 10 principles outlined in Schedule 5 of the *Environmental Protection Act 1986*. These principles aim to ensure that all potential impacts resulting from removal of native vegetation are assessed in an integrated method and consistently applied to all lands throughout Western Australia. The principles address the four environmental areas of biodiversity significance, land degradation, conservation estate and ground and surface water quality.

The following sections discuss the potential impacts associated with clearing for the Project. A summary of the outcomes of the assessment against the 10 Clearing Principles is provided in Table 8.

Table 8: Summary of Clearing Assessment Against Clearing Principles

Principle Number	Clearing Principle	Outcome
A	Native vegetation should not be cleared if it comprises a high level of biological diversity.	Unlikely to be at variance
B	Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.	Not at variance
C	Native vegetation should not be cleared if it includes or is necessary for the continued existence of threatened flora.	Not at variance
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.	Not at variance
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.	Not at variance
F	Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.	Unlikely to be at variance
G	Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.	Unlikely to be at variance
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 areas.	Not at variance
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.	Unlikely to be at variance
J	Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence of flooding.	Unlikely to be at variance

5.2 Biodiversity

Clearing Principal A: Native vegetation should not be cleared if it comprises a high level of biological diversity.

5.2.1 Potential Impacts

Impacts to the biological diversity of native vegetation associated with the proposed clearing are expected to be limited to the localised loss of native vegetation and associated habitat within the PPA, together with the potential spread of existing weed species and introduction of new weed species through construction and earthworks activities.

Two pre-European vegetation communities occur within the PPA, the Barlee and Jackson vegetation associations with both remaining over 99% of their total pre-European vegetative extent.

The vegetation observed during the surveys was not considered to be one of the PECs recorded in the region, nor were any of the units considered to represent a unique assemblage of species.

A total of 26 vegetation units within seven broad landforms were described within the larger Project area (Niche Environmental Services, 2012). Potential impacts to vegetation communities within the proposed disturbance area are detailed in Table 9. From this it can be seen that clearing is proposed in 24 of the 26 vegetation communities. The majority of clearing is within vegetation unit BW3 (Banded Ironstone Formation supporting Low Open Woodland), where clearing of 87.3 ha (91% of the mapped area of the community) is proposed. This accounts for 39.8% of the proposed clearing.

The majority of the vegetation was widespread in the local area and the region. In addition to being comparatively widespread vegetation units, none of the vegetation within the project was identified as being in a condition that was better than the surrounding landscape. The assessment of the vegetation was that in many instances, it was in poorer condition relative to the surrounding landscape, largely as a consequence of historic disturbances associated with mining, exploration and pastoral activities. Based on an assessment of these factors, none of the vegetation in the project area was considered to have conservation value (Niche Environmental Services, 2012).

Indirect impacts to surrounding native vegetation and flora may include dust generation, particulate deposition and the spread of weeds via vehicles, machinery and earthmoving equipment. These impacts have the potential to affect the health and condition of adjacent vegetation if not appropriately managed.

Table 9: Potential Impacts to Vegetation Communities (ha)

Vegetation Community	Description	Total Mapped Area	Area in PPA	Clearing Footprint Area	Mapped Area Impacted (%)
Basalt Hills					
BHLW	Low Woodland B Acacia species and Allocasuarina dielsiana over Open Low Scrub A of *Dodonaea rigida, Protstanthera alotherferi* subsp. *althoferi* and *Acacia caesanaeura* on red clay with scattered basalt stones and outcropping	1.56	1.56	0.65	42%
BHOLW-A	Open Low Woodland A of *Casuarina pauper* over Open Low Scrub B of *Scaevola spinescens*, *Eremophila decipiens* subsp. *decipiens* and *E. scoparia* on red clay on low hill of basalt	1.26	1.26	0.56	44%
BHOLW-B	Open Low Woodland B of *Acacia cockertoniana, A. caesaneura* and *A. aneura* over Low Scrub B of *Baeckea aff. elderiana* on red clay on weathered basalt and ironstone.	0.20	0.20	0.03	15%
BHS	Scrub of *Dodonaea lobulata* and *Acacia acuminata* on light red clay on low hill of basalt.	0.31	0.31	0.14	45%
Banded Ironstone Formation					
BW2	Low Woodland B of *Acacia species* and *Grevillea nematophylla* var. *nematophylla*. The vegetation in this unit was characterised by an upper storey to 4 m comprised of *Acacia ramulosa var. ramulosa, A. acuminata* and *A. tetragonophylla* with *Grevillea nematophylla var. nematophylla* recorded as a co-dominant species. Other species recorded in this unit included *Hakea recurva, Psydrax linearis, Eremophila latrobei* and *Westringia rigida.*	6.36	5.2	4.87	77%
BW3	Open Low Woodland A of *Eucalyptus* species over Low Woodland B of *Acacia ramulosa* var. *ramulosa, A. aneura* and *A. caesaneura* over Open Low Scrub B of *Philotheca brucei* subsp. *brucei, Dodonaea rigida* and *Eremophila decipiens* subsp. *decipiens* on red flat plain to very gently sloping low hills of red clay with ironstone, quartz and basalt gravel and very occasional minor outcroppings of basalt and ironstone.	96.17	96.17	87.28	91%
Ephemeral Drainage Line					
EDW1	Open Low Woodland A of *Eucalyptus loxophleba* and *E. kochii* over Open Low Woodland B of *Acacia ramulosa var. ramulosa, A. aneura* and *A. acuminata* on red clay with sections of exposed, laterised hardcap and calcrete.	17.47	0	0	0%
EDW2	Low Woodland B of *Acacia* species on red clay with exposed hardcap of concretionary laterised ironstone.	0.99	0.99	0.41	41%
Floodplains					
FPW1	Low Woodland of *Acacia aneura, A. ramulosa* var. *ramulosa* and *A. acuminata* with occasional emergent *Eucalyptus loxophleba* on red clay	24.26	0	0	0%
FPW2	Open Woodland of *Eucalyptus griffithsii* over Open Low Woodland B of *Acacia* species and *Eremophila scoparia* on red clay with occasional sections of exposed hardcap of weather basalt.	0.49	0.48	0.20	41%
FPW3	Open Woodland of *Eucalyptus kochii* and *E. loxophleba* over Open Low Woodland B of *Acacia acuminata* and *Eremophila oppositifolia* subsp. *angustifolia* on red clay with occasional scattered outcropping of weathered basalt.	2.47	2.47	1.04	42%
Greenstone Hills					
GW	Low Woodland B of *Acacia* species and *Eremophila oldfieldii* subsp. *angustifolia* on red clay on low greenstone hill.	2.76	0.60	0.16	6%
Plains					
PW1	Low Woodland B of *Acacia cockertoniana, A, burkittii* and *Eremophila oldfieldii* with an emergent canopy of *Allocasuarina acutivalvis* subsp. *acutivalvis* over Low Scrub B of *Philotheca brucei* subsp. *brucei, Dodonaea rigida* and *Leucopogon* sp. Clyde Hill (M.A. Burgman 1207) over Open Dwarf Scrub D of *Prostanthera althoferi* subsp. *althoferi* and *Dianella revoluta* var. *divaricata* over Very Open Low Grasses of *Monachather paradoxus* and *Amphipogon caricinus* var. *caricinus* on red clay on low ridge of basalt with ironstone intrusions.	6.43	6.43	5.95	92%
PW2	Low Woodland B of *Acacia ramulosa* var. *ramulosa, A. aneura* and *A. caesaneura* on red clay	277.68	161.85	36.35	13%
PW3	Woodland of *Eucalyptus salubris* and *E. clelandii* over Open Low Scrub B of *Atriplex nummularia, Eremophila pantonii* and *Senna artemisioides* subsp. x *artemisioides* over Open Dwarf Scrub D of chenopods on plains with red clay and scattered gravel of ironstone and quartz.	37.74	37.74	29.91	79%
PW4	Open Low Woodland A of *Callitris columellaris* over Open Low Woodland B of *Acacia ramulosa* var. *ramulosa, A. acuminata* and *Grevillea obliqiostigma* subsp. *obliquistigma* on red clay	0.73	0.73	0.3	41%
PW5	Open Low Woodland A of *Eucalyptus clelandii* over Open Dwarf Scrub C of *Atriplex nummularia* on red clay with scattered pebbles and stones of basalt.	2.80	2.80	1.19	42%
PW6	Open Low Woodland A of *Eucalyptus griffithsii* and *Casuarina pauper* over Low Woodland B of *Acacia* species on red clay with scattered ironstone and basalt pebbles	16.97	16.96	7.03	41%

Vegetation Community	Description	Total Mapped Area	Area in PPA	Clearing Footprint Area	Mapped Area Impacted (%)
PW7	Open Low Woodland A of *Eucalyptus griffithsii* over Open Low Scrub A of *Eremophila scoparia* and *Atriplex nummularia* on red clay with very scattered ironstone and basalt pebbles.	6.17	6.17	2.5	41%
PW8	Open Low Woodland A of Eucalyptus kochii and Casuarina pauper over Low Woodland B of Acacia species on red clay with scattered ironstone pebbles and stones	5.46	5.46	2.28	42%
PW9	Open Low Woodland A of Eucalyptus kochii over Low Woodland B of Acacia species on red clay with ironstone pebbles	2.35	2.35	0.99	42%
PW10	Low Woodland A of *Eucalyptus* species over Low Woodland B of *Acacia ramulosa* tvar. *ramulosa, A. aneura* and *A. caesaneura* over red clay with scattered gravel of ironstone and quartz.	40.50	40.5	19.14	47%
PW11	Open Low Woodland of *Eucalyptus salubris* over Open Scrub B of *Eremophila scoparia, Exocarpos aphyllus* and mixed species on red clay with ironstone and quartz pebbles and stones	2.22	2.21	0.92	41%
PW12	Open Woodland of *Eucalyptus oleosa* over Low Woodland B of *Acacia ramulosa* var. *ramulosa, A. aneura* and *A. acuminata* on red clay with basalt and ironstone pebbles	1.16	1.16	0.5	43%
Sandplains					
SS	Sandplain Scrub of *Acacia ramulosa* var. *ramulosa, A. aneura* and *Grevillea obliquistigma* subsp. *obliquistigma* Parker Range form on shallow light orange sandy loam over concretionary gravel.	3.20	3.2	1.33	42%
	Sub Total Native Vegetation	***557.71***	***396.80***	***203.73***	***37%***
Cleared	Land cleared of native vegetation.	17.96	17.96	15.53	86%
	TOTAL Including Cleared Areas	**575.67**	**414.76**	**219.26**	**38%**

As summarised in Table 10, four Priority flora species were identified within the project area, all of which are also present within the PPA. The proposed clearing will directly affect one Priority 2, two Priority 3 and one Priority four flora species. Information on population and abundance for areas outside of the project area was obtained from the DBCA database. The maximum percentage take based on publicly available data within a 100 km radius of the Project will be for *Eucalyptus formanii* C.A. Gardner (P4) with an estimate of 6.6% of the population proposed to be taken.

Table 10: Potential Impacts to Priority Flora

Species	Status	No. of Known Records Outside of Survey Area	No. in Survey Area	No. of Individuals in PPA	No. in Clearing Area (% Take)
Malleostemon sp. Adelong (G.J. Keighery 11825)	P2	23	1	1	1 (4.2%)
Philotheca deserti subsp. *brevifolia* Paul G. Wilson	P3	613	24	1	1 (0.2%)
Rinzia triplex (previously named *Baeckea* sp. Parker Range (M. Hislop & F. Hort MH 2968).	P3	7218	23	23	19 (0.3%)
Eucalyptus formanii C.A. Gardner	P4	3,723	821	821	299 (6.6%)

**Based on DBCA search records within 100 km radius*

The fauna assemblage is moderately rich and substantially intact except for the loss of a suite of medium sized mammal species. While likely to be typical of fauna assemblages for this region, the project area contains elements of two sub-regions, Eastern Murchison and Coolgardie, making it a unique and possibly richer assemblage than surrounding regions (Bamford Consulting Ecologists,2012).

The Project area supports habitat that may be suitable for a small number of conservation significant fauna species. However, much of the available habitat is widespread throughout the surrounding landscape and is not considered to represent critical habitat for any species. The following conservation significant species were identified by Bamford Consulting Ecologists (2012) as either recorded or having the potential to occur within the Project area:

- Malleefowl (*Leipoa ocellata*) – Vulnerable (EPBC Act and BC Act):
  - The site layout has been designed to minimise impacts on known Malleefowl mounds to the greatest extent practicable; however, the limited available area within M 77/1263 prevents further refinement of the layout. Of the 11 Malleefowl mound records, four known Malleefowl mound records will be impacted by the Project, comprising three mounds within the proposed disturbance footprint and one mound located approximately 1 m outside the disturbance boundary (Figure 8). The two mounds recorded during the 2012 fauna survey (one within the disturbance footprint and one immediately adjacent to it) were both assessed as inactive at the time of the survey. The remaining two mound records are from the DBCA database and their activity status is unknown.
- Peregrine Falcon (*Falco peregrinus*) – Other Specially Protected (BC Act):

  - This species may occur as an occasional visitor to the project area. Suitable foraging habitat is present; however, nesting habitat is limited and the species is highly mobile. The Project is unlikely to result in significant impacts given the small disturbance footprint and the abundance of similar habitat in the surrounding landscape.

- Rainbow Bee-eater (*Merops ornatus*) – Migratory (EPBC Act):
  - This migratory species may use the project area opportunistically for foraging during seasonal movements. Habitat within the project area is common and widespread throughout the region, and the proposed clearing is unlikely to affect the species' ecological function or migratory behaviour.
- Fork-tailed Swift (*Apus pacificus*) – Migratory (EPBC Act):
  - This highly aerial migratory species may occasionally fly over the project area during migration but is unlikely to rely on habitats within the Project area. No significant impacts are anticipated.
- Tree-stem Trapdoor Spider (*Aganippe castellum*) – Priority 4 (BC Act):
  - This species was recorded within the survey area and occurs near the northern extent of its known distribution. Suitable habitat extends beyond the proposed disturbance footprint, with individuals also recorded on nearby ironstone ridges. Consequently, the Project is not expected to significantly affect the local population.
- Arid Bronze Azure Butterfly (*Ogyris subterrestris petrina*) – Critically Endangered (EPBC Act and BC Act):
  - The species has the potential to occur where its associated ant hosts are present. Targeted surveys of suitable habitat did not locate ant nests or evidence of the species. Given the absence of confirmed habitat features and the limited disturbance footprint, significant impacts to the species are not anticipated.
- Carpet Python (*Morelia spilota imbricata*) – Priority 3 (BC Act):
  - The project area is at the northern edge of the currently recognised distribution of this species. Although suitable habitat may be present, the species was not recorded during field surveys and is considered unlikely to occur regularly within the project area. Vegetation clearing in the PPA, particularly when similar habitats exist in neighbouring areas, is considered unlikely to significantly affect this species.

5.2.2 Management and Mitigation

The PPA and indicative clearing footprint were designed to minimise environmental impact to vegetation communities, and conservation significant flora and fauna species as much as practicable, including making use of previously cleared areas.

Management and mitigation measure to reduce impacts on biological diversity comprise:

- Site layout has been designed to minimise impact to Priority flora as much as possible.

- Clearing of vegetation will be kept to the minimum required for the Project.
- Utilising existing disturbed areas where possible.
- Managing clearing via the internal Ground Disturbance Permit (GDP) Procedure.
- Clearly delineating the clearing area to ensure only that required for safe working area is cleared.
- Implement a procedure to record the amount of clearing undertaken and report the cumulative total in the Annual Environmental Report (AER) and Mine Rehabilitation Fund (MRF) reporting.
- Vehicle and equipment hygiene procedures will be implemented to minimise entry of weed and soil borne diseases.
- Site weed and dust control measured will be conducted as required.
- Stockpiling stripped topsoil and vegetation for use in future rehabilitation activities.
- Progressively rehabilitate disturbed areas on completion of Project activities.
- Implementing speed limits to minimise dust emissions and to minimise the risk of fauna injury or death due to vehicle traffic.
- All personnel will participate in a site induction which will include detail on the importance of flora and fauna management.
- Forrestania has revised the previously approved Malleefowl Management Plan (Vector Resources Ltd, 2013) and will implement the revised Plan. The management measures outlined in the revised Malleefowl Management Plan will apply to all Malleefowl mounds other than the four known mound records located within or immediately adjacent to the proposed disturbance footprint, where avoidance and implementation of the standard exclusion buffers are not practicable due to the spatial constraints of the Project. Key management measures include:
  - Avoiding clearing within areas known to support Malleefowl mounds.
  - Undertaking pre-clearance surveys prior to commencing clearing.
  - Implementing buffer distances for observed mounds with the distance relevant to its status and timing of activities in relation to the breeding season. Ground disturbance will be avoided within 50 m of inactive mounds and 200 m of active mounds. During the breeding season (September to March), no ground-disturbing activities will be undertaken within 200 m of either active or inactive mounds.
  - Implementation of speed limits on haul roads and access tracks.
  - Recording of mound positions and activity status.

5.2.3 Outcome

Given the widespread and common nature of vegetation communities and fauna habitat in the region, the Project is not considered to comprise a high level of biological diversity. Therefore, the proposed clearing is unlikely to be at variance with Clearing Principle A.

5.3 Significant Fauna Habitat

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.

5.3.1 Potential Impacts

The proposed extent of potential impacts to fauna habitats are summarised in Table 11.

Table 11: Potential Impacts to Fauna Habitat

VSA	Habitat Type	Mapped Extent (ha)	Extent in PPA (ha)	Clearing Area (ha)	Extent in Clearing Area (%)
VSA01	Acacia shrublands	287.23	170.25	42.55	15%
VSA02	Mixed Acacia shrublands	144.86	144.86	113.05	78%
VSA03	Mixed Eucalypt woodlands	37.74	37.74	29.91	79%
VSA04	Low woodland	5.98	5.98	2.53	42%
VSA05	Mixed shrublands	1.57	1.57	0.70	45%
VSA06	Minor drainage lines	42.72	0.99	0.41	1%
VSA07	*Eucalyptus clelandii* woodlands	5.56	3.40	1.35	24%
VSA08	*Eucalyptus salubris* woodlands	31.30	31.28	12.93	41%
VSA09	Dense *Acacia ramulosa* shrubland	0.73	0.73	0.30	41%
VSA10	Cleared/previously disturbed land	17.96	17.96	15.53	86%
	Total	**575.67**	**252.88**	**219.26**	**38%**

It can be seen that the majority of the proposed clearing (71%) will occur in Acacia shrublands and mixed Acacia shrublands This is fauna habitat type is considered to be locally common and is not considered to have conservation value (Niche Environmental Services, 2012).

The project area does not provide an important ecological linkage or a fauna movement corridor, as the surrounding bioregion is mainly intact.

The impacts on fauna are generally considered to be only minor, with this also consistent for the majority of the conservation significant fauna species. This is due to the relatively small footprint of the project which is located mostly within widespread, common and disturbed environments (Bamford Consulting Ecologists, 2012). The exception is the eucalypt woodlands, which are small northern outliers of the Great Western Woodlands. Noting that Eucalypt woodlands are a dominant characteristic of the region to the south.

5.3.2 Management and Mitigation

The main risk to fauna and habitat is loss or fragmentation of habitat through clearing activities.

The highest potential for impacts on fauna would result from disturbance to eucalypt woodlands, which are small northern outliers of the Great Western Woodlands and from disturbance of Acacia shrublands on ironstone landforms noting these may provide habitat for conservation significant fauna. In order to limit impacts on fauna within these habitat types, the Project will aim to:

- Avoid removal of large, hollow-bearing trees.
- Avoid disturbance to ironstone ridges and associated lower slopes.
- Avoid disturbances to drainage lines.

Management measures to reduce impacts on fauna and habitat comprise:

- Clearing of vegetation will be kept to the minimum required for the Project.
- Utilising existing disturbed areas and locating roads and infrastructure to avoid fauna habitat where possible.
- Managing clearing via and internal Land Clearing Procedure.
- Clearly delineating the clearing area with to ensure only that required for a safe working area is cleared.
- Implement a procedure to record the amount of clearing undertaken and report the cumulative total in the AER and MRF reporting.
- Progressively rehabilitating disturbed areas on completion of Project activities.
- Implementing speed limits to minimise the risk of fauna injury or death due to vehicle traffic.
- All personnel will undertake a site induction which will include detail on the importance of flora and fauna management.

5.3.3 Outcome

As outlined by Bamford Consulting Ecologists (Appendix C), the mapped fauna habitat types (VSAs) within the PPA are considered locally common, regionally widespread and well represented. The Project will result in the loss of a small area of fauna habitat, however in general, similar habitat is abundant throughout the surrounding landscape.

While the PPA contains Eucalypt woodlands which are outliers of the Great Western Woodlands, with the implementation of the proposed mitigation and management measures, significant impacts to fauna habitat and conservation significant fauna will be minimised.

Accordingly, the proposed clearing will not be at variance with Clearing Principle B.

5.4 Threatened Flora

Clearing Principle C: Native vegetation should not be cleared if it includes or is necessary for the continued existence of rare (Threatened) flora.

5.4.1 Potential Impacts

Direct impacts relate to removal of Threatened flora as a result of clearing. Indirect impacts to Threatened flora include dust, particulate matter deposition, microclimate changes, and the spread of exotic (weed) species by earth moving equipment. These indirect impacts may negatively impact the significant flora species.

No Threatened flora species were recorded within surveys undertaken by Niche Environmental Services (2012a) within the PPA or wider project area. DBCA records do not indicate the presence of any Threatened flora species within a 10 km radius of the PPA.

5.4.2 Management and Mitigation

Despite the absence of Threatened flora species within the project area, the presence of four Priority flora species is acknowledged. Management measures to reduce impacts to significant flora from land clearing is documented in Section 5.2.2.

5.4.3 Outcome

Given the relatively low numbers of conservation significant flora species, and no rare (Threatened) flora species being recorded in the survey area, the Project is not considered to compromise the continued existence of rare (Threatened) flora.

Accordingly, the proposed clearing is not at variance with Clearing Principle C.

5.5 Threatened Ecological Communities

Clearing Principle D: Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a threatened ecological community.

No TECs or PECs as listed under either the *EPBC Act* or *BC Act* have been identified within the PPA.

Based on the above, clearing for the Project is not at variance with Principle D.

5.6 Remnant Vegetation

Clearing Principle E: Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.

The EPA uses a standard level of native vegetation retention of at least 30% of the pre-clearing extent of an ecological community as a benchmark. The levels of native vegetation retention have most recently been recognised in the National Objectives and Targets for Biodiversity Conservation 2001-2005, which recognised that the retention of 30%, or more, of the pre-clearing extent of an ecological community is necessary if Australia's biological diversity is to be protected (Environment Australia, 2001).

The pre-European vegetation types occurring in the PPA (Barlee and Jackson) both have greater than 99% of their pre-European extent remaining. Clearing associated with the Project will not result in loss of a significant remnant of native vegetation.

Based on the above, the proposed clearing is not at variance with Clearing Principle E.

5.7 Watercourse or Wetland Environments

Clearing Principle F: Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.

There are no RAMSAR wetlands or wetlands of national importance (ANCA Wetlands) within the PPA or within a 40 km radius.

There are no permanent water features within the PPA.

Two ephemeral drainage line vegetation units were identified by Niche Environmental Services in the 2012 flora and vegetation assessment (Appendix C). These were EDW1 and EDW2. The PPA has been designed to avoid EDW1 completely. A small section of the PPA needed for the access road intersects EDW2.

Minor ephemeral drainage lines which are not regionally or locally significant intersect the PPA, however, suitable drains or culverts will be installed to transfer flow past infrastructure and return it to its natural flow path.

Based on the above, the Project is considered unlikely to be at variance with Clearing Principle F.

5.8 Land Degradation

Clearing Principle G: Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.

5.8.1 Potential Impacts

Vegetation communities mapped within the PPA range from 'very good' to 'degraded' condition (Appendix B). Existing land degradation is mostly attributed to clearing for access tracks, historical mining and exploration activities. The presence of weeds in disturbed areas and along tracks also contributes to existing land degradation.

Publicly available mapping indicates that the PPA is predominantly located within the Moriarty (263Mo) and Tealtoo (263Te) land systems. The mapping provides a regional-scale indication of the soils expected within the PPA and has not been verified by a site-specific soil and landform assessment.

The Moriarty Land System is characterised by low greenstone rises and stony plains supporting halophytic and acacia shrublands with patchy eucalypt overstoreys (Payne,1998). Within the sections of the project defined as being on the Moriarty Land System, the majority was considered to fit within the areas defined as being 'stony plains' and 'gravelly saline alluvial plains' (Vector Resources, 2013). Several of the other units within the land system are susceptible to water erosion when perennial

cover is removed but the 'stony plains' and 'gravelly saline alluvial plains' units have mantles of pebbles and cobbles to protect from erosion (Payne, 1998).

The Tealtoo Land System is characterised by level to gently undulating loamy plains with fine ironstone lag gravel supporting dense acacia shrublands (Payne, 1998). This land system is generally not prone to soil erosion (Payne, 1998).

Potential sources of land degradation from clearing activities include:

- Wind and mechanical erosion during vegetation and topsoil stripping activities.
- Wind and water erosion of topsoil stockpiles and cleared areas.
- Water erosion due to changes in surface water flow.
- Soil compaction.
- Soil contamination (i.e. spills or machinery failure).
- Introduction and/or spread of weeds.

5.8.2 Management and Mitigation

Minimisation of land degradation will be achieved by applying recognised clearing and rehabilitation methods.

Management and mitigation strategies to achieve this include:

- Minimising the area requiring vegetation clearing.
- Managing clearing via the GDP Procedure.
- Confining vehicle movements to defined roads and tracks.
- Conducting topsoil stripping activities during periods of low winds.
- Stockpiling topsoil and vegetation for later use in rehabilitation away from the path of drainage lines.
- Storing hydrocarbons and reagents in bunded areas and applying spill response procedures.
- Progressive rehabilitation of completed areas to minimise active areas exposed where possible.
- Scarifying or deep ripping (as appropriate) compacted tracks and roads as part of rehabilitation.
- Establishment of surface water management infrastructure to direct surface water flow to natural drainage channels.
- Monitoring of high-risk erosion events, such as extreme weather, to mitigate impacts as far as reasonably practicable.
- Dust suppression via water cart where practicable.

5.8.3 Outcome

In the context of the local land systems, intact native vegetation on a regional scale and existing level of localised land degradation, the scale of disturbance from the proposed clearing is not anticipated to significantly increase overall land degradation.

As such, proposed clearing is considered unlikely to be at variance with Clearing Principle G.

5.9 Conservation Estate

Clearing Principle H: Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.

The PPA is not located within the Western Australian conservation estate or any DBCA-managed conservation reserve. The nearest conservation areas are the former Mt Elvire Pastoral Lease, proposed for conservation and located approximately 5 km east of the Project, Mount Manning Range Conservation Park (R48470) and Helena and Aurora Range National Park (R36208), both located approximately 8 km south of the PPA.

Given the separation distance and the nature and scale of the proposed clearing, no impacts to the conservation values of these reserves are anticipated. Accordingly, the proposed clearing is not considered to be at variance with Clearing Principle H.

5.10 Surface and Groundwater Quality

Clearing Principle I: Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.

5.10.1 Potential Impacts

Surface water quality has the potential to be affected by increased sedimentation caused through clearing and soil disturbance and removal of vegetation that acts to bind soil, including riparian vegetation. Hydrocarbon spills may occur from earth moving machinery used for land clearing activities. Uncontained spills may affect both surface and/or groundwater quality.

There are no permanent water bodies or wetlands within the PPA. The Project is located close a local surface water divide and is located within a very small (2.5 km^2) subcatchment. As a result, there is very little surface water run off across the proposed mine site.

There are several ephemeral drainage lines present within the project area which are generally located at lower points in the landscape and have poorly developed banks. The PPA has been designed to avoid more significant ephemeral drainage lines where possible. There is limited clearing proposed of vegetation within ephemeral drainage lines.

Smaller ephemeral drainage lines are present across the project area, only flowing briefly immediately following significant rainfall events. Potential impacts associated with increased stormwater runoff generated by the Project can be managed through appropriate onsite drainage infrastructure that does not increase downstream flows.

The application area is approximately 10 km south of Lake Barlee, an ANCA wetland. There is no direct hydraulic connection between the project area and Lake Barlee with the project unlikely to have any impact on the lake (Vector Resources, 2013).

The application area is not located within a Public Drinking Water Source Area (PDWSA). The nearest PDWSA is Menzies Water Reserve, which is approximately 150 km to the east. The proposed clearing is unlikely to affect the water quality of the water reserve due to the large distance between it and the application area.

The Project is not located within a proclaimed Surface Water Area under the *RIWI Act*.

The project area is underlain by fractured-rock aquifers comprising greenstone, granitoid and minor intrusive rock units. These aquifers exhibit secondary porosity and permeability, with groundwater storage and flow controlled primarily by the degree of fracturing and weathering. Groundwater depths are approximately 35 - 40 m below ground level (mbgl), corresponding to around 420 mRL., with more significant groundwater inflows encountered below approximately 65 - 70 mbgl..

5.10.2 Management and Mitigation

Management measures to prevent impacts to surface and groundwater quality include:

- PPA and clearing area has been designed to avoid major drainage lines.
- Existing disturbed areas will be used where possible.
- Managing clearing via the GDP Procedure.
- Clearing and construction will be scheduled outside of peak rainfall events to avoid times of high surface/sheet flows and reduce the risk of erosion and elevated turbidity to drainage lines from disturbed areas.
- Where necessary, suitable floodways, drains and culverts will be installed to transfer flow past infrastructure and return it to its natural flow path.
- Hydrocarbons will be stored in bunded areas. Spill kits will be maintained to allow containment and treatment of spillages of hydrocarbons from clearing equipment hose failures or leaks.
- Progressive rehabilitation of completed areas to minimise active areas exposed where possible.
- Forrestania will operate in compliance with their current and future obligations under the RIWI Act 5C licence to manage potential impacts to groundwater and surface water.

5.10.3 Outcome

Impacts to surface water and groundwater quality from the proposed clearing are not anticipated to be significant. Localised, short-term impacts on surface water quality during clearing works can be managed using standard erosion and sediment control mitigation measures.

Based on the above the proposed clearing is unlikely to be at variance with Clearing Principle I.

5.11 Flooding Potential

Clearing Principle J: Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence of flooding.

5.11.1 Potential Impacts

Removal of vegetation generally increases flooding whereby uptake, infiltration, moisture retention and physical barriers to reduce flow velocities provided by vegetation are also removed.

The linking road between the mine site (M 77/1263) and the accommodation site (G 77/119) traverses predominantly subdued terrain with roads grades <1%. Few drainage lines and no permanent water courses are intersected by the proposed access road.

Ponding and shallow stormwater flow could affect parts of the access roads after heavy rain. Ponding and flow are likely to be shallow and low velocity, so there is little risk to the safety of traffic on the road. Given the road is pre-existing and the clearing relates to minor areas of widening to improve safety and trafficability for ore trucks, changes to flooding potential are considered to be insignificant.

There is little flood risk for the pit or infrastructure in the vicinity of the pit as the site is located on a local surface water divide and is located within a very small (2.5 km^2) subcatchment. The major drainage line located on G 77/119 has been avoided as part of site planning.

The application area is within the Raeside-Ponton catchment areas. Given the size of the area to be cleared in relation to the size of the catchment area (11,589,532 ha), the proposed clearing is not likely to increase the potential of flooding on a local or catchment scale.

5.11.2 Management and Mitigation

Management strategies to prevent flooding include:

- Clearing will be conducted to ensure no significant alteration the natural landscape, contours, or drains that could otherwise impact flooding potential.
- Appropriate surface water diversion works will be constructed to minimise erosion hazard and risk of surface water contamination that could otherwise result from interaction between surface flows and waste landforms and/or other operational areas.
- Support facilities such as the accommodation village, workshops and evaporation ponds will be located outside the estimated 1 in 100 year floodplain of ephemeral drainage lines in the project area.
- Managing clearing via the GDP Procedure.
- Vegetation will be removed in stages with disturbance kept to a minimum to reduce surface runoff.

5.11.3 Outcome

Based on the above, there is considered to be low potential for localised flooding as a result of land clearing and as such the Project is unlikely to be at variance with Clearing Principle J.

6. References

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APPENDIX A

APPENDIX A:
EVIDENCE OF TENURE

Register for Tenement G 77/119

Identifier: G 77/119

Status: Live
Area: 298.14900 HA
Markout: 10/09/2012 09:20:00
Received: 12/09/2012 15:00:23
Term Granted: 21 Years
Commence: 21/02/2013
Expiry: 20/02/2034
Death:

Rent Status

Due for Year End 20/02/2027: PAID IN FULL
Rental for Year End 20/02/2028: $8,282.30

Expenditure Status

Expended Year End : NO EXPENDITURE REQUIRED
Current Year Commitment: NO EXPENDITURE REQUIRED

Holders | Description | Relationships | Survey | General | Shire | Grant | Conditions | Dealings
Payments | Expenditure | Combined Reporting | Bond | Map | Native Title | Warden's Court | Documents

Current Holders | Holder Changes | Applicants On Receival

Organisation	AURUMIN JOHNSON RANGE PTY LTD		100/100
ACN	639 574 324	**ABN**	30 639 574 324

Designated Tenement Contact (Correspondence Details)

Name	MCMAHON MINING TITLE SERVICES PTY LTD
Address	C/- MCMAHON MINING TITLE SERVICES PTY LTD, PO BOX 6301, EAST PERTH, WA, 6892
Email	xxxx@mmts.net.au
Telephone	xxxxxxxxxx997

Street Address Details

Address	C/- MCMAHON MINING TITLE SERVICES PTY LTD, LEVEL 1, 1 ADELAIDE TERRACE, EAST PERTH, WA, 6004
Email	xxxx@mmts.net.au
Telephone	xxxxxxxxxx997

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Register for Tenement L 77/248

Identifier: L 77/248

Status: Live
Area: 96.00000 HA
Markout: 11/09/2012 07:15:00
Received: 12/09/2012 15:56:31
Term Granted: 21 Years
Commence: 21/02/2013
Expiry: 20/02/2034
Death:

Rent Status

Due for Year End 20/02/2027: PAID IN FULL
Rental for Year End 20/02/2028: $2,659.20

Expenditure Status

Expended Year End : NO EXPENDITURE REQUIRED
Current Year Commitment: NO EXPENDITURE REQUIRED

Holders | Description | Relationships | Survey | General | Shire | Grant | Conditions | Dealings
Payments | Expenditure | Combined Reporting | Bond | Map | Native Title | Warden's Court | Documents

Current Holders | Holder Changes | Applicants On Receival

Organisation	AURUMIN JOHNSON RANGE PTY LTD		100/100
ACN	639 574 324	**ABN**	30 639 574 324

Designated Tenement Contact (Correspondence Details)

Name	MCMAHON MINING TITLE SERVICES PTY LTD
Address	C/- MCMAHON MINING TITLE SERVICES PTY LTD, PO BOX 6301, EAST PERTH, WA, 6892
Email	xxxx@mmts.net.au
Telephone	xxxxxxxxxxx997

Street Address Details

Address	C/- MCMAHON MINING TITLE SERVICES PTY LTD, LEVEL 1, 1 ADELAIDE TERRACE, EAST PERTH, WA, 6004
Email	xxxx@mmts.net.au
Telephone	xxxxxxxxxxx997

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Register for Tenement M 77/1263-I

Identifier: M 77/1263-I

>>> Authorised For Iron <<<

Status:	Live
Area:	184.65000 HA
Markout:	05/12/2011 16:26:00
Received:	06/12/2011 08:30:00
Term Granted:	21 Years
Commence:	15/05/2012
Expiry:	14/05/2033
Death:	

Rent Status

Due for Year End 14/05/2027:	PAID IN FULL
Rental for Year End 14/05/2028:	$5,568.50

Expenditure Status

Expended Year End 14/05/2026:	EXPENDED IN FULL
Current Year Commitment:	$18,500.00

Holders | Description | Relationships | Survey | General | Shire | Grant | Conditions | Dealings
Payments | Expenditure | Combined Reporting | Bond | Map | Native Title | Warden's Court | Documents

Current Holders | Holder Changes | Applicants On Receival

Organisation	AURUMIN JOHNSON RANGE PTY LTD	100/100
ACN	639 574 324 **ABN**	30 639 574 324

Designated Tenement Contact (Correspondence Details)

Name	MCMAHON MINING TITLE SERVICES PTY LTD
Address	C/- MCMAHON MINING TITLE SERVICES PTY LTD, PO BOX 6301, EAST PERTH, WA, 6892
Email	xxxx@mmts.net.au
Telephone	xxxxxxxxxxx997

Street Address Details

Address	C/- MCMAHON MINING TITLE SERVICES PTY LTD, LEVEL 1, 1 ADELAIDE TERRACE, EAST PERTH, WA, 6004
Email	xxxx@mmts.net.au
Telephone	xxxxxxxxxxx997

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APPENDIX B:

BASELINE FLORA SURVEY (NICHE, 2012)

Report documenting the findings of a Level 2 flora and vegetation survey at the Vector Resources' Gwendolyn East Cutback Project.

Report prepared for





December 2012

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1.0 SUMMARY

Vector Resources Ltd (Vector) is proposing to develop a gold resource within its Gwendolyn East Cutback Project (the project), located approximately 150 km to the west of the locality of Menzies, within Western Australia. The project is located on tenements M77/1263, which contains the resource and will be developed to contain the pit and waste landform, L77/248, which will be used for linear infrastructure, and G77/119, which will be used for the camp, processing plant and tailings storage facility. Tenement M77/1263 has an area of approximately 190 ha, tenement L77/248 has an area of approximately 95 ha and tenement G77/119 has an area of approximately 298 ha.

Prior to commencing fieldwork at the project, a desktop review was completed, with the objective of identifying any significant ecological values in the area and to place the site in its local and regional context. The desktop review comprised a study of literature and GIS datasets relevant to the area and searches of the DEC Threatened (Declared Rare) Flora and Threatened Ecological Communities databases. In addition to this, a search of the protected matters database was undertaken to determine whether there were triggers for a Federal referral under the provisions of the *Environment Protection and Biodiversity Conservation Act 1999.*

There was one threatened (declared rare) species flora listed in the DEC database search results for the survey area and surrounds, *Tectratheca paynterae* subsp. *cremnobata* R. Butcher. The record of this species was outside of the project. There were 13 priority species listed in the database search. There were no records from within the project; however, there were two records of the priority 4 species *Eucalyptus formanii* C. A. Gardner on the edge of the tenement.

There were no Threatened Ecological Communities (TECs) within the project area or surrounds. There were five Priority Ecological Communities (PECs) in the region. None of these were within the project area, although the buffer of the Die Hardy Range/Diemals vegetation complexes (banded ironstone formation; P1) was within 1 km of the southeast corner of the project. All of the PECs within the area were vegetation complexes on banded ironstone formations.

There were no matters listed under the provisions of the *EPBC Act* that were considered to be relevant to the project area. Based on this, there are not considered to be any flora and vegetation issues that would require referral for assessment under the provisions of the Act.

During autumn, a quadrat-based survey was conducted within M77/1263, in which a total of six 20 m × 20 m quadrats were established and surveyed. During spring, the quadrats in M77/1263 were subject to a follow-up survey, while six quadrats were established in G77/119 and 31 quadrats were established in L77/248. In addition to the quadrat-based survey, targeted searches were conducted during spring for flora of conservation recorded in M77/1263. The targeted searches included tenements G77/119 and L77/248, as well as areas outside of the project.

Within M77/1263, a total of five vegetation units were defined and delineated. The vegetation was broadly characterised as being either *Eucalyptus* woodlands, *Acacia* woodlands or woodland comprised of the *Eucalyptus* and *Acacia* species. The vegetation had been impacted by previous mining and exploration related activities. The vegetation in the project area was noted as being widespread in the region. With the exception of the records of the three priority flora species in the tenement, *Malleostemon* sp. Adelong (G.J. Keighery 11825), *Baeckea* sp. Parker Range (M. Hislop & F. Hort MH 2968) and *Eucalyptus formanii* C.A. Gardner, the vegetation within M77/1263 was not considered to have conservation value.

The vegetation in tenement G77/119 was broadly classified as being *Acacia* woodlands on plains and flood plains, *Eucalyptus* woodlands in ephemeral drainage lines and a low hillock with exposed concretionary, weathered ironstone. The vegetation in this tenement was notably impacted by pastoral activities, with numerous access tracks, cattle tracks and evidence of grazing-related damage. The vegetation in tenement G77/119 was considered to be more consistent with Eremaean vegetation recorded in the Murchison bioregion, and is not considered to have conservation value.

Tenement L77/248 was a linear tenement, which had a width of 60 m and had three main sections: the proposed access track from the Bullfinch – Evanston Road to the southeast corner of M77/1263, a length of approximately 5 km; the proposed haulroad between M77/1263 and G77/119, which is approximately 6.2 km; and, the proposed access track from the Diemals – Menzies Road to the northwest corner of M77/1263, a length of approximately 3 km. The section between the Bullfinch – Evanston Road and the southeast corner was noted as hosting *Eucalyptus* woodlands and a small section of *Acacia* species scrubland. Within this section, there were records of *Philotheca deserti* subsp. *brevifolia* Paul G. Wilson and *Eucalyptus formanii* C.A. Gardner. There will be no impacts to the location in which *P. deserti* subsp. *brevifolia* was recorded and there will be limited impacts to locations at which *E. formanii* was recorded. It was noted that an old haulroad, with a width of 12 -14 m, was located in the centre of this section. The old haulroad was poorly revegetated and was not considered to constitute native vegetation, and vegetation on the edges of the old haulroad was in poorer condition than the vegetation further from the old haulroad. While there is a section of vegetation with high conservation value due to the presence of a P1 species, the balance of the vegetation was considered to have low conservation value.

