

McPhersons Reward Level 2 Flora and Vegetation Survey
Level 1 Fauna Survey with Targeted Mallee Fowl Survey



Surveyed by Jenny Borger Botanical Consulting

For Primary Gold Limited October 2016

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1. Background

Primary Gold Limited (Primary) have acquired mining tenements in the area known as McPhersons Reward, approximately six kilometres south of Coolgardie (Figure 1) and plan to undertake exploration and mining activities. Tenements within the proposed survey area (study area) include M15/128, M 15/148, M15/40 and M15/1808 (Figure 2). The prospects and deposits have a number of descriptive names including McPhersons, Franks, Tycho and Bakers (Appendix 9), but will be referred to as McPhersons Reward in this report. A Level 2 Vegetation and flora survey and Level 1 fauna survey with a targeted mallee fowl survey were commissioned as part of recording the environmental conditions prior to the commencement of mining activities. Previous environmental survey work in the southern area of the tenements was undertaken by Phoenix Environmental Sciences Pty Ltd (Clark & Wells 2014) in 2013 for MacPhersons Resources Limited – Biological survey for the Tycho Gold Project. It was requested that results of the Phoenix survey be incorporated into this study. This survey was undertaken from the 18th to the 20th of October 2016.

1.1. Scope and Objectives

- Conduct a desktop review of relevant databases to determine potential occurrences of conservation listed flora and fauna
- Conduct a desktop survey for the potential occurrence of Short Range Endemic (SRE) invertebrate fauna
- Level 2 flora survey targeting known priority and threatened species if they have the potential to occur
- Level 1 fauna survey with targeted search for mallee fowl
- Collect soil samples from nine locations as specified by Primary
- Undertake data analysis and map occurrences of taxa within the study area
- Report findings from the study area
- Analyse results against the 10 clearing principles

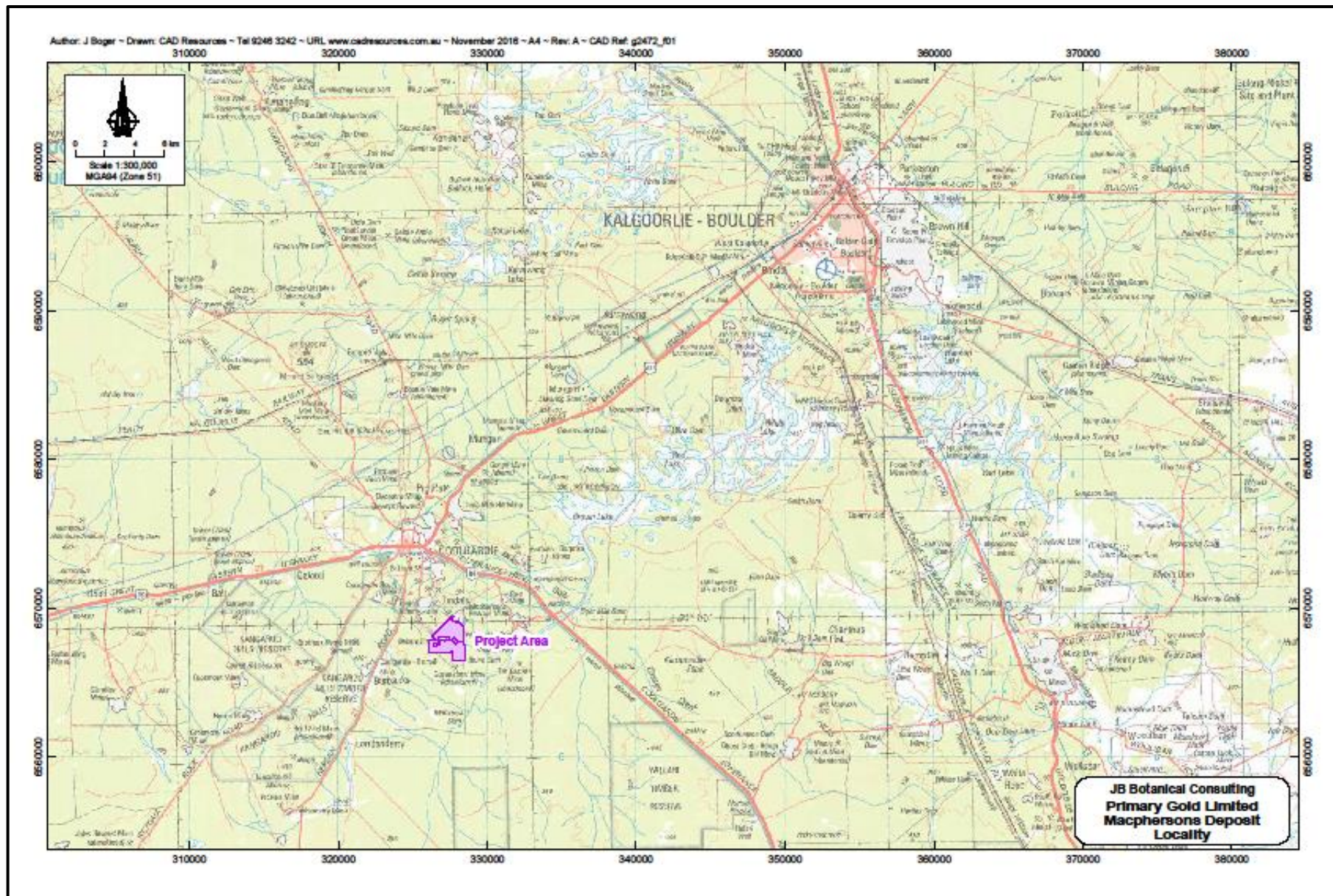


Figure 1: Regional location of the study area

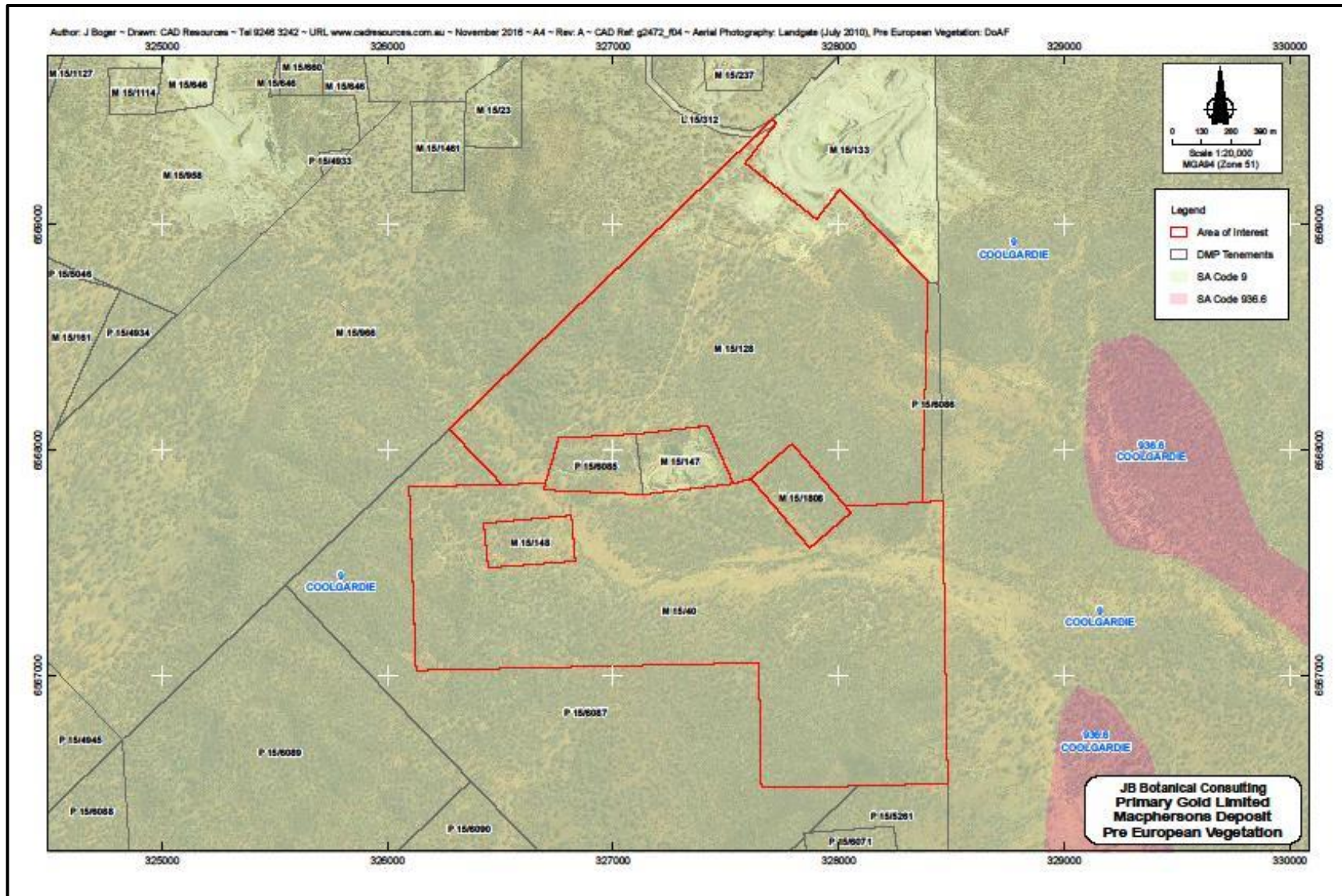


Figure 2: Pre-European mapped vegetation. The project area is mapped as Vegetation Association Coolgardie 9: medium woodland; Coral gum (*Eucalyptus torquata*) and Goldfields blackbutt (*E. lesouefii*)

2. Environment

2.1 Interim Biogeographic Regionalisation of Australia

Recent mapping of the Interim Biogeographic Regionalisation for Australia (IBRA) places the sites within the Coolgardie (COO) IBRA region. The Coolgardie bioregion covers an area of 129,117 km² and is divided into three subregions; Mardabilla (COO 01), Southern Cross (COO 02) and Eastern Goldfields (COO 03) (Thackway and Cresswell 1995).

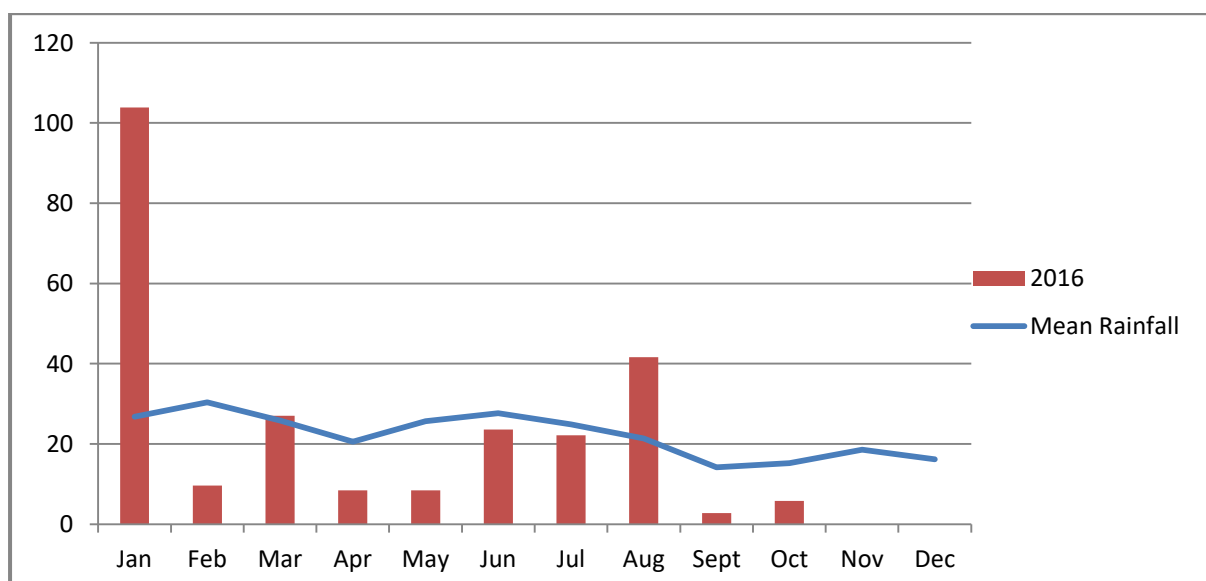
The proposal is located in the Eastern Goldfield subregion (COO 03). This subregion is characterised by gently undulating plains with low hills and ridges of Archaean greenstones in the west and in the east by a horst (raised fault block) of Proterozoic basic granulite. Tertiary soils dominated by calcareous earths overlay eroded gneisses and granites. In the western half, a series of large playa lakes indicate the remnants of an ancient major drainage line (Cowan 2001).

The vegetation is described as mallee, *Acacia* thickets and shrub-heaths on sandplain, with dwarf shrublands of samphire adjacent to salt lakes, and surrounded by *Eucalyptus* woodlands. These woodlands are included in the Great Western Woodlands, which cover approximately 16 million hectares.

2.2 Climate

The Coolgardie bioregion climate is described as arid non-seasonal to semi-arid Mediterranean, with cool winters and hot dry summers, with highest temperatures recorded in January and lowest in July (Bureau of Meteorology (BOM) 2016). Rainfall recorded at Kalgoorlie-Boulder Airport (BOM Station 12038 1929 - 2016), approximately 56 km north-east of the survey area, shows no particular wet season, with highest monthly averages recorded in February, May and June (Figure 3).

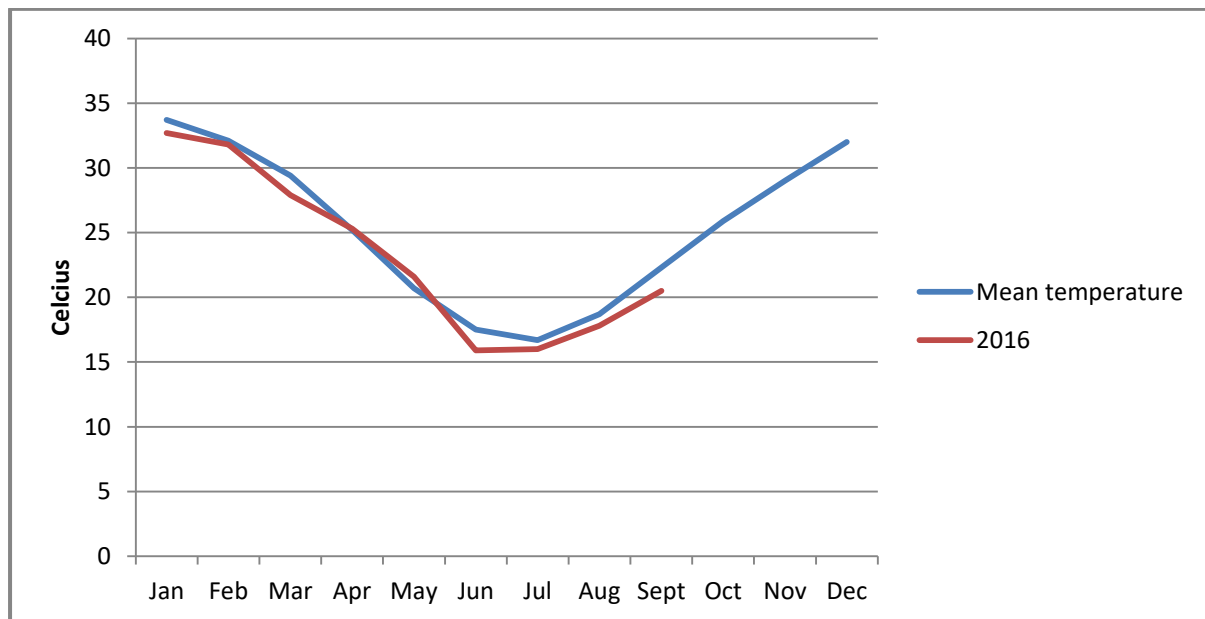
Figure 3: Mean monthly rainfall recorded at Kalgoorlie-Boulder Airport with rainfall received in 2016 prior to the survey



The lowest monthly averages are recorded for the period September to December. The annual average is recorded at 266.3 mm. Significant rainfall events have been recorded in summer, usually as a result of south east moving rain bearing depressions, which can be ex-tropical cyclones.

Rainfall can have a significant impact on the occurrence of annual species of plants. The sparse groundcover recorded in most of the survey area may be a result of lower than average rainfall recorded for September and October (prior to the survey), although significant falls were recorded in August, which received nearly twice the monthly average. Other factors which could impact on low forb densities include grazing and historical clearing.

Figure 4: Mean monthly temperature recorded at Kalgoorlie-Boulder Airport



Monthly average temperatures were lower in the four months prior to the survey (Figure 4). The cooler temperatures would result in reduced evaporation which can offset some of the impact of lower rainfall. The condition of the vegetation was generally healthy with few signs of water stress in the perennial taxa, except on some of the stony ridges.

2.3 Landform, Soils and Hydrology

Landforms in the survey area included low rocky rises or hills and gently sloping plains with broad drainage lines. Two broad drainage lines are present which flow east to south east and eventually join east of the study area. A number of smaller but deeper channels are present with the hilly areas which drain into the broader channels on the plains.

Soils were mainly reddish brown clay loams with some occurrences of calcrete on the surface. Some areas of likely sodic soils were present in the drainage line just south of the main pit. Nine soil samples were collected for Primary for further testing. Various levels of land surface disturbance were recorded with much of the area moderately to highly disturbed through historic pastoral and mining activities as well as current impacts from goats and rabbits. This has resulted in significant erosion in some areas. The middle and upper slopes of the hill in the south east of the area showed

low levels of land surface disturbance. The presence of moderate to high levels of surface rock on these slopes also provides some protection.



There are no wetlands within the survey area, and drainage lines are ephemeral. No water was present in the channels at the time of survey.

Regional drainage is to the east and north east into a series of salt lakes between Coolgardie and Kalgoorlie. Most of the drainage areas within the site (Figure 5) were disturbed with moderate to high levels of erosion and sedimentation. Small areas of sodic soils were present in the drainage line just south of the main pit. These areas are prone to erosion.

Figure 5 – Drainage channels (Google Earth™ Image (2016)): Main drainage channels within the study area, with flow west to east

2.4 Vegetation

The survey area lies within the south western interzone (Coolgardie Botanical District) and is predominantly *Eucalyptus* woodlands becoming open with a saltbush – bluebush understorey on the more calcareous soils, patches of shrub steppe, and scrub-heath and *Allocasurina* thickets on sandplains. The survey area is mapped entirely as Vegetation Association Coolgardie 9: medium woodland; Coral gum (*Eucalyptus torquata*) and Goldfields blackbutt (*E. lesouefii*) as well as occurrences of e10, 11 – *Eucalyptus transcontinentalis* or *moderata*; and *E. flocktoniae* (Beard et al 2013). Vegetation Association Coolgardie 936 (medium woodland; Salmon gum) is mapped as occurring to the east of the survey area. A small area of Salmon gum was recorded within the survey area.

A total of 558 taxa have been recorded within a 25 km range of the study area.

The protection of flora and fauna in Western Australia is currently governed under the:

- *Commonwealth Environment and Protection and Biodiversity Act 1999* (EPBC Act)
- *Wildlife Conservation Act 1950* (WC Act) and the *Sandalwood Act 1929*.
- *Environmental Protection Act 1986* (EP Act)

The WC Act and parts of the Sandalwood Act will be replaced by the *Biodiversity Conservation Act 2016* (BC Act). Regulations for the BC Act are proposed to be defined by the end of 2017. The BC Act provides coverage for flora and fauna as in the WC Act but also enhances protection for threatened species and introduces protection for threatened ecological communities; provides coverage of other matters such as habitat, communities, threatening processes, environmental pests and weeds (DPaW 2016d; Govt. WA 2016).

A description of conservation legislation and terminology is presented in Appendices 8A – 8C.

2.4.1 Conservation Significant Flora

A desktop survey (NatureMap (2016), FloraBase (2016), Phoenix (2014)) was undertaken to determine conservation significant taxa which may occur within the survey area using a 25 km buffer. Results of the survey are listed in Table 1. *Eremophila praecox* was recorded during the Phoenix survey approximately 3 km east of the study area, and was actively searched for. This was not listed in the NatureMap search. *Austrostipa* sp. Dowerin P3 and *Austrostipa blackii* P3 were determined to have a moderate likelihood of occurring in the study area. These are grasses and most of the ground cover in the area was sparse to isolated tussocks or forbs through a combination of grazing by goats, rabbits and native fauna, and historical impacts through mining and pastoral activities, including grazing and removal of topsoil through erosion. *Phlegmatospermum eremaeum* (forb) also had a moderate likelihood of occurring. *Gastrolobium graniticum* (T) is unlikely to occur in the study area as it has been recorded from granite areas which are not present at the site.

No sandplain areas were present within the study area, which decreases the likelihood of a number of the priority taxa recorded from this habitat from occurring within the study area.

2.4.2 Threatened and priority ecological communities

A desktop search of Department of Parks and Wildlife (DPaW) databases (DPaW 2016) show no records of priority or threatened ecological communities occurring within or in close proximity to the study area. No wetlands or vegetation which might be considered groundwater dependent was recorded within the study area. The study area occurs within the Great Western Woodlands (GWW). The occurrences within the wheatbelt have recently been added to the nationally threatened communities (EPBC 2016).

2.4.3 Conservation Reserves

A number of timber reserves (Kangaroo Hills Reserve, Kangaroo Hills Timber Reserve, Scahill Timber Reserve and Karramindie State Forest) are located within 20 km of the study area.

2.5 Fauna

2.5.1 Vertebrate Fauna

Database searches record 161 species of fauna within 25 km of the study area, of which three are of conservation concern:

- *Leipoa ocellata* (mallee fowl; VU and Mig. EPBC Act; S1 WC Act),
- *Merops ornatus* (Rainbow Bee-eater; Mig. EPBC Act; S3 WC Act) and

- *Morelia spilota* subsp. *imbricatus* (South western carpet python S4 WC Act).

Two conservation listed species were recorded during the Phoenix survey in 2014 – *Apus pacificus* (Fork tailed swift (Mig. EPBC Act; P3 WC Act)) and the Western rosella (inland subsp. – *Platycercus icterotis xanthogenys* P4 WC Act). The Phoenix survey found no evidence of Mallee fowl, Rainbow Bee-eaters (suitable habitat for foraging but not breeding) or the South Western carpet python. Information on other surveys from the area is well covered within the Phoenix (2014) report. The Fork tailed swift breed in the northern hemisphere and overwinter in Australia, arriving in northern Australia in early October.

2.5.2 Short Range Endemic Invertebrate Fauna

Short Range Endemic (SRE) species are defined as terrestrial or aquatic invertebrate fauna that have naturally small distributions of less than 10,000 km². It has been suggested that SRE invertebrates are often confined to disjunct refugia having persisted from a time when the climate was wetter, or wet conditions were more evenly distributed (Harvey 2002). Another possibility is that some may have evolved to conditions of habitats of restricted distribution in more recent times. The Department of Mines and Petroleum (DMP) acknowledges that not all mining proposals will impact on SRE, however where there is a potential of these occurring they should be addressed through the Mining Proposal risk assessment. Many of the SRE taxa occur in specialized habitats such as caves, aquatic habitats or within specialized geological formations such as banded ironstone formations (BIF). The number of invertebrate fauna surveys is increasing; however many of the taxa recorded from the Goldfields area have not been described, so there are difficulties when trying to establish the broader distribution and potential SRE status.

Where there is a lack of SRE survey data other indicators can be looked at to determine the potential of SRE occurring. One of these indicators is the vegetation type. Where the vegetation types are restricted to the potential impact area and are distinct from adjoining vegetation types, either structurally or floristically, there may be potential for SRE to occur. If the vegetation is well represented over a broader area (outside the proposed impact area) then the likelihood of an SRE being confined to the proposal is reduced. Pre-European vegetation of McPhersons Reward (The proposal) is mapped entirely as Vegetation Association Coolgardie 9: medium woodland; Coral gum (*Eucalyptus torquata*) and Goldfields blackbutt (*E. lesouefii*) as well as occurrences of e10, 11 – *Eucalyptus transcontinentalis* or *moderata*; and *E. flocktoniae* (Beard et al 2013). Vegetation Association Coolgardie 936 (medium woodland; Salmon gum) is mapped as occurring to the east of the survey area; however a small area of Salmon gum was recorded within the survey area. The potential for SRE occurring within the proposal will be discussed in section 6.

