NATIVE VEGETATION CLEARING PERMIT
MOUNT GOULD IRON PROJECT
M52/236

PREPARED FOR:

NEWCAM MINERALS PTY LTD

NOVEMBER 2024

[redacted]

MBS ENVIRONMENTAL

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MOUNT GOULD IRON ORE PROJECT
NATIVE VEGETATION CLEARING PERMIT

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1. INTRODUCTION

Newcam Minerals Pty Ltd (Newcam) owns and operates the Mount Gould Iron Project (the Project), located approximately 900 km north of Perth and 140 km west northwest of Meekatharra in the Mid west region of Western Australia (WA) (Figure 1). The Project is on tenement M52/236 which overlies the Mount Gould Pastoral Station.

Mount Gould has previously been mined for Micaceous Iron Ore (MIO), and a small pit is present on the saddle ridge between the two main peaks forming the landform. The summit of Mount Gould lies on the northeastern peak which attenuates to the west. The deposit was originally mined in two separate campaigns between 1995 and 2004 and produced approximately 8,000 t of ore during the period. Ore from early operations was crushed on site and transported to facilities in either Perth, Northam, or Jandakot for further crushing and processing. Historically the Project consists of exploration drilling, an open pit, waste landforms and associated support infrastructure including roads and access tracks, a maintenance shed and hardstand area, ore storage bays, ore load out and magazine hardstand area. In 2008, geological mapping and biological surveys were undertaken on the tenement however no physical works, including exploration were completed.

Newcam Minerals Pty Ltd (Newcam) acquired the Mount Gould Iron Project and the tenement in 2019. Following exploration drilling and some site layout planning, Newcam applied for a Purpose Permit (CPS 9417/1) for the clearing of 95.6 ha of native vegetation in August 2021, which was subsequently granted in May 2022. The CPS 9417/1 extent and associated indicative clearing footprint that has been used throughout this document to assess cumulative impacts is presented in Figure 2. Newcam also applied for and had approved two stages of works under mining proposals, with the most recent approved in February 2024 (Registration ID 120381).

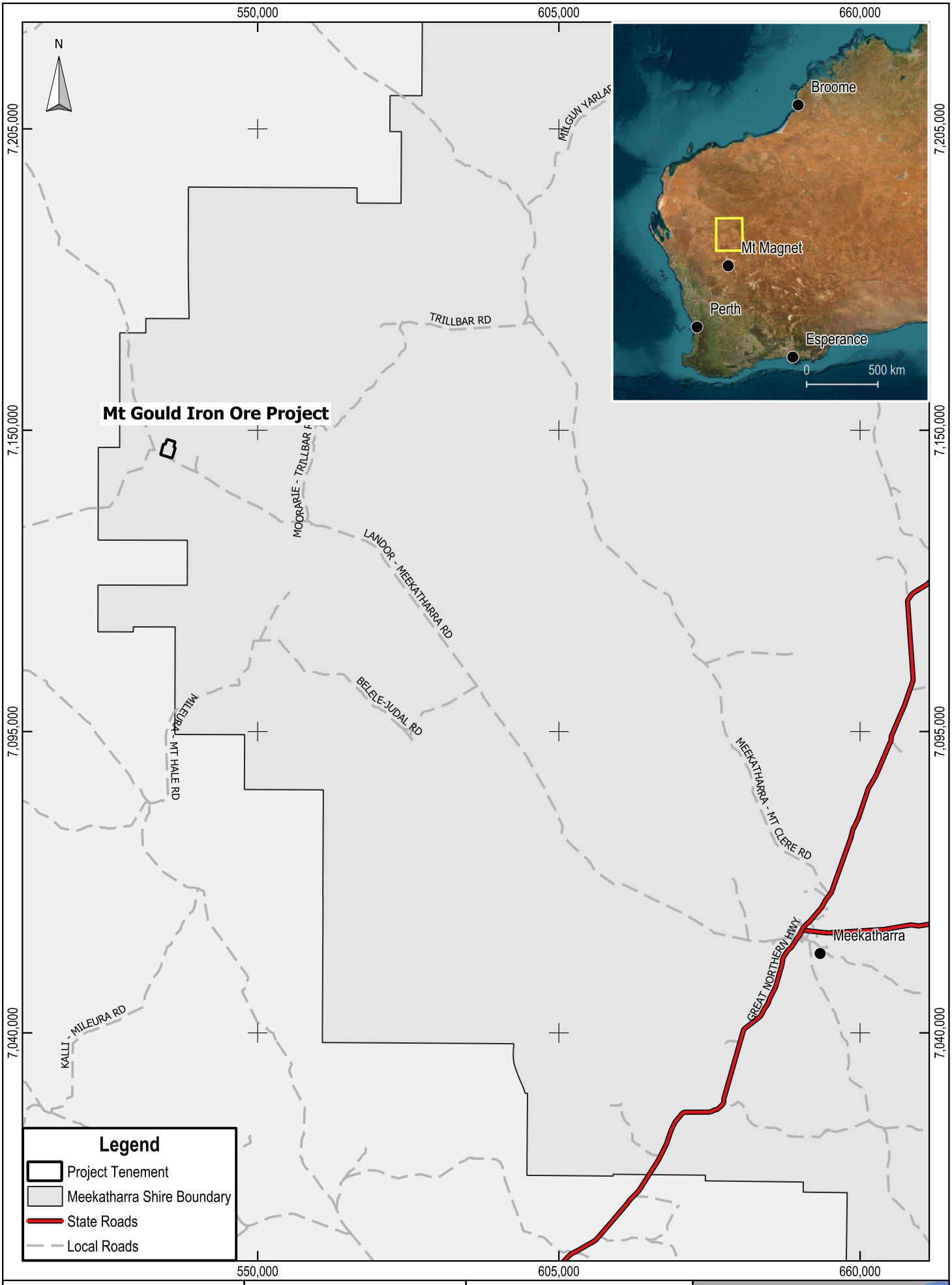
Newcam's current mining operations consist of a small-scale open pit and scree mining, crushing, and trucking operation, where ore is transported to Geraldton Port for direct shipping export. Newcam now intends to:

- Cutback the existing small open pit to increase the mined ore volumes.
- Widen the existing haul road leading to the Pit.
- Expand the existing waste rock dump (WRD) to accommodate extra waste from the proposed pit cutback.

The proposed additional works are being termed 'Stage 3'.

Clearing of native vegetation is required for the proposed Stage 3 works. Newcam proposes to clear 9.65 ha of native vegetation within a Purpose Permit Area of 15.79 ha (Figure 2). Note no additional clearing for widening of the haul road is anticipated to be required under this Native Vegetation Clearing Permit (NVCP), however as the proposed clearing is hard against the existing NVCP Purpose Permit Boundary (CPS 9417/1), this application looks to widen the Purpose Permit Area from within which the clearing would occur.

This document has been prepared to support the application for an additional Purpose Permit. This application is being submitted to the Department of Energy, Mines, Industry Regulation, and Safety (DEMIRS) in parallel with submission of a Stage 3 Mining Proposal (MP) and Mine Closure Plan (MCP) for evaluation of the environmental and social impacts of the Project and to outline how activities will be managed. The MP and MCP are anticipated to be submitted to DEMIRS in November 2024.



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Original Size: A4
Grid: GDA94 / MGA zone 50

0 10 20 km

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Mount Gould Iron Ore Project

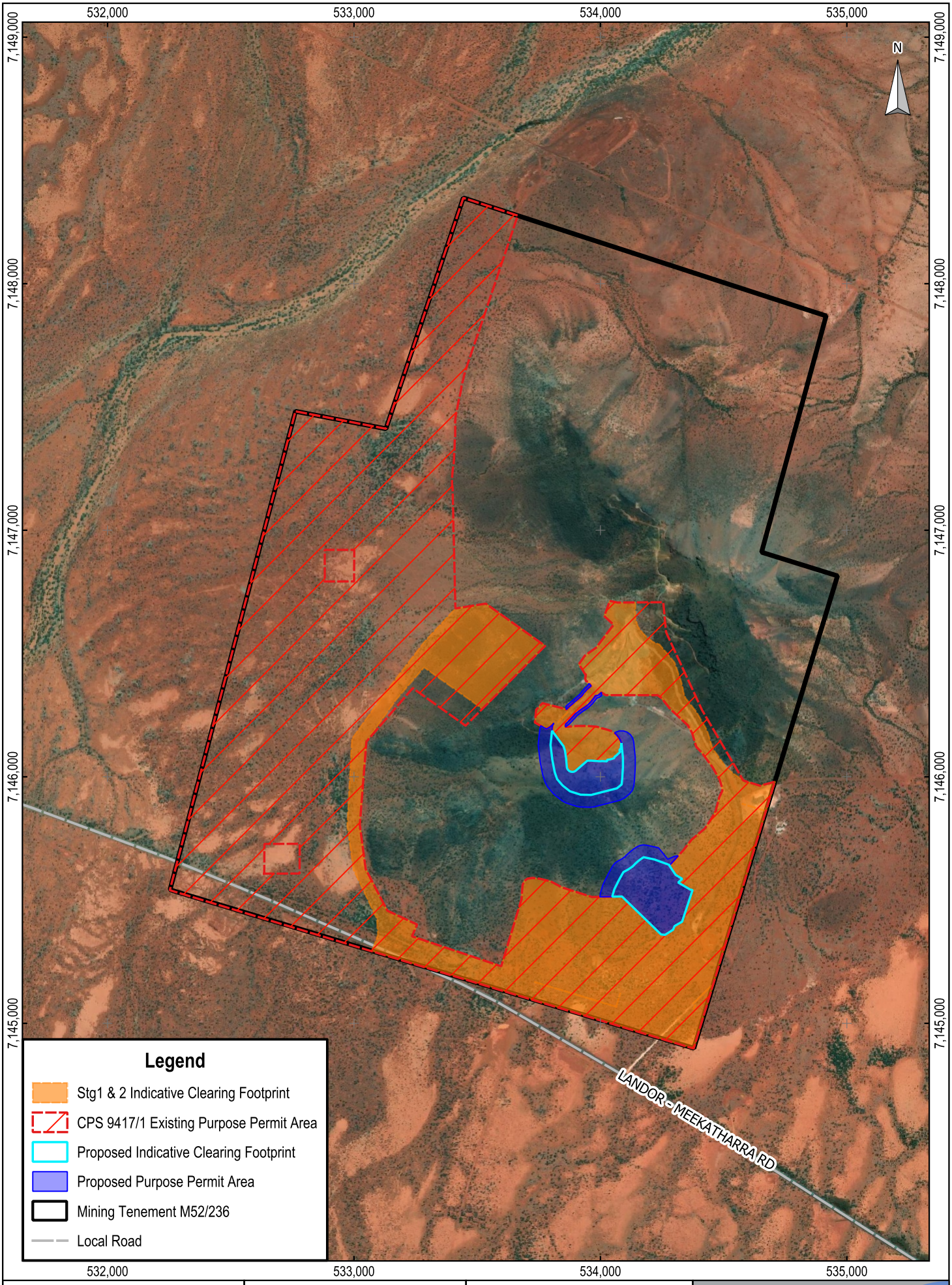
Figure 1

Mount Gould Project Location

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Scale: 1: 20,000
Original Size: A4
Grid: GDA94 / MGA zone 50

0 250 500 m

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Mount Gould Iron Ore Project

Figure 2

Existing and Proposed Purpose Permit Area

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\\mbssvr\working\Newcam Minerals\Approvals\Native Veg Clearing Permit\Stage 3_2024\GIS\Newcam_NVCP_Stage 3_2024.qgz 31/10/2024 F02 Existing and Proposed Purpose Permit Area

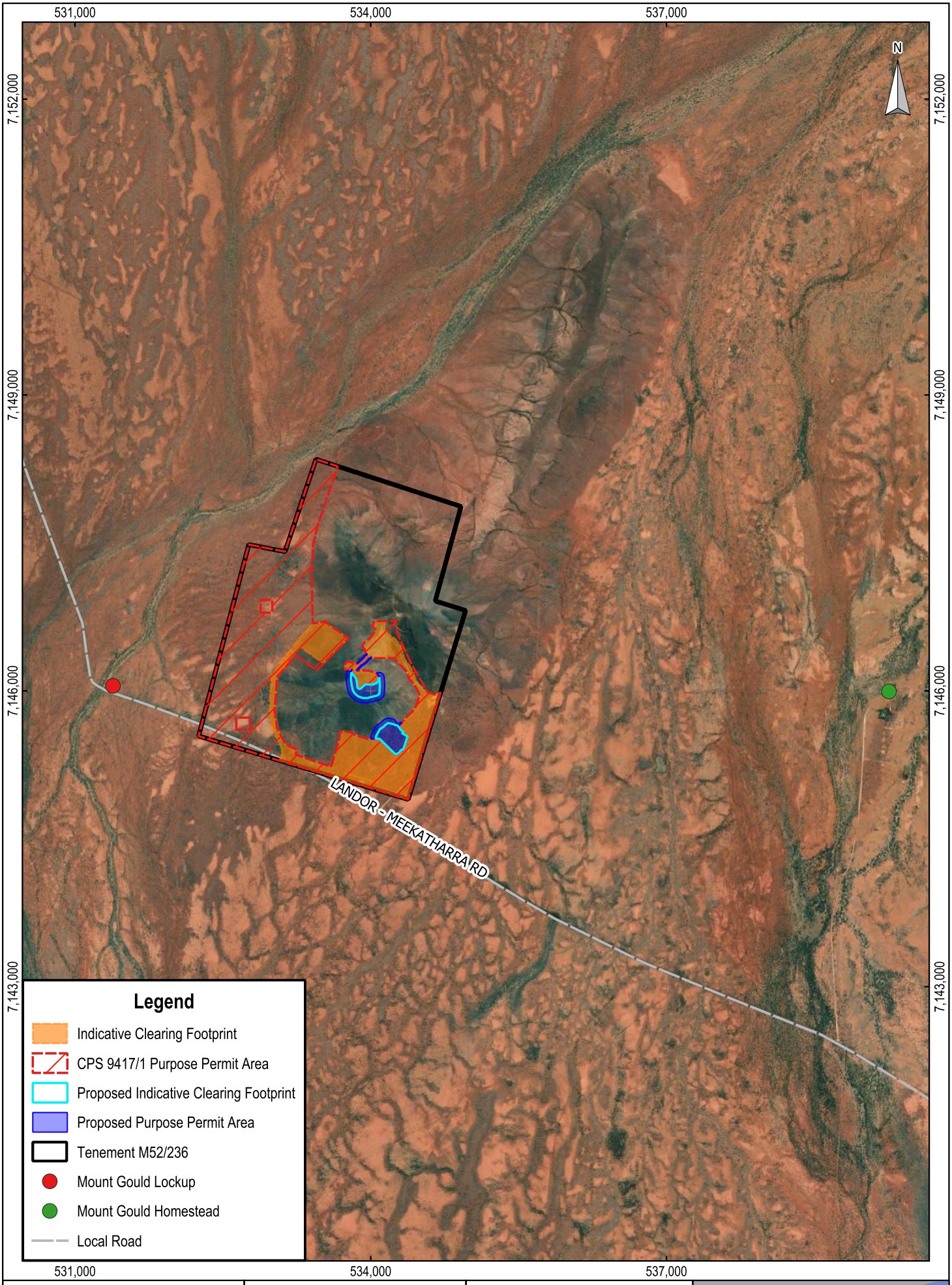
2. ACCESS AND TENURE

The Project is located in the Shire of Meekatharra within the Mid West region of Western Australia. The Project is located approximately 700 km north of Perth, 140 km west northwest of Meekatharra and approximately 500 km northeast of Geraldton and is accessed via the Great Northern Highway and the partially sealed Landor - Meekatharra Road (Figure 1). The Mount Gould Homestead and the historic Mount Gould Lock Up are located approximately 5 km east and 3 km west of the Project, respectively (Figure 3).

Newcam Minerals are the holders of the tenement in which the Purpose Permit Area is located and all decisions regarding the operations and management of the lease are solely made and authorised by Newcam. Relevant tenement details are provided in Table 1. A record of tenure ownership is provided in Appendix 1.

Table 1: Mount Gould Project Tenements

Tenement	Tenement Holder	Area (ha)	Grant Date	Expiry Date
M52/236	Newcam Minerals Pty Ltd	613.5	24/01/1992	23/01/2034



Scale: 1: 50,000
Original Size: A4
Grid: GDA94 / MGA zone 50

0 0.75 1.5 km

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Mount Gould Iron Ore Project

Figure 3

Access and Tenure

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3. BASELINE ENVIRONMENT

3.1 CLIMATE

The Purpose Permit Area is located within the Murchison Bioregion which experiences desert climate typified by hot dry summers and mild winters, commonly with 12 dry months a year. Rainfall is mostly unreliable and occurs predominantly in winter, however low erratic bimodal rainfall events are possible in both summer and winter (Tille 2006). A representative Bureau of Meteorology (BoM) weather station is located at Meekatharra Airport (Site 7045), approximately 140 km southeast of the Purpose Permit Area.

Climate data from the weather station shows monthly mean minimum temperatures range from 7.5°C to 24.5°C and monthly mean maximum temperatures range from 19.3°C to 38.4°C (Chart 1). The hottest month is January with a mean maximum temperature of 38.4°C and mean minimum temperature of 24.5°C, whilst July is the coldest month with average maximum and minimum temperatures of 19.3°C and 7.5°C, respectively (BoM 2024).

Mean annual rainfall is 232.5 mm (BoM 2024) with average rainfall peaking in February (Chart 1). Annual precipitation falls predominantly in late summer/ early autumn (January to March) with winter rains also apparent in June and July. Summer rains are influenced by tropical cyclones which form off the Pilbara coast between December and April and bring rain-bearing depressions into the region (Meissner *et al* 2009). Winter rains are influenced by strong cold fronts from the south weakening as they move upwards (Meissner *et al* 2009) bringing isolated showers and strong winds.

The single largest daily rainfall event was 114.4 mm, recorded in June 1989 (BoM 2024). The largest annual rainfall (since 1944) occurred in 2000 with the area receiving 573.2 mm (BoM 2024). Historically average annual rainfall has been received 45% of the time, however 2015 was the last time average annual rainfall has been received in recent years. The average annual rainfall is exceeded by the average annual evaporation rate of approximately 3,200 mm, by a factor of approximately 13.