The section of tenement L77/248 between Diemals – Menzies Road and the northwest corner of M77/1263 was characterised by a series of ephemeral drainage lines dissecting low hills of weathered, concretionary ironstone and undulating plains, with a small section of greenstone at the northern end of the tenement. The vegetation within this section of the tenement was typically *Acacia* woodlands on ephemeral drainage lines and low hills and *Eucalyptus* woodlands on the undulating plains. This section contained the access track used during exploration and a series of old exploration tracks running essentially perpendicular to the access track. There were no flora of conservation

significance recorded in this section. The vegetation in this section was not considered to have any conservation value.

The section of tenement L77/248 between M77/1263 and G77/119 was characterised by a series of gently undulating plains, low hills of either weathered ironstone or basalt, and ephemeral drainage lines. The plains typically hosted *Acacia* woodlands, with the balance generally hosting *Eucalyptus* woodlands. The vegetation in this section had been clearly impacted by historic exploration and pastoral activities. There were a series of well-established access tracks and smaller exploration tracks and old drill pads within this area. In addition to this, there was evidence of impacts to the vegetation due to pastoral activities. There were a number of records of the P4 species *Eucalyptus formanii* within this section; however, this species was also noted as being common in the surrounding landscape and as such, the impacts are not considered to be significant. In addition to this, there were three locations at which the P3 species *Baeckea* sp. Parker Range (M. Hislop & F. Hort MH 2968) was recorded. Despite the records of priority flora within this section, the vegetation was not considered to have conservation value, largely due to the residual effects of historic and ongoing exploration and pastoral activities.

During the survey, a total of 139 native species, including subspecies, variants and forms, were collected. The 139 species were from 74 genera within 30 families. The flora was dominated by the family Fabaceae, with 23 species from five genera. Other widely represented families during the survey included: Myrtaceae, with 16 species from five genera; Chenopodiaceae, with 14 species from five genera; Asteraceae, with 12 species from 10 genera; and, Scrophulariaceae, with nine species from 1 genus. No threatened flora were recorded during the survey. There were four priority species recorded during the survey: the priority 1 species *Philotheca deserti* subsp. *brevifolia* Paul G. Wilson*;* the priority 2 species *Malleostemon* sp. Adelong (G.J. Keighery 11825); the priority 3 species *Baeckea* sp. Parker Range (M. Hislop & F. Hort MH 2968); and, the priority 4 species *Eucalyptus formanii* C.A. Gardner. There were a total of seven non-native weed species and one native weed species recorded during the surveys.

There are no proposed impacts to the area in which *Philotheca. deserti* subsp. *brevifolia* was recorded. There was one record of one plant of *Malleostemon* sp. Adelong (G.J. Keighery 11825) within tenement M77/1263, with no other records outside of the project area. This species will likely be impacted by the proposed development. There were records of *Baeckea* sp. Parker Range (M. Hislop & F. Hort MH 2968) within tenement M77/1263 and tenement L77/248. There was one plant within tenement M77/1263, which will be impacted by the proposed development, but the other 23 plants recorded at three sites within L77/248 will be avoided.

There were numerous records of *Eucalyptus formanii* within the project area and the surrounding landscape. It was noted that in some areas, this species is either a locally dominant or co-dominant species. While there will be impacts to a number of plants recorded within the project area, it is proposed that these will not significantly impact on the species and will not alter its threatening

processed profile. Based on information gathered in this survey, database records and population information from other regional sites, it appears that there may be valid grounds to question whether a conservation code is still required for this species.

There were a limited number of weed species recorded during the survey, with the records largely restricted to areas within M77/1263. To avoid dispersing these into the surrounding landscape, it is recommended that a weed management program should be focused on both controlling populations where recorded, and monitoring the surrounding landscape to ensure that these species do not spread into areas outside of the current distribution.

2.0 INTRODUCTION

2.1 Project Background

Vector Resources Ltd (Vector) is proposing to develop a gold resource within its Gwendolyn East Cutback Project (the project), located approximately 150 km to the west of the locality of Menzies, within Western Australia. The project is located on tenements M77/1263, which contains the resource and will be developed to contain the pit and waste landform, L77/248, which will be used for linear infrastructure, and G77/119, which will be used for the camp, processing plant and tailings storage facility. Tenement M77/1263 has an area of approximately 190 ha, tenement L77/248 has an area of approximately 95 ha and tenement G77/119 has an area of approximately 298 ha. To advance development of the project and facilitate future exploration and to provide information for inclusion within a mining proposal, Vector contracted Niche Environmental Services (Niche) to complete a Level 2 flora and vegetation survey over the area.

2.2 Scope and Objectives of the Study

To determine the appropriate level of survey for the areas over which the project is proposed to be located, an assessment of the potential impacts in the context of the Environmental Protection Authority (EPA) *Position Statement No 3: Terrestrial Biological Surveys as an Element of Biodiversity Protection* and *Guidance Statement No 51: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* was completed. In the EPA *Guidance Statement 51* (EPA, 2004), the state is broken into three sensitivity groups (at the bioregion level). The survey area was located within the Murchison bioregion, which is a Group 2 bioregion. The factors listed in *Guidance Statement 51* were reviewed in consideration of the proposed area of disturbance to determine the appropriate level of survey. These are summarised in **Table 1.** Based on the review of these factors, a Level 2 survey was considered appropriate.

A Level 2 survey is comprised of

- A desktop review to collect ecological data relevant to the area to be surveyed and surrounds. The desktop review should involve a search of all sources of literature, data and map-based information. In this report, the desktop review includes:
    - Searches of relevant DEC databases;
    - A search of the EPBC Act Protected Matters database;
    - Interrogation of relevant GIS datasets; and
    - Reviews of publicly-available ecological information.
- A site visit to
    - Conduct a reconnaissance survey with the objectives of:
        - Verifying the information collected in the desktop review;
        - Completing a census of the flora, with a focus on determining the presence of any flora of conservation significance;
        - Assessing the condition of the vegetation;

        - Developing a preliminary delineation and description of the vegetation; and
        - Identifying any potential impacts.
    - Complete a quadrat-based survey of the vegetation to assist with:
        - Enhancing knowledge of the flora and vegetation, with the specific aim of placing the vegetation in a local and regional context. This is achieved by collecting data in a manner consistent with known or recommended levels of sampling effort and quadrat sizes. A minimum of two quadrats per vegetation unit is recommended.

This report contains the following

- An overview of the survey site, which serves to place the survey site in a regional context;
- The findings of the desktop review;
- A detailed description of the methods used;
- A summary of the flora recorded, with reference to flora of conservation significance, if found;
- The findings of the field survey, incorporating a description of the vegetation, an assessment of the condition using the scale devised by Keighery (1994), and an assessment of the conservation significance of the vegetation with the specific objective of determining whether any TECs or PECs are present;
- An assessment of the adequacy of the survey; and
- Conclusions and recommendations based on findings from the survey.

3.0 SURVEY AREA

3.1 Study site

The project was located on the Diemals' pastoral lease, approximately 150 km west of the locality of Menzies and approximately 425 km northeast of the city of Perth in Western Australia (**Figure 1**). The project was within the Eastern Murchison subregion, but it was located close to the Yalgoo bioregion and the Southern Cross subregion. The project is comprised of three tenements: tenement M77/1263, which contains the deposit and will be developed to contain the pit and waste landform; tenement L77/248, which will be developed to contain linear infrastructure such as the haulroad and access roads; and, tenement G77/119, which will contain the camp, processing plant and the waste landform. Tenement M77/1263 covers an area of approximately 190 ha, while tenement L77/248 covers an area of 95 ha and tenement G77/119 covers an area of approximately 298 ha. An aerial photograph showing the survey areas is presented as **Figure 2**.

4.0 METHODS – DESKTOP REVIEW

4.1 Overview

A desktop review was conducted prior to field surveys. The purpose of the desktop review was to collect information about the site and surrounds that would potentially assist with the design and implementation of the field survey. The desktop review consisted of:

- A limited review of publicly available reports, publications, websites and GIS datasets containing flora, vegetation and ecological information relevant to the survey area;
- A search of the Western Australian Department of Environment and Conservation (DEC) Threatened (Declared Rare) Flora database, the Western Australian Herbarium (WAHERB) database and the Declared Rare and Priority Flora List for rare and priority flora collected from the survey area and surrounds or potentially occurring within the survey area;
- A search of the DEC Threatened Ecological Communities (TEC) database for listings of Threatened Ecological Communities or Priority Ecological Communities (PEC) recorded at or in the surrounds of the survey area; and
- A search of the Federal Government *Environment Protection and Biodiversity Conservation (EPBC) Act 1999* Protected Matters database. The search was conducted to determine whether there were any flora and vegetation listings of relevance to the Toro project and to assess whether there were grounds for referral in relation to any of these matters.

4.1.1 Limited Literature and GIS Review

The limited literature and GIS review was focused on information that would place the survey area into a local and regional context. The review included the following:

- A review of the relevant bioregions within the DEC Biodiversity audit;
- A review of Beard vegetation descriptions for the area;
- A review of climate information for the area; and
- A review of the Inventory and Condition Assessment of the Sandstone – Yalgoo – Paynes Find completed by the Department of Agriculture.

4.1.2 Threatened (Declared Rare) and Priority Flora – DEC Database Search

In Section 23F of the *Wildlife Conservation Act 1950,* flora that, in the opinion of the Minister, is likely to become extinct or is rare or is otherwise in need of special protection, may be declared rare by notice published in the *Government Gazette.* Once a species is declared rare, no person, whether licensed to collect flora or the owner of land or an occupier of land, is authorised to take the species without the written permission of the Minister. To take, in the context of the *Act,* includes to gather, pluck, cut, pull up, destroy, dig up, remove or injure the flora or to cause or permit the same to be done by any means.

Priority Flora are not subject to the same level of protection declared rare flora, but, like all vegetation in Western Australia, are protected under the *Environmental Protection Act 1986* and are considered when assessing the conservation value of an area, especially in the context of clearing. A description of the differences between the conservation codes is presented in **Appendix A**.

A search of the DEC *Threatened (Declared Rare) Flora* database and the *Western Australian Herbarium Specimen* database was completed prior to the field survey, based on a polygon with a centre in the middle of the project and a 20 km radius.

4.1.3 Threatened Ecological Communities – DEC Database Search

Within Western Australia, biological assemblages that are considered to be unique, restricted or both can be assigned a status as a Threatened Ecological Community (TEC) or a Priority Ecological Community (PEC). A TEC is gazetted in parliament and Ministerial approval must be sought for any disturbance. There are currently four categories of TEC recognised by the DEC: Presumed Totally Destroyed, Critically Endangered, Endangered and Vulnerable. Definitions of these are presented in **Appendix B**.

Ecological communities that are not recognised as TECs can be listed as Priority Ecological Communities. There are currently four classes of PEC (**Appendix B**). It is possible that ecological communities can be under threat, but do not meet the TEC criteria. In this instance, these communities may be listed as Priority Ecological Communities. It is possible that communities that are currently only considered to be PECs may be upgraded to TECs should threatening processes continue. In light of this, any assessment of vegetation that will potentially be cleared needs to consider both categories of communities and any potential impacts.

A search of the DEC TEC database was completed, based on a polygon with a centre of 50 J 735975, 6711126 (WGS84).

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

The *Environment Protection and Biodiversity Conservation EPBC Act 1999* is a Federal Act drafted to facilitate a national level of protection for natural assets of conservation significance on Commonwealth, State and private lands. The key features of the legislation are the provision of a means to:

- protect biodiversity by identifying threatening processes and ensuring these are appropriately assessed and managed;
- protect critical habitat;
- ensure compliance and enforcement through auditing and legal processes;
- conduct assessments in addition to state assessments; and
- protect natural assets on Commonwealth lands.

To determine whether there were potential matters of national environmental significance associated with the proposed project, a search of the Protected Matters database was undertaken. The Protected Matters database provides a summary of listings under the provisions of the Act. The proposed disturbances do not occur on Commonwealth lands and as such listings of relevance only to Commonwealth lands were not considered. The search was conducted using a search with a radius of 10 km and a centre of -29.70847, 119.43771.

4.2 METHODS – FIELD SURVEY

4.2.1 Timing of Surveys

The autumn survey over tenement M77/1263 was conducted between 16APR12 and 18APR12. The spring survey over tenements M77/1263, L77/248 and G77/119 was conducted between 09SEP12 and 17SEP12.

4.2.2 Survey Locations

A total of six quadrats were established and surveyed within tenement M77/1263 during the autumn survey. A total of 36 quadrats were established and surveyed within tenements L77/248 and G77/119 during the spring survey. The quadrats were located in areas that were considered to be representative of the variation of vegetation within the survey area, and that were subject to the least amount of obvious disturbance, as far as was practicable. The distribution of the quadrats in the survey area is mapped in **Figure 3**. In addition to the quadrats, two releves were used on the old airstrip and adjacent to the old pit and tailings storage facility (TSF) during the autumn survey.

4.2.3 Quadrat Survey Methods

At each quadrat , the following was completed:

- A quadrat measuring 20 m × 20 m was pegged out using 1170 mm Waratah Fence Droppers. The cardinal fence dropper was typically located in the northwest corner. The cardinal fence dropper and the fence dropper located diagonally across the quadrat were left in place. For releves, no pegging out was required.
- A photograph was taken of the quadrat. The photograph was always taken from the cardinal corner. Photographs were taken using Fujifilm A170 digital camera.
- The location of the survey area was recorded using a Garmin GPSmap 62s GPS, with the location recorded in WGS84, UTM.
- All flora present was recorded, with estimates of height and cover made to assist with describing the vegetation. Any species with less than 2 % cover was recorded as a +, all other cover values were recorded as ranges (eg. 2-5, 5-10 etc.).
- The condition of the vegetation and any disturbances were noted.
- The geographical location of the site was recorded, with slope, topography and soil type recorded.
- The extent and nature of litter cover was recorded.

4.2.4 Traverse to develop census

To develop the census, traverses were conducted within the survey area. Traverses were typically completed in the area surrounding quadrats and releves. All specimens collected were assigned a field number and were pressed to facilitate identification in the herbarium. Where appropriate, duplicate specimens were collected from different vegetation units.

4.2.5 Targeted Flora Searches

During the autumn surveys within tenement M77/1263, three priority taxa were recorded: *Baeckea* sp. Parker Range (P3), *Eucalyptus formanii* (P4) and *Malleostemon* sp. Adelong (P2). To develop an understanding of the potential impacts to the these species as a consequence of the disturbance within tenement M77/1263, targeted searches were conducted during spring. Targeted searches were focused within all of the project areas, and adjacent vegetation. In addition to this, areas that were identified as potential habitat for the species in the areas surrounding the project were also subject to searches. In addition to the three species recorded during the autumn, the priority 1 species *Philotheca deserti* subsp. *brevifolia* was recorded during the spring survey. Targeted searches were also conducted for this species in the area in which it was found. Where priority species were observed, the location, number of plants in the area and vegetation unit were recorded.

4.3 METHODS – DATA ANALYSIS AND INTERPRETATION

4.3.1 Taxonomy

Taxonomic work was completed using relevant taxonomic keys, manuscripts and herbarium specimens. Nomenclature was based on Florabase (Western Australian Herbarium, 2012). Where required, opinion from relevant experts was sought.

4.3.2 Vegetation Description and Mapping

The vegetation within the survey area was described using the scale of Muir (1977) (**Appendix C**). The condition of vegetation was described using the scale of Keighery (1994) (**Appendix D**). Vegetation maps presented in the report have been developed based on the information collected during the survey and the interpretation of aerial photography.

4.5 Project personnel

The survey work was completed by Brett Neasham B.Sc. (Biol.) Hons. (Env. Man.).

5.0 RESULTS AND DISCUSSION – DESKTOP REVIEW

5.1 Environmental Setting

5.1.1 IBRA Bioregion

The project was located on the southern border of the Murchison biogeographic region (bioregion), and in close proximity to the Coolgardie and Yalgoo bioregions of the Interim Biogeographic Regionalisation for Australia (or IBRA) (Thackway and Cresswell, 1995). The Murchison bioregion comprises the northern part of the Yilgarn Craton and includes two major components, or subregions; the Eastern Murchison (MUR1), and the Western Murchison (MUR2). The project was within the Eastern Murchison (MUR1) subregion, and adjacent to the Southern Cross (COO2) subregion and as previously stated, the Yalgoo subregion.

The Eastern Murchison (MUR1) subregion was characterised by systems of internal drainage, with extensive tracts of red sandplains, series of salt lake systems that are associated with an occluded Paleodrainage system, broad plains of red-brown soils, and breakaway complexes (Cowan, 2001). The Eastern Murchison (MUR1) subregion was 7 847 996 ha in size and comprised the "Southern Cross" and "Eastern Goldfields" Terranes of the Yilgarn Craton (Cowan, 2001). Vegetation was dominated by Mulga Woodlands that are frequently rich in ephemerals, hummock grasslands, saltbush shrublands and *Halosarcia* shrublands (Cowan, 2001).

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

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

The Yalgoo bioregion was defined as an interzone between the Southwest bioregions and the Murchison bioregion (Desmond and Chant, 2001). The bioregion was approximately 4 858 849 ha in area. Vegetation within the Yalgoo bioregion was characterised as being low to open woodlands comprised of *Eucalyptus, Acacia* and *Callitris* on red sandy plains of the Western Yilgarn Craton and the southern Carnarvon Basin with open woodlands and scrubs of *Acacia aneura* ssp, *Callitris* and *Eucalyptus salubris* and *Acacia ramulosa* on sandy plains in the Western Yilgarn Craton (Desmond and Chant, 2001).

The Southern Cross (COO2) subregion of the Coolgardie bioregion was described by Cowan *et al.* (2001) as being located on the Southern Cross Terrains of the Yilgarn Craton, with a subdued relief largely comprised of gently undulating uplands and broad valley floors with low greenstone hills. The subregion was approximately 7 041 232 ha and has an arid to semi-arid warm Mediterranean climate with mean annual rainfall between 250 – 300 mm (Cowan *et al.,* 2001). Vegetation in the bioregion ranges from Eucalyptus woodlands located on the edges of salt lakes, on low greenstone hills, alluvial valley floors, and plains with calcareous soils, to low heath of samphire on salt lakes to mallees and scrub heath on the uplands and on sandy areas around granite outcrops, on which *Borya constricta* was dominant under a canopy of *Acacia acuminata* and *Eucalyptus loxophleba.*

5.1.2 Beard Vegetation

The project was located within the area described by Beard (1990) as being the Coolgardie Botanical District, within the Southwestern Interzone, but lies very close to its border with the Murchison Region within the Austin Botanical District. The Southwestern Interzone is the region that lays between the Southwest Botanical Province, defined by a more regular dry summer and wet winter climate, and the Eremaean, which is generally more arid and with a more variable rainfall pattern. The Interzone is recognised as displaying vegetation characteristics of both provinces, effectively along a cline.

The Coolgardie region was defined by Beard (1990) as being an area of 126 500 km^2, with no clearing for agriculture and an arid non-seasonal to semi-arid Mediterranean climate with mean annual rainfall between 250 – 300 mm. Beard (1990) described the geology as being Proterozoic granite and gneiss with Archaean granite with volcanics and meta-sediments of the Yilgarn Block. The topography of the area includes gently undulating, with ranges of low hills, sandplains and extensive salt lake systems (Beard, 1990).

The northern section of the Coolgardie region, in which the project is located, adjoins the Murchison region. This area demarcates the boundary between *Eucalyptus* woodlands and *Acacia* woodlands (Beard, 1990). Vegetation in the area immediately to the south of the project, which is an defined by a series of ironstone ranges, ranges from *Acacia quadrimarginea* and *Casuarina* species on rocky sections of ridges, to mallee woodlands on hill slopes and onto plains (Beard, 1990). The understorey was observed by Beard (1990) to contain a mix of *Eremophila* species in the midstorey and *Ptilotus obovatus* and chenopods, with *Atriplex* species the most conspicuous.

The Murchison region was described as being predominately mulga (*Acacia aneura*) woodland on plains which was reduced to scrub on the hills, with *Eucalyptus* spp. and *Triodia basedowii* on sand plains (Beard, 1990). The region was arid, with annual rainfall of approximately 200 mm, received in both summer and winter (Beard, 1990). The geology of the region was Archaean granite with infolded volcanics and greenstones which form the Yilgarn block (Beard, 1990).

5.1.3 Climate

The project falls into a broad bioclimatic region of semi-desert Mediterranean (Leighton, 1998) or hot dry summer and cold winter (Bureau of Meteorology, 2012). This zone was characterised by an annual climate pattern of nine to 11 months of dry weather, with hot dry summers and mild, wet winters (Beard, 1990). The project area was mapped as falling within the arid rainfall zone, characterised by mean annual rainfall of less than 250 mm, by the Bureau of Meteorology (2012) and within the semi-arid zone, characterised by a mean annual rainfall of greater than 250 mm rainfall, by Leighton (Leighton, 1998). The discrepancy is not considered to be significant and is more than likely a product of resolution of mapping of zones. The climate in the region was broadly defined by two patterns; the summer pattern, which runs from November to April; and, the winter pattern, which runs from May to October (Leighton, 1998).

The summer climate pattern was influenced by high pressure systems known as anticyclone systems, which traverse from west to east (Leighton, 1998). The anticyclone produces easterly winds north of 37˚ S. Rainfall can occur as a by-product of cyclones in the north of the state (Leighton, 1998). The presence of low pressure systems can result in the production of heat lows, which produce hot, dry conditions (Leighton, 1998). The winter pattern is defined by the movement of the anticyclone to approximately 29˚ S (Leighton, 1998). As the anticyclone moves, it can remain stationary over areas, resulting in cool, moist, westerly winds and rain producing cold fronts (Leighton, 1998).

Prior to undertaking the surveys, reviews of recent rainfall data for the nearest Bureau of Meteorology recording stations are undertaken. There was no currently operating station at Diemals, but there was a station in operation at the site from 1970 – 1994 (Commonwealth of Australia, 2012). During this timeframe, mean annual rainfall recorded at the site was 275.5 mm, with rainfall received in all months, with a peak of 39 mm in June to a minimum of 14 mm in November (Commonwealth of Australia, 2012). Temperature ranged from a mean maximum of 36.1° C in January and a mean minimum of 17.5° C in July (Commonwealth of Australia, 2012).

The two nearest operating Bureau recording stations to the stations were Paynes Find and Menzies, both of which are approximately 160 km from the project, west and east respectively. In the twelve months prior to the autumn survey (April 2011 – March 2012), there was 494.8 mm of rainfall recorded at Paynes Find, which was substantially higher than the long term average for the site of 284.6 mm (Commonwealth of Australia, 2012). In the three months prior to the autumn survey (January – March 2012), there was 82 mm of rainfall recorded at the site, which was above the long term average for these months of 67.6 mm. In the 12 months prior to the spring survey (September 2011 – August 2012), there was 350.8 mm of rainfall recorded at Paynes Find, which was above the long term average for the site. In the three months prior to the spring survey (June – August 2012), there was 95 mm of rainfall recorded at the Paynes Find recording station, which was slightly below the long term average of 106 mm.

There were no rainfall records for Menzies for the period between January to April 2012 on the Bureau of Meteorology website, and no indication as to whether this reflects an absence of records or of rainfall. In the four months prior to the spring survey (May – August 2012), there was 44.9 mm of rain recorded at the Menzies recording site, which was less than half of the long term average for the four months of 96.7 mm.

To further assist with assessing the potential for adequate rainfall in the region prior to the surveys, the data for Southern Cross, approximately 170 km to the south, and Sandstone, approximately 190 km to the north, was reviewed. In the three months prior to the autumn survey (January – March 2012), there was 42.4 mm of rainfall recorded at Southern Cross, while a total of 83.8 mm of rainfall was recorded for the three months prior to the spring survey (June – July 2012). No average rainfall

data is available for this site, but based on a review of data for the previous years, the 2012 rainfall appears to have been below average.

The variability in rainfall in the region is acknowledged, and it is posited that, based on the rainfall records from a number of sites, there was a general decline in rainfall as recording station locations moved east and south from Paynes Find, which was the site with the highest rainfall in the area surrounding the site. In addition to this, higher levels of rainfall appear to have been recorded during the summer rainfall period, with a clear decline moving towards spring. This pattern is broadly consistent with the weakly bimodal rainfall patter in the region, although there was a clear increase in rainfall recorded in summer of 2012 compared to long term patterns. Given the high variability in this region, it is asserted that there was a high probability of adequate rainfall before the autumn surveys, but that rainfall prior to the spring surveys may have been less than optimal. The considerations of this in relation to the survey are addressed in the survey limitations.

5.1.4 Payne *et al.* (1998)

A survey of the Sandstone – Yalgoo – Paynes Find area was undertaken by Payne *et al.* (1998), with a view to delineating and defining the natural values of the area. While the surveys were completed to assist with understanding pastoral potential in the area, the information collected provides a valuable broadscale view of the region. The surveys covered an area of 94 700 km^2 and included the region in which the Gwendolyn Gold Project was located.

One of the key outcomes of the survey by Payne *et al.* (1998) was the development of a series of maps illustrating the land types and land systems throughout the Sandstone – Yalgoo – Paynes Find area. The region was noted as containing 20 land types, within which there were 76 land systems (Payne *et al.,* 1998). The land systems were of the main interest in this report, as they provide a description of the landscape based on landforms, soils, vegetation and drainage patterns.

The project was located on four land systems: Moriarty, Tealtoo, Dryandra and Bannar. The distribution of these over the survey area is illustrated in **Figure 4**. A brief summary of the key features of the two land systems is provided.

The majority of the project was located on the Moriarty land system. The Moriarty land system formed part of land type 8, which were described as being wash plains on hardpan with mulga shrublands (Payne *et al.,* 1998). The Moriarty system was mapped by Payne *et al.* (1998) as covering 825 km^2, or 0.9 % of the Sandstone – Yalgoo – Paynes Find survey area. Payne *et al.* (1998) defined six distinct zones within the Moriarty land system – low rises, stony plains, gravelly saline plains, gravelly plains, alluvial plains and drainage tracts.

Within the sections of the project defined as being on the Moriarty land system, the majority was considered to fit within the areas defined by Payne *et al.* (1998) as being stony plains and gravelly

saline alluvial plains. Of the vegetation types Payne *et al.* (1998) describe as likely to occur on the previous landforms, the Plains Eucalypt Chenopod Woodland (PECW) is considered to be the type at the site. The PECW unit was characterised by Pringle (1998) as having a canopy dominated by *Eucalyptus salubris,* with *E. loxophleba* and *E. salmonophloia* as less commonly observed co-dominant species, over a midstorey comprised of *Atriplex* species, *Eremophila* species and *Acacia acuminata* over an understorey of low chenopod species, *Ptilotus obovatus* and *Olearia muellerii* with mixed grasses.

A substantial proportion of the project was on the Tealtoo land system. The Tealtoo land system formed part of land type 16, which were described as being level to gently undulating loamy plains with fine ironstone lag gravel supporting dense acacia shrublands (Payne *et al.,* 1998). The Tealtoo land system covers 693 km^2, or 0.7 % of the Sandstone – Yalgoo – Paynes Find area as surveyed by Payne *et al.* (1998). Within the Tealtoo land system, Payne *et al.* (1998) mapped five distinct zones – stony plains, gravelly plain/loamy plain, gravelly hardpan plain, gravelly sand sheet and alluvial plain. Of these, the project is considered to be on the stony plains and the gravelly plains/loamy plains landforms.

The section of the project defined as being on the stony plains landform was considered to host the vegetation type defined by Pringle (1998) as Stony ironstone acacia shrubland (SIAS). The SIAS vegetation type was characterised by Pringle (1998) as being dominated by *Acacia* species with an occasional overstorey, which was not observed at a number of sites, of *Eucalyptus* or *Casuarina* species, over a highly variable midstorey and lower storey.

On the gravelly plains/loamy plains landform, the vegetation type Plain York gum acacia woodland (PYAW), as described by Pringle (1998), was considered to be the vegetation type at the project. The PYAW vegetation unit was characterised by Pringle (1998) as a canopy of *Eucalyptus loxophleba,* and other *Eucalyptus* species over a midstorey dominated by *Acacia ramulosa, A. tetragonophylla* and *A. acuminata* over a midstorey and lower storey of *Senna artemisioides, Eremophila* species and a mix of *Acacia* species and chenopod species over grasses dominated by *Monachather paradoxus* and *Amphipogon caricinus*.

The balance of the project area was located on the Bannar and Dryandra land systems. The Bannar land system formed part of the land type 11, which were described as being level to gently undulating sandy plains with acacia shrublands, commonly with patchy native pines and mallees (Payne *et al.,* 1998). The Bannar land system covers 6 937 km^2, or 7.3 % of the Sandstone – Yalgoo – Paynes Find area as surveyed by Payne *et al.* (1998). Within the Bannar land system, Payne *et al.* (1998) mapped four distinct zones – gravelly sand sheets, sand sheets, loamy plains and stony plains. The section of the project on the Bannar land systems was considered to be on the gravelly sand sheets, with the lateritic sandplain acacia shrubland (LACS) described by Pringle (1998) the vegetation within the project area.

The Dryandra land system formed part of the land type 2, which were described as being ridges of banded ironstone formation supporting dense mixed shrublands with emergent native pines, mallees and casuarinas (Payne *et al.,* 1998). The Dryandra land system covered 353 km^2, or 0.4 % of the Sandstone – Yalgoo – Paynes Find survey area as surveyed by Payne *et al.* (1998). Within the Dryandra land system, Payen *et al.* (1998) mapped four distinct zones – ridges, hillslopes, stony plains and narrow drainage lines. The section of the project area on the Dryandra land system was considered to be on the hillslopes, and hosted the vegetation unit described by Pringle (1998) as greenstone hill mixed woodland or shrubland (GHMW).

5.2 Threatened (Declared Rare) and Priority Flora – DEC Database Search

According to DEC records (database search 24 – 0112FL; DEC, 2012a), there was one Threatened (Declared Rare) Flora recorded close to the project area, being *Tetratheca paynterae* subsp. *cremnobata* R. Butcher. There were two WAHERB records of this species, both at the same location, approximately 20 km south of the project (**Figure 5**). This species is typically recorded on proud ridges of banded ironstone, and, based on site-specific information, was considered to be unlikely to occur within the project area

There were 13 priority species listed in the database search. The 13 species were comprised of two priority species, one priority 2 species, seven priority 3 species and three priority 4 species. There were no records from within the project; however, there were two records of the priority 4 species *Eucalyptus formanii* on the edge of the tenement (**Figure 5**). A summary of the species recorded in the database search and their habitat is provided in **Table 2**. Based on the review of habitat data for the species, it was considered that all priority flora listed in the search had the potential to occur within the project area.

5.3 Threatened Ecological Communities – DEC database search

There were no Threatened Ecological Communities (TECs) identified as occurring within the database search area (reference 19 – 0512EC; DEC 2012b). There were five Priority Ecological Communities (PECs) identified in the database search. The PECs occurring the area are:

- Lake Giles vegetation complexes (banded ironstone formation).
- Mount Manning Range vegetation complexes (banded ironstone formation).
- Mount Jackson Range vegetation complexes (banded ironstone formation).
- Windarling Range vegetation complexes (banded ironstone formation).
- Die Hardy Range vegetation complexes (banded ironstone formation).

These vegetation complexes are all priority 1 ecological communities. None of the PECs are within the project area. The Die Hardy Range vegetation complexes are the closest, with the buffer of this PEC within 1 km of the southeast corner of the tenement. It is noted that the buffer of this PEC is 18 500 m. The distribution of the PECs in relation to the project is presented in **Figure 6**.

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

There was two species of flora listed in the EPBC Protected Matters database search, *Ricinocarpos brevis* and *Tetratheca paynterae.* It was noted that *T. paynterae* is a common species, while the subspecies *T. paynterae* subsp. *cremnobata* is listed as threatened by the DEC. *Tetratheca paynterae* subsp. *cremnobata* was listed in the DEC database search for the area, but there were no records of *R. brevis* (refer 7.2). There were no ecological communities, conservation areas or other areas of national environmental significance listed for the search area. The weed species *Carrichtera annua* was listed in the database search results, but a record of this in the project area is not likely to constitute an impact of national environmental significance. Based on this, there were not considered to be any reasons for referring the project based on impacts to flora and vegetation.

6.0 RESULTS and DISCUSSION - VEGETATION

6.1 Vegetation Descriptions and Condition Assessment

There were a total of 26

vegetation units defined and delineated within the project area. The vegetation units were within seven broad groups, which were based on landforms on which the vegetation was observed. The broad landform groupings for the vegetation were:

- Plains vegetation
- Sandplains vegetation
- Floodplains vegetation
- Ephemeral drainage line vegetation
- Banded Ironstone Formation and concretionary weathered ironstone vegetation
- Basalt hills vegetation
- Greenstone hills vegetation

The vegetation units found within the survey area are detailed and discussed based on the landforms. An image of each of the units is presented in **Appendix E.** The location of the vegetation units within the survey area is presented on **Figures 7 – 10.**

6.1.1 Plains vegetation

The plains vegetation within the project was generally defined by soils of red clay, on flat to very gently sloping plains that were noted in areas to contain pebbles and stones of ironstone, quartz and basalt. The plains vegetation units were the most widely observed within the project area, and contained a total of 12 units.

> BW1 – Low Woodland B of *Acacia ramulosa* var. *ramulosa, Eucalyptus ewartiana* and *A. aneura* over Open Low Scrub A of *Baeckea elderiana, Prostanthera grylloana* and *Eremophila forestii* subsp. *forestii* on red clay in a flat to very gently sloping valley floor.

This vegetation unit was characterised by an upper storey to 5 m that was dominated by *Acacia ramulosa* var. *ramulosa* and *A. aneura* with either *Eucalyptus ewartiana* or *E. kochii* subsp. *plenissima* over a midstorey to 1.5 m that included *Baeckea elderiana, Prostanthera grylloana, Eremophila forestii* subsp. *forestii, Acacia tetragonophylla* and *Senna artemisioides* subsp. *filifolia.* The understorey was poorly developed and consisted of scattered occurrences of *Ptilotus obovatus, Dianella revoluta* var. *divaricata.* There were very occasional clumps of grasses within the vegetation. The priority 2 species *Malleostemon* sp. Adelong (G. J. Keighery 11825) was recorded in this vegetation unit. The vegetation in this unit was assessed as being in good to very good condition. The vegetation was noted as being close to old exploration tracks and was adjacent to the old workings. An image of this unit is presented as **Plate 1** in **Appendix E**. This vegetation unit was recorded in M77/1263. The distribution of this unit is presented in **Figure 7**.

PW2 - Low Woodland B of *Acacia ramulosa* var. *ramulosa, A. aneura* and *A. caesaneura* on red clay

This vegetation was characterised by an upper storey to 5 m dominated by *Acacia* species, with scattered occurrences of *Grevillea nematophylla* subsp. *nematophylla* and *Hakea recurva.* There was a very scattered emergent canopy of *Eucalyptus kochii* and *E. loxophleba* in this unit. The understorey in this unit was variable, with *Scaevola spinescens, Eremophila latrobei, Eremophila forestii* and *Ptilotus obovatus* commonly observed. Grasses recorded in this unit included *Monachather paradoxus* and *Amphipogon caricinus* var. *caricinus.* The vegetation in this unit was assessed as being in good to degraded condition. The vegetation was dissected by a number of tracks and fencelines. In addition to this, there was evidence of logging in some areas and impacts associated with cattle. An image of this unit is presented as **Plate 2** in **Appendix E**. This vegetation unit was recorded in G77/119 and L77/248. The distribution of this unit is presented in **Figures 8** and **9.**

PW3 – Woodland of *Eucalyptus salubris* and *E. clelandii* over Open Low Scrub B of *Atriplex nummularia, Eremophila pantonii* and *Senna artemisioides* subsp. x *artemisioides* over Open Dwarf Scrub D of chenopods on plains with red clay and scattered gravel of ironstone and quartz.

This vegetation unit was characterised by a canopy to 15 m of *Eucalyptus salubris* and *E. clelandii,* with these trees usually having a patchy, clumped distribution. The midstorey of this unit was comprised of an Open Low Scrub to 1.5 m comprised of *Atriplex nummularia, Eremophila pantonii* and *Senna artemisioides* subsp. *x artemisioides,* with *Exocarpos aphyllus, Eremophila decipiens* subsp. *decipiens* and *Scaevola spinescens* also widely observed. The lower-story was very sparse and open, and was dominated by chenopods. The vegetation in this unit was assessed as being in good to degraded good condition. There was some disturbance to the vegetation as a consequence of proximity to the old airstrip and the main access track into M77/1263, as well as old and new exploration tracks. In addition to this, there was a small area that was infested with the weed species *Centaurea melitensis* and *Solanum hoplopetalum.* The infestation was noted as being restricted to

one small area adjacent to the old strip. There was no evidence of any other disturbances in this unit. An image of this unit is presented as **Plate 3** in **Appendix E**. This vegetation unit was recorded in M77/1263 and L77/248. The distribution of this unit is presented in **Figure 7**.

PW4 – Open Low Woodland A of *Callitris columellaris* over Open Low Woodland B of *Acacia ramulosa* var*. ramulosa, A. acuminata* and *Grevillea obliqiostigma* subsp*. obliquistigma* on red clay

This vegetation unit was characterised by an emergent canopy to 10 m of *Callitris columellaris* over an Open Low Woodland to 4 m dominated by *Acacia* species and *Grevillea obliquistigma* subsp. *obliquistigma* . The mid storey in this unit was comprised of *Westringia rigida, Baeckea elderiana, Scaevola spinescens* and *Prostanthera grylloana.* The understorey contained *Dianella revoluta* var. *divaricata, Ptilotus obovatus* and *Monachather paradoxus*. The vegetation in this unit was assessed as being in good to degraded condition. The main disturbance associated within this unit was the old haulroad, which dissected the unit. An image of this unit is presented as **Plate 4** in **Appendix E**. This vegetation unit was recorded in L77/248. The distribution of this unit is presented in **Figure 10**.

PW5 – Open Low Woodland A of *Eucalyptus clelandii* over Open Dwarf Scrub C of *Atriplex nummularia* on red clay with scattered pebbles and stones of basalt.

This vegetation unit was characterised by a canopy to 15 m of *Eucalyptus clelandii* over a very poorly developed understorey dominated by *Atriplex nummularia* and *Eremophila scoparia.* Other species recorded in this unit included *Acacia acuminata, Ptilotus obovatus, Scaevola spinescens* and *A. tetragonophylla;* however, these were very scattered. The vegetation in this unit was assessed as being in good to very good condition. There were some impacts associated with grazing and pastoral activities, but these appeared to have been fairly limited. An image of this unit is presented as **Plate 5** in **Appendix E**. This vegetation unit was recorded in L77/248. The distribution of this unit is presented in **Figure 8**.

PW6 – Open Low Woodland A of *Eucalyptus griffithsii* and *Casuarina pauper* over Low Woodland B of *Acacia* species on red clay with scattered ironstone and basalt pebbles

This vegetation was characterised by a canopy to 15 m of *Eucalyptus griffithsii* and *Casuarina pauper* over a Low Woodland B of *Acacia ramulosa* var. *ramulosa, A. cockertoniana* and *A. aneura.* Thie midstorey in this unit was variable, and included *Philotheca brucei* var. *brucei, Eremophila latrobei, Eremophila forestii, Eremophila decipiens* subsp. *decipiens, Lecuopogon* sp. Clyde Hill and *Scaevola spinescens.* The understorey contained *Ptilotus obovatus,* and a mix of chenopods and grasses. An image of this unit is presented as **Plate 6** in **Appendix E**. This vegetation unit was recorded in L77/248. The distribution of this unit is presented in **Figures 8** and **10**.

PW7 – Open Low Woodland A of *Eucalyptus griffithsii* over Open Low Scrub A of *Eremophila scoparia* and *Atriplex nummularia* on red clay with very scattered ironstone and basalt pebbles.

This vegetation was characterised by a canopy to 15 m of *Eucalyptus griffithsii* over a species poor Open Low Scrub comprised almost entirely of *Eremophila scoparia* and *Atriplex nummularia* to about 2 m. The very poorly developed understorey was comprised largely of chenopods. The vegetation in the unit was assessed as being in good to degraded condition. The vegetation on the eastern haulroad within L77/248 had been dissected by the old haulroad, while the vegetation on the western haulroad section of L77/248 had been affected by pastoral tracks and grazing by cattle. An image of this unit is presented as **Plate 7** in **Appendix E**. This vegetation unit was recorded in L77/248. The distribution of this unit is presented in **Figures 8** and **10**.