Table 1: Conservation significant flora recorded within 25 km of the survey area

Taxon	Cons code	Habitat	Likely occurrence
<i>Gastrolobium graniticum</i>	T	Margins of granite outcrops	Unlikely
<i>Acacia coatesii</i>	P1	Low rocky hills in <i>Eucalyptus</i> woodland	Moderate
<i>Acacia sclerophylla</i> var. <i>teretiuscula</i>	P1	Poor information; collection 1968 in Coolgardie region; clay & loam, salt flats in wheatbelt	Low
<i>Acacia websteri</i>	P1	Low lying areas, flats; red sand, loam or clay	Low
<i>Austrostipa</i> sp. Carlingup Road	P1	<i>Eucalyptus griffithsii</i> woodland over <i>Trymalium</i> and <i>Dodonaea lobulata</i> near Widgiemooltha	Moderate
<i>Baekkea</i> sp. Bulla Bulling (D J E Whibling 4648)	P1	Yellow sandy loam	Unlikely
<i>Dampiera plumosa</i>	P1	Red Sandy soils	Unlikely
<i>Eucalyptus websteriana</i> subsp. <i>norsemanica</i>	P1	Rocky rises	Moderate
<i>Lepidosperma</i> sp. Parker Range (N Gibson & M Lyons 2094)	P1	Ridge; laterite/ granite	Low
<i>Phebalium appressum</i>	P1	Yellow sandplain	Unlikely
<i>Thryptomene</i> sp. Coolgardie (E Kelso s. n. 1902)	P1	Poor information; collections 1902 and 1920	Unlikely
<i>Thryptomene</i> sp. Londonderry (R H Kuchel 1763)	P1	Sandplains; gravelly sandplain	Low
<i>Austrostipa</i> sp. Dowerin (G Whiel F 8004)	P2	Upper slopes and crest of basalt in Coolgardie area; <i>Eucalyptus torquata</i> over <i>Dodonaea lobulata</i>	Moderate to high
<i>Hakea rigida</i>	P2	Yellow sand	Unlikely
<i>Phebalium clavatum</i>	P2	Sandplains	Unlikely
<i>Allocasuarina eriochlamys</i> subsp. <i>grossa</i>	P3	Sandplains	Unlikely
<i>Austrostipa blackii</i>	P3	Variety of habitats	Moderate
<i>Chrysocephalum apiculatum</i> subsp. <i>norsemanense</i>	P3	Sandplains	Unlikely
<i>Diocirea acutifolia</i>	P3	Undulating flats; gravelly, clay loam	Moderate
<i>Diocirea microphylla</i>	P3	BIF scree slopes	Unlikely
<i>Eremophila praecox</i>	P3	Undulating plains; red brown sandy loam	Moderate to high
<i>Eremophila veronica</i>	P3	Lateritic breakaways	Low
<i>Gnephosis intonsa</i>	P3	Stony saline loam	Low
<i>Grevillea georgeana</i>	P3	Ironstone hilltops and slopes	Low – mod
<i>Phlegmatospermum eremaeum</i>	P3	Stony loam; herb	Moderate
<i>Eremophila caerulea</i> subsp. <i>merrallii</i>	P4	Undulating plains	Low-Mod
<i>Eucalyptus jutsonii</i> subsp. <i>jutsonii</i>	P4	Undulating areas; dunes	Unlikely

3. Methodology

3.1 Vegetation and Flora Survey

The survey area was designated by Primary (Figure 6). Aerial photograph interpretation was used to determine initial site description locations based on differences in vegetation patterns and landforms. Previous mapping by Phoenix was also considered for ground truthing and to determine likely sites which may support the priority taxon *Eremophila praecox* which was located during that survey. Nine soil sample locations were predetermined by Primary, and these were also used as opportunistic description sites (Figure 8).

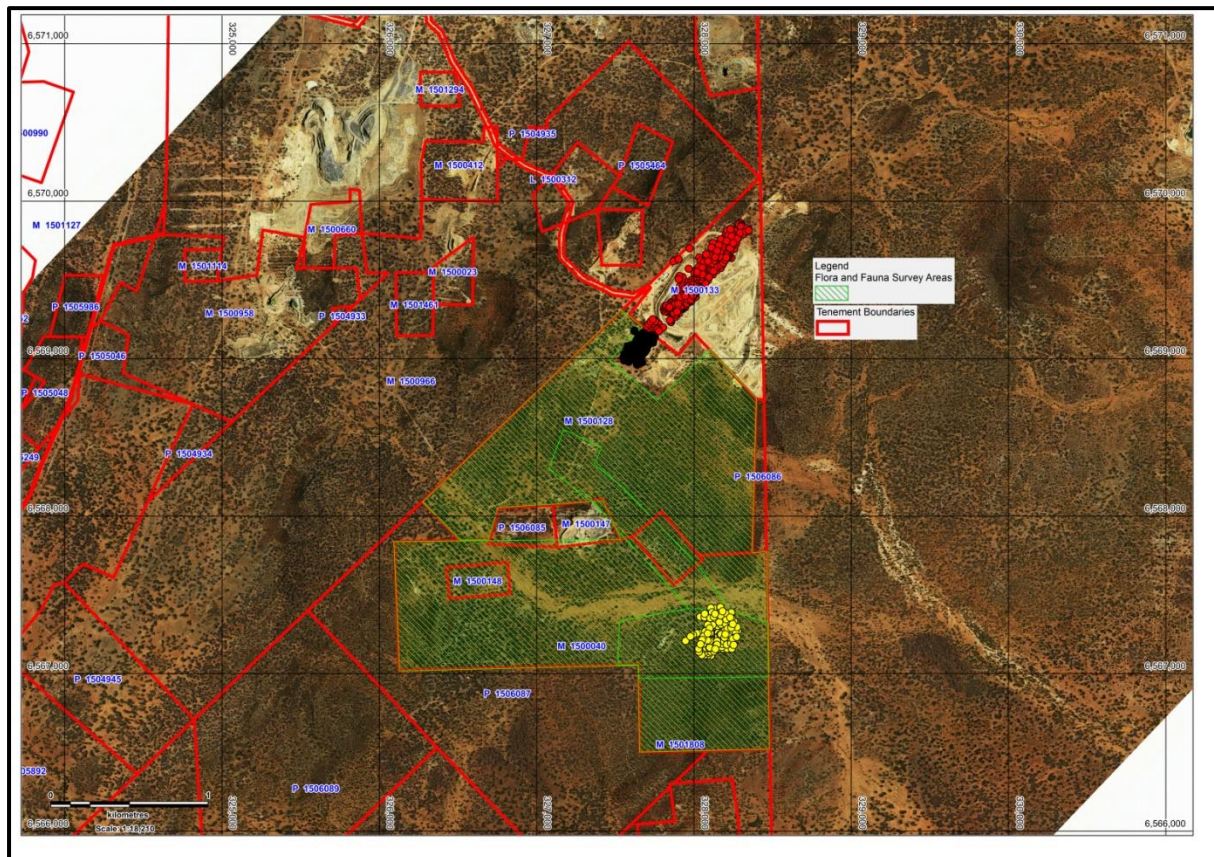


Figure 6: proposed survey area (green) (Primary Gold 2016)

20 m x 20 m quadrats were established for the vegetation site descriptions based on Keighery’s (1994) format (Table 4). Data recorded at the various sites are detailed in Tables 2, 3 and 4 below.

3.1.1 Land surface information

Table 2: Land surface information recorded

Date	GPS Location Easting/ Northing	Landform, slope, aspect
Soil texture	Soil Colour	Litter depth & % cover
Fallen timber cover %	Surface rock type & cover %	Cryptogam type & % cover

3.1.2 Vegetation structure

Table 3: Vegetation habit and height classes - % cover (Chenopod shrubs were included in the shrub category)

Tree/ mallee > 8 m	Tree/ mallee 2 – 8 m	Shrub > 2m
Shrub 1 – 2 m	Shrub 0.5 – 1 m	Shrub < 0.5 m
Forb	Grass	Sedges & rushes
Ferns		

Species present within each category were listed in order of dominance (% cover) and vegetation descriptions were based on dominant species and height categories using terminology used for the National Vegetation Inventory System (NVIS). For example trees less than 10 m high, with a canopy cover of 10 – 30 % would be described as low woodland; shrubs > 2m with a canopy cover 2 – 10 % would be described as a tall sparse shrubland. These are further described in Appendix 10.

3.1.3 Vegetation Condition

The condition of the vegetation was based on parameters described by Keighery (1994) (Table 4). Some assumptions were made in the field as there were likely current and historical impacts resulting in the absence of some taxa and strata within the description sites. Current and potential threats were also recorded.

Table 4: Vegetation condition descriptions (Keighery 1994)

Condition	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
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it.
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management.
Completely degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species

3.2 Fauna survey

Fauna habitat descriptive sites were included with the vegetation sites. Opportunistic sightings (such as mallee fowl mounds) were recorded. Areas which supported significant trees with hollows were also recorded, but not individual trees.

Evidence such as mounds, tracks, scats or feathers of mallee fowl were searched for. Feral fauna activity was also recorded. A fauna habitat description was recorded for each of the quadrat sites.

4. Results

4.1 Summary

4.1.1 Vegetation and flora

A total of seventy eight taxa were recorded from the survey area from twenty one families and thirty four genera. The most well represented families were Chenopodiaceae (6 genera, 12 species), Scrophulariaceae (1 genus, 11 species), Fabaceae (3 genera, 10 species (1 alien)) and Myrtaceae (1 genus, 8 species). Overall diversity was low, with very low numbers of annual species. Occurrences of forbs were sparse, with some areas having zero ground cover. Three weed species – *Carrichtera annua**, *Medicago minima** and *Nicotiana glauca** were recorded, with *Carrichtera* being quite common in the groundcover. No threatened or priority flora were recorded. A few occurrences of sandalwood (*Santalum spicatum*, a registered species) were recorded (Figure 7). It is likely that sandalwood would have been harvested in the area.

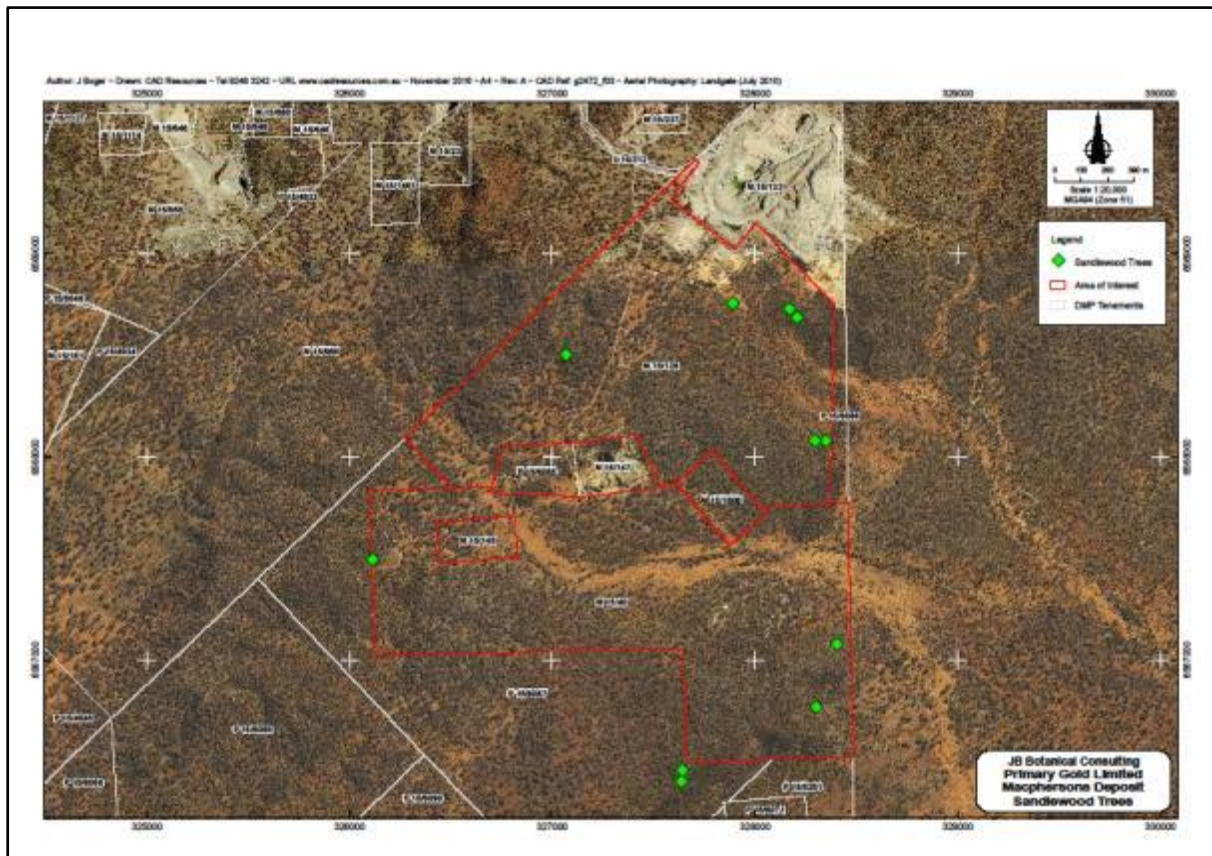
The vegetation was dominated by *Eucalyptus* spp., *Eremophila* spp., and *Atriplex* spp., with woodlands accounting for more than 70 % of the vegetation associations. A small area of *Eucalyptus salmonophloia* (Salmon gum) was present in the central west of the site which corresponds with Coolgardie 936.3 which is mapped as occurring outside the study area. Vegetation condition ranged from degraded (particularly along the broad drainage lines) to excellent. The low hills at the southern end of the study area were mostly in very good to excellent condition, particularly on mid and upper slopes. Vegetation near the pit areas ranged from degraded to good, with some areas very good. Disturbances in the area included historical and current mining (drill access tracks), historical pastoral activities (clearing (including timber harvesting for posts), grazing), rabbits and goats (current). These have resulted in clearing of vegetation, poor recruitment, likely loss of species (loss of diversity), introduction of weeds (minor), erosion and sedimentation. Some rubbish was present within the area, but this was sporadic and at low levels (e.g. old bottles, tins and other metallic rubbish).

4.1.2 Fauna

Twenty eight species of fauna including nineteen birds, four reptiles and five mammals (including three feral animals) were recorded. No conservation listed fauna were recorded in the study area. At least three inactive mallee fowl mounds were recorded (Appendix 7A), with no recent activity noted, and likely nesting absence for more than twenty years. Two other possible extinct mounds were located but are currently active rabbit warrens and with the level of disturbance may prove not to be mallee fowl mounds. No signs (tracks, scats or feathers) were noted in the area. The rainbow bee-eater (*Merops ornatus*), which prefers nesting in sandy banks, was not observed and no nesting sites were located in the creek banks towards the south of the area. The broad drainage channel in the northern part was heavily disturbed with active erosion, and also unlikely to support nesting having high clay content.

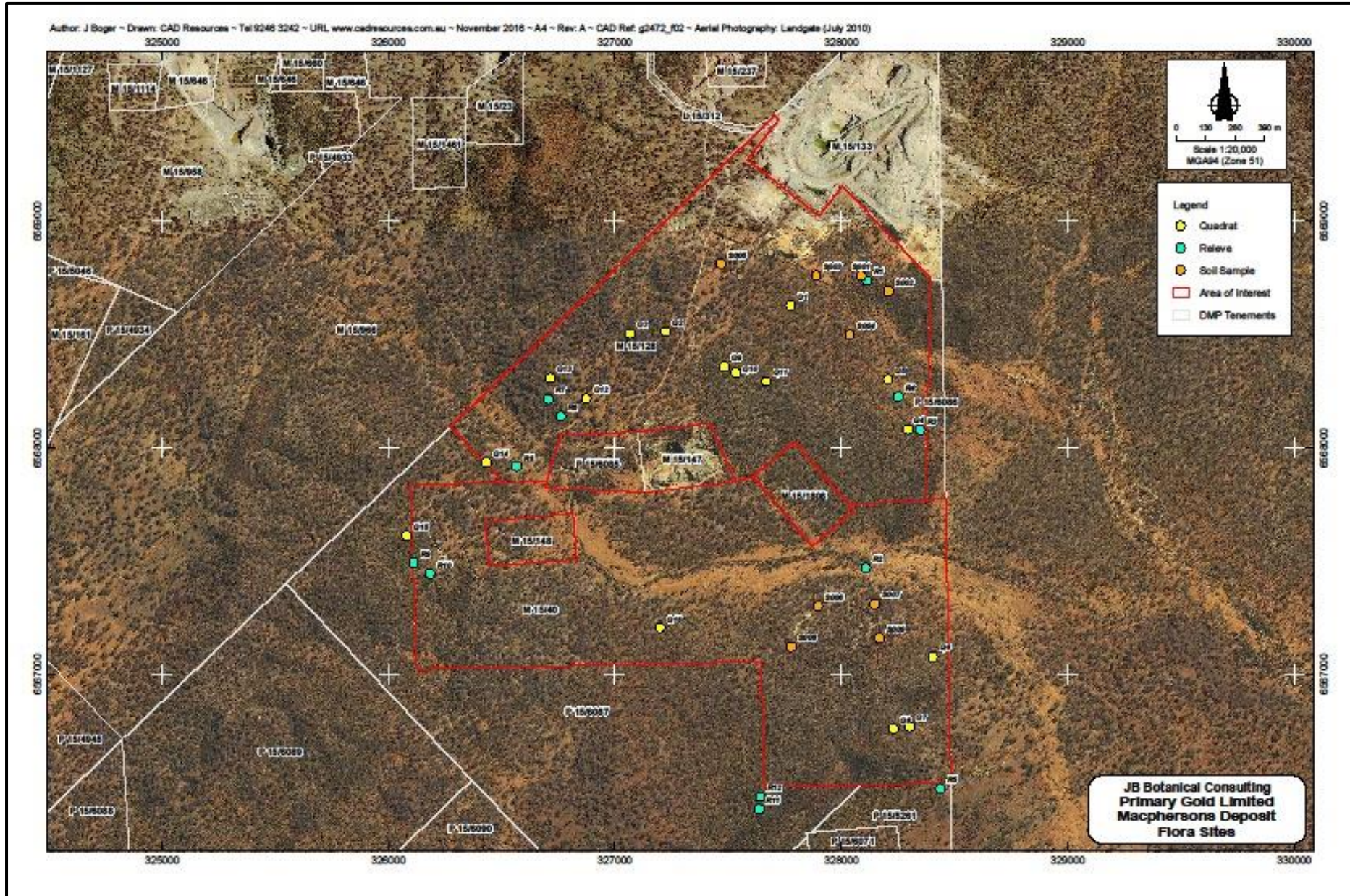
Signs were noted of kangaroos and emus (scats, tracks) and echidnas (diggings). Recent activity was observed of goats (vegetation damage, tracks, smell, scats). A skull was also located near relevé O1. Rabbits appear to be active in the area with numerous scat piles and warrens (active and inactive). A list of fauna recorded in the study area is listed in Appendix 6.

Figure 7: Records of sandalwood (*Santalum spicatum*) from the survey



Sandalwood has been harvested for over a century within the wheatbelt and semi-arid zones, having a significant impact on the species distribution and population size. Protection of sandalwood is covered by the *Sandalwood Act 1929*, and the *Wildlife Conservation Act 1950*. Records of sandalwood from the survey are mapped in Figure 7, with GPS locations listed in Appendix 5. They are a registered species, and a licence is required to harvest them. A commercial licence is required to harvest sandalwood from government managed lands.

Figure 8: Location of quadrats, relevés and soil sample sites



4.2 Vegetation and flora results

A list of taxa recorded in the study area is presented in Appendix 1. Sixteen quadrats were established (Figure 8), nine soil sample locations and twelve relevé sites were described. This information was used to map the vegetation types, also including information from the Phoenix survey undertaken in 2013 (Phoenix 2014). Flora which couldn't be identified in the field was collected and identified using taxonomic keys and reports, FloraBase, or compared with specimens at the WA Herbarium. Assistance with/ confirmation of *Eremophila* species identifications was given by Dr Andrew Brown (DPaW).

Fifteen vegetation types (Figure 9, Tables 5 & 6) were described from the survey results, and include six of the Phoenix vegetation types (1 – 7). Disturbances within the study area have resulted in a likely loss of some of the mid and lower strata species, as well as selective timber removal, which needs to be taken into account when determining vegetation types. Phoenix vegetation type 4: High open shrubland of *Eremophila interstans* subsp. *interstans*, *Eremophila oppositifolia* subsp. *angustifolia* and *Sida spodachroma* (not recorded in study area; a prostrate perennial herb ^0.3 m high) over low shrubland of *Eremophila glabra* subsp. *glabra* has been included within Vegetation type 1, as it is likely a small area of disturbed vegetation. Vegetation type 1 are woodlands with *Eucalyptus clelandii* being dominant in much of the area, however there are occurrences of other *Eucalyptus* species including *E. torquata*, *E. griffithsii* and *E. celastroides*.

In addition to the Phoenix vegetation types, a further eight vegetation types (8 – 15) are mapped as occurring in the McPhersons study area, which did not occur within the Phoenix Tycho study area. These mostly occurred on low rocky hills in the west and south of the area. Significant areas of *Eucalyptus campaspe*, which is related to *E. salubris* (gimlet) occurred, with *E. campaspe* dominant low woodlands on lower to midslopes (Veg unit 10), grading to *E. campaspe*/ *E. griffithsii* / *E. celastroides* (Veg unit 11) on mid to upper slopes. A small area of *Eucalyptus salmonophloia* (Salmon gum) open woodland was recorded on plains north of the main drainage line (Veg unit 9). *E. salubris* was recorded in the Phoenix survey area.

Eucalyptus torquata low woodland over *Eremophila oldfieldii* subsp. *angustifolia* and *Dodonaea* spp. was dominant in the upper stratum on the rocky hill in the south east (Veg unit 14), with some occurrences of *Eucalyptus griffithsii* on the ridge and south facing slopes (Veg unit 12). Vegetation unit 15 – *Eucalyptus griffithsii* and/ or other *Eucalyptus* spp. over *Allocasuarina hemiteles* and *Triodia* sp. grass tussocks – was recorded in two areas on the eastern side. These were the only sites where *Allocasuarina hemiteles* and *Triodia* were recorded. *Eremophila alternifolia* (poverty bush) was common along the main drainage line, and was flowering at the time of survey, with pink and white-cream flowering forms (Veg unit 7). This species was used as an indicator species for this vegetation unit, and aligns closely with the Phoenix 7 description. Vegetation unit 8: Isolated *Eucalyptus griffithsii*, *Santalum spicatum* to low open woodland over *Acacia burkittii*, *Bertya dimerostigma*, *Eremophila* spp., and *Dodonaea stenozyga*, *D. lobulata* tall shrubland over *Eremophila* spp., *Dodonaea* spp., *Acacia calcarata* and *Stenanthemum stipulosum* – occurred south of the main pit with a few areas along the eastern boundary. *Eremophila gibbosa* was also recorded in this unit, but was not common. These areas would be suitable mallee fowl habitat, and an extinct mound was recorded in this area. Vegetation unit 13 (*Casuarina pauper* low open woodland; Relevé 10) had a

high level of historic disturbance in a valley/ drainage line on midslopes. The regrowth was semi-mature.