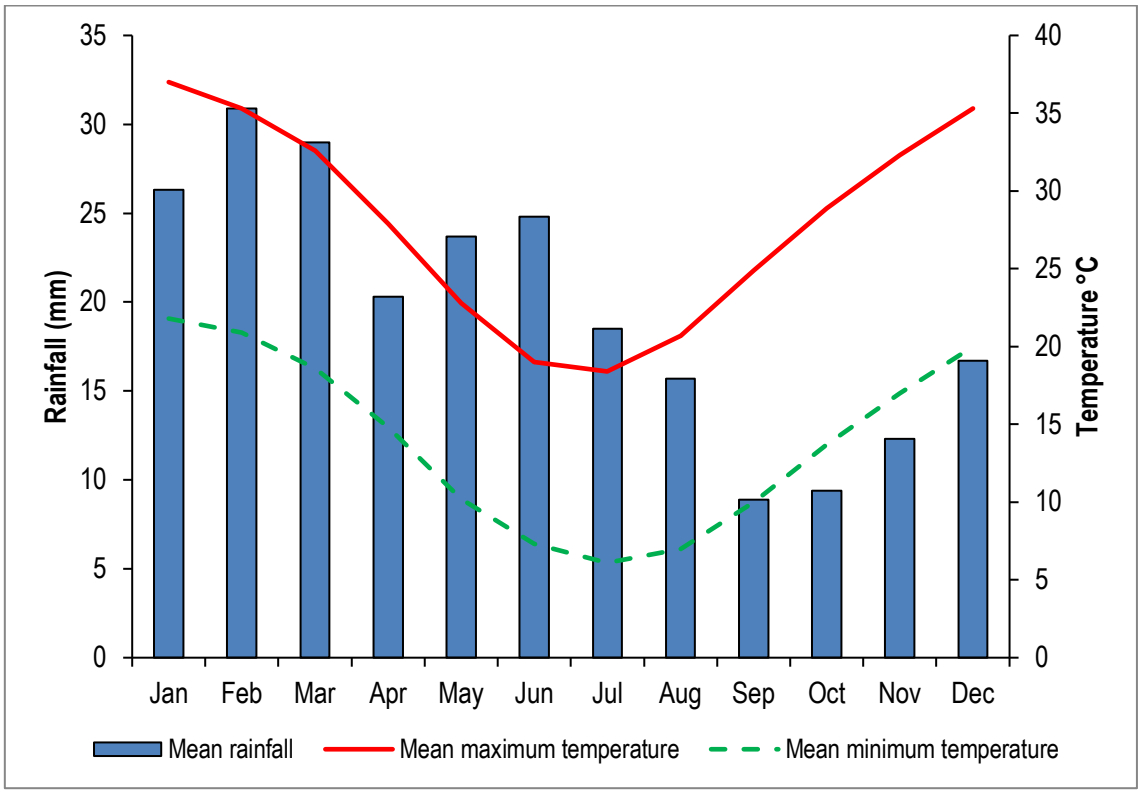


Chart 1: Meekatharra Airport Weather Station Climate Data 1944 – 2024 (BoM 2024)

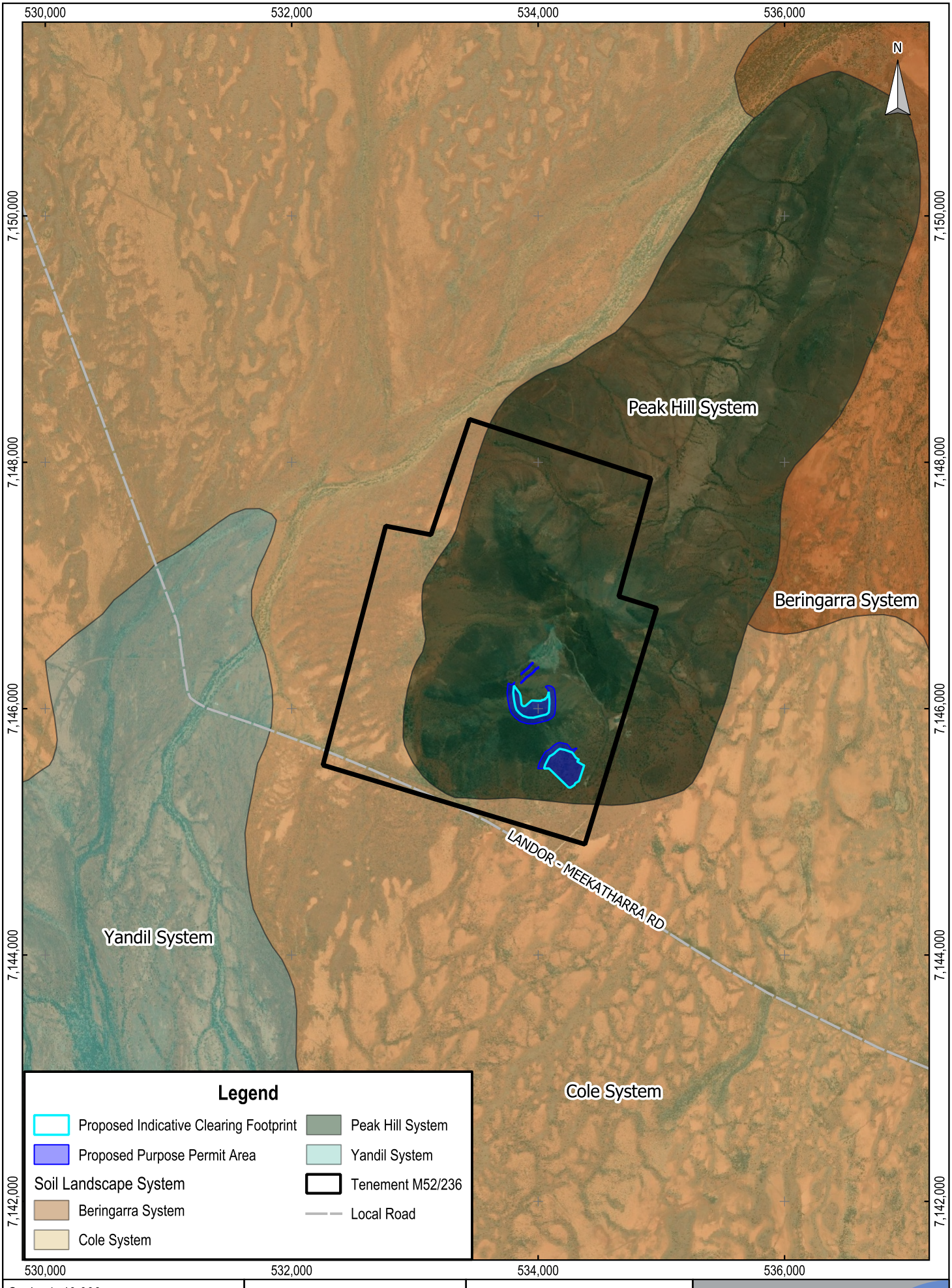
3.2 SOILS AND LAND SYSTEMS

A baseline soil and landform assessment was undertaken by MBS (2021) to broadly define the soil types in and surrounding the Project, identify any adverse characteristics of the soil types and any potential limitations for use of soils in project planning and rehabilitation. Based on this assessment, soils of the proposed Purpose Permit Area include Red-brown Hardpan Shallow Loams and Stony Soils/Bare Rock (MBS 2021).

Red-brown hardpan shallow loams are generally found on the gentle eastern hillslopes of Mount Gould and includes parts of the proposed WRD expansion within the Purpose Permit Area. These areas are characterised by a shallow red-brown silty layer that extended for between 30 - 60 cm below the surface, followed by heavily weathered fragile chemical sedimentary rock extended for approximately 1 m (MBS 2021). This soil type supports moderate cover of 1-2 m shrubs and an associated understory of perennial grasses, herbs, and forbs. This soil type is subject to sheet erosion and can have a moderate to high risk of erosion after major depletion of perennial plants (Hennig 2009). However, as elevation in the landscape increases, soils become increasingly skeletal in nature, and the volume of soil present decreases as a dense surface gravel and outcropping layer becomes prominent (MBS 2021), reducing the risk of erosion. As the WRD expansion occurs in an area of elevation that is relatively low for this soil type, red-brown hardpan shallow loams will likely dominate, with some surface gravel and outcropping present.

Stony soils are common throughout the northern portion of the Purpose Permit Area, typically aligning with the peaks of Mount Gould and are characterised by containing >20% cobbles (>16 mm) by mass (MBS 2021). In relation to the Purpose Permit Area, these soils occur in the pit cutback and road widening area, as well as some parts of the WRD expansion. These soils contain a dense cover of surface gravel and support a moderate cover of 1-2 m shrubs and associated understory of perennial grasses, herbs, and forbs (MBS 2021). The soil surface is outcropping rock or a dense stony mantle and are not prone to any erosion risk (Hennig 2009).

A third less mentioned soil type that is present within the Purpose Permit Area is bare rock. Based on mapped soil types (MBS, 2021) and on-site anecdotal evidence, bare rock occurs predominantly in areas of high elevation, which include the proposed pit cutback and haul road widening.



Scale: 1: 40,000
Original Size: A4
Grid: GDA94 / MGA zone 50

0 0.5 1 km

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Mount Gould Iron Ore Project

Figure 4

Landscape Systems of the Project Area

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\\mbssvr\working\Newcam Minerals\Approvals\Native Veg Clearing Permit\Stage 3_2024\GIS\Newcam_NVCP_Stage 3_2024.qgz 31/10/2024 F04 Land Systems

3.3 FLORA AND VEGETATION

A number of flora and vegetation assessments have been undertaken across the tenement, encompassing the Purpose Permit Area, these include:

- Mount Gould Flora and Vegetation Assessment Desktop Review (Woodman 2008).
- Mount Gould DSO Project Flora and Vegetation Assessment (Woodman 2009).
- Mount Gould Proposed Exploration Drilling Program Conservation Significant Flora and Vegetation Assessment - Draft (Woodman 2010).
- Mount Gould DSO Project Local and Regional Significant Flora Assessment and Regional Vegetation Review (Woodman 2012).
- Mount Gould: Flora and Vegetation Assessment (Biologic 2023).
- Targeted Flora Survey - Mining Tenement M52/236-I (Emerge 2024a).
- Targeted Flora Survey - Haul Road and Scree Deposit (Emerge 2024b).

Except for the Woodman 2010 and both Emerge Targeted Flora surveys, which focus on specified footprints within the Purpose Permit Area, the survey extent of the baseline flora studies corresponds with the tenement boundary (survey area) and covers an area of 613 ha. The Woodman 2010 report remains in draft form and does not provide any further information to what was provided in the other baseline flora reports. For this reason, the report has not been heavily referred to for analysis and assessment of the baseline environment. The Biologic 2022 survey includes the area north of the M52/236 tenement, encompassing the Mount Gould PEC area. Baseline flora survey reports are attached in Appendix 2, Appendix 3, Appendix 4, Appendix 5, Appendix 6, Appendix 7, and Appendix 8.

3.3.1 Pre-European Vegetation Associations

Pre-European vegetation associations (VAs) of Western Australia were first mapped by Beard (1976) and later reinterpreted and redefined by Shepherd (*et al* 2002) to reflect national standards and the extensive clearing undertaken since the Beard mapping (1976). One pre-European vegetation association, number 202, is within the Purpose Permit Area. Vegetation association 202 has been described as "*Scrub, open scrub or sparse scrub with Wattle, teatree & other Acacia spp. And Melaleuca spp.*" (DPIRD 2021b). The current and pre-European extents of the vegetation association is shown in Table 2.

Table 2: Pre-European Vegetation Systems and Extent

Pre-European VA	Pre-European Extent (ha)	Current Extent (ha)
202	448,529.31	448,343.80

3.3.2 Vegetation Communities

Baseline flora survey (Biologic 2023) mapped and described twelve vegetation types within the survey area of which four intersect the proposed Purpose Permit Area and Indicative Clearing Footprint. No more than 9.65 ha is proposed to be disturbed within the Purpose Permit Area. The vegetation types are described in Table 3 and shown in Figure 5.

Table 3: Vegetation Types of the Survey Area and Mount Gould

Broad Landform / Vegetation Type	Summary	Overall Surveyed Extent (ha/%)	Surveyed Extent Within Indicative Clearing Footprint (ha/%)
Drainage / Floodplain		**209.05 (11.77%)**	**0 (0%)**
D1 AaAptApr (D1)	Forming from the minor drainage lines and depressions on slopes and plains. Significant flora present: *Eremophila warnesii* (P1), *Halgania gustafsenii var. Murchison* (T) and *Tribulus adelacanthus* (P3). Overall Condition: Good to Very Good.	38.90 (2.19%)	0 (0%)
F1 MacScdi (F1)	Claypan on plains. Presents optimal habitat for *Rhodanthe sphaerocephala*. Overall Condition: Good to Very Good.	96.77(5.45%)	0 (0%)
F2 ArhErarArc (F2)	Sandy clay plains on foothills of Survey area. Significant flora present: *Halgania gustafsenii var. Murchison* (T) and *Tribulus adelacanthus* (P3).	73.38(4.13%)	0 (0%)
Hills, Crests and Slopes		**471.36 (26.54%)**	**9.65 (2.05%)**
H1 PhbcErlt Tm (H1)	Crest of southern hill. Significant flora present: *Eremophila warnesii* (P1). Representative of the Mt Gould PEC. Overall Condition: Excellent.	18.22 (1.03%)	2.28 (12.52%)
H2 PtoErwErlc (H2)	Crests and slopes to upper slopes of Mt Gould, mostly northern aspect. Presents optimal habitat for *Eremophila warnesii* (P1). Other significant flora present: *Halgania gustafsenii var. Murchison* (T) and *Tribulus adelacanthus* (P3). Representative of the Mt Gould PEC. Overall Condition: Very Good to Excellent.	48.67 (2.74%)	0 (0%)
H3 AaAciAr (H3)	Crests and slopes to upper slopes of Mt Gould, mostly southern and western aspect. Significant flora present: *Eremophila warnesii* (P1), *Halgania gustafsenii var. Murchison* (T) and *Tribulus adelacanthus* (P3). Representative of the Mt Gould PEC. Overall Condition: Very Good to Excellent.	68.00 (3.83%)	1.42 (2.08%)
S1 AaAinAf (S1)	Lower slopes and foothills of Mt Gould, mostly southern aspect. Presents optimal habitat for *Halgania gustafsenii var. Murchison* (T). Other significant flora present: *Eremophila warnesii* (P1) and *Tribulus adelacanthus* (P3). Possible representative of the Mt Gould PEC.	125.15(7.05%)	0 (0%)
S2 ArAptAin (S2)	Lower slopes and foothills of Mt Gould, mostly northern aspect. Significant flora present: *Eremophila warnesii* (P1), *Halgania gustafsenii var. Murchison* (T) and *Tribulus adelacanthus* (P3). Possible representative of the Mt Gould PEC.	116.24 (6.55%)	0 (0%)
S3 AinApt (S3)	Lower slopes and foothills of Mt Gould, mostly eastern aspect. Presents optimal habitat for *Halgania gustafsenii var. Murchison* (T). Other significant flora present: *Eremophila warnesii* (P1) and *Tribulus adelacanthus* (P3). Possible representative of the Mt Gould PEC.	66.83 (3.76%)	5.95 (8.90%)

Broad Landform / Vegetation Type	Summary	Overall Surveyed Extent (ha/%)	Surveyed Extent Within Indicative Clearing Footprint (ha/%)
S4 AaGrbAf (S4)	Bands of ironstone crests follow the bedrock geology associated with the northern extent of the PEC. Significant flora present: *Halgania gustafsenii var. Murchison* (T) and *Tribulus adelacanthus* (P3). Possible representative of the Mt Gould PEC.	28.25 (1.59%)	0 (0%)
Plains		**900.36 (50.70%)**	**<0.1 (<0.1%)**
P1 ErfrSeaPtro (P1)	Stony plains of the northern Mt Gould PEC. Presents optimal habitat for *Tribulus adelacanthus* (P3). Other significant flora present: *Halgania gustafsenii var. Murchison* (T). Overall Condition: Good to Very Good.	639.24 (35.99%)	0 (0%)
P2 ArrAkApt (P2)	Stony and sandy plains of the foothills of the Survey Area. Presents optimal habitat for *Tribulus adelacanthus* (P3). Other significant flora present: *Eremophila warnesii* (P1) and *Halgania gustafsenii var. Murchison* (T). Overall Condition: Poor to Excellent.	261.12 (14.70%)	0.002 (<0.1%)
Other		**195.16(10.99%)**	**0 (0%)**
Cleared	Cleared	42.28 (2.38%)	0 (0%)
Unsurveyed	Unsurveyed area within Mt. Gould PEC	152.88 (8.61%)	0 (0%)
	Total	**1775.93**	**9.65 (0.54%)**

In general, the vegetation in the survey area was in 'Excellent' to 'degraded' condition, with the majority considered to be in excellent or very good condition (21.35% and 52.51% respectively) (Biologic 2023). The main disturbances observed were associated with introduced flora and mining/exploration related activities or historic infrastructure, including drill pads, tracks, and camp remnants. There were minor signs of goat and cattle grazing and trampling, and introduced taxa usually spread by livestock were low in number and extent (Biologic 2023).

Previous baseline flora surveys indicated no Threatened Ecological Communities (TEC) pursuant to Commonwealth and State legislation are located within the survey area and therefore the Purpose Permit Area (Woodman 2009, Woodman 2012). However, the surveys have indicated the presence of one Priority 1 Ecological Community (PEC), the Mount Gould Vegetation Complex BIF (the Mount Gould PEC), listed at State level by the Department of Biodiversity, Conservation and Attractions (DBCA) (Woodman 2009, Woodman 2012).

Twenty-eight BIF ranges including Mount Gould as part of the Jack Hills complex were identified in a strategic review of the BIF ranges in the Midwest and Goldfields (DBCA 2007). The Biologic (2023) report considered the Jack Hills complex a priority area for conservation where threats include mining with significant potential loss through cumulative impacts. The community types of the Jack Hills BIF complex, including Mount Gould are recognised as endemic to the respective ranges (DBCA 2007). Considering this endemism and cumulative threats of mining the ranges, the vegetation types representative of the Mount Gould BIF PEC are considered to be high local and high regional significance. The vegetation types possibly representative of the Mount Gould BIF PEC are considered of moderate local and low regional significance.