PW8 – Open Low Woodland A of Eucalyptus kochii and Casuarina pauper over Low Woodland B of Acacia species on red clay with scattered ironstone pebbles and stones

This vegetation was characterised by a canopy to 10 m of *Eucalyptus kochii* and *Casuarina pauper* over a Low Woodland B to 4 m dominated by *Acacia ramulosa* var. *ramulosa, A. aneura, A. tetragonophylla* and *A. caesaneura.* Other species recorded in this unit included *Brachychiton gregori, Eremophila forestii, Eremophila latrobei* and *Dodonaea rigida.* The vegetation in this unit was assessed as being in good to very good condition, with a limited amount of evidence of grazing by cattle. An image of this unit is presented as **Plate 8** in **Appendix E**. This unit was recorded L77/248. The distribution of this unit is presented in **Figure 8**.

PW9 – Open Low Woodland A of Eucalyptus kochii over Low Woodland B of Acacia species on red clay with ironstone pebbles

This vegetation was characterised by a canopy to 15 m of *Eucalyptus kochii* over a Low Woodland B to 4 m dominated by *Acacia ramulosa* var. *ramulosa, A. aneura, A. tetragonophylla* and *A. caesaneura.* The mid storey in this unit also feature *Brachychiton gregori, Eremophila latrobei* and *Philotheca brucei* var. *brucei.* The vegetation in this unit was assessed as being in good to degraded condition. The vegetation on the western haulroad section of L77/248 was good condition, wthi some evidence of impacts from grazing and old exploration tracks, which the vegetation to the north of M77/1263 was in worse condition, largely due to the access track into the project area. An image of this unit is presented as **Plate 9** in **Appendix E**. This unit was recorded in L77/248. The distribution of this unit is presented **Figure 7** and **8**.

PW10 – Low Woodland A of *Eucalyptus* species over Low Woodland B of *Acacia ramulosa* var. *ramulosa, A. aneura* and *A. caesaneura* over red clay with scattered gravel of ironstone and quartz.

This vegetation unit was characterised by a Low Woodland A comprised of *Eucalyptus salubris, E. kochii* subsp. *plenissima, E. loxophleba* subsp. *supralaevis* and *E. formanii* (P4), growing to approximately 10 m. Approximately 30 trees of *E. formanii* were recorded in the area surrounding the

quadrat. There were also scattered occurrences of *Callitris columellaris* in this strata. The Low Woodland B, to a height of 3 m, with *Acacia ramulosa* var. *ramulosa* as the main species, and *A. aneura* and *A. caesaneura* as co-dominants. Other species recorded in this strata included *A. tetragonophylla* and *Dodonaea rigida.* The lower stratum were poorly developed, with scattered *Spartothamnella teucriiflora, Dianella revoluta* var. *divaricata* and *Ptilotus obovatus* over *Monachather paradoxus.* The vegetation in this unit was assessed as being in good to degraded condition. The vegetation had been impacted by clearing for tracks used for historic and current exploration. In addition to this, the vegetation in some sections had been impacted by disturbances associated with the development and use of the old pit. In areas where there had been no direct disturbance, the structure of the vegetation was largely intact. Litter cover was up to 70 % in some areas, and was largely comprised of leaves and bark, with occasional twigs and branches. With the exception of some rabbit scratchings and droppings, there was no evidence of terrestrial vertebrate activity in the area.
An image of this unit is presented as **Plate 10** in **Appendix E**. This vegetation unit was recorded in M77/1263 and L77/248. The distribution of this unit is presented in **Figure 7**.

PW11 – Open Low Woodland of *Eucalyptus salubris* over Open Scrub B of *Eremophila scoparia, Exocarpos aphyllus* and mixed species on red clay with ironstone and quartz pebbles and stones

This vegetation was characterised by a canopy to 15 m with comparatively poorly developed mid and lower stories dominated by *Eremophila scoparia* and *Exocarpos aphyllus* to 2 m. Other species recorded in this unit included *Acacia acuminata, Ptilotus obovatus* and *Senna artemisioides* subsp. *filifolia.* The vegetation in this unit was assessed as being in good to degraded condition. The vegetation had been impacted by grazing by cattle, and the occurrences adjacent to the access track into M77/1263 had been dissected by the track. An image of this unit is presented as **Plate 11** in **Appendix E**. This vegetation unit was recorded in L77/248. The distribution of this unit is presented in **Figures 7** and **8**.

PW12 - Open Woodland of *Eucalyptus oleosa* over Low Woodland B of *Acacia ramulosa* var. *ramulosa, A. aneura* and *A. acuminata* on red clay with basalt and ironstone pebbles

The vegetation in this unit was characterised by a canopy to 10 m of *Eucalyptus oleosa* over a Low Woodland B to 4 m dominated by *Acacia* species. The understorey in this unit was dominated by chenopods, with scattered occurrences of *Ptilotus obovatus* and grasses. The vegetation in this unit was assessed as being in good condition, with evidence of impacts from gravel and a series of tracks in the area. An image of this unit is presented as **Plate 12** in **Appendix E**. This vegetation unit was recorded in L77/248. The distribution of this unit is presented in **Figure 8**.

6.1.2 Sandplains vegetation

There was small section of sandplains located on the eastern end of tenement L77/248. This area was characterised by shallow light orange sandy loam over concretionary gravel. There was one vegetation unit located on the sandplains.

> SS – Sandplain Scrub of *Acacia ramulosa* var. *ramulosa, A. aneura* and *Grevillea obliquistigma* subsp. *obliquistigma* Parker Range form on shallow light orange sandy loam over concretionary gravel.

This vegetation unit was characterised by a scrub, typically to around 3 m, dominated by *Acacia ramulosa* var. *ramulosa, A. aneura* and *Grevillea obliquistigma* subsp. *obliquistigma* Parker Range form with *Baeckea* aff. *elderiana, Eremophila latrobei* and *Melaleuca uncinata* and occasional emergent *Allocasuarina eriochlamys* subsp. *eriochlamys* over a mid storey of *Prostanthera grylloana* and *Euryomrytus recurva.* The priority 1 species *Philotheca deserti* subsp. *brevifolia* was recorded in this unit. The vegetation in this unit was assessed as being in very good condition, with limited disturbance from old tracks and rabbits. An image of this unit is presented as **Plate 13** in **Appendix E**. This vegetation unit was recorded in L77/248. The distribution of this unit is presented in **Figure 10**.

6.1.3 Floodplains vegetation

There were three floodplain vegetation units recorded within the project survey area. These units were characterised by proximity to ephemeral drainage lines, but generally lacked any clearly defined banks or contouring consistent with the ephemeral drainage lines. The floodplains units were considered to be consistent with plains vegetation units *sens lat* of the Murchison, where plain and floodplain topography plays a role in promoting the rapid movement of water from significant rainfall events into better developed drainage systems.

> FPW1 – Low Woodland of *Acacia aneura, A. ramulosa* var. *ramulosa* and *A. acuminata* with occasional emergent *Eucalyptus loxophleba* on red clay

This vegetation unit was characterised by a Low Woodland to a maximum height of 7 m, but with most plants ranging between 2 – 4 m, dominated by *Acacia aneura,* with *A. ramulosa* var. *ramulosa* and *A. acuminata* as co-dominant species. There were occasional emergent *Eucalyptus loxophleba* recorded in this unit, with the concentration of these increasing with proximity to the ephemeral drainage line unit located adjacent to this unit. The understorey in this unit was poorly developed, potentially as a consequence of grazing by cattle. The vegetation in this unit was assessed as being in good condition, with obvious impacts associated with activity by cattle and some evidence of impacts from historic clearing. No flora of conservation significance were observed in this unit. An image of this unit is presented as **Plate 14** in **Appendix E**. This vegetation unit was recorded in G77/119. The distribution of this unit is presented in **Figure 9**.

FPW2 – Open Woodland of *Eucalyptus griffithsii* over Open Low Woodland B of *Acacia* species and *Eremophila scoparia* on red clay with occasional sections of exposed hardcap of weather basalt.

This vegetation unit was characterised by a canopy to 15 m of *Eucalyptus griffithsii* over a Low Woodland B to 2 m containing *Acacia tetragonophylla, A. acuminata* and *A. obtecta* with *Eremophila scoparia* as a co-dominant species. The understorey in this unit was comprised of a mix of grasses, *Ptilotus obovatus* and chenopods, generally to a maximum height of 0.5 m. The vegetation in this unit was assessed as being in good condition. The vegetation was dissected by a pastoral track, and was clearly impacted by pastoral activities and grazing by cattle. An image of this unit is presented as **Plate 15** in **Appendix E**. This vegetation unit was recorded in L77/248. The distribution of this unit is presented in **Figure 8**.

FPW3 – Open Woodland of *Eucalyptus kochii* and *E. loxophleba* over Open Low Woodland B of *Acacia acuminata* and *Eremophila oppositifolia* subsp. *angustifolia* on red clay with occasional scattered outcropping of weathered basalt.

This vegetation unit was characterised by a canopy to 15 m of *Eucalyptus kochii* and *E. loxophleba* over a Low Woodland B to 3 m, dominated by *Acacia acuminata* and with *Eremophila oppositifolia* subsp. *angustifolia.* The lower stories in this unit were dominated by chenopods. The vegetation in this unit was assessed as being in good condition, with evidence of impacts associated with cattle the main disturbance observed. An image of this unit is presented as **Plate 16** in **Appendix E**. This vegetation unit was recorded in L77/248. The distribution of this unit is presented in **Figure 8**.

6.1.4 Ephemeral drainage line vegetation

There were two ephemeral drainage line vegetation units defined and delineated within the survey area. The key differences between the floodplain and ephemeral drainage line units related to the presence of some degree of bank formation in the ephemeral drainage lines.

EDW1 – Open Low Woodland A of *Eucalyptus loxophleba* and *E. kochii* over Open Low Woodland B of *Acacia ramulosa* var. *ramulosa, A. aneura* and *A. acuminata* on red clay with sections of exposed, laterised hardcap and calcrete.

This vegetation unit was characterised by a canopy to 15 m of *Eucalyptus loxophleba* and *E. kochii* over an Open Low Woodland B to 4 m dominated by *Acacia* species. The understorey in this unit was generally comprised of chenopods, with occasional grasses and *Ptilotus* species. The vegetation in this unit was assessed as being in good to very good condition. There was evidence of impacts from tracks associated with pastoral activities and grazing by cattle. An image of this unit is presented as **Plate 17** in **Appendix E**. This vegetation unit was recorded in G77/119. The distribution of this unit is presented in **Figure 9**.

EDW2 – Low Woodland B of *Acacia* species on red clay with exposed hardcap of concretionary laterised ironstone.

This vegetation unit was characterised by an upper storey to 4 m, comprised of *Acacia acuminata, A.aneura, A. ramulosa* var. *ramulosa* and *A. tetragonophylla,* with *Grevillea nematophylla* subsp. *nematophylla, Eucalyptus ewartiana* and *Brachychiton gregori* as co-occurring species. The understorey in this unit was poorly developed, largely due to the extensive sections of exposed hardcap. The vegetation in this unit was assessed as being in good to degraded condition. The unit was dissected by the main access track into M77/1263 and a series of smaller, old drill lines. An image of this unit is presented as **Plate 18** in **Appendix E**. This vegetation unit was recorded in L77/248, to the north of M77/1263. The distribution of this vegetation is presented in **Figure 7**.

6.1.5 Banded Ironstone Formation and concretionary weathered ironstone vegetation

There were several small sections of low banded ironstone and concretionary weathered ironstone formations in the project areas. These were generally characterised by a low topography, containing ironstone rocks of varying sizes, some of which were clearly weathered or had undergone further geological process to form ironstone that was more concretionary in nature. There were three vegetation units recorded on these formations.

PW1 – Low Woodland B of *Acacia cockertoniana, A, burkittii* and *Eremophila oldfieldii* with an emergent canopy of *Allocasuarina acutivalvis* subsp. *acutivalvis* over Low Scrub B of *Philotheca brucei* subsp. *brucei, Dodonaea rigida* and *Leucopogon* sp. Clyde Hill (M.A. Burgman 1207) over Open Dwarf Scrub D of *Prostanthera althoferi* subsp. *althoferi* and *Dianella revoluta* var. *divaricata* over Very Open Low Grasses of *Monachather paradoxus* and *Amphipogon caricinus* var. *caricinus* on red clay on low ridge of basalt with ironstone intrusions.

This unit was characterised by an upper storey to 4 m of *Acacia cockertoniana, A. burkittii* and *Eremophila oldfieldii* subsp. *angustifolia,* with *A. caesaneura* and *A. tetragonophylla* with an emergent canopy to 10 m of *Allocasuarina acutivalvis* subsp. *acutivalvis.* The mid storey was to a height of 1.5 to 2 m, and was dominated by *Philotheca brucei* subsp. *brucei, Dodonaea rigida* and *Leucopogon* sp. Clyde Hill, with *Exocarpus aphyllus, Senna artemisioides* subsp. *filifolia* and *Eremophila decipiens* subsp. *decipiens* as co-occurring species. The lower storey, to a height of 0.5 m, was mainly comprised of *Prostanthera althoferi* subsp. *althoferi,* with *Dianella revoluta* var. *divaricata* and *Ptilotus obovatus* the next two most widely observed species in this storey. The grass layer was dominated by *Monachather paradoxus* and *Amphipogon caricinus* var. *caricinus.* This vegetation unit was assessed as being in good condition, according to the scale of Keighery (1994). The unit was adjacent to the old pit and TSF, and contained a number of old tracks. A number of the old tracks appeared to have been undisturbed for some time, and were in comparatively advanced stages of revegetation. An image of this unit is presented as **Plate 19** in **Appendix E**. This vegetation unit was recorded in M77/1263. The distribution of this unit is presented in **Figure 7**.

BW2 – Low Woodland B of *Acacia* species and *Grevillea nematophylla* var. *nematophylla*

The vegetation in this unit was characterised by an upper storey to 4 m comprised of *Acacia ramulosa* var. *ramulosa, A. acuminata* and *A. tetragonophylla* with *Grevillea nematophylla* var. *nematophylla* recorded as a co-dominant species. Other species recorded in this unit included *Hakea recurva, Psydrax linearis, Eremophila latrobei* and *Westringia rigida.* The vegetation in this unit was assessed as being in good to very good condition. These were some impacts associated with cattle and a fenceline. An image of the vegetation is presented as **Plate 20** in **Appendix E**. This vegetation unit was recorded in G77/119. A map showing the distribution of this unit is presented in **Figure 9**.

BW3 – Open Low Woodland A of *Eucalyptus* species over Low Woodland B of *Acacia ramulosa* var. *ramulosa, A. aneura* and *A. caesaneura* over Open Low Scrub B of *Philotheca brucei* subsp. *brucei, Dodonaea rigida* and *Eremophila decipiens* subsp. *decipiens* on red flat plain to very gently sloping low hills of red clay with ironstone, quartz and basalt gravel and very occasional minor outcroppings of basalt and ironstone.

This vegetation unit was characterised by an Open Low Woodland A comprised of *Eucalyptus salubris, E. loxophleba* subsp. *supralaevis* and *E. kochii* subsp. *plenissima,* to a height of 10 m, with occasional *Allocasuarina acutilvalvis* subsp. *acutivalvis* and *Casuarina pauper.* The middle storey, to a height of 4 m, was dominated by *Acacia ramulosa* var. *ramulosa, A. aneura* and *A. caesaneura,* with *A. burkittii* and *A. tetragonophylla* also comparatively common. The lower storey was comparatively open and scattered, with *Philotheca brucei* subsp. *brucei, Dodonaea rigida* and *Eremophila decipiens* subsp. *decipiens* as the key species, with *Scaevola spinescens, Senna artemisioides* subsp. *filifolia* and *Senna artemisioides* subsp. x *artemisioides* as co-occurring species. The lowest strata was poorly developed, with occasional *Ptilotus obovatus* and *Olearia muellerii* the most widely observed species, with scattered patches of chenopods also noted. The priority 3 species *Baeckea* sp. Parker Range (M. Hislop & F. Hort MH 2968) was recorded in this unit. The condition of the vegetation was assessed as being good to degraded. The main disturbances noted in this unit were associated with an old haulroad or main access track and a series of old exploration tracks. It was noted that impacts were highly localised and areas that had been free of disturbance for some time were revegetating. An image of the vegetation is presented as **Plate 21** in **Appendix E**. This vegetation unit was recorded in M77/1263 and L77/248. The distribution of this unit in the project is presented in **Figures 7** and **10.**

6.1.6 Greenstone hills vegetation

There was a section of greenstone hills at the northern end of the proposed access track into the main project area (M77/1263). There was one vegetation unit recorded on this section of greenstone hills.

GW – Low Woodland B of *Acacia* species and *Eremophila oldfieldii* subsp. *angustifolia* on red clay on low greenstone hill.

The vegetation in this unit was characterised by an upper storey to 4 m of *Acacia aneura, A. ramulosa* var. *ramulosa, A. tetragonophylla* and *A. acuminata,* with *Eremophila oldfieldii* subsp *angustifolia* and *Santalum acuminatum* as co-dominant species. The mid storey in this unit contained *Dodonaea rigida, Scaevola spinescens* and *Philotheca brucei* subsp. *brucei.* The understorey in this unit was species poor, with *Ptilotus obovatus* the main plant observed. The vegetation in this unit was assessed as being good to degraded condition. The vegetation was dissected by a number of tracks and the Diemals – Menzies Road. An image of this unit is presented as **Plate 22** in **Appendix E**. This vegetation unit was recorded in L77/248 at the northern end of the access track into the project area. The distribution of this vegetation is presented in **Figure 7**.

6.1.7 Basalt hills vegetation

There were a series of low basalt hills located on the western end of L77/248, close the G77/119. These hills formed part of an undulating landscape, with the low hills interspersed with sections of plains and floodplains vegetation. There were four units defined and delineated on the basalt hills.

BHLW – Low Woodland B *Acacia* species and *Allocasuarina dielsiana* over Open Low Scrub A of *Dodonaea rigida, Protstanthera alotherferi* subsp. *althoferi* and *Acacia caesanaeura* on red clay with scattered basalt stones and outcropping

This vegetation unit was characterised by an upper storey to 5 m of *Acacia ramulosa* var. *ramulosa, A. aneura* and *A. tetragonophylla,* with *Allocasuarina dielsiana* as a co-dominant species. There was an emergent canopy of scattered *Casuarina pauper.* The Low Scrub to 2 m in this unit was dominated by *Dodonaea rigida, Prostanthera althoferi* subsp. *althoferi* and *A. caesaneura,* with *Hakea recurva, Westringia rigida* and *Scaevola spinescens* also recorded in this unit. The vegetation in this unit was assessed as being in good – very good condition, with evidence of disturbance associated with cattle noted. An image of this unit is presented as **Plate 23** in **Appendix E**. This vegetation unit was recorded in L77/248 in the western section of the haulroad. The distribution of this vegetation is presented in **Figure 8.**

BHOLW-A – Open Low Woodland A of *Casuarina pauper* over Open Low Scrub B of *Scaevola spinescens, Eremophila decipiens* subsp. *decipiens* and *E. scoparia* on red clay on low hill of basalt

This vegetation was characterised by an upper storey to 5 m of *Casuarina pauper* over an Open Low Scrub B to 1.5 m dominated by *Scaevola spinescens, Eremophila decipiens* subsp. *decipiens* and *e. scoparia,* with *Westringia rigida, Alyxia buxifolia* and *Dodoanea lobulata* as co-occurring species. There was a very poorly defined mid storey of *Acacia acuminata* and *Santalum acuminatum* and a poorly defined understorey of *Ptilotus obovatus* and chenopods and grasses. The vegetation in this unit was assessed as being in good to degraded condition. The vegetation had been impacted by historic disturbances associated with exploration and impacts from cattle. An image of this unit is

presented as **Plate 24** in **Appendix E**. This vegetation unit was recorded in L77/248 in the western section of the haulroad. The distribution of this vegetation is presented in **Figure 8**.

BHOLW-B – Open Low Woodland B of *Acacia cockertoniana, A. caesaneura* and *A. aneura* over Low Scrub B of *Baeckea* aff. *elderiana* on red clay on weathered basalt and ironstone.

This vegetation was characterised by an upper storey to 3 m of *Acacia* species, with occasional emergent *Casuarina pauper* and *Eucalyptus formanii* over a mid storey to 1.5 m that was effectively comprised of *Baeckea* aff. *elderiana.* This species formed small thickets that were scattered through this unit. In the mid storey, there were also records of *Grevillea obliquistigma* subsp. *obliquistigma* Parker Range form, *Dodonaea rigida* and *Prostanthera althoferi* var. *althoferi.* This vegetation unit was assessed as being in good to very good condition., with evidence of disturbance from cattle an old exploration tracks. An image of this unit is presented as **Plate 25** in **Appendix E**. This vegetation unit was recorded in L77/248 in the western section of the haulroad. The distribution of this vegetation is presented in **Figure 8**.

BHS – Scrub of Dodonaea lobulata and Acacia acuminata on light red clay on low hill of basalt.

This vegetation was characterised by a scrub to 2 m dominated by *Dodonaea lobulata,* with *Acacia acuminata, Santalum acuminatum* and *A. tetragonophylla* as co-occurring species. The vegetation in this unit was assessed as being in good to very good condition, with some evidence of damage to grazing by cattle. This vegetation unit was restricted in distribution to a small area of approximately 1 ha on the northern edge of the survey boundary within L77/248, on the section between M77/1263 and G77/119. The distribution of this unit is presented in **Figure 8**.

6.2 Conservation Significance of Vegetation

To determine whether vegetation was considered to have conservation significance, an assessment was made against the following factors:

- Presence of flora of conservation significance;
- Presence of new flora records;
- Vegetation unit potentially restricted in distribution;
- Vegetation in condition that was better than the surrounding landscape;
- Vegetation containing a unique assemblage of species; and/or
- Identified by a recognised authority as being a unit with conservation significance.

The vegetation observed during the surveys was not considered to be one of the PECs recorded in the region, nor were any of the units considered to represent a unique assemblage of species. The majority of the vegetation was widespread in the local area and the region. In addition to being comparatively widespread vegetation units, none of the vegetation within the project was identified as being in a condition that was better than the surrounding landscape. The assessment of the vegetation was that in many instances, it was in poorer condition relative to the surrounding

landscape, largely as a consequence of historic disturbances associated with mining, exploration and pastoral activities. Based on an assessment of these factors, none of the vegetation in the project area was considered to have conservation value.

Where conservation value may be considered is in relation to the presence of flora of conservation significance. The vegetation unit SS, located in L77/248, hosted the priority 1 species *Philotheca deserti* subsp. *brevifolia,* and as such, may be considered to have some conservation value. In light of this, the proposed impacts to this unit have been minimised. The other records of priority flora were either widespread, such as *Eucalyptus formanii,* which can be a structurally dominant species were observed. These vegetation units were not considered to have conservation value.

6.3 Extent of Vegetation

The vegetation within the project area was within the 1:250 000 scale Barlee vegetation map sheet of Beard (1974). The project area was noted to contain the following Beard vegetation types:

- eMi – *Eucalyptus* species (e) Medium trees 10 – 25 m (M) with an incomplete canopy, with a projected foliage cover of 10 – 30 % (i).
- a_1Li – *Acacia aneura* (a_1) Low trees < 10 m (L) with an incomplete canopy – projected foliage cover of 10 – 30 % (i).
- $e_6Mia_{919}Si$ – *Eucalyptus loxophleba* (e_6) Medium trees 10 – 25 m (M) with an incomplete canopy – project foliar cover of 10 – 30 % (i) and *Acacia ramulosa* and *A. linophylla* (syn. *A. ramulosa* var. *linophylla*) (a9) and *A. acuminata* (syn. *A. burkittii*) Shrubs > 1 m (S) with an incomplete canopy – project foliage cover of 10 – 30 % (i)
- a_nSc – *Acacia* numerous species (a_n) Shrubs > 1m (S) with a mid-dense canopy – projected foliage cover of 30 -70 % (c).

The Shepherd *et al.* (2007) dataset estimating the extent of remaining native vegetation for the Coolgardie 2 subregion was reviewed to determine the extent of the vegetation within the project. Based on the Beard mapping, it was determined that the following two units in the Shepherd *et al.* (2007) dataset were most likely to be in the project:

- Vegetation type 18: Low woodland: mulga (*Acacia aneura*) – there was approximately 3 198 859 ha of this vegetation type in the Murchison 1 subregion, of which there was 100 % of the inferred pre-European extent remaining.
- Vegetation type 141: Medium woodland: York gum (*Eucalyptus loxophleba*) salmon gum (*Eucalyptus salmonophloia*) gimlet (*Eucalyptus salubris*) – there was approximately 3 316 ha of this unit in the Murchison 1 subregion, of which there was 100 % of the inferred pre-European extent remaining. It was noted that there was approximately 883 085 ha of this unit in the Coolgardie 2 subregion, which is the subregion immediately to the south of the project area, of which there was 97.28 % of the inferred pre-European extent remaining.

- Vegetation type 385: Shrublands; bowgada & jam scrub with scattered York gum – there was approximately 44 336 ha of this unit within the Murchison 1 subregion, of which there was 100 % of the inferred pre-European extent remaining.
- Vegetation type 437: Shrublands; Mixed acacia thicket on sandplain – there was approximately 11 650 ha of this unit within the Murchison 1 subregion, of which there was 100 % of the inferred pre-European extent remaining.

Based on this assessment, the clearing proposed for this project is not considered to significantly impact on the extent of either of these units.

7.0 RESULTS and DISCUSSION - FLORA

7.1 Native Flora

During the survey, a total of 139 native species, including subspecies, variants and forms, were collected. The 139 species were from 74 genera within 30 families. The flora was dominated by the family Fabaceae, with 23 species from five genera. Other widely represented families during the survey included: Myrtaceae, with 16 species from five genera; Chenopodiaceae, with 14 species from five genera; Asteraceae, with 12 species from 10 genera; and, Scrophulariaceae, with nine species from 1 genus. No threatened flora were recorded during the survey. There were four priority flora recorded during the survey (refer section 7.2). A summary of the flora recorded during the survey is presented in **Appendix F**.

7.2 Priority Flora

There were four priority species recorded during the survey: the priority 1 species *Philotheca deserti* subsp. *brevifolia* Paul G. Wilson*;* the priority 2 species *Malleostemon* sp. Adelong (G.J. Keighery 11825); the priority 3 species *Baeckea* sp. Parker Range (M. Hislop & F. Hort MH 2968); and, the priority 4 species *Eucalyptus formanii* C.A. Gardner*.* Details of the records and potential impacts to these species are presented below.

7.2.1 *Philotheca deserti* subsp. *brevifolia* Paul G. Wilson

There were 24 plants of this species recorded at nine locations within and immediately to the north of the proposed haulroad within the buffer of L77/248. Of the nine locations at which this species was recorded, one was within the buffer of L77/248, with one plant recorded at this point. While this record falls within the buffer of L77/248, it is proposed that there will be no impacts to this species, as the proposed disturbance width at the location is 21 m, which means that this plant can be avoided. The locations of the records of this species in the project area and surrounds is presented in **Figure 11**. The locations of the records of this species is presented in **Table 2**.

7.2.2 *Malleostemon* sp. Adelong (G.J. Keighery 11825)

There was one record of this species made during the autumn survey over tenement M77/1263, with one plant recorded at the location shown in **Figure 11**. Targeted searches for this species were

conducted during the spring surveys, but no additional plants were recorded, either in the project areas or the immediate surrounding area.

7.2.3 *Baeckea* sp. Parker Range (M. Hislop & F. Hort MH 2968)

There was one record of this species made during the autumn survey over tenement M77/1263, with one plant recorded at the location. During the spring surveys, an additional three populations were recorded, all within a length of 250 m within tenement L77/248, with a total of 22 plants recorded. The spring and autumn survey numbers bring to 23 the number of plants recorded. The record within M77/1263 will be removed to facilitate development of the pit. The three records made within L77/248 during the spring survey can all be avoided by ensuring that the haulroad at this section is located on the southern edge of the tenement. The locations of the records of this species within the survey areas is presented in **Figure 11**. The location of the records of this species is presented in **Table 3**.

7.2.4 *Eucalyptus formanii* C.A. Gardner

There were a total of 821 records of *Eucalyptus formanii* made at 217 different locations during the spring and autumn surveys. Of the 821 plants recorded, there were 361 within tenement M77/1263 and 32 within tenement L77/248. The remaining records were all outside of the project areas. It was noted that all of the records made during the survey were new records of this species. The distribution of this species in relation to the project is shown in **Figure 11**. The distribution of the records of this species is presented in **Table 4.** It is proposed the impacts to this species associated with the proposed development will not alter the threatening processes profile for this species, nor are they likely to result in the loss of the species from the local area. In addition to this, it is proposed that given the high number of individuals of this species in the area, and the numbers located adjacent to the Bullfinch – Evanston Road and the Diemal – Menzies Road, as well as the range over which this species occurs, that a revision of the conservation code attached to this species may be warranted.

7.3 Alien Flora

There were a total of seven non-native weed species recorded during the surveys. In addition to the non-native weed species, there was one native weed species recorded in the project area, *Solanum hoplopetalum. Solanum hoplopetalum* is known to occur in the region, but it has the potential to be a weed in disturbed areas (Western Australian Herbarium, 2012). The records of this species made during the survey were in areas that were subject to previous disturbance, with no records made in areas in which there had been no previous significant disturbances. Based on this assessment, *S. hoplopetalum* within the project is considered to be a weed species.

The weed species recorded in the survey were included in the DEC Weed Assessment for the Goldfields region. The assessment for the species recorded in the survey area was:

- *Brassica tournefortii* – this species was assessed as having rapid dispersal and a high ecological impact.
- *Carrichtera annua* – this species was assessed as having rapid dispersal and a high ecological impact.

- *Centaurea melitensis* – this species was assessed as having rapid dispersal and a high ecological impact.
- *Cucumis myriocarpus* – this species was assessed as having rapid dispersal and an unknown ecological impact.
- *Solanum hoplopetalum* – this species was assessed as having a low ecological impact.
- *Sisymbrium orientale* – this species was assessed as having an unknown distribution and unknown ecological impact.
- *Salvia verbenaca* – this species was assessed as having a low ecological impact.

The records of weed species made during the survey were restricted to areas in which there had been a previous disturbance, or adjacent to where there had been a previous disturbance. The presence of these species in the project should be contained with a weed management programme, which Vector currently undertake. It is recommended that ongoing weed monitoring and weed management should be maintained to restrict the movement of these species and to work towards their eradication in the area.

8.0 SURVEY LIMITATIONS

Niche planned and implemented the surveys detailed in this report in accordance with EPA guidelines and requirements (EPA 2000, 2004). Within the survey guidelines a number of potential limitations to the completeness of surveys are presented. An assessment of the survey in response to these as considered relevant is presented below.

- Competency of botanist – this survey was completed by a botanist from Niche, who has relevant experience in the design and implementation of flora and vegetation surveys for environmental impact assessments within Western Australia. The botanist had over 5 years of relevant experience in the completion of surveys in the region.
- Scope – the scope for this work was clearly defined, being a Level 2 flora and vegetation survey over a well-defined area. The scope was considered to be realistically achievable within the allocated timeframe and with the allocated resources.
- Proportion of flora identified – During the survey, approximately 200 specimens were collected, from which a total of 144 species were identified. All specimens collected were identified to at least genus level, with only two species identified only to genus and one species with a level of uncertainty regarding the specific epithet.
- Timing of surveys – the first survey was conducted during autumn 2012, which was focused on the project area within M77/1263. The second survey was conducted during spring 2012, and included a second pass survey of M77/1263 and surveys of L77/248 and G77/119. The autumn survey was conducted in April, and followed a period during which above-average rainfall had been recorded in some Bureau of Meteorology recording stations in the region surrounding the project. The spring surveys were conducted after a period of what was posited to be a winter with below-average rainfall.

- Access to land – there were no access-related issues associated with the survey area, with all areas readily accessible by vehicle or foot.
- Completeness and further work – the surveys as detailed in this report are considered to meet the underlying requirements of a Level 2 survey. The work completed during the surveys was considered to be sufficient to provide information to describe and delineate the vegetation within the project area, to develop a census of the flora and to determine whether flora of conservation significance were within the proposed disturbance areas. While the census of the flora was noted as being comparatively low in annual taxa, this is not considered to be a significant limiting factor and further work is not considered to be necessary to address this.
- Disturbances – within tenement M77/1263, there was a decommissioned mine, old TSF, partially revegetated airstrip and a series of old and new exploration and access tracks and drill pads. During the completion of survey work, an extensive drill programme was undertaken, which has substantially increased the amount of disturbance with tenement M77/1263. Tenement L77/248 contained an old haulroad, the current access track into tenement M77/1263 and was dissected by a number of access tracks and exploration tracks. Tenement G77/119 was the least disturbed of the survey areas, with the main disturbance in this area associated with pastoral activities. The revegetation of previously disturbed areas was in various states, with some areas noted as being in advanced stages of revegetation and other areas having very limited revegetation. In addition to the impacts associated with the previous mining and exploration works, there was clear evidence of grazing by cattle.

9.0 CONCLUSION

The Vector Resources Gwendolyn East Cutback Project, within the Murchison 1 IBRA subregion of Western Australia, was subject to a Level 2 survey during autumn and spring 2012. The surveys were focused on tenements M77/1263, in which the project resource is located, tenement G77/119, in which the proposed plant and accommodation site will be located, and tenement L77/119, in which the haulroads and access tracks will be located.

The project area contains seven broad landforms, on which a total of 26 vegetation units were defined and delineated. While there were 26 vegetation units, it was noted that these could be broadly summarised as being either woodlands of *Eucalyptus* species, woodlands of *Acacia* species or woodlands of *Eucalyptus* species over *Acacia* species. The vegetation within the project area was considered to be relatively common in the local area and region, and had been clearly impacted by historic disturbances associated with mining, exploration and pastoral activities. In particular, it was noted that the vegetation within M77/1263 was significantly impacted by previous mining and exploration works as well as intensive drilling associated with the current project. There were no sections of vegetation observed during the surveys in which some level of anthropogenic disturbance was absent.

The census of the flora for the project was considered to be relatively comprehensive, particularly in the context of the extent of disturbance in the region. It is proposed that the relatively low numbers of annual taxa recorded during the survey may be a reflection of historic disturbances, as much as they would potentially be a product of recent weather patterns in the region. Notwithstanding any effects from climate or disturbance, the survey was effective in adding to the knowledge of the distribution of priority flora in the region, with new records made of four priority species. The new records of the priority one species *Philotheca deserti* subsp. *brevifolia* were of note, as this species is known from only a limited number of records. It is proposed that there may be a substantial population of this species in the *Acacia* scrub vegetation in which it was found. To minimise impacts to this species, the disturbances in the area will be focused on previously disturbed areas.

The priority 4 species *Eucalyptus formanii* was found in comparatively high numbers in the region, with over 800 plants recorded. The search for this species was by no means exhaustive, and given the number of plants observed adjacent to the Bullfinch Evanston Road and the Diemals Menzies Road, this species may prove to be relatively common in the area. It is proposed that there may be grounds to review the conservation code assigned to this species.

There were a limited number of weed species recorded during the survey, with the records largely restricted to areas within M77/1263. To avoid dispersing these into the surrounding landscape, it is recommended that a weed management program should be focused on both controlling populations where recorded, and monitoring the surrounding landscape to ensure that these species do not spread into areas outside of the current distribution.

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Figures

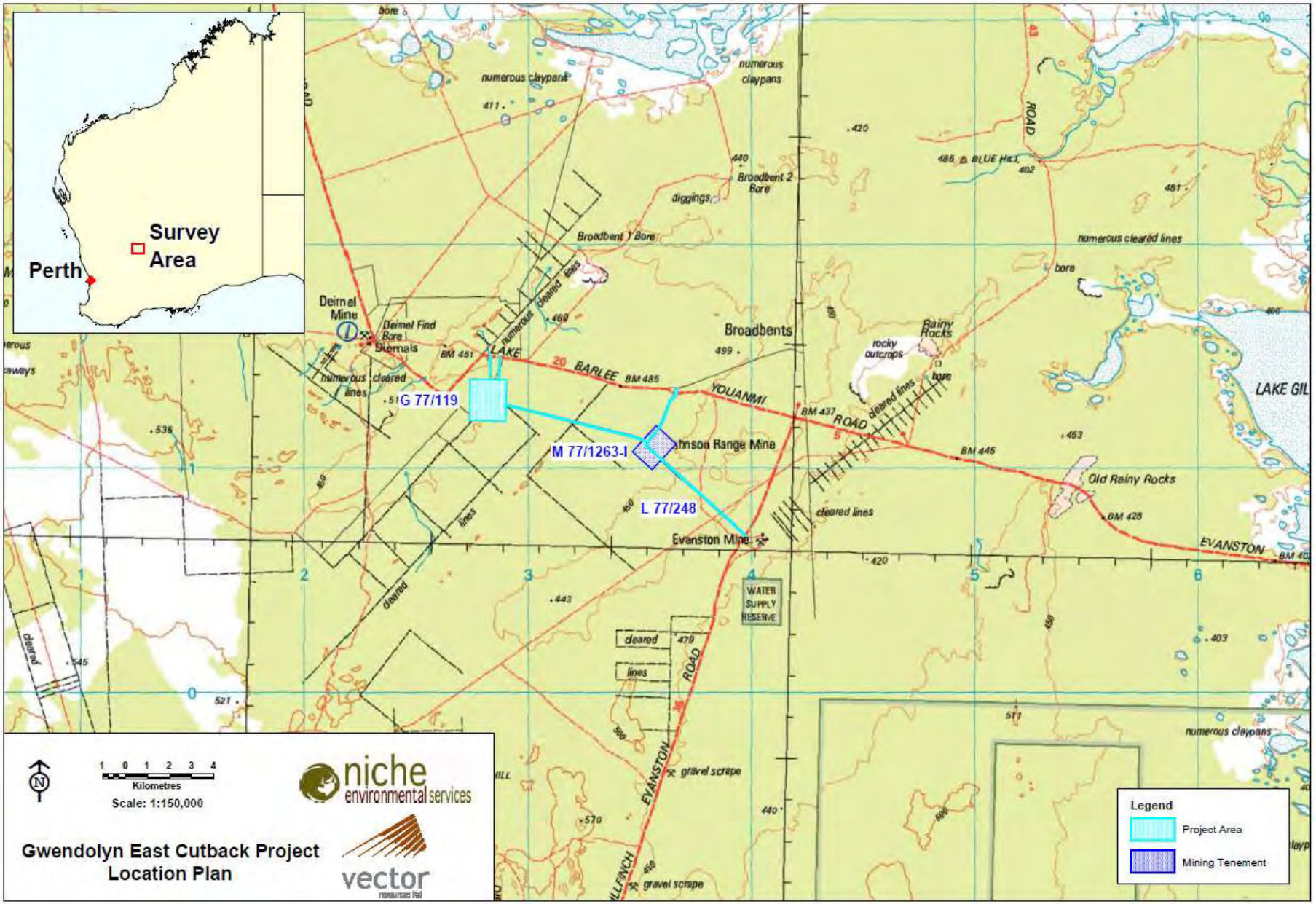


Figure 1 **Map showing the location of the Vector Resources Gwendolyn East Cutback Project.**

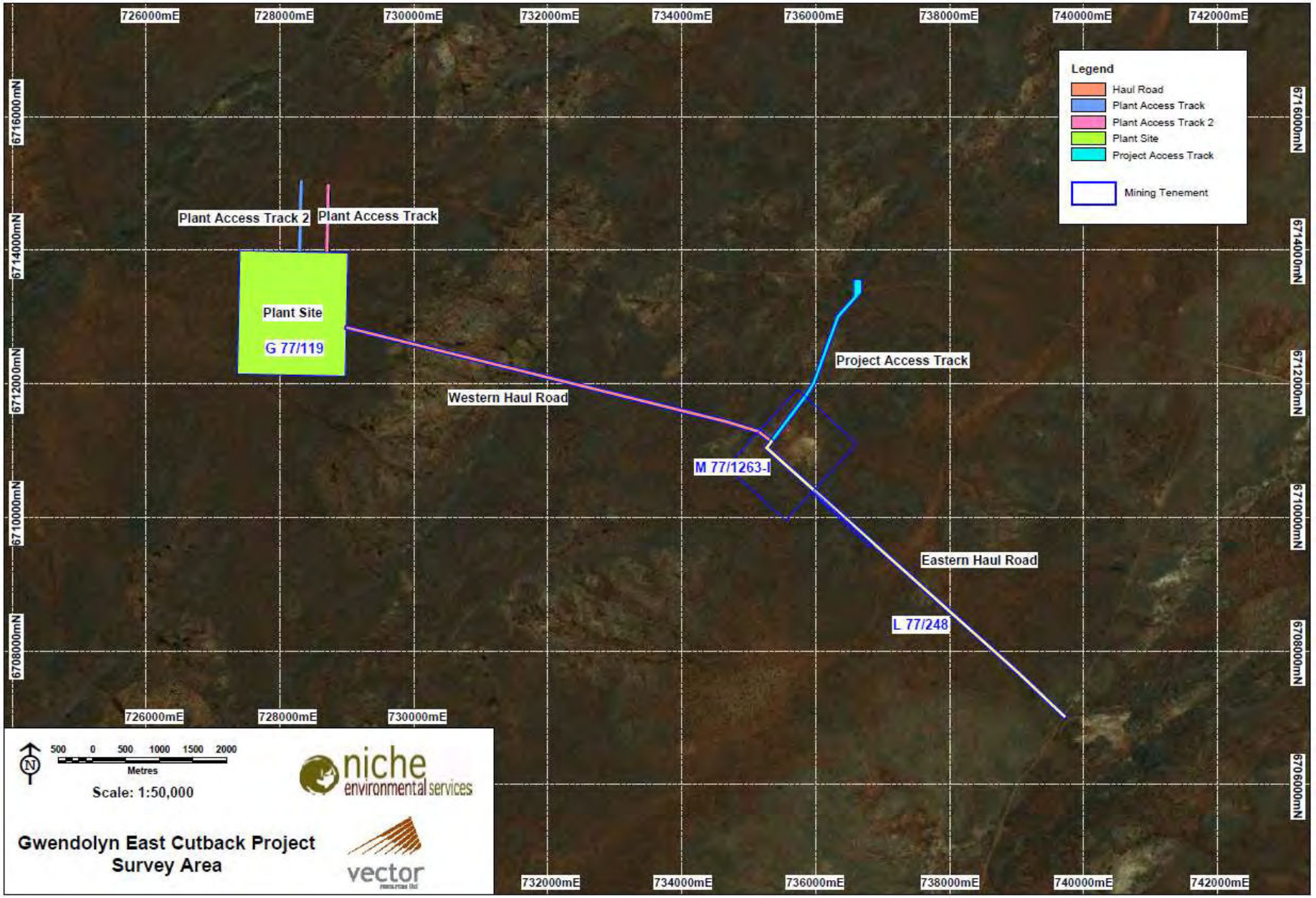


Figure 2 **Map showing the Vector Resources Gwendolyn East Cutback Project tenements as surveyed by Niche Environmental Services in autumn and spring 2012.**