Figure 9: Vegetation types (Google Earth™ 2016)

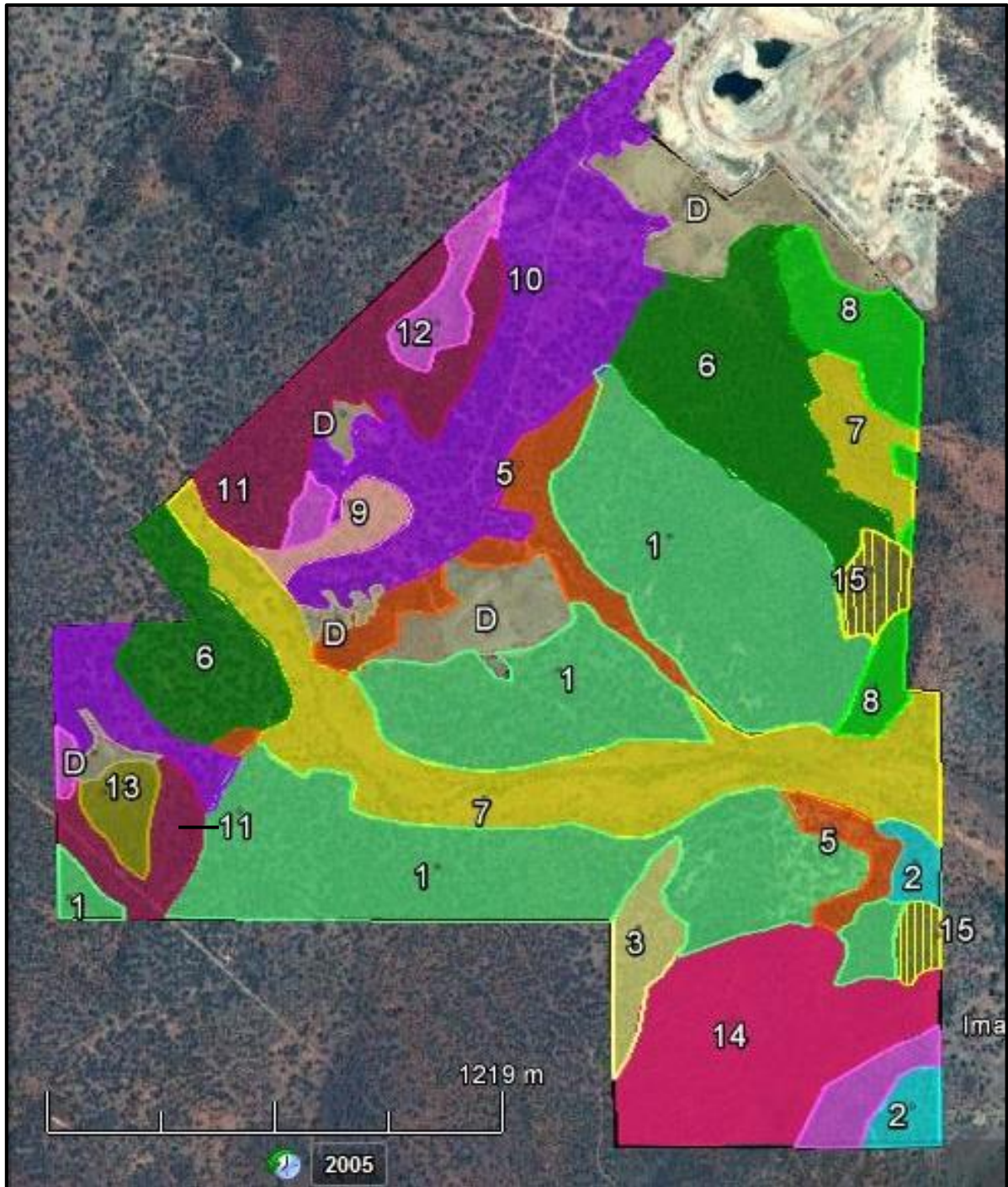







Table 5: Vegetation unit descriptions summary (Veg units 1 – 7 based on the Phoenix survey 2013)



Unit	Landform	Description summary
D	various	Degraded to completely degraded
1	Lower slopes, plains	<i>Eucalyptus clelandii</i> low woodland with occasional <i>E. griffithsii</i> over <i>Eremophila interstans</i> , <i>E. parviflora</i> , <i>E. glabra</i> , <i>E. scoparia</i> , <i>Olearia muelleri</i> , <i>Senna artemisioides</i> , <i>Scaevola spinescens</i> ; small areas of <i>Eremophila interstans</i> , <i>E. oppositifolia</i> tall open shrubland
2	Lower slopes	<i>Eucalyptus griffithsii</i> open forest to low woodland over <i>Eremophila</i> spp. tall sparse shrubland over <i>Atriplex</i> spp., <i>Olearia muelleri</i> , <i>Ptilotus obovatus</i> low open shrubland
3	Lower to mid-slopes	<i>Eucalyptus celastroides</i> subsp. <i>celastroides</i> low woodland to open woodland over a low mixed shrubland; small occurrences in Veg unit 8
4		Included in Vegetation unit 1
5	Lower slopes	<i>Eucalyptus torquata</i> low open forest to low woodland over <i>Eremophila</i> spp., <i>Dodonaea stenozyga</i> , <i>Olearia muelleri</i> , <i>Acacia hemiteles</i> , <i>A. erinacea</i> sparse shrubland
6	Plains, low rises	<i>Eucalyptus longissima</i> low open forest to tall open mallee woodland over <i>Acacia hemiteles</i> , <i>Eremophila scoparia</i> , <i>Atriplex nummularia</i> , <i>Senna artemisioides</i> , <i>Cratystylis conocephala</i> , <i>Acacia calcarata</i> open shrubland
7	Broad drainage lines	<i>Eucalyptus griffithsii</i> isolated trees over <i>Atriplex nummularia</i> , <i>A. vesicaria</i> , <i>Eremophila alternifolia</i> , <i>Lycium australe</i> open to sparse shrubland
8	Plain with low stoney rises	<i>Eucalyptus griffithsii</i> , and occ. <i>E. celastroides</i> open mallee woodland to isolated mallee over <i>Acacia burkittii</i> , <i>Bertya dimerostigma</i> , <i>Eremophila decipiens</i> , <i>E. oppositifolia</i> , <i>E. glabra</i> , <i>Dodonaea lobulata</i> tall shrubland
9	Plain	<i>Eucalyptus salmonophloia</i> open forest to open woodland
10	Lower & midslopes	<i>Eucalyptus campaspe</i> , <i>E. griffithsii</i> low open forest over <i>Eremophila interstans</i> isolated tall shrubs over <i>Atriplex</i> spp. and <i>Eremophila</i> spp.
11	Mid to upper slopes	<i>Eucalyptus campaspe</i> , <i>E. clelandii</i> , <i>E. celastroides</i> low woodland to open woodland over <i>Eremophila</i> spp., <i>Exocarpos aphyllus</i> , <i>Senna artemisioides</i> , <i>Santalum acuminatum</i> tall open shrubland
12	Ridges of rocky hills	<i>Eucalyptus griffithsii</i> low open woodland to isolated trees over <i>Eremophila oldfieldii</i> subsp. <i>angustifolia</i> , <i>E. decipiens</i> , <i>E. interstans</i> , <i>Exocarpos aphyllus</i> tall sparse shrubland to open shrubland over <i>Acacia erinacea</i> , <i>Dodonaea lobulata</i> , <i>Acacia tetragonophylla</i> open shrubland
13	Valley; midslope	<i>Casuarina pauper</i> isolated low trees over mixed shrubland; semi mature regrowth
14	Upper slopes rocky hills	<i>Eucalyptus torquata</i> , <i>E. griffithsii</i> low open forest over <i>Eremophila oldfieldii</i> subsp. <i>angustifolia</i> , <i>Santalum spicatum</i> tall open shrubland over <i>Dodonaea</i> and <i>Eremophila</i> spp., <i>Grevillea acuaria</i> open shrubland; areas of <i>Eremophila</i> tall shrubland
15	Lower slopes & plain	<i>Eucalyptus griffithsii</i> , <i>E. celastroides</i> &/or <i>E. torquata</i> mallee woodlands over <i>Allocasuarina helmsii</i> , <i>Eremophila interstans</i> , <i>Acacia densiflora</i> , <i>Santalum spicatum</i> isolated tall shrubs over <i>Allocasuarina helmsii</i> , <i>Acacia hemiteles</i> , <i>Westringia rigida</i> low shrubs over <i>Triodia scariosa</i> open tussock grassland



Table 6: Vegetation types recorded in the survey area (aligned with Phoenix descriptions)



Vegetation type	Vegetation description	Site photo	Field sites
<p>1 Lower slopes to plains</p>	<p><i>Eucalyptus clelandii</i> low woodland with occasional small areas of <i>E. griffithsii</i> & <i>E. torquata</i></p> <p>PHOENIX 1: <i>Eucalyptus clelandii</i> low woodland occasionally with other <i>Eucalyptus</i> spp. trees over scattered shrubs to open shrubland of <i>Exocarpos aphyllus</i> over a low open shrubland to shrubland of <i>Cratystylis conocephala</i>, <i>Eremophila</i> spp. (<i>parviflora</i> subsp. <i>auricampa</i>, <i>glabra</i>, <i>scoparia</i>, <i>interstans</i> subsp. <i>interstans</i>), <i>Olearia muelleri</i>, <i>Scaevola spinescens</i> and <i>Senna artemisioides</i> subsp. <i>filifolia</i> over sparse to isolated <i>Austrostipa</i> spp. tussocks, <i>Sclerolaena</i> and <i>Zygophyllum</i> herbs</p> <p>Q16: (Lower slope) <i>Eucalyptus clelandii</i> low open forest over <i>Eremophila parviflora</i> subsp. <i>auricampa</i>, <i>E. scoparia</i>, <i>E. glabra</i>, <i>Atriplex nummularia</i>, <i>A. vesicaria</i>, <i>Olearia muelleri</i> and <i>Senna artemisioides</i> subsp. <i>filifolia</i> isolated shrubs to sparse shrubland over <i>Sclerolaena</i> isolated forbs (<i>Eucalyptus griffithsii</i>, <i>E. torquata</i> outside quadrat)</p> <p>Q11: (lower slope) <i>Eucalyptus clelandii</i>, <i>E. griffithsii</i> low open forest over <i>Eremophila interstans</i>, <i>E. parvifolia</i>, <i>Dodonaea stenozyga</i>, <i>Olearia muelleri</i> and <i>Westringia rigida</i> isolated shrubs over isolated grass tussocks (grazed) and <i>Ptilotus holosericeus</i> forbs</p> <p>PHOENIX 4: High open shrubland of <i>Eremophila interstans</i> subsp. <i>interstans</i>, <i>E. oppositifolia</i> subsp. <i>angustifolia</i> and <i>Sida spodachroma</i> over low shrubland of <i>Eremophila glabra</i> subsp. <i>glabra</i>, <i>Senna artemisioides</i> subsp. <i>filifolia</i>, <i>Scaevola spinescens</i> and <i>Dodonaea lobulata</i> over scattered <i>Austrostipa elegantissima</i> and <i>A. scabra</i> tussocks.</p>		<p>Q16 (image), Q11, S6</p>



<p>2 Lower slopes</p>	<p>PHOENIX 2: A low open forest to low woodland of <i>Eucalyptus griffithsii</i> occasionally with <i>Eucalyptus salicola</i> over scattered tall shrubs to high open shrubland of <i>Eremophila</i> spp., <i>Exocarpos aphyllus</i> and <i>Santalum</i> spp. over a low open shrubland to low shrubland of <i>Acacia hemiteles</i>, <i>Atriplex</i> spp., <i>Eremophila</i> spp., <i>Olearia muelleri</i> and <i>Senna artemisioides</i> subsp. <i>filifolia</i> over scattered <i>Austrostipa</i> spp. tussocks and <i>Sclerolaena</i> spp. herbs</p> <p>R5: <i>Eucalyptus griffithsii</i> open forest over <i>Eremophila decipiens</i> subsp. <i>decipiens</i> tall sparse shrubland to isolated shrubs over <i>Dodonaea lobulata</i>, <i>Eremophila decipiens</i> subsp. <i>decipiens</i> open shrubland over <i>Ptilotus obovatus</i>, <i>Atriplex vesicaria</i> low shrubland to low open shrubland</p> <p>Other species: <i>Maireana sedifolia</i>, <i>Atriplex nummularia</i> subsp. <i>spathulata</i></p>		<p>R5</p>
<p>3 Mid slopes</p>	<p>PHOENIX 3: A low woodland to open woodland of <i>Eucalyptus celastroides</i> subsp. <i>celastroides</i> over low mixed shrubland to open shrubland of <i>Eremophila</i> spp., <i>Atriplex</i> spp., and <i>Senna artemisioides</i> subsp. <i>filifolia</i> over scattered herbs to very open herbfield of <i>Sclerolaena</i> spp. & <i>Carrichtera annua</i>*, and scattered tussocks of <i>Austrostipa elegantissima</i> and <i>A. eremophila</i>.</p>	<p>This vegetation type has minor occurrences within vegetation type 8</p>	<p>Ph Q3</p>
<p>5 Mid to lower slopes</p>	<p>PHOENIX 5: A low woodland of <i>Eucalyptus torquata</i> and <i>E. yilgarnensis</i> over a low open shrubland of <i>Eremophila scoparia</i>, <i>Dodonaea stenozyga</i>, <i>Atriplex vesicaria</i> and <i>Olearia muelleri</i> over scattered <i>Austrostipa scabra</i> and <i>A. elegantissima</i> tussocks with scattered <i>Maireana tomentosa</i> and <i>Sclerolaena diacantha</i> herbs</p> <p>Q9: <i>Eucalyptus torquata</i> low open forest over <i>Eremophila interstans</i> subsp. <i>interstans</i> tall sparse shrubland over <i>Dodonaea stenozyga</i>, <i>Acacia erinacea</i>, <i>Atriplex nummularium</i> subsp. <i>spathulata</i> sparse shrubland over <i>Westringia rigida</i>, <i>Olearia muelleri</i>, <i>Acacia hemiteles</i>, <i>Acacia erinacea</i> low sparse shrubland</p> <p>S7 (heavily disturbed area): <i>Eremophila interstans</i> subsp. <i>interstans</i>, <i>Atriplex nummularia</i> subsp. <i>spathulata</i>, <i>Maireana pentatropis</i> isolated shrubs and subshrubs; Adjacent: <i>Eucalyptus torquata</i>, <i>E. clelandii</i> woodland over <i>Exocarpos aphyllus</i> isolated shrubs over <i>Eremophila</i> spp., <i>Cratystylis conocephala</i>, <i>Olearia muelleri</i> isolated low shrubs</p> <p>S9: <i>Eucalyptus griffithsii</i> , <i>Eucalyptus yilgarnensis</i> open woodland over <i>Santalum acuminatum</i>, <i>Dodonaea lobulata</i>, <i>Eremophila interstans</i> subsp. <i>interstans</i> tall sparse shrubland over <i>Westringia rigida</i>, <i>Scaevola spinescens</i>, <i>Dodonaea lobulata</i>, <i>Atriplex nummularia</i> subsp. <i>spathulata</i>, <i>Eremophila interstans</i> subsp. <i>interstans</i>, <i>E. interstans</i> subsp. <i>virgata</i> and <i>E. glabra</i> subsp. <i>glabra</i> open shrubland</p>		<p>Q9 (image) S7, S9</p>

<p>6 Undulating plain, low rises</p>	<p>PHOENIX 6: Low woodland of <i>Eucalyptus longissima</i> over low shrubland of <i>Cratystylis conocephala</i>, <i>Acacia hemiteles</i> and <i>Eremophila scoparia</i> over scattered <i>Zygophyllum eremaeum</i> and <i>S. glaucum</i> herbs and scattered <i>Austrostipa elegantissima</i> and <i>A. eremophila</i> tussocks</p> <p>Q1: <i>Eucalyptus griffithsii</i>, <i>E. longissima</i> open forest over <i>Eremophila interstans</i> tall sparse shrubland over <i>Acacia hemiteles</i>, <i>Eremophila interstans</i> and <i>Senna artemisioides</i> subsp. <i>filifolia</i> open shrubland over <i>Atriplex nummularia</i> subsp. <i>spathulata</i>, <i>Olearia muelleri</i>, <i>Acacia calcarata</i>, <i>A. hemiteles</i>, <i>Cratystylis conocephala</i> low sparse shrubland</p> <p>Q14: <i>Eucalyptus longissima</i> low open forest over <i>Senna artemisioides</i> subsp. <i>filifolia</i>, <i>Eremophila scoparia</i>, <i>Atriplex nummularia</i> subsp. <i>spathulata</i> sparse shrubland over <i>Senna artemisioides</i> subsp. <i>filifolia</i>, <i>Eremophila parvifolia</i> subsp. <i>auricampa</i>, <i>Atriplex vesicaria</i> low sparse shrubland</p> <p>R8: <i>Eucalyptus longissima</i> tall open mallee woodland over <i>Atriplex</i> spp., <i>Senna artemisioides</i> subsp. <i>filifolia</i>, <i>Acacia tetragonophylla</i>, <i>A. hemiteles</i> and <i>Dodonaea lobulata</i> open shrubland</p> <p>Minor occurrences of R4: <i>Eucalyptus horistes</i> low mallee woodland with <i>Eremophila interstans</i> subsp. <i>interstans</i> over <i>Atriplex nummularia</i> subsp. <i>spathulata</i>, <i>Eremophila interstans</i> subsp. <i>interstans</i>, <i>Atriplex vesicaria</i>, <i>Olearia muelleri</i> low open shrubland over isolated <i>Austrostipa trichophylla</i> grass tussocks and <i>Ptilotus</i> sp. Goldfields herbs</p>		<p>Q1, Q14 R8, R4</p>
<p>7 Broad drainage lines</p>	<p>PHOENIX 7: A low open shrubland of <i>Atriplex nummularia</i> subsp. <i>spathulata</i>, <i>A. vesicaria</i>, <i>Eremophila alternifolia</i>, <i>Lycium australe</i> and <i>Rhagodia</i> sp. over scattered <i>Austrostipa elegantissima</i> tussocks over an open herbfield of <i>Carrichtera annua</i>*, <i>Dissocarpus paradoxus</i>, <i>Sclerolaena fusiformis</i> and <i>S. diacantha</i></p> <p>Q5: <i>Eucalyptus griffithsii</i> open woodland over <i>Eremophila</i> spp. tall sparse shrubland over <i>Eremophila</i> spp., <i>Atriplex</i> spp., <i>Exocarpos aphyllus</i>, <i>Acacia hemiteles</i>, <i>Lycium australe</i>, <i>Senna stowardii</i> and <i>Dodonaea lobulata</i> sparse shrubland to low shrubland over isolated <i>Austrostipa elegantissima</i> tussocks and isolated <i>Sclerolaena fusiformis</i> and <i>Carrichtera annua</i>* forbs</p> <p>R2: <i>Eucalyptus griffithsii</i> isolated trees over <i>Eremophila</i> spp., <i>Acacia</i> spp., <i>Senna cardiosperma</i>, <i>Atriplex nummularia</i> open shrubland over <i>Lycium australe</i>, <i>Atriplex</i> spp., <i>Eremophila</i> spp., <i>Senna artemisioides</i> subsp. <i>filifolia</i>, <i>Maireana</i> spp. low open shrubland over <i>Dissocarpus paradoxus</i>, <i>Carrichtera annua</i>*, <i>Austrostipa eremophila</i>, <i>Sclerolaena fusiformis</i> low forbland with isolated grass tussocks</p>		<p>Q5, R2</p>

<p>8 Plains, with low stony rises</p> <p>Mallee fowl habitat</p>	<p>Soil 1: <i>Eucalyptus griffithsii</i> low isolated mallee over <i>Acacia burkittii</i> tall open shrubland over <i>Dodonaea stenozyga</i>, <i>Eremophila decipiens</i> subsp. <i>decipiens</i> shrubland over <i>Eremophila oppositifolia</i> subsp. <i>angustifolia</i>, <i>E. glabra</i> subsp. <i>glabra</i> and <i>Acacia calcarata</i> low isolated shrubs</p> <p>Soil 2: <i>Eucalyptus griffithsii</i> open woodland over <i>Santalum spicatum</i> low isolated trees over <i>Bertya dimerostigma</i>, <i>Acacia burkittii</i>, <i>Dodonaea lobulata</i> shrubland over <i>Waitzia fitzgibbonii</i>, <i>Austrostipa</i> sp., <i>Carrichtera annua</i>* isolated herbs and grass tussocks</p> <p>R1: <i>Eucalyptus griffithsii</i> and <i>E. celastroides</i> subsp. <i>celastroides</i> open mallee woodland over <i>Acacia burkittii</i>, <i>Dodonaea lobulata</i> tall shrubland over <i>Dodonaea lobulata</i> shrubland over <i>Senna artemisioides</i> subsp. <i>filifolia</i>, <i>Stenanthemum stipulosum</i>, <i>Bertya dimerostigma</i> low open shrubland</p> <p>Other species: <i>Eremophila interstans</i> subsp. <i>interstans</i>, <i>Acacia burkittii</i>, <i>A. calcarata</i>, <i>Olearia muelleri</i>, <i>Santalum spicatum</i></p>		<p>S1, S2 (image), R1</p>
<p>9 Plain</p>	<p><i>Eucalyptus salmonophloia</i> open forest to woodland over <i>Atriplex nummularia</i>, <i>A. vesicaria</i>, <i>Maireana</i> spp., <i>Enchylaena tomentosa</i> chenopod open shrubland over <i>Sclerolaena fusiformis</i> sparse forbland</p> <p>Isolated <i>Eucalyptus campaspe</i> occurred in the area</p>		<p>Q12</p>

<p>10 Lower and mid slopes</p>	<p>Q2 area: <i>Eucalyptus campaspe</i>, <i>E. griffithsii</i> low open forest over <i>Eremophila interstans</i> subsp. <i>interstans</i> isolated tall shrubs over <i>Atriplex vesicaria</i>, <i>Eremophila interstans</i> low sparse shrubland over <i>Sclerolaena fusiformis</i>, <i>Ptilotus holosericeus</i> isolated forbs and <i>Austrostipa elegantissima</i> isolated grass tussocks</p> <p>S5: <i>Eucalyptus campaspe</i> isolated trees to low open woodland over <i>Eremophila glabra</i> subsp. <i>glabra</i>, <i>E. decipiens</i> subsp. <i>decipiens</i>, <i>Atriplex nummularia</i> subsp. <i>spathulata</i> isolated shrubs over <i>Atriplex vesicaria</i> and <i>A. nummularia</i> subsp. <i>spathulata</i> low open shrubland over <i>Maireana trichoptera</i>, <i>M. tomentosa</i> subsp. <i>tomentosa</i>, <i>Ptilotus chamaecladus</i>, <i>Medicago minima</i>*, <i>Sclerolaena fusiformis</i>, <i>Carrichtera annua</i>* low sparse forbland</p>		<p>Q2 (image), S5</p>
<p>11 Mid to upper slopes</p> <p>Likely mallee fowl habitat</p> <p>Moderate to high levels of disturbances in some areas</p>	<p>Low woodlands with occasional areas of tall shrubland to tall open shrublands</p> <p>Q13: <i>Eucalyptus campaspe</i>, <i>E. clelandii</i>, <i>E. celastroides</i> low woodland over <i>Santalum acuminatum</i>, <i>Eremophila interstans</i>, <i>E. scoparia</i> tall open shrubland over <i>Eremophila</i> spp., <i>Exocarpos aphyllus</i>, <i>Acacia hemiteles</i>, <i>Senna artemisioides</i> subsp. <i>filifolia</i> and <i>Olearia muelleri</i> sparse shrubland to isolated shrubs over <i>Atriplex</i> spp., <i>Senna artemisioides</i> subsp. <i>filifolia</i>, <i>Olearia muelleri</i>, <i>Eremophila scoparia</i> and <i>Maireana georgei</i> low sparse shrubland with isolated forbs (<i>Waitzia fitzgibbonii</i>, <i>Dissocarpus paradoxus</i>, <i>Carrichtera annua</i>*)</p> <p>R7A: <i>Eucalyptus clelandii</i>, <i>E. campaspe</i> open woodland over isolated <i>Senna artemisioides</i> subsp. <i>filifolia</i> shrubs and <i>Ptilotus</i> sp. Goldfields herbs</p> <p>R7B: <i>Eremophila decipiens</i> subsp. <i>decipiens</i>, <i>E. glabra</i> subsp. <i>glabra</i>, <i>Dodonaea lobulata</i>, <i>Senna artemisioides</i> subsp. <i>filifolia</i>, <i>Eremophila scoparia</i> shrubland to open shrubland over <i>Ptilotus obovatus</i> and <i>Atriplex vesicaria</i> low open shrubland</p> <p>R9: (Regrowth) <i>Acacia tetragonophylla</i>, <i>Eremophila decipiens</i> subsp. <i>decipiens</i>, <i>Dodonaea lobulata</i>, <i>Santalum spicatum</i> tall shrubland over <i>Eremophila decipiens</i> subsp. <i>decipiens</i>, <i>Scaevola spinescens</i>, <i>Dodonaea lobulata</i>, <i>Senna artemisioides</i> subsp. <i>filifolia</i>, <i>Atriplex nummularia</i> subsp. <i>spathulata</i> open shrubland over <i>Ptilotus obovatus</i>, <i>Scaevola spinescens</i> low sparse shrubland over <i>Sclerolaena fusiformis</i>, <i>Maireana</i> spp. sparse forbland</p> <p>Other species: <i>Eucalyptus campaspe</i></p>		<p>Q13, R7, R9</p>

<p>12 Upper slopes, rocky hills</p> <p>Potential mallee fowl habitat</p>	<p>Q15: <i>Eucalyptus griffithsii</i> low open woodland over <i>Eremophila oldfieldii</i> subsp. <i>angustifolia</i>, <i>E. scoparia</i>, <i>Exocarpos aphyllus</i> tall sparse shrubland over <i>Dodonaea lobulata</i>, <i>Eremophila scoparia</i>, <i>E. oldfieldii</i> subsp. <i>angustifolia</i>, <i>Senna artemisioides</i> subsp. <i>filifolia</i> open shrubland over <i>Acacia erinacea</i>, <i>Dodonaea lobulata</i>, <i>Senna artemisioides</i> subsp. <i>filifolia</i>, <i>Ptilotus obovatus</i>, <i>Atriplex vesicaria</i> low sparse shrubland</p> <p>Q3: <i>Eucalyptus griffithsii</i> low woodland over <i>Eremophila interstans</i> subsp. <i>virgata</i>, <i>Senna artemisioides</i> subsp. <i>filifolia</i>, <i>Eremophila decipiens</i>, <i>Dodonaea lobulata</i> open shrubland over <i>Senna artemisioides</i> subsp. <i>filifolia</i>, <i>Scaevola spinescens</i>, <i>Dodonaea lobulata</i>, <i>Olearia muelleri</i>, <i>Acacia tetragonophylla</i>, <i>A. erinacea</i> low sparse shrubland</p> <p>Q10: <i>Eucalyptus griffithsii</i> mallee woodland over <i>Eremophila interstans</i> subsp. <i>interstans</i>, <i>Dodonaea lobulata</i> tall sparse shrubland over <i>Senna artemisioides</i> subsp. <i>filifolia</i>, <i>Acacia erinacea</i>, <i>Dodonaea lobulata</i>, <i>Dodonaea stenozyga</i>, <i>Eremophila interstans</i> subsp. <i>interstans</i> open shrubland over <i>Westringia rigida</i>, <i>Lycium australe</i>, <i>Acacia erinacea</i>, <i>Olearia muelleri</i>, <i>Dodonaea stenozyga</i> low open shrubland</p> <p>R6: <i>Eucalyptus griffithsii</i> isolated trees over <i>Eremophila decipiens</i> subsp. <i>decipiens</i>, <i>E. interstans</i> subsp. <i>interstans</i>, <i>Acacia burkittii</i> tall sparse shrubland over <i>Eremophila scoparia</i>, <i>E. decipiens</i> subsp. <i>decipiens</i>, <i>Senna artemisioides</i> subsp. <i>filifolia</i>, <i>Atriplex nummularia</i> subsp. <i>spathulata</i> sparse shrubland over <i>Senna artemisioides</i> subsp. <i>filifolia</i>, <i>Atriplex nummularia</i> subsp. <i>spathulata</i>, <i>Eremophila glabra</i> subsp. <i>glabra</i>, <i>Dodonaea lobulata</i>, <i>Eremophila scoparia</i>, <i>E. decipiens</i> open shrubland over <i>Senna artemisioides</i> subsp. <i>filifolia</i>, <i>Atriplex vesicaria</i>, <i>Ptilotus obovatus</i>, <i>Dodonaea lobulata</i> and <i>Eremophila</i> species low sparse shrubland. Other species: <i>Scaevola spinescens</i>, <i>Olearia muelleri</i>, <i>Rhagodia drummondii</i></p>		<p>Q3, Q15, Q10, R6</p>
<p>13 Semi mature regrowth on lower mid slope; drainage line</p>	<p>R10: <i>Casuarina pauper</i> isolated low trees over <i>Eremophila oldfieldii</i> subsp. <i>angustifolia</i>, <i>E. scoparia</i>, <i>Dodonaea lobulata</i>, <i>Acacia hemiteles</i>, <i>A. burkittii</i>, <i>Eucalyptus griffithsii</i> tall shrubland over <i>Casuarina pauper</i>, <i>Eremophila scoparia</i>, <i>E. glabra</i> subsp. <i>glabra</i>, <i>Atriplex nummularia</i>, <i>Acacia hemiteles</i>, <i>Dodonaea lobulata</i>, <i>D. adenophora</i> open shrubland over <i>Olearia muelleri</i>, <i>Atriplex</i> spp., <i>Acacia hemiteles</i> low open shrubland</p>		<p>R10</p>