Recent search results from the DBCA Threatened and Priority Ecological Community Database confirmed findings from the baseline surveys to be valid, indicating no presence of TECs within the Purpose Permit Area (DBCA 2021a), and the presence of the Mount Gould PEC. The mapped extent of the Mount Gould PEC (inclusive of a 500 m buffer) is 1,683.7 ha, which overlaps the entirety of the 15.79 ha Purpose Permit Area and 9.65 indicative clearing footprint (Figure 6 and Table 4).

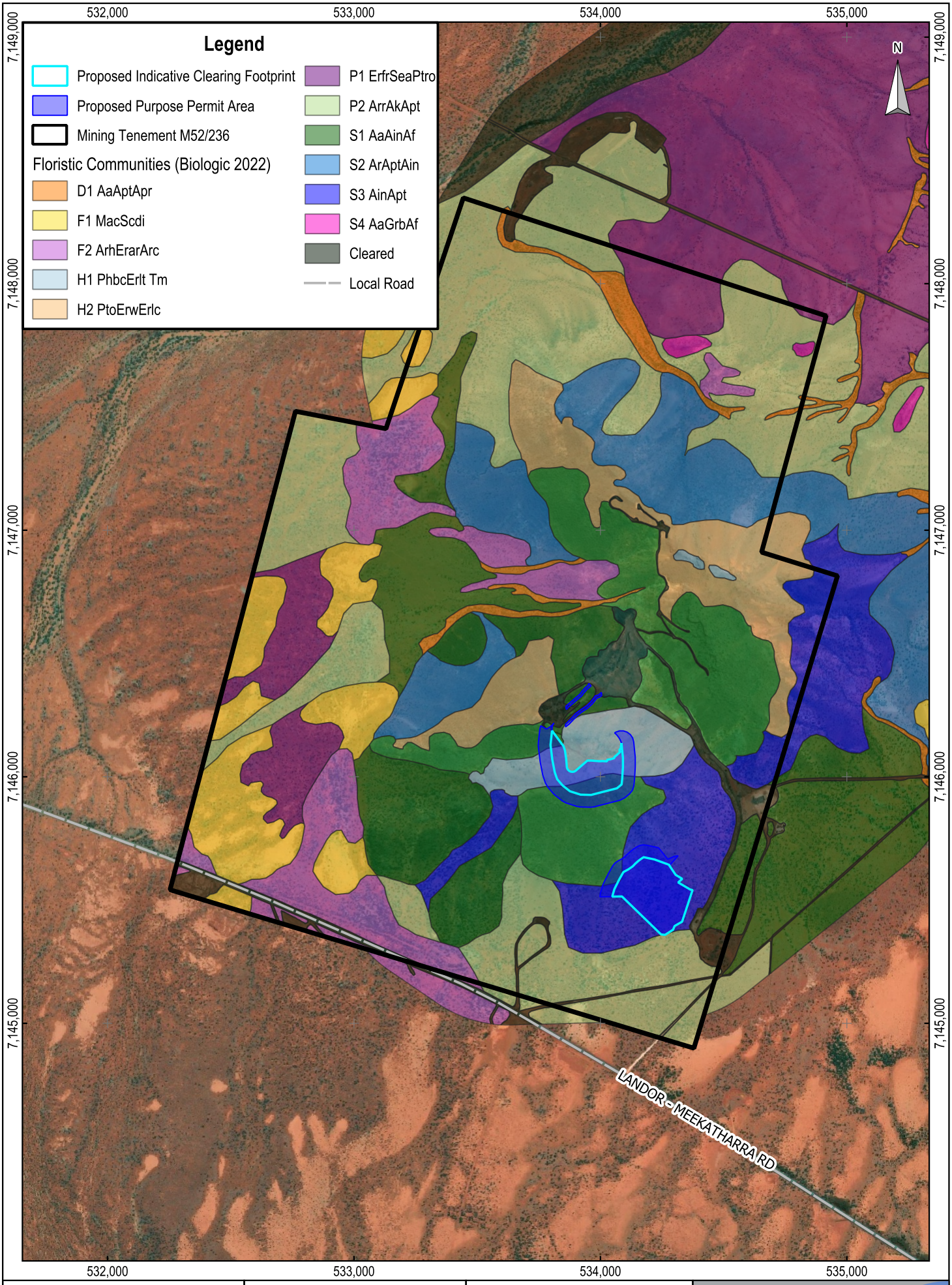
Vegetation types holding refuge for significant flora habitat are also considered when determining local and regional significance. Six vegetation types were considered by Biologic to provide optimal habitat for significant flora. Three of these vegetation types are considered to be of greater significance as they hold optimal habitat for significant flora that is restricted or known from fewer than ten records. The population of *Eremophila warnesii* occurring at Mount Gould is a considerably different habitat type for the taxon (usually recorded from sandy plains) and only occurs on this BIF range in the Yilgarn craton. This taxon has a limited distribution in the broader area. Habitats for *Eremophila warnesii* hold high local and high regional significance. The vegetation types supporting *Halgania gustafsenii var. Murchison* are also considered to hold high local and high regional significance due to the endemism of this taxon. The other three vegetation types supporting optimal habitat for significant flora are considered to have moderate local and low regional significance as these taxa have a broader regional distribution and are known from more populations (Biologic 2023).

Local and regional significance of the vegetation types present within the Purpose Permit Area can be considered as follows according to Biologic (2023):

- High local and high regional significance:
  - H1: as a representation of the Mount Gould BIF PEC.
  - H3: as a representation of the Mount Gould BIF PEC.
  - S3: as a possible representation of the Mount Gould BIF PEC, and optimal habitat for endemic *Halgania gustafsenii var. Murchison*.
- Moderate local and low regional significance:
  - P2: optimal habitat for *Tribulus adelacanthus*.

Table 4: Potential Cumulative Impacts to Mount Gould PEC

Total Mapped Extent (ha)	Stage 1 + 2 Approved Impact (ha/%)	Stage 3 Potential Impacts (ha/%)	Cumulative Impacts (ha/%)
1,683.7	95.76 (5.69)	9.65 (0.57)	105.36 (6.26)



Scale: 1: 20,000
Original Size: A4
Grid: GDA94 / MGA zone 50

0 250 500 m

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Mount Gould Iron Ore Project

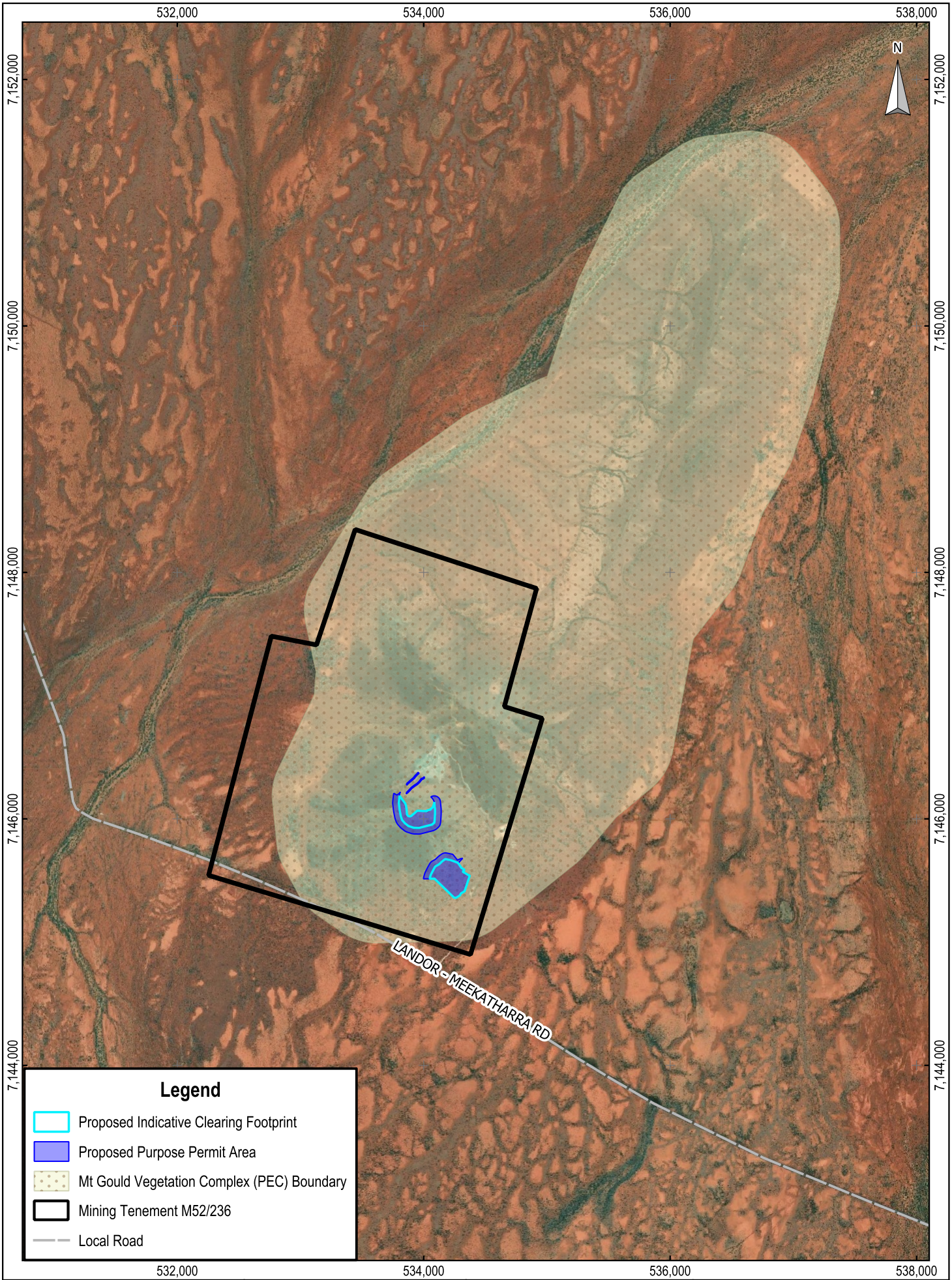
Figure 5

Floristic Community Types in the Survey Area

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\\mbssvr\working\Newcam Minerals\Approvals\Native Veg Clearing Permit\Stage 3_2024\GIS\Newcam_NVCP_Stage 3_2024.qgz 31/10/2024 F05 Floristic Community Types



Scale: 1: 40,000
Original Size: A4
Grid: GDA94 / MGA zone 50

0 0.5 1 km

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Figure 6

Mount Gould PEC Extent

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3.3.3 Significant Flora Species

Results from the database searches conducted as part of the desktop assessments by Biologic 2023, recognised 31 significant flora species with the potential to occur within proximity to the Project. This included one Threatened species, ten Priority 1 species, four Priority 2 species, 13 Priority 3 species and three Priority 4 species (Table 5). Table 5 summarises the likelihood of occurrence of these species pre- and post-survey. Some taxa that were returned in the database searches may have little or no likelihood of occurring within the Survey Area. Justification for the assigned likelihood of occurrence is provided in Appendix 6.

The Threatened taxon, *Pityrodia augustensis* was returned from a search of the EPBC database search. This database often provides a conservative and broad indication of significant taxa present for an area. *P. augustensis* is known to occur primarily within the Mt Augustus locality and is considered Unlikely to occur in the Survey Area (Biologic 2023). Of the 30 Priority flora species with potential to occur at the Project, four have been recorded to date as shown in Table 5.

MBS Environmental (MBS) reviewed and verified the conservation status of all species identified in the database searches as of October 2024.

Table 5: Significant Flora Likelihood of Occurrence Assessment

Significant Flora Species	Conservation Status		Pre-Survey Likelihood of Occurrence	Post-Survey Likelihood of Occurrence
	EPBC Act (BC Act)	DBCA		
Acacia sp. Jack hills		P1	Possible	Possible
Angianthus microcephalus		P2	Likely	Possible
Calytrix praecipua		P3	Possible	Unlikely
Calytrix verruculosa		P3	Possible	Possible
Dodonaea amplisemina		P4	Possible	Unlikely
Eremophila sp. Ironstone		P1	Possible	Possible
Eremophila margarethae subsp. straight sepals		P1	Possible	Possible
Eremophila petrophila subsp. densa		P3	Possible	Unlikely
Eremophila prolata		P1	Unlikely	Unlikely
Eremophila warnesii ms		P1	Recorded	Recorded
Frankenia confusa		P4	Likely	Possible
Goodenia berringbinensis		P4	Possible	Unlikely
Gunniopsis divisia		P3	Highly Unlikely	Highly Unlikely
Halgania gustafsenii (var. Murchison)		EN	Recorded	Recorded
Hemigenia tysonii		P3	Possible	Unlikely
Hemigenia virescens		P3	Possible	Unlikely
Homalocalyx echinulatus		P3	Possible	Unlikely
Indigofera fractiflexa subsp. Augustensis		P2	Possible	Unlikely
Lepidium xylodes		P1	Possible	Possible
Maireana murrayana		P3	Unlikely	Unlikely
Maireana prosthecochaeta		P3	Unlikely	Highly Unlikely
Neotysonia phyllostegia		P1	Highly Unlikely	Highly Unlikely
Thysanotus fragrans (formerly Murchisonia)		P2	Highly Unlikely	Highly Unlikely
Ptilotus lazaridis		P3	Likely	Possible
Ptilotus tetrandrus		P1	Possible	Possible

Significant Flora Species	Conservation Status		Pre-Survey Likelihood of Occurrence	Post-Survey Likelihood of Occurrence
	EPBC Act (BC Act)	DBCA		
Pityrodia augustensis	VU	-	Highly Unlikely	Highly Unlikely
Prostanthera ferricola		P3	Possible	Unlikely
Rhodanthe sphaerocephala		P1	Recorded	Recorded
Stenanthemum mediale		P1	Possible	Unlikely
Tribulus adelacanthus		P3	Recorded	Recorded
Verticordia jamiesonii		P3	Likely	Possible

Field surveys carried out between 2009 and 2024 (Woodman 2009, Woodman 2010, Woodman 2012, Biologic 2023, Emerge 2023, Emerge 2024a, Emerge 2024b) recorded and confirmed the presence of four significant flora species within the surveyed areas (Table 5), including *Eremophila warnesii* (P1), *Halgania gustafsenii* variance Murchison (T), *Rhodanthe sphaerocephala* (P1) and *Tribulus adelacanthus* (P3).

E. warnesii is known to occur on red-brown clayey sand on open scrub. During the surveys it was recorded on the steep banded ironstone slope of Mount Gould often with northern aspect and within open shrublands on red-brown sandy soil plains with no significant elevation in regional areas (Biologic 2023). This taxon is known from the Murchison and Gascoyne.

H. gustafsenii var. Murchison is known to occur on the lower slopes of Mount Gould, predominantly western aspect and adjacent on ironstone outcropping, quartz ridges, sandy loam, and clay soils and in drainage depressions. The recorded individuals within and immediately outside the eastern boundary of M52/236 are defined as a single population (Biologic 2023). A second population of the species is known to occur approximately 2 km north of Population 1 outside of M52/236 but within the defined Mount Gould PEC boundary (Figure 7). In 2023, a supplementary targeted survey for the species recorded an additional 4,364 individuals. It was noted further undocumented *H. gustafsenii* var. Murchison individuals were considered likely to occur in the Project surrounds (Emerge 2023).

R. sphaerocephala is found on flat and claypan in clayey loam soils and was observed on open claypans flats/depressions during the surveys. This taxon has a known distribution from the Gascoyne and Murchison. Observations made during the regional survey are indicative of a new population for this taxon (Biologic 2023).

T. adelacanthus is known to occur on hillslopes, banded ironstone in red-brown shallow sandy loam soils. During the surveys, this taxon was observed on banded ironstone slopes, sandy clay plains and cobble flats during the field survey. This taxon has a broad distribution throughout the Gascoyne and Murchison (Biologic 2023).

In addition to the field surveys, known data records held by adjacent landholders have also been taken into account when determining total numbers of significant flora present. The total number of recorded individuals for each significant flora species occurring at the Project, from all data sources is provided in Table 6 and shown in Figure 7.

Table 6 shows the overall number of individual flora species impacted by the various stages of the Project. The proposed clearing within the Purpose Permit Area will not impact any known significant flora species. Table 6 also outlines the potential cumulative impacts (Stage 1 + Stage 2 + Stage 3) of the Project.