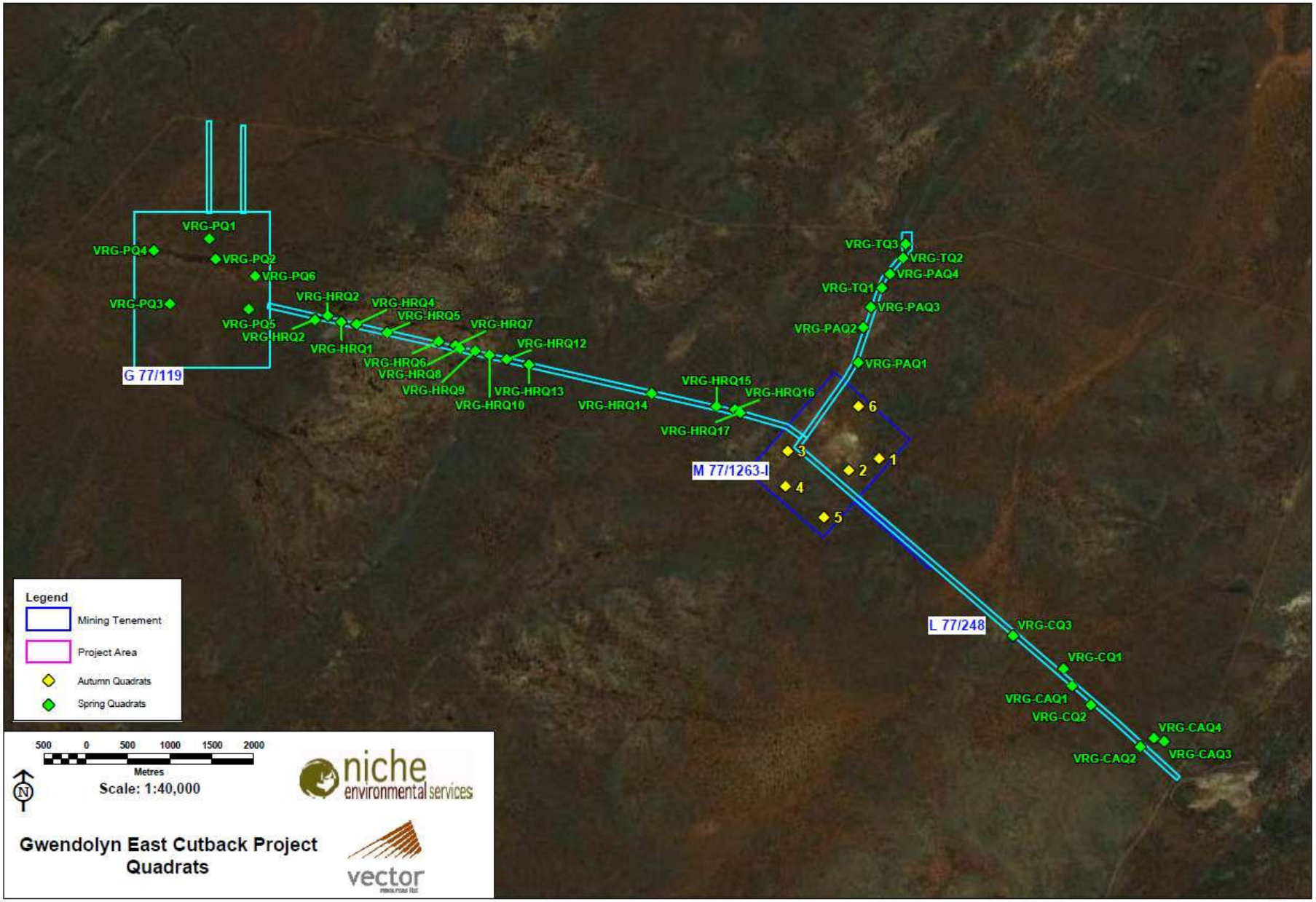


Figure 3 **Map showing the location of quadrats used for survey in autumn and spring 2012 by Niche Environmental Services within the Vector Resources Gwendolyn East Cutback Project.**

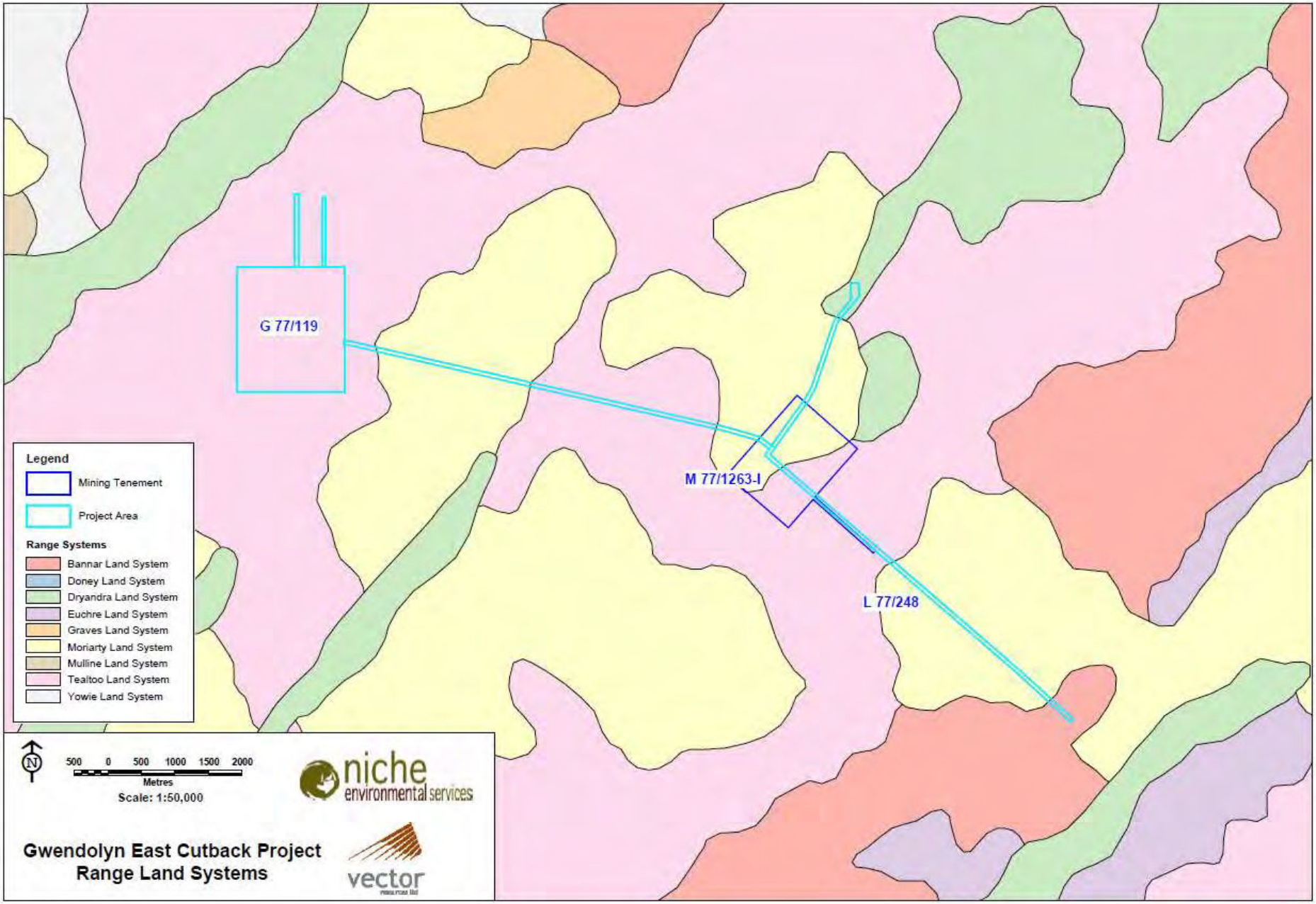


Figure 4 **Map showing land systems on which the Vector Resources Gwendolyn East Cutback Project is location**

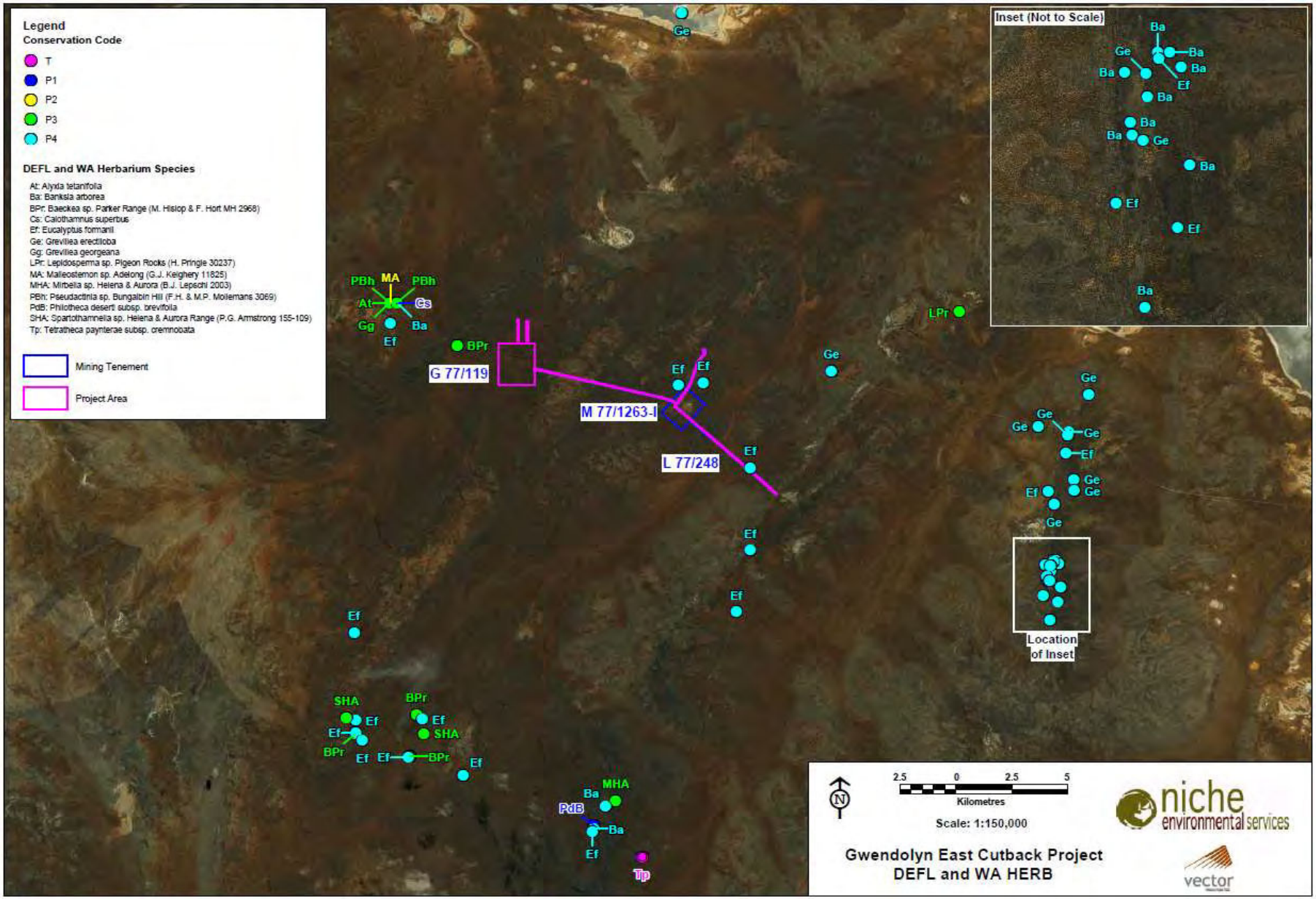


Figure 5 **Map showing the locations of threatened (declared rare) and priority flora listed in DEC database search 24-0112FL in relation to the Vector Resources Gwendolyn East Cutback project.**

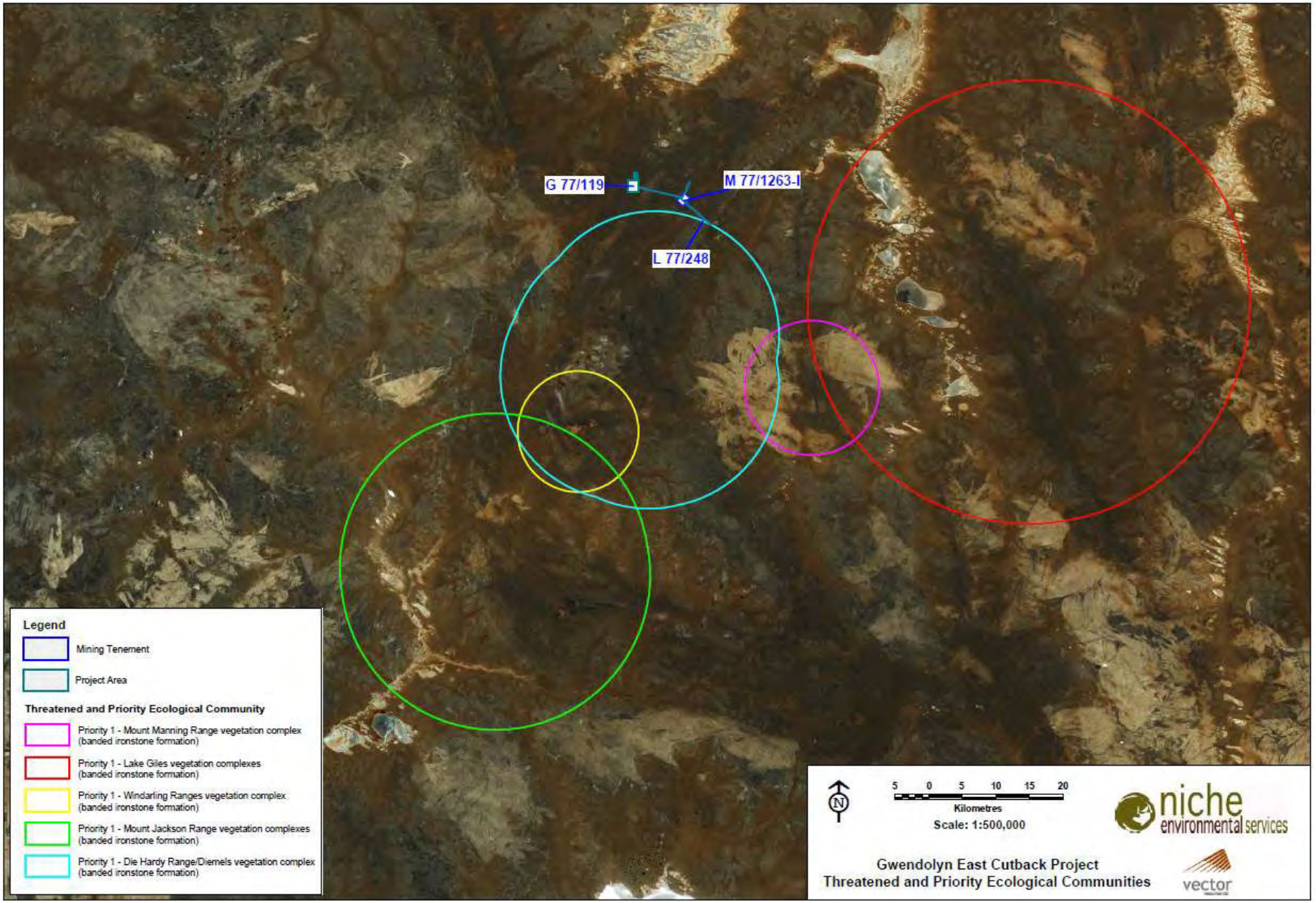


Figure 6 **Map showing the locations of Priority Ecological Communities listed in DEC database search 19 – 0512EC in relation to the Vector Resources Gwendolyn East Cutback Project.**



Figure 7 **Map showing vegetation within M77/1263 and the project access track in the northern section of L77/248 of the Vector Resources Gwendolyn East Cutback Project.**

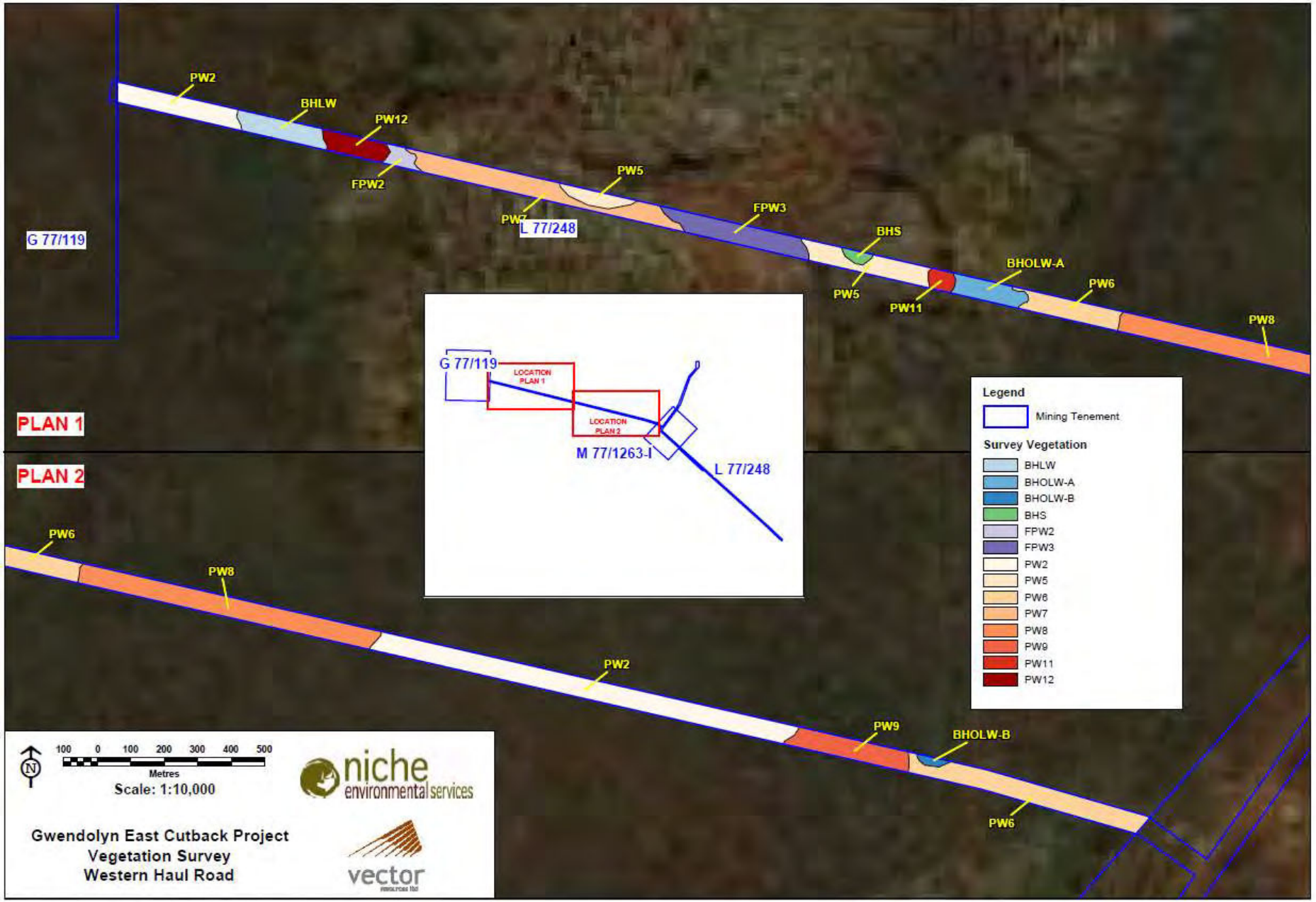


Figure 8 **Map showing vegetation within the western haulroad section of L77/248 of the Vector Resources Gwendolyn East Cutback Project.**



Figure 9 **Map showing vegetation within G77/119 of the Vector Resources Gwendolyn East Cutback Project.**

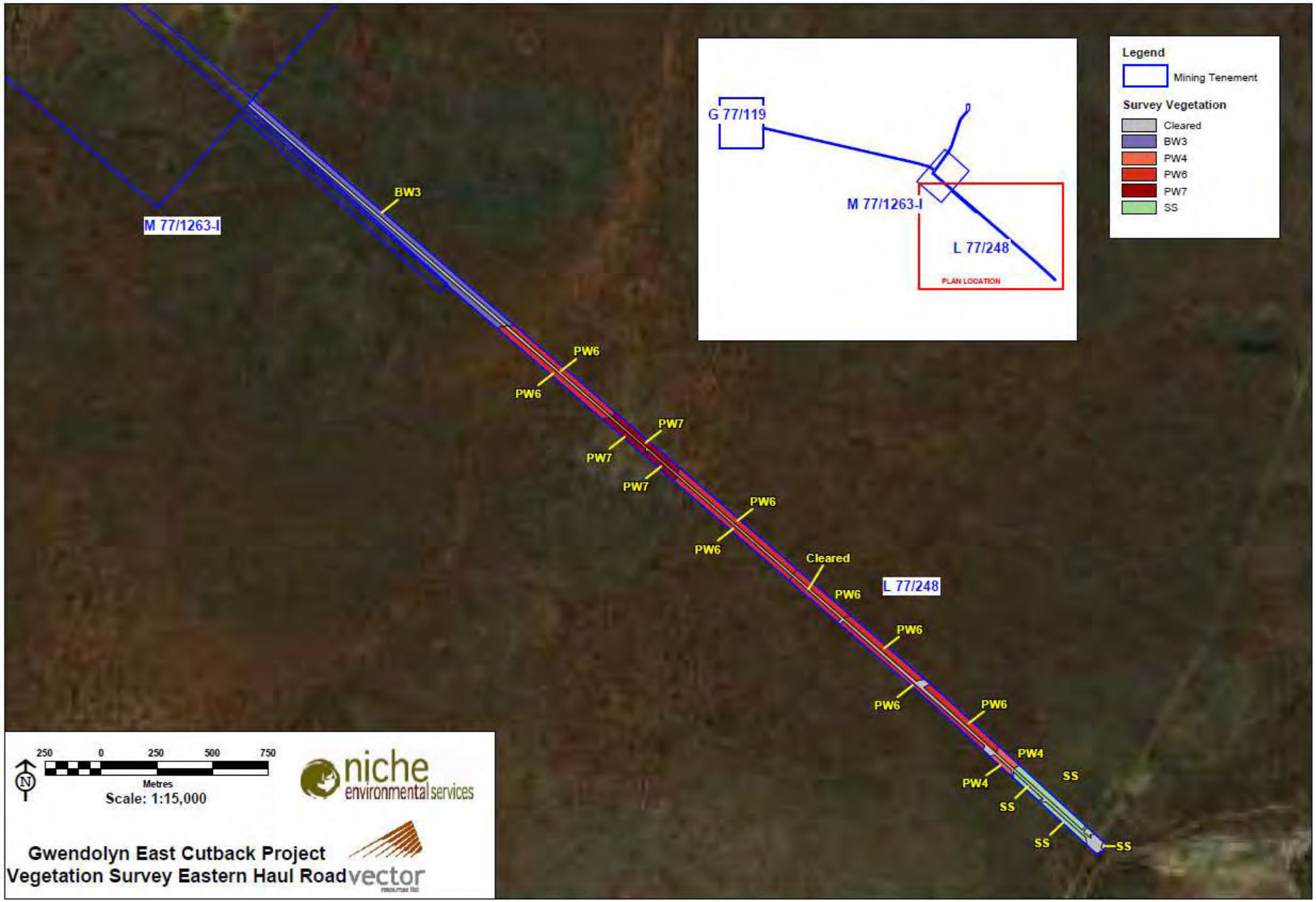


Figure 10 **Map showing vegetation within the eastern haulroad within L77/248 of the Vector Resources Gwendolyn East Cutback Project.**

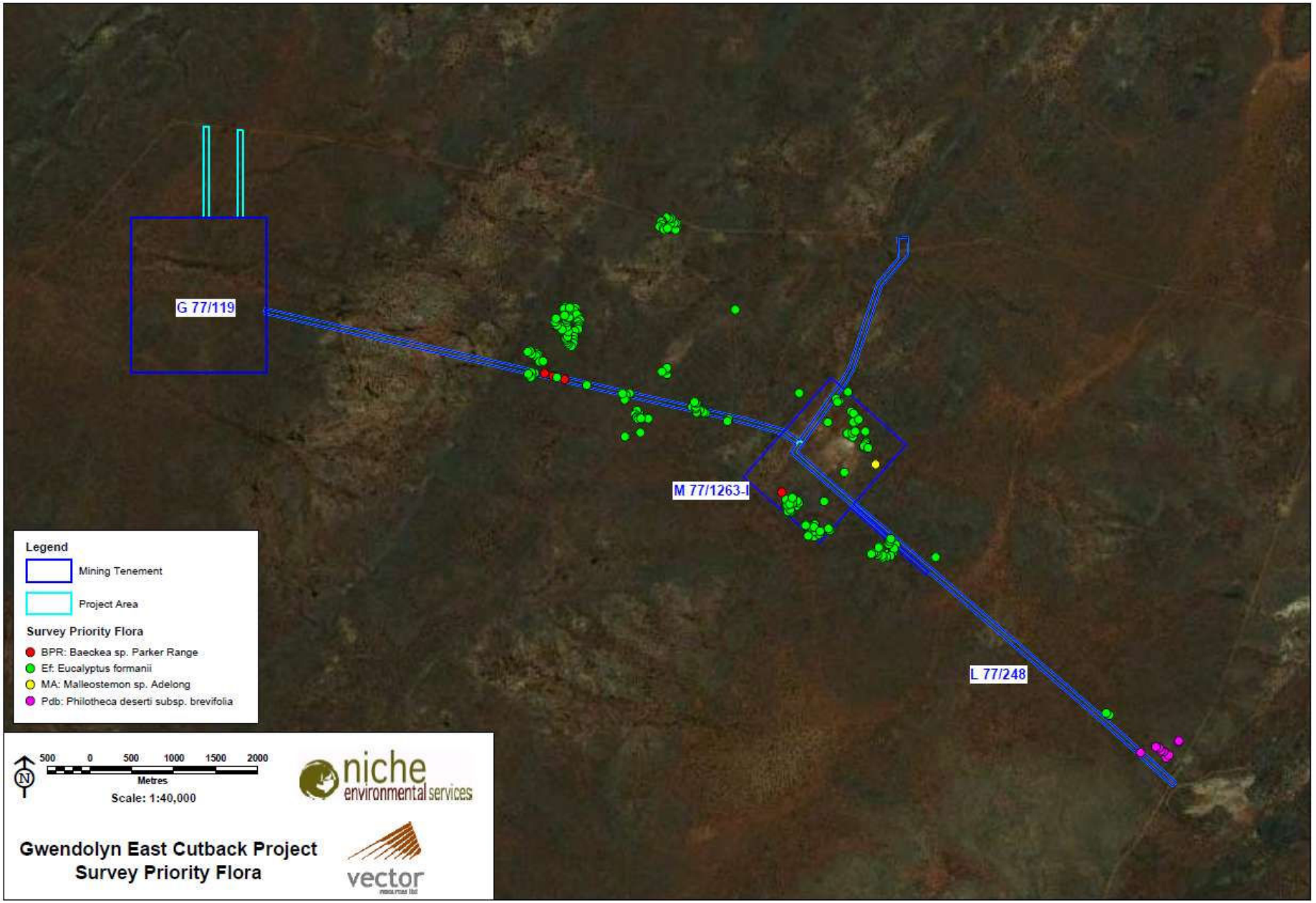


Figure 11 **Map showing locations of priority flora within the project area and surrounding vegetation of the Vector Resources Gwendolyn East Cutback Project.**

Tables

Table 1 Assessment of survey area against factors listed in EPA (2004)

Factor	Assessment of survey area	Scale of impact
Degree of degradation or clearing in region	The area has not been extensively cleared, with greater than 50 % of vegetation in better condition	Low
Scale of clearing	Clearing is greater than 50 ha	High
Rarity of vegetation	Vegetation in the survey area naturally more widespread than 10 % of the local area (15 km radius) and the bioregion	Low
Significant vegetation units	Significant vegetation units are not known in the area (they are noted as being in close proximity)	Low
Rare or priority flora	Priority species are found in the area or in similar vegetation in its immediate vicinity (based on database search results)	Moderate
Size of remnant and intactness of vegetation	Area is not in a fragmented environment	Low
Ecological linkage	The area is part of an ecological linkage at the local or regional scale	High
Complexity of vegetation	The area and its surrounds have a similar range of components to relative to the characteristics at the local or regional scale	Moderate

Table 2 Summary of threatened and priority flora recorded in the DEC database search for the Vector Resources Gwendolyn East Cutback Project, with information in relation to the habitat of the species.

Species	Code	Habitat
Alyxia tetanifolia Cranfield	P3	Sandy clay, loam, concretionary gravel. Drainage lines, near lakes
Baeckea sp. Parker Range (M. Hislop & F. Hort MH 2968)	P3	Yellow to roange sandy loam with laterite gravel. Gently undulating sandplains, low ridges, road verges
Banksia arborea (C.A. Gardner) A.R.Mast & K.R. Thiele	P4	Stony loam. Ironstone hills
Calothamnus superbus Hawkeswood & Mollemans	P1	Yellow/brown sand with pebbles. Sandplains
Eucalyptus formanii C.A. Gardner	P4	Ironstone slopes
Grevillea erectiloba F.Muell	P4	Gravelly loam. Lateritic ridges
Grevillea georgeana McGill.	P3	Stony loam/clay. Ironstone hilltops and slopes
Lepidosperma sp. Pigeon Rocks (H. Pringle 30237)	P3	
Malleostemon sp. Adelong (G.J. Keighery 11825)	P2	Red sand
Mirbelia sp. Helena and Aurora (B.J. Lepschi 2003)	P3	Stony loam over ironstone, clayey sand. Upper slopes of stony hills
Philotheca deserti subsp. *brevifolia* Paul G. Wilson	P1	Red sandy clay
Pseudactinia sp. Bungalbin Hill (F.H. & M.P. Mollemans 3069)	P3	Yellow sand, yellow-brown loamy sand
Spartothamnella sp. Helena and Aurora Range (P.G. Armstrong 155-109)	P3	
Tetratheca paynterae subsp. *cremnobata* R. Butcher	T	Shallow red-brown loam, clayey silt, ironstone. Outcrops, ridges, breakaways, rocky slopes.

Table 3 Summary of locations at which *Philotheca deserti* subsp. *brevifolia* Paul G. Wilson was recorded

Species	Datum	Zone	mE	mN	No.
Philotheca deserti subsp. *brevifolia*	WGS84 UTM	50 J	739337	6707387	1
Philotheca deserti subsp. *brevifolia*	WGS84 UTM	50 J	739793	6707502	3
Philotheca deserti subsp. *brevifolia*	WGS84 UTM	50 J	739795	6707518	3
Philotheca deserti subsp. *brevifolia*	WGS84 UTM	50 J	739641	6707321	3
Philotheca deserti subsp. *brevifolia*	WGS84 UTM	50 J	739674	6707349	2
Philotheca deserti subsp. *brevifolia*	WGS84 UTM	50 J	739614	6707394	1
Philotheca deserti subsp. *brevifolia*	WGS84 UTM	50 J	739580	6707406	2
Philotheca deserti subsp. *brevifolia*	WGS84 UTM	50 J	739557	6707439	6
Philotheca deserti subsp. *brevifolia*	WGS84 UTM	50 J	739519	6707451	3

Table 4 Summary of locations at which *Baeckea* sp. Parker Range (M. Hislop & F. Hort MH 2968) was found.

Species	Datum	Zone	mE	mN	No.
Baeckea sp. Parker Range	WGS84 UTM	50 J	732540	6711961	8
Baeckea sp. Parker Range	WGS84 UTM	50 J	732404	6712001	10
Baeckea sp. Parker Range	WGS84 UTM	50 J	732303	6712037	4
Baeckea sp. Parker Range	WGS84 UTM	50 J	735110	6710568	1

Table 5 Summary of locations at which *Eucalyptus formanii* C.A. Gardner was recorded

Species	Datum	Zone	mE	mN	No.
Eucalyptus formanii	WGS84	50 J	738972	6707841	1
Eucalyptus formanii	WGS84	50 J	738935	6707865	2
Eucalyptus formanii	WGS84	50 J	736464	6709918	1
Eucalyptus formanii	WGS84	50 J	736423	6709870	3
Eucalyptus formanii	WGS84	50 J	736423	6709823	5
Eucalyptus formanii	WGS84	50 J	736437	6709870	1
Eucalyptus formanii	WGS84	50 J	736396	6709787	5
Eucalyptus formanii	WGS84	50 J	736936	6709760	1
Eucalyptus formanii	WGS84	50 J	736344	6709775	2
Eucalyptus formanii	WGS84	50 J	736361	6709814	3
Eucalyptus formanii	WGS84	50 J	736303	6709769	1
Eucalyptus formanii	WGS84	50 J	736296	6709792	3
Eucalyptus formanii	WGS84	50 J	736240	6709804	6
Eucalyptus formanii	WGS84	50 J	736221	6709826	2
Eucalyptus formanii	WGS84	50 J	736193	6709827	1
Eucalyptus formanii	WGS84	50 J	736165	6709814	1
Eucalyptus formanii	WGS84	50 J	736254	6709887	1
Eucalyptus formanii	WGS84	50 J	736379	6709925	1
Eucalyptus formanii	WGS84	50 J	736393	6709960	3
Eucalyptus formanii	WGS84	50 J	736404	6709989	2
Eucalyptus formanii	WGS84	50 J	734600	6712748	2
Eucalyptus formanii	WGS84	50 J	733504	6711498	6
Eucalyptus formanii	WGS84	50 J	733437	6711533	2
Eucalyptus formanii	WGS84	50 J	733423	6711544	13
Eucalyptus formanii	WGS84	50 J	733397	6711573	3
Eucalyptus formanii	WGS84	50 J	733374	6711529	2
Eucalyptus formanii	WGS84	50 J	733405	6711504	2
Eucalyptus formanii	WGS84	50 J	733394	6711488	2
Eucalyptus formanii	WGS84	50 J	733414	6711470	1
Eucalyptus formanii	WGS84	50 J	733444	6711481	3
Eucalyptus formanii	WGS84	50 J	733518	6711481	1
Eucalyptus formanii	WGS84	50 J	733531	6711474	1
Eucalyptus formanii	WGS84	50 J	733434	6711311	1
Eucalyptus formanii	WGS84	50 J	733251	6711269	5
Eucalyptus formanii	WGS84	50 J	733766	6711997	1
Eucalyptus formanii	WGS84	50 J	733756	6712035	2
Eucalyptus formanii	WGS84	50 J	733764	6712053	3
Eucalyptus formanii	WGS84	50 J	733769	6712074	50
Eucalyptus formanii	WGS84	50 J	733706	6712028	1
Eucalyptus formanii	WGS84	50 J	732689	6712805	1
Eucalyptus formanii	WGS84	50 J	732674	6712777	9
Eucalyptus formanii	WGS84	50 J	732702	6712730	11
Eucalyptus formanii	WGS84	50 J	732737	6712662	2
Eucalyptus formanii	WGS84	50 J	732714	6712638	1
Eucalyptus formanii	WGS84	50 J	732723	6712623	5
Eucalyptus formanii	WGS84	50 J	732723	6712601	3
Eucalyptus formanii	WGS84	50 J	732717	6712578	2

Species	Datum	Zone	mE	mN	No.
Eucalyptus formanii	WGS84	50 J	732715	6712554	5
Eucalyptus formanii	WGS84	50 J	732670	6712534	4
Eucalyptus formanii	WGS84	50 J	732662	6712466	7
Eucalyptus formanii	WGS84	50 J	732658	6712426	12
Eucalyptus formanii	WGS84	50 J	732656	6712389	9
Eucalyptus formanii	WGS84	50 J	732630	6712352	14
Eucalyptus formanii	WGS84	50 J	732594	6712379	6
Eucalyptus formanii	WGS84	50 J	732579	6712401	9
Eucalyptus formanii	WGS84	50 J	732575	6712428	3
Eucalyptus formanii	WGS84	50 J	732569	6712448	4
Eucalyptus formanii	WGS84	50 J	734491	6711449	3
Eucalyptus formanii	WGS84	50 J	734479	6711424	1
Eucalyptus formanii	WGS84	50 J	734220	6711527	1
Eucalyptus formanii	WGS84	50 J	734194	6711539	3
Eucalyptus formanii	WGS84	50 J	734150	6711564	8
Eucalyptus formanii	WGS84	50 J	734109	6711538	1
Eucalyptus formanii	WGS84	50 J	734100	6711583	1
Eucalyptus formanii	WGS84	50 J	734104	6711603	2
Eucalyptus formanii	WGS84	50 J	734110	6711647	1
Eucalyptus formanii	WGS84	50 J	734091	6711659	1
Eucalyptus formanii	WGS84	50 J	734057	6711606	1
Eucalyptus formanii	WGS84	50 J	733313	6711776	1
Eucalyptus formanii	WGS84	50 J	733271	6711758	3
Eucalyptus formanii	WGS84	50 J	733255	6711706	1
Eucalyptus formanii	WGS84	50 J	733231	6711779	1
Eucalyptus formanii	WGS84	50 J	732803	6711890	1
Eucalyptus formanii	WGS84	50 J	732451	6711986	1
Eucalyptus formanii	WGS84	50 J	732186	6712044	2
Eucalyptus formanii	WGS84	50 J	732152	6712030	1
Eucalyptus formanii	WGS84	50 J	732144	6712053	2
Eucalyptus formanii	WGS84	50 J	732139	6711999	7
Eucalyptus formanii	WGS84	50 J	732108	6712036	3
Eucalyptus formanii	WGS84	50 J	732588	6712469	5
Eucalyptus formanii	WGS84	50 J	732596	6712528	4
Eucalyptus formanii	WGS84	50 J	732578	6712547	3
Eucalyptus formanii	WGS84	50 J	732581	6712586	11
Eucalyptus formanii	WGS84	50 J	732580	6712641	4
Eucalyptus formanii	WGS84	50 J	732575	6712670	1
Eucalyptus formanii	WGS84	50 J	732586	6712696	3
Eucalyptus formanii	WGS84	50 J	732609	6712698	7
Eucalyptus formanii	WGS84	50 J	732582	6712766	4
Eucalyptus formanii	WGS84	50 J	732565	6712782	2
Eucalyptus formanii	WGS84	50 J	732552	6712799	1
Eucalyptus formanii	WGS84	50 J	732567	6712820	5
Eucalyptus formanii	WGS84	50 J	732619	6712812	1
Eucalyptus formanii	WGS84	50 J	732556	6712720	7
Eucalyptus formanii	WGS84	50 J	732493	6712602	9