<p>14 Upper slopes, rocky hills</p> <p>Suitable mallee fowl habitat</p>	<p><i>Eucalyptus torquata</i> woodlands with areas of <i>Eremophila</i> spp. tall open shrubland</p> <p>Q8: <i>Eucalyptus torquata</i>, <i>E. griffithsii</i> low open forest over <i>Eremophila oldfieldii</i> subsp. <i>angustifolia</i>, <i>Dodonaea lobulata</i>, <i>Eremophila interstans</i> subsp. <i>interstans</i>, <i>E. glabra</i> subsp. <i>glabra</i> sparse shrubland to tall sparse shrubland over <i>Dodonaea stenozyga</i>, <i>Eremophila oldfieldii</i> subsp. <i>angustifolia</i>, <i>Scaevola spinescens</i>, <i>E. glabra</i> subsp. <i>glabra</i> sparse shrubland over <i>Ptilotus obovatus</i>, <i>Dodonaea stenozyga</i>, <i>Olearia muelleri</i>, <i>Senna artemisioides</i> subsp. <i>filifolia</i> low sparse shrubland</p> <p>Q7: <i>Eremophila oldfieldii</i> subsp. <i>angustifolia</i>, <i>Santalum spicatum</i> tall open shrubland over <i>Dodonaea lobulata</i>, <i>Eremophila oldfieldii</i> subsp. <i>angustifolia</i>, <i>Eremophila glabra</i> subsp. <i>glabra</i>, <i>Senna artemisioides</i> subsp. <i>filifolia</i> sparse shrubland over low isolated shrubs</p> <p>R 11/ 12: <i>Eucalyptus torquata</i> woodland over <i>Eremophila oldfieldii</i> subsp. <i>angustifolia</i>, <i>Santalum spicatum</i>, <i>Exocarpos aphyllus</i>, <i>Acacia tetragonophylla</i> tall open shrubland over <i>Eremophila scoparia</i>, <i>Dodonaea lobulata</i>, <i>D. stenozyga</i>, <i>Scaevola spinescens</i>, <i>Eremophila glabra</i> subsp. <i>glabra</i>, <i>Atriplex nummularia</i> subsp. <i>spathulata</i>, <i>Grevillea acuaria</i> shrubland over <i>Ptilotus obovatus</i>, <i>Senna artemisioides</i> subsp. <i>filifolia</i>, <i>Olearia muelleri</i>, <i>Grevillea acuaria</i>, <i>Dodonaea stenozyga</i>, <i>Acacia erinacea</i> low open shrubland</p> <p>Other species: <i>Dodonaea adenophora</i> on midslopes</p>		<p>Q8 (image), Q7, R11, R12</p>
<p>15 Lower slopes and plain</p>	<p>Q6 <i>Eucalyptus griffithsii</i>, <i>E. celastroides</i> subsp. <i>celastroides</i> mallee woodland over <i>Acacia densiflora</i> isolated tall shrubs over <i>Santalum spicatum</i>, <i>Exocarpos aphyllus</i>, <i>Acacia hemiteles</i>, <i>A. densiflora</i>, <i>Allocasuarina helmsii</i> isolated shrubs to sparse shrubland over <i>Westringia rigida</i>, <i>Dodonaea stenozyga</i>, <i>Acacia densiflora</i>, <i>Eremophila parvifolia</i> subsp. <i>auricampa</i> sparse shrubland to low sparse shrubland over <i>Triodia scariosa</i> open tussock grassland</p> <p>Q4: <i>Eucalyptus torquata</i>, <i>E. griffithsii</i> low open forest over <i>Dodonaea lobulata</i> and <i>Atriplex nummularia</i> subsp. <i>spathulata</i>, <i>Allocasuarina helmsii</i>, <i>Stenanthemum stipulosum</i> open shrubland over <i>Dodonaea lobulata</i>, <i>Westringia rigida</i>, <i>Atriplex nummularia</i> subsp. <i>spathulata</i>, <i>Senna artemisioides</i> subsp. <i>filifolia</i>, <i>Stenanthemum stipulosum</i> low sparse shrubland over <i>Triodia scariosa</i> low sparse tussock grassland</p> <p>R3: <i>Allocasuarina helmsii</i>, <i>Santalum spicatum</i>, <i>Eremophila interstans</i> subsp. <i>interstans</i>, <i>Bertya dimerostigma</i>, <i>Acacia burkittii</i> tall open shrubland over <i>Senna artemisioides</i> subsp. <i>filifolia</i>, <i>Allocasuarina helmsii</i>, <i>Bertya dimerostigma</i>, <i>Eremophila scoparia</i>, <i>Acacia hemiteles</i> and <i>Stenanthemum stipulosum</i> open shrubland over <i>Triodia scariosa</i>, <i>Westringia rigida</i>, <i>Sclerolaena fusiformis</i> and <i>Senna artemisioides</i> subsp. <i>filifolia</i> low sparse shrubland over <i>Asteridea anthraxioides</i> and <i>Carrichtera annua</i>* sparse forbland</p>		<p>Q6 (image), Q4 R3 – close to boundary with Veg 8</p>

4.3 Fauna results

4.3.1 Vertebrate Fauna

Site descriptions for fauna assessments were taken at the vegetation monitoring sites. Individual habitat trees were not recorded due to the size of the study area; however large trees with hollows were noted. The main areas where these are present are within the Salmon gum vegetation type (VT9), occasional large trees within VT 7 – broad drainage line, particularly the south western end; VT12 – large *Eucalyptus griffithsii* on ridges, often occurring as isolated trees. Much of the woodland area supported trees with smaller trunks and branches, or smaller mallee with very small holes. No species of conservation significance (CS) were recorded during the survey. Two species of birds of CS were recorded during the Phoenix survey in November 2013 – Fork-tailed swift and the Western Rosella, neither of which were observed during the survey. Fork –tailed swifts are recorded as arriving in Northern Australia in early October and likely arrive in southern areas of Australia in late October to November. No recent signs were observed of the mallee fowl; however three extinct mounds were located in the area. (Figure 10)

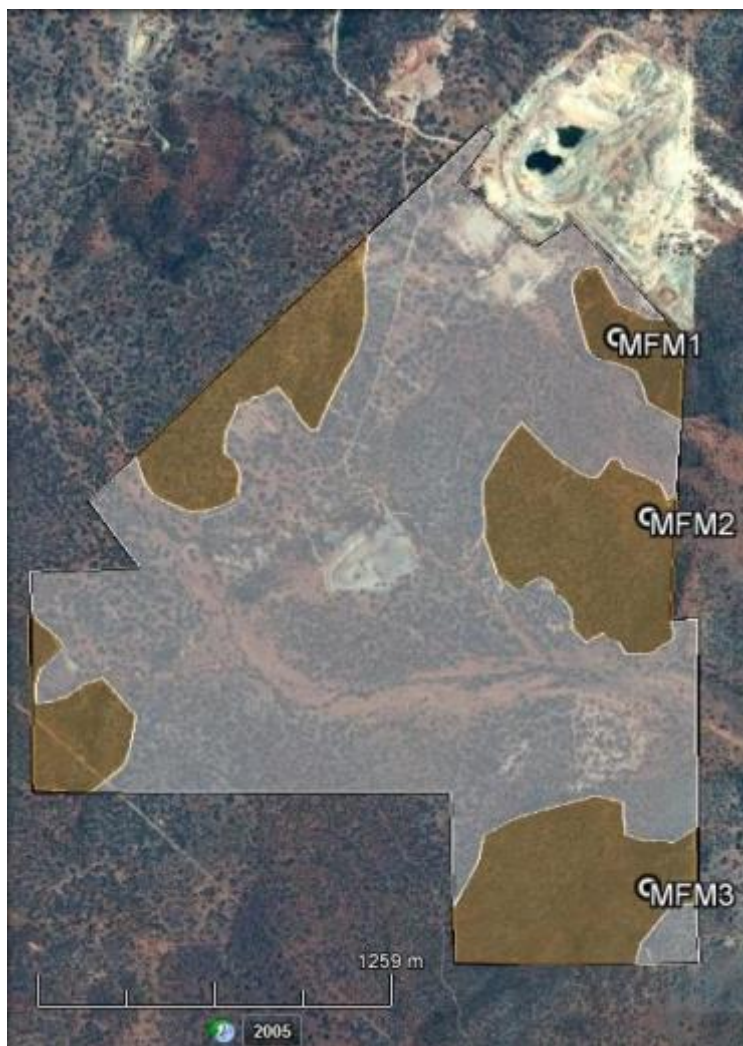


Figure 10: Potential mallee fowl habitat – medium to high (brown); low – white. Locations of the three identifiable mounds are marked.

Potential mallee fowl habitat has been mapped according to vegetation type and condition, with areas having an intact tall shrubland layer present, within open woodlands or with isolated trees being the most likely. Moderate to high levels of disturbances in much of the area would result in habitat unlikely to be suitable. Further details of the mounds are presented in Appendix 7.

Suitable habitat for the south-western carpet python (*Morelia imbricata*) includes woodlands which provide hollow bearing trees for shelter. Due to long term historic disturbances for pastoral and mining activities (using logs for firewood; timber removal for fence posts and/or mining structures) has resulted in low occurrences of hollow logs and old trees with hollows which would provide shelter. There was more fallen timber and larger trees on some of the ridges and low hills, particularly in the south eastern area (vicinity of MFM3). A few large trees with

hollows were present within the Salmon gum woodland and within the broad drainage line at the southern end (Vegetation type 7), but these are not likely to be suitable for the carpet python. The area within which MFM1 occurs also had fallen timber with hollows which could provide habitat for the south-western carpet python.

4.3.2 Short Range Endemic Invertebrate Fauna

A desktop survey was undertaken for the potential of SRE invertebrates to occur within the proposal. As mentioned in Section 2.5.2 where there is a lack of SRE survey data other indicators can be looked at to determine the potential of SRE occurring such as vegetation type. Vegetation mapping from the survey resulted in fifteen vegetation types (VT) being described (Figure 8), with types 12 and 14 being the least impacted and most likely to support populations of SRE invertebrates. VT 11 was recorded in the west of the proposal, with some occurrences on rocky substrate, however most of the area had moderate to high levels of disturbance.

Table 7: Vegetation types which may provide habitat for SRE fauna

Vegetation type	Description
11	<i>Eucalyptus campaspe</i> , <i>E. clelandii</i> , <i>E. celastroides</i> low woodland to open woodland over <i>Eremophila</i> spp., <i>Exocarpos aphyllus</i> , <i>Senna artemisioides</i> , <i>Santalum acuminatum</i> tall open shrubland
12	<i>Eucalyptus griffithsii</i> low open woodland to isolated trees over <i>Eremophila oldfieldii</i> subsp. <i>angustifolia</i> , <i>E. decipiens</i> , <i>E. interstans</i> , <i>Exocarpos aphyllus</i> tall sparse shrubland to open shrubland over <i>Acacia erinacea</i> , <i>Dodonaea lobulata</i> , <i>Acacia tetragonophylla</i> open shrubland
14	<i>Eucalyptus torquata</i> , <i>E. griffithsii</i> low open forest over <i>Eremophila oldfieldii</i> subsp. <i>angustifolia</i> , <i>Santalum spicatum</i> tall open shrubland over <i>Dodonaea</i> and <i>Eremophila</i> spp., <i>Grevillea acuaria</i> open shrubland; areas of <i>Eremophila</i> tall shrubland

The proposal is located on undulating plains and low hills in an area that has moderate to high levels of historic impact through mining and pastoral activities. No caves are present within the area, although there are abandoned shafts which may provide a similar environment. Ephemeral drainage lines are present; however there are no water bodies, such as might be associated with springs, or deep depressions other than the mine pit and areas from which gravel/ overburden has been removed in the south west of the area which may provide short term ponding.

Results of SRE Survey at Koolyanobbing

Biota Environmental Sciences (BES, 2012) undertook an SRE study at the south end of the Koolyanobbing Range which is located 160 west of the proposal. The SRE survey was carried out on *Acacia quadrimarginea* thicket on BIF ranges and surrounding *Eucalyptus* woodland areas (Medium woodland: wandoo, salmon gum, Morrel, gimlet and *Eucalyptus* sp.). Twenty one putative taxa from groups known to support SRE, including one land snail, five millipedes and approximately fifteen mygalomorphs (spiders). Of the 21 taxa three were not considered SRE, and the SRE status of the remaining taxa could not be established due to insufficient contextual information. Most were collected from debris at the base of large *Eucalyptus* trees and beneath large rocks in sheltered areas.

BES (2012) found most of the invertebrates in areas with deep litter. Few areas of deep litter are present within the proposal due to the extent of disturbances (including current impacts from goats and rabbits). A few areas near the summits of the low hills in the south (VT 12 & 14) of the proposal do have higher amounts of litter and fallen timber which could provide suitable habitat for a range of invertebrates. Few large/ old trees or mallee are present within the proposal, with the exception of the southern drainage line, the salmon gum woodland area and on the summits of the hills, particularly the southern area. The salmon gum woodland has been moderately to heavily impacted so the likelihood of it supporting SRE is low. Rocky areas are present within VTs 11 (minor areas), 12 and 14.

Eucalyptus campaspe (Silver Gimlet; VT 11) and *E. torquata* (Coral Gum; VT 14) woodlands were recorded within the proposal. Both species have a recorded range of approximately 300 km x 100 km (30,000 km²). They are not considered under threat; however they occur in an area which has historic and ongoing threats from mining and pastoral activities which may have impacted on the invertebrate fauna which may inhabit these woodland areas specifically, although whether there are targeted studies within these woodland types is unclear.

A desktop invertebrate study was undertaken for Phoenix Gold Ltd at the Kintore Prospect, located 41 km north of Coolgardie (~ 45 km north of the proposal) (Harewood 2013). Some areas of *Eucalyptus campaspe* woodland were present within the survey area. The Clearing Permit Decision Report (DMP 2014) states that the invertebrate survey reported that the presence of SRE fauna was considered unlikely, and that the vegetation communities were well represented outside the disturbance area.

A number of surveys have been undertaken within *E. torquata* woodlands but there appears to be little information specifically regarding SRE presence.

Conclusion

Vegetation types mapped as occurring within the proposal are well represented in the region. The condition of habitat within the proposal has varying levels of historic disturbances which may reduce the presence of suitable habitat for SRE fauna. The landforms present within the proposal are unlikely to provide habitat for SRE fauna. The least disturbed areas with vegetation of the most restricted type (*E. torquata* woodland) occur on low hills at the south eastern end of the proposal. *E. torquata* has a range of approximately 30,000 km², and it is also unlikely that invertebrate fauna associated with this species are likely to be SRE. The *E. campaspe* woodlands have moderate to high levels of disturbance and are unlikely to support SRE fauna. In concluding, the potential occurrence of SRE's in the proposed disturbance area of the Coolgardie Project (McPherson's Reward) is deemed highly unlikely based on the terrain, geomorphology, surface drainage, vegetation assemblages and previous surveys in the broader area.

5. Proposed works

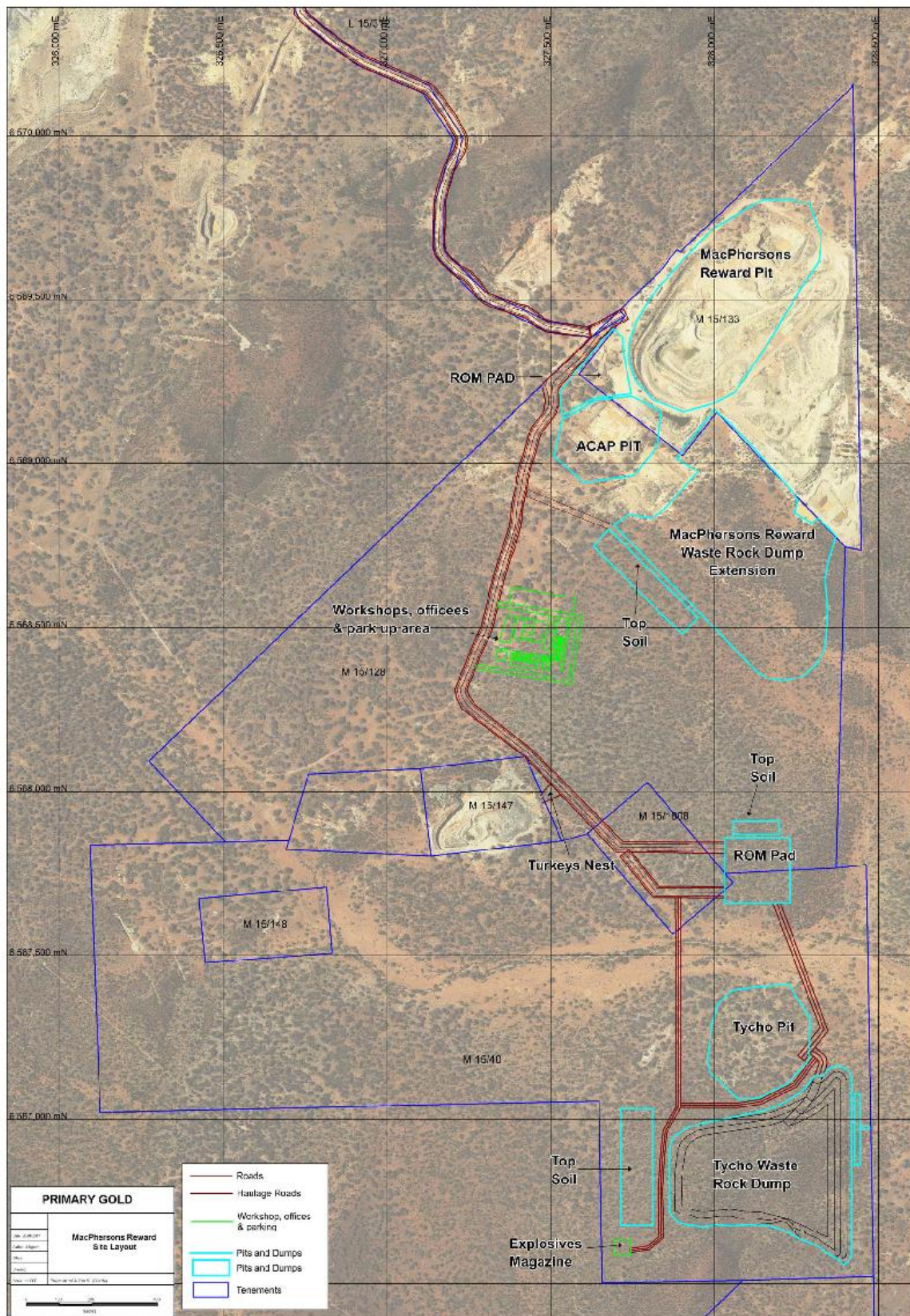
Primary has designed the proposed site layout following preliminary results of the surveys (Figure 11; Primary April 2007). The existing MacPhersons Reward (MR) pit will remain the same with the ACAP Pit being extended to the south. The MR waste rock dump (WRD) extension will be located south east of the pits within Vegetation types 7, 8 and 16 and includes part of the northern drainage line. Flow into this system has already been interrupted through historic mining activity, and a significant amount of runoff is captured within the existing ACAP pit and WRD. Top soil will be stockpiled south of the WRD.

The workshops, offices and park up area are to be located south of the pits in an area which has a high level of disturbance, particularly within Vegetation type 10 – *Eucalyptus campaspe* low woodlands. The access road will be upgraded basically following the existing track, with the exception of the area near M15/147, where a new track will be established through existing vegetation. The existing track in this area follows the drainage line which has caused some erosion, and relocating the track to the north will decrease the level of disturbance to the drainage system in this area. Access to the proposed Tycho ROM pad will be established from the new track in M 15/1808, as well as from the proposed Tycho Pit, located south of the main drainage line. Two access routes will be established across the ephemeral drainage line to access the Tycho mining area and will be designed based on surface water modelling to minimally impact on flow.

The Tycho pit will be located within moderately disturbed woodland areas, and the associated Tycho WRD will be located on the mid slopes south of the Pit. The design of the WRD will avoid many of larger trees which are likely to be important fauna habitat along the ridge. Topsoil from the Tycho disturbances will be stockpiled west of the WRD.

No mallee fowl activity was noted in the proposal areas during the survey in 2016, and these areas will need to be checked prior to the commencement of works.

Figure 11: MacPhersons Reward site layout (Primary April 2017)



6. Assessment against the 10 Clearing Principles

Table 8: Assessment against the clearing principles

Clearing Principle		Comment
1	Native vegetation should not be cleared if it comprises a high level of biological diversity.	<p>Proposal is unlikely to be at variance with this principle</p> <p>The study area is located within a moderately disturbed landscape, the vegetation of which is representative of widespread communities. Diversity was very low in groundcover species, which may be a result of climate, impact from grazers (current & historic; native and introduced), and land surface erosion in some areas. A total of seventy five native taxa were recorded from the survey area from twenty families and thirty one genera. Over 50 % of taxa were recorded from four families – Chenopodiaceae (12), Scrophulariaceae (11), Fabaceae (9) and Myrtaceae (8). Much of the woodland areas were young growth (i.e. not old growth) with a lack of nesting holes.</p>
2	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.	<p>Proposal is unlikely to be at variance with this principle</p> <p>The vegetation in the study area is representative of widespread communities and is not considered to represent the whole part, or be necessary for the maintenance of a significant habitat for conservation of significant fauna species.</p> <p>The area once supported mallee fowl, but no recent activity was found of this species. Two of the three mounds located are extinct, with profile 6; while the third is also likely to be extinct, but has held some shape due to the amount of rock in the mound.</p> <p>The rainbow bee-eater has been recorded in the area (Phoenix 2014), however it is unlikely that suitable habitat is present for nesting (creek banks in sandy loam), but the area is used for foraging.</p> <p>An assessment of the site for SRE invertebrate fauna habitat finds that there is a low likelihood of habitat necessary for the maintenance of the SRE fauna occurring within the disturbance area.</p>
3	Native vegetation should not be cleared if it includes, or is necessary, for the continued existence of rare flora	<p>Proposal is unlikely to be at variance with this principle</p> <p>No rare flora were recorded from the study area, and the vegetation is representative of communities mapped by Beard (1975) of which in excess of 99% of the pre-European extent remains (Coolgardie 9). A priority taxon – <i>Eremophila praecox</i> (P1) – was recorded > 2km east of the area; however this taxon was not recorded within the McPhersons area. Disturbance to vegetation within McPhersons is unlikely to have any impact on this population.</p>

Clearing Principle		Comment
4	Native vegetation should not be cleared if it compromises the whole or part of, or is necessary for the maintenance of a threatened ecological community	<p>Proposal is unlikely to be at variance with this principle</p> <p>No threatened communities are located within or near the proposal.</p>
5	Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.	<p>Proposal is unlikely to be at variance with this principle</p> <p>The proposal is located within vegetation communities of which > 99% remains of the pre-European extent. Condition of the vegetation is variable, but there are some areas which have been less impacted and are in better condition. There is a low level of fragmentation in the area, with most vegetation areas continuous within the landscape.</p>
6	Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.	<p>Proposal is unlikely to be at variance with this principle</p> <p>A defined watercourse runs west – east through the southern part of the proposal, with another smaller watercourse present south of MacPhersons Reward (MR) pit. Both watercourses have a high level of disturbance through historical pastoral and mining activities, with active erosion and sedimentation processes present. A defined creek channel, with vegetation, which follows part of the current access track, drains into the southern broad channel. All drainage lines are ephemeral and unlikely to hold water for long periods of time. No vegetation is representative of any listed watercourse or wetland of sub-bioregional importance.</p> <p>MR waste rock dump is proposed to be located over the northern drainage line. Drainage into this system has already been compromised through historic mining activities. The proposal will impact on approximately 600 metres of the watercourse and a surface water assessment by Primary has highlighted that a diversion structure is required to divert runoff and discharge from the disturbed catchment area above the MR waste rock dump into the local system further to the south of the MR waste rock dump.</p> <p>Due to the moderate to high levels of disturbance already existing within the watercourses within the site, it is unlikely that the proposal will be at variance with this principle.</p>
7	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.	<p>Proposal is unlikely to be at variance with this principle</p> <p>There are no conservation areas nearby.</p>

Clearing Principle		Comment
8	Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation	<p>Proposal is unlikely to be at variance with this principle</p> <p>Much of the area between the main pit and the southern drainage line currently has moderate to high levels of disturbances. The gradient of this area is mostly gentle, which, with careful management and appropriate conservation earthworks, is unlikely to exacerbate vegetation condition outside the area of disturbance further.</p> <p>The low hills (vegetation types 11, 12 & 14) have moderate slopes which may erode without appropriate management. Disturbance from goats and rabbits may further contribute to land surface instability and some control measures may be required. Provided Primary adopt a progressive approach to land clearing and rehabilitation the proposal is unlikely to cause appreciable land degradation at a localised scale.</p>
9	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.	<p>Proposal is unlikely to be at variance with this principle</p> <p>The drainage lines are ephemeral and only flow intermittently. A high level of disturbance already exists in these areas and further clearing may cause further erosion and sedimentation resulting in deterioration in water quality. Avoiding the main channel areas would be advised to minimize impacts on quality of surface water during those periods when flows occur. Leaving vegetation intact along drainage channel edges would also be advised.</p> <p>Minimal impact to groundwater will occur as hydrological work commissioned by Primary has demonstrated the project area is underlain by tightly defined and spatially confined fractured rock aquifers.</p>
10	Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence of flooding.	<p>Proposal is unlikely to be at variance with this principle</p> <p>Clearing and the positioning of mining features has taken into consideration the potential for flooding associated with the project via a surface water assessment. This assessment has also determined the design of earthworks and water management to minimise the effect of flooding in areas within proximity of the project.</p>

7. Discussion and summary

Vegetation present within the study area was dominated by woodlands or mallee woodlands with occasional areas of tall shrubland. The dominant *Eucalyptus* species included *Eucalyptus griffithsii*, *E. clelandii*, *E. torquata*, *E. campaspe*, *E. celastroides* subsp. *celastroides* and *E. longissima* with a minor occurrence of *E. salmonophloia* and *E. horistes*. The understorey was dominated by *Eremophila* spp., *Atriplex nummularia*, *A. vesicaria*, *Maireana* spp., *Westringia rigida*, *Olearia muelleri*, *Senna artemisioides* subsp. *filifolia* and *Dodonaea lobulata* with less common occurrences of *Acacia* spp., *Allocasuarina helmsii*, *Santalum spicatum*, *Scaevola spinescens* and *Ptilotus obovatus*. The least common species included *Eremophila gibbosa*, *Triodia scariosa*, *Vittadinia eremaea*, *Acacia densiflora* and *Pimelea microcephala*. No threatened or priority flora were recorded. *Santalum spicatum* (registered) was recorded from a few areas. No vegetation types representative of threatened or priority communities were present.