Table 6: Records and Potential Impacts to Significant Flora

Significant Flora Taxa	No. of Recorded Individuals[1]	No Taken by 2022-2024 Clearing[3] (No. /%)	Approved Additional Take (Stage 1 + Stage 2)	Stage 3 Potential Impacts (No. /%)	Potential Cumulative Impact (No. /%)
Eremophila warnesii (P1)	16,967	15 (<0.1%)	41	0 (0%)	56 (0.3%)
Halgania gustafsenii (T)	18,355	774 (4.2%)	3	0 (0%)	777 (4.3%)
Rhodanthe sphaerocephala (P1)	154	0 (0%)	2	0 (0%)	2 (1.9%)
Tribulus adelacanthus (P3)	2,451	301 (12.3%)	1	0 (0%)	302 (12.4%)

[1] *Includes survey data from Woodman 2008, 2009, 2012, Biologic 2023, Emerge 2024a, Emerge 2024b and other publicly available information.*

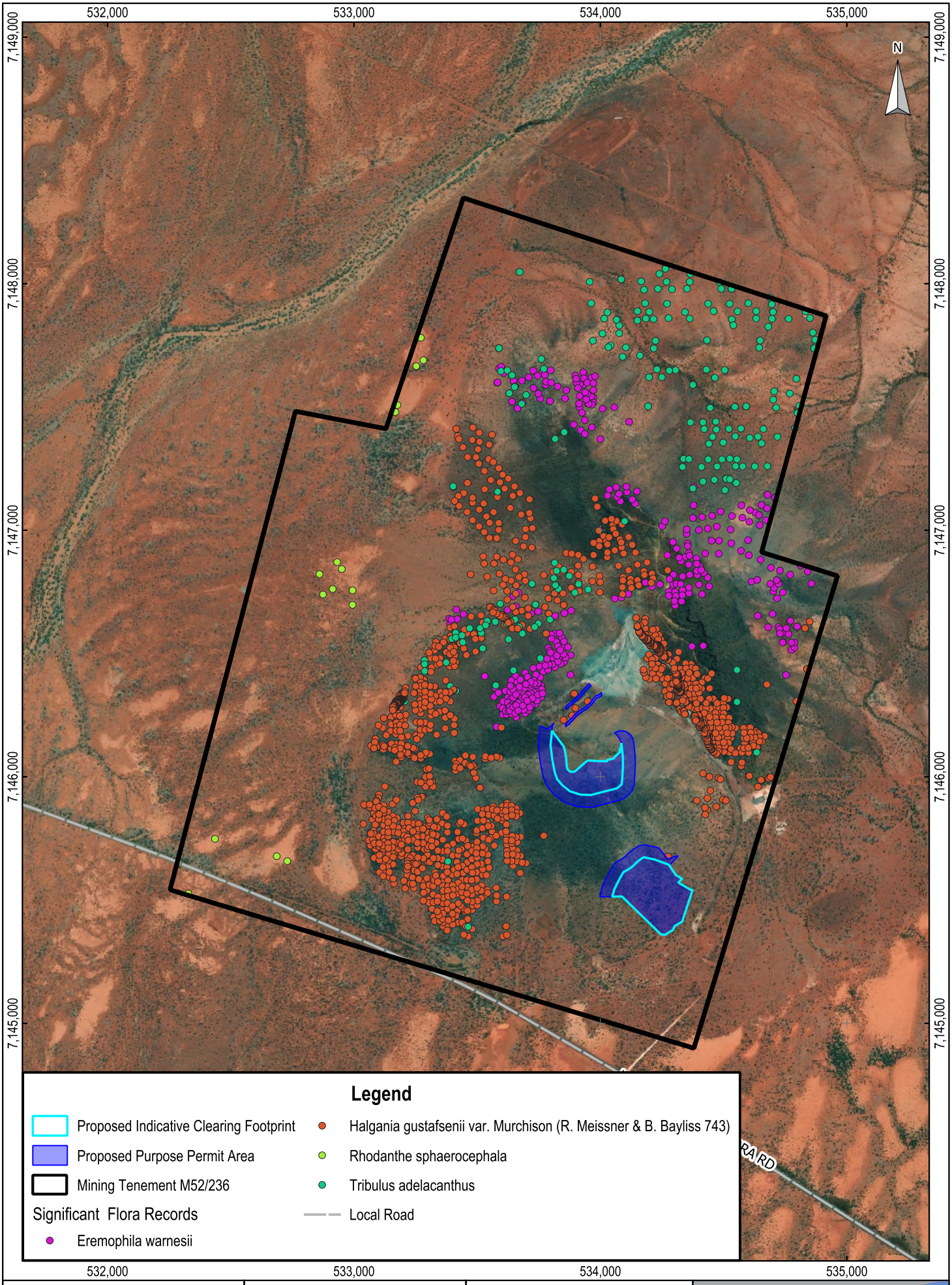
[2] *The total number of recorded individuals excludes any occurrence of significant flora in historical disturbance areas of the Project.*

[3] *The current total number of individuals impacted under CPS 9417/1 between 2022-2024.*

3.3.4 Introduced Flora Species

Biologic (2023) identified the presence of eight introduced taxa in the Survey Area; none of which are recognised as a Weed of National Significance (WoNS) or a 'Priority Alert' weed by Parks and Wildlife. Overall, there were few individual weeds across the Survey Area. *Cuscuta epipthymum* and *Cuscuta planiforra* (Dodder) had the greatest abundance (15 individuals each) and *Cenchrus ciliaris* (Buffel grass) had the greatest distribution (10 individuals from three locations). Introduced flora were more prevalent on the lower landforms, particularly drainage lines, floodplains, and stony plains where seeds are more easily dispersed by water, water availability, and livestock grazing.

One introduced species was previously recorded in the survey area, *Portulaca oleracea* (Duckweed) (Woodman, 2009). This species is not recognised as a Weed of National Significance (WoNS) or Declared Pest under the *Biosecurity and Agriculture Management Act 2007* (WA).



Scale: 1: 20,000
Original Size: A4
Grid: GDA94 / MGA zone 50

0 250 500 m

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Figure 7

Significant Flora Recorded in the Survey Area

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\\mbssvr\working\Newcam Minerals\Approvals\Native Veg Clearing Permit\Stage 3_2024\GIS\Newcam_NVCP_Stage 3_2024.qgz 31/10/2024 F07 Significant Flora Recorded in the Survey Area

3.4 TERRESTRIAL FAUNA AND HABITAT

Fauna and habitat baseline studies undertaken across the tenement, and therefore the Purpose Permit Area, include:

- Mount Gould Vertebrate Fauna Study (Biologic 2012a)
- Mount Gould SRE Invertebrate Study (Biologic 2012b).
- Mount Gould Vertebrate Fauna Desktop Assessment (Biologic 2022a).
- Mount Gould Basic Terrestrial Vertebrate Fauna Survey (Biologic 2022b).

The survey extent of the baseline fauna studies corresponds with the tenement boundary (survey area) which covers an area of 613 ha. Survey reports are attached in Appendix 9, Appendix 10, Appendix 11, and Appendix 12 respectively.

3.4.1 Significant Vertebrate Fauna Habitat

The Biologic (2022b) survey reviewed the seven fauna habitat types identified by Biologic in 2012 (2012a). Five broad fauna habitats were delineated and characterised within the survey area (Biologic 2022b) as described in Table 7 and shown in Figure 8 and include:

- Rocky Hill.
- Sandy Plain.
- Stony Plain.
- Rocky Outcrop/Breakaway
- Minor Drainage Line.

Rocky outcrop/Breakaway and Sandy Plain habitats were considered to be of moderate significance, as they provide critical habitat for a number of significant species including the Long-tailed Dunnart and Peregrine Falcon within Rocky Outcrop/Breakaway habitat and the Brush-tailed Mulgara within the Sandy Plain habitat (Biologic 2022b). The remaining three fauna habitats (Rocky Hill, Stony Plain and Minor Drainage Line) may provide supporting habitat (i.e. foraging and dispersal) for some significant species; however, are unlikely to be relied upon for the persistence of any species at a local or regional scale and are therefore deemed low significance. All mapped habitats mapped occur more broadly across the Murchison bioregion (Biologic 2022b).

The Indicative Clearing Footprint will impact Rocky Hill, Sandy Plain, Rocky Outcrop/Breakaway and Minor Drainage Line habitats, with the Minor Drainage Line habitat being impacted the greatest at nearly 9% of its mapped extent (Table 7). Note the Purpose Permit Area contains the same habitats as the indicative clearing footprint and no more than 9.65 ha within this Purpose Permit Area will be disturbed.

Table 8 shows the cumulative impacts from the Project. From this it can be seen that the Minor Drainage Line and Sandy Plains will experience the most significant cumulative impacts with 24.18% and 17.01% of their mapped extents impacted, respectively.

Table 7: Fauna Habitats of the Survey Area

Habitat	Description	Total Mapped Extent* (ha)	Extent Within Indicative Clearing Footprint (ha/%)
Rocky Hill	Rocky Hill habitat comprises hills and undulating stony plains of higher elevation, supporting spinifex or tussock grassland, *Ptilotis* spp. and sparse mulga woodland on a mantle of gravel and larger rocks with occasional minor to moderate ironstone/ granite outcropping.	256.63	7.81 (3.04%)
Sandy Plain	Sandy Plain habitat comprises flat plains with vegetation dominated by scattered *Acacia* spp. and mulga trees and shrubs and patches of various small to medium shrub species on soft sandy clay loam substrates. Evidence of cattle and camel trampling and grazing.	246.33	0.10 (0.04%)
Stony Plain	Stony Plain habitat comprises flat to low undulating areas and low hills with vegetation dominated by mulga trees over tussock. Grasslands on stony clay loam substrates.	59.40	0 (0%)
Rocky Outcrop/ Breakaway	Rocky Outcrop/ Breakaway habitat provided some of the most elevated and steepest terrain within the project tenement. Composed of piles of large ironstone and haematite boulders, this habitat type was scattered patchily throughout the project tenement. This habitat also provides a multitude of deep cracks and crevices in rocky outcropping for shelter for a range of vertebrate fauna species. In some areas of this habitat scattered *Acacia* spp. shrubs provided additional shelter or foraging opportunities.	16.52	0.65 (3.93%)
Minor Drainage Line	Drainage lines were located in the footslopes of Mt Gould and adjacent to Gorge/ Gully, Rocky Hill, and Stony Plain habitats. Vegetation within this habitat comprised of scattered to dense mixed *Acacia* species (*A. aneura, A. grasbyi*), with the exception of the drainage line in the centre of the Study Area, which was associated with previous mining operations and consequently, highly disturbed. Soils were often soft and deep, and conducive to burrowing.	12.29	1.10 (8.92%)
Cleared	Access tracks and cleared areas associated with mining/ exploration activities (i.e. mine pit, lay down areas).	21.91	0 (0%)
	Total	**613.44**	**9.65**

**The total extent of mapped fauna habitats excludes historical disturbance on the Project, resulting in a reduced mapped extent total used in impact calculations compared to totals presented in baseline reports.*

Table 8: Potential Cumulative Impacts to Fauna Habitat

Habitat Type	Stage 1 + 2 Approved Impacts (ha/%)	Stage 3 Potential Impacts (ha/%)	Potential Cumulative Impacts (ha/%)
Rocky Hill	32.8 (12.78)	7.80 (3.04)	40.61 (15.82)
Sandy Plain	41.8 (16.97)	0.10 (0.04)	41.91 (17.01)
Stony Plain	3.1 (5.3)	0 (0)	3.1 (5.3)
Rocky Outcrop /Breakaway	0.1 (0.84)	0.65 (3.93)	0.79 (4.78)
Minor Drainage Line	1.9 (15.26)	1.10 (8.92)	2.97 (24.18)
Cleared	15.9 (72.71)	0 (0)	15.9 (72.71)
Total	**95.6**	**9.65**	**105.25**

3.4.2 Significant Fauna Species

A total of 222 vertebrate fauna species were identified in the desktop assessment (Biologic 2022a) as potentially occurring within the survey including 28 mammals (19 native and nine introduced), 144 birds, 46 reptiles and four amphibians. Of these, 16 significant fauna species with the potential to occur within the survey area were identified, including four mammals, 11 birds, and one reptile (Table 9).

During the Biologic (2012a) assessment, an additional seven species recorded were considered to be significant species. However, they have since been delisted and are no longer considered to represent significant species (Biologic 2022a), this includes:

- Bush Stone-curlew (*Burhinus grallarius*) — previously listed as Priority 4 by DBCA.
- Australian Bustard (*Ardeotis australis*) — previously listed as Priority 4 by DBCA.
- Rainbow Bee-eater (*Merops ornatus*) — previously listed as Migratory under the EPBC Act.
- Woolley's *Pseudantechinus* (*Pseudantechinus woolleyae*) — previously listed as BIF Dependent by DBCA.
- Little Woodswallow (*Artamus minor*) — previously listed as BIF Dependent by DBCA.
- Painted Finch (*Emblema pictum*) — previously considered locally significant.
- Little Broad-nosed Bat (*Scotorepens greyii*) — previously considered locally significant.

Table 9 provides an assessment of the likelihood of occurrence of significant fauna species within the survey area (Biologic 2022a).

The Peregrine Falcon was the only significant fauna species recorded from the field surveys. Similar to the 2012 survey, the 2022 survey observed two adults near the summit of Mount Gould, confirming the species is an established resident within the Project tenement (Biologic 2022b).

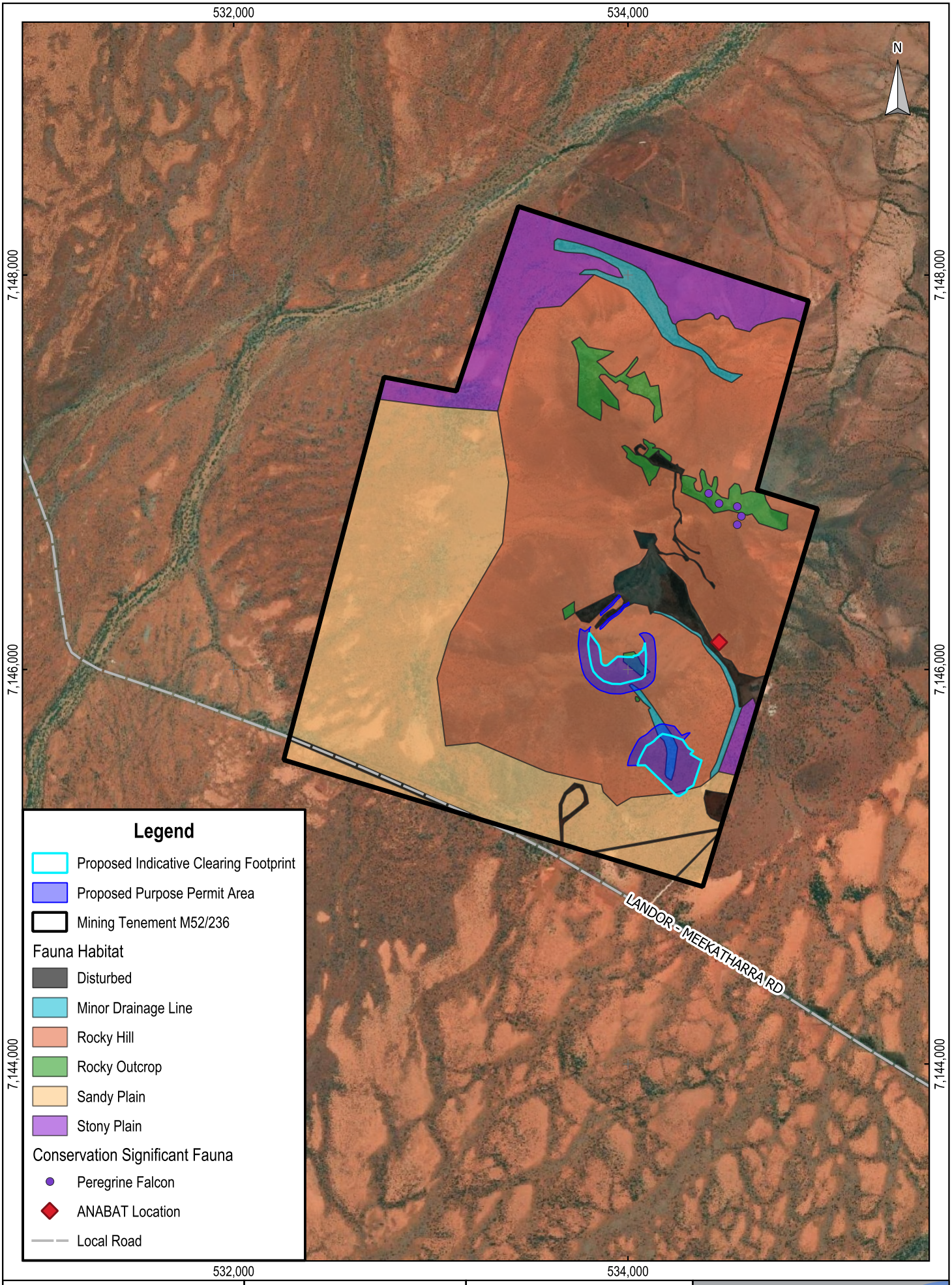
The Peregrine Falcon is listed as Specially Protected under the BC Act and is considered uncommon and rare throughout Western Australia except for in the Stirling Range (Biologic 2012b). This species habitat most often comprises cliffs above rivers ranges and wooded watercourses and lakes and nests recesses of cliff faces, tree hollows and abandoned nests of other birds (Biologic 2012b). Its utilisation range is roughly 20–30 km^2. The Peregrine Falcon was recorded on the summit of Mount Gould which comprises a series of cliff faces with numerous ledges and recesses within Rocky Outcrop/ Breakaway habitat (Figure 8). It is likely to be utilising this habitat for breeding. Rocky Hill, Sandy Plain, Stony Plain and Minor Drainage Line habitats are also likely to utilised as foraging and dispersal habitat by the species. The species broad foraging ranges suggests the species is likely to forage broadly across most habitats of the Project tenement and occasionally beyond (Biologic 2022b).