Species	Datum	Zone	mE	mN	No.
Eucalyptus formanii	WGS84	50 J	732521	6712552	2
Eucalyptus formanii	WGS84	50 J	732462	6712604	9
Eucalyptus formanii	WGS84	50 J	732443	6712647	7
Eucalyptus formanii	WGS84	50 J	732455	6712686	8
Eucalyptus formanii	WGS84	50 J	732196	6712273	1
Eucalyptus formanii	WGS84	50 J	732216	6712279	1
Eucalyptus formanii	WGS84	50 J	732225	6712262	6
Eucalyptus formanii	WGS84	50 J	732206	6712243	1
Eucalyptus formanii	WGS84	50 J	732246	6712176	4
Eucalyptus formanii	WGS84	50 J	732291	6712184	1
Eucalyptus formanii	WGS84	50 J	732154	6712272	1
Eucalyptus formanii	WGS84	50 J	732146	6712292	1
Eucalyptus formanii	WGS84	50 J	732134	6712309	3
Eucalyptus formanii	WGS84	50 J	732107	6712299	1
Eucalyptus formanii	WGS84	50 J	733741	6713824	1
Eucalyptus formanii	WGS84	50 J	733751	6713805	1
Eucalyptus formanii	WGS84	50 J	733734	6713808	2
Eucalyptus formanii	WGS84	50 J	733742	6713774	2
Eucalyptus formanii	WGS84	50 J	733716	6713748	1
Eucalyptus formanii	WGS84	50 J	733761	6713732	4
Eucalyptus formanii	WGS84	50 J	733770	6713716	2
Eucalyptus formanii	WGS84	50 J	733809	6713729	3
Eucalyptus formanii	WGS84	50 J	733834	6713722	2
Eucalyptus formanii	WGS84	50 J	733858	6713736	12
Eucalyptus formanii	WGS84	50 J	733888	6713732	1
Eucalyptus formanii	WGS84	50 J	733913	6713745	3
Eucalyptus formanii	WGS84	50 J	733905	6713710	1
Eucalyptus formanii	WGS84	50 J	733914	6713789	1
Eucalyptus formanii	WGS84	50 J	733887	6713787	3
Eucalyptus formanii	WGS84	50 J	733846	6713789	2
Eucalyptus formanii	WGS84	50 J	733856	6713845	1
Eucalyptus formanii	WGS84	50 J	733831	6713842	5
Eucalyptus formanii	WGS84	50 J	733799	6713856	1
Eucalyptus formanii	WGS84	50 J	735415	6710045	12
Eucalyptus formanii	WGS84	50 J	735489	6710032	1
Eucalyptus formanii	WGS84	50 J	735548	6710062	2
Eucalyptus formanii	WGS84	50 J	735495	6710097	7
Eucalyptus formanii	WGS84	50 J	735462	6710141	2
Eucalyptus formanii	WGS84	50 J	735390	6710171	3
Eucalyptus formanii	WGS84	50 J	735206	6710332	1
Eucalyptus formanii	WGS84	50 J	735178	6710341	6
Eucalyptus formanii	WGS84	50 J	735211	6710362	2
Eucalyptus formanii	WGS84	50 J	735187	6710378	3
Eucalyptus formanii	WGS84	50 J	735166	6710378	2
Eucalyptus formanii	WGS84	50 J	735173	6710413	2
Eucalyptus formanii	WGS84	50 J	735162	6710483	1
Eucalyptus formanii	WGS84	50 J	735235	6710431	10

Species	Datum	Zone	mE	mN	No.
Eucalyptus formanii	WGS84	50 J	735271	6710431	4
Eucalyptus formanii	WGS84	50 J	735285	6710402	3
Eucalyptus formanii	WGS84	50 J	735203	6710427	3
Eucalyptus formanii	WGS84	50 J	735497	6710177	6
Eucalyptus formanii	WGS84	50 J	735487	6710149	4
Eucalyptus formanii	WGS84	50 J	735562	6710097	2
Eucalyptus formanii	WGS84	50 J	735674	6710103	2
Eucalyptus formanii	WGS84	50 J	735660	6710126	10
Eucalyptus formanii	WGS84	50 J	735616	6710451	10
Eucalyptus formanii	WGS84	50 J	735312	6710439	6
Eucalyptus formanii	WGS84	50 J	735293	6710463	2
Eucalyptus formanii	WGS84	50 J	735236	6710500	7
Eucalyptus formanii	WGS84	50 J	735927	6711741	2
Eucalyptus formanii	WGS84	50 J	735345	6711741	5
Eucalyptus formanii	WGS84	50 J	735785	6711665	2
Eucalyptus formanii	WGS84	50 J	735799	6711625	1
Eucalyptus formanii	WGS84	50 J	735819	6711635	1
Eucalyptus formanii	WGS84	50 J	735962	6711510	4
Eucalyptus formanii	WGS84	50 J	735990	6711484	10
Eucalyptus formanii	WGS84	50 J	736051	6711411	2
Eucalyptus formanii	WGS84	50 J	736126	6711268	3
Eucalyptus formanii	WGS84	50 J	736008	6711378	8
Eucalyptus formanii	WGS84	50 J	735986	6711388	3
Eucalyptus formanii	WGS84	50 J	735911	6711250	7
Eucalyptus formanii	WGS84	50 J	735975	6711207	8
Eucalyptus formanii	WGS84	50 J	735968	6711254	2
Eucalyptus formanii	WGS84	50 J	736004	6711273	3
Eucalyptus formanii	WGS84	50 J	736129	6711142	1
Eucalyptus formanii	WGS84	50 J	736123	6711119	1
Eucalyptus formanii	WGS84	50 J	736104	6711095	5
Eucalyptus formanii	WGS84	50 J	736155	6711071	1
Eucalyptus formanii	WGS84	50 J	735415	6710045	12
Eucalyptus formanii	WGS84	50 J	735489	6710032	1
Eucalyptus formanii	WGS84	50 J	735548	6710062	2
Eucalyptus formanii	WGS84	50 J	735495	6710097	7
Eucalyptus formanii	WGS84	50 J	735462	6710141	2
Eucalyptus formanii	WGS84	50 J	735390	6710171	3
Eucalyptus formanii	WGS84	50 J	735206	6710332	1
Eucalyptus formanii	WGS84	50 J	735178	6710341	6
Eucalyptus formanii	WGS84	50 J	735211	6710362	2
Eucalyptus formanii	WGS84	50 J	735187	6710378	3
Eucalyptus formanii	WGS84	50 J	735166	6710378	2
Eucalyptus formanii	WGS84	50 J	735173	6710413	2
Eucalyptus formanii	WGS84	50 J	735162	6710483	1
Eucalyptus formanii	WGS84	50 J	735235	6710431	10
Eucalyptus formanii	WGS84	50 J	735271	6710431	4
Eucalyptus formanii	WGS84	50 J	735285	6710402	3

Species	Datum	Zone	mE	mN	No.
Eucalyptus formanii	WGS84	50 J	735203	6710427	3
Eucalyptus formanii	WGS84	50 J	735497	6710177	6
Eucalyptus formanii	WGS84	50 J	735487	6710149	4
Eucalyptus formanii	WGS84	50 J	735562	6710097	2
Eucalyptus formanii	WGS84	50 J	735674	6710103	2
Eucalyptus formanii	WGS84	50 J	735660	6710126	10
Eucalyptus formanii	WGS84	50 J	735616	6710450	10
Eucalyptus formanii	WGS84	50 J	735312	6710439	6
Eucalyptus formanii	WGS84	50 J	735293	6710463	2
Eucalyptus formanii	WGS84	50 J	735236	6710500	4
Eucalyptus formanii	WGS84	50 J	735927	6711741	2
Eucalyptus formanii	WGS84	50 J	735345	6711741	5
Eucalyptus formanii	WGS84	50 J	735783	6711665	2
Eucalyptus formanii	WGS84	50 J	735799	6711625	1
Eucalyptus formanii	WGS84	50 J	735819	6711635	1
Eucalyptus formanii	WGS84	50 J	735962	6711510	4
Eucalyptus formanii	WGS84	50 J	735990	6711484	10
Eucalyptus formanii	WGS84	50 J	736051	6711411	2
Eucalyptus formanii	WGS84	50 J	736126	6711268	3
Eucalyptus formanii	WGS84	50 J	736008	6711378	8
Eucalyptus formanii	WGS84	50 J	735986	6711383	3
Eucalyptus formanii	WGS84	50 J	735911	6711250	7
Eucalyptus formanii	WGS84	50 J	735975	6711207	8
Eucalyptus formanii	WGS84	50 J	735968	6711254	2
Eucalyptus formanii	WGS84	50 J	736004	6711273	3
Eucalyptus formanii	WGS84	50 J	736129	6711142	1
Eucalyptus formanii	WGS84	50 J	736123	6711119	1
Eucalyptus formanii	WGS84	50 J	736104	6711095	5
Eucalyptus formanii	WGS84	50 J	736155	6711071	1

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Appendix A

Definitions of Threatened (Declared Rare) and Priority Flora

Definition of Declared Rare and Priority Flora Species (DEC, 2012a)

Conservation Code	Category Description
T	*Threatened – (Declared Rare Flora – Extant)* Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such (Schedule 1 under the Wildlife Conservation Act, 1950). Threatened Flora (Schedule 1) are further ranked by the DEC according to their level of threat using IUCN Red List Criteria: CR: Critically Endangered – considered to be facing an extremely high risk of extinction in the wild EN: Endangered – considered to be facing a very high risk of extinction in the wild VU: Vulnerable – considered to be facing a high risk of extinction in the wild
X	*X: Presumed Extinct Flora (Declared Rare Flora — Extinct)* Taxa which have been adequately searched for and there is no reasonable doubt that the last individual has died, and have been gazetted as such (Schedule 2 under the Wildlife Conservation Act 1950)
Species that have not yet been adequately surveyed to be listed under Schedule 1 or 2 are added to the Priority Flora List under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened flora or fauna. Species that are adequately known, are rare but not threatened, or meet criteria for Near Threatened, or that have been recently removed from the threatened list for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring. Conservation Dependent species are placed in Priority 5.	
P1	*Priority One – Poorly-known Species* Species that are known from one or a few collections or sight records (generally less than five), all on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, Shire, Westrail and Main Roads WA road, gravel and soil reserves, and active mineral leases and under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes.
P2	*Priority Two – Poorly Known Species* Species that are known from one or a few collections or sight records, some of which are on lands not under imminent threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes.
P3	*Priority Three – Poorly Known Species* Species that are known from collections or sight records from several localities not under imminent threat, or from few but widespread localities with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and known threatening processes exist that could affect them.
P4	*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 do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. c. Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.
P5	*Priority Five – Conservation-dependent species* Species that are not threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

Appendix B

Definitions of Threatened and Priority Ecological Communities

Threatened Ecological Community Classifications and Descriptions (DEC, 2012b)

Category	Category Description
Presumably totally destroyed (PD)	An ecological community that has been adequately searched for but for which no representative occurrences have been located. The community has been found to be completely destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the forseeable future. An ecological community will be listed as presumed totally destroyed if there are no recent records of the community being extant AND EITHER of the following applies: A) Records within the last 50 years have not been confirmed despite thorough searches of known or likely habitats **or** B) All occurrences within the last 50 years have been destroyed.
Critically endangered (CR)	An ecological community will be listed as critically endangered when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future. This is determined on the basis of the best available information, by it meeting ANY ONE OR MORE of the following criteria (A, D, or G): **A) The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 90 % and either or both of the following apply (B or C):** B) Geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is imminent (within approximately 10 years); C) Modification throughout its range is continuing such that in the immediate future (within approximately 10 years) the community is unlikely to be capable of being substantially rehabilitated. **D) Current distribution is limited, and one or more of the following apply (E or F):** E) Geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the immediate future (within approximately 10 years); F) There may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes. G) **The ecological community exists only as highly modified occurrences that may be capable of being rehabilitated if such work begins in the immediate future (within approximately 10 years).**
Endangered	An ecological community will be listed as endangered when it has been adequately surveyed and is not critically endangered but is facing a very high risk of total destruction in the near future. This will be determined on the basis of the best available information by it meeting ANY ONE OR MORE of the following (A, D or H): **A) The geographic range, and/or total area occupied, and/or number of discrete occurrences have been reduced by at least 70 % since European settlement and either or both of the following apply (B or C):** B) The estimated geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is likely in the short term future (within approximately 20 years); C) Modification throughout its range is continuing such that in the short term future (within approximately 20 years). **D) Current distribution is limited, and one or more of the following apply (E, F or G):** E) Geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the short term future (within approximately 20 years); F) There are few occurrences, each of which is small and/or isolated and all or most occurrences are very vulnerable to known threatening processes; G) There may be many occurrences but the total area is small and/or isolated and all or most occurrences are small and/or isolated and very vulnerable to known threatening processes. **H) The ecological community exists only as very modified occurrences that may be capable of being substantially restored or rehabilitated if such work begins in the short-term future (within approximately 20 years).**
Vulnerable	An ecological community will be listed as vulnerable when it has been adequately surveyed and is not critically endangered or endangered but is facing a high risk of total destruction or significant modification in the medium to long-term future. This will be determined on the basis of the best available information by meeting **any one or more** of the following criteria (A, B or C): A) The ecological community exists largely as modified occurrences that are likely to be capable of being substantially restored or rehabilitated. B) The ecological community may already be modified and would be vulnerable to threatening processes, is restricted in area and/or range and/or is only found at a few locations. C) The ecological community may be still widespread but is believed to move into a category of higher threat in the medium to long-term future because of existing or impending threatening processes.

Priority Ecological Community Classifications and Descriptions (DEC, 2012b)

Category	Category Description
Priority One	Poorly-known ecological communities Ecological communities that are known from very few occurrences with a very restricted distribution (generally ≤ 5 occurrences or a total area of ≤ 100 ha). Occurrences are believed to be under threat due to limited extent, or being on lands under which immediate threat (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist. May include communities with occurrences on protected lands. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.
Priority Two	Poorly-known ecological communities Communities that are known from few occurrences with a restricted distribution (generally ≤ 10 occurrences or a total area of ≤ 200 ha). At least some occurrences are not believed to be under immediate threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.
Priority Three	Poorly-known ecological communities Communities that are known from several to many occurrences, a significance number or area of which are not under threat of habitat destruction or degradation; or Communities known from a few widespread occurrences, which are either large or with significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat; or, Communities made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes. Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect.
Priority Four	Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring. Rare – Ecological communities known from few occurrences 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 communities are usually represented on conservation lands. Near Threatened – Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. Ecological communities that have been removed from the list of threatened communities during the past five years.
Priority Five	Conservation-Dependent ecological communities Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

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Appendix C

Classification of Vegetation Structural Formation and Height Classes

LIFE FORM/HEIGHT CLASS	CANOPY COVER			
	DENSE **70% - 100%**	**MID DENSE** **30% - 70%**	**SPARSE** **10% - 30%**	**VERY SPARSE** **2% - 10%**
Trees > 30m	Dense Tall Forest	Tall Forest	Tall Woodland	Open Tall Woodland
Trees 15 – 30m	Dense Forest	Forest	Woodland	Open Woodland
Trees 5 – 15m	Dense Low Forest A	Low Forest A	Low woodland A	Open Low Woodland A
Trees < 5m	Dense Low Forest B	Low Forest B	Low Woodland B	Open Low Woodland B
Mallee Tree Form	Dense Tree Mallee	Tree Mallee	Open Tree Mallee	Very Open Tree Mallee
Mallee Shrub Form	Dense Shrub Mallee	Shrub Mallee	Open Shrub Mallee	Very Open Shrub Mallee
Shrubs > 2m	Dense Thicket	Thicket	Scrub	Open Scrub
Shrubs 1.5 – 2m	Dense Heath A	Heath A	Low Scrub A	Open Low Scrub A
Shrubs 1 – 1.5m	Dense Heath B	Heath B	Low Scrub B	Open Low Scrub B
Shrubs 0.5 – 1m	Dense Low Heath C	Low Heath C	Dwarf Scrub C	Open Dwarf Scrub C
Shrubs 0 – 0.5m	Dense Low Heath D	Low Heath D	Dwarf Scrub D	Open Dwarf Scrub D
Mat Plants	Dense Mat Plants	Mat Plants	Open Mat Plants	Very Open Mat Plants
Hummock Grass	Dense Hummock Grass	Mid-dense Hummock Grass	Hummock Grass	Open Hummock Grass
Bunch grass >0.5m	Dense Tall Grass	Tall Grass	Open Tall Grass	Very Open Tall Grass
Bunch grass < 0.5m	Dense Low Grass	Low Gras	Open Low Grass	Very Open Low Grass
Herbaceous spp.	Dense Herbs	Herbs	Open Herbs	Very Open Herbs
Sedges > 0.5m	Dense Tall Sedges	Tall Sedges	Open Tall Sedges	Very Open Tall Sedges
Sedges < 0.5m	Dense Low Sedges	Low Sedges	Open Low Sedges	Very Open Low Sedges
Ferns	Dense ferns	Ferns	Open Ferns	Very Open Ferns
Mosses, liverworts	Dense Mosses	Mosses	Open Mosses	Very Open Mosses

Appendix D
Vegetation Condition Scale

Vegetation Condition Scale (Keighery, 1994)

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

Appendix E
Vegetation photographs



Plate 1 Image of BW1



Plate 2 Image of PW2



Plate 3 Image of PW3



Plate 4 Image of PW4



Plate 5 Image of PW5



Plate 6 Image of PW6



Plate 7 Image of PW7



Plate 8 Image of PW8



Plate 9 Image of PW9



Plate 10 Image of PW10



Plate 11 Image of PW11



Plate 12 Image of PW12



Plate 13 Image of SS



Plate 14 Image of FPW1



Plate 15 Image of FPW2



Plate 16 Image of FPW3



Plate 17 Image of EDW1



Plate 18 Image of EDW2



Plate 19 Image of PW1



Plate 20 Image of BW2



Plate 21 Image of BW3



Plate 22 Image of GW2



Plate 23 Image of BHLW



Plate 24 Image of BHOLW-A



Plate 25 Image of BHOLW-B

Appendix F
Species Summary

Family	Genus	Species
Amaranthaceae	*Ptilotus*	*drummondii*
	Ptilotus	*exaltatus*
	Ptilotus	*obovatus*
Apiaceae	*Daucus*	*glochidiatus*
Apocynaceae	*Alyxia*	*buxifolia*
	Marsdenia	*australis*
Araliaceae	*Trachymene*	*ornata*
Asparagaceae	*Chamaxeros*	*macranthera*
	Thysanotus	*manglesianus*
Asteraceae	*Calocephalus*	*multiflorus*
	**Centaurea*	*melitensis*
	Gilruthia	*osbornei*
	Lawrencella	*davenportii*
	Olearia	*humilis*
	Olearia	*muelleri*
	Olearia	*pimelioides*
	Pluchea	*dentex*
	Podolepis	*canescens*
	Senecio	*lacustrinus*
	**Sonchus*	*oleraceus*
	Vittadinia	*eremaea*
	Waitzia	*acuminata*
Brassicaceae	**Brassica*	*tournefortii*
	**Carrichtera*	*annua*
	Menkea	*australis*
	**Sisymbrium*	*orientale*
	Stenopetalum	*filifolium*
Casuarinaceae	*Allocasuarina*	*dielsiana*
	Allocasuarina	*eriochlamys* subsp. *eriochlamys*
	Allocasuarina	*acutivalvis* subsp. *acutivalvis*
	Casuarina	*pauper*
Chenopodiaceae	*Atriplex*	*nummularia*
	Atriplex	*paludosa*
	Atriplex	*stipitata*
	Enchylaena	*tomentosa* var. *tomentosa*
	Maireana	*amoena*
	Maireana	*?eriosphaera*
	Maireana	*pentatropis*
	Maireana	*sedifolia*
	Maireana	*trichoptera*
	Maireana	*triptera*
	Rhagodia	*drummondii*
	Sclerolaena	*diacantha*

Family	Genus	Species
Chenopodiaceae	*Sclerolaena*	*fusiformis*
	Sclerolaena	*patenticuspis*
Cucurbitaceae	**Cucumis*	*myriocarpus*
Cupressaceae	*Callitris*	*columellaris*
Ericaceae	*Leucopogon*	sp. Clyde Hill (M.A. Burgman 1207)
Fabaceae	*Acacia*	*aneura*
	Acacia	*burkittii*
	Acacia	*caesaneura*
	Acacia	*cockertoniana*
	Acacia	*erinacea*
	Acacia	*jennerae*
	Acacia	*murrayana*
	Acacia	*obtecta*
	Acacia	*prainii*
	Acacia	*pteraneura*
	Acacia	*quadrimarginea*
	Acacia	*ramulosa* var. *ramulosa*
	Acacia	*sibina*
	Acacia	*tetragonophylla*
	Bossiea	*walkeri*
	Daviesia	*incrassata* subsp. *incrassata*
	Daviesia	*purpurascens*
	Mirbelia	*microphylla*
	Senna	*artemisioides* subsp. *filifolia*
	Senna	*artemisioides* subsp. x *artemisioides*
	Senna	*pleurocarpa* var. *angustifolia*
	Senna	*pleurocarpa* var. *pleurocarpa*
	Senna	*stowardii*
Frankeniaceae	*Frankenia*	*irregularis*
Geraniaceae	*Erodium*	*cygnorum*
Goodeniaceae	*Brunonia*	*australis*
	Goodenia	*havillandii*
	Scaevola	*spinescens*
	Velleia	*rosea*
Hemerocallidaceae	*Dianella*	*revoluta* var. *divaricata*
Lamiaceae	*Prostanthera*	*althoferi* subsp. *althoferi*
	Prostanthera	*grylloana*
	**Salvia*	*verbenaca*
	Spartothamnella	*teucriiflora*
	Westringia	*rigida*
Malvaceae	*Brachychiton*	*gregorii*
	Sida	sp (sterile)
	Sida	sp. dark green fruits (S van Leeuwen 2260)

Family	Genus	Species
Myrtaceae	*Baeckea*	aff. *elderiana*
	Baeckea	*elderiana*
	Baeckea	sp. Parker Range (M. Hislop & F. Hort MH 2968) (P3)
	Eucalyptus	*clelandii*
	Eucalyptus	*ewartiana*
	Eucalyptus	*formanii* (P4)
	Eucalyptus	*griffithsii*
	Eucalyptus	*kochii* subsp. *plenissima*
	Eucalyptus	*leptopoda*
	Eucalyptus	*longissima*
	Eucalyptus	*loxophleba* subsp. *supralaevis*
	Eucalyptus	*oleosa*
	Eucalyptus	*rigidula*
	Eucalyptus	*salubris*
	Euryomyrtus	*recurva*
	Malleostemon	sp. Adelong (G.J. Keighery 11825) (P2)
	Melaleuca	*uncinata*
Pittosporaceae	*Pittosporum*	*angustifolium*
Poaceae	*Amphipogon*	*caricinus* var. *caricinus*
	Amphipogon	*strictus*
	Aristida	*holathera* var. *holathera*
	Austrostipa	*nitida*
	Austrostipa	sp. (sterile)
	Monachather	*paradoxus*
	Triodia	*rigidissima*
Proteaceae	*Grevillea*	*nematophylla* subsp. *nematophylla*
	Grevillea	*obliquistigma* subsp. *obliquistigma*
	Grevillea	*obliquistigma* subsp. *obliquistigma* Parker Range Form
	Grevillea	*paradoxa*
	Hakea	*recurva*
Pteridaceae	*Cheilanthes*	*sieberi* subsp. *sieberi*
Rhamnaceae	*Cryptandra*	*connata*
Rutaceae	*Phebalium*	*canaliculatum*
	Philotheca	*brucei* var. *brucei*
	Philotheca	*desertii* subsp. *brevifolia* (P1)
	Philotheca	*tomentella*
Santalaceae	*Exocarpos*	*aphyllus*
	Santalum	*acumintum*
Sapindaceae	*Dodonaea*	*lobulata*
	Dodonaea	*rigida*
Scrophulariaceae	*Eremophila*	*alternifolia*
	Eremophila	*caperata*
	Eremophila	*decipiens* subsp. *decipiens*

Family	Genus	Species
Scrophulariaceae	*Eremophila*	*eriocalyx*
	Eremophila	*forrestii* subsp. *forrestii*
	Eremophila	*glutinosa*
	Eremophila	*granitica*
	Eremophila	*latrobei* subsp. *latrobei*
	Eremophila	*oldfieldii* subsp. *angustifolia*
	Eremophila	*oppositifolia* subsp. *angustifolia*
	Eremophila	*scoparia*
	Eremophila	sp. Mt Jackson (G. J. Keighery 4372)
Solanaceae	*Nicotiana*	*rosulata*
	Solanum	*ellipticum*
	**Solanum*	*hoplopetalum*
	Solanum	*lasiophyllum*
	Solanum	*nummularium*
Zygophyllaceae	*Zygophyllum*	*aurantiacum*
	Zygophyllum	*compressum*
	Zygophyllum	*eremaeum*

APPENDIX C

APPENDIX C:

BASELINE FAUNA SURVEY (BAMFORD CONSULTING BOTANISTS, 2012)

MBS ENVIRONMENTAL

Vector Resources
Gwendolyn Project
Fauna Assessment



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12th December 2012

EXECUTIVE SUMMARY

Vector Resources Limited (Vector) proposes to develop the Gwendolyn project, located on Diemal Station, approximately 170 km north of Southern Cross and 160 km west of Menzies, in the Goldfields region of Western Australia.

As part of the Environmental Impact Assessment for the Project, Bamford Consulting Ecologists (BCE) was commissioned by Vector Resources Limited Pty Ltd to conduct a Level 1 fauna investigation (desktop review and fauna assessment) of the area. BCE uses an impact assessment process with the following components:

- The identification of **fauna values**:
  - Assemblage characteristics: uniqueness, completeness and richness;
  - Species of conservation significance;
  - Recognition of 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).
- The **recommendation** of actions to mitigate impacts.

The identification of fauna values involved a desktop assessment and a site reconnaissance field survey in September 2012. The desktop survey identified 257 fauna species potentially occurring in the survey area. This comprised five frog, 74 reptile, 140 bird, 28 native mammal and ten introduced mammal species. A total of 83 fauna species was recorded during the field survey (11 reptile, 60 bird, seven native mammal and five introduced mammal species). Invertebrate specimens colleted during the site reconnaissance inlcuded a caemanid land snail (tentatively identified as *Pleuroxia* sp. nov.) that is currently considered to be a short range endemic (SRE), with other records of the same or similar species from nearby banded ironstone formation hills.

Fauna assemblage. Moderately rich and substantially intact except for the loss of a suite of medium-size mammal species. While likely to be typical of fauna assemblages for this region, the Gwendolyn survey area contains elements of two sub-regions (Eastern Murchison

and Coolgardie) making it a unique and possibly richer assemblage than surrounding regions. In particular this includes small areas of outlying eucalypt woodland, which are a dominating characteristic of the region to the south.

Species of conservation significance. Nine conservation significant fauna species were recorded during the field survey. These include seven bird species, 1 mammal species and 1 invertebrate. Species of note are the Vulnerable Malleefowl, several woodland birds in decline including the infrequently seen Scarlet-chested Parrot and a priority species, the Tree-stem Trapdoor Spider. The status of a probable SRE snail *Pleuroxia* sp. nov., is uncertain. It is probably most closely associated with the Dryandra land system that lies largely outside impact areas.

Vegetation and Substrate Associations. Ten VSAs were identified across the project area, although four of these can be grouped as eucalypt woodlands. Most of the VSAs are regionally widespread and well-represented, but the Acacia shrublands on Ironstone Ridges (VSA 1) and pockets of eucalypt woodlands representing the northern extent of the Great Western Woodlands, as outliers, are restricted in distribution.

Patterns of biodiversity. Biodiversity is likely to be spread across the VSAs and the landscape, but areas of particular significance include the eucalypt woodlands which support a number of conservation significant fauna and declining woodland birds. Historical disturbance and clearing throughout eucalypt woodlands in the region has led to the reduction of large, mature eucalypt trees. The remaining mature eucalypt trees contain tree hollows, providing roosting and breeding sites for conservation significant birds and bats.

Key Ecological Processes - Impacts on fauna are generally considered to be only minor, and this is also consistent for the majority of the conservation significant species. This is due to the relatively small footprint of the project which is located mostly within widespread, common and disturbed environments. The exception is the eucalypt woodlands, which are small northern outliers of the Great Western Woodlands. Impact to these would be considered moderate. The main processes affecting the fauna assemblage include: fauna mortality, loss of specific habitats, potential changes in hydrology, and impacts of dust, noise, light and disturbance.

Recommendations relate to impacts and include:

- minimising impacts on important fauna habitats (Acacia shrublands on Ironstone Ridges (VSA 1), eucalypt and Malleefowl habitat);
- minimising the removal of large, hollow-bearing trees;
- minimising roadkill risk, especially to species such as the Malleefowl;
- develop a Malleefowl Management Plan – to minimise any associated impacts on the local population;

- A number of uncapped drill holes were found. These act as long term highly efficient pit traps for small fauna unless capped, and
- taking a precautionary approach to minimise impacts through changes in hydrology, light pollution, the inadvertent (or deliberate) encouragement of feral species and the spread of weeds.

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1 INTRODUCTION

1.1 Introduction

Vector Resources Limited (Vector) proposes to develop the Gwendolyn project, located on Diemal Station, approximately 170 km north of Southern Cross and 160 km west of Menzies, in the Goldfields region of Western Australia.

As part of the Environmental Impact Assessment for the Gwendolyn Project, Bamford Consulting Ecologists (BCE) was commissioned by Vector to conduct a Level 1 fauna assessment (desktop review and site inspection) within the Gwendolyn area. A Level 1 Fauna Assessment is required to identify the fauna values of a site so that impacts upon these from any proposed development can be assessed and, where possible, minimised.

1.2 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 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).
- The recommendation of actions to mitigate impacts.

Descriptions and background information on these values and processes can be found in Appendices 1 to 4. 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 development; and provide recommendations to mitigate these impacts.

1.3 Description of Survey Area.

The Gwendolyn Project is situated approximately 5 km east of Diemal Homestead on the Lake Barlee – Youanmi Rd, near the Bullfinch – Evanston Rd intersection. The project includes two tenements - mining tenement M77 / 1263 and the nearby exploration tenement G77 / 119 (formerly E77 / 1580 (see Figure 1)). The project development is initially centred on M77 / 1263, with an extensive drilling program already undertaken. To support the project several additional roads and a new mining camp are proposed.

The fauna assessment for the Gwendolyn project included all areas of proposed development:

1. M77 / 1263 (195 ha): comprising a previously- mined shallow open pit, an extensive network of cleared drill lines and surrounding intact native vegetation;
2. G77 / 119 (formerly E77 / 1580 (300 ha)): comprising mostly intact native vegetation with very few cleared areas (two existing access tracks present). Mining camp to be located in this area;
3. A network of proposed access tracks of approximately 15 km connecting the above (L77/245, L77/247 and L77/248).

Figure 1. The Gwendolyn Project Location showing tenements M77/1263 and G77/119 (formerly E77/1580).

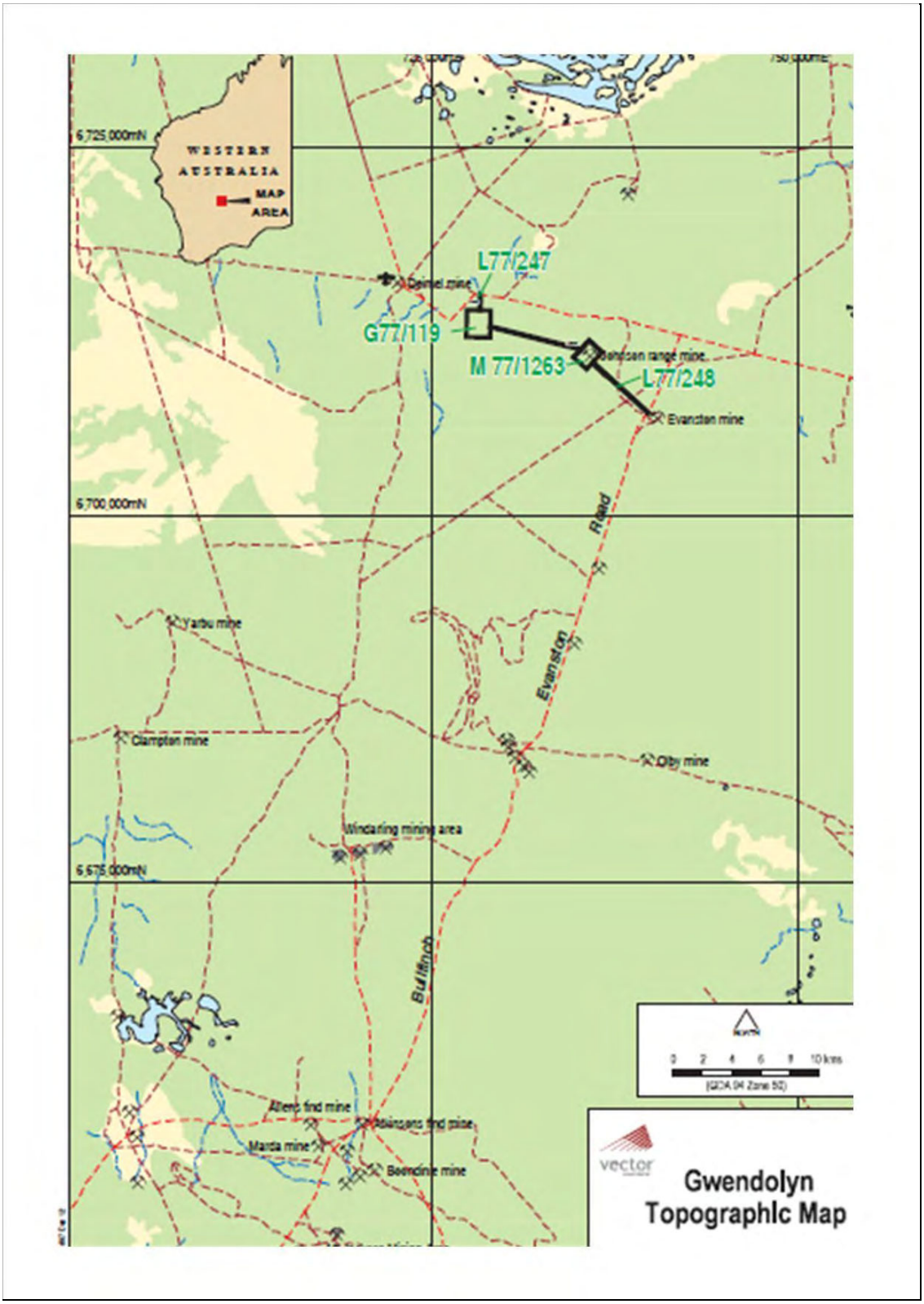
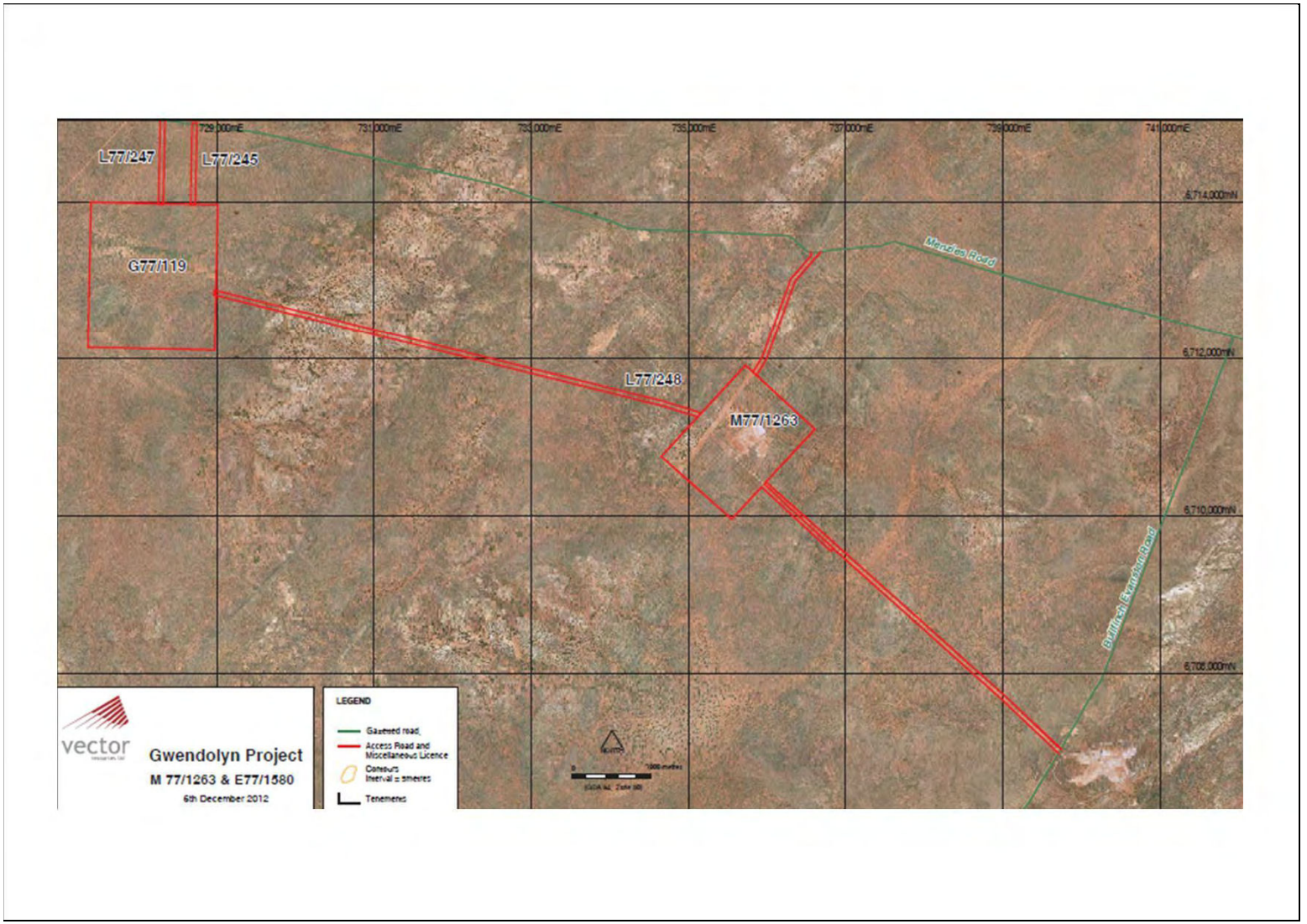


Figure 2. The Gwendolyn Project Survey Area showing tenements M77/1263 and G77/119 (formerly E77/1580) and associated access tracks.



2 BACKGROUND

2.1 Regional Description

The Interim Biogeographic Regionalisation of Australia (IBRA) (Environment Australia, 2000) has identified 26 bioregions in Western Australia. 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 Vector survey area lies on the southern fringe of the Murchison Bioregion and within the Eastern Murchison Subregion (Coolgardie 3, IBRA, 2008). The Murchison Bioregion falls within the Bioregion Group 2 classification (EPA, 2004). Bioregions within Group 2 have "native vegetation that is largely contiguous but is used for commercial grazing."

The general features of the Eastern Murchison subregion are summarised by Cowan (2001). The subregion is characterised by its internal drainage and extensive areas of elevated red desert sandplains with minimal dune development. The climate is arid.

The subregion contains:

"Salt lake systems associated with an occluded Paleodrainage system, broad plains of red-brown soils, breakaway complexes as well as red sandplains. Vegetation is dominated by Mulga Woodlands often rich in ephemerals; hummock grasslands, saltbush shrublands and Halosarcia shrublands (Cowan, 2001)."

The dominant land use in this subregion is grazing, with smaller areas of crown reserves, and mining. Only 1.4% of the sub-region is vested within conservation reserves (Cowan, 2001).

The Gwendolyn Survey area is of interest as it lies on the southern fringe of the Eastern Murchison sub-region and, as a result, contains elements of the Coolgardie sub-region to the south. In particular this includes areas of Eucalypt Woodland, which are a dominating characteristic of the region to the south. As a result the fauna assemblage expected is likely to contain elements of both the Eastern Murchison and Southern Cross regions

2.2 Land Systems

Pringle *et al*. (1994) classified and mapped the land forms of the Goldfields region including the survey area. Land Types are classified according to similarities in landform, soil, vegetation, geology and geomorphology. The survey area contains four land types (Table 1). Land Types are further divided into Land Systems based on similarities of vegetation, landform and soil. The

Land Systems present in the survey area are listed below (Table 2). Land Systems provide an indication of the fauna habitats present within the survey area (see Figure 3).