Condition of the site ranged from completely degraded to excellent, with most areas in the range good to very good. The main disturbances were from historic mining and pastoral activities, with current threats from rabbits and goats (grazing – removal of annuals and grasses, and impacting on recruitment of mid and upper storey taxa; land surface disturbances resulting in erosion), and mining. These impacts have resulted in an absence of logs and other fallen timber in much of the area which may have provided habitat for fauna such as the south western carpet python. Long term disturbances have resulted in the absence of mallee fowl, for which there is evidence (extinct mounds) that they did once inhabit the area. The introduction of the European fox and possibly wild dogs and feral cats would have had a major impact on their population. No conservation listed fauna were recorded. *Apus pacificus* (Fork-tailed Swift), a migratory bird listed under international agreements, was recorded by Phoenix (Clark & Wells 2014) in November 2013 to the east of the site. It is known to breed in Siberia, the Himalayas and Japan, arriving in NW Australia in early October and can be found in a range of habitats, including open country, from semi deserts to forests. This survey was undertaken in mid-October and the birds may not have arrived in the area at this time.

The occurrence of weeds was very sparse with *Carrichtera annua** being the most common. *Nicotiana glauca** (Tree tobacco) occurred in areas which will not be impacted during the planned mining activities. *Medicago minima** was found in Vegetation type 10: *Eucalyptus campaspe* woodland – mostly in heavily disturbed areas just to the north of the proposed workshop and offices (Figure 11).

Disturbances to the land surface have resulted in erosion and deposition, particularly within the broad drainage channels, and within the *Eucalyptus campaspe* low woodland area along the main access track south of MacPhersons Reward pit. An area within Bakers prospect in the south west has had significant mining impacts, with numerous shafts, and excavations and large areas of clearing. No works will be undertaken in this area under the current plan.

Planned works will mostly avoid areas supporting large trees which were recorded mainly within the southern drainage line and on the crests of low hills. Impacts to drainage will mostly be within the northern drainage line which already has moderate to high levels of impact through historic mining and pastoral activities.

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Appendix 1: Vascular plants recorded from the survey

Family	Scientific Name		
Amaranthaceae	<i>Ptilotus chamaecladus</i>		
	<i>Ptilotus holosericeus</i>		
	<i>Ptilotus obovatus</i>		
	<i>Ptilotus</i> sp. Goldfields (formerly <i>P. nobilis</i>)		
Apocynaceae	<i>Rhyncharrhena linearis</i>		
Asparagaceae	<i>Thysanotus patersonii</i>		
Asteraceae	<i>Asteridea anthrxioides</i>		
	<i>Cratystylis conocephala</i>		
	<i>Leiocarpa semicalva</i>		
	<i>Olearia muelleri</i>		
	<i>Vittadinia eremaea</i>		
	<i>Waitzia fitzgibbonii</i>		
Brassicaceae	<i>Carrichtera annua</i> *	Alien	
Casuarinaceae	<i>Allocasuarina helmsii</i>		
	<i>Casuarina pauper</i>		
Chenopodiaceae	<i>Atriplex nummularia</i> subsp. <i>spathulata</i>		
	<i>Atriplex vesicaria</i>		
	<i>Dissocarpus paradoxus</i>		
	<i>Enchylaena tomentosa</i> var. <i>tomentosa</i>		
	<i>Maireana georgei</i>		
	<i>Maireana pentatropis</i>		
	<i>Maireana sedifolia</i>		
	<i>Maireana tomentosa</i> subsp. <i>tomentosa</i>		
	<i>Maireana trichoptera</i>		
	<i>Rhagodia drummondii</i>		
	<i>Sclerolaena fusiformis</i>		
	<i>Sclerolaena</i> sp.		
	Cupressaceae	<i>Exocarpos aphyllus</i>	
	Euphorbiaceae	<i>Bertya dimerostigma</i>	
Fabaceae	<i>Acacia burkittii</i>		
	<i>Acacia calcarata</i>		
	<i>Acacia densiflora</i>		
	<i>Acacia erinacea</i>		
	<i>Acacia hemiteles</i>		
	<i>Acacia tetragonophylla</i>		
	<i>Medicago minima</i> *	Alien	
	<i>Senna artemisioides</i> subsp. <i>filifolia</i>		
	<i>Senna cardiosperma</i>		
	<i>Senna stowardii</i>		
Goodeniaceae	<i>Scaevola spinescens</i>		
Lamiaceae	<i>Westringia rigida</i>		

Family	Scientific Name	
Myrtaceae	<i>Eucalyptus campaspe</i>	
	<i>Eucalyptus celastroides</i> subsp. <i>celastroides</i>	
	<i>Eucalyptus clelandii</i>	
	<i>Eucalyptus griffithsii</i>	
	<i>Eucalyptus horistes</i>	
	<i>Eucalyptus longissima</i>	
	<i>Eucalyptus salmonophloia</i>	
	<i>Eucalyptus torquata</i>	
	Poaceae	<i>Austrostipa elegantissima</i>
<i>Austrostipa eremophila</i>		
<i>Austrostipa puberula</i>		
<i>Austrostipa scabra</i>		
<i>Austrostipa trichophylla</i>		
<i>Triodia scariosa</i>		
Proteaceae	<i>Grevillea acuaria</i>	
Rhamnaceae	<i>Stenanthemum stipulosum</i>	
Santalaceae	<i>Santalum acuminatum</i>	
	<i>Santalum spicatum</i>	
Sapindaceae	<i>Dodonaea adenophora</i>	
	<i>Dodonaea lobulata</i>	
	<i>Dodonaea stenozyga</i>	
Scrophulariaceae	<i>Eremophila alternifolia</i>	
	<i>Eremophila decipiens</i> subsp. <i>decipiens</i>	
	<i>Eremophila georgei</i>	
	<i>Eremophila gibbosa</i>	
	<i>Eremophila glabra</i> subsp. <i>glabra</i>	
	<i>Eremophila interstans</i> subsp. <i>interstans</i>	
	<i>Eremophila interstans</i> subsp. <i>virgata</i>	
	<i>Eremophila oldfieldii</i> subsp. <i>angustifolia</i>	
	<i>Eremophila oppositifolia</i> subsp. <i>alternifolia</i>	
	<i>Eremophila parviflora</i> subsp. <i>auricampa</i>	
	<i>Eremophila scoparia</i>	
Solanaceae	<i>Lycium australe</i>	
	<i>Nicotiana glauca</i> *	Alien
	<i>Solanum lasiophyllum</i>	
	<i>Solanum nummularium</i>	
Thymelaeaceae	<i>Pimelea microcephala</i> subsp. <i>microcephala</i>	

Appendix 2: Quadrat descriptions

Site: Q01	20m x 20m Quadrat	Date: 18/10/16
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GPS 51J: 327777 E/ 6568628 N Tenement: M15/128

Condition: Excellent

Landform: Undulating plain; gentle slope; southerly aspect

Land surface: yellowish red clay loam; surface rock: 20 – 30 % ironstone gravel, greenstone, quartz, mostly 1 – 2 cm ^ 8cm; litter 30 – 50 % ^ 10cm deep; fallen timber 2 – 3 %; cryptogam 5 - 10 %, lichen; bare ground 2 – 3 %; surface dry but moist at depth

Threats: mining operations; goats & rabbits

Height (m)	Habit	% cover	Species	No.
> 8	M, T	40 – 60	<i>Eucalyptus griffithsii</i>	5
2 – 8	M, T	2 – 10	<i>Eucalyptus griffithsii</i> , <i>E. longissima</i>	2
> 2	S	2 – 10	<i>Eremophila interstans</i> subsp. <i>interstans</i> (16), <i>Eremophila interstans</i> subsp. <i>virgata</i> (5)	21
1.5 – 2	S	2 – 10	<i>Acacia hemiteles</i> (8), <i>Eremophila interstans</i> subsp. <i>interstans</i> (5), <i>Senna artemisioides</i> subsp. <i>filifolia</i> (3)	16
1 – 1.5	S, C	10 – 30	<i>Senna artemisioides</i> subsp. <i>filifolia</i> (36), <i>Eremophila interstans</i> subsp. <i>interstans</i> (10), <i>Atriplex nummularia</i> subsp. <i>spathulata</i> (1), <i>Exocarpos aphyllus</i> (1)	48
0.5 – 1	S, C	2 – 10	<i>Atriplex nummularia</i> subsp. <i>spathulata</i> (6), <i>Acacia calcarata</i> (2), <i>Acacia hemiteles</i> (1), <i>Senna artemisioides</i> subsp. <i>filifolia</i> (2), <i>Eremophila interstans</i> subsp. <i>interstans</i> (3)	14
< 0.5	S, C	2 – 10	<i>Olearia muelleri</i> (33), <i>Pimelea microcephala</i> subsp. <i>microcephala</i> (1), <i>Eremophila interstans</i> (11), <i>Cratystylis conocephala</i> (2), <i>Senna artemisioides</i> subsp. <i>filifolia</i> (1), <i>Atriplex nummularia</i> subsp. <i>spathulata</i> (6), <i>Atriplex vesicaria</i> (1), <i>Solanum nummularium</i> (1)	56
	Grass	0		
	Forb	0		

Other species in area: *Lycium australe*, *Eremophila decipiens* subsp. *decipiens*, *Maireana trichoptera*, *Eucalyptus campaspe* (Silver gimlet), *Carrichtera annua**, *Austrostipa eremophila*

Vegetation type: *Eucalyptus griffithsii*, *E. longissima* open forest over *Eremophila interstans* tall sparse shrubland over *Acacia hemiteles*, *Eremophila interstans* and *Senna artemisioides* subsp. *filifolia* open shrubland over *Atriplex nummularia* subsp. *spathulata*, *Olearia muelleri* low sparse shrubland

No. of species: 14

No. stems: 162

Quadrat PG01



Fauna habitat: small hollows in trees; no logs; litter cover good under trees/ mallees

GPS 51J: 327225 E/ 6568511 N 405 m a s l Tenement: M15/128

Condition: Very good; historic clearing (timber removal; access tracks); erosion – minor; likely some loss of mid-stratum

Landform: Low hill, hillside midslope; gentle slope; aspect east

Land surface: yellowish red (5YR5/6) clay loam; surface rock: dolerite 5 – 10 %, fragments 2 – 5 cm; litter: 50 – 60 % ^ 20 cm; fallen timber 1 – 2 %; cryptogam 0; bare ground 20 – 30 %; surface slightly moist

Threats: mining, rabbits, goats

Height (m)	Habit	% cover	Species	No.
> 8	T	30 – 50	<i>Eucalyptus campaspe</i>	7
2 – 8	T	10 – 20	<i>Eucalyptus campaspe</i> (4), <i>E. celastroides</i> subsp. <i>celastroides</i> (1)	5
> 2	S	<2	<i>Eremophila interstans</i> subsp. <i>interstans</i> , <i>E. decipiens</i> subsp. <i>decipiens</i>	2
1.5 – 2	S	<1	<i>Eremophila interstans</i> subsp. <i>interstans</i>	3
1 – 1.5	S, C	<1	<i>Eremophila interstans</i> subsp. <i>interstans</i>	4
0.5 – 1	S, C	2 – 4	<i>Eremophila interstans</i> subsp. <i>interstans</i> (8), <i>Atriplex vesicaria</i> (33), <i>Atriplex nummularia</i> subsp. <i>spathulata</i> (2), <i>Maireana georgei</i> (1)	44
< 0.5	S, C	2 – 4	<i>Atriplex vesicaria</i> (91), <i>Atriplex nummularia</i> subsp. <i>spathulata</i> (1), <i>Maireana trichoptera</i> (1), <i>Lycium australe</i> (1)	93
	Grass	<1	<i>Austrostipa elegantissima</i>	
	Forb	<2	<i>Sclerolaena fusiformis</i> , <i>Ptilotus holosericeus</i>	

Other species in area: *Eucalyptus griffithsii*

Vegetation type: *Eucalyptus campaspe* low open forest over *Eremophila interstans* subsp. *interstans* isolated tall shrubs over *Atriplex vesicaria*, *Eremophila interstans* subsp. *interstans* low sparse chenopod shrubland

No. of species: 12

No. of stems: 158

Quadrat PG02



Fauna habitat: no significant hollows in trees; litter cover excellent; fallen timber is mostly small branches/ branchlets which would not provide significant cover for fauna

GPS 51J: 327068 E/ 6568504 N Elevation: 410 m a s l Tenement: M15/128

Condition: Very good; historic clearing on north side; mature regrowth; recent disturbance (access track) on eastern side (outside) with some timber pushed over

Landform: Low hill; summit; upper slope – westerly aspect

Land surface: light reddish brown clay loam; surface rock: > 60 % dolerite, greenstone, quartz; litter: 20 – 30 % ^10 cm; fallen timber 5 – 7 %; cryptogam: lichen on rocks, minor occurrence on land surface (<1 %); bare ground < 5 %; surface dry, moist at depth

Threats: mining, goats, edge effects

Height (m)	Habit	% cover	Species	No.
> 8	M	25 – 30	<i>Eucalyptus griffithsii</i>	2
2 – 8	T	<1	<i>Eucalyptus griffithsii</i> , <i>Santalum spicatum</i>	2
> 2	S	<2	<i>Eremophila interstans</i> subsp. <i>virgata</i> , <i>E. decipiens</i> subsp. <i>decipiens</i>	2
1.5 – 2	S	20 – 30	<i>Senna artemisioides</i> subsp. <i>filifolia</i> (32), <i>Eremophila decipiens</i> subsp. <i>decipiens</i> (1), <i>Dodonaea lobulata</i> (5), <i>Atriplex nummularia</i> subsp. <i>spathulata</i> (2), <i>Scaevola spinescens</i> (1), <i>Acacia erinacea</i> (1)	43
1 – 1.5	S, C	10 – 20	<i>Dodonaea lobulata</i> (7), <i>Senna artemisioides</i> subsp. <i>filifolia</i> (9), <i>Acacia tetragonophylla</i> (2), <i>Atriplex nummularia</i> subsp. <i>spathulata</i> (2), <i>Acacia erinacea</i> (2)	22
0.5 – 1	S, C	5 – 10	<i>Senna artemisioides</i> subsp. <i>filifolia</i> (18), <i>Scaevola spinescens</i> (8), <i>Dodonaea lobulata</i> (6), <i>Maireana trichoptera</i> (3), <i>Atriplex vesicaria</i> (2), <i>Olearia muelleri</i> (2), <i>Acacia erinacea</i> (1), <i>Acacia tetragonophylla</i> (3)	43
< 0.5	S, C	2 – 5	<i>Ptilotus obovatus</i> (36), <i>Scaevola spinescens</i> (17), <i>Senna artemisioides</i> subsp. <i>filifolia</i> (45), <i>Dodonaea lobulata</i> (9), <i>Eremophila decipiens</i> (2), <i>Olearia muelleri</i> (8), <i>Acacia tetragonophylla</i> (4), <i>A. erinacea</i> (4), <i>Atriplex vesicaria</i> (2), <i>Maireana pentatropis</i> (7)	135
<0.25	Grass	<1	<i>Austrostipa elegantissima</i>	
<0.2	Forb	<1	<i>Sclerolaena fusiformis</i> , <i>Carrichtera annua</i> *	

Other species in area:

Vegetation type: *Eucalyptus griffithsii* low woodland over *Senna artemisioides* subsp. *filifolia*, *Eremophila decipiens* subsp. *decipiens*, *Dodonaea lobulata* open shrubland over *Senna artemisioides* subsp. *filifolia*, *Scaevola spinescens*, *Dodonaea lobulata* and *Acacia tetragonophylla* low sparse shrubland

No. of species: 17 (includes 1 alien)

No. of stems: 249

Quadrat 03



Fauna habitat: several small shelter areas available for small reptiles with significant cover of small to medium branches and rocks. There are potentially some areas which could provide shelter for carpet pythons in the area. A few small nesting holes are present in the trees in the area. There are significant areas of tall shrubland to open shrubland which were used by small birds. A tree had been pushed over/ fallen over recently adjacent to the access track. It had no hollows.

GPS 51J: 328298 E/ 6568081 N Elevation: 387 Tenement: M15/128

Condition: Excellent; signs of rabbits in adjacent area; goat tracks adjacent areas; extinct mallee fowl mound (328294/ 6568092)

Landform: Plain; gentle slope; aspect east; drainage line just to north; mid catchment

Land surface: reddish brown (2.5YR 4/4) clay loam; surface rock: greenstone, calcrete 30 – 40 %, fragment size (1) 3 -5 (10) cm; litter: 2 – 10 % ^ 10cm; fallen timber <2 %; cryptogam: lichen 20 – 30 %; bare ground 2 – 10 %; surface dry, moist at depth

Threats: minor erosion, goats, rabbits, mining

Height (m)	Habit	% cover	Species	No.
2 – 8	T	30 – 35	<i>Eucalyptus torquata</i> (3), <i>E. griffithsii</i> (3)	6
> 2	S	5 – 10	<i>Santalum spicatum</i> (2), <i>Acacia hemiteles</i> (1), <i>Dodoniaea lobulata</i> (1), <i>Eremophila interstans</i> subsp. <i>interstans</i> (2), <i>Allocasuarina helmsii</i> (3), <i>Acacia densiflora</i> (1)	10
1.5 – 2	S	10 – 20	<i>Dodoniaea lobulata</i> (5), <i>Atriplex nummularia</i> subsp. <i>spathulata</i> (2), <i>Acacia densiflora</i> (2)	20
1 – 1.5	S, C	2 – 10	<i>Dodoniaea lobulata</i> (12), <i>Atriplex nummularia</i> subsp. <i>spathulata</i> (3), <i>Stenanthemum stipulosum</i> (2), <i>Allocasuarina helmsii</i> (4), <i>Senna artemisioides</i> subsp. <i>filifolia</i> (1)	22
0.5 – 1	S, C	2 – 10	<i>Dodoniaea lobulata</i> (29), <i>Westringia rigida</i> (8), <i>Atriplex nummularia</i> subsp. <i>spathulata</i> (3), <i>Stenanthemum stipulosum</i> (2), <i>Senna artemisioides</i> subsp. <i>filifolia</i> (1), <i>Eremophila glabra</i> subsp. <i>glabra</i> (1)	44
< 0.5	S, C	2 – 10	<i>Westringia rigida</i> (81), <i>Dodoniaea lobulata</i> (23), <i>Eremophila glabra</i> subsp. <i>glabra</i> (2), <i>Senna artemisioides</i> subsp. <i>filifolia</i> (2), <i>Atriplex nummularia</i> subsp. <i>spathulata</i> (2), <i>Olearia muelleri</i> (1), <i>Allocasuarina helmsii</i> (1)	112
< 0.4	Grass	2 – 10	<i>Triodia scariosa</i>	
	Forb			

Other species in area: *Ptilotus obovatus*, *Waitzia fitzgononii*

Vegetation type: *Eucalyptus torquata*, *E. griffithsii* low open forest over *Dodoniaea lobulata* and *Atriplex nummularia* subsp. *spathulata* open shrubland over *Dodoniaea lobulata*, *Westringia rigida* and *Atriplex nummularia* subsp. *spathulata* low sparse shrubland over *Triodia scariosa* low sparse tussock grassland

No. of species: 15

No. stems: 214

Quadrat 4



Fauna habitat: an extinct mallee fowl mound was located just north of the quadrat. Litter and fallen timber cover was low, with no large logs providing shelter fauna such as pythons. The land surface had 30 – 40 % rock cover, most of which were 3 – 5 cm, and likely to provide minor shelter for small reptiles. Shrub cover was mostly 10 – 20 % providing habitat for small birds. There were no significant hollows in the trees/ mallee.

Numerous signs of rabbits were present in the area, with an active mound to the east of the quadrat, which may have been an extinct mallee fowl mound. Burrows (likely to be a sand monitor) were also present in the warren area, but no recent tracks were observed. Tussocks of spinifex (*Triodia* sp.) were present as a groundcover which may also provide habitat for small reptiles and mammals.

GPS 51J: 328207 E/ 6568301 N

Tenement: M15/128

Condition: Good; a lot of surface disturbance; likely historic grazing; signs of goats and kangaroos; soil maybe slightly sodic – powdery on the surface; surface sheet erosion and minor gully erosion in creekline; threats: goats, erosion, mining

Landform: Plain, gentle slope; broad drainage line; mid catchment; drainage to the east

Land surface: reddish yellow (5YR 6/8) sandy clay loam; surface rock: greenstone, dolerite, quartz, ironstone gravel, 20 – 30 %, fragment size (0.5) 2 – 3 (10) cm; litter: 2 – 10 % ^ 3cm, deeper under tree; fallen timber <1 %; cryptogam: lichen <2%; bare ground: 40 – 50 %; surface dry

Height (m)	Habit	% cover	Species	No.
2 – 8	T	3 – 4	<i>Eucalyptus griffithsii</i>	1
> 2	S	2 – 3	<i>Eremophila interstans</i> subsp. <i>interstans</i> (3), <i>Eremophila scoparia</i> (3)	6
1.5 – 2	S	<2	<i>Eremophila scoparia</i> (7), <i>Exocarpos aphyllus</i> (4), <i>Dodonaea lobulata</i> (2), <i>Atriplex nummularia</i> subsp. <i>spathulata</i> (6), <i>Eremophila interstans</i> subsp. <i>virgata</i> (1), <i>Eremophila interstans</i> subsp. <i>interstans</i> (3)	23
1 – 1.5	S, C	2 – 10	<i>Atriplex nummularia</i> subsp. <i>spathulata</i> (5), <i>Eremophila scoparia</i> (14), <i>Exocarpos aphyllus</i> (5), <i>Eremophila interstans</i> subsp. <i>interstans</i> (1), <i>Eremophila glabra</i> (4), <i>Acacia hemiteles</i> (1), <i>Lycium australe</i> (3), <i>Senna stowardii</i> (2), <i>Dodonaea lobulata</i> (1)	36
0.5 – 1	S, C	<2	<i>Senna stowardii</i> (13), <i>Atriplex nummularia</i> subsp. <i>spathulata</i> (8), <i>Lycium australe</i> (5), <i>Eremophila glabra</i> subsp. <i>glabra</i> (5), <i>Eremophila interstans</i> subsp. <i>interstans</i> (1), <i>Acacia hemiteles</i> (1), <i>Exocarpos aphyllus</i> (1), <i>Maireana georgei</i> (1)	35
< 0.5	S, C	<2	<i>Senna stowardii</i> (24), <i>Eremophila interstans</i> subsp. <i>interstans</i> (4), <i>Dodonaea lobulata</i> (3), <i>Atriplex nummularia</i> subsp. <i>spathulata</i> (7), <i>Maireana tomentosa</i> subsp. <i>tomentosa</i> (4), <i>Eremophila scoparia</i> (1), <i>Lycium australe</i> (2), <i>Olearia muelleri</i> (1)	46
<0.3	Grass	<1	<i>Austrostipa elegantissima</i>	
	Forb	<1	<i>Sclerolaena fusiformis</i> , <i>Carrichtera annua</i> *, <i>Vittadinia eremaea</i>	

Other species in area: *Eremophila gibbosa* on low stony rise within drainage channel

Vegetation type: *Eucalyptus griffithsii* isolated low trees over *Eremophila interstans* subsp. *interstans*, *E. scoparia* tall sparse shrubland over *Eremophila scoparia*, *Atriplex nummularia* subsp. *spathulata*, and *Exocarpos aphyllus* open shrubland over *Senna stowardii*, *Eremophila interstans* subsp. *interstans*, *Atriplex nummularia* subsp. *spathulata*, *Eremophila glabra* subsp. *glabra* low sparse shrubland to isolated low shrubs

No. of species: 18 (1 alien)

No. stems: 147

Quadrat 05



Fauna habitat: the level of disturbance at this site has resulted in low potential habitat for fauna such as the python or mallee fowl. Creek banks were low and actively eroding and not suitable for nesting sites for the Rainbow bee-eater. Some shelter was present under/ within the *Atriplex* shrubs and *Ptilotus* which could be used by small reptiles and birds. Small hollows were present in the trees. Numerous signs of goats and rabbits were noted in the area.