Table 9: Summary of Significant Fauna Assessment Results

Common Name (Species Name)	Conservation Status			Preferred Broad Habitat	Likelihood of Occurrence
	EPBC Act* (BC Act)	DBCA Listing	Local Significance		
Brush-tailed Mulgara (*Dasycercus blythi)*		P4		Can occur in a range of habitats across the Australian arid zone, often dominated by spinifex *Triodia* spp. grasslands on sandy or stony plains where suitable burrowing substrate is present. Mature spinifex hummocks appear to be important for protection from introduced predators.	Possible
Common Sandpiper *(Actitis hypoleucos)*	Mi (Mi) Marine	-	-	Estuaries and deltas of streams, as well as banks farther upstream; around lakes, pools, billabongs, reservoirs, dams and claypans.	Highly unlikely
Curlew Sandpiper *(Calidris ferruginea)*	CR (CR) Mi Marine	-	-	Inhabits intertidal mudflats in sheltered coastal areas (i.e. estuaries, bays, inlets, and lagoons). This rare species generally roosts on bare dry shingle, shell, or sand beaches, sandspits and islets in or around coastal or near-coastal lagoons and other wetlands.	Highly unlikely
Greater Bilby *(Macrotis lagotis)*	VU (VU)			Variety of habitats including spinifex hummock grassland and Acacia shrubland, on soft soils. In the Pilbara often associated with major drainage line sandy terraces. Includes residual landforms (e.g. laterite rises), loamy or sandy soils associated with palaeodrainage lines and perched drainage lines, sandplains and dune fields, habitat types where shrubs containing root dwelling larvae are common, and recently burnt habitat (within the last 1–3 years).	Unlikely
Grey Falcon *(Falco hypoleucos)*	VU (VU)	-	-	Timbered lowlands, particularly Acacia shrubland and along inland drainage systems. Also frequents spinifex and tussock grassland habitats to forage. The species commonly nests in timbered areas, particularly tall trees along watercourses, or tall infrastructure (e.g. powerline towers) and forages in open or more sparsely vegetated habitats.	Possible
Grey Wagtail *(Motacilla cinerea)*	Mi (Mi) Marine	-	-	Rare vagrant to Western Australia where it has been recorded within various habitats with open waterbodies.	Highly unlikely
Gull-billed Tern *(Gelochelidon nilotica)*	Mi (Mi)			Found in freshwater swamps, brackish and salt lakes, beaches and estuarine mudflats, floodwaters, sewage farms, irrigated croplands, and grasslands. In the interior, they are often associated with inundated salt lakes and claypans and watercourses. Colonially breeds and nests on islets in partially filled salt lakes or saltmarshes in mid-western interior.	Highly unlikely
Long-tailed Dunnart *(Sminthopsis longicaudata)*	-	P4	BIF Dependent	Typically occurs on plateaus near breakaways and scree slopes, and on rugged boulder-strewn scree slopes. Once considered rare but now shown to be relatively common and widespread in rocky habitats.	Highly likely
Night Parrot *(Pezoporus occidentalis)*	EN (CR)			The Night Parrot prefers sandy/stony plain habitat with old-growth spinifex for roosting and nesting in conjunction with native grasses and herbs for foraging.	Unlikely

Common Name (Species Name)	Conservation Status			Preferred Broad Habitat	Likelihood of Occurrence
	EPBC Act* (BC Act)	DBCA Listing	Local Significance		
Oriental Plover *(Charadrius veredus)*	Mi (Mi) Marine	-	-	Variety of habitats, including coastal habitats, such as estuarine mudflats and sandbanks, on sandy or rocky ocean beaches as well as open inland environments such as, semi-arid or arid grasslands, where the grass is short and sparse.	Highly unlikely
Pectoral Sandpiper *(Calidris melanotos)*	Mi (Mi) Marine	-	-	Coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains, and artificial wetlands. It prefers wetlands with open fringing mudflats and low, emergent, or fringing vegetation.	Highly unlikely
Peregrine Falcon *(Falco peregrinus)*	(OS)	-	BIF Dependent	Arid areas and is most often encountered along cliffs above rivers, ranges, and wooded watercourses where it hunts birds. It typically nests on rocky ledges occurring on tall, vertical cliff faces between 25 m and 50 m high. In general, it nests on cliffs, granite outcrops, quarries and in the wheatbelt, old Raven and Whistling Kite nests.	**Recorded**
Sharp tailed Sandpiper *(Calidris acuminata)*	Mi (Mi) Marine	-	-	Coastal and inland areas saline and freshwater but prefers non-tidal fresh or brackish wetlands. Favours flooded samphire flats and grasslands, mangrove creeks mudflats, beaches, river pools, saltwork ponds, sewage ponds and freshwater soaks	Highly unlikely
Western pebble-mound Mouse *(Pseudomys chapmani)*		P4		This species occurs on the gentler slopes of rocky ranges where the ground is covered with a stony mantle and vegetated by hard spinifex, often with a sparse overstorey of eucalypts and scattered shrubs. Species is considered to be extinct from the Murchison region.	Highly Unlikely
Western Spiny-tailed Skink *(Egernia stokesii badia)*	EN (VU)	-	-	This species has been recently recorded at several locations in the Murchison region, including near Weld Range. In the Murchison, the Western Spiny-tail Skink inhabits deep rock crevices on granite outcrops and hills. There are no areas of granite outcropping within the Mt Gould tenement and the Study Area sits outside of the species recognised distribution.	Unlikely
Yellow Wagtail *(Motacilla flava)*	Mi (Mi) Marine	-	-	An uncommon but regular visitor to the Pilbara region. Occupies a range of damp or wet habitats with low vegetation although favours edges of fresh water, especially sewage ponds.	Highly unlikely

**Mi - Migratory, OS - Other Specially Protected Fauna, VU - Vulnerable, EN - Endangered, CR - Critically Endangered*



Scale: 1: 25,000
Original Size: A4
Grid: GDA94 / MGA zone 50

0 250 500 m

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Figure 8

Fauna Habitat and Significant Fauna Recorded in the Survey Area

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3.4.3 Short Range Endemics

Baseline studies for short-range endemic fauna species (SREs) undertaken across the tenement include:

- Mount Gould SRE Invertebrate Study (Biologic 2012b).
- Mount Gould Basic Terrestrial Vertebrate Fauna Survey (Biologic 2022b).
- Desktop Assessment of Short-Range Endemic Fauna at the Mount Gould Iron ore Project (Bennelongia 2022).

The reports are provided in Appendix 10, Appendix 12, and Appendix 13 respectively.

Previous field surveys (Biologic 2012b) recorded 29 invertebrate specimens of SRE taxa occurring within M52/236 comprising 26 pseudoscorpions, three isopods, one spider and one land snail (Biologic 2012b). Of these, only two species were considered to be Potential SRE species, this comprised of one pseudoscorpion (*Synsphyronus* 'PSE010') species and one trapdoor spider species (*Idiommatta* 'MYG254).

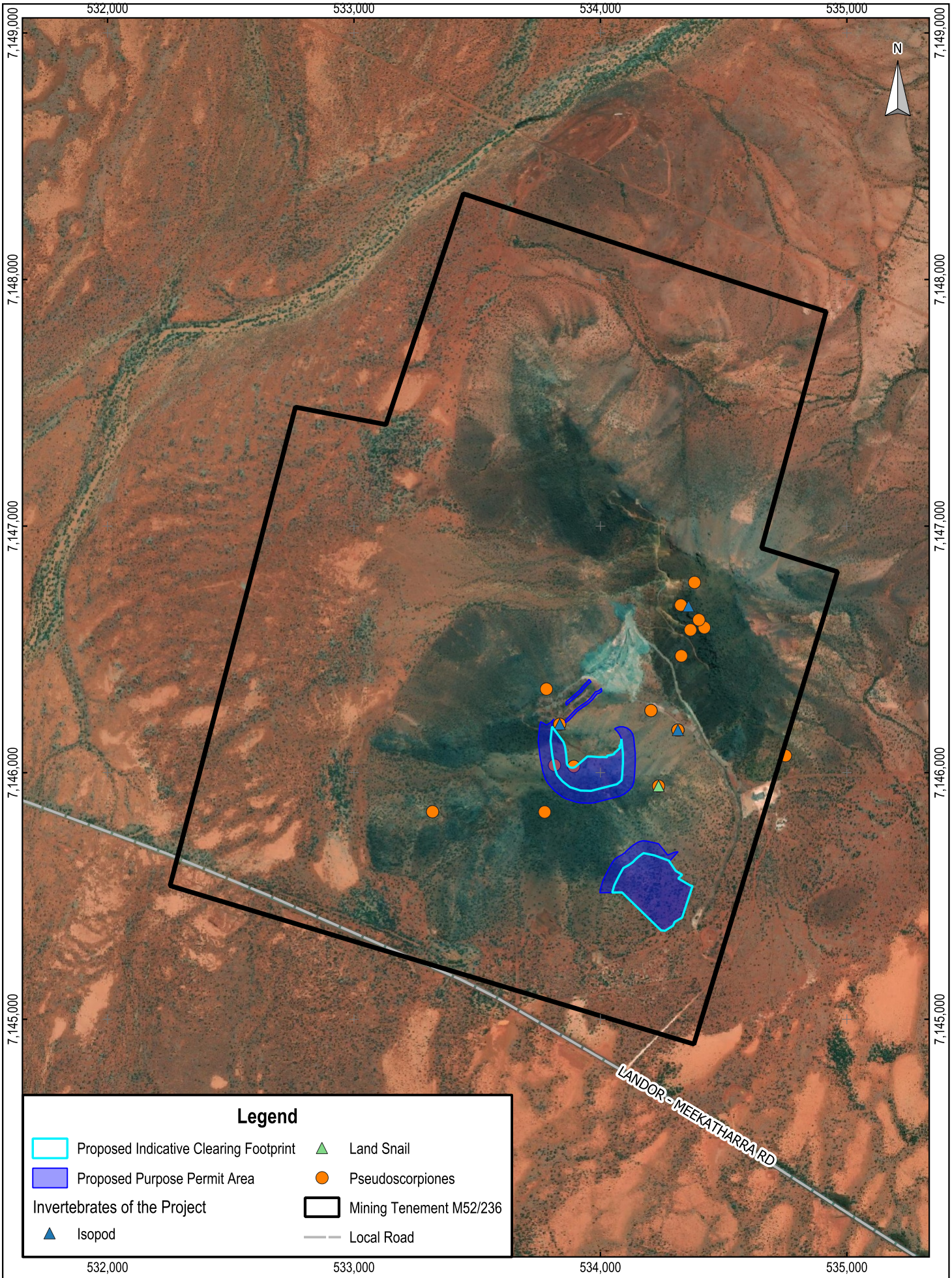
The pseudoscorpion species was represented within the survey area by 15 specimens across eight sites typically within microhabitats of leaf litter, under rocks, within spinifex, outcroppings, boulders, and exposed slopes, all ground-dwelling in nature (Biologic 2012b). This species is also known from outside the survey area but is still restricted to the local region. The trapdoor spider (species unknown) was a mature male recorded within a pitfall trap and was considered to be dispersing to find a mate (Biologic 2012b). Due to the large distances that trapdoor spiders can traverse and that only a singular specimen was recorded, it was considered likely this species occurs in the surrounding plains of the region and had wandered from outside the survey area (Biologic 2012b). No evidence of burrows was observed during the survey.

No known SRE taxa were recorded during the survey.

A desktop assessment undertaken in 2022 (Bennelongia 2022) to verify the results of the 2012 survey identified a moderately rich SRE Group community of at least 48 SRE species within 100 km^2 of the Project. Of these, only one of the records, Shield-backed spider (*Idiosoma clypeatum*) was listed as a significant species (P3), however this record was a historical artefact (Bennelongia 2022). None of the records were Confirmed SRE species (Bennelogia 2022) which is consistent with the results of the 2012 survey. Several records did however fall into the Likely Potential SRE category. The most common SRE Group identified in the desktop assessment were pseudoscorpions, however these species were assigned as Unlikely Potential SREs due to previous field collections of specimens from multiple habitat types (Bennelongia 2022). The desktop assessment also noted the mygalomorph spider *Idiommata 'MYG254'* identified in the 2012 survey is currently the only Likely Potential SRE known from within the Project tenement (Bennelongia 2022).

The invertebrate fauna recorded in the survey area are shown in Figure 9.

Three potential SRE habitats were identified during the desktop habitat assessment (Biologic 2012b). The outcropping and minor breakaway areas provided a high level of exposure protection and lack of habitat diversity due to low soil quantities and is considered likely to support SRE taxa (Biologic 2012b). The Spinifex Hummock Grasslands (Figure 9) was identified as likely SRE habitat, due to its locally isolated occurrence and increased cover, which resulted in cooler localised soil conditions, recording an increased abundance of invertebrate activity. The exposed ironstone at the peaks of Mount Gould, and the Breakaway Systems (Figure 9) was also considered potential SRE habitat to a lesser degree, due to its exposure protection (Biologic 2012b). The desktop assessment concluded that habitat that is prospective for SREs (rocky outcrops and slopes, spinifex grasslands and acacia shrublands) occurs at the Project and due to Mount Gould's isolation within the landscape it is likely to support species in SRE Groups. However, the nearby Jack Hills Range potentially contains a similar SRE Group community to that of Mount Gould due to similarities in geologies and habitats (Bennelongia 2022).



Scale: 1: 20,000
Original Size: A4
Grid: GDA94 / MGA zone 50

0 250 500 m

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Figure 9

Invertebrate Fauna Recorded in the Survey Area

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3.5 SURFACE WATER AND GROUNDWATER

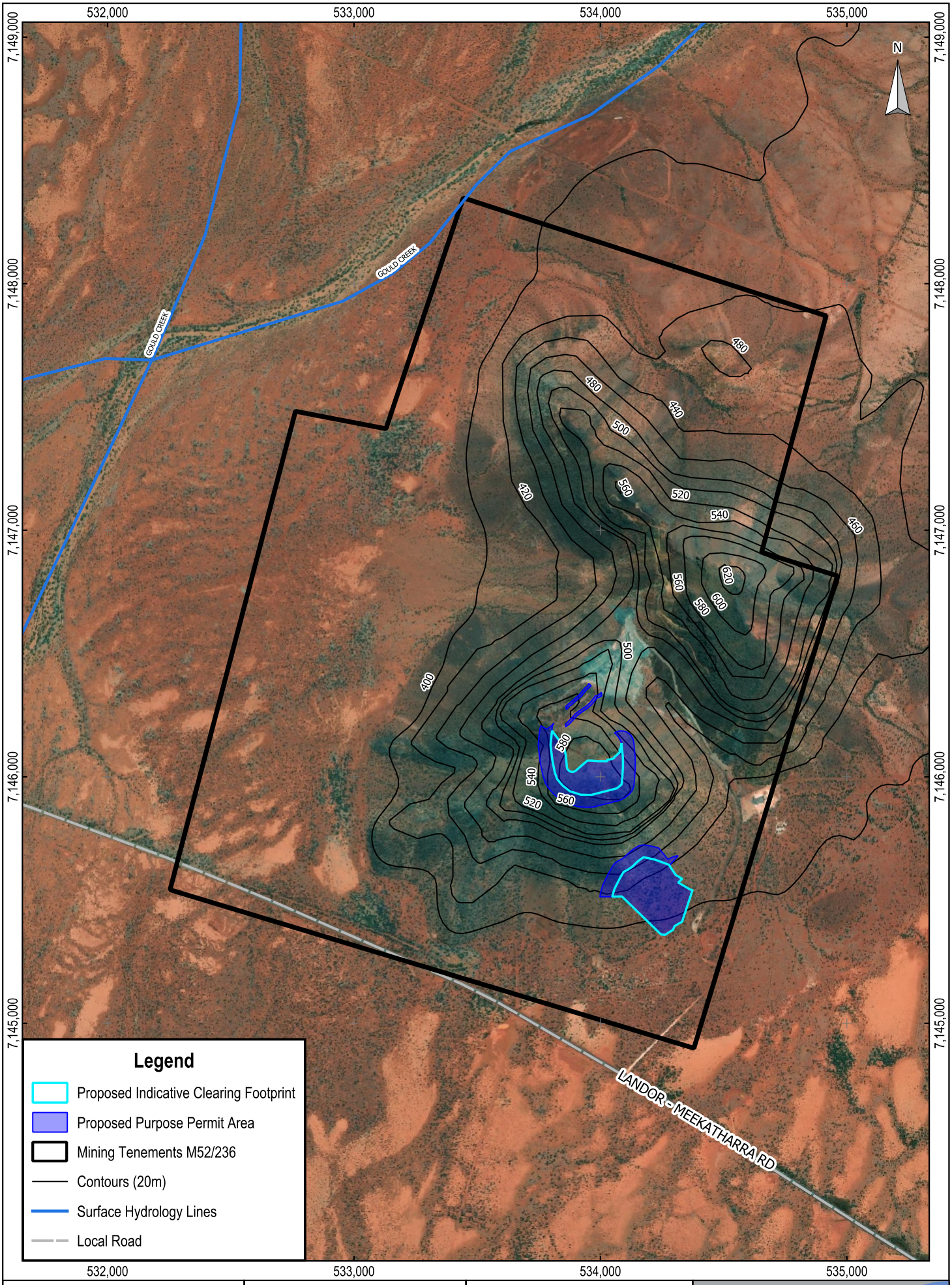
The Purpose Permit Area lies within the Murchison River Basin which covers an area of 82,000km^2. The majority of surface water flows in the Basin generally drain to the west into major watercourses, namely the Murchison, Wooramel, and Greenough Rivers eventually discharging into the Indian Ocean at Kalbarri, whilst the remaining surface water discharges inland to Salt Lake systems (Curry *et al* 1994). There are no perennial rivers in the Western Murchison bioregion, watercourses are ephemeral, and therefore dry up for at least part of the year, leaving dry sandy riverbeds and intermittent permanent pools (Curry *et al* 1994). The bioregion has a surface water deficiency due to its low annual rainfall (190 - 240 mm), erratic seasonal distribution, and high evaporation potential (Curry *et al* 1994).

The Purpose Permit Area sits on an escarpment encompassing the headwater of the Murchison and Wooramel Rivers and is flanked by three minor ephemeral watercourses, Bedaburra Creek 3 km to the east and Gould Creek and Mukalo Creek, approximately 2 and 3 km to the west respectively. Similar to the Murchison River, the creeks flow intermittently after long periods of heavy rainfall, typically arising from cyclonic events. During these events, the high topographic relief (400 m - 620 m) (Figure 10) of the Purpose Permit Area promotes rainfall and surface water runoff to flow downslope to the washplain below and into the nearby creeks, eventually converging with the Murchison River approximately 12 km south. There are no major or minor watercourses within the Purpose Permit Area, with Gould Creek being the closest watercourse located approximately 2 km west of the Purpose Permit Area.

Limited groundwater data is available for the Purpose Permit Area. Groundwater is likely to occur in low yielding, fractured rock aquifers and calcrete aquifers in paleochannels surrounding the Mount Gould landform. Water for mining activities is sourced from two production bores (Bore 01 and Bore 02), which were installed in the paleochannel aquifer on the project tenement in January 2022.

Groundwater levels across the Purpose Permit Area vary between 368 mAHD to 390 mAHD, with a groundwater flow direction from the north of the tenement to the south, following topographic gradients (AQ2 2021). The groundwater quality ranges from brackish to saline (AQ2 2021), with the Total Dissolved Solids (TDS) concentrations ranging from 2,100 to 28,000 mg/L. The relative concentrations of the major ions in collected samples suggest groundwater receives low volumes of direct recharge and groundwater salinity is derived from cyclic salts from precipitation and salts leached from bedrock and the lateritic and weathered soil profile during recharge (Curry *et al* 2004, AQ2 2021).

The Purpose Permit Area does not occur within a proclaimed surface water area under the *Rights in Water and Irrigation Act 1914* (RIWI Act) (DWER 2021a). The Project is situated in the East Murchison Groundwater Proclamation Area under Section 26B (1) of the RIWI Act. The Purpose Permit Area does not intercept any public drinking water source areas (DWER 2021b).