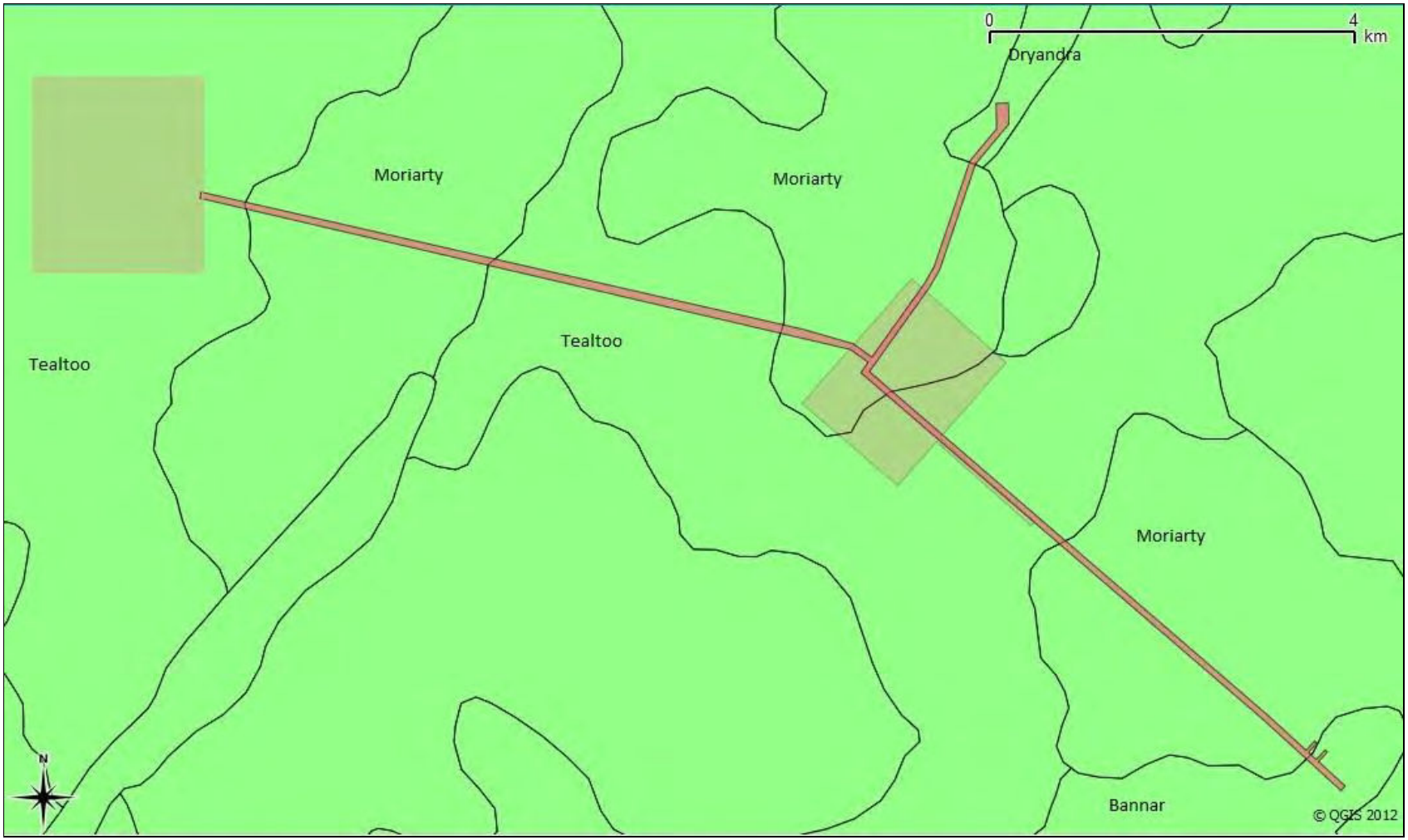
Table 1. Major Land Types found within the survey area (Land System in brackets).

Land Type	Description
1	Hills and ranges with acacia shrublands (Dryandra).
17	Stony plains with acacia shrublands and halophytic shrublands (Tealtoo).
26	Sandplains with acacia, mallees and heath (Bannar).
29	Sandy plains with acacia shrublands and wanderrie grasses (Moriarty).

Table 2. Land Systems found within the survey area.

Land System	Landform
Tealtoo	Level to gently undulating loamy plains with fine ironstone lag gravel supporting dense acacia shrublands.
Moriarty	Low greenstone rises and stony plains supporting chenopod shrublands with patchy eucalypt overstoreys.
Dryandra	Ridges of banded iron formation supporting dense mixed shrublands with emergent native pines, mallees and casuarinas.
Bannar	Level to gently undulating sandy plains with acacia shrublands, commonly with patchy native pines and mallees.

Figure 3. Land Systems within the survey area (shaded pink).



2.3 Vegetation Units

Beard (1972, 1976) mapped the vegetation of the region including the survey area. Four vegetation communities were mapped in survey area:

1. a1,14Si. *Acacia aneura* and *Acacia quadrimarginea* scrub;
2. E6Mra9, 19Si. *Acacia ramulosa var. ramulosa, Acacia ramulosa var. linophylla* and *Acacia acuminata* scrub with scattered *Eucalyptus loxophleba.*
3. anSc. Thickets of mixed Acacia species and Allocasurina on sandplain; and
4. e6,8,34Mi. Sclerophyll woodland dominated by *Eucalyptus loxophleba, E. salmonophloia* and *Eucalyptus salubris*.

Niche Environmental Services (2012) surveyed and mapped the vegetation of the Gwendoyln project. Five vegetation units were defined and delineated within the mining lease area (mining tenement M77/ 1263). In addition to this, there were two areas that were regenerating after disturbance:

- W1 – Low Woodland B of *Acacia ramulosa var. ramulosa*, *Eucalyptus ewartiana* and *A. aneura* over Open Low Scrub A of B*aeckea elderiana, Prostanthera grylloana* and *Eremophila forestii* subsp. *forestii* on red clay in a flat to very gently sloping valley floor.
- W2 – Low Woodland B of *Acacia cockertoniana, A, burkittii* and *Eremophila oldfieldii* with an emergent canopy of *Allocasuarina acutivalvis* subsp. *acutivalvis* over Low Scrub B of *Philotheca brucei* subsp. *brucei*, *Dodonaea rigida* and *Leucopogon* sp. Clyde Hill (M.A. Burgman 1207) over Open Dwarf Scrub D of *Prostanthera althoferi* subsp. *althoferi* and *Dianella revoluta* var. *divaricata* over Very Open Low Grasses of *Monachather paradoxus* and *Amphipogon caricinus var. caricinus* on red clay on low ridge of basalt with ironstone intrusions.
- W3 – Woodland of *Eucalyptus salubris* and *E. clelandii* over Open Low Scrub B of *Atriplex nummularia*, *Eremophila pantonii* and *Senna artemisioides* subsp. x *artemisioides* over Open Dwarf Scrub D of chenopods on plains with red clay and scattered gravel of ironstone and quartz.
- W4 – Low Woodland A of Eucalyptus species over Low Woodland B of *Acacia ramulos*a var. *ramulosa, A. aneura* and *A. caesaneura* over red clay with scattered gravel of ironstone and quartz.
- W5 – Open Low Woodland A of Eucalyptus species over Low Woodland B of *Acacia ramulosa var. ramulosa*, *A. aneura* and *A. caesaneura* over Open Low Scrub B of *Philotheca brucei* subsp. *brucei*, *Dodonaea rigida* and *Eremophila decipiens* subsp.

decipiens on red flat plain to very gently sloping low hills of red clay with ironstone, quartz and basalt gravel and very occasional minor outcroppings of basalt and ironstone.

- D1 – Disturbed area 1 (Old pit). Included the old pit, haul road, TSF and access tracks.
- D2 – Disturbed area 2 (Old airstrip). The old airstrip was approximately 1 600 m in length, running in a northeasterly direction across the entire tenement, with a width of approximately 40 m. The area had been remediated and was clearly revegetating, however the old airstrip was not considered to be structurally analogous to any of the adjacent vegetation.

2.4 Great Western Woodlands

The survey area lies just to the north of the Great Western Woodlands, and has some elements typical of the woodlands. The Great Western Woodlands is a large tract of Eucalypt Woodland extending from the Wheatbelt to the inland deserts of Western Australia (Watson *et al*., 2008).

The Great Western Woodlands is the largest remaining intact temperate woodland in the world and extends from Southern Cross to Kalgoorlie and east to Balladonia, and south to near Ravensthorpe. The Great Western Woodlands is one of the very few, large, intact landscapes remaining in temperate Australia and is of Global significance (Watson *et al.,* 2008).

3 METHODS

3.1 Overview

The methods used in these investigations are based upon the general approach to fauna investigations for impact assessment as outlined in Section 1.2 and with reference to Appendices 1 to 4. Thus, the impact assessment process involves the identification of fauna values, review of impacting processes and preparation of mitigation recommendations.

In addition, the approach to fauna impact assessment was carried out 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). The EPA proposes two levels of investigation that differ in the approach to field investigations, Level 1 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 (eg. 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.

Due to the size and location of the proposed project Vector requested a Level 1 fauna assessment with some additional targeted surveying. A Level 1 fauna assessment consists of a desktop study and basic ground-truthing through a reconnaissance survey.

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 study, 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 (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.

3.2 Desktop Assessment

3.2.1 Sources of information

Information on the fauna assemblage of the project area was drawn from a wide range of sources. These included state and federal government databases and results of regional studies. Databases accessed were the DEC Naturemap (incorporating the Western Australian Museum's FaunaBase and the DEC Threatened and Priority Fauna Database), Birdlife Australia's Atlas Database (BA), the EPBC Protected Matters Search Tool and the BCE database (Table 3). 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 & Doughty (2009);
- Reptiles: Storr *et al.* (1983); Storr *et al.* (1990); Storr *et al.* (1999); Storr *et al.* (2002) and Wilson & Swan (2008);
- Birds: Blakers *et al.* (1984); Johnstone and Storr (1998, 2004) and Barrett *et al.* (2003); and
- Mammals: Menkhorst & Knight (2001); Strahan (2004); Churchill (2008); and Van Dyck and Strahan (2008).

The Biological Surveys Committee of Western Australia coordinated an inventory of vegetation, flora and fauna of the Eastern Goldfields, including the Lake Barlee area (Records of Western Australian Museum, Supplement 41). Species recorded during these surveys are listed in Appendix 5.

Table 3. Sources of information used for the desktop assessment.

Database	Type of records held on database	Area searched / Year
NatureMap (DEC 2012)	Records in the WAM and DEC databases. Includes historical data and records on Threatened and Priority species in WA.	Gwendolyn survey Area – plus 20 km buffer
Birdlife Australia Atlas Database	Records of bird observations in Australia, 1998-2011.	Species list for one degree cell containing: Gwendolyn Survey Area
EPBC Protected Matters	Records on matters of national environmental significance protected under the EPBC Act.	Gwendolyn Survey Area – plus 10km buffer
Biological Survey of the Eastern Goldfields	Part 12: Barlee - Menzies Study Area	1979 - 1981
BCE Database	Previous BCE surveys in the region conducted at Mt Jackson and Windarling and also at the Carina Iron Ore Mine.	2008 - 2011

3.2.2 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 Vertebrates of Western Australia* 2008. The authorities used for each vertebrate group were: amphibians (Doughty and Maryan 2010a), reptiles (Doughty and Maryan 2010b), birds (Christidis and Boles 2008), and mammals (How *et al*. 2009). 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.

3.2.3 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 was highly unlikely that these species would be present. In general, however, species returned by the desktop review process are considered to be potentially present in the survey area whether or not they were recorded during field surveys. This is because fauna are highly mobile, often seasonal and frequently cryptic. This is particularly important for significant species that are often rare and hard to find.

Interpretation of species lists generated through the desktop review included assigning an expected status within the survey area to species of conservation significance. This is particularly important for birds that may naturally be migratory or nomadic, and for some mammals that can also be mobile or irruptive. The status categories used are:

- Resident: species with a population permanently present in the survey area;
- Regular migrant or visitor: species that occur within the survey area regularly in at least moderate numbers, such as part of annual cycle;
- Irregular Visitor: 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: 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 has not been recently recorded in the local area and therefore is almost certainly no longer present in the survey area.

3.3 Field survey

3.3.1 Overview

The field survey included several components:

1. targeted searching for conservation significant fauna;
2. bird census;
3. bat surveys;
4. use of motion sensitive cameras;
5. opportunistic fauna survey sites;
6. habitat assessment; and
7. opportunistic observations.

3.3.2 Dates and Personnel

The Gwendolyn survey area was assessed from the 18th to the 23rd September 2012 by:

- Mr Jeff Turpin (B.Sc.Zool);
- Mr Tim Gamblin (B.Sc.Zool.Cert.Env.Man);
- Mr Peter Smith (Dip.Ag.Farm Man); and
- Ms Sarah Smith (B.Sc.Biol).

The field survey was conducted under DEC Regulation 17 (Licence to take Fauna for Scientific Purposes) licence number SF008837. This fauna assessment document was prepared by Mr Jeff Turpin and Dr Mike Bamford (B.Sc. Hons. Ph.D), and was reviewed by Mr Tim Gamblin.

3.3.3 Vegetation and Substrate Associations

Vegetation and Substrate Associations (VSAs) throughout the survey area were assessed during the desktop review and as part of the field investigations. Within the survey area each major VSA was visited to develop an understanding of major fauna habitat types present and to assess the likelihood of conservation significant species being present in the area.

3.3.4 Targeted searching for conservation significant species

Significant species recorded during the desktop assessment include several that can be found by searching for evidence of their activities (e.g. scats, tracks, diggings, burrows). These included the Malleefowl (which creates distinctive mounds and has distinctive tracks), Trapdoor Spiders (which build distinctive burrows) and the ant *Camponotus terebrans* which has distinctive gallery entrances at the base of certain eucalypts. These provide shelter for the threatened Arid Bronze Azure Butterfly. Searching for evidence of significant fauna was therefore undertaken by walking through habitat considered suitable for such species.

3.3.5 Targeted Fauna Transects

To search for conservation significant fauna, several fauna transects were traversed across the survey area (see Figure 4). Tenement M77/1263 was searched intensively for Malleefowl (mounds) and the presence of Tree-stem Trapdoor Spiders (burrows). Within G77/119 (formerly E77/1580), habitats deemed suitable to support such species were targeted and traversed by personnel. All proposed access tracks were traversed by two personnel spaced 20m apart. The proposed new mining camp was also searched intensively with four personnel spaced 20 m apart.

3.3.6 Bat surveys

Ultrasonic echolocation calls of bats were recorded with an AnaBat SD1 bat detector, and later processed using AnalookW software (Titley Scientific, Brisbane). Identification of species was assisted by measuring the following echolocation call parameters:

- Fmax Maximum call frequency (kHz)
- Fmin Maximum call frequency (kHz)
- Fc Characteristic frequency (kHz)
- Fpeak Frequency with peak number of cycles (kHz)
- DUR Duration of call (ms)

The AnaBat detector was deployed overnight at four sites (see Table 4).

Table 4. Bat survey sites (Zone 50J).

Site	Easting	Northing	Dates	VSA/ Habitat
Bat 1	735473	6710746	18/09/12	Ironstone ridge with mixed Acacia shrublands
Bat 2	735930	6710808	19/09/12	Vector Camp – mixed shrublands on stony rise
Bat 3	728236	6713359	20/09/12	Dense Mulga Drainage line
Bat 4	736285	6711267	21/09/12	Ironstone ridge with mixed Acacia shrublands

3.3.7 Motion-sensitive cameras

Six motion-sensitive camera sites were established within the survey area to record fauna (see Table 5). All cameras were baited with universal bait (sardines, peanut butter, rolled oats).

Table 5. Motion-sensitive camera sites (Zone 50J).

Site	Easting	Northing	Date Set	VSA / Habitat	# Nights
Cam 1	735473	6710746	18/09/12	Ironstone ridge with mixed Acacia shrublands	3
Cam 2	735035	6711288	19/09/12	Eucalypt Woodland - large hollow log	3
Cam 3	735057	6710873	19/09/12	Rocky ridge with extensive outcropping	3
Cam 4	727414	6712488	20/09/12	Ironstone ridge with mixed Acacia shrublands and rock outcropping	2
Cam 5	736300	6711279	21/09/12	Ironstone ridge with mixed Acacia shrublands and rock outcropping	2
Cam 6	736302	6711287	21/09/12	Ironstone ridge with mixed Acacia shrublands and rock outcropping	2

3.3.8 Sampling for Short Range Endemic Fauna

Leaf litter samples were collected from rare or isolated habitats to sample for Short Range Endemic Invertebrate Fauna. Leaf litter was collected at four sites, with two samples taken from each site (see Table 6). Litter samples were taken to Dalcon Environmental for sorting, with specimens forwarded to specialists for identification.

Table 6. Leaf litter Sample Sites (Zone 50J).

Site	Easting	Northing	VSA / Habitat
Leaf 1	735480	6710755	Ironstone ridge with mixed Acacia shrublands
Leaf 2	727414	6712488	Ironstone ridge with mixed Acacia shrublands and rock outcropping
Leaf 3	728250	6713365	Dense Mulga Drainage line
Leaf 4	736290	6711260	Ironstone ridge with mixed Acacia shrublands

3.3.9 Opportunistic observations

At all times, observations of fauna were noted when they contributed to the accumulation of information on the fauna of the site. These included such casual observations as birds or reptiles seen while travelling through the site.

Figure 4. Survey Effort within the Gwendolyn Survey Area. Note fauna transects are shown as red lines, with Motion Camera Sites (Black Squares), Bat Detector Sites (White Circles) and Leaf Litter Sites (Crosses) indicated.



3.4 Survey limitations

The EPA Guidance Statement 56 (EPA 2004) outlines a number of limitations that may arise during surveying. These survey limitations are discussed in the context of the BCE fauna survey at the project area in Table 7.

Table 7. Survey limitations as outlined by EPA (2004).

EPA Limitation	BCE Comment
Level of survey.	Level 1 (desktop study and reconnaissance survey). Survey intensity was deemed adequate due to the level of survey and the number of fauna surveys previously conducted in the region.
Competency/experience of the consultant(s) carrying out the survey.	The authors have had extensive experience in conducting desktop reviews and site inspections.
Scope. (What faunal groups were sampled and were some sampling methods not able to be employed because of constraints?)	Birds were sufficiently sampled however due to the nature of the survey, low level sampling was conducted for reptiles, amphibians and mammals. To sample for SRE invertebrates several leaf litter samples were collected.
Proportion of fauna identified, recorded and/or collected.	No vertebrate species collected, all fauna observed identified. Leaf litter samples were collected to sample for SREs.
Sources of information e.g. previously available information (whether historic or recent) as distinct from new data.	Sources include previous reports on the fauna of the local area (BCE database); databases (BA, DEC, WAM, EPBC); BCE (and other) surveys in nearby areas.
The proportion of the task achieved and further work which might be needed.	Site inspection completed.
Timing/weather/season/cycle.	Site inspection conducted during September 2012. Conditions were mild, no rainfall recorded
Disturbances (e.g. fire, flood, accidental human intervention etc.) which affected results of survey.	No disturbances affected the survey.
Intensity. (In retrospect, was the intensity adequate?)	Survey intensity was low (desktop study and site inspection) however was adequate to satisfy EPA guidelines.
Completeness (e.g. was relevant area fully surveyed).	Desktop study covered survey area and adjacent habitats. Site inspection covered all areas of the project.
Resources (e.g. degree of expertise available in animal identification to taxon level).	All species identified to taxon level.
Remoteness and/or access problems.	No access problems.
Availability of contextual (e.g. biogeographic) information on the region.	Extensive regional information was available and was consulted.

3.5 Impact Assessment

3.5.1 Fauna values and ecological processes

As outlined in Section 1.2, the impact assessment process involves identifying fauna values and reviewing impacting ecological processes. Fauna values include fauna assemblage and distribution, VSAs, and conservation significant fauna (see Appendix 1). Ecological processes that may impact upon these fauna values are discussed in Appendix 2, with processes specific to this project examined in Section 5.4. While some impacts are unavoidable during a development, of concern are long-term, deleterious impacts upon biodiversity. These are discussed under the following categories:

- VSAs. Impacts may be significant if the VSA is rare, a large proportion of the VSA is affected and/or the VSA supports significant fauna.
- Conservation significant fauna. Impacts may be significant if species of conservation importance are affected.
- Processes. Ecological processes are complex and can include hydrology, fire, predator/prey relationships and spatial distribution of a population. Impacts upon ecological processes may be significant if large numbers of species or large proportions of populations are affected.

3.5.1 Criteria for impact assessment

Impact assessment criteria are based on the severity of impacts on the fauna assemblage and conservation significant fauna, and were quantified on the basis of predicted population change (Table 8). Population change can be the result of direct habitat loss and/or impacts upon ecological processes.

Table 8. Assessment criteria of impacts upon fauna**.**

Impact Category	Observed Impact
Negligible	Effectively no population decline; at most few individuals impacted and any decline in population size within the normal range of annual variability.
Minor	Short-term population decline (recovery after end of project) within project area, no change in viability of conservation status of population. Where environment permanently altered, no change in viability or conservation status of population
Moderate	Permanent population decline, change in viability or conservation status of population considered unlikely
Major	Permanent population decline resulting in change in viability or conservation status of population
Critical	Taxon extinction (i.e. extinction of species, sub-species or of a recognisably discrete genetic population).

4 RESULTS

4.1 Vegetation and Substrate Associations

Ten major VSAs were identified during field investigations. These were:

1. Acacia shrublands (dominated by *Acacia ramulosa* and *A. aneura*) with some scattered *Casuarina pauper* on Ironstone Ridges. Ridge crests contain some areas of ironstone outcropping;
2. Mixed Acacia shrublands (including *Acacia aneura*, *Acacia ramulosa, Acacia cockertoniana, A. burkittii, A. caesaneura, A. burkittii* and *A. tetragonophylla*) with scattered Eucalypts on gravelly ironstone slopes and rises;
3. Mixed Eucalypt Woodlands dominated by *Eucalyptus salubris* and *E. clelandii* over *Atriplex nummularia*, *Eremophila pantonii* and *Senna artemisioides* on plains with red clay and scattered gravel of ironstone and quartz.
4. Low Woodland of eucalypt species (dominated by *E. loxophleba* and *E. formanii*) with scattered *Callitris columellaris* over *Acacia ramulosa, A. aneura* and *A. caesaneura* over red sandy clay loam with scattered gravel of ironstone and quartz.
5. Mixed shrublands of *Acacia aneura* and *Acacia ramulosa* on clay flats;
6. Minor drainage lines supporting dense *Acacia aneura* shrublands with *A. burkittii* and scattered Eucalypts;
7. *Eucalyptus clelandii* woodlands supporting chenopod shrublands on low greenstone rises and stony plains;
8. *Eucalyptus salubris* woodlands on loam flats and drainage valleys;
9. Dense *Acacia ramulosa* shrubland with scattered Mallee, *Callitris columellaris* and Grevillea sp. on level to gently undulating sandy / gravelly plains.
10. Cleared or previously disturbed land.

The above VSAs were identified from across the entire survey area. The breakdown of VSAs present within each survey component is listed in Table 9 below. In addition to the VSAs described above, previously cleared or disturbed areas also occur, particularly within M77/1263 where previously mining and exploration has been undertaken. VSAs are described below and photographs of each VSA are presented in Plates 1 to 13.

Table 9. VSAs present within each survey component.

Survey Component	VSA 1	VSA 2	VSA 3	VSA 4	VSA 5	VSA 6	VSA 7	VSA 8	VSA 9	VSA 10
M77 / 1263	X	X	X	X						X
G77/119 (formerly E77/1580)	X	X			X	X				
Network of proposed access tracks	X	X	X	X		X	X	X	X	X

Plate 1. VSA 1 - Acacia shrublands on Ironstone Ridges. Ridge crests contain some areas of ironstone outcropping.



Plate 2. VSA 1 - Acacia shrublands on Ironstone Ridges. Ridge crests contain some areas of ironstone outcropping.



Plate 3. VSA 1 - Acacia shrublands on Ironstone Ridges. Ridge crests contain some areas of ironstone outcropping**.**



Plate 4. VSA 2 – Mixed Acacia shrublands on gravelly ironstone slopes and rises.



Plate 5. VSA 2 – Mixed Acacia shrublands on gravelly ironstone slopes and rises**.**



Plate 6. VSA 2 – Mixed Acacia shrublands on gravelly ironstone slopes and rises.



Plate 7. VSA 3 – mixed Eucalypt woodlands.



Plate 8. VSA 4 - Low Woodland of Eucalyptus species dominated by *E. loxophleba* and *E. formanii* with scattered *Callitris columellaris* over *Acacia ramulosa, A. aneura* and *A. caesaneura* over red sandy clay loam.



Plate 9. VSA 5 – Mixed shrublands of *Acacia aneura* and *Acacia ramulosa* on clay flats.



Plate 10. VSA 5 – Mixed shrublands of *Acacia aneura* and *Acacia ramulosa* on clay flats.



Plate11. VSA 6 – Minor drainage lines supporting dense *Acacia aneura* shrublands with *A. burkittii* and scattered Eucalypts**.**



Plate 11. VSA 6 - *Eucalyptus clelandii* woodlands supporting chenopod shrublands on low greenstone rises and stony plains.



Plate 12. VSA 8 - *Eucalyptus salubris* woodlands on loam flats and drainage valleys.



Plate 13. VSA 9 - Dense *Acacia ramulosa* shrubland with scattered Mallee, *Callitris columellaris* and Grevillea sp. on level to gently undulating sandy / gravelly plains.



4.2 Fauna

4.2.1 Overview of fauna assemblage

The vertebrate fauna with the potential to occur (including those also recorded) in the survey area is presented in Appendix 5. The faunal assemblage expected is typical of the region. Most fauna species occurring or expected to occur in the survey area are widespread but some species may have restricted or habitat limited distributions, and some fauna species expected have declined in the region. The composition of the vertebrate fauna expected to occur and recorded within the survey area is presented in Table 10 (and see Appendix 5 and Appendix 6).

The desktop survey identified 257 fauna species potentially occurring in the vicinity of the survey area (Table 10). This comprised five frog, 74 reptile, 140 bird, 28 native mammal and ten introduced mammal species. Twenty five conservation significant species are considered likely to occur within the survey area (either as a resident or as a visitor on seasonal basis, see Table 11). This includes one reptile (1 CS1), 18 bird (5 CS1, 3 CS2, 10 CS3), four mammal (1 CS1, 1 CS2, 2 CS3) and two invertebrate species (1CS1, 1 CS2). In addition, one probable SRE invertebrate was collected.

A total of 83 fauna species was recorded during the field survey (Table 10, see Appendix 5). This comprised 11 reptile, 60 bird, seven native mammal and five introduced mammal species. Ten conservation significant fauna species were recorded during the field survey (Tables 10 and 11).

Locations of significant species recorded during the survey are provided in Appendix 7. Details of each conservation significant species expected to occur in the survey area are provided in Table 11. Conservation significant fauna species occurring or likely to occur in the survey area are discussed below.

Table 10. Composition of vertebrate fauna assemblage expected to occur within the survey area.

Taxon	Number of species expected	Number Recorded	Significant fauna Expected (recorded)		
			CS1	CS2	CS3
Frogs	5	0	-	-	-
Reptiles	74	11	1	-	-
Birds	140	60	5 (1)	3	10 (6)
Native Mammals	28	7	1	1	2 (1)
Introduced Mammals	10	5	-	-	-
Invertebrates	NA	NA	1	1 (1)	- (1)
Total	**257**	**83**	**8**	**5**	**12**

Table 11. Conservation status of significant fauna species expected to occur in the study (based on desktop review and field investigation). See Appendix for descriptions of conservation significance levels. Species recorded are indicated and the predicted status of each species in the project is also given (as per Section 2.4.1).

Common Name	Species Name	Conservation Status			Local Records	Habitat Type	Habitat Present in Survey Area	Expected Status in Survey Area	Recorded in Survey Area
REPTILES		**CS1**	**CS2**	**CS3**					
Carpet Python	*Morelia spilota imbricata*	S4	P4		Lake Walton	Eucalypt Woodland	Yes	Potential Resident	
Western Spiny-tailed Skink	*Egernia stokesii badia*	S1			None	Eucalypt Woodland	Yes	Unlikely to occur	
BIRDS									
Malleefowl	*Leipoa ocellata*	Vul			Windarling, Die Hardy Range.	Acacia shrublands, dense woodlands.	Yes	Visitor / Resident	Recorded
Slender-billed Thornbill	*Acanthiza iredalei*	Vul			Lake Barlee	Samphire, Chenopods	No	Unlikely to occur	
Peregrine Falcon	*Falco peregrinus*	S4			Windarling	Rocky ridges, major drainage lines, woodland	Yes	Visitor / Resident	
Major Mitchell's Cockatoo	*Lophochroa leadbeateri*	S4			Marda	Eucalypt Woodland	Yes	Visitor / Resident	
Western Rosella	*Platycercus icterotis*		P4		Southern Cross	Eucalypt and Sheoak Woodlands	Yes	Unlikely Visitor / Vagrant	
Rainbow Bee-eater	*Merops ornatus*	Mig			Lake Barlee	Watercourses, woodland	Yes	Regular Migrant	
Fork-tailed Swift	*Apus pacificus*	Mig			Southern Cross	Aerial	Yes	Irregular Visitor	
Australian Bustard	*Ardeotis australis*		P4		Lake Barlee	Plains	Yes	Visitor	
Bush Stone-curlew	*Burhinus grallarius*		P4		Lake Moore	Acacia shrublands, Woodlands	Yes	Potential Resident	
Shy Heathwren	*Hylacola cauta whitlocki*		P4		Hunt Range.	Dense mallee shrub thicket	Yes	Potential Resident	
Square-tailed Kite	*Lophoictinia isura*			CS3	Lake Barlee.	Woodland and Heath	Yes	Visitor	
Scarlet-chested Parrot	*Neophema splendida*			CS3	Jaurdi	Arid Woodland	Yes	Irregular Visitor	Recorded
Regent Parrot	*Polytelis anthopeplus*			CS3	Pigeon Rocks.	Forest, Woodland	Yes	Visitor	
Southern Scrub-robin	*Drymodes brunneopygia*			CS3	Pigeon Rocks Deception Hill.,	dense mallee dense shrubs	Yes	Potential Resident	
Western Yellow-robin	*Eopsaltria griseogularis*			CS3	Pigeon Rocks	Eucalypt Woodland, dense Acacia lined drainages.	Yes	Resident	Recorded
Purple-crowned Lorikeet	*Glossopsitta porphyrocephala*			CS3	Lake Barlee	Woodland, Mallee	Yes	Visitor	

Rufous Tree-creeper	*Climacteris rufus*			CS3	Lake Barlee	Mature Woodland with tree hollows	Yes	Resident	Recorded
Chestnut Quail-thrush	*Cinclosoma castanotus*			CS3	Mount Geraldine	Woodland, Mallee, rocky ridges	Yes	Resident	Recorded
Gilbert's Whistler	*Pachycephala inornata*			CS3	Lake Barlee	Mallee, Woodland	Yes	Resident	Recorded
Yellow-plumed Honeyeater	*Lichenostomus ornatus*			CS3	Lake Barlee	Eucalypt Woodland	Yes	Resident	Recorded
Mammals									
Chuditch	*Dasyurus geoffroyii*	Vul			Southern Cross	Woodland, forest, Mallee	Yes	Probably locally extinct	
Central Long-eared Bat	*Nyctophilus timoriensis*		P4		Southern Cross	Woodlands, shrublands	Yes	Resident	
Kultarr	*Antechinomys laniger*			CS3	Kalgoorlie	Stony plains	Yes	Potential resident	
Woolley's Pseudantechinus	*Pseudantechinus woolleyae*			CS3	Gwendolyn	Rocky Ridges	Yes	Resident	Recorded
Invertebrates									
Tree-stem Trapdoor Spider	*Aganippe castellum*		P4		Koolyanobbing	Ironstone ridges, slopes, stony plains	Yes	Resident	Recorded
Arid Bronze Azure	*Ogyris subterrestris petrina*	S1			Lake Douglas	Eucalypt Woodland, smooth barked Eucalypts	Yes	Potential Resident	
Inland Hairstreak Butterfly	*Jalmenus aridus*		P1		Lake Douglas	*Acacia tetragonophylla* and *Senna nemophila*	Yes	Unlikely to occur	
Fairy Shrimp	*Branchinella denticulata*		P1		Kalgoorlie	Temporary wetlands	Yes	Unlikely to occur	
Caemanid land snail	*Pleuroxia* sp. nov.			CS3	Windalring, Mt Richardson and Cashmere Downs	Banded ironstone hills	Yes	Resident	Recorded

Codes:

- EPBC Act listed species: Vul = Vulnerable, End = Endangered, Mig = Migratory
- WC Act listed species: S1 = Schedule 1, S3 = Schedule3, S4 = Schedule 4, DEC Priority Species: P1 = Priority 1, P4 = Priority 4.

4.2.2 Amphibians

A total of five species of frog may occur in the vicinity of the survey area (Appendix 5). None of the frog species expected is of conservation significance.

4.2.3 Reptiles

A total of 74 reptile species may occur in the vicinity of the survey area (Appendix 5). Eleven species were recorded during the field survey (see Appendix 5 and 6). One reptile species of conservation significance is known from the region and is discussed below.

Conservation Significance Level 1 (CS1)

South-west Carpet Python (*Morelia spilota imbricata*)

The south-western race of the Carpet Python occurs in south-west Western Australia, from Northampton, south to Albany and eastwards to Kalgoorlie. It also occurs in large undisturbed remnant bushland near Perth and the Darling Ranges (Bush *et al*., 2007). This species occurs in Banksia woodland, Eucalypt Woodland, forests, dense coastal scrub, granite and limestone outcrops and along watercourses (Bush *et al*., 2007). Carpet Pythons are arboreal, terrestrial, and rock-dwelling and can shelter in burrows made by other animals, hollow tree limbs, or rock crevices. The South-west Carpet Python has declined in distribution due to the loss of habitat (associated with land clearance), and changed fire regimes. Predation by exotic predators (foxes and feral cats) may have also contributed to the decline of python populations (Bush *et al*., 2007). There are several records of the Carpet Python from the Southern Cross and Koolyanobbing areas (DEC, 2012) however the Gwendolyn survey area lies to the north of the species' current known distirbution.

4.2.4 Birds

A total of 140 bird species may occur in the vicinity of the survey area. Appendix 5 presents the bird assemblage expected to occur and recorded in the vicinity of the survey area. The field survey recorded 60 bird species. Seven conservation significant species were recorded during the survey (see Appendix 7 for location details). These were:

- Malleefowl (EPBC Vulnerable) – nine mounds and fresh tracks recorded;
- Scarlet-chested Parrot (Locally significant) – one male indicating potential breeding site;
- Rufous Tree-creeper (Locally significant) – pair recorded.
- Western Yellow Robin (Locally significant) – pairs recorded at two locations;
- Yellow-plumed Honeyeater (Locally significant);
- Gilbert's Whistler (Locally significant); and
- Chestnut Quail-thrush (Locally significant).

Eighteen conservation significant birds are considered likely to occur within the survey area (Table 11). Conservation significant birds known from the region are discussed below.

Conservation Significance Level 1 (CS1)

Malleefowl (*Leipoa ocellata*)

In Western Australia, Malleefowl occur mainly in scrubs and thickets of Mallee (*Eucalyptus* spp.), Boree (*Melaleuca pauperiflora*) and Acacia (particularly *Acacia linophylla* and *Acacia aneura*) and also other dense litter-forming shrublands (Johnstone and Storr 2004).

The Malleefowl previously inhabited most of the Goldfields however has undergone a dramatic range reduction in the region. The widespread clearing of suitable habitat, coupled with the degradation of habitat by fire and livestock, and fox predation has reduced Malleefowl numbers considerably (Johnstone and Storr 2004).

Malleefowl have developed a highly sophisticated method of temperature control for egg incubation. The species constructs distinctive nests that comprise a large mound covering a central core of leaf litter. Nests are typically built in areas of dense vegetation. In the Goldfields region, BCE has recorded mounds within Mallee (*Eucalyptus* spp.), Tammar (*Allocasuarina campestris*) thickets, Sheoak (*Casuarina pauper*) Woodland, Acacia (eg. *Acacia aneura, Acacia linophylla*) and Boree (*Melaleuca pauperiflora*) shrublands. Mounds have been constructed on stony, sand or loam substrates.

Near the survey area, the Malleefowl has been recorded at Windarling, Die Hardy Range and at Mt Jackson (DEC, 2012). BCE recorded a pair of Malleefowl at Mt Jackson on transit to the survey area.

Targeted searching for the Malleefowl was undertaken within the survey area, in areas of suitable habitat. Nine Malleefowl mounds were recorded (see Appendix 7 and 8 and Plates 14 - 15) within dense Acacia shrublands and fresh tracks were recorded near the proposed camp. Of the mounds recorded, one was active (with fresh excavations into old decomposing leaf litter, fresh scratching on mound with fresh droppings), one mound had been recently excavated and seven were considered inactive without any evidence of recent use.

Plate 14. Recently excavated Malleefowl mound recorded in the survey area.



Plate 15. Inactive Malleefowl mound recorded in the survey area.



Western Slender-billed Thornbill (*Acanthiza iredalei iredalei*)

The Western Slender-billed Thornbill occurs in shrubland, typically in areas of saltmarsh dominated by samphire, bluebush (*Maireana* spp.) or saltbush (*Atriplex* spp.) around salt lakes or low heath on sandplain (Pavey 2006). The species occurs in a number of disjunct populations in Western Australia, from Shark Bay to the Nullarbor (Johnstone and Storr 2004). The Western Slender-billed Thornbill is considered uncommon, rare, and in some areas locally extinct, in inland Western

Australia. The species is declining in much of its range owing to the degradation of chenopod vegetation by livestock and rabbits (Johnstone and Storr 2004). This species has been recorded at scattered locations throughout the Murchison and Goldfields, including from Lake Barlee (Birdlife Australia 2012). As the species inhabits samphire amongst the margins of salt lakes, the Slender-billed Thornbill is not expected to occur within the survey area.

Peregrine Falcon (*Falco peregrinus*)

The Peregrine Falcon is classified as "Specially Protected Fauna" under Schedule 4 of the Wildlife Conservation Act. In addition, DEC has listed the Peregrine Falcon as being a species that is significantly dependent on banded ironstone formation ranges in the region (DEC 2007). This species is found in a variety of habitats, including rocky ledges, cliffs, watercourses, open woodland and acacia shrublands. The distribution of the Peregrine Falcon is often tied to the abundance of prey as this species predates heavily on other birds. The Peregrine Falcon lays its eggs in recesses of cliff faces, tree hollows or in large abandoned nests of other birds (Birdlife Australia 2012). The Peregrine Falcon mates for life with pairs maintaining a home range of about 20 - 30 km^2 throughout the year. Blakers *et al.* (1984) consider that Australia is one of the strongholds of the species, since it has declined in many other parts of the world. The Peregrine Falcon has been recorded Lake Barlee (Birdlife Australia, 2012) and is likely to occur within the survey area.

Major Mitchell's Cockatoo (*Lophochroa leadbeateri*)

Major Mitchell's Cockatoo is sporadically distributed through arid and semi-arid Australia, particularly within Eucalypt Woodland (DEC, 2012). In the Goldfields region this species occurs within Eucalypt Woodland including Salmon Gum Woodland (J. Turpin, pers. obs.). It was recorded from Eucalypt Woodland on transit to the Gwendolyn site (see Appendix 7). Major Mitchell's Cockatoo may occur within the Gwendolyn survey area within the areas of Eucalypt Woodland.

Migratory species

The two migratory species potentially occurring within the survey area are the Fork-tailed Swift (an aerial species) and Rainbow Bee-eater (an abundant, ground-nesting species that catches insects on the wing over a range of environments).

Conservation Significance Level 2 (CS2)

Western Rosella (*Platycercus icterotis xanthogenys*)

The inland subspecies of the Western Rosella inhabits Eucalypt and Sheoak Woodland and scrubs, especially those containing Wandoo (*E. wandoo*), Flooded Gum, Salmon Gum (*E. salmonophloia*), tall mallee and Rock Sheoak (*Allocasuarina huegeliana*). It occurs from Northam and Wongon Hills, inland to the Kambalda region and south to the Stirling Range (DEC, 2009). The Western Rosella has undergone a significant change in distribution and status since 1970. It has

disappeared from the northern and eastern parts of its range due to the removal of feeding and breeding habitat (DEC, 2009). It is considered locally extinct within most of the northern and eastern wheatbelt, declining in remaining parts of the wheatbelt, but remains stable in the Goldfields area (Garnett and Crowley, 2000). The Western Rosella's known distribution lies at least 100km to the south of the Gwendolyn site and as such this species is considered unlikely to occur within the survey area. However it was recorded at Mt Jackson during the Eastern Goldfields surveys between 1979 and 1981. Generally occurring in the southern semi-arid interior, this small parrot has been recorded as a casual visitor to areas further north.

Australian Bustard (*Ardeotis australis*)

The Australian Bustard This species is a large, ground-dwelling bird known to occur in open or lightly-wooded country in Australia (extinct in south-eastern Australia) and southern New Guinea. It is nomadic and may range over very large areas, largely dependent on rainfall and hence food availability. This species was recorded at Mount Jackson on transit to the Gwendolyn site. It may be an occasional visitor to the survey area.

Bush Stone-curlew (*Burhinus grallarius*)

The Bush Stone-curlew is often associated with woodlands and dense shrublands such as Mulga (J. Turpin, pers. obs.). The Bush Stone-curlew has a widespread distribution, however, has significantly declined in southern parts of its range. It may be present within the survey area, and has been recorded north-west of the survey area at Youanim (Birdlife Australia, 2012).

Shy Heathwren (*Hylacola cauta whitlocki*)

The western sub-species of the Shy Heathwren inhabits areas of woodland with dense heathy understory. The subspecies whitlocki occurs in heathy woodlands of the south-west of Western Australia (Duncan *et al.,* 2006). The Shy Heathwren is documented as declining in the Wheatbelt (Saunders & Ingram, 1995) with significant loss of habitat in the south-west Wheatbelt. This species has been recorded south of the survey area at the Hunt Range, and at the Helena and Aurora Range and Mt Jackson (Birdlife Australia, 2012).

The survey area lies near the extreme edge of this species range however there is the potential for the Shy Heathwren to occur due to the occurrence of suitable habitat.

Crested Shrike-tit (*Falcunculus frontatus*)

The south-western sub-species of the Crested Shrike-tit occurs from north of Perth to Esperance (Birdlife Australia, 2012) and is an uncommon inhabitant of semi-arid woodlands. The Western Crested Shrike-tit has been historically recorded from the Kalgoorlie area and more recently from the Bremer Range near Norseman (Birdlife Australia, 2012). It is unlikely to occur within the survey area which appears to lie outside the current known range of this species.

Hooded Plover (*Charadrius rubricollis*)

The Hooded Plover frequents the margins and shallows of salt lakes and along coastal beaches, where it forages for invertebrates along the water's edge. Due to the absence of suitable habitat this species is unlikely to occur within the survey area.