GPS 51J: 328406 E/ 6567077 N Elevation: 377 m a s l Tenement: M15/40

Condition: very good to excellent; old disturbance – old access tracks with lichen on surface, slight indentations still apparent; goats, grazing

Landform: low rise; hillside midslope, east aspect; gentle slope

Land surface: reddish yellow clay loam; surface rock: Calcrete, greenstone, quartz 25 – 30 %, fragment size <1 – 3 (8) cm; litter: 10 – 15 % ^ 4cm; fallen timber: <2 %; cryptogam: lichen 10 – 15 %; bare ground: 10 -20 %; surface dry

Threats: mining, goats

Height (m)	Habit	% cover	Species	No.
> 8	M, T	3 – 4	<i>Eucalyptus griffithsii</i>	1
2 – 8	M, T	25 – 30	<i>Eucalyptus griffithsii</i> (4), <i>E. celastroides</i> subsp. <i>celastroides</i> (2)	6
> 2	S	<1	<i>Acacia densiflora</i>	1
1.5 – 2	S	1 – 2	<i>Santalum spicatum</i> (1), <i>Exocarpos aphyllus</i> (1), <i>Acacia hemiteles</i> (1), <i>Stenanthemum stipulosum</i> (1)	4
1 – 1.5	S, C	<1	<i>Acacia densiflora</i> (1), <i>Allocasuarina helmsii</i> (1)	2
0.5 – 1	S, C	1 – 2	<i>Dodonaea stenozyga</i> (3), <i>Acacia densiflora</i> (4), <i>Westringia rigida</i> (7), <i>Stenanthemum stipulosum</i> (1), <i>Eremophila parvifolia</i> subsp. <i>auricampa</i> (4), <i>Olearia muelleri</i> (1), <i>Allocasuarina helmsii</i> (1)	21
< 0.5	S, C	5 – 10	<i>Westringia rigida</i> (127), <i>Senna artemisioides</i> subsp. <i>filifolia</i> (2), <i>Eremophila parvifolia</i> subsp. <i>auricampa</i> (2), <i>Olearia muelleri</i> (1), <i>Rhagodia drummondii</i> (1)	133
	Grass	25 – 30	<i>Triodia scariosa</i>	
	Forb	0		

Other species in area: *Austrostipa scabra*

Vegetation type: *Eucalyptus griffithsii*, *E. celastroides* subsp. *celastroides* mallee woodland over *Acacia densiflora* isolated tall shrubs over *Santalum spicatum*, *Exocarpos aphyllus*, *Acacia hemiteles*, *A. densiflora*, *Allocasuarina helmsii* isolated shrubs to sparse shrubland over *Westringia rigida*, *Dodonaea stenozyga*, *Acacia densiflora*, *Eremophila parvifolia* subsp. *auricampa* sparse shrubland to low sparse shrubland over *Triodia scariosa* open tussock grassland

No. of species: 15

No. stems: 168

Quadrat 06



Fauna habitat: Spinifex tussocks were present which provide suitable habitat for small reptiles and mammals, and perhaps for some of the ground nesting birds. Tree/ mallee stems were not large and very few nesting holes were present in the area. No significant logs were present, although there were some medium size branches which may provide some shelter to small fauna.

GPS 51J: 328302 E/ 6566767 N Elevation: 391m a s l Tenement: M15/40

Condition: Very good; old access tracks through area; possibly some historic clearing (e.g. sandalwood, timber); stable surface with high cryptogam cover; there are several young plants present, showing that recruitment is occurring

Landform: Hill; midslope; moderate gradient; northerly aspect

Land surface: reddish brown clay loam; surface rock: greenstone, dolerite, quartz, 10 – 20 %, fragment size (1) 3 – 4 (6) cm; litter: < 2 % ^ 1cm depth; fallen timber: 1 – 2%; cryptogam: 50 – 60 %, lichen; bare ground: <10 %; surface dry

Threats: mining, goats

Height (m)	Habit	% cover	Species	No.
2 – 8	T	<1	<i>Santalum spicatum</i>	1
> 2 (3 – 5)	S	15 – 20	<i>Eremophila oldfieldii</i> subsp. <i>angustifolia</i> (9), <i>Eremophila interstans</i> subsp. <i>interstans</i> (1), <i>Dodonaea lobulata</i> (3)	13
1.5 – 2	S	5 – 10	<i>Dodonaea lobulata</i> (14), <i>Eremophila oldfieldii</i> subsp. <i>angustifolia</i> (2), <i>Eremophila glabra</i> subsp. <i>glabra</i> (1), <i>Senna artemisioides</i> subsp. <i>filifolia</i> (2)	19
1 – 1.5	S, C	<2	<i>Dodonaea lobulata</i> (2), <i>Senna artemisioides</i> subsp. <i>filifolia</i> (1)	3
0.5 – 1	S, C	<1	<i>Dodonaea lobulata</i> (5)	5
< 0.5	S, C	<2	<i>Dodonaea lobulata</i> (24), <i>Eremophila oldfieldii</i> subsp. <i>angustifolia</i> (2), <i>Ptilotus obovatus</i> (2)	28
	Grass	<1	<i>Austrostipa</i> sp. (grazed)	
	Forb	<1	<i>Carrichtera annua</i> *	

Other species in area: *Atriplex nummularia* subsp. *spathulata*, *Austrostipa trichophylla*, *Eucalyptus torquata*

Vegetation type: *Eremophila oldfieldii* subsp. *angustifolia* tall open shrubland over *Dodonaea lobulata*, *Eremophila oldfieldii* subsp. *angustifolia*, *Eremophila glabra* subsp. *glabra*, *Senna artemisioides* subsp. *filifolia* sparse shrubland over low isolated shrubs

No. of species: 9 (1 alien)

No. stems: 69

Quadrat Q07



Fauna habitat: Litter and fallen timber cover was very sparse in this area. Some cover was present under some of the shrubs, but no significant logs were present. Several ant nests were present in the area. The shrubs were quite dense and had been used as nesting sites, most likely by white-browed babblers (*Pomatostomus superciliosus*). A mallee fowl mound (No. 3) was located between this quadrat and quadrat 8.

GPS 51J: 328231 E/ 6566758 N

Elevation: 401 m a s l Tenement: M15/40

Condition: Excellent; fauna tracks through area; very old vehicle access tracks, regrowth mature; litter under trees quite deep

Landform: Hill; upper slope; moderate gradient with northerly aspect

Land surface: reddish brown clay loam; surface rock: greenstone, dolerite, calcrete, 40 – 50 % cover, fragment size – gravel to boulders with exposed bedrock; litter: 25 – 30 % ^ 20cm; fallen timber: 2 – 4 %; cryptogam: 2 – 5 % cover on land surface, lichen, mostly on rocks; bare ground: 10 – 20 %; surface dry

Threats: mining, goats

Height (m)	Habit	% cover	Species	No.
2 – 8	T	35 – 40	<i>Eucalyptus torquata</i> (2), <i>E. griffithsii</i> (1)	3
> 2	S	3 – 5	<i>Eremophila oldfieldii</i> subsp. <i>angustifolia</i> (7), <i>Dodonaea lobulata</i> (1)	8
1.5 – 2	S	2 – 3	<i>Eremophila oldfieldii</i> subsp. <i>angustifolia</i> (2), <i>Dodonaea lobulata</i> (7), <i>Eremophila interstans</i> subsp. <i>interstans</i> (1), <i>E. glabra</i> subsp. <i>glabra</i> (1), <i>Stenanthemum stipulosum</i> (1), <i>Eremophila scoparia</i> (1)	13
1 – 1.5	S, C	3 – 5	<i>Dodonaea stenozyga</i> (34), <i>Eremophila oldfieldii</i> subsp. <i>angustifolia</i> , <i>Scaevola spinescens</i> (2), <i>Eremophila glabra</i> subsp. <i>glabra</i> (1)	38
0.5 – 1	S, C	4 – 6	<i>Dodonaea stenozyga</i> (35), <i>Scaevola spinescens</i> (12), <i>Eremophila glabra</i> subsp. <i>glabra</i> (4), <i>Senna artemisioides</i> subsp. <i>filifolia</i> (2), <i>Eremophila oldfieldii</i> subsp. <i>angustifolia</i> (1), <i>Olearia muelleri</i> (2), <i>Ptilotus obovatus</i> (1)	58
< 0.5	S, C	3 – 5	<i>Ptilotus obovatus</i> (26), <i>Dodonaea stenozyga</i> (14), <i>Olearia muelleri</i> (5), <i>Scaevola spinescens</i> (5), <i>Eremophila glabra</i> subsp. <i>glabra</i> (5), <i>Westringia rigida</i> (2), <i>Eremophila oldfieldii</i> subsp. <i>angustifolia</i> (1), <i>Senna artemisioides</i> subsp. <i>filifolia</i> (7), <i>Maireana sp.</i> (5), <i>Maireana georgei</i> (1)	71
	Grass	0		
	Forb	0		

Vegetation type: *Eucalyptus torquata*, *E. griffithsii* low open forest over *Eremophila oldfieldii* subsp. *angustifolia* , *Dodonaea lobulata*, *Eremophila interstans* subsp. *interstans*, *E. glabra* subsp. *glabra* sparse shrubland to tall sparse shrubland over *Dodonaea stenozyga*, *Eremophila oldfieldii* subsp. *angustifolia* , *Scaevola spinescens*, *E. glabra* subsp. *glabra* sparse shrubland over *Ptilotus obovatus*, *Dodonaea stenozyga*, *Olearia muelleri*, *Senna artemisioides* subsp. *filifolia* low sparse shrubland

No. of species: 16

No. stems: 191

Figure : Quadrat PG08



Fauna habitat: small to medium nesting holes were present in some of the larger trees in the area. Litter and fallen timber cover was much higher in this area than most other sites closer to the main pit. A mallee fowl mound which is likely to be extinct was located between here and Q7, and there is a high likelihood that other mounds are also located in the area. The foliage within the shrub strata was quite dense, and provided good cover for birds. The rocky surface, and outcropping bedrock also provide several potential habitat sites for reptiles and other fauna. Some evidence of echidnas was noted in the area (scratchings). Kangaroo resting areas were also present.

GPS 51J: 327484 E/ 6568358 N Elevation: 374 m a s l Tenement: M15/128

Condition: Very good to excellent; stable land surface with high cover of litter; some historic access tracks; likely goat grazing, but not obvious

Landform: Low rise; hillside, gentle slope, westerly aspect

Land surface: pale reddish brown clay loam; surface rock: greenstone, calcrete < 10 %, fragment size 1 – 2 cm; litter: > 70 % ^ 10 cm; fallen timber: 2 – 3 %; cryptogam: <2 %, lichen; bare ground: < 2 %; surface dry

Threats: mining, goats

Height (m)	Habit	% cover	Species	No.
> 8	T	40 – 50	<i>Eucalyptus torquata</i>	9
2 – 8				
> 2	S	2 – 3	<i>Eremophila interstans</i> subsp. <i>interstans</i>	8
1.5 – 2	S	<1	<i>Dodonaea stenozyga</i>	1
1 – 1.5	S	2 – 3	<i>Acacia erinacea</i> (4), <i>Dodonaea stenozyga</i> (4), <i>Atriplex nummularium</i> subsp. <i>spathulata</i> (1), <i>Eremophila parvifolia</i> subsp. <i>auricampa</i> (1)	10
0.5 – 1	S, C	2 – 4	<i>Acacia erinacea</i> (10), <i>Eremophila scoparia</i> (4), <i>Olearia muelleri</i> (5), <i>Acacia hemiteles</i> (2), <i>Exocarpos aphyllus</i> (1), <i>Dodonaea stenozyga</i> (4), <i>Westringia rigida</i> (3), <i>Senna artemisioides</i> subsp. <i>filifolia</i> (1), <i>Lycium australe</i> (1), <i>Maireana trichoptera</i> (1)	31
< 0.5	S, C	2 – 4	<i>Westringia rigida</i> (12), <i>Olearia muelleri</i> (23), <i>Acacia hemiteles</i> (1), <i>Acacia erinacea</i> (5), <i>Eremophila interstans</i> subsp. <i>interstans</i> (2), <i>Lycium australe</i> (7), <i>Dodonaea stenozyga</i> (1), <i>Maireana sp</i> (7), <i>Maireana trichoptera</i> (1)	59
	Grass			
	Forb			

Other species in area: *Maireana sedifolia*

Vegetation type: *Eucalyptus torquata* low open forest over *Eremophila interstans* subsp. *interstans* tall sparse shrubland over *Dodonaea stenozyga*, *Acacia erinacea*, *Atriplex nummularium* subsp. *spathulata* sparse shrubland over *Westringia rigida*, *Olearia muelleri*, *Acacia hemiteles*, *Acacia erinacea* low sparse shrubland

No. of species: 14

No. stems: 118

Quadrat 9



Fauna habitat: no significant logs were located in the area, and it is likely that many have been used as fuel for fires during historical mining activity. Litter cover was high (>70 %), and quite deep in places (^ 10 cm) which would provide habitat for small reptiles and insects. Shrub cover was low. Very few suitable nesting holes were present in the area.

GPS 51J: 327535 E/ 6568329 N Elevation: 400 m a s l Tenement: M15/128

Condition: Excellent; some wind damage, with some trees, shrubs blown over; excellent diversity in the lower strata, with a high stem count for the quadrat

Landform: Low rise; broad ridge; upper catchment, drainage east – west

Land surface: pale reddish brown clay loam; surface rock: greenstone 20 -30 %, fragment size 2 -3 cm; litter: 30 – 40 % ^20 cm; fallen timber: 8 – 10 %; cryptogam: 2 – 5 % lichen; bare ground: 5 – 10 %; surface moist, light showers

Threats: mining, goats, rabbits

Height (m)	Habit	% cover	Species	No.
> 8	M, T	20 – 25	<i>Eucalyptus griffithsii</i>	4
2 – 8	M, T	<1	<i>Eucalyptus griffithsii</i>	1
> 2	S	3 – 5	<i>Eremophila interstans</i> subsp. <i>interstans</i> (11), <i>Dodonaea lobulata</i> (1)	12
1.5 – 2	S	5 – 10	<i>Senna artemisioides</i> subsp. <i>filifolia</i> (20), <i>Dodonaea stenozyga</i> (5), <i>D. lobulata</i> (4), <i>Eremophila interstans</i> subsp. <i>interstans</i> (2), <i>Acacia hemiteles</i> (1), <i>A. tetragonophylla</i> (1)	33
1 – 1.5	S	5 – 10	<i>Acacia erinacea</i> (15), <i>Dodonaea lobulata</i> (5), <i>Lycium australe</i> (5), <i>Dodonaea stenozyga</i> (4), <i>Senna artemisioides</i> subsp. <i>filifolia</i> (1), <i>Scaevola spinescens</i> (1), <i>Eremophila interstans</i> subsp. <i>interstans</i> (2), <i>E. parvifolia</i> subsp. <i>auricampa</i> (1)	34
0.5 – 1	S, C	10 – 20	<i>Lycium australe</i> (29), <i>Acacia erinacea</i> (29), <i>Dodonaea stenozyga</i> (12), <i>Westringia rigida</i> (5), <i>Olearia muelleri</i> (4), <i>Dodonaea lobulata</i> (6), <i>Acacia hemiteles</i> (1), <i>Eremophila interstans</i> subsp. <i>interstans</i> (1), <i>Atriplex nummularia</i> subsp. <i>spathulata</i> (5), <i>A. vesicaria</i> (2)	94
< 0.5	S, C	5 – 10	<i>Westringia rigida</i> (38), <i>Lycium australe</i> (54), <i>Olearia muelleri</i> (19), <i>Atriplex nummularia</i> subsp. <i>spathulata</i> (5), <i>Acacia erinacea</i> (8), <i>Dodonaea stenozyga</i> (4), <i>D. lobulata</i> (5), <i>Atriplex vesicaria</i> (3), <i>Ptilotus obovatus</i> (1), <i>Eremophila parvifolia</i> subsp. <i>auricampa</i> (1), <i>Maireana tomentosa</i> subsp. <i>tomentosa</i> (1)	139
	Grass	<1	<i>Austrostipa eremophila</i>	
	Forb			

Other species in area: *Eremophila glabra* subsp. *glabra*, *Dissocarpus paradoxus*, *Carrichtera annua* *

Vegetation type: *Eucalyptus griffithsii* mallee woodland over *Eremophila interstans* subsp. *interstans*, *Dodonaea lobulata* tall sparse shrubland over *Senna artemisioides* subsp. *filifolia*, *Acacia erinacea*, *Dodonaea lobulata*, *Dodonaea stenozyga*, *Eremophila interstans* subsp. *interstans* open shrubland over *Westringia rigida*, *Lycium australe*, *Acacia erinacea*, *Olearia muelleri*, *Dodonaea stenozyga* low open shrubland

No. of species: 18

No. stems: 317

Quadrat 10



Fauna habitat: litter cover was very good, with much fallen timber including some larger branches in the area. No hollow logs were present so it is unlikely that carpet pythons would live in the area. Holes in the trees/ mallee were mostly very small.

GPS 51J: 327670 E/ 6568292 N Elevation: 397 m a s l Tenement: M15/128

Condition: Very good; likely historic clearing with a few stumps present; minor sheet erosion and occasional rill, debris dams; rubbish

Landform: Valley between low rises; gentle to moderate slope; aspect east, drainage south

Land surface: light reddish brown clay loam; surface rock: greenstone, black rock (?), ironstone gravel, calcrete, 20 – 30 %; litter: 40 – 50 % ^5 cm; fallen timber: 2 – 3 %; cryptogam: < 1 % lichen; bare ground: 5 – 10 %; surface moist, light showers

Threats: mining, goats

Height (m)	Habit	% cover	Species	No.
> 8	T	40 – 50	<i>Eucalyptus clelandii</i>	6
2 – 8 (4)	T	<1	<i>Eremophila interstans</i> subsp. <i>interstans</i>	1
> 2	S			
1.5 – 2	S	<1	<i>Eremophila interstans</i> subsp. <i>interstans</i> (1), <i>Dodonaea stenozyga</i> (1)	2
1 – 1.5	S	<1	<i>Eremophila parvifolia</i> subsp. <i>auricampa</i>	1
0.5 – 1	S	<2	<i>Dodonaea stenozyga</i> (8), <i>Eremophila parvifolia</i> subsp. <i>auricampa</i> (4), <i>Olearia muelleri</i> (2), <i>Lycium australe</i> (1)	15
< 0.5	S, C	<1	<i>Olearia muelleri</i> (17), <i>Westringia rigida</i> (13), <i>Eremophila parvifolia</i> subsp. <i>auricampa</i> (8), <i>Lycium australe</i> (7), <i>Dodonaea stenozyga</i> (2), <i>Dodonaea lobulata</i> (1), <i>Atriplex nummularia</i> subsp. <i>spathulata</i> (1), <i>Eremophila interstans</i> subsp. <i>interstans</i> (1), <i>Maireana tomentosa</i> subsp. <i>tomentosa</i> (1), <i>M. trichoptera</i> (4)	57
	Grass	<1	<i>Grazed tussock</i>	
	Forb	<1	<i>Ptilotus holosericeus</i>	

Other species in area: *Eucalyptus torquata*, *E. griffithsii*

Vegetation type: *Eucalyptus clelandii* low open forest over *Eremophila interstans* subsp. *interstans* tall sparse shrubland over *Eremophila interstans* subsp. *interstans*, *Dodonaea stenozyga*, *Eremophila parvifolia* subsp. *auricampa*, *Olearia muelleri*, *Westringia rigida* sparse shrubland over isolated grass tussocks and *Ptilotus holosericeus* isolated forbs

No. of species: 13

No. stems: 82

Quadrat 11



Fauna habitat: Litter cover was good and some fallen timber was present, but mostly small branchlets. Understorey cover was very low, and does not provide much shelter or foraging habitat for fauna. Some small to medium nesting holes were present in the trees in the area. More understorey was present in the adjacent vegetation, providing more habitat for fauna.

GPS 51J: 326877 E/ 6568217 N Elevation: 399 m a s l Tenement: M15/128

Condition: Good to very good; likely historic clearing/ grazing in area; some loss of mid-storey; recent access tracks, drilling in area

Landform: Broad gently sloping valley, at change of slope; aspect south easterly; drainage south

Land surface: light reddish brown clay loam; surface rock: Dolerite, quartz, ironstone gravel, black rock < 1%, fragment size 1 – 2 (6) cm; litter: 50 – 60 % ^ 20 cm; fallen timber: 1 – 2 %; cryptogam: <1 % lichen; bare ground: 15 – 20 %; surface slightly moist, showers

Threats: mining, goats, rabbits

Height (m)	Habit	% cover	Species	No.
> 8	T	30 – 40	<i>Eucalyptus salmonophloia</i>	2
1.5 – 2	C	<1	<i>Atriplex nummularia</i> subsp. <i>spathulata</i>	1
1 – 1.5	C	<1	<i>Atriplex nummularia</i> subsp. <i>spathulata</i>	3
0.5 – 1	C	10 -20	<i>Atriplex vesicaria</i> (64), <i>Atriplex nummularia</i> subsp. <i>spathulata</i> (5), <i>Maireana georgei</i> (6)	75
< 0.5	C	2 – 3	<i>Atriplex vesicaria</i> (18), <i>Maireana georgei</i> (6), <i>Enchylaena tomentosa</i> var. <i>tomentosa</i> (5), <i>Maireana tomentosa</i> subsp. <i>tomentosa</i> (7)	36
	Grass			
	Forb	<1	<i>Sclerolaena fusiformis</i>	

Other species in area: *Eucalyptus campaspe*, *Cratystylis conocephala*, *Maireana pentatropis*

Vegetation type: *Eucalyptus salmonophloia* open forest over *Atriplex nummularia* subsp. *spathulata* sparse chenopod shrubland over *Atriplex vesicaria*, *A. nummularia* subsp. *spathulata*, *Maireana georgei*, *Enchylaena tomentosa* var. *tomentosa*, *Maireana tomentosa* subsp. *tomentosa* low open chenopod shrubland

No. of species: 7

No. stems: 117

Quadrat 12



Fauna habitat: Some significant trees with hollows in area; lack of midstorey provides little cover for birds; Lower shrub layer provides some cover. There is very little fallen timber of habitat value for pythons etc. Habitat suitability for mallee fowl is low.

GPS 51J: 326715 E/ 6568307 N Elevation: 418 m a s l Tenement: M15/128

Condition: Very good; historic mining in area, timber removal; goats

Landform: Hill, hillside upper slope, moderate gradient; southerly aspect

Land surface: reddish brown clay loam; surface rock: dolerite, > 60 %; litter: 40 – 60 % ^ 20 cm, dense under trees; fallen timber: 2 – 3 %; cryptogam: 5 – 10 % lichen; bare ground: < 10 %; surface slightly moist, recent shower

Threats: mining, goats

Height (m)	Habit	% cover	Species	No.
> 8	T	8 – 10	<i>Eucalyptus clelandii</i> (1), <i>E. celastroides</i> subsp. <i>celastroides</i> (2)	3
4 – 8	M, T	20 – 30	<i>Eucalyptus campaspe</i> (9), <i>E. celastroides</i> subsp. <i>celastroides</i> (3), <i>Santalum acuminatum</i> (1), <i>Eremophila interstans</i> subsp. <i>interstans</i> (1)	14
> 2	S	5 – 10	<i>Eremophila interstans</i> subsp. <i>interstans</i> (13), <i>E. scoparia</i> (9)	22
1.5 – 2	S	< 2	<i>Eremophila scoparia</i> (15), <i>Eremophila interstans</i> subsp. <i>interstans</i> (6), <i>Acacia hemiteles</i> (1), <i>Exocarpos aphyllus</i> (1), <i>Senna artemisioides</i> subsp. <i>filifolia</i> (2)	25
1 – 1.5	S	< 2	<i>Eremophila scoparia</i> (10), <i>Senna artemisioides</i> subsp. <i>filifolia</i> (7), <i>Exocarpos aphyllus</i> (1)	18
0.5 – 1	S	< 2	<i>Eremophila scoparia</i> (9), <i>Eremophila parvifolia</i> subsp. <i>auricampa</i> (3), <i>Eremophila interstans</i> subsp. <i>interstans</i> (4), <i>Senna artemisioides</i> subsp. <i>filifolia</i> (3), <i>Olearia muelleri</i> (3), <i>Eremophila glabra</i> subsp. <i>glabra</i> (1)	23
< 0.5	S, C	< 2	<i>Atriplex nummularia</i> subsp. <i>spathulata</i> (7), <i>Senna artemisioides</i> subsp. <i>filifolia</i> (3), <i>Atriplex vesicaria</i> (19), <i>Olearia muelleri</i> (3), <i>Eremophila scoparia</i> (1), <i>Maireana georgei</i> (3)	36
	Grass			
	Forb			

Other species in area: *Waitzia fitzgibbonii*, *Thysanotus ?patersonii*, *Carrichtera annua* *, *Ptilotus holosericeus*, *Dissocarpus paradoxus*; *Eucalyptus clelandii* woodland on the summit; *Nicotiana glauca** in disturbed areas

Vegetation type: *Eucalyptus clelandii*, *E. celastroides* subsp. *celastroides* open woodland over *Eucalyptus campaspe*, *E. celastroides* subsp. *celastroides*, *Santalum acuminatum* low woodland over *Eremophila interstans* subsp. *interstans*, *E. scoparia* tall sparse shrubland over *Eremophila scoparia*, *Eremophila interstans* subsp. *interstans*, *Senna artemisioides* subsp. *filifolia* sparse shrubland over *Atriplex nummularia* subsp. *spathulata*, *Atriplex vesicaria* low isolated chenopod shrubs

No. of species: 15

No. stems: 141

Quadrat 13



Fauna habitat: there is a dense cover of litter under the trees (^ 20cm) which would provide excellent cover for insects and smaller reptiles. There is some fallen timber (small branches) but this would be unlikely suitable habitat for carpet pythons. Small nesting holes were present in some trees/ mallee. Areas of tall shrubland provide excellent shelter for birds.