Scale: 1: 20,000
Original Size: A4
Grid: GDA94 / MGA zone 50

0 250 500 m

Newcam Minerals Pty Ltd
Mount Gould Iron Ore Project

Figure 10

Topography of the Project Area

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\\mbssvr\working\Newcam Minerals\Approvals\Native Veg Clearing Permit\Stage 3_2024\GIS\Newcam_NVCP_Stage 3_2024.qgz 31/10/2024 F10 Topography

4. PROPOSED LAND CLEARING

The Mount Gould Iron Project requires clearing 9.65 within the proposed Purpose Permit Area of 15.79 ha as shown in Figure 2. The proposed Purpose Permit Area has been designed to minimise impacts to the environmental values of the region by excluding populations of Threatened and Priority flora species and significant fauna habitats where possible and minimising the indicative clearing footprint within vegetation communities of high conservation values as much as practicable.

Clearing will facilitate mining and associated activities occurring wholly within mining tenement M52/236. This NVCP application is developed in conjunction with a Mining Proposal for the evaluation of the significant environmental and social impacts of the Mount Gould Iron Project and how relevant activities will be managed. Clearing may be undertaken in a staged manner as necessary approvals are obtained for the Project over time.

Shapefiles are provided for the Purpose Permit Area and Indicative Clearing Footprint with this NVCP application. There may be minor variations made to the precise location of relevant infrastructure and access tracks within this nominated footprint, however the area covered by the footprint, in which all disturbance will occur, will not change.

5. ASSESSMENT OF CLEARING PRINCIPLES

5.1 NATIVE VEGETATION CLEARING PRINCIPLES

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

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

Table 10: Summary of Clearing Assessment Against Clearing Principles

Principle Number	Clearing Principle	Outcome
a	Native vegetation should not be cleared if it comprises a high level of biological diversity.	Unlikely to be at variance
b	Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.	Unlikely to be at variance
c	Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora.	Not at variance
d	Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a Threatened Ecological Community (TEC).	Not at variance
e	Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.	Not at variance
f	Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.	Not at variance
g	Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.	Unlikely to be at variance
h	Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation areas.	Not at variance
i	Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.	Unlikely to be at variance
j	Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence of flooding.	Unlikely to be at variance

5.2 BIODIVERSITY

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

Impacts to the biological diversity of native vegetation associated with clearing in the Purpose Permit Area are limited to localised flora and/or habitat loss, damage, or death as a result of mechanised clearing for Project development and the introduction and/or spread of weed species via earthwork and ancillary machinery movements.

Only one Other Specially Protected fauna species was identified within the survey area which has been recorded outside the Purpose Permit Area in the surrounding region (Biologic 2022b, Biologic 2012a).

No TECs were identified within or adjacent to the Purpose Permit Area. The Purpose Permit Area intersects a portion of the Mount Gould Vegetation Complex PEC.

The most recent Biologic (2023) survey identified vegetation communities beyond the extent of the M52/236 tenement. As previous surveys have only been conducted within this tenement (Biologic 2012a), the assessment of vegetation communities and their extent has been confined to the M52/236 tenement area.

The potential impacts of clearing up to 9.65 ha within the Purpose Permit Area and cumulative clearing of mapped vegetation types are detailed in Table 11.

Table 11: Mapped Extent and Potential Impact on Vegetation Types

Vegetation Type	Mapped Extent (ha)	Potential Impact Within Indicative Clearing Footprint (ha /%)	Cumulative Potential Impact (Stage 1 + 2 + 3) (ha)
D1	38.90	0 (0%)	1.12 (2.88%)
F1	96.77	0 (0%)	2.49 (2.57%)
F2	73.38	0 (0%)	6.48 (8.83%)
H1	18.22	2.28 (12.52%)	5.50 (30.19%)
H2	48.67	0 (0%)	2.04 (4.19%)
H3	68.00	1.42 (2.08%)	5.88 (8.65%)
S1	125.15	0 (0%)	12.19 (9.74%)
S2	116.24	0 (0%)	5.02 (4.32%)
S3	66.83	5.95 (8.90%)	19.77 (29.58%)
S4	28.25	0 (0%)	0 (0%)
P1	639.24	0 (0%)	0 (0%)
P2	262.12	0.01 (<0.1%)	30.62 (11.68%)
Cleared/Unsurveyed	195.16	0 (0%)	14.31 (7.33%)
Total	**1,175.93**	**9.65 (0.54%)**	**105.4 (8.96%)**

From this it can be seen that:

- The Purpose Permit Area and Indicative Clearing Footprint will intersect four of the twelve vegetation types mapped within the Project area.
- The Indicative Clearing Footprint does not intersect high local and regional significance vegetation types H2, and S1 and moderate local and low regional significance vegetation types S2, S4, F1, P1, and marginally intersects moderate local and low regional significance vegetation community P2.
- Vegetation types H1, H3, S3 and P2 comprise 23.22% (or 390.94 ha) of the total mapped vegetation and 100% (or 9.65 ha) of the Indicative Clearing Footprint.
- Cumulative potential impact of the previously approved and new proposed clearing amounts within the Purpose Permit Areas to any mapped vegetation type does not exceed 31 ha or 31% of any individual vegetation type.
- The greatest potential impact of clearing for this Purpose Permit application to any vegetation type of local significance, H1, is 2.3 ha which equates to about 12.5% of its mapped extent (18.2 ha). The Purpose Permit Area has been specifically designed to minimise clearing of H1 where practicable. Due to surrounding topographical constraints, major site infrastructure is situated within this vegetation type.
- Potential impact to all other locally significant vegetation types (H3, S3 and P2) do not exceed 9% of their mapped extent.

It is unlikely that the proposed disturbance will spread or introduce weed species, due to the low occurrence of weed taxa within the survey area. The occurrence of one introduced species was recorded within the Purpose Permit Area, however, this was outside the indicative clearing footprint and is unlikely to be disturbed.

Management measures to reduce impacts on biodiversity include:

- Clearing activities will be carried out in accordance with best industry practice.
- Clearing of native vegetation within the Purpose Permit Area will not exceed 9.65 ha.
- The Purpose Permit Area has been designed to avoid and/or minimise vegetation types of high conservation value.
- Utilising existing disturbed areas to reduce impacts to significant flora and vegetation.
- Clearing activities will be supervised by Traditional Owners.
- Clearly delineating clearing areas with survey pegs and/or flagging tape.
- Stockpiling stripped topsoil and vegetation for use in future rehabilitation activities.
- Implement an internal clearing register to record the amount of clearing undertaken and report the cumulative total in the Annual Environmental Report (AER) and NVCP Annual Clearing Report, submitted to DEMIRS.
- Vehicle and equipment hygiene procedures will be implemented to minimise introduction and or spread of weeds in the Purpose Permit Area.
- As disturbed areas become available for rehabilitation, stockpiled topsoil and vegetation will be spread to act as a seed source and mulch to protect the soil from erosion and provide habitat for fauna.
- Implementing dust control measures.
- Implementing speed limits to minimise dust emissions and to minimise the risk of fauna injury or death due to vehicle traffic.
- All personnel will undertake a site induction which will include detail on the importance of flora and fauna management.

The Purpose Permit Area has been designed to minimise impact to the biodiversity values of the region by minimising the clearing footprint within PEC and vegetation types of high conservation values as much as possible. Complete avoidance of conservation significant vegetation types is not achievable given topographical environment, and the geographical extents of vegetation along the resource boundary.

It is not expected proposed clearing will significantly impact the biodiversity of the area and subsequently is unlikely to be at variance with Clearing Principle A.

5.3 SIGNIFICANT FAUNA HABITAT

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

Five broad fauna habitats were recorded and mapped by Biologic (2022) within M52/236 (Table 7),

Table 12 describes the spatial extent and potential impact to the mapped fauna habitats.

Table 12: Mapped Extent and Potential Impact on Fauna Habitat Types

Fauna Habitat ID	Mapped Extent (ha)	Potential Impact Within Indicative Clearing Footprint (ha %)	Cumulative Potential Impact (Stage 1 + 2 + 3) (ha/%)
Rocky Hill	256.63	7.81 (3.04%)	40.61 (15.82%)
Sandy Plain	246.33	0.10 (0.04%)	41.91 (17.01%)
Stony Plain	59.40	0 (0%)	3.15 (5.30%)
Rocky Outcrop/Breakaway	16.52	0.65 (3.93%)	0.79 (4.78%)
Minor Drainage Line	12.29	1.10 (8.92%)	2.97 (24.18%)
Cleared/ Historic Disturbance	21.91	0 (0%)	15.93 (72.71%)
Total	**613.44**	**9.65 (1.57%)**	**105.4 (17.17%)**

From this it can be seen that:

- Rocky Hill, Sandy Plain, and Minor Drainage Line habitat types are considered common and widespread within both the survey area and the Murchison bioregion, comprising 84.0% (or 515.21 ha) of the total mapped fauna habitats and 93.2% (or 8.99 ha) of the Purpose Permit Area.
- Stony Plain and Rocky Outcrop/Breakaway are considered widespread throughout the Murchison bioregion, comprising 12.38% (75.87 ha) of the habitats mapped and 0.1% (0.66 ha) of the Purpose Permit Area.
- The largest portion of proposed clearing of any habitat (Minor Drainage Line) is approximately 8.92% (1.10 ha) of its mapped extent (12.29 ha). However, this is more a reflection of the limited mapped extent rather than the significance of proposed clearing. All other fauna habitat types will be potentially impacted by <4%.
- Overall, clearing of up to 9.65 ha within the Purpose Permit Area restricts clearing of fauna habitats to < 2% of the mapped survey area.

One significant fauna species was recorded within M52/236 during the Biologic (2022) survey, the Peregrine Falcon. One additional species was considered Highly Likely to occur (Long-tailed Dunnart) and two species were considered to Possibly occur (Brush-tailed Mulgara and Grey Falcon). The Sandy Plain habitat type is considered critical habitat for the Brush-tailed Mulgara, Peregrine Falcon and Grey Falcon, and the Rocky Outcrop/Breakaway habitat type is considered critical habitat for the Peregrine Falcon and Long-tailed Dunnart. The potential impact of the Indicative Clearing Footprint on these two habitat types is 0.04% (or 0.1 ha) and 3.93% (or 0.65 ha) respectively.

The main risk to fauna habitat is loss or fragmentation through clearing activities. To minimise impacts to significant fauna habitat, management measures include:

- Clearing activities will be carried out in accordance with best industry practice.
- The Purpose Permit Area has been designed to avoid fauna habitats of conservation significance where practicable.
- Utilising existing disturbed areas to avoid significant fauna habitat where possible.
- Clearing activities will be supervised by Traditional Owners.
- Implement an internal clearing register to record the amount of clearing undertaken and report the cumulative total in the Annual Environmental Report (AER) and Annual Clearing Report, submitted to DEMIRS.
- Vehicle and equipment hygiene procedures will be implemented to minimise entry and or spread of weeds in the Purpose Permit Area.
- Implementing speed limits to minimise dust emissions and to minimise the risk of fauna injury or death due to vehicle traffic.

- All personnel will undertake a site induction which will include detail on the importance of flora and fauna management.

The conservation and locally significant fauna, whilst primarily occurring within the Sandy Plain, Rocky Outcrop/Breakaway habitats are deemed to be of moderate significance and occur more broadly throughout the Murchison bioregion, although their occurrence and extent are often sporadically distributed. Therefore, the proposed clearing is unlikely to be at variance with Clearing Principle B.

5.4 THREATENED FLORA AND PRIORITY FLORA

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

Baseline flora surveys identified no conservation significant flora species as being present within the Purpose Permit Area as shown in Table 13 and (Figure 7). For consistency and the assessor's consideration, impacts from the previously approved clearing permit CPS 9417/1 are also shown in Table 13.

Table 13: Significant Flora Potentially Impacted in the Purpose Permit Area

Significant Flora Taxa	No. of Recorded Individuals[1]	No. of Individuals Within Proposed Purpose Permit Area	Total Cumulative Impact
Eremophila warnesii (P1)	16,967	0	59
Halgania gustafsenii (T)	18,355	0	2304
Rhodanthe sphaerocephala (P1)	154	0	28
Tribulus adelacanthus (P3)	2,451	0	389

[1] *Includes survey data from Woodman 2008, 2009, 2012, Biologic 2023, Emerge 2024a, Emerge 2024b and other publicly available information.*

[2] *The total number of recorded individuals excludes any occurrence of significant flora within historical disturbance areas of the Project.*

Management measures to ensure impacts on significant flora do not occur include:

- Clearing activities will be carried out in accordance with best industry practice.
- The Purpose Permit Area has been designed to avoid clearing impacts on significant flora
- Clearing activities will be supervised by Traditional Owners.
- Clearly marking in the field and recording GPS locations of significant flora individuals near proposed clearing to avoid accidental disturbance.
- Clearly delineating all clearing areas with survey pegs and/or flagging tape.
- Vehicle and equipment hygiene procedures will be implemented to minimise entry and or spread of weeds in the Purpose Permit Area.
- All personnel will undertake a site induction which will include detail on the importance of flora and fauna management.

As no Threatened or Priority flora will be impacted, the proposed Purpose Permit is not at variance with Principle C.

5.5 THREATENED ECOLOGICAL COMMUNITIES

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

No TECs listed under the EPBC Act or BC Act were identified within a 50 km search radius.

The Mount Gould Vegetation Complex is listed as a Priority 1 PEC and extends throughout the existing (CPS 9417/1) and Proposed Purpose Permit Areas. Approximately 222.2 ha (13.2%) (existing Purpose Permit Area) and 9.65 ha (0.57%) (proposed Purpose Permit Area) of its spatial extent will be potentially impacted by both the Project. Of this, a maximum of 146.15 ha will be cleared, which represents 8.7% of the PEC's mapped extent.

The existing and proposed Purpose Permit Area and Indicative Clearing Footprint were designed to minimise impacts to the PEC as much as practicable. Complete avoidance of the PEC is not achievable considering the topographical nature of the existing and proposed Purpose Permit Area and resource locale.

Management measures to reduce impacts on the Mount Gould PEC include:

- Clearing of the PEC within the proposed Purpose Permit will not exceed 9.65 ha.
- Cumulative impacts, including Stage 1 and 2 clearing will not exceed 146.15 ha.
- The Purpose Permit Area has been designed to avoid and/or minimise vegetation types representative of the PEC.
- Clearly delineating all clearing areas with survey pegs and/or flagging tape.
- Collection of seed from local species for use in future rehabilitation activities and implementation of rehabilitation trials where considered necessary.

As the proposed clearing will have no impacts on a TEC it is not at variance to Clearing Principle D.

5.6 REMNANT VEGETATION

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

The Purpose Permit Area intersects one pre-European vegetation association, as detailed in Table 14 .

The Environmental Protection Authority (EPA) uses a standard level of native vegetation retention of at least 30% of the pre-clearing extent of an ecological community as a benchmark. The levels of native vegetation retention have most recently been recognised in the *National Objectives and Targets for Biodiversity Conservation 2001-2005*, which suggests the retention of 30% or more, of the pre-clearing extent of an ecological community is necessary if Australia's biological diversity is to be protected (DoEH 2001). The pre-European vegetation associations within the Purpose Permit Area will have at least 99% remaining at a State level after the proposed clearing (Table 14).

Table 14: Pre-European Vegetation Association Representation

Vegetation Association	Original Extent (ha)	Current Extent (ha)	Area Within Indicative Clearing Footprint (ha)	% Remaining
202	448,529.31	448,343.80	96.5	99.94

As the remaining extent of the vegetation associations at the State-wide, scales exceed 99%, the Purpose Permit Area will not have a significant impact on pre-European vegetation and therefore will not be at variance with Clearing Principle E.

5.7 WATERCOURSE OR WETLAND ENVIRONMENTS

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

There are no permanent water bodies or wetland systems within or intersecting the Purpose Permit Area (Figure 10). The closest water body, Gould Creek, is located 2 km west of the Purpose Permit Area.

The proposed pit cutback and haul road are located near the top of Mount Gould and as such have limited catchments and are topographically upstream of localised ephemeral watercourses. The proposed expansion of the WRD will intercept natural water flows based on topography and mapped local surface hydrology. This is proposed to be managed by constructing clean water diversion drains upstream of the WRD that will redirect freshwater flows around the WRD while not significantly altering the natural flow volumes or directions.

As clearing will not impact watercourses or wetlands, it will not be at variance with Clearing Principle F.

5.8 LAND DEGRADATION

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

Generally, vegetation was assessed as being in Excellent to Degraded condition (Biologic 2023). Approximately 21.5 ha of existing disturbance was present in M52/236 from previous mining and pastoral activities prior to commencement of activities by Newcam in 2022.

Existing land degradation is mostly attributed to previous mining and exploration activity as well as grazing by livestock on the flats surrounding Mount Gould, and minor feral goat grazing on the slopes and summits of Mount Gould (Woodman 2009). Due to the absence of water bodies within the Purpose Permit Area, land degradation from erosion and reshaping of the landscape from localised flooding would not be expected during typical weather conditions. Due to the low presence of weeds within the survey area, land degradation from weed infestation would not be expected.

The Red Brown Hardpan Shallow Loam soil type was described as having a moderate to high erosion risk after clearing of perennial vegetation, which may occur due to the proposed clearing (Hennig 2009). However, as elevation increases it was noted that soils of the Purpose Permit Area become skeletal in nature, with soil volume decreasing as a surface gravel layer becomes prominent, accompanied by the emergence of outcropping and significant rocky features (MBS 2021). Therefore, the risk of soil erosion will decrease along slopes of increasing elevations.

The proposed WRD expansion is likely to have the highest risk of soil erosion. The pit cutback and much of the haul road widening areas are located on upper slope areas are comprised of bare rock with very limited soil resources. Therefore, soil erosion and other forms of land degradation are considered low risk from mining activities in these areas.

Potential sources of land degradation from clearing activities include:

- Wind erosion during vegetation stripping activities for the WRD extension.
- Wind and water erosion of cleared areas.

- Water erosion due to changes in surface water flow noting the majority of the proposed clearing for the pit cutback and haul road widening is in elevated areas with very small catchments.
- Soil compaction noting the proposed clearing areas are on a rocky/stoney landform and as such contain limited soil volumes.
- Soil contamination.
- Introduction and/or spread of weeds.