Conservation Significance Level 3 (CS3)

Square-tailed Kite (*Lophoictinia isura*)

The Square-tailed Kite is sparsely distributed over much of the Australian mainland, with a few scattered records from the Southern Cross region (Birdlife Australia, 2012). It is a specialised predator of the canopy, foraging primarily over forest, woodland, mallee and heath (Garnett and Crowley, 2000). This species has been recorded at Lake Barlee and at Windarling (M. Bamford pers. obs) and is likely to periodically occur within the survey area.

Western Regent Parrot (*Polytelis anthopeplus anthopeplus*)

The Western Regent Parrot occurs in south-west Western Australian, within Eucalypt Woodland and Mallee, nesting in hollows of Eucalypts (particularly *Eucalyptus salmonophloia*). The Regent Parrot has declined over its range due to clearing for agriculture and the decline of suitable nest trees (particularly *Eucalyptus salmonophloia*) due to salinity (Garnett and Crowley, 2000). This species was recorded at Mount Jackson on transit to the Gwendolyn Site and is likely to periodically occur within the survey area.

Scarlet-chested Parrot (*Neophema splendida*)

The Scarlet-chested Parrot formerly occurred across the Murchison and into the south-west of Western Australia, however has declined in the Goldfields and has not been recorded near the West Australian coast since 1854 (Garnet and Crowley, 2000). Most recent records come from arid inland Australia including the Great Victoria Desert. One male was recorded from the survey area (see Appendix 7), from within Eucalypt Woodland along a proposed access road. The male was observed from a small patch of Eucalypt woodland with many hollow nesting species conspicuously numerous (Australian Ringnecks, Mulga Parrots, Rufous Tree-creepers). Additionally the male was reluctant to leave the small area of woodland suggesting a female may have been present in a hollow nearby.

Western Yellow Robin (*Eopsaltria griseogularis rosinae*)

The inland subspecies of the Western Yellow Robin (*Eopsaltria griseogularis rosinae*) is listed as CS3 because much of this subspecies' habitat has been cleared for agriculture and the subspecies continues to disappear from remnants in the Wheatbelt (Garnet and Crowley, 2000). It occurs in the wheatbelt and the adjacent Mid-West and Goldfields, within the 200-500mm rainfall zone (in an approximate strip between Shark Bay and the Nullarbor, Birdlife Australia, 2012). The Western Yellow Robin occurs in the survey area on the extreme edge of its range and is restricted to small areas of favourable habitat (particularly dense shrublands on the lower slopes of hills). In the Eastern Goldfields it is generally restricted to the lower slopes of BIF ranges and is associated with dense vegetation along gullies and drainage lines.

Pairs of Western Yellow Robins were recorded from dense shrublands (at the base of an ironstone ridge and also along a drainage line) within both survey tenements (see Appendix 7).

Southern Scrub-robin (*Drymodes brunneopygi*)

The Southern Scrub-robin is listed as CS3 because of this species' tendency to disappear from fragmented vegetation blocks and its decline in the Wheatbelt region (Garnet and Crowley, 2000). This species occurs in Mallee, dry scrub, heaths, lignum on claypans and coastal tea-tree thickets. It occurs in the region at the eastern extreme of its range and has been recorded south of the survey area at Pigeon Rocks and Deception Hill (Birdlife Australia, 2012). This species may occur within dense vegetation in the survey area, particularly the vegetation associated with the rocky hills.

Declining Woodland Species

A number of south-west Australian woodland bird species are recognized as declining (Saunders and Ingram, 1995, Birdlife Australia, 2012). These species have lost considerable areas of habitat throughout the Wheatbelt and adjacent Goldfields as a result of large scale habitat clearance and the removal of mature Eucalypt trees.

Listed species include Regent Parrot, Southern Scrub-robin, Purple-crowned Lorikeet, Gilbert's Whistler, Chestnut Quail-thrush, Rufous Tree-creeper, Purple-gaped Honeyeater and Yellow-plumed Honeyeater. These species remain widespread and in some cases abundant in the broader Great Western Woodlands. The retention of these species in their natural abundances is of particular conservation significance as they are now increasingly absent or rare over much of the Wheatbelt (Duncan *et al.*, 2006). Gilbert's Whistler, Yellow-plumed Honeyeater and Rufous Treecreeper, reduced to relictual populations in few wheatbelt woodlands, are still relatively common in uncleared tall eucalypt and mallee woodland (Birdlife Australia, 2012). The Great Western Woodlands hold nationally important populations of a range of declining woodland birds, including the Malleefowl and Chestnut Quail-thrush (Birdlife Australia, 2012). Of these species, the Gilbert's Whistler, Rufous Tree-creeper, Chestnut Quail-thrush and Yellow-plumed Honeyeater were recorded within the

survey area. Locations of declining woodland species recorded during the survey are listed in Appendix 7.

4.2.5 Mammals

Twenty eight native mammal species may occur in the survey area (Appendix 5). The field survey recorded seven native species and five introduced mammal species (see Appendix 5). Additionally a *Notomys* (Hopping Mouse) species, either *Notomys alexis* or *Notomys mitchelli,* was recorded on a motion camera. *N. alexis* has been recorded to the south of the survey area at Deception Hill (DEC, 2012), and *N. mitchelli* at Mt Dimer 100km to the south-east (BCE database).

Four conservation significant mammal species are known from the region and are described below.

Conservation Significance Level 1 (CS1)

Chuditch (*Dasyurus geoffroii*)

The Chuditch currently survives only in south-western Western Australia, in areas dominated by eucalypt forest or woodland and mallee shrubland (Van Dyck and Strahan, 2008), and also persists amongst rocky outcrops. This carnivorous marsupial occupies large home ranges, is highly mobile and appears able to utilise bush remnants and corridors (Orell and Morris, 1994). The Chuditch has been recorded in the Great Western Woodlands region, from Southern Cross (1989), Ghooli (1989), Kambalda and Norseman (1994, DEC, 2012). These records appear to lie near the extreme north and east of the species' range (Orell and Morris, 1994). The Chuditch was formerly known from the Kalgoorlie region and may persist in small numbers. Suitable habitat for this species occurs within the survey area however the project lies outside the current known range of this species.

Conservation Significance Level 2 (CS2)

Greater Long-eared Bat (Central Form, *Nyctophilus timoriensis*)

The central form of the Greater Long-eared Bat is regarded as locally common in the Coolgardie Bioregion, where it occurs in Eucalypt Woodlands with a tall shrub understorey and roosts in tree hollows. This species also inhabits Mallee and Acacia shrublands and has been found to the fringes of the Nullarbor Plain (DEC, 2012). Suitable habitat for this species occurs within the survey area, which lies within a region where the Greater Long-eared Bat is considered locally common. This species is likely to occur within the survey area.

Conservation Significance Level 3 (CS3)

Woolley's Pseudantechinus (*Pseudantechinus woolleyae*)

Woolley's Pseudantechinus occurs in arid Western Australia from the Pilbara south to the Goldfields. This species favours rocky, rugged stony habitats and has been recorded through the Murchison and south to the Kalgoorlie area (DEC, 2012). Woolley's Pseudantechinus is listed as significantly dependent on banded ironstone formations in the region (DEC 2007). Woolley's Pseudantechinus is restricted to rocky ridges and breakaways and is considered habitat limited in the region.

This species was recorded from the survey area on a motion camera placed along an ironstone ridge (see Appendix 7).

Kultarr (*Antechinomys laniger*)

The Kultarr occurs in arid and semi-arid mallee, shrubland, floodplain and gibber (Van Dyck and Strahan, 2008). The Kultarr occurs across central Australia extending into the Great Western Woodlands region (DEC, 2012). It is often associated with stony, granitic plains dominated by Acacia, Eremophila and Senna shrublands (Van Dyck and Strahan, 2008). The Kultarr is uncommon over most of its range, and populations appear to fluctuate seasonally (Van Dyck and Strahan, 2008). This species may occur periodically within the survey area or be resident, probably in low numbers.

4.3 Significant Invertebrates

Several conservation significant invertebrate species have been recorded from the greater region (DEC, 2012). These include the Tree-stem Trapdoor Spider (*Aganippe castellum*) and Arid Bronze Azure Butterfly (*Ogyris subterrestris petrina*).

The Tree-stem Trapdoor Spider, *Aganippe castellum*, is listed as Priority 4 by DEC. This species occurs on the mid to lower slopes of rocky ridges and the adjacent plains, where it builds a distinctive burrow against Eucalypts, Broom bush, Sheoaks and other shrubs (BCE database). The Tree-stem Trapdoor Spider was recorded from the survey area (see Plate 16), from both tenements M77/ 1263 and E77 / 1580 and along several proposed access roads (see Appendix 8 and 9). This species occurs in the Gwendolyn survey area near the extreme north of its known range.

Plate 16. Tree-stem Trapdoor Spider (*Aganippe castellum*) recorded in the survey area.



The Arid Bronze Azure Butterfly is listed as Critically Endangered under the Wildlife Conservation Act and is currently being assessed for listing under the EPBC Act (M. Williams, pers. comm.). It is only known from Barbalin Nature Reserve (10km west of Mukinbudin, in the Wheatbelt), however was formerly known from the Lake Douglas area (12 km south-west of Kalgoorlie).

The Arid Bronze Azure Butterfly larvae feed on the secretions of its attendant ant (Pale form of *Camponotus terebrans*.) and the eggs are laid on a mallee eucalypt with an ant nest at the base. At Lake Douglas, the Arid Bronze Azure has been recorded from undulating stony rises supporting *Eucalyptus concinna*. While the species has not been recorded in the Lake Douglas area since 1993 (M. Williams, pers. comm.), it has the potential to persist in the wider area if the associated ants are present. Targeted searching in areas of suitable habitat did not locate any *Camponotus* sp. nests.

The Short-range Endemic millipede *Atelomastix bamfordi* occurs on the slopes of Mt Jackson, Koolyanobbing and the Windarling Ranges. *Atelomastix bamfordi* specimens have been collected from under leaf litter of a variety of plant genera including *Dryandra*, *Allocasuarina*, *Acacia* and *Eucalyptus,* and from different elevations, including "peaks" as well as the intervening valleys (Biota, 2009). Previous surveys have found the species to be abundant and relatively ubiquitous on the Koolyanobbing Range (Biota, 2009). At Windarling, the northern known limit of the species' range, and specimens were collected only from deep (greater than 10cm) litter beds at the base of Dryandra, suggesting this may be the limit of its distribution (Biota, 2009). Gwendolyn lies approximately 40 km north of Windarling and thus *A. bamfordi* may not be present.

In addition, a land snail (family Caemanidae, tentatively identified as *Pleuroxia* sp. nov. by Whisson 2012) was collected in litter samples from an ironstone ridge on the eastern edge of M77/1263 (litter sample 4, see Table 6). The taxonomic status of this snail is uncertain, but it is similar to, and may be the same species as, taxa known from Windarling, Mt Richardson and Cashmere Downs. Whether the same or a similar species, it is still currently considered an SRE restricted to narrow ridges and hills of banded ironstone (Whisson 2012). Whisson (2012) recommends that *Pleuroxia* sp. nov. from the region (Windarling to Mt Richardson, including the current project area) should be subject to molecular studies to determine the number of species present. Banded ironstone ridges equate to the Dryandra Land system (See Figure 3) and VSA 1, but it should be noted that this land system is more extensive than is mapped. It is well-developed north of M77/1263 (as shown on Figure 3) but small areas of ironstone ridge are also present elsewhere in the region, including in both G77/119 and M77/1263. Regionally, the Dryandra land sysem is quite widespread, as shown on Figure 5.

A second land snail (family Punctidae) was found in litter sample 4, but was considered to represent a widespread taxon (Whisson 2012).

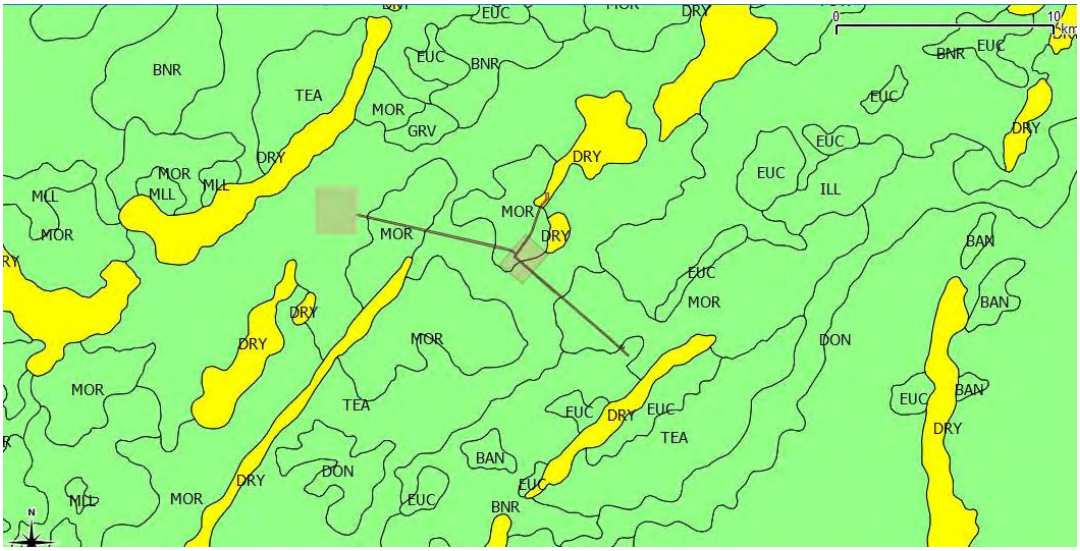


Figure 5. The distribution of the Dryandra (DRY) land system (ironstone ridges; VSA 1) in the region of the project area.

5 IMPACT ASSESSMENT

5.1 Overview of Impacts

The development of the project may adversely impact upon fauna in a number of ways. While some impacts upon fauna are unavoidable during a development project, of concern are long-term, deleterious impacts upon biodiversity. Impacts expected from this project may include the following:

- Death/injury/displacement/disturbance of fauna during clearing and impacts with vehicles/machinery.
- Loss of habitat
- Degradation of fauna habitat
- Obstructions to the movements of terrestrial fauna.
- Altered hydrological processes
- Disturbance of fauna in nearby areas.
- Changes in the abundance of feral species.

Potential impacts from the project upon fauna are considered under the categories outlined in Section 3.5: impacts to VSAs, conservation significant fauna and ecological processes that may affect the fauna assemblage. These are discussed in the following sections. Impact assessment categories are applied as described in Section 3.5.2.

5.2 Vegetation and Substrate Associations

The significance of impacts upon VSAs is related to the fauna they support and the degree of impact from the proposed development. The main VSAs in the survey area are described in Section 4.1 above. The extent and impact on each VSA type are summarised below (excluding VAS 9 which is cleared land) as follows:

1. VSA 1: Acacia shrublands on Ironstone Ridges with areas of ironstone outcropping.
    a. Representation. Occurs as a series of hills and ridges throughout the local area. Relatively small areas occur within the survey area with a small ridge occurring in the north-east corner of M77/1263 and also extending west of the existing open pit. Additionally a small area of this VSA occurs in the south-west corner of G77/119 (formerly E77/1580). Generally supports dense Acacia shrublands, particularly on lower slopes. While it is widespread in the region, it has a restricted occurrence.
    b. Conservation Significance for Fauna. Due to its restricted range, this VSA is likely to support a restricted fauna assemblage. Conservation significant species occurring within this habitat type include the

Malleefowl (some mounds recorded within this VSA), Tree-stem Trapdoor Spider (recorded), Woolley's Pseudantechinus (recorded), Western Yellow Robin (recorded) and several CS3 bird species species. Additionally, one probable SRE invertebrate, the land snail *Pleuroxia* sp. nov., is confirmed as present.

c. Impact Assessment. Impacts to this VSA are considered of minor significance as, despite the presence of conservation significant fauna such as the Malleefowl and the SRE snail *Pleuroxia* sp. nov., only very small areas are likely to be directly impacted. The VSA is also well-represented regionally (see figure 5). Disturbances to this VSA should be avoided where possible.

2. VSA 2: Mixed Acacia shrublands with scattered Eucalypts on gravelly ironstone slopes and rises.

   a. Representation. Occurs in areas adjacent to the ironstone ridges.

   b. Conservation Significance for Fauna. This VSA supports some conservation significant fauna including the Malleefowl (recorded), Tree-stem Trapdoor Spider (recorded) and several CS3 bird species

   c. Impact Assessment. Impacts to this VSA are considered of minor to moderate significance due to the presence of conservation significant fauna such as the Malleefowl and Tree-stem Trapdoor Spider.

3. VSA 3, 4, 7 and 8: Eucalypt Woodlands.

   a. Representation. Occurs in small areas throughout the survey area. The Eucalypt Woodlands present in the survey area are northern outliers of the extensive Great Western Woodlands that lie south of the survey area.

   b. Conservation Significance for Fauna. Eucalypt Woodlands support a number of conservation significant fauna and declining woodland birds. These include Carpet Python, Peregrine Falcon, Major Mitchell's Cockatoo, Scarlet-chested Parrot, Central Long-eared Bat and several CS3 birds such as Regent Parrot, Rufous Tree-creeper, Chestnut Quail-thrush and Gilbert's Whistler. Historical disturbance and clearing throughout Eucalypt Woodlands in the region has led to the reduction of large, mature Eucalypt trees. The remaining mature Eucalypt trees contain tree hollows, providing roosting and breeding sites for conservation significant birds and bats.

   c. Impact Assessment. Impacts to this VSA are considered to be of minor significance as the VSA is widespread in the local area and is extensive outside the survey area. However disturbances to large, hollow-bearing trees should be avoided where possible.

4. VSA 5: Mixed shrublands of *Acacia aneura* and *Acacia ramulosa* on clay flats.

   a. Representation. Occurs throughout the survey area and is widespread in the region.

   b. Conservation Significance for Fauna. Potentially supports some conservation significant fauna, however is a widespread fauna habitat.

   c. Impact Assessment. Impacts to this VSA are considered to be of minor significance as it is widespread in the local area and extensive outside the survey area.

5. VSA 6: Minor drainage lines supporting dense *Acacia aneura* shrublands with *A. burkittii* and scattered Eucalypts.

   a. Representation. Occurs in small areas throughout the survey area. Widespread in the region.

   b. Conservation Significance for Fauna. Potential to support some conservation significant fauna, however is a widespread fauna habitat. The CS3 Western Yellow Robin was recorded along this VSA.

   c. Impact Assessment. Impacts to this VSA are considered to be of minor significance as it is widespread in the local area and extensive outside the survey area. However disturbances to drainage lines and natural hydrological processes should be avoided where possible.

6. VSA 9: Dense *Acacia ramulosa* shrubland with scattered Mallee, *Callitris columellaris* and Grevillea sp. on level to gently undulating sandy / gravelly plains.

   a. Representation. Restricted to the Bannar Land System in the south-west of the project area, along a proposed road.

   b. Conservation Significance for Fauna. Highly likely to support Malleefowl and fresh Malleefowl tracks were recorded within this VSA. However the proposed camp area was intensively searched with no Malleefowl mounds recorded.

   c. Impact Assessment. Impacts to this VSA are considered to be negligible because only a very small area occurs within the disturbance footprint and no Malleefowl mounds were recorded.

Habitats and VSAs of conservation significance tend to be those that are both rare across the landscape and that are important for significant species and/or for biodiversity. In particular, two VSAs / Fauna habitats within the survey area are regionally restricted and support some conservation significant fauna. They are:

a. Acacia shrublands on Ironstone Ridges with areas of ironstone outcropping (VSA 1, roughly equivalent to the Dryandra land system mapped on Figure 5).

b. Eucalypt Woodlands with large, mature, hollow-bearing trees.

5.3 Conservation Significant Species

Impacts on conservation significant species are anticipated to be mostly of low to moderate significance (Table 7). Several conservation significant species occur or are expected to occur within the survey area (ten species recorded). However, 15 of these species are of particular interest as they occur and rare considered likely to have resident populations in the area. These include habitat specialists or restricted species:

- Malleefowl (CS1), recorded from survey area, resident;
- Tree-stem Trapdoor Spider (CS2), recorded from survey area, resident;
- Woolley's Pseudantechinus (CS3), recorded from survey area, resident;
- Western Yellow Robin (CS3), recorded from survey area, resident;
- Scarlet-chested Parrot (CS3), recorded from survey area, visitor;
- Rufous Tree-creeper (CS3), recorded from survey area, resident;
- Chestnut Quail-thrush (CS3), recorded from survey area, resident;
- Gilbert's Whistler (CS3), recorded from survey area, resident;
- Peregrine Falcon (CS1), recorded nearby, likely resident;
- Major Mitchell's Cockatoo (CS1), recorded nearby, potential resident or visitor;
- Shy Heathwren (CS2), recorded nearby, likely resident;
- Regent Parrot (CS3), recorded nearby, likely visitor;
- Southern Scrub-robin (CS3), recorded nearby, likely resident;
- Purple-crowned Lorikeet (CS3), recorded nearby, likely visitor;
- Central Long-eared Bat (CS2), recorded nearby, likely resident.
- Land snail *Pleuroxia* sp nov. (CS3), recorded from survey area, resident.

A summary of the potential impacts upon conservation significant species and actions that may minimise these impacts are detailed in Table 12.

Table 12. **Potential impacts upon conservation significant species that are expected to occur in the survey area. Criteria for significance of impacts are outlined in Section 3.5.2.**

Species Name	Nature and significance of likely impact		Action required
	Nature of impact	**Significance**	
Malleefowl	Loss of habitat and disturbance. Potential for roadkill.	Low (Malleefowl present within survey area, how impacts anticipated to be low providing active mounds are not disturbed coupled with small area of disturbanc). Field survey recorded all mounds likely to occur within M77/ 1263.	Avoid disturbance to mounds and Malleefowl habitat – ironstone ridges and hills and dense Acacia shrublands on stony slopes and plains.
Tree-stem Trapdoor Spider	Loss of habitat, removal of some proportion of local population.	Minor (Tree-stem Trapdoor Spider occurs in survey area at the northern limit of its known range). However, species expected to be widespread in local area with some individuals recorded on ironstone ridges outside the disturbance footprint along the Lake Barlee – Youanmi Rd.	Where possible, avoid disturbance to known locations of trapdoor spiders and avoid disturbance to trapdoor spider habitat (ironstone ridges and lower slopes).
Peregrine Falcon	Potential loss of habitat and disturbance.	Low (likely in survey area as occasional visitor, minor loss of habitat).	Avoid disturbance to large, mature Eucalypt trees as these providing potential breeding sites for the species.
Major Mitchell's Cockatoo	Potential loss of habitat and disturbance.	Low (likely in survey area as occasional visitor, minor loss of habitat).	Avoid disturbance to large, mature Eucalypt trees as these providing potential breeding sites for the species.
Shy Heathwren	Potential loss of habitat and disturbance.	Low (recorded in local area).	Minimise disturbance footprint.
Western Yellow Robin	Loss of habitat and disturbance.	Low (recorded within both tenements M77/ 1263 and E77 / 1580).	Where possible avoid disturbance to Western Yellow Robin habitat (ironstone ridges and lower slopes supporting dense shrublands).
Scarlet-chested Parrot	Loss of habitat and disturbance.	Low (potential breeding visitor to survey area).	Avoid disturbance to large, mature Eucalypt trees as these providing potential breeding sites for the species.
CS3 Birds – Declining Woodland Species	Potential loss of habitat and disturbance.	Low (recorded in local area)	Avoid disturbance to ironstone hills and ridges Avoid disturbance to large, mature Eucalypt trees as these providing potential breeding sites Minimise habitat loss and utilise existing tracks to avoid vegetation clearance for the construction of new tracks.
Central Long-eared Bat	Potential loss of habitat and disturbance.	Low (recorded in local area)	Avoid disturbance to large, mature Eucalypt trees as these providing potential breeding sites.

Woolley's Pseudantechinus	Potential loss of habitat and disturbance. Potential death through falling into uncapped drill holes.	Low (recorded in survey area)	Avoid disturbance to ironstone outcrops and ridges. Cap drill holes.
Caemanid land snail *Pleuroxia* sp. nov.	Loss of habitat, removal of some proportion of local population.	Minor (possibly Moderate, depending upon the extent of impact upon banded ironsrtone ridges). There is also some taxonomic resolution needed to determine whether or not the snails are the same species as those found on nearby ironstone hills.	Avoid disturbance to ironstone outcrops and ridges.

5.4 Ecological Processes

Many of the potential impacts of the proposed development upon fauna can be related to ecological processes (Appendices 2 and 4). There are currently 17 key threatening processes listed by the federal Department of Sustainability, Environment, Water, Population and Community (DSEWPaC 2011, see Appendix 4). Several of these processes may be applicable to the survey area:

- Land clearance;
- Loss of climatic habitat caused by anthropogenic emissions of greenhouse gases;
- Predation by the Feral Cat;
- Predation by the European Red Fox;
- Competition and land degradation by feral Rabbits; and
- Competition and land degradation by feral/unmanaged Goats.

There are common themes through the ecological processes outlined by Soule *et al.* (2004), the key threatening processes listed by DSEWPC 2011 and some of the impacts discussed with respect to threatened species (see Appendix 4). Potential impacts of the proposed project upon the fauna assemblage in the survey area are discussed under the headings of ecological processes below.

5.4.1 Increased mortality

Direct mortality of common species during clearing is unavoidable but can be minimised (see recommendations below). In general, areas to be cleared are small within the context of the regional landscape so mortality during clearing is likely to represent only small proportions of regional populations. However, the viability of species that occur at low population densities may be compromised by ongoing mortality. Ongoing mortality may arise through roadkill. Species occurring at low densities, such as the Malleefowl, may be susceptible to roadkill. Also ongoing mortality can arise from uncapped drill holes, which act as efficient long-term pit traps.

5.4.2 Loss of habitat affecting population survival

The loss of significant habitat may be detrimental to local fauna populations. Of particular significance may be impacts to ironstone ridges and mature eucalypt trees within the survey area (see Section 5.2). These support a number of conservation significant species, contain breeding or roosting sites (tree hollows), are likely to support species with restricted ranges and potentially short-range endemic fauna. To minimise impacts to significant fauna species impacts to the ironstone ridges and mature eucalypt trees should be avoided where possible. Climate change could affect the viability and senstivity of isolated populations such as SRE inverterbates on ironstone ridges.

5.4.3 Loss of habitat leading to population fragmentation

The survey area contains VSAs that are mostly widespread and extensive in the region. Fragmentation of populations leading to isolation and reduced movement/gene flow is anticipated to be minimal.

5.4.4 Species interactions, including predators and other feral species

Feral species are a major conservation concern in general but are a small component of the fauna of the survey area. Vegetation degradation by cattle, goats and rabbits is an increasing issue in the region. Within the survey area there is evidence of grazing degrading vegetation. Foxes and feral cats are likely to be attracted by recent disturbance, possibly leading to increased local impacts on native fauna in disturbed areas. Inappropriate waste management may also attract foxes and feral cats, as well as native predators and scavengers, which may exacerbate localised impacts on other native fauna.

Additionally, weed invasion poses a significant threat to the fauna and flora values of the survey area. Several weed species occur in the region. Invasive weed species can replace native species and degrade fauna habitats. Weeds can be spread by vehicles, earthworks and road construction.

5.4.5 Hydroecology

Interruptions of hydroecological processes are a concern where disturbances are associated with the major rivers and riparian vegetation. It is not known if there will be localised or broad scale impacts from the project, or no impacts at all, but this needs to be investigated. Changes in groundwater levels may affect any groundwater dependent ecosystems, which may consequently impact on fauna utilising such areas.

5.4.6 Changes in fire regime

Some conservation significant fauna are particularly susceptible to fire. However, changes to the local fire regimes arising from the proposed project are anticipated to be negligible providing management measures are in place.

5.4.1 Dust, light, noise and disturbance

Impacts of dust, light, disturbance and noise upon fauna are difficult to predict. Due to its location these are already factors influencing the fauna of the site.

5.5 Summary of impacts

Impacts upon ecological processes are summarised in Table 12. Impacts upon key fauna values (important VSAs and conservation significant fauna of interest) are summarised in Table 13. Most ecological processes are expected to have minor to moderate impacts, providing management measures are in place. Impacts upon fauna values are generally considered to be only minor, even upon the majority of significant species (see Table 11). This is because of the relatively small footprint of the project which is located within mostly widespread habitats, some already significantly modified.

Table 13. Summary of potential impacts upon ecological processes.

Impacting process	Impact
Habitat loss leading to population decline	Minor. However loss of significant VSAs is of concern. Disturbances to the ironstone ridges and mature Eucalypt trees should be avoided where possible as these support conservation significant fauna.
Population fragmentation and disruption of movement and gene flow due to habitat fragmentation	Minor. Minimal habitat fragmentation will result from the proposed project as the project involves the expansion of mining infrastructure in an already disturbed area.
Increased mortality leading to population decline; e.g. due to ongoing roadkill	Minor. Provided uncapped drill holes are capped (these act as long term highly efficient pit traps for small fauna).Increase in vehicular traffic anticipated. Potential increase in feral species. A Malleefowl Management Plam should be developed to minimize impacts of the local population.
Habitat degradation due to weed invasion	Minor. Low risk of further weed invasion beyond that current, provided management measures are in place.
Hydrological change	Unknown. Impacts to hydrology are largely unknown.
Species interactions due to feral or over-abundant native species	Minor. Low risk of increased feral species beyond that current
Changes in fire regime	Minor. There should be little risk of a change in the fire regime, provided management measures are in place.
Effects of disturbance, dust and light	Minor. Some disturbance may result, however disturbances are mostly within widespread fauna habitats.

Table 14. Summary of possible impacts upon key fauna values.

Fauna Value	Impacts from proposal	Significance of impacts
Fauna assemblage	Small loss of habitat that is mostly continuous and widespread in region. Disturbances to Ironstone ridges and mature trees are recommended to be avoided as these contain significant breeding sites for conservation significant fauna.	Minor
VSAs	Small losses and generally widespread VSAs. Ironstone hills (VSA 1) are limited in extent within the survey area itself. Disturbances to Ironstone hills and mature eucalypt trees are recommended to be avoided as these contain significant breeding sites for conservation significant fauna.	Minor
Malleefowl	Small loss of habitat, active, recently used and inactive mounds recorded within survey area. Disturbances to Malleefowl mounds should be avoided and disturbances to Malleefowl habitat should be minimised where possible. A Malleefowl Management Plan Should be developed.	Minor.
Tree-stem Trapdoor Spider	Small loss of habitat. Disturbances to this spider's habitat should be minimised where possible.	Minor
Caemanid land snail *Pleuroxia* sp. nov.	Loss of habitat (Banded ironstone hills; VSA 1). This VSA is limited in extent in the impact area and well-represented regionally, but impacts should be minimised. Note there is uncertainty regarding the taxonomic status of this snail.	Minor (Moderate?)
Peregrine Falcon	Some loss of potential habitat, potential disturbances to breeding sites however disturbances to large, hollow bearing trees are recommended to be avoided.	Minor.
Major Mitchell's Cockatoo	Some loss of potential habitat, potential disturbances to breeding sites however disturbances to large, hollow bearing trees are recommended to be avoided	Minor.
CS3 Birds – Declining Woodland Species	Some loss of potential habitat, potential disturbances to breeding sites however disturbances to large, hollow bearing trees are recommended to be avoided	Minor
Woolley's Pseudantechinus	Likely to be restricted to the ironstone ridges within the survey area.	Minor

5.6 RECOMMENDATIONS

Section 5 (Impact Assessment) identified several potential adverse impacts that may occur from the proposed development within the survey area. Management strategies are recommended below to reduce the potential impacts of this development on fauna species.

Increased mortality. Sources of ongoing mortality could include collision with vehicles. Some increase in vehicular traffic is anticipated. This will need to be managed to minimise the impact of roadkill on the local Malleefowl population. A number of uncapped drill holes were found. These act as long term highly efficient pit traps for small fauna including conservation significant species, unless capped.

Loss of habitat. The loss of habitat from vegetation clearing should be minimised where possible. Existing tracks should be utilised to avoid vegetation clearance for the construction of new tracks. The permitted clearing area should be clearly delineated to prevent the clearing of fauna habitat beyond this area.

Loss of significant VSAs may be of concern. Disturbances to the ironstone ridges and mature eucalypt trees should be avoided where possible as these support conservation significant fauna. Management recommendations to reduce habitat loss include:

1. Avoid disturbance to Malleefowl mounds;
2. Avoid disturbance to Malleefowl and Tree-stem Trapdoor Spider habitat where possible;
3. Avoid disturbance to ironstone ridges and associated lower slopes – two small ironstone ridges occur in the corners of both tenements at 736290E, 6711260N and 727414E, 6712488N;
4. Avoid disturbance to large mature eucalypt trees where possible;
5. Minimise the disturbance footprint as far as practicable, and
6. Clearly delineate the permitted clearing area.

In addition, a Malleefowl Management Plan should be developed for the site, to ensure impacts on the local Malleefowl Population are minimized. This should include the rentention of significant breeding sites and habitat.

Fragmentation of habitat. Minimal habitat fragmentation will result from the proposed project as the project involves the expansion of mining infrastructure in an already disturbed area. Potential effects of fragmentation could be minimised by limiting the disturbance footprint size and retaining areas of native vegetation that maintain linkages to adjacent vegetation.

Species interactions including predation and competition. The presence of feral species, particularly the Feral Cat and Fox, should be discouraged. Appropriate waste management and education of on-site personnel to eliminate artificial food sources and other attractants is recommended.

Hydrological changes. It is recommended that an understanding of the surface and sub-surface drainage be developed in order to identify the potential for hydrological changes that could potentially impact fauna habitats, and where possible, implement

management actions where it is expected that changes to hydrology may affect significant fauna habitats.

Habitat degradation due to weed invasions. Invasive weed species can replace native species and degrade fauna habitats. Weeds can be spread by vehicles, earthworks and road construction. Weed outbreaks tend to occur on recently disturbed ground such as road sides and drainage channels. A weed prevention and control strategy should be implemented to prevent the spread of weeds in the area.

Changes in fire regime. A fire management plan should be implemented to protect property and infrastructure, and this needs to have regard for the ecological role of fire.

Dust, noise, light and disturbance. Disturbances from these factors during construction are poorly understood, but a precautionary approach is recommended.

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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 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, for example, by the sorts of species present.

Vegetation/substrate associations (VSAs)

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. 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 Wildlife Conservation Act1950* (Wildlife Conservation Act). In addition, the Western Australian DEC 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 categories, schedules and priority levels mentioned below is provided in Appendix 3.

Conservation Significance (CS) 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 Bonn Convention (The Convention on the Conservation of Migratory Species of Wild Animals). The Wildlife Conservation Act uses a series of Schedules to classify status, but also recognizes the IUCN categories.

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

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

Conservation Significance (CS) 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, 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 DEC (2000), used this sort of interpretation to identify significant bird species in the Perth metropolitan area as part of the Perth Bushplan.

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.

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 and under the EPBC Act, in which threatening processes are listed (see Appendix 4). 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. 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 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 from 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 & Jones 1999; Clevenger & Waltho 2000; Jackson & 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 & 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 water points 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 e.g. (Gill *et al.* 1981; Fox 1982; Letnic *et al.* 2004). 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. Fire management may be considered the responsibility of managers of large tracts of land.

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 & 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 & 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.

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 *Wildlife Conservation Act*1950.

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

Schedules used in the *WA Wildlife Conservation Act*

Schedule 1	Rare and Likely to become Extinct.
Schedule 2	Extinct.
Schedule 3	Migratory species listed under international treaties.
Schedule 4	Other Specially Protected Fauna

WA Department of Environment and Conservation Priority species (species not listed under the *Wildlife Conservation Act 1950*, but for which there is some concern).

Priority 1	Taxa with few, poorly known populations on threatened lands.
Priority 2	Taxa with few, poorly known populations on conservation lands; or taxa with several, poorly known populations not on conservation lands.
Priority 3	Taxa with several, poorly known populations, some on conservation lands.
Priority 4.	Taxa in need of monitoring. 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.
Priority 5	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).

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 issue of ecological processes, 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 (1999), 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 19 key threatening processes listed by the federal Department of Sustainability, Environment, Water, Population and Communities (SEWPaC.)

- Competition and land degradation by feral/unmanaged Goats (*Capra hircus*);
- Competition and land degradation by feral Rabbits (*Oryctolagus cuniculus*);
- Dieback caused by the root-rot fungus (*Phytophthora cinnamomi*);
- Incidental catch (by catch) of Sea Turtles during coastal otter-trawling operations within Australian waters north of 28 degrees South;
- Incidental catch (or by catch) 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;
- Predation by exotic rats on Australian offshore islands of less than 1000 km2 (100,000 ha);

- Predation by feral Cats (*Felis catus*);
- Predation by the European Red Fox (*Vulpes vulpes*);
- Predation, Habitat Degradation, Competition and Disease Transmission by Feral Pigs (*Sus scrofa*);
- Psittacine Circoviral (beak and feather) Disease affecting endangered psittacine species;
- The biological effects, including lethal toxic ingestion, caused by Cane Toads (*Bufo marinus*); and
- The reduction in the biodiversity of Australian native fauna and flora due to the imported Red Fire Ant, *Solenopsis invicta*.

General processes that threaten biodiversity across Australia (The National Land and Water Resources Audit):

- 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, the DSEWPaC 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 listed below.

Will the proposed action lead to a long-term decrease in the size of a population?
Will the proposed action will 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 will 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 will interfere with the recovery of the species?

Appendix 5. Fauna Recorded or Expected to occur in the Gwendolyn Survey Area

(Tables 1 to 5).

These lists are derived from the results of database and literature searches and from previous field surveys conducted in the local area. These are:

- NatureMap Database (N): searched September, 2012;
- Birdlife Australia Database (BA): searched September, 2012;
- Western Australian Museum Fauna Survey (WAM): conducted at Mt Manning Range and Mt Elvire;
- BCE database;
- Species recorded from the BCE Gwendolyn field survey are also listed (X).

TABLE 1. Frogs expected to occur and recorded in the Survey Area.

Common Name	Species Name	Conservation Status	Nature Map	WAM	Vector
MYOBATRACHIDAE					
Kunapalri Frog	*Neobatrachus kunapalari*				
Humming Frog	*Neobatrachus pelobatoides*				
Shoemaker Frog	*Neobatrachus sutor*				
Goldfields Bull Frog	*Neobatrachus wilsmorei*		X	X	
Western Toadlet	*Pseudophryne occidentalis*		X	X	
Total Number of Species Expected: 5			2	2	0

TABLE 2. Reptiles expected to occur and recorded in the Survey Area.