Site: Q14 20m x 20m Quadrat Date: 20/10/16

GPS 51J: 325434 E/ 6567935 N

Elevation: 405 m a s l

Tenement: M15/128

Condition: Very good; historic timber removal, access tracks in area, mining activities

Landform: Low rise, lower slope, gentle, northerly aspect

Land surface: reddish brown clay loam; surface rock: < 5 %, dolerite and quartz, fragment size 2 – 3 cm; litter: 40 – 50 % ^ 10 cm; fallen timber: 3 – 5 %; cryptogam: 10 – 15 % lichen; bare ground: 20 – 25 %; surface moist, showers

Threats: mining, goats, rabbits

Height (m)	Habit	% cover	Species	No.
> 8 (9 –10)	T	40 – 50	<i>Eucalyptus longissima</i>	6
2 – 8	T	8 – 10	<i>Eucalyptus longissima</i>	4
> 2	S	<1	<i>Eremophila scoparia</i>	1
1.5 – 2	S, C	2 – 5	<i>Senna artemisioides</i> subsp. <i>filifolia</i> (14), <i>Eremophila scoparia</i> (1), <i>Atriplex nummularia</i> subsp. <i>spathulata</i> (2)	17
1 – 1.5	S, C	<1	<i>Atriplex nummularia</i> subsp. <i>spathulata</i> (1), <i>Eremophila scoparia</i> (3)	4
0.5 – 1	S, C	3 – 4	<i>Senna artemisioides</i> subsp. <i>filifolia</i> (10), <i>Eremophila parvifolia</i> subsp. <i>auricampa</i> (15), <i>Atriplex nummularia</i> subsp. <i>spathulata</i> (8), <i>A. vesicaria</i> (6), <i>Eremophila scoparia</i> (4)	43
< 0.5	S, C	3 – 4	<i>Atriplex vesicaria</i> (37), <i>Senna artemisioides</i> subsp. <i>filifolia</i> (34), <i>Eremophila parvifolia</i> subsp. <i>auricampa</i> (7), <i>Maireana georgei</i> (1)	79
	Grass			
	Forb			

Other species in area: *Eucalyptus campaspe*, *E. griffithsii*

Vegetation type: *Eucalyptus longissima* low open forest over *Senna artemisioides* subsp. *filifolia*, *Eremophila scoparia*, *Atriplex nummularia* subsp. *spathulata* sparse shrubland over *Senna artemisioides* subsp. *filifolia*, *Eremophila parvifolia* subsp. *auricampa*, *Atriplex vesicaria* low sparse shrubland

No. of species: 8

No. stems: 154

Quadrat 14



Below: *Eucalyptus griffithsii* low open forest adjacent to Q14



Fauna habitat: Shrub cover within the woodland areas is generally sparse providing minimal cover/shelter for small birds. Litter cover was very good (for small reptiles and insects), with some small branchlets also present; however there are no suitable sites for carpet pythons to shelter.

GPS 51J: 326082 E/ 6567610 N Elevation: 418 m a s l Tenement: M15/40 (edge)

Condition: Excellent; high diversity for area; historic mining activity on lower slopes; few very old access tracks near quadrat

Landform: Hill, ridge; aspect east to south east, drainage north-south & east; slope gentle on ridge, moderate on hill side

Land surface: reddish brown clay loam; surface rock: dolerite, greenstone, quartz, > 60 %, fragment size (1) 5 – 10 (20) cm; litter: 15 – 20 % ^ 10 cm; fallen timber: 2 – 3 %; cryptogam: 20 – 25 % lichen; bare ground: < 5 %; surface dry, recent showers

Threats: mining, goats

Height (m)	Habit	% cover	Species	No.
> 8 (10)	T	20 – 25	<i>Eucalyptus griffithsii</i>	2
2 – 8	T	10 – 15	<i>Eucalyptus griffithsii</i>	1
> 2	S	5 – 10	<i>Eremophila oldfieldii</i> subsp. <i>angustifolia</i> (5), <i>E. scoparia</i> (8), <i>Exocarpos aphyllus</i> (2)	15
1.5 – 2	S, C	15 – 20	<i>Dodonaea lobulata</i> (11), <i>Eremophila scoparia</i> (9), <i>E. oldfieldii</i> subsp. <i>angustifolia</i> (8), <i>Senna artemisioides</i> subsp. <i>filifolia</i> (12), <i>Exocarpos aphyllus</i> (2), <i>Eremophila glabra</i> (2), <i>Atriplex nummularia</i> subsp. <i>spathulata</i> (2)	46
1 – 1.5	S, C	2 – 5	<i>Eremophila scoparia</i> (10), <i>Dodonaea lobulata</i> (4), <i>Senna artemisioides</i> subsp. <i>filifolia</i> (7), <i>Acacia erinacea</i> (3), <i>Atriplex nummularia</i> subsp. <i>spathulata</i> (4), <i>Eremophila glabra</i> subsp. <i>glabra</i> (1), <i>Lycium australe</i> (1)	30
0.5 – 1	S, C	4 – 6	<i>Acacia erinacea</i> (21), <i>Dodonaea lobulata</i> (12), <i>Senna artemisioides</i> subsp. <i>filifolia</i> (10), <i>Eremophila glabra</i> subsp. <i>glabra</i> (6), <i>E. scoparia</i> (9), <i>E. oldfieldii</i> subsp. <i>angustifolia</i> (2), <i>Dodonaea adenophora</i> (4), <i>Olearia muelleri</i> (2), <i>Eremophila interstans</i> subsp. <i>interstans</i> (1), <i>Scaevola spinescens</i> (1), <i>Lycium australe</i> (3), <i>Atriplex nummularia</i> subsp. <i>spathulata</i> (2), <i>A. vesicaria</i> (1), <i>Maireana trichoptera</i> (1)	75
< 0.5	S, C	<2	<i>Ptilotus obovatus</i> (28), <i>Senna artemisioides</i> subsp. <i>filifolia</i> (19), <i>Atriplex vesicaria</i> (5), <i>Westringia rigida</i> (5), <i>Lycium australe</i> (5), <i>Eremophila scoparia</i> (5), <i>Acacia erinacea</i> (4), <i>Scaevola spinescens</i> (2), <i>Dodonaea lobulata</i> (2), <i>Maireana tomentosa</i> var. <i>tomentosa</i> (2), <i>Eremophila glabra</i> subsp. <i>glabra</i> (2), <i>Maireana trichoptera</i> (2), <i>Olearia muelleri</i> (1), <i>Eremophila oldfieldii</i> subsp. <i>angustifolia</i> (1), <i>Atriplex nummularia</i> subsp. <i>spathulata</i> (1)	84
<0.2	Vine	<1	<i>Rhyncharrhena linearis</i>	2
<0.3	Grass	<1	<i>Austrostipa eremophila</i> , <i>A. puberula</i>	
<0.1	Forb	<1	<i>Leiocarpa semicalva</i>	

Other species in area: *Eucalyptus campaspe*

Vegetation type: *Eucalyptus griffithsii* low open woodland over *Eremophila oldfieldii* subsp. *angustifolia*, *E. scoparia*, *Exocarpos aphyllus* tall sparse shrubland over *Dodonaea lobulata*, *Eremophila scoparia*, *E. oldfieldii* subsp. *angustifolia*, *Senna artemisioides* subsp. *filifolia* open shrubland over *Acacia erinacea*, *Dodonaea lobulata*, *Senna artemisioides* subsp. *filifolia*, *Ptilotus obovatus*, *Atriplex vesicaria* low sparse shrubland

No. of species: 24

No. stems: 255

Quadrat 15



Fauna habitat: there were some significant habitat trees in the area with good size nesting holes. Litter was quite deep under the trees/ mallee (shelter for insects, small reptiles) and the shrubs had dense foliage which also provides shelter for birds. It is possible that there would be some potential habitat for carpet pythons in the area. The land surface also had a rocky surface which provides niches for many fauna. It is also potential mallee fowl habitat, including the mid to upper slope areas.

GPS 51J: 327201 E/ 6567203 N Elevation: 389 m a s l Tenement: M15/40

Condition: Very good; historic clearing, old access tracks

Landform: Gently sloping plain, lower slope, aspect north; drains north into broad drainage line

Land surface: reddish brown clay loam; surface rock: fine ironstone gravel, 10 – 30 %; litter: 45 – 55 % cover ^ 15cm, mostly 3 – 5 cm; fallen timber: 3 – 5 %; cryptogam: 10 – 20 % lichen; bare ground: < 10 %; surface slightly moist, showers earlier in day

Threats: mining, goats

Height (m)	Habit	% cover	Species	No.
> 8	T	30 – 40	<i>Eucalyptus clelandii</i>	6
1.5 – 2	S, C	<1	<i>Eremophila scoparia</i> (1), <i>Atriplex nummularia</i> subsp. <i>spathulata</i> (1)	2
1 – 1.5	S, C	<1	<i>Atriplex nummularia</i> subsp. <i>spathulata</i>	1
0.5 – 1	S, C	2 – 3	<i>Atriplex vesicaria</i> (11), <i>Eremophila scoparia</i> (4), <i>E. glabra</i> subsp. <i>glabra</i> (2), <i>Atriplex nummularia</i> subsp. <i>spathulata</i> (3), <i>Olearia muelleri</i> (2), <i>Eremophila parvifolia</i> subsp. <i>auricampa</i> (2), <i>Senna artemisioides</i> subsp. <i>filifolia</i> (1)	25
< 0.5	S, C	<2	<i>Olearia muelleri</i> (28), <i>Atriplex vesicaria</i> (22), <i>Eremophila scoparia</i> (3), <i>Maireana tomentosa</i> subsp. <i>tomentosa</i> (3), <i>Eremophila glabra</i> subsp. <i>glabra</i> (2), <i>Senna artemisioides</i> subsp. <i>filifolia</i> (2), <i>Eremophila parvifolia</i> subsp. <i>auricampa</i> (1)	61
	Grass			
	Forb		<i>Sclerolaena</i> sp., <i>Carrichtera annua</i> *	

Vegetation type: *Eucalyptus clelandii* low open forest over *Atriplex vesicaria*, *Eremophila scoparia*, *E. glabra* subsp. *glabra*, *Atriplex nummularia* subsp. *spathulata* low sparse shrubland

No. of species: 11 (1 alien)


No. stems: 95


Quadrat 16





Fauna habitat: Litter cover was good under the trees. Fallen timber was mostly branchlets with occasional larger branches in the area and fallen trees. Most of the area would not provide suitable habitat for the carpet python, however, there are likely to be some areas of suitable habitat. There are some significant trees with suitable hollows for nesting. It is unlikely to provide suitable habitat for mallee fowl as there is little mid to tall shrub cover.


Appendix 3: Relevé Site descriptions


Relevé 01 Tenement: M15/128	Date: 18 th October 2016 GPS: 328115 E/ 6568738 N
Landform: gently sloping plain with small rocky rises	
Condition: very good to excellent; minor historic disturbances in area	
Fauna habitat: Hollows in mallees mostly small; some fallen timber with potential for carpet pythons; an extinct mallee fowl mound was nearby (MFM1). Strata are intact and provide a good level of shelter and foraging. Echidna scratchings in area.	
Vegetation: <i>Eucalyptus griffithsii</i> and <i>E. celastroides</i> subsp. <i>celastroides</i> open mallee woodland over <i>Acacia burkittii</i> , <i>Dodonaea lobulata</i> tall shrubland over <i>Dodonaea lobulata</i> shrubland over <i>Senna artemisioides</i> subsp. <i>filifolia</i> , <i>Stenanthemum stipulosum</i> , <i>Bertya dimerostigma</i> low open shrubland Other species: <i>Eremophila interstans</i> subsp. <i>interstans</i> , <i>Acacia burkittii</i> , <i>A. calcarata</i> , <i>Olearia muelleri</i> , <i>Santalum spicatum</i>	



Relevé 02 Tenement: M15/40	Date: 19 th October 2016 GPS: 328109 E/ 6567468 N
Landform: broad drainage line; gently sloping; defined channel on north side	
Condition: Good; some historic clearing through mining and pastoral activities likely; vehicle access tracks	
Fauna habitat: Low levels of shelter, however there are some larger trees with hollows. <i>Eremophila alternifolia</i> was common and flowering, and were visited by a number of bird species.	
Vegetation: <i>Eucalyptus griffithsii</i> isolated trees over <i>Eremophila alternifolia</i> , <i>Acacia burkittii</i> , <i>Senna cardiosperma</i> , <i>Atriplex nummularia</i> subsp. <i>spathulata</i> and <i>Acacia hemiteles</i> open shrubland over <i>Lycium australe</i> , <i>Atriplex nummularia</i> subsp. <i>spathulata</i> , <i>Eremophila alternifolia</i> , <i>E. interstans</i> subsp. <i>interstans</i> , <i>Atriplex vesicaria</i> , <i>Senna artemisioides</i> subsp. <i>filifolia</i> , <i>Maireana georgei</i> , <i>M. pentatropis</i> low open shrubland over <i>Dissocarpus paradoxus</i> , <i>Carrichtera annua</i> *, <i>Austrostipa eremophila</i> , <i>Sclerolaena fusiformis</i> low forbland with isolated grass tussocks Areas of <i>Eucalyptus griffithsii</i> mallee woodland dominated some areas, and along the drainage channel. <i>Eremophila alternifolia</i> were mostly pink, with occasional white flowering shrubs. Other species: <i>Santalum acuminatum</i> , <i>Eremophila glabra</i> subsp. <i>glabra</i> , <i>Eucalyptus salmonophloia</i> , <i>Solanum lasiophyllum</i>	


Relevé 03 Tenement: M15/128	Date: 19 th October 2016 GPS: 328350 E/ 6568077 N
Landform: Midslope of gently sloping plain	
<p>Condition: Very good; some old tracks, rabbit warren, fresh signs of rabbits in area; goat tracks through area</p> <p>Fauna habitat: Spinifex tussocks provide shelter; likely sand monitor burrow in rabbit warren. An extinct mallee fowl mound was located nearby in the adjacent mallee woodland area.</p>	
<p><i>Allocasuarina helmsii</i>, <i>Santalum spicatum</i>, <i>Eremophila interstans</i> subsp. <i>interstans</i>, <i>Bertya dimerostigma</i>, <i>Acacia burkittii</i> tall open shrubland over <i>Senna artemisioides</i> subsp. <i>filifolia</i>, <i>Allocasuarina helmsii</i>, <i>Bertya dimerostigma</i>, <i>Eremophila scoparia</i>, <i>Acacia hemiteles</i> and <i>Stenanthemum stipulosum</i> open shrubland over <i>Triodia scariosa</i>, <i>Westringia rigida</i>, <i>Sclerolaena fusiformis</i> and <i>Senna artemisioides</i> subsp. <i>filifolia</i> low sparse shrubland over <i>Asteridea anthraxioides</i> and <i>Carrichtera annua</i>* sparse forbland</p> <p>Other species: <i>Eremophila glabra</i> subsp. <i>glabra</i>, <i>Dodonaea lobulata</i></p>	


Relevé 04 Tenement: M15/128	Date: 19 th October 2016 GPS: 328253 E/ 6568225 N
Landform: broad drainage line on gently sloping plain	
<p>Condition: Good; likely significant historic pastoral disturbances; current disturbances from rabbits and goats; some surface erosion including gullying in drainage line to the north; at change from mallee woodland to broad drainage line (Quadrat 5); condition improves away from the drainage line</p> <p>Fauna habitat: This site was at the edge of an area of high disturbance. Understorey was sparse in the area. Holes in mallee were mostly small.</p>	
<p>Vegetation: <i>Eucalyptus horistes</i> low mallee woodland with <i>Eremophila interstans</i> subsp. <i>interstans</i> over <i>Atriplex nummularia</i> subsp. <i>spathulata</i>, <i>Eremophila interstans</i> subsp. <i>interstans</i>, <i>Atriplex vesicaria</i>, <i>Olearia muelleri</i> low open shrubland over isolated <i>Austrostipa trichophylla</i> grass tussocks and <i>Ptilotus</i> sp. Goldfields herbs</p>	


Relevé 05 Tenement: M15/40	Date: 19 th October 2016 GPS: 328439 E/ 6566494 N
Landform: Hill; lower slope, southerly aspect	
Condition: Good to very good; historic pastoral disturbances; vehicle access tracks; drill locations; active erosion along some of the track.	
Fauna habitat: A few larger branches were present on the ground with a few small hollows. Litter was mostly present at the base of shrubs. Some hollows in trees suitable for nesting.	
<p>Vegetation: <i>Eucalyptus griffithsii</i> open forest over <i>Eremophila decipiens</i> subsp. <i>decipiens</i> tall sparse shrubland to isolated shrubs over <i>Dodonaea lobulata</i>, <i>Eremophila decipiens</i> subsp. <i>decipiens</i> open shrubland over <i>Ptilotus obovatus</i>, <i>Atriplex vesicaria</i> low shrubland to low open shrubland</p> <p>Other species: <i>Maireana sedifolia</i>, <i>Atriplex nummularia</i> subsp. <i>spathulata</i></p>	


Relevé 06 Tenement: M15/128	Date: 20 th October 2016 GPS: 326763 E/ 6568138 N
Landform: Hill; rocky ridge midslope; gentle gradient; aspect east; surface rock 30 – 60 % quartz & dolerite 15 – 30 cm	
Condition: Very good; some mining disturbances in area	
Fauna habitat: The rocky surface provides potential habitat for smaller reptiles. Shrub cover is adequate for small birds for nesting and foraging. Small nesting holes were present in a few trees.	
<p>Vegetation: <i>Eucalyptus griffithsii</i> isolated trees over <i>Eremophila decipiens</i> subsp. <i>decipiens</i>, <i>E. interstans</i> subsp. <i>interstans</i>, <i>Acacia burkittii</i> tall sparse shrubland over <i>Eremophila scoparia</i>, <i>E. decipiens</i> subsp. <i>decipiens</i>, <i>Senna artemisioides</i> subsp. <i>filifolia</i>, <i>Atriplex nummularia</i> subsp. <i>spathulata</i> sparse shrubland over <i>Senna artemisioides</i> subsp. <i>filifolia</i>, <i>Atriplex nummularia</i> subsp. <i>spathulata</i>, <i>Eremophila glabra</i> subsp. <i>glabra</i>, <i>Dodonaea lobulata</i>, <i>Eremophila scoparia</i>, <i>E. decipiens</i> open shrubland over <i>Senna artemisioides</i> subsp. <i>filifolia</i>, <i>Atriplex vesicaria</i>, <i>Ptilotus obovatus</i>, <i>Dodonaea lobulata</i> and <i>Eremophila</i> species low sparse shrubland</p> <p>Other species: <i>Scaevola spinescens</i>, <i>Olearia muelleri</i>, <i>Rhagodia drummondii</i></p>	

Relevé 07 Tenement: M15/128	Date: 20 th October 2016 GPS: 326708 E/ 6568213 N
Landform: Rocky ridge, dolerite and greenstone; midslope	Condition: Good; historical mining disturbances in area; timber clearing
Vegetation: <i>Eucalyptus clelandii</i> , <i>E. campaspe</i> open woodland over isolated <i>Senna artemisioides</i> subsp. <i>filifolia</i> shrubs and <i>Ptilotus</i> sp. Goldfields herbs Old tree stumps were present in the area; lack of understorey Fauna habitat: The rocky surface provides some habitat for small reptiles. No suitable nesting holes at this site. Some larger fallen timber but no hollows.	
Vegetation: An area of shrubland was adjacent to the "woodland" which may have been regrowth following clearing: <i>Eremophila decipiens</i> subsp. <i>decipiens</i> , <i>E. glabra</i> subsp. <i>glabra</i> , <i>Dodonaea lobulata</i> , <i>Senna artemisioides</i> subsp. <i>filifolia</i> , <i>Eremophila scoparia</i> shrubland to open shrubland over <i>Ptilotus obovatus</i> and <i>Atriplex vesicaria</i> low open shrubland <i>Nicotiana glauca</i> * was present in more disturbed areas	

Relevé 08 Tenement: M15/128	20 th October 2016 GPS: 326568 E/ 6567916 N
Landform: Valley; broad drainage line	
Condition: Good; edge of track, impacts from clearing; soil disturbances	
Fauna habitat: Some of the trees had small nesting holes. There was some diversity in the shrub stratum, with potential nesting sites available. Fallen timber was mostly branchlets without hollows.	
Vegetation: <i>Eucalyptus longissima</i> tall open mallee woodland over <i>Atriplex</i> spp., <i>Senna artemisioides</i> subsp. <i>filifolia</i> , <i>Acacia tetragonophylla</i> , <i>A. hemiteles</i> , <i>Dodonaea lobulata</i> open shrubland	

Relevé 09 Tenement: M15/40	20 th October 2016 GPS: 326112 E/ 6567491 N
Landform: Valley; midslope	
<p>Condition: Good - regrowth; goats; historic mining impacts, erosion to moderate levels</p> <p>Fauna habitat: The tall shrubs were quite dense and would provide suitable nesting sites for a number of species of birds. Prior to disturbances this area would have been mallee fowl habitat.</p>	
<p>Vegetation: <i>Acacia tetragonophylla</i>, <i>Eremophila decipiens</i> subsp. <i>decipiens</i>, <i>Dodonaea lobulata</i>, <i>Santalum spicatum</i> tall shrubland over <i>Eremophila decipiens</i> subsp. <i>decipiens</i>, <i>Scaevola spinescens</i>, <i>Dodonaea lobulata</i>, <i>Senna artemisioides</i> subsp. <i>filifolia</i>, <i>Atriplex nummularia</i> subsp. <i>spathulata</i> open shrubland over <i>Ptilotus obovatus</i>, <i>Scaevola spinescens</i> low sparse shrubland over <i>Sclerolaena fusiformis</i>, <i>Maireana</i> spp. sparse forbland</p> <p>Other species: <i>Eucalyptus campaspe</i> on lower slopes (less disturbed areas)</p>	


Relevé 10 Tenement: M15/40	20 th October 2016 GPS: 326185 E/ 6567443 N
Landform: Valley, mid catchment	
<p>Condition: Very good; regrowth, healthy; erosion and deposition along drainage channels; access tracks present; historic mining impacts</p> <p>Fauna habitat: There are some dense areas of vegetation which would provide nesting and foraging habitats birds.</p>	
<p>Vegetation: <i>Casuarina pauper</i> isolated low trees over <i>Eremophila oppositifolia</i> subsp. <i>angustifolia</i>, <i>E. scoparia</i>, <i>Dodonaea lobulata</i>, <i>Acacia hemiteles</i>, <i>A. burkittii</i>, <i>Eucalyptus griffithsii</i> tall shrubland over <i>Casuarina pauper</i>, <i>Eremophila scoparia</i>, <i>E. glabra</i> subsp. <i>glabra</i>, <i>Atriplex nummularia</i>, <i>Acacia hemiteles</i>, <i>Dodonaea lobulata</i>, <i>D. adenophora</i> open shrubland over <i>Olearia muelleri</i>, <i>Atriplex</i> spp., <i>Acacia hemiteles</i> low open shrubland</p>	


Relevé 11, 12 Tenement M15/40	20 th October 2016 GPS: 327638 E/ 6566403 N; 327646 E/ 6566445 N
Landform: Rocky hill, upper slope to summit	
Condition: Excellent Minimal disturbances; structure in place; good level of diversity Suitable mallee fowl and possibly carpet python habitat.	
Vegetation: <i>Eucalyptus torquata</i> woodland over <i>Eremophila oldfieldii</i> subsp. <i>angustifolia</i> , <i>Santalum spicatum</i> , <i>Exocarpos aphyllus</i> , <i>Acacia tetragonophylla</i> tall open shrubland over <i>Eremophila scoparia</i> , <i>Dodonaea lobulata</i> , <i>D. stenozyga</i> , <i>Scaevola spinescens</i> , <i>Eremophila glabra</i> subsp. <i>glabra</i> , <i>Atriplex nummularia</i> subsp. <i>spathulata</i> , <i>Grevillea acuararia</i> shrubland over <i>Ptilotus obovatus</i> , <i>Senna artemisioides</i> subsp. <i>filifolia</i> , <i>Olearia muelleri</i> , <i>Grevillea acuararia</i> , <i>Dodonaea stenozyga</i> , <i>Acacia erinacea</i> low open shrubland Other species: <i>Dodonaea adenophora</i> on midslopes	