Management measures to reduce impacts on land degradation include:

- Clearing activities will be carried out in accordance with best industry practice.
- The indicative clearing footprint has been designed to minimise the amount of clearing as much as possible whilst allowing for safe operations, given the topographic constraints.
- Confining vehicle movements to defined roads and tracks.
- Stockpiling topsoil and stripped vegetation for reuse in rehabilitation where sufficient soil is available for stripping.
- As disturbed areas become available for rehabilitation, stockpiled topsoil and vegetation will be spread over disturbed areas to act as a seed source and mulch to protect the soil from erosion.
- Establishment of surface water management infrastructure to direct surface water flow to natural drainage channels.
- Monitoring of high-risk erosion events, such as extreme weather, to mitigate impacts as far as reasonably practicable.
- Minimising area for vegetation clearance.
- Dust suppression via water cart where practicable.
- Conducting soil-stripping activities during periods of low winds.
- Vehicle and equipment hygiene procedures will be implemented to minimise entry and or spread of weeds in the Purpose Permit Area.
- Scarifying compacted soil prior to rehabilitation.

In the context of the low erodibility of the land system and intact vegetation on a local and regional scale, the extent of disturbance from the proposed clearing is not anticipated to increase land degradation. As such, the clearing is unlikely to be at variance with Clearing Principle G.

5.9 CONSERVATION ESTATE

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

The proposed clearing area is not associated with any conservation lands and the nearest conservation estate, Collier Range National Park, is located approximately 177 km northeast of the Purpose Permit Area, therefore proposed clearing is not considered to be at variance with Clearing Principle H.

5.10 SURFACE AND GROUNDWATER QUALITY

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

There are no major watercourses, permanent water bodies, wetlands, riparian vegetation, or groundwater dependent ecosystems within the Purpose Permit Area. There are no surface water management areas in the Purpose Permit Area, however it does intersect the proclaimed East Murchison Groundwater Area.

Surface water quality has extremely limited potential to be affected by increased sedimentation caused through clearing of surfaces and soil disturbance during sporadic but intense rainfall events over the proposed Purpose Permit Area as the pit cutback and haul road are located on areas mapped as bare rock/stony soils. Areas cleared for the WRD extension are lower in the topographic profile in areas of stony soil/red brown hardpan shallow loams and have some potential for loss of sediment to lower areas if not appropriately managed. Intense rainfall events, environmentally important to the region, are likely to increase surface run-off from cleared areas and may mobilise sediment into the surrounding floodplains. However, due to the low rainfall experienced in the region (Chart 1), such weather events are considered infrequent and impacts to surface water quality minimal. Typical season conditions (dry) are expected to prevail during clearing activities and are therefore unlikely to transport sediment from the cleared areas and impact the water quality of ephemeral watercourses outside of the Purpose Permit Area.

Due to the elevated position of the open pit and haul road, groundwater will not be intercepted.

Hydrocarbon and chemical spills may occur from vehicles and machinery used for land clearing activities. Uncontained spills and wastewater from vehicles wash downs have the potential to affect surface water and groundwater quality.

Management measures to prevent deterioration n of surface and groundwater quality include:

- Clearing activities will be carried out in accordance with best industry practice.
- Diversion drains will be constructed where necessary to redirect clean water flows around the proposed WRD expansion.
- Refuelling and maintenance activities will continue to be conducted using drip trays, liners, bunds, or spill mats to minimise hydrocarbon spillage and contamination of surface and groundwater.
- Vehicles and machinery will be subject to pre-start checks and scheduled maintenance to ensure adequate function and condition and to reduce occurrence of hydrocarbon and chemical spills.
- Waste will be removed from site and appropriately disposed.
- Progressive rehabilitation of completed surfaces to minimise active areas exposed where possible.
- Natural surface water drainage channels/patterns will be reinstated during rehabilitation.

All personnel will undertake a site induction which will include detail on the importance surface water management.

Proposed disturbance is unlikely to mobilise sediment into the nearby watercourses and volumes of sediment are unlikely to adversely impact surface water quality and subsequent groundwater quality considering normal environmental conditions expected to prevail during clearing activities. Heavy rainfall events may cause greater impacts, although this is generally a natural process and generally sporadic. Surface water diversions drains, and bunds will be established to manage such events.

Proposed disturbance is unlikely to cause deterioration in the quality of surface or groundwater within the Purpose Permit Area. No significant impacts to s are anticipated and subsequently the clearing is considered unlikely to be at variance with Clearing Principle I.

5.11 FLOODING POTENTIAL

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

The Purpose Permit Area is within the Murchison IBRA region which experiences arid climate where annual rainfall is generally less than 365 mm and the region loses more water via evapotranspiration than it receives as rain by a factor of 13, typically a result of hot, sunny weather and limited rainfall volumes. The mean annual rainfall is 234.9 mm, of which approximately 60% falls in winter (Chart 1) when thunderstorms and the occasional influence of cyclone activity are more likely to occur. While minor localised flooding is not uncommon in the Murchison region major floods are few, with historical records indicating nine major floods in the region since 1848 (Curry *et al* 1994).

Geoscience Australia's *"Water Observation from Space"* dataset gives national coverage of the probability of an area being covered in water, based on satellite imagery. Applying this dataset to the Purpose Permit Area indicates no detection of water, except for small areas of occasional ponding 3 km east and suggests the Purpose Permit Area is dry the majority of the time which is expected in the arid zone of WA. From this it can be determine the Purpose Permit Area is not in an area that regularly floods for prolonged period.

Mount Gould acts as a local watershed, dissecting and dispersing rainfall on areas of high topographic relief to the surrounding flat wash plains below which generally sheets surface water flow. Removal of vegetation generally increases flooding whereby uptake, infiltration, moisture retention and physical barriers to reduce flow velocities provided by vegetation are removed. Clearing of the perennial vegetation in the Purpose Permit Area has potential to impact water flow velocities and water shedding capacity during rainfall events. Minor watercourses nearby are ephemeral and will only flow during significant rainfall events, when shallow pooling is also evident is some areas throughout the broader landscape (Geoscience Australia 2021). The hills and ridges of the Purpose Permit Area are covered with dense ironstone mantles, hematite shales and frequent outcropping. Soils are typically stony or shallow gravel. Vegetation cover within these areas is typically sparser than the downslope areas. Removal of vegetation for the WRD expansion may increase localised water flows. Localised surface water runoff may increase where vegetation is cleared, however, the impact is unlikely to be detectable in the context of the range of the natural variability of runoff.

Management measures to prevent flooding include:

- Clearing activities will be carried out in accordance with best industry practice.
- The Purpose Permit Area has been designed with consideration to drainage lines and flood levels with the aim of minimising disturbance of these areas.
- Existing flow paths will be maintained where possible.
- Diversion drains will be constructed to redirect clean water flows from rainfall events around the proposed WRD expansion to reduce localised pooling/flooding.
- Progressive rehabilitation of completed surfaces to minimise active areas exposed where possible.
- Natural surface water drainage channels/patterns will be reinstated during rehabilitation.

Overall, the proposed clearing is unlikely to increase the flooding potential within the Purpose Permit Area and its immediate surrounds. Therefore, the proposed clearing is unlikely be at variance with Clearing Principle J.

6. REPORTING AND AUDITING

Disturbance as a result of the proposed vegetation clearing will be reported yearly within the Mount Gould AER and Mine Rehabilitation Fund (MRF) reporting.

Upon approval of this NVCP, subsequent environmental approvals under the Mining Act will be sought to construct and develop the Mount Gould Iron Project. These approvals will include additional conditions and commitments relating to environmental monitoring and reporting.

7. CONCLUSION

The vegetation and habitats present within the Purpose Permit Area are generally well represented on a local and regional scale. The Purpose Permit Area has been designed to minimise impacts to the environmental values of the region by excluding populations of Threatened and Priority flora species and significant fauna habitats where possible, and to minimise the clearing footprint area within vegetation types of high conservation values.

It is considered unlikely there will be significant adverse impacts on the conservation status of relevant flora and fauna species or vegetation communities. There are likely to be only minor, localised impacts from loss of vegetation and fauna habitat.

The proposed clearing will not impact significantly upon the ten clearing principles and a range of environmental management measures will be implemented to ensure clearing is managed to minimise potential adverse impacts. Rehabilitation will minimise exposed areas and the long-term loss of vegetation cover.

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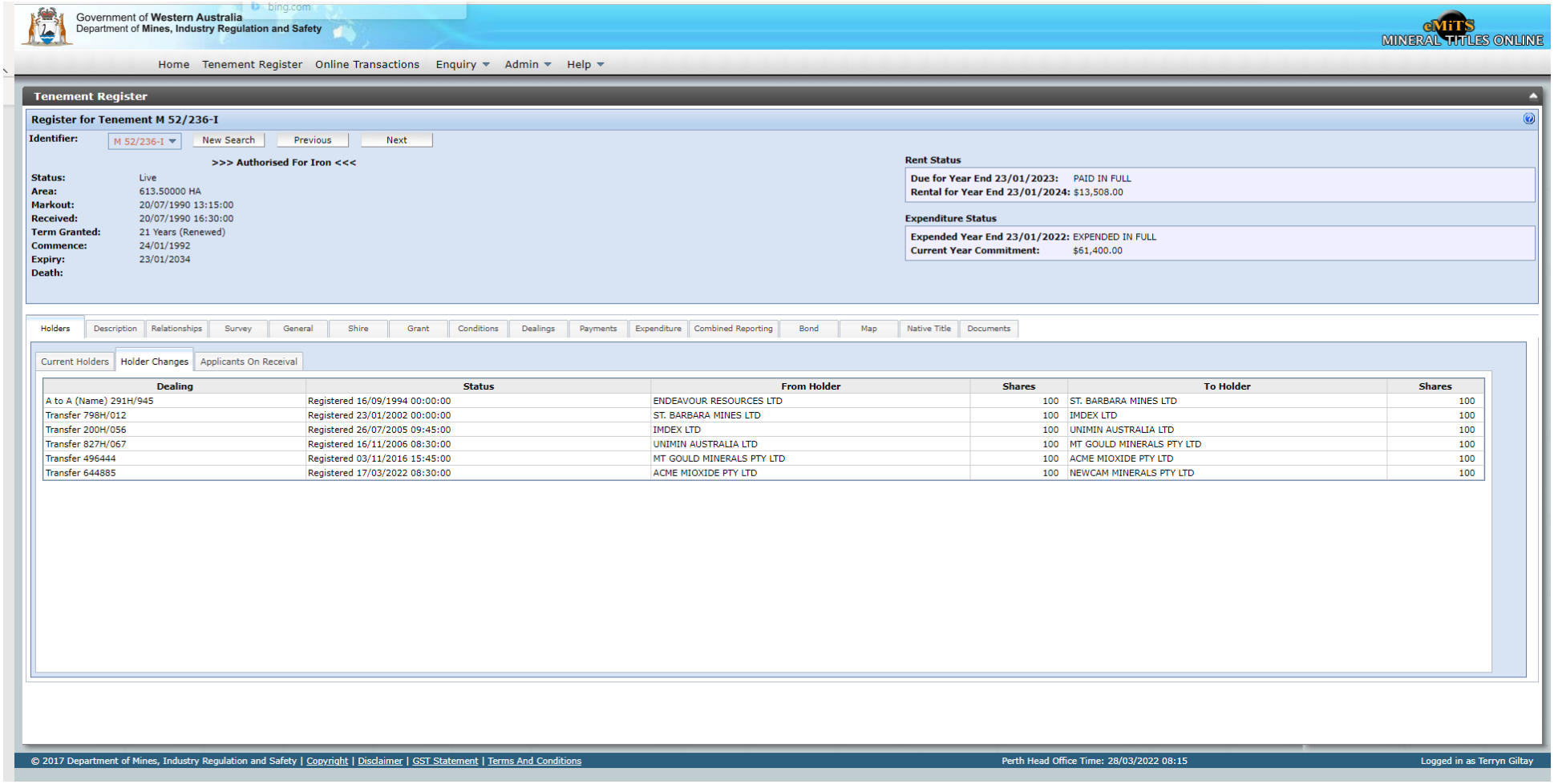
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APPENDICES

APPENDIX 1: RECORD OF TENEMENT OWNERSHIP

Appendix 1: Tenement Holder Authorisation



APPENDIX 2: MOUNT GOULD TENEMENT FLORA AND VEGETATION ASSESSMENT DESKTOP REVIEW (WOODMAN 2008)

ATLAS IRON LIMITED

MOUNT GOULD TENEMENT

FLORA AND VEGETATION ASSESSMENT

DESKTOP REVIEW

April 2008

woodmanenvironmentalconsulting

A.C.N. 088 055 903

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FIGURES

Figure 1: Average maximum and minimum temperatures (ºCelsius) and average rainfall (mm) for Meekatharra Airport (Bureau of Meteorology 2007)

1. DESCRIPTION OF PROJECT AND PROJECT AREA

Atlas Iron Limited (Atlas) is proposing to conduct preliminary exploration drilling for iron ore within tenement M52/236 located at Mount Gould ('Mount Gould tenement'). The Mount Gould tenement is located within the Mid-West Region, approximately 150 km north-east of Meekatharra, just north of the Murchison River. Exploration and mining for minerals including iron ore has historically been undertaken in the Mount Gould area, with more recent exploration at the nearby Jack Hills, located approximately 20 km to the south-east (Murchison Metals Ltd 2007). It is estimated that the preliminary drilling program will clear less than 2 hectares (ha) of native vegetion, as a number of pre-existing cleared tracks will be used for exploration activities.

The Mid-West Region is attracting considerable interest in recent times with regard to proposed mining projects on Banded Ironstone Formation (BIF) ranges. This includes existing and proposed mines at Koolanooka, Mt Gibson, Minjar, Golden Grove (including Gossan Hill), Karara-Mungada and Jack Hills. The Department of Environment and Conservation (DEC) has recently conducted a series of vegetation assessments concentrating on BIF within the Mid-West Region, to further knowledge regarding the flora and vegetation on these formations in response to these proposals.

The level of Flora and Vegetation survey for this project has been defined as a Level 2 Survey, which consists of background research/desktop study and reconnaissance survey, followed by either a detailed or comprehensive survey. The level of survey required has been determined from Table 2 of the Environmental Protection Authority's (EPA) Guidance Statement No. 51 (Environmental Protection Authority 2004), where the Bioregion Group is defined as Group 2, and the nature of the impact is considered to be moderate. The purpose of the background research/desktop study is to review known information on the target area through all sources of literature available (Environmental Protection Authority 2004).

Atlas commissioned Woodman Environmental in 2007 to conduct a desktop review of the flora and vegetation values of the Mount Gould tenement. This has been undertaken in conjunction with a desktop survey of Atlas's Wilgie-Mia tenement (tenement M20/118), located approximately 130 km south of the project area, which has been conducted as a separate report.

2. EXISTING ENVIRONMENT

2.1 CLIMATE

The Mount Gould tenement is located close to the south-western boundary of the desert bioclimatic regions, which is characterised by low and erratic rainfall that can occur in both summer and winter (Beard 1976). Figure 1 displays average monthly maximum and minimum temperatures, and average monthly rainfall, recorded for Meekatharra Airport,

the nearest meteorological station to the Mount Gould tenement (Bureau of Meteorology 2007).

The average daily maximum temperatures at Meekatharra Airport peak in January, and lowest average minimum temperatures are experienced in July. The average annual rainfall for this station is 236.6 mm. Average monthly rainfall peaks in both summer and winter. The summer rainfall is influenced by tropical cyclones, which generally form between December to April, while during winter, strong cold fronts from the south produce some rainfall.

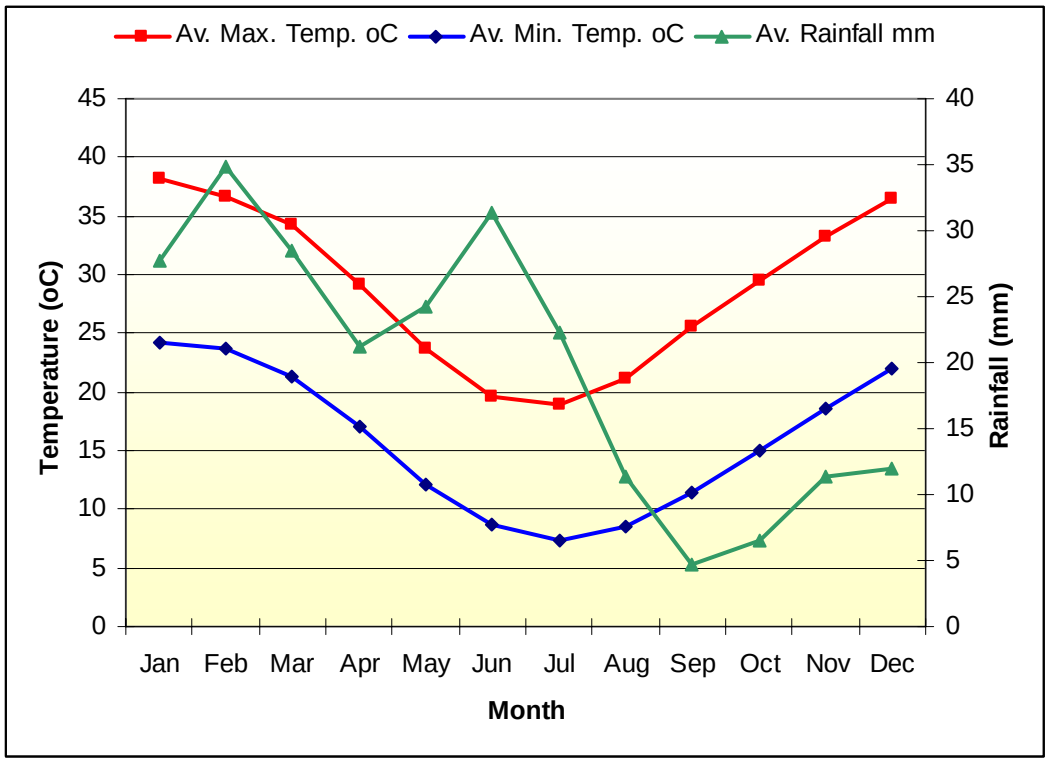


Figure 1: Average maximum and minimum temperatures (^{o}Celsius) and average rainfall (mm) for Meekatharra Airport (Bureau of Meteorology 2007)

2.2 SOILS AND LANDFORMS

The Mount Gould tenement is located in the Murchison Bioregion (Austin Botanical District), which is formed of Archaean granite with infolded volcanics and meta-sediments of like age, composing the Yilgarn Block (Beard 1990). This region is generally undulating, with occasional ranges of low hills, and extensive sandplains in the eastern half.