Common Name	Species Name	Conservation Status	Nature Map	WAM	Vector
AGAMIDAE					
Mulga Dragon	*Caimanops amphiboluroides*				
Crested Dragon	*Ctenophorus cristatus*		X	X	X
Mallee Military Dragon	*Ctenophorus fordi*		X	X	
Western Netted Dragon	*Ctenophorus reticulatus*		X	X	X
Claypan Dragon	*Ctenophorus salinarum*		X	X	
Lozenge-marked Dragon	*Ctenophorus scutulatus*		X	X	X
Thorny Devil	*Moloch horridus*		X	X	
Bearded Dragon	*Pogona minor*		X	X	X
Pebble Dragon	*Tympanocryptis cephalus*				
DIPLODACTYLIDAE					
Clawless Gecko	*Crenadactylus ocellatus*		X		
Western Stone Gecko	*Diplodactylus granariensis*		X	X	
Beautiful Gecko	*Diplodactylus pulcher*		X	X	
Main's Ground Gecko	*Lucasium maini*		X		
Reticulated Velvet Gecko	*Oedura reticulata*		X	X	
Beaked Gecko	*Rhynchoedura ornata*		X	X	
Thorn -tailed Gecko	*Strophurus assimilis*		X	X	
Jewelled Gecko	*Strophurus elderi*		X	X	
Ring-tailed Gecko	*Strophurus strophurus*		X		
CARPHODACTYLIDAE					
Pale Knob-tailed Gecko	*Nephrurus laevissimus*				
Barking Gecko	*Nephrurus milii*		X	X	
Midline Knob-tail	*Nephrurus vertebralis*		X	X	
GEKKONIDAE					
Purplish Dtella	*Gehyra purpurascens*		X	X	
Tree Dtella	*Gehyra variegata*		X	X	X
Bynoe's Gecko	*Heteronotia binoei*		X	X	X
PYGOPODIDAE					
Marble-faced Delma	*Delma australis*		X		
Unbanded Dema	*Delma butleri*		X	X	
Fraser's Delma	*Delma fraseri*				
Burton's Legless-Lizard	*Lialis burtonis*		X	X	
Common Scaly-foot	*Pygopus lepidopodus*		X		
Western Hooded Scaly-foot	*Pygopus nigriceps*		X		
SCINCIDAE					
A skink	*Cryptoblepharus australis*				

Common Name	Species Name	Conservation Status	Nature Map	WAM	Vector
A skink	*Cryptoblepharus buchananii*		X	X	
Southern Mallee Skink	*Ctenotus atlas*		X	X	
Leonhardi's Ctenotus	*Ctenotus leonhardii*		X	X	
Checker-sided ctenotus	*Ctenotus mimetes*		X	X	
Barred Wedge-snouted Ctenotus	*Ctenotus schomburgkii*		X	X	
Rock Ctenotus	*Ctenotus severus*		X		
Spotted Ctenotus	*Ctenotus uber*		X	X	
Spinifex Slender Blue-tongue	*Cyclodomorphus melanops*		X	X	
Pygmy Spiny-tailed Skink	*Egernia depressa*		X	X	X
Goldfields Crevice Skink	*Egernia formosa*		X	X	
Desert Skink	*Egernia inornata*			X	
Night Skink	*Egernia striata*				
Broad-banded Sandswimmer	*Eremiascincus richardsonii*		X	X	
Southern Five-toed Mulch Skink	*Hemiergis initialis*		X	X	
Common Mulch Lerista	*Lerista kingi*		X		
Unpatterned robust slider	*Lerista macropisthopus*		X	X	
Common Mulch Lerista	*Lerista timida*		X		X
Common Dwarf Skink	*Menetia greyii*		X	X	
Woodland Dark Fleck Skink	*Morethia butleri*		X	X	
Woodland Flecked Skink	*Morethia obscura*				
Western Blue-tongue	*Tiliqua occipitalis*				
VARANIDAE					
Pygmy Mulga Monitor	*Varanus caudolineatus*		X	X	
Perentie	*Varanus giganteus*				X
Sand Monitor	*Varanus gouldii*		X	X	X
Racehorse Monitor	*Varanus tristis tristis*		X	X	X
TYPHLOPIDAE					
Southern Blind Snake	*Ramphotyphlops australis*				
Dark-spinned Blind Snake	*Ramphotyphlops bicolor*		X		
Prong-snouted Blind Snake	*Ramphotyphlops bituberculatus*		X		
Northern Hook-Snouted Blind Snake	*Ramphotyphlops hamatus*			X	
Common Beaked Blind Snake	*Ramphotyphlops waitii*				
BOIDAE					

Common Name	Species Name	Conservation Status	Nature Map	WAM	Vector
Stimson's Python	*Antaresia stimsoni*		X		
Carpet Python	*Morelia spilota imbricata*	CS1			
ELAPIDAE					
Narrow-banded Shovel-nosed Snake	*Brachyurophis fasciolata*				
Southern Shovel-nosed Snake	*Brachyurophis semifasciata*		X		
Yellow-faced Whipsnake	*Demansia psammophis*		X	X	
Moon Snake	*Furina ornata*				
Black-naped Snake	*Neelaps bimaculatus*		X	X	
Monk Snake	*Parasuta monachus*		X	X	
Mulga Snake	*Pseudechis australis*				
Ringed Brown Snake	*Pseudonaja modesta*		X	X	
Western Brown Snake	*Pseudonaja mengdeni*		X	X	
Jan's Banded Snake	*Simoselaps bertholdi*		X	X	
Rosen's Snake	*Suta fasciata*				
Total Number of Species Expected: 74					
Total Recorded:			**56**	**46**	**11**

TABLE 3. Birds expected to occur and recorded in the Survey Area.

Common Name	Species Name	Conservation Significance	BA	Nature Map	WAM	Vector
CASUARIIDAE						
Emu	*Dromaius novaehollandiae*		X	X	X	X
PHASIANIDAE						
Stubble Quail	*Coturnix pectoralis*					
MEGAPODIIDAE						
Malleefowl	*Leipoa ocellata*	CS1			X	X
ANATIDAE						
Black Swan	*Cygnus atratus*				X	
Australian Shelduck	*Tadorna tadornoides*		X		X	
Australian Wood Duck	*Chenonetta jubata*				X	
Pacific Black Duck	*Anas superciliosa*		X		X	
Pink-eared Duck	*Malacorhynchus membranaceus*				X	
Grey Teal	*Anas gracilis*		X		X	
Chestnut Teal	*Anas castanea*					
Hardhead	*Aythya australis*				X	
PODICIPEDIDAE						
Australasian Grebe	*Tachybaptus novaehollandiae*					
Hoary-headed Grebe	*Poliocephalus poliocephalus*		X		X	
COLUMBIDAE						
Common Bronzewing	*Phaps chalcoptera*		X	X	X	X
Crested Pigeon	*Ocyphaps lophotes*		X		X	
Diamond Dove	*Geopelia cuneata*					
PODARGIDAE						
Tawny Frogmouth	*Podargus strigoides*		X		X	
EUROSTOPODIDAE						
Spotted Nightjar	*Eurostopodus argus*		X		X	
AEGOTHELIDAE						
Australian Owlet-nightjar	*Aegotheles cristatus*		X	X	X	X
APODIDAE						
Fork-tailed Swift	*Apus pacificus*	CS1				
ARDEIDAE						
White-faced Heron	*Egretta novaehollandiae*		X		X	
White-necked Heron	*Ardea pacifica*		X		X	
Eastern Great Egret	*Ardea modesta*	CS1				
ACCIPITRIDAE						
Black-shouldered Kite	*Elanus axillaris*					

Common Name	Species Name	Conservation Significance	BA	Nature Map	WAM	Vector
Square-tailed Kite	*Lophoictinia isura*	CS3	X		X	
Black-breasted Buzzard	*Hamirostra melanosternon*		X		X	
Whistling Kite	*Haliastur sphenurus*		X		X	
Black Kite	*Milvus migrans*					
Brown Goshawk	*Accipiter fasciatus*		X		X	X
Collared Sparrowhawk	*Accipiter cirrocephalus*		X		X	X
Spotted Harrier	*Circus assimilis*		X		X	
Wedge-tailed Eagle	*Aquila audax*		X		X	
Little Eagle	*Hieraaetus morphnoides*		X		X	
FALCONIDAE						
Nankeen Kestrel	*Falco cenchroides*		X	X	X	
Brown Falcon	*Falco berigora*		X	X	X	X
Australian Hobby	*Falco longipennis*		X		X	
Peregrine Falcon	*Falco peregrinus*	CS1	X		X	
RALLIDAE						
Eurasian Coot	*Fulica atra*				X	
Black-tailed Native-hen	*Tribonyx ventralis*		X			
OTIDIDAE						
Australian Bustard	*Ardeotis australis*	CS2	X			
BURHINIDAE						
Bush Stone-curlew	*Burhinus grallarius*	CS2				
CHARADRIIDAE						
Red-capped Plover	*Charadrius ruficapillus*		X		X	
Black-fronted Dotterel	*Elseyornis melanops*		X		X	
Red-kneed Dotterel	*Erythrogonys cinctus*				X	
Inland Dotterel	*Charadrius australis*					
Banded Lapwing	*Vanellus tricolor*		X		X	
TURNICIDAE						
Little Button-quail	*Turnix velox*		X		X	
LARIDAE						
Silver Gull	*Larus novaehollandiae*				X	
CACATUIDAE						
Galah	*Eolophus roseicapillus*		X		X	X
Little Corella	*Cacatua sanguinea*					
Cockatiel	*Nymphicus hollandicus*		X		X	X
Major Mitchell's Cockatoo	*Lophochroa leadbeateri*	CS1				
PSITTACIDAE						
Purple-crowned Lorikeet	*Glossopsitta porphyrocephala*	CS3	X	X		

Common Name	Species Name	Conservation Significance	BA	Nature Map	WAM	Vector
Regent Parrot	*Polytelis anthopeplus*	CS3	X			
Australian Ringneck	*Barnardius zonarius*		X		X	X
Mulga Parrot	*Psephotus varius*		X		X	X
Budgerigar	*Melopsittacus undulatus*		X		X	
Bourke's Parrot	*Neopsephotus bourkii*		X		X	
Scarlet-chested Parrot	*Neophema splendida*	CS3			X	X
CUCULIDAE						
Horsfield's Bronze-Cuckoo	*Chalcites basalis*		X		X	X
Black-eared Cuckoo	*Chalcites osculans*		X			
Pallid Cuckoo	*Cacomantis pallidus*		X		X	X
STRIGIDAE						
Southern Boobook	*Ninox novaeseelandiae*		X	X	X	
TYTONIDAE						
Eastern Barn Owl	*Tyto alba*		X			
HALCYONIDAE						
Red-backed Kingfisher	*Todiramphus pyrrhopygius*		X		X	X
Sacred Kingfisher	*Todiramphus sanctus*					
MEROPIDAE						
Rainbow Bee-eater	*Merops ornatus*	CS1	X	X	X	
CLIMACTERIDAE						
White-browed Treecreeper	*Climacteris affinis*		X	X	X	X
Rufous Treecreeper	*Climacteris rufa*	CS3	X	X	X	X
PTILONORHYNCHIDAE						
Western Bowerbird	*Ptilonorhynchus guttatus*		X			
MALURIDAE						
Splendid Fairy-wren	*Malurus splendens*		X	X	X	X
White-winged Fairy-wren	*Malurus leucopterus*		X		X	
Variegated Fairy-wren	*Malurus lamberti*				X	
Blue-breasted Fairy-wren	*Malurus pulcherrimus*					
ACANTHIZIDAE						
Shy Heathwren	*Hylacola cauta*	CS2				
Rufous Fieldwren	*Calamanthus campestri*					
Redthroat	*Pyrrholaemus brunneus*		X	X	X	X
Weebill	*Smicrornis brevirostris*		X	X	X	X
Western Gerygone	*Gerygone fusca*		X		X	X
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*		X	X	X	X
Chestnut-rumped Thornbill	*Acanthiza uropygialis*		X	X	X	X
Slaty-backed Thornbill	*Acanthiza robustirostris*			X		

Common Name	Species Name	Conservation Significance	BA	Nature Map	WAM	Vector
Inland Thornbill	*Acanthiza apicalis*		X	X	X	X
Slender billed Thornbill	*Acanthiza iredalei*	CS1	X		X	
Southern Whiteface	*Aphelocephala leucopsis*		X	X	X	X
PARDALOTIDAE						
Spotted Pardalote	*Pardalotus punctatus*		X			
Striated Pardalote	*Pardalotus striatus*		X	X	X	X
MELIPHAGIDAE						
Pied Honeyeater	*Certhionyx variegatus*		X	X	X	
Singing Honeyeater	*Lichenostomus virescens*		X	X	X	X
White-eared Honeyeater	*Lichenostomus leucotis*		X	X	X	
Yellow-plumed Honeyeater	*Lichenostomus ornatus*	CS3	X	X	X	X
Grey-fronted Honeyeater	*Lichenostomus plumulus*		X	X	X	
White-fronted Honeyeater	*Purnella albifrons*		X		X	X
Yellow-throated Miner	*Manorina flavigula*		X	X	X	X
Spiny-cheeked Honeyeater	*Acanthagenys rufogularis*		X	X	X	X
Red Wattlebird	*Anthochaera carunculata*		X	X	X	
White-fronted Cat	*Epthianura albifrons*		X		X	
Crimson Chat	*Epthianura tricolor*		X		X	X
Black Honeyeater	*Sugomel niger*		X		X	X
Brown Honeyeater	*Lichmera indistincta*		X	X	X	X
Brown-headed Honeyeater	*Melithreptus brevirostris*		X	X	X	X
POMATOSTOMIDAE						
White-browed Babbler	*Pomatostomus superciliosus*		X	X	X	X
PSOPHODIDAE						
Chestnut Quail-thrush	*Cinclosoma castanotus*	CS3	X		X	X
NEOSITTIDAE						
Varied Sittella	*Daphoenositta chrysoptera*		X		X	
CAMPEPHAGIDAE						
Ground Cuckoo-shrike	*Coracina maxima*				X	
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*		X	X	X	X
White-winged Triller	*Lalage sueurii*		X		X	
PACHYCEPHALIDAE						
Gilbert's Whistler	*Pachycephala inornata*	CS3	X	X	X	X
Rufous Whistler	*Pachycephala rufiventris*		X	X	X	X
Golden Whistler	*Pachycephala pectoralis*					
Grey Shrike-thrush	*Colluricincla harmonica*		X	X	X	X
Crested Bellbird	*Oreoica gutturalis*		X	X	X	X
ARTAMIDAE						

Common Name	Species Name	Conservation Significance	BA	Nature Map	WAM	Vector
Masked Woodswallow	*Artamus personatus*		X		X	X
Black-faced Woodswallow	*Artamus cinereus*		X		X	
Dusky Woodswallow	*Artamus cyanopterus*		X	X	X	X
Little Woodswallow	*Artamus minor*		X	X	X	
Grey Butcherbird	*Cracticus torquatus*		X	X	X	X
Pied Butcherbird	*Cracticus nigrogularis*		X	X	X	X
Australian Magpie	*Cracticus tibicen*		X	X	X	X
Grey Currawong	*Strepera versicolor*		X	X	X	X
RHIPIDURIDAE						
Grey Fantail	*Rhipidura albiscapa*		X		X	X
Willie Wagtail	*Rhipidura leucophrys*		X	X	X	X
CORVIDAE						
Little Crow	*Corvus bennetti*		X	X	X	
Torresian Crow	*Corvus orru*		X			
Australian Raven	*Corvus coronoides*		X	X		X
MONARCHIDAE						
Magpie-lark	*Grallina cyanoleuca*		X		X	
PETROICIDAE						
Red-capped Robin	*Petroica goodenovii*		X	X	X	X
Hooded Robin	*Melanodryas cucullata*		X		X	X
Jacky Winter	*Microeca fascinans*		X	X	X	X
Western Yellow Robin	*Eopsaltria griseogularis*	CS3	X			X
Southern Scrub-robin	*Drymodes brunneopygia*	CS3	X	X		
MEGALURIDAE						
Rufous Songlark	*Cincloramphus mathewsi*		X		X	
Brown Songlark	*Cincloramphus cruralis*				X	
HIRUNDINIDAE						
White-backed Swallow	*Cheramoeca leucosterna*		X			
Welcome Swallow	*Hirundo neoxena*		X	X	X	X
Fairy Martin	*Petrochelidon ariel*		X		X	
Tree Martin	*Petrochelidon nigricans*		X		X	X
NECTARINIIDAE						
Mistletoebird	*Dicaeum hirundinaceum*		X	X	X	X
ESTRILDIDAE						
Zebra Finch	*Taeniopygia guttata*		X	X	X	X
MOTACILLIDAE						
Australasian Pipit	*Anthus novaeseelandiae*		X		X	X
TOTAL	**140**		**111**	**50**	**113**	**60**

TABLE 4. Mammals expected to occur and recorded in the Survey Area.

Common Name	Species Name	Conservation Status	Nature Map	WAM	Vector
TACHYGLOSSIDAE					
Echidna	*Tachyglossus aculeatus*			X	X
DASYURIDAE					
Ride's Ningaui	*Ningaui ridei*		X	X	
Mallee Ningaui	*Ningaui yvonneae*		X	X	
Kultarr	*Antechinomys laniger*	CS3			
Woolley's Pseudantechinus	*Pseudantechinus woolleyae*	CS3		X	X
Fat-tailed Dunnart	*Sminthopsis crassicaudata*		X	X	
Little Long-tailed Dunnart	*Sminthopsis dolichura*		X	X	
Gilbert's Dunnart	*Sminthopsis gilberti*				
Stripe-faced Dunnart	*Sminthopsis macruora*		X		
BURRAMYIDAE					
Western Pygmy-possum	*Cercartetus concinnus*				
MACROPODIDAE					
Western Grey Kangaroo	*Macropus fuliginosus*			X	
Euro	*Macropus robustus*		X	X	X
Red Kangaroo	*Macropus rufus*			X	
MOLOSSIDAE					
Inland Freetail Bat	*Mormopterus sp. 3*				
Southern Freetail Bat	*Mormopterus sp. 4*		X	X	
White-striped Freetail Bat	*Tadarida australis*		X	X	X
VESPERTILIONIDAE					
Gould's Wattled Bat	*Chalinolobus gouldii*		X	X	X
Chocolate Wattled Bat	*Chalinolobus morio*		X	X	X
Lesser Long-eared Bat	*Nyctophilus geoffroyi*		X	X	
Greater Long-eared Bat	*Nyctophilus timoriensis*	CS2		X	
Inland Broad-nosed Bat	*Scotorepens balstoni*		X	X	
Southern Forest Bat	*Vespadelus regulus*		X	X	
Inland forest bat	*Vespadelus baverstocki*		X	X	
MURIDAE					
Spinifex Hopping Mouse	*Notomys alexis*		X	X	X?
Mitchell's Hopping Mouse	*Notomys mitchelli*		X		
Ash-grey Mouse	*Pseudomys albocinereus*		X	X	

Common Name	Species Name	Conservation Status	Nature Map	WAM	Vector
Bolam's Mouse	*Pseudomys bolami*		X	X	
Sandy Inland Mouse	*Pseudomys hermannsburgensis*		X	X	
INTRODUCED MAMMALS					
Dingo / Dog	*Canis lupus*		X	X	X
European Red Fox	*Vulpes vulpes*			X	
Feral Cat	*Felis catus*			X	X
Rabbit	*Oryctolagus cuniculus*			X	X
House Mouse	*Mus musculus*		X	X	
Goat	*Capra hircus*			X	
Horse	*Equus caballus*				X
Dromedary Camel	*Camelus dromedarius*				
Cattle	*Bos taurus*		X		X
Sheep	*Ovis aries*			X	
Total Number of Native Species: 28		**3**	**19**	**22**	**7**
Total Number of Introduced Species: 10			**3**	**7**	**5**

Appendix 6. Species recorded during Vector Resources Gwendolyn Field Survey.

Reptiles

Species		Status	M77 / 1263	G77/119	Proposed Tracks
Gekkonidae (geckoes)					
Gehyra variegata	Variegated Dtella		X		
Heteronotia binoei	Bynoe's Gecko		X	X	X
Agamidae (dragon lizards)					
Ctenophorus cristatus	Crested Dragon		X		
Ctenophorus reticulatus	Western Netted Dragon				X
Ctenophorus scutulatus	Lozenge-marked Dragon		X	X	X
Pogona minor	Dwarf Bearded Dragon		X		
Varanidae (monitors or goannas)					
Varanus giganteus	Perentie				X
Varanus gouldii	Sand Goanna		X	X	X
Varanus tristis	Black-headed Monitor				X
Scincidae (skink lizards)					
Egernia depressa	Pygmy Spiny-tailed Skink				X
Lerista timida				X	
Total: 11					

Birds

Species		Status	M77/ 1263	G77/119	Proposed Tracks
CASUARIIDAE (Cassowaries and emus)					
Dromaius novaehollandiae	Emu				X
MEGAPODIIDAE (Megapodes)					
Leipoa ocellata	Malleefowl	CS1	X	X	X
COLUMBIDAE (Pigeons and doves)					
Phaps chalcoptera	Common Bronzewing		X		X
AEGOTHELIDAE (Owlet-nightjars)					
Aegotheles cristatus	Australian Owlet-nightjar			X	X
ACCIPITRIDAE (Osprey, hawks and eagles)					
Accipiter fasciatus	Brown Goshawk		X		X
Accipiter cirrhocephalus	Collared Sparrowhawk			X	
FALCONIDAE (Falcons)					
Falco berigora	Brown Falcon				X
Turnix varia	Painted Button-quail				
CACATUIDAE (Cockatoos)					
Eolophus roseicapilla	Galah		X	X	X
Nymphicus hollandicus	Cockatiel				X
PSITTACIDAE (Parrots)					
Barnardius zonarius	Australian Ringneck		X	X	X
Psephotus varius	Mulga Parrot		X	X	X
Neophema splendida	Scarlet-chested Parrot	CS3			X
CUCULIDAE (Old world cuckoos)					
Cuculus pallidus	Pallid Cuckoo		X		
Chrysococcyx basalis	Horsfield's Bronze-Cuckoo		X		X
HALCYONIDAE (Kingfishers)					
Todiramphus pyrrhopygia	Red-backed Kingfisher			X	X
CLIMACTERIDAE (Australo-Papuan treecreepers)					
Climacteris affinis	White-browed Treecreeper			X	
Climacteris rufa	Rufous Treecreeper	CS3			X
MALURIDAE (Fairy-wrens, emu-wrens, grasswrens)					
Malurus splendens	Splendid Fairy-wren		X	X	X
PARDALOTIDAE (Pardalotes, scrubwrens, thornbills)					
Pardalotus striatus	Striated Pardalote		X	X	X
Pyrrholaemus brunneus	Redthroat	CS3	X	X	X
Smicrornis brevirostris	Weebill		X	X	X
Gerygone fusca	Western Gerygone				X

Species	Status	M77/ 1263	G77/119	Proposed Tracks
Acanthiza apicalis Inland Thornbill		X	X	X
Acanthiza uropygialis Chestnut-rumped Thornbill		X	X	X
Acanthiza chrysorrhoa Yellow-rumped Thornbill				X
Aphelocephala leucopsis Southern Whiteface			X	
MELIPHAGIDAE (Honeyeaters)				
Acanthagenys rufogularis Spiny-cheeked Honeyeater		X	X	X
Manorina flavigula Yellow-throated Miner		X		
Lichenostomus virescens Singing Honeyeater		X	X	X
Lichenostomus ornatus Yellow-plumed Honeyeater				X
Melithreptus brevirostris Brown-headed Honeyeater		X		X
Lichmera indistincta Brown Honeyeater				X
Phylidonyris albifrons White-fronted Honeyeater				X
Certhionyx niger Black Honeyeater				X
Epthianura tricolor Crimson Chat				X
POMATOSTOMIDAE (Babblers)				
Pomatostomus superciliosus White-browed Babbler	CS2	X	X	X
CINCLOSOMATIDAE (Quail-thrushes and allies)				
Cinclosoma castanotum Chestnut Quail-thrush		X	X	X
CAMPEPHAGIDAE (Cuckoo-shrikes and trillers)				
Coracina novaehollandiae Black-faced Cuckoo-shrike		X		X
PACHYCEPHALIDAE (Whistlers, shrike-thrushes and allies)				
Oreoica gutturalis Crested Bellbird	CS2	X	X	X
Pachycephala inornata Gilbert's Whistler	CS3			X
Pachycephala rufiventris Rufous Whistler		X	X	X
Colluricincla harmonica Grey Shrike-thrush		X	X	X
ARTAMIDAE (Woodswallows, butcherbirds and currawongs)				
Artamus personatus Masked Woodswallow		X	X	X
Artamus cyanopterus Dusky Woodswallow		X		X
Cracticus torquatus Grey Butcherbird		X		X
Cracticus nigrogularis Pied Butcherbird		X		
Gymnorhina tibicen Australian Magpie		X		
Strepera versicolor Grey Currawong		X	X	X
DICRURIDAE (Monarchs, fantails and drongos)				
Rhipidura albiscapa Grey Fantail		X		X
Rhipidura leucophrys Willie Wagtail		X		X

Species		Status	M77/ 1263	G77/119	Proposed Tracks
CORVIDAE (Crows and allies)					
Corvus coronoides	Australian Raven		X	X	X
PETROICIDAE (Robins)					
Microeca leucophaea	Jacky Winter		X		X
Petroica goodenovii	Red-capped Robin		X	X	X
Melanodryas cucullata	Hooded Robin			X	
Eopsaltria griseogularis	Western Yellow Robin	CS3	X	X	
HIRUNDINIDAE (Swallows and martins)					
Hirundo neoxena	Welcome Swallow				X
Hirundo nigricans	Tree Martin				X
DICAEIDAE (Flowerpeckers)					
Dicaeum hirundinaceum	Mistletoebird		X		X
PASSERIDAE (Sparrows, weaverbirds, waxbills and allies)					
Taeniopygia guttata	Zebra Finch			X	
MOTACILIDAE (Old world wagtails and pipits)					
Anthus novaeseelandiae	Australian Pipit				X
Total: 60					

Mammals

Species		Status	M77/ 1263	G77/11 9	Proposed Tracks
TACHYGLOSSIDAE (Echidnas)					
Tachyglossus aculeatus	Echidna		X	X	X
DASYURIDAE (Dasyurids)					
Pseudantechinus woolleyae	Woolley's Pseudantechinus	CS3	X		X
MACROPODIDAE (Kangaroos, wallabies)					
Macropus robustus	Euro		X		X
VESPERTILIONIDAE (Vespertillionid bats)					
Chalinolobus gouldii	Gould's Wattled Bat		X		X
Chalinolobus morio	Chocolate Wattled Bat				X
MOLOSSIDAE (Freetail bats)					
Tadarida australis	White-striped Freetail-bat		X		X
MURIDAE (Rats and mice)					
Notomys alexis	Spinifex Hopping-mouse				X?
Total: 7					
Introduced Species					
Oryctolagus cuniculus	Rabbit	INT	X	X	X
Canis lupus dingo	Dingo				X
Felis catus	Cat	INT	X	X	X
Bos taurus	*Cattle*		X	X	X
Equus ferus	*Horse*		X	X	X
Total: 5					

Appendix 7. Locations of Conservation Significant Fauna Recorded during the June 2012 survey (Note: Zone 50J).

Common Name	Species Name	Status	Comments	Species Records	
				Easting	Northing
Malleefowl	*Leipoa ocellata*	C1	Mound	736410	6711274
Malleefowl	*Leipoa ocellata*	C1	Mound	736395	6711150
Malleefowl	*Leipoa ocellata*	C1	Mound	734499	6711493
Malleefowl	*Leipoa ocellata*	C1	Mound	734364	6711477
Malleefowl	*Leipoa ocellata*	C1	Mound	734315	6711486
Malleefowl	*Leipoa ocellata*	C1	Mound	739702	6707533
Malleefowl	*Leipoa ocellata*	C1	Mound	727609	6712507
Malleefowl	*Leipoa ocellata*	C1	Mound	727770	6712617
Malleefowl	*Leipoa ocellata*	C1	Fresh Tracks	739319	6707384
Scarlet-chested Parrot	*Neophema splendida*	CS3	One male observed in Eucalypt woodland.	730270	6712486
Rufous Tree-creeper	*Climacteris rufus*	CS3	Two individuals observed in Eucalypt woodland	730380	6712460
White-browed Tree-creeper	*Climacteris affinis*	CS3	Three individuals observed in Mulga	727834	6712603
Western Yellow Robin	*Eopsaltria griseogularis*	CS3	Two individuals observed in dense Acacia shrubland	736431	6711252
Western Yellow Robin	*Eopsaltria griseogularis*	CS3	Two individuals observed in dense Acacia shrubland	728625	6713286
Gilbert's Whistler	*Pachycephala inornata*	CS3	One individual heard calling in Eucalypt woodland	731009	6712298
Chestnut Quail-thrush	*Cinclosoma castanotus*	CS3	Small party observed		
Chestnut Quail-thrush	*Cinclosoma castanotus*	CS3	Small party observed		
Chestnut Quail-thrush	*Cinclosoma castanotus*	CS3	Small party observed		
Chestnut Quail-thrush	*Cinclosoma castanotus*	CS3	Small party observed		
Yellow-plumed Honeyeater	*Lichenostomus ornatus*	CS3		730774	6712543
Woolley's Pseudantechinus	*Pseudantechinus woolleyae*	CS3	Recorded on motion camera	736300	6711279
Tree-stem Trap-door Spider	*Aganippe castellum*	CS2	Trapdoor Spider burrow observed.	735552	6710707
Tree-stem Trap-door Spider	*Aganippe castellum*	CS2	Trapdoor Spider burrow observed.	735552	6710707
Tree-stem Trap-door Spider	*Aganippe castellum*	CS2	Trapdoor Spider burrow observed.	735552	6710707
Tree-stem Trap-door Spider	*Aganippe castellum*	CS2	Trapdoor Spider burrow observed.	736563	6713536
Tree-stem Trap-door Spider	*Aganippe castellum*	CS2	Trapdoor Spider burrow observed.	736556	6713536
Tree-stem Trap-door Spider	*Aganippe castellum*	CS2	Trapdoor Spider burrow observed.	736728	6713515
Tree-stem Trap-door Spider	*Aganippe castellum*	CS2	Trapdoor Spider burrow observed.	736803	6713586
Tree-stem Trap-door Spider	*Aganippe castellum*	CS2	Trapdoor Spider burrow observed.	735551	6710700
Tree-stem Trap-door Spider	*Aganippe castellum*	CS2	Trapdoor Spider burrow observed.	736718	6713636
Tree-stem Trap-door Spider	*Aganippe castellum*	CS2	Trapdoor Spider burrow observed.	736771	6713799
Tree-stem Trap-door Spider	*Aganippe castellum*	CS2	Trapdoor Spider burrow observed.	736796	6713584
Tree-stem Trap-door Spider	*Aganippe castellum*	CS2	Trapdoor Spider burrow observed.	736336	6711326
Tree-stem Trap-door Spider	*Aganippe castellum*	CS2	Trapdoor Spider burrow observed.	736323	6711335
Tree-stem Trap-door Spider	*Aganippe castellum*	CS2	Trapdoor Spider burrow observed.	736316	6711333

Tree-stem Trap-door Spider	*Aganippe castellum*	CS2	Trapdoor Spider burrow observed.	736375	6711260
Tree-stem Trap-door Spider	*Aganippe castellum*	CS2	Trapdoor Spider burrow observed.	736396	6711262
Tree-stem Trap-door Spider	*Aganippe castellum*	CS2	Trapdoor Spider burrow observed.	736394	6711251
Tree-stem Trap-door Spider	*Aganippe castellum*	CS2	Trapdoor Spider burrow observed.	736450	6711218
Tree-stem Trap-door Spider	*Aganippe castellum*	CS2	Trapdoor Spider burrow observed.	736497	6711143
Tree-stem Trap-door Spider	*Aganippe castellum*	CS2	Trapdoor Spider burrow observed.	736455	6711059
Tree-stem Trap-door Spider	*Aganippe castellum*	CS2	Trapdoor Spider burrow observed.	736456	6711108
Tree-stem Trap-door Spider	*Aganippe castellum*	CS2	Trapdoor Spider burrow observed.	736236	6711257
Tree-stem Trap-door Spider	*Aganippe castellum*	CS2	Trapdoor Spider burrow observed.	736202	6711282
Tree-stem Trap-door Spider	*Aganippe castellum*	CS2	Trapdoor Spider burrow observed.	736225	6711290
Tree-stem Trap-door Spider	*Aganippe castellum*	CS2	Trapdoor Spider burrow observed.	736134	6711173
Tree-stem Trap-door Spider	*Aganippe castellum*	CS2	Trapdoor Spider burrow observed.	736193	6711167
Tree-stem Trap-door Spider	*Aganippe castellum*	CS2	Trapdoor Spider burrow observed.	736321	6710936
Tree-stem Trap-door Spider	*Aganippe castellum*	CS2	Trapdoor Spider burrow observed.	736311	6710941
Tree-stem Trap-door Spider	*Aganippe castellum*	CS2	Trapdoor Spider burrow observed.	727863	6712694
Tree-stem Trap-door Spider	*Aganippe castellum*	CS2	Trapdoor Spider burrow observed.	728039	6712583
Tree-stem Trap-door Spider	*Aganippe castellum*	CS2	Trapdoor Spider burrow observed.	728903	6712526
Tree-stem Trap-door Spider	*Aganippe castellum*	CS2	Trapdoor Spider burrow observed.	728679	6712421
Tree-stem Trap-door Spider	*Aganippe castellum*	CS2	Trapdoor Spider burrow observed.	728215	6712471
Tree-stem Trap-door Spider	*Aganippe castellum*	CS2	Trapdoor Spider burrow observed.	728076	6712472
Tree-stem Trap-door Spider	*Aganippe castellum*	CS2	Trapdoor Spider burrow observed.	728076	6712472
Tree-stem Trap-door Spider	*Aganippe castellum*	CS2	Trapdoor Spider burrow observed.	728076	6712472
Tree-stem Trap-door Spider	*Aganippe castellum*	CS2	Trapdoor Spider burrow observed.	728076	6712472
Tree-stem Trap-door Spider	*Aganippe castellum*	CS2	Trapdoor Spider burrow observed.	728064	6712474
Tree-stem Trap-door Spider	*Aganippe castellum*	CS2	Trapdoor Spider burrow observed.	727838	6712497
Tree-stem Trap-door Spider	*Aganippe castellum*	CS2	Trapdoor Spider burrow observed.	736617	6713476
Tree-stem Trap-door Spider	*Aganippe castellum*	CS2	Trapdoor Spider burrow observed.	736661	6713486
Tree-stem Trap-door Spider	*Aganippe castellum*	CS2	Trapdoor Spider burrow observed.	734431	6711463
Tree-stem Trap-door Spider	*Aganippe castellum*	CS2	Trapdoor Spider burrow observed.	734038	6711568
Tree-stem Trap-door Spider	*Aganippe castellum*	CS2	Trapdoor Spider burrow observed.	733663	6711759
Tree-stem Trap-door Spider	*Aganippe castellum*	CS2	Trapdoor Spider burrow observed.	736633	6713558
Tree-stem Trap-door Spider	*Aganippe castellum*	CS2	Trapdoor Spider burrow observed.	736610	6713560
Caemaind land snail	*Pleuroxia* sp. nov.	CS3	Several specimens collected in litter samples	735480	6710755
Species recorded outside the survey area during the field survey					
Major Mitchell's Cockatoo	*Lophochroa leadbeateri*	CS1	One observed	712559	6638940
Australian Bustard	*Ardeotis australis*	CS2	One observed.	712559	6638940

Appendix 8. Details of Malleefowl mounds recorded (Note: Zone 50J).

Common Name	Records	Status	Substrate	Central Depression	Width	Height	Species Records	
				(mm)	(m)	(mm)	Easting	Northing
Malleefowl	Mound	Inactive	Gravel/ loam	300	5	200	736410	6711274
Malleefowl	Mound	Inactive – recently excavated	Gravel	550	5	500	736395	6711150
Malleefowl	Mound	Inactive	Laterite gravel	300	5	300	734499	6711493
Malleefowl	Mound	Inactive	Gravel	400	8	300	734364	6711477
Malleefowl	Mound	Active preparation fresh excavations into old decomposing leaf litter, fresh scratching on mound with fresh droppings	Gravel	400	5	400	734315	6711486
Malleefowl	Mound	Inactive	Gravel	none	7	100	739702	6707533
Malleefowl	Mound	Inactive	Gravel	none	9	150	727609	6712507
Malleefowl	Mound	Inactive	Loam	100	4	100	736372	6710838
Malleefowl	Mound	Inactive	Gravel	150	4.5	200	727770	6712617

Appendix 9. Details of Tree-stem Trap-door Spiders (*Aganippe castellum*) recorded.

Burrow	Easting	Northing	Height up stem	Diameter of burrow	Species of tree	Trunk diameter of tree	Active Inactive	Comments
Tenement M77/ 1263								
1	736336	6711326	15mm	8mm hole	*Acacia tetragonaphylla*	40mm trunk	old abandoned no lid	
2	736323	6711335	20mm	8mm hole	*Acacia tetragonaphylla*	60mm trunk	active	Upper slope of BIF ridge
3	736316	6711333	10mm	6mm hole	*Eremophila* sp.	20mm trunk	active	Upper slope of BIF ridge
4	736375	6711260	15mm	10mm hole	*Acacia aneura*	50mm trunk	active	lower slope of BIF ridge
5	736396	6711262	15mm	25mm hole	*Acacia sp*	50mm gtrunk	active	lower slope of BIF ridge
6	736394	6711251	20mm	12mm hole	*Acacia sp*	40mm trunk	active	
7	736450	6711218	15mm	6mm holes	*Acacia aneura*	60mm trunk	active	
8	736497	6711143	15mm	10mm hole	*Acacia sp (dead)*	30mm trunk	active	lower slope of BIF ridge
9	736455	6711059	10mm	5mm hole	*Acacia aneura*	70mm trunk	active	
10	736456	6711108	15mm	10mm hole	*Acacia sp (dead)*	40mm trunk	active	
11	736236	6711257	15mm	5mm hole	*Acacia aneura*	40mm trunk	inactive	
12	736202	6711282	20mm	5mm hole	*dead shrub*	40mm trunk	active	
13	736225	6711290	10mm	8mm hole	*Eremophila sp.*	15mm trunk	active	
14	736134	6711173	10mm	10mm hole	*Acacia aneura*	60mm trunk	active	
15	736193	6711167	90mm	20mm holr	*Acacia aneura*	60mm trunk	active	
16	736321	6710936	15mm	12mm hole	*Acacia sp*	50mm trunk	active	
17	736311	6710941	20mm	8mm hole	*Acacia aneura*	50mm trunk	active	
18	735552	6710707	10mm	12mm	*Scaevola spinescens*	20mm	active	Slope of ironstone ridge
19	735552	6710707	15mm	16mm	*Scaevola spinescens*	20mm	active	Slope of ironstone ridge
20	735551	6710700	9mm	14mm	*Acacia sp.*	20mm	Inactive	
Tenement G77/119 (formerly E77/1580)								
21	727863	6712694	15mm	8mm hole	*Eremophila sp.*	40mm trunk	active	
22	728039	6712583	10mm	10mm hole	*Acacia aneura*	75mm trunk	active	
23	728903	6712526	5mm	10mm hole	*Acacia aneura*	75mm trunk	active	
24	728679	6712421	20mm	10mm hole	*Eremophila sp.*	20mm trunk	active	

25	728215	6712471	10mm	12mm hole	*Senna artemissioides ssp. filifolia*	30mm trunk	active	
26	728076	6712472	20mm	10mm hole	dead senna	30mm trunk	active	
27	728076	6712472	15mm	6mm hole	*Acacia aneura*	40mm trunk	inactive no lid	
28	728076	6712472	15mm	10mm hole	*Acacia aneura*	60mm trunk	active	
29	728076	6712472	15mm	12mm hole	*Senna artemissioides ssp. filifolia*	50mm trunk	active	
30	728064	6712474	20mm	10mm hole	*Acacia aneura*	50mm trunk	active	
31	727838	6712497	5mm	8mm hole	*Acacia burkitti*	25mm trunk	active	
Exploration camp to Evanston rd corridor.								
32	736617	6713476	20mm	15mm hole	*Dodonea*		inactive no lid	
33	736661	6713486	5mm	5mm hole	*Acacia aneura*		active	
Access Corridor between tenements								
34	734431	6711463	10mm	8mm hole	*Philotheca sp*	20mm trunk	active	
35	734038	6711568	10mm	10mm hole	*Acacia aneura*	60mm trunk	active	
36	733663	6711759	12mm	6mm hole	*Acacia aneura*	50mm trunk	active	
East Tenement to Menzies rd corridor								
37	736633	6713558	10mm	8mm hole	*Eremophila sp. (dead)*	30mm trunk	active	
38	736610	6713560	25mm	10mm hole	*Eremophila sp.*	30mm trunk	active	
39	736563	6713536	10	10	*Scaevola spinescens*	Na	active	BIF ridge
40	736556	6713536	10	10	*Dodenia sp.*	Na	active	BIF ridge
41	736728	6713515	10	10	*Acacia sp.*	Na	active	BIF ridge
42	736803	6713586	10	10	*Acacia sp.*	Na	Inactive	BIF ridge
43	736718	6713636	10	16	*Acacia aneura*	Na	Active	
44	736771	6713799	7	4	Rock	Na	Active	
45	736796	6713584	12	8	*Acacia aneura*	Na	Active	

Land snails from NNE of Yokradine Hills, Western Australia

Report to *Dalcon Environmental*

1 November 2012

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Although identifications in this report were consistent with the best available information and current scientific thinking at the time of identification the use of this report is at the risk of the user. Any liability to users of this report for loss of any kind arising out of the use of this report or the information and identifications it contains is expressly disclaimed.

Summary

The two samples from approximately 24km NNE of Yokradine Hills, submitted to the Western Australian Museum on the 18th October 2012, contained two species belonging to the families Camaenidae and Punctidae. The punctid species is regarded as being widespread. The camaenid most closely resembles the genus *Pleuroxia* and probably represents a new species. It is currently regarded as a short-range endemic (SRE) species until a wider distribution is shown. Molecular work is recommended.

RESULTS

The land snails collected during this survey belong to the terrestrial pulmonate families Camaenidae and Punctidae (Appendix A). All the species identified from this survey are considered native to Western Australia.

Family Camaenidae

cf. *Pleuroxia* sp. nov.

The umbilicate specimens taken during the survey most closely resemble the genus *Pleuroxia* but based on shell shape, sculpture and size, cannot be placed with any described species and probably represent a new species.

Based on the few records in the collections of the WA Museum, similar specimens have been collected from narrow Banded Ironstone Formation (BIF) ridges at Windarling Hill (Koolyanobbing area); Mt Richardson area (approximately 120 kilometres north of Windarling Hill) and the Cashmere Downs area (just west of Mt Richardson). The relationship between the Mt Richardson; Cashmere Downs; Windarling Hill and current survey specimens (ie. 24 kilometres NNE of the Yokradine Hills) is unknown. They are all tentatively regarded as distinct species, but molecular work may prove both them to be conspecific.

cf. *Pleuroxia* sp. nov. is currently regarded as a short-range endemic (SRE) species until a wider distribution is shown.

Family Punctidae

***Westralaoma expicta* Iredale, 1939**

Widespread species.

REFERENCES

Iredale, T. (1939). A review of the land mollusca of Western Australia. *Rec. West. Aust. Museum* **2**: 1-88.

Appendix A: Land snail from 24km NNE of Yokradine Hills

Site	Family	Genus	Species	Reg. No. (WAM S)	No. Specimens
Kurrajong 003	Camaenidae	cf. *Pleuroxia*	sp. nov.	83899	2 dead-taken, juveniles
Eucalyptus 002	Punctidae	*Westralaoma*	*expicta*	83900	1 dead-taken