Appendix 4: Soil collection sites and vegetation descriptions


October 2016


Colsoil001	328090	6568760
Colsoil002	328210	6568690
Colsoil003	327890	6568760
Colsoil004	328040	6568500
Colsoil005	327470	6568810
Colsoil006	327900	6567300
Colsoil007	328150	6567310
Colsoil008	327780	6567120
Colsoil009	328170	6567160


COLSOIL001 Tenement: M15/128	18 th October 2016 GPS: 328090 E/ 6568760 N
Landform: low rocky ridge - dolerite; gentle slope; surface rock 20 – 40%; litter 25 – 40 %; fallen timber 10 – 20 %; cryptogams > 50%	
Condition: Very good, land surface in excellent condition; likely old clearing in area; old access tracks nearby Potential mallee fowl & carpet python habitat	
Vegetation: <i>Eucalyptus griffithsii</i> low isolated mallee over <i>Acacia burkittii</i> tall open shrubland over <i>Dodonaea stenozyga</i> , <i>Eremophila decipiens</i> subsp. <i>decipiens</i> shrubland over <i>Eremophila oppositifolia</i> subsp. <i>angustifolia</i> , <i>Eremophila glabra</i> subsp. <i>glabra</i> , <i>Acacia calcarata</i> low isolated shrubs	


COLSOIL002 Tenement: M15/128	18 th October 2016 GPS: 328210 E/ 6568690 N
Condition: Very good; some old disturbances, old access tracks	
Landform: gently sloping plain with low rocky hill to west Potential mallee fowl habitat	
Vegetation: <i>Eucalyptus griffithsii</i> open woodland over <i>Santalum spicatum</i> low isolated trees over <i>Bertya dimerostigma</i> , <i>Acacia burkittii</i> , <i>Dodonaea lobulata</i> shrubland over <i>Waitzia fitzgibbonii</i> , <i>Austrostipa</i> sp., <i>Carrichtera annua</i> * isolated herbs and grass tussocks Other species: <i>Acacia calcarata</i> , <i>Stenanthemum stipulosum</i>	


COLSOIL003 Tenement: M15/128	18 th October 2016 GPS: 327890 E/ 6568760 N
Condition: Good; disturbed – historic, access tracks; mature regrowth	
Landform: low rise; rocky (surface rock 30 -40 % dolerite; 5 – 15 cm) Small nesting holes in trees; the level of disturbance in the area makes it unlikely habitat for mallee fowl or carpet pythons	
Vegetation: <i>Eucalyptus griffithsii</i> open woodland over <i>Eremophila decipiens</i> subsp. <i>decipiens</i> , <i>Dodonaea lobulata</i> tall shrubland over <i>Senna artemisioides</i> subsp. <i>filifolia</i> , <i>Scaevola spinescens</i> , <i>Atriplex nummularia</i> subsp. <i>spathulata</i> , <i>Olearia muelleri</i> and <i>Atriplex vesicaria</i> low open shrubland Other species: <i>Eremophila interstans</i> subsp. <i>interstans</i> , <i>Ptilotus obovatus</i> , <i>Maireana tomentosa</i> , <i>Eremophila glabra</i> subsp. <i>glabra</i> , <i>Santalum spicatum</i>	


COLSOIL004 Tenement: M15/128	18 th October 2016 GPS: 328040 E/ 6568500 N
Landform: low rise; surface rock ?greenstone < 5% ^ 3cm; litter 2 – 10 %; fallen timber < 2%	
Condition: Good; historic clearing for mining activities Unlikely habitat for mallee fowl or carpet pythons	
Vegetation: <i>Eucalyptus griffithsii</i> low mallee woodland over <i>Eremophila interstans</i> subsp. <i>interstans</i> , <i>Exocarpos aphyllus</i> tall open shrubland over <i>Senna artemisioides</i> , <i>Acacia calcarata</i> open shrubland over <i>Olearia muelleri</i> , <i>Atriplex vesicaria</i> , <i>Senna artemisioides</i> subsp. <i>filifolia</i> , <i>Dodonaea lobulata</i> , <i>Acacia erinacea</i> and <i>Maireana</i> sp. (grazed) low sparse shrubland	

COLSOIL005 Tenement: M15/128	19 th October 2016 GPS: 327604 E/ 6568649 N
Landform: plain; gently sloping; surface rock > 50 %, mostly lateritic gravel	
Condition: Degraded to good; disturbed; some clearing, ground disturbances – erosion and excavations; vehicle access tracks Some shelter provided by trees for fauna. Small nesting holes.	
Vegetation: <i>Eucalyptus campaspe</i> isolated trees to low open woodland over <i>Eremophila glabra</i> subsp. <i>glabra</i> , <i>E. decipiens</i> subsp. <i>decipiens</i> , <i>Atriplex nummularia</i> subsp. <i>spathulata</i> isolated shrubs over <i>Atriplex vesicaria</i> and <i>A. nummularia</i> subsp. <i>spathulata</i> low open shrubland over <i>Maireana trichoptera</i> , <i>M. tomentosa</i> subsp. <i>tomentosa</i> , <i>Ptilotus chamaecladus</i> , <i>Medicago minima</i> * , <i>Sclerolaena fusiformis</i> , <i>Carrichtera annua</i> * low sparse forbland Other species: <i>Eremophila scoparia</i> , <i>Senna artemisioides</i> subsp. <i>filifolia</i>	

COLSOIL006 Tenement: M15/40	19 th October 2016 GPS: 327900 E/ 6567300 N
Landform: lower slope of hill; gently sloping	
Condition: Very good; historic clearing and disturbances; old access tracks; some erosion; rabbits Fauna habitat: unlikely to support mallee fowl or carpet pythons	
Vegetation: <i>Eucalyptus clelandii</i> , <i>E. griffithsii</i> woodland over <i>Eremophila interstans</i> subsp. <i>interstans</i> , <i>E. scoparia</i> , <i>E. glabra</i> subsp. <i>glabra</i> , <i>Atriplex nummularia</i> subsp. <i>spathulata</i> , <i>Olearia muelleri</i> open shrubland over isolated <i>Austrostipa eremophila</i> and <i>A. scabra</i> grass tussocks	

COLSOIL007 Tenement: M15/40	19 th October 2016 GPS: 328150 E/ 6567310 N
Landform: lower slope of hill	
Condition: Mostly degraded; disturbed access tracks and drill sites; some regrowth Some small nesting holes are present in the trees in the broader area. Much of the understorey has been cleared and provides low foraging potential.	
Vegetation: <i>Eremophila interstans</i> subsp. <i>interstans</i> , <i>Atriplex nummularia</i> subsp. <i>spathulata</i> , <i>Maireana pentatropis</i> isolated shrubs and subshrubs Adjacent: <i>Eucalyptus torquata</i> , <i>E. clelandii</i> woodland over <i>Exocarpos aphyllus</i> isolated shrubs over <i>Eremophila</i> spp., <i>Cratystylis conocephala</i> , <i>Olearia muelleri</i> isolated low shrubs	

COLSOIL008 Tenement: M15/40	19 th October 2016 GPS: 327780 E/ 6567120 N
Landform: low ridge; quartz, ?gneiss	
Condition: very good; lot of mining disturbance in the adjacent area The condition of the vegetation would be unlikely to support mallee fowl or carpet pythons.	
Vegetation: <i>Eucalyptus griffithsii</i> , <i>E. celastroides</i> open woodland over <i>Santalum acuminatum</i> , <i>Dodonaea lobulata</i> , <i>Eremophila interstans</i> subsp. <i>interstans</i> tall sparse shrubland over <i>Westringia rigida</i> , <i>Scaevola spinescens</i> , <i>Dodonaea lobulata</i> , <i>Atriplex nummularia</i> subsp. <i>spathulata</i> , <i>Eremophila interstans</i> subsp. <i>interstans</i> , <i>E. interstans</i> subsp. <i>virgata</i> and <i>E. glabra</i> subsp. <i>glabra</i> open shrubland	

<p>COLSOIL009 Tenement: M15/40</p>	<p>19th October 2016 GPS: 328170 E/ 6567160 N</p>
<p>Landform: Lower slope of hill</p>	
<p>Condition: Degraded; rehabilitated; some regrowth occurring – <i>Maireana pentatropis</i>, <i>Atriplex nummularia</i>, <i>Senna artemisioides</i> subsp. <i>filifolia</i>, <i>Eremophila scoparia</i>; old access tracks and drill sites in area; erosion and deposition active in some areas</p>	
<p>Vegetation in area: <i>Eucalyptus clelandii</i>, <i>E. griffithsii</i> open woodland over <i>Exocarpos aphyllus</i>, <i>Eremophila interstans</i> subsp. <i>interstans</i> tall sparse shrubland over <i>Maireana sedifolia</i>, <i>Eremophila scoparia</i>, <i>Atriplex nummularia</i> subsp. <i>spathulata</i>, <i>Olearia muelleri</i> open shrubland over <i>Maireana pentatropis</i>, <i>Atriplex nummularia</i> low sparse shrubland</p>	



Appendix 5: Sandalwood locations


	Easting	Northing	No.
<i>Santalum spicatum</i>	328172	6568729	3
<i>Santalum spicatum</i>	327890	6568760	1
<i>Santalum spicatum</i>	328210	6568690	1
<i>Santalum spicatum</i>	328350	6568077	1
<i>Santalum spicatum</i>	326112	6567491	1
<i>Santalum spicatum</i>	327638	6566403	1
<i>Santalum spicatum</i>	327644	6566457	1
<i>Santalum spicatum</i>	327068	6568504	1
<i>Santalum spicatum</i>	328298	6568081	2
<i>Santalum spicatum</i>	328406	6567077	1
<i>Santalum spicatum</i>	328302	6566767	1

Appendix 6: Fauna observations

Scientific Name	Common Name	Signs
Birds		
<i>Anthochaera carunculata</i>	Red wattlebird	Sound
<i>Barnardius zonarius</i>	Australian ringneck	Visual, sound
<i>Cacomantis pallidus</i>	Pallid cuckoo	Visual, sound
<i>Coracine novaehollandiae</i>	Black-faced cuckoo shrike	Visual, sound
<i>Corvus coronoides</i>	Australian raven	Visual, sound, common
<i>Dromaius novaehollandiae</i>	Emu	Scats
<i>Eleophus roseicapilla</i>	Galah	Visual, sound, common
<i>Falco cenchroides</i>	Nankeen Kestrel	Visual
<i>Haliastur sphenurus</i>	Whistling Kite	Visual
<i>Leipoa ocellata</i>	Mallee Fowl	Extinct mounds; no recent activity
<i>Lichenostomus leucotis</i>	White-eared honeyeater	Visual, sound; nests
<i>Ocyphaps lophotes</i>	Crested Pigeon	Visual, sound
<i>Pardalotus striatus</i>	Striated pardalote	Visual, sound
<i>Petroica goodenovii</i>	Red-capped robin	Visual, sound
<i>Phaps chalcoptera</i>	Common Bronzewing	Visual
<i>Pomatostomus superciliosus</i>	White-browed babbler	Nest; visual
<i>Psephotus varius</i>	Mulga parrot	Visual, sound
<i>Rhipidura leucophrys</i>	Willie wagtail	Visual, sound
<i>Smicornis brevicostus</i>	Weebill	Visual
<i>Taeniopygia guttata</i>	Zebra finch	Visual, sound, common
Reptiles		
<i>Ctenophorus scutulatus</i>	Lozenge-marked Dragon	Visual; near spinifex tussocks
<i>Ctenophorus sp.</i>	Dragon lizard	Visual; likely <i>C. cristatus</i>
<i>Ctenotus sp.</i>	<i>Ctenotus</i>	Visual; likely southern mallee <i>Ctenotus</i>
<i>Varanus gouldii</i>	Sand monitor	Tracks; burrow
Mammals		
<i>Capra hircus</i>	Goat (Feral)	Visual, scats, smell, damaged vegetation
<i>Macropus fuliginosus</i>	Western grey kangaroo	Visual, scats, resting areas
<i>Oryctolagus cuniculus</i>	Rabbit (Feral)	Visual, scats, warrens
<i>Tachyglossus aculeatus</i>	Echidna	Diggings
<i>Vulpes vulpes</i>	Fox (Feral)	Scats

Appendix 7A: Mallee Fowl Mound Records

No.	Image	Easting/ Northing	Date		Mound profile
PG1		328172 E 6568729 N Near Col soil 002	18/10/16	<i>Eucalyptus griffithsii</i> mallee woodland over <i>Acacia burkittii</i> , <i>Dodonaea lobulata</i> shrubland over <i>Senna artemisioides</i> subsp. <i>filifolia</i> , <i>Dodonaea lobulata</i> , <i>Stenanthemum stipulosum</i> , <i>Olearia muelleri</i> low open shrubland	Extinct Profile 6 This MFM was almost level with the surrounding land surface. A mature <i>Acacia burkittii</i> shrub was present in the original middle of the mound, and would be several years old. There were no signs of any mallee fowl activity in the area, including a lack of tracks, feathers or egg shells.
PG2		328294 E 6568092 N 51J Near Q4	19/10/16	<i>Eucalyptus torquata</i> , <i>E. griffithsii</i> woodland over <i>Santalum spicatum</i> , <i>Acacia hemiteles</i> , <i>Dodonaea lobulata</i> , <i>Eremophila interstans</i> subsp. <i>interstans</i> , <i>Allocasuarina eriochlamys</i> subsp. <i>eriochlamys</i> tall open shrubland	Extinct Profile 6 The MFM was almost level with the surrounding land surface, with no distinct inner area. A few herbs were present on the outer edges, but these were very sparse in the general area as well. Another possible extinct mound was located to the east of this site, but was highly disturbed with an extensive rabbit warren, and so was not recorded.

PG3		<p>328320 E 6566762 N</p> <p>Near Q7</p>	19/10/16	<p><i>Eucalyptus torquata</i>, <i>E. griffithsii</i> woodland over <i>Eremophila oldfieldii</i> subsp. <i>angustifolia</i>, <i>Dodonaea lobulata</i> tall open shrubland</p>	<p>Profile 1</p> <p>This MFM is likely to have been inactive for > 20 years. It has held its shape due to the amount of rock in the structure. The rocks appear to have been in situ for several years. There was a slight dip in the centre which had windblown organic matter, as well as a few branchlets from the adjacent tree. There were no signs of recent mallee fowl activity in the area, including no egg shells, feathers or tracks.</p>
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Appendix 7B: Mallee Fowl Mound Monitoring sheet

DATE: _____

GRID: _____

NAME(S): _____

Page of _____

Nest	Scrapped (y/n)	Fossil (y/n)	Sinked (y/n)	Trigger (y/n)	Active (Y/N)	Profile (see below)	X sticks (see below)	Scrapped (Y/N)	Leggell (y/n)	Yolk	Egg	Egg	Egg	Clt. (specify)	Outer nest surface (m/s/l)					Inner nest surface (m/s/l)					Dime. (cm)					Photo (y/n)	X sites replaced (y/n)	Notes							
															crust	moss	herb	sub	tree	crust	moss	herb	sub	tree	height	area	depth	H-M	H-S										
86	x	x	x	x	N	5	N	N																															
R01	x				N	6	N	N																															Very flat, extinct
R02	x				N	6	N	N																														Very flat, extinct	
R03	x				N	1	N	N																														Rocky, hard to determine crust	

For prints & scats:
 C = crust
 M = moss
 H = herb
 S = sub
 T = tree

Prints:
 1
 2
 3
 4
 5
 6

Other notes:
 Discovered on ground
 G-gate

Notes:
 If you require more room use the back of this form sheet!



Appendix 8A: Legislation

Flora and fauna are protected in Western Australia under the following acts:

- Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act)
- State *Wildlife Conservation Act* (WC Act)
- State *Environmental Protection Act 1986* (EP Act)
- *Sandalwood Act 1929*

1. Commonwealth

EPBC Act – under the act, actions that have, or are likely to have, a significant impact on a matter of national environmental significance (NES), require approval from the Australian Government Minister for the Environment. The EPBC Act provides for the listing of threatened native flora, fauna and threatened ecological communities (TEC).

Conservation categories applicable to threatened flora and fauna are as follows:

- Extinct (EX) – there is no reasonable doubt that the last individual has died
- Extinct in the wild (EW) – taxa known to survive only in captivity
- Critically Endangered (CR) – taxa facing an extremely high risk of extinction in the wild in the immediate future
- Endangered (EN) – taxa facing a very high risk of extinction in the wild in the near future
- Vulnerable (VU) – taxa facing a high risk of extinction in the wild in the medium-term
- Conservation Dependent – taxa whose survival depends upon ongoing conservation measures; without these measures, a conservation dependent taxon would be classified as Vulnerable or more severely threatened.

Threatened ecological communities can be listed as TECs under the EPBC Act as: Critically endangered, Endangered and Vulnerable.

Protection of migratory species is also included under the EPBC Act under international agreements:

- Japan-Australia Migratory Bird Agreement (JAMBA)
- China-Australia Migratory Bird Agreement (CAMBA)
- Convention on the Conservation of Migratory Species of Wild Animals (Bonn)
- Agreement between the Government of Australia and the Government of the Republic of Korea on the Protection of Migratory Birds (ROKAMBA)

The Rainbow bee-eater (*Merops ornatus*) is listed under international agreement (IA)

2. State

Wildlife Conservation Act 1950 – provides for the listing of native flora (Threatened Flora (T)) and fauna (Threatened fauna T) species which are deemed to be under threat of extinction. Flora are also assigned to one of three categories Critically endangered, Endangered or Vulnerable. These are further described in appendices 8B and 8C. Mallee fowl (*Leipoa ocellata*) are listed as T.

Environmentally Sensitive Areas (ESAs) – are generally where the vegetation has a high conservation value, and may include:

- Vegetation within 50 m of threatened flora
- The area covered by a TEC
- A defined wetland and the area within 50 m of the wetland.

The protection and harvesting of sandalwood (*Santalum* spp.) is also controlled under the *Sandalwood Act 1929*.

Environment Protection Act 1986 (EP Act) allows for assessment of activities likely to impact on conservation listed flora and fauna can be assessed by the Environmental Protection Authority. Impacts on TECs can also be referred to the EPA for formal assessment.

The *WC Act 1950* and *Sandalwood Act 1929* will be replaced by the *Biodiversity Conservation Act 2016*, the objectives of which are: to conserve and protect biodiversity and biodiversity components in the State; and to promote the ecologically sustainable use of biodiversity components in the State. The reporting of threatened species and habitat recorded from EP Act surveys; provision of listing of critical habitat (for the survival of a threatened species or community), biodiversity management programs, recovery plans and interim recovery plans are some areas which will be included/ improved. The regulations are due for release towards the end of 2017.

Appendix 8B: Conservation code descriptions (Fauna) Western Australia

- Schedule 1: Fauna that is likely to become extinct (S1)
- Schedule 2: Fauna that is presumed to be extinct (S2)
- Schedule 3: Migratory birds protected under an international agreement (S3)
- Schedule 4: Other specially protected fauna (e.g. *Morelia spilota imbricata* – Carpet Python)

Appendix 8C: Conservation code descriptions (Flora) Western Australia

T: Threatened Flora (Declared Rare Flora — Extant)

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

1: Priority One: Poorly-known taxa

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

2: Priority Two: Poorly-known taxa

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

3: Priority Three: Poorly-known taxa

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

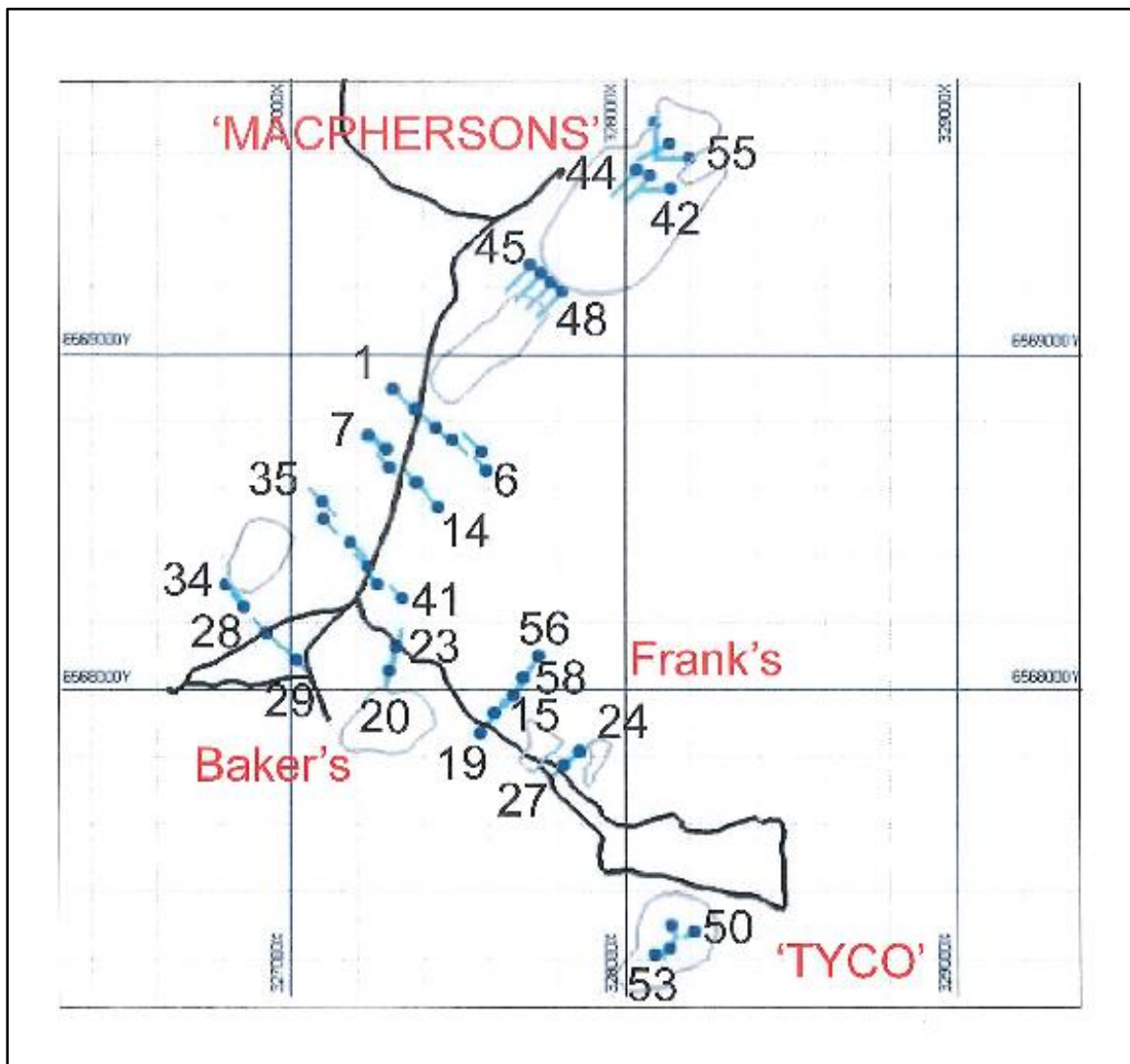
4: Priority Four: Rare, Near Threatened and other taxa in need of monitoring

1. Rare. Taxa that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These taxa are usually represented on conservation lands.
2. Near Threatened. Taxa that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.
3. Taxa that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

5: Priority Five: Conservation Dependent taxa

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

Appendix 9: Location of prospects within the study area with cap location numbering



Appendix 10: NVIS Vegetation structural types relevant for the survey area

Growth Form	Height (m)	Canopy Cover				
		70 – 100 %	30 – 70 %	10 – 30 %	2 – 10 %	< 2 %
Tree	10 – 30	Closed forest	Open Forest	Woodland	Open woodland	Isolated trees
	< 10	Low closed forest	Low open forest	Low woodland	Low open woodland	Low isolated trees
Tree mallee	10 – 30	Tall closed mallee forest	Tall open mallee forest	Tall mallee woodland	Tall open mallee woodland	Tall isolated mallee trees
	3 – 10	Closed mallee forest	Open mallee forest	Mallee woodland	Open mallee woodland	Isolated mallee trees
Shrubs	> 2	Tall closed shrubland	Tall shrubland	Tall open shrubland	Tall sparse shrubland	Tall isolated shrubs
	1 – 2	Closed shrubland	Shrubland	Open shrubland	Sparse shrubland	Isolated shrubs
	<1	Low closed shrubland	Low shrubland	Low open shrubland	Low sparse shrubland	Low isolated shrubs
Hummock grass	0.5 – 1	Closed hummock grassland	Hummock grassland	Open hummock grassland	Sparse hummock grassland	Isolated hummock grasses
	<0.5	Low closed hummock grassland	Low hummock grassland	Low open hummock grassland	Low sparse hummock grassland	Low isolated hummock grasses
Tussock & other grasses	0.5 – 1	Closed tussock grassland	Tussock grassland	Open tussock grassland	Sparse tussock grassland	Isolated tussock grasses
	< 0.5	Low closed tussock grassland	Low tussock grassland	Low open tussock grassland	Low sparse tussock grassland	Low isolated tussock grasses
Forb	0.5 – 1	Closed forbland	Forbland	Open forbland	Sparse forbland	Isolated forbs
	<0.5	Low closed forbland	Low forbland	Low open forbland	Low sparse forbland	Low isolated forbs
Ferns	<0.5	Low closed fernland	Low fernland	Low open fernland	Low sparse fernland	Low isolated ferns