Beard (1976) termed the central northern part of this region (where the Mount Gould tenement is situated) the Upper Murchison sub-region, which contains the Murchison River basin. This area has been strongly dissected, resulting in most of the Tertiary

plateau surface being removed, and sandplains existing as small remnants. Most of the country is hilly and undulating, with shallow soils and exposures of granite in the hills, but also extensive plains at the lower levels (Beard 1976). The principle ranges are the Weld Range and Jack Hills, the latter located 20 km from the Mount Gould Tenement.

Beard (1976) divided the Upper Murchison into eastern and western portions when describing dominant soil types; only the western portion is relevant to the Mount Gould Tenement. Beard (1976) described 5 principal soil units in the western portion of the Upper Murchison; as described below:

1. Shallow, stony, earthy loams on hills and ranges, with extensive portions without soil cover;
2. Earthy loams overlying red-brown hardpan at shallow depth, on undulating pediments;
3. Shallow acid red earths and shallow earthy loams, often occurring in intimate micro-association and overlying red-brown hardpan within 75 cm of the surface, on extensive flat and gently-sloping plains with a scatter of surface gravels;
4. Hard alkaline and neutral red soils on alluvial flats that are frequently saline and flank river courses; and
5. Deep earthy loams in recent alluvia of river floodplains.

It is likely that the soils of the Mount Gould Tenement consist primarily of soil unit 1, however units 2 and 3 could also potentially occur.

3. FLORA AND VEGETATION

3.1 DECLARED RARE AND PRIORITY FLORA, AND INTRODUCED SPECIES

The DEC Declared Rare Flora (DRF) and Priority Flora taxa databases, including the Western Australian Herbarium (WAHerb) specimen database, were interrogated for information regarding significant taxa within the tenement area and its immediate surrounds (DEC 2007a). The following search co-ordinates, encompassing the entire Mount Gould tenement with a buffer of approximately 20 km, were used:

North-west corner:	-25^{o} 33'	116^{o} 59'
South-east corner:	-26^{o} 04'	117^{o} 37'

Nine taxa of conservation significance were returned from the above database searches (Table 1). Appendix A presents a description of conservation status codes (DEC 2006).

Table 1: Information regarding DRF and Priority Flora taxa listed on DEC Threatened Flora Databases, and the WAHerb Specimen Database, for Mount Gould tenement (DEC 2007a)

Taxon	Status	Number of Specimens in WAHerb	WAHerb Specimen Database	DEC Threatened Flora Database (DEFL Database)	DEC DRF / Priority Flora List	Distribution (Declared Rare and Priority Flora List)
Calytrix verruculosa	P1	13	x	-	x	Tuchanana Ck, Yoothapina Stn, Mt Hale, Meekatharra, (Leinster, Mt Keith)
Eremophila warnesii ms	P1	3	-	-	x	Yarlarweelor, Mt Gould, Mt Clere
Lepidium xylodes	P1	5	x	-	x	Belele Stn, Moorarie Stn
Ptilotus lazaridis	P1	8	x	-	-	-
Stenanthemum mediale	P1	7	x	-	-	-
Murchisonia fragrans	P2	9	-	-	x	Kalbarri, Mileura, Moorarie.
Gunniopsis propinqua	P3	14	x	-	-	-
Hemigenia tysonii	P3	17	x	-	x	Byro Stn, Mt Narryer, Cue, Mt Hale
Verticordia jamiesonii	P3	22	x	x	x	Mt Hale, Yalgoo, Cue, Sth Warburton, Waterfall Gorge, Rowe Hills

A search of the Department of Environment and Water Resources (DEWR) database, with regard to taxa of significance as listed under the *Environmental Protection and Biodiversity Conservation Act 1999*, was performed for the Mount Gould tenement (DEWR 2007a). One Threatened Species, *Pityrodia augustensis* (DRF) (Mt Augustus Foxglove), was listed as potentially occurring in the tenement area (Department of Environment and Water Resources 2007a). This species is listed as Vulnerable under the *Environmental Protection and Biodiversity Conservation Act 1999*. This species is currently known from the Mt Augustus area, and Mt Fraser within the Robinson Range (Brown *et. al.* 1998; DEC 2007c). As this species was not recorded within the search of the DEC's DRF and Priority Flora taxa databases, it is highly unlikely that it will be present within the Mount Gould tenement.

Two invasive taxa, *Cenchrus ciliaris* and *Prosopis* spp., were also listed as potentially occurring in the Mount Gould tenement (DEWR 2007a). *Prosopis* spp. are classified as P1 Declared Plants for the whole of Western Australia under the *Agriculture and Related Resources Protection Act 1976* (Department of Agriculture and Food 2007), meaning movement of plants or their seeds within the state, including on contaminated machinery and produce, is prohibited. *Prosopis* spp. are also listed as Weeds of National Significance (Thorp & Lynch 2000), and are under national management for the purpose of restricting their spread, and eradicating them from parts of Australia. *C. ciliaris* is not listed as a Declared Plant in Western Australia (Department of Agriculture and Food 2007) but is considered by the States and Territories to pose a particularly significant threat to biodiversity (Department of Environment and Water Resources 2007a).

3.2 PREVIOUS FLORA SURVEYS

Mattiske Consulting Pty Ltd (2005) undertook a detailed flora and vegetation survey of the proposed iron ore mining area and associated infrastructure facilities at Murchison Metals Ltd's Jack Hills project area, located approximately 20 km south of the Mount Gould Tenement, between 2004 and 2005. Some searching of Mt Gould was undertaken as part of this project. A total of 215 plant taxa from 185 genera and 36 families were recorded within the project area. The most well-represented families included Mimosaceae, Myoporaceae, Poaceae, Chenopodiaceae and Asteraceae. No DRF taxa were located during this survey, however 3 Priority taxa were located; *Calytrix verruculosa* (P1), *Gunniopsis divisa* (P1) and *Verticordia jamiesonii* (P3). None of these species were recorded at Mt Gould (Mattiske Consulting 2005).

Meissner and Caruso (2006) undertook a regional flora survey of the Jack Hills, located approximately 20 km south of the Mount Gould tenement, during August 2005, as part of a wider series of flora surveys throughout the Mid-West for the DEC. A total of 50 permanent 20 m x 20 m quadrats were established, covering the major geographical, geomorphologic and floristic variation found in the study area. A total of 209 plant taxa from 98 genera and 43 families were recorded from the quadrats and adjacent areas. The most-well represented families included Asteraceae, Poaceae, Mimosaceae, Malvaceae and Myoporaceae. No DRF taxa were located during this survey, however 1 Priority taxon, *Gunniopsis propinqua* (P3), was recorded. They also identified 2 new taxa at the time of survey: *Prostanthera* sp. Murchison (G. Byrne 239) and *Lobelia heterophylla*

subsp. Pilbara (R. Meissner & Y. Caruso 1). Currently, neither of these taxa are listed Priority taxa however *Prostanthera.* sp. Murchison (G. Byrne 239) is under consideration for Priority 1 status (Markey & Dillon 2006). Additionally, Meissner & Caruso (2006) identified 6 taxa that currently require further taxonomic review to determine whether they are conservation significant and represent distinct entities, as listed below:

- *Abutilon* sp. (R. Meissner & Y. Caruso 136)
- *Calandrinia* sp. (R. Meissner & Y. Caruso 111)
- *Glycine* sp. (R. Meissner & Y. Caruso 110)
- *Gunniopsis* aff. *divisa* (R Meissner & Y. Caruso 125)
- *Hibiscus* sp. (R. Meissner & Y. Caruso 123)
- *Indigofera* aff. *australis*

Markey & Dillon (2006) undertook a regional flora survey of the Weld Range, located approximately 130 km south of the Mount Gould tenement, during August 2005, also as part of a wider series of flora surveys throughout the Mid-West for the DEC. A total of 52 permanent 20 m x 20 m quadrats were established, covering the major geographical, geomorphologic and floristic variation found in the study area, however quadrat locations were restricted to areas where road access was adequate, as much of the range was inaccessible due to heavy rains and poor track conditions. A total of 243 plant taxa from 52 families were recorded from the quadrats and adjacent areas. The most well-represented families included Asteraceae, Poaceae, Mimosaceae, Chenopodiaceae, Myoporaceae, Amaranthaceae and Goodeniaceae. No DRF taxa were located during this survey, however 7 Priority taxa were recorded (Table 2). They also identified *Prostanthera* sp. Murchison (G. Byrne 239), which is under consideration for P1 status. Additionally, Markey & Dillon (2006) identified 7 taxa that require further study, to determine whether they represent distinct entities, as listed below:

- *Sida* aff. *atrovirens* (A. Markey & S. Dillon 3076)
- *Sida* aff. *fibulifera* (A. Markey & S. Dillon 3084)
- *Sida* sp. (A. Markey & S. Dillon 3071)
- *Calandrinia* sp. (R. Meissner & Y. Caruso 111)
- *Eremophila* aff. *georgei* (A. Markey & S. Dillon 2928)
- *Plantago* aff. *hispida* (A. Markey & S. Dillon 3440)
- *Crassula* aff. *tetramera* (pentamerous variant)

Table 2: Conservation-significant taxa recorded during flora and vegetation assessment of the Weld Range (Markey & Dillon 2006)

Taxon	Status
Dodonaea sp. Ninghan (H. Demarz 5121)	P1
Micromyrtus placoids	P1
Phyllanthus baeckeoides	P1
Prostanthera petrophila	P1

Taxon	Status
Sauropus sp. Woolgorong (M. Officer s.n. 10/8/94)	P1
Stenanthemum patens	P1
Acacia speckii	P3

3.3 VEGETATION

The study area is located within the northern section of the Murchison IBRA Region (Interim Biogeographic Regionalisation for Australia) (DEWR 2007b), and specifically within the MUR2 – Western Murchison Subregion (Desmond, Cowan and Chant 2001). The subregion forms the northern part of the Murchison Terrains of the Yilgarn Craton and contains the headwaters of the Murchison and Wooramel Rivers which drain west towards the coast. Pastoralism occupies approximately 96% of the region and there are numerous mining interests.

The study area is located within the Austin Botanical District within the Murchison Region, as defined by Beard (1990). The vegetation of district is predominantly mulga low woodland (*Acacia aneura*) on plains with scrub on hills. There is also tree steppe of *Eucalyptus* spp. and *Triodia basedowii* on the sand plains. Vegetation within the Murchison Region was broadly mapped and described by Beard at a scale of 1:1,000,000 (Beard 1976). Shepard *et. al.* (2002) mapped and described vegetation community associations related to physiognomy, based on the original Beard mapping. The project area encompasses 2 vegetation types which are summarised in Table 3.

The DEC Threatened Ecological Communities (TEC) database was interrogated upon request (DEC 2007b). There are no occurrences of TECs within the search area. Definitions of TEC criteria are given in Appendix B. Although no TECs are known from the search area, there is currently considerable interest in the flora and vegetation of BIF in the Mid-West region by the DEC.

Table 3: Description, Pre-European Extent, Current Extent and Reservation Status of Vegetation Community Association Related to Physiognomy in the Mount Gould Survey Area (Shepard *et al*. 2002)
(Areas in hectares unless indicated)

Vegetation Association	Description	Current Extent	Remaining Since Pre – European Extent (%)	IUCN Class 1-4 Reserves (%)	Other Reserves (%)	CALM pastoral leases
29	Sparse low woodland; mulga, discontinuous in scattered groups	7,782,264	100	0.3	0	2.4
202	Shrublands; mulga & *Acacia quadrimarginea* scrub	405,532	98.1	0	1.1	1.5

3.4 PREVIOUS VEGETATION SURVEYS

A total of 18 plant communities were defined for the Jack Hills project area by Mattiske Consulting (2005) during surveys in 2005. Communities were described based on dominance of species within a vegetation unit. The majority of the project area was dominated by Low Open Woodlands of *Acacia aneura, Acacia kempeana, Acacia rhodophloia* and *Grevillea berryana* on broad plains and flats interspersed with minor flow lines dominated by Low Woodlands of *Acacia aneura, Acacia citrinoviridis, Acacia tetragonophylla, Acacia rhodophloia, Acacia pruinocarpa* and *Psydrax latifolia*. The project area encompassed a number of major and minor flowlines, rocky ridges, breakaways, gravel slopes and plains. Two communities described within the Jack Hills project area were observed at Mt Gould:

T1: Hummock Grassland of *Triodia melvillei* with emergent *Acacia aneura* var. *major, Acacia rhodophloia, Acacia xiphophylla* over *Eremophila margarethae, Philotheca brucei* subsp. *cinerea, Hibiscus sturtii* var. *forrestii, Ptilotus obovatus* var. *obovatus, Eriachne pulchella* subsp. *pulchella* and *Goodenia tenuiloba* on upper slopes and rocky ridges of main ranges.

T2: Hummock Grassland of *Triodia melvillei* with denser pockets emergent species including *Acacia aneura* var. *major, Acacia ramulosa* subsp. *linophylla, Acacia xiphophylla, Grevillea berryana, Eremophila margarethae* and *Philotheca brucei* subsp. *cinerea* over *Hibiscus sturtii* var. *forrestii, Ptilotus obovatus* var. *obovatus, Eriachne pulchella* subsp. *pulchella* and *Goodenia tenuiloba* on upper slopes and rocky ridges of main ranges.

None of the plant communities described were considered to be Threatened Ecological Communities (Mattiske 2005).

Additional studies conducted by the DEC identified 6 floristic community types (FCTs) within the Jack Hills area (Meissner and Caruso 2006). None of the FCTs defined are found within conservation reserves. FCT 6 (Shrublands of *Acacia cockertoniana* ms, *Philotheca brucei* subsp. *cinerea, Eremophila* spp. over hummock grasslands of *Triodia melvillei)* is believed to be a relictual community with high perennial species richness. This community is known from high altitudes between Mt Matthew and Mt Hale. Further surveys are required to determine the relationships between FCT 6 and the Triodia-dominated vegetation communities of Mt Gould and Robinson Ranges (Meissner and Caruso 2006).

Markey and Dillon (2006) identified 8 FCTs within the Weld Range survey area. The area encompassed a number of rocky hillslopes, banded iron outcrops, footslopes and colluvial fans. None of these communities are reported to be found within conservation reserves. These communities are not restricted to the Weld Range area, however they are believed to be distinctly different to that observed in the Jack Hills area.

4. CLEARING REGULATIONS

Under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*, clearing resulting from low impact or other mineral or petroleum activities, are controlled under Regulation 5 Item 20 (Clearing: low impact or other mineral or petroleum activities), in accordance with Schedule 1 of the regulations. This provides an exemption for mineral or petroleum activities as defined in clause 2(2) of Schedule 1, allowing clearing of up to 10 hectares per financial year for clearing authorised under the Mining Act 1978 and the various Petroleum Acts in an authority area, including mining tenements as defined in the *Mining Act 1978*. Clearing must also be undertaken outside non-permitted areas (as defined in Schedule 1 of the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*). Non-permitted areas are described in Table 4:

Table 4: Non-Permitted areas as described under the Environmental *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*

Item	Non-permitted Area	Further Description
a.)	The following bioregions, or part-bioregions:	Avon Wheatbelt
		Esperance
		Geraldton Sandplains
		Jarrah Forest
		Mallee
		Swan Coastal Plain
		Warren
		Intensive-Land Use Zone of the Yalgoo Bioregion;
b.)	Alienated Land as defined in Section 3(1) of the Land Administration Act 1997	
c.)	A townsite as defined in Section 3(1) of the Land Administration Act 1997 that is occupied	
d.)	A conservation area as defined in Schedule 5 Clause 2 to the Act;	Conservation park, national park, nature reserve, marine nature reserve, marine park or marine management area within the meaning of the Conservation and Land Management Act 1984, or any other lands or waters reserved, protected or managed for the purposes of, or purposes including, nature conservation
e.)	Crown Land reserved under the Land Administration Act 1997 the care and control of which is placed with the Water and Rivers Commission under that Act or Section 32 of the Waterways Conservation Act 1976	

Item	Non-permitted Area	Further Description
f.)	A water supply area;	
g.)	An area covered by the riparian vegetation of a wetland or watercourse;	
h.)	The area extending 2km inland from the high water mark of the coastline of Western Australia;	
i.)	An environmentally sensitive area (ESA);	See Table 5
j.)	An area known as a 'priority one area' as described in 'Wild Rivers of Western Australia) (1999) published by the Water and Rivers Commission, Perth;	
k.)	An area known as a 'Red Book Area'.	

Table 5 defines criteria for ESAs, and the position of the project area in relation to these criteria.

Table 5: Description of Environmentally Sensitive Areas, and their application to the project area

Letter	Description	Application
A	A declared World Heritage property	-
B	Area registered under the Register of the National Estate, because of its natural heritage values under the *Australian Heritage Commission Act 1975*	-
C	A defined wetland and the area within 50m of the wetland	-
D	Area covered by vegetation within 50m of rare flora, to the extent where the vegetation is continuous with the vegetation in which the rare flora is located	-
E	Area covered by a threatened ecological community	-
F	A Bush Forever Site, except to the extent to which the site may be cleared under a decision of the Western Australia Planning Commission	-
G	Areas covered under the *Environmental Protection (Gnangara Mound Crown Land) Policy 1992* and the *Environmental Protection (Western Swamp Tortoise) Policy 2002*	-
H	Areas covered by the lakes to which the *Environmental Protection (Swan Coastal Plain Lakes) Policy 1992* applies	-
I	Protected wetlands as defined in the *Environmental Protection (South West Agricultural Zone Wetlands) Policy 1998*	-
J	Areas of fringing native vegetation in the policy area as defined in the *Environmental Protection (Swan and Canning Rivers) Policy 1998*	-

5. SUMMARY OF ENVIRONMENTAL FACTORS

This desktop review of flora and vegetation within the Mt Gould project area has identified the following key issues that may require management prior to commencement of exploration activities:

6. Potentially 9 Priority Flora taxa (Table 3) present in the project area;
7. Potentially 1 Declared and 1 Invasive weed species present in the project area;
8. No TECs known from the project area.

Currently, the Mt Gould tenement is not located within a non-permitted area (Section 4), although significant riparian vegetation may occur within the area. Although no TECs are currently located within the project area, the DEC is showing considerable interest in the vegetation of BIF areas within the Mid-West region.

From the results of the desktop flora and vegetation study, the conservation significance of the project area is moderate to high due to:

- The likelihood of Priority Flora species occurring in the project area;
- The limited number of previous flora surveys conducted in the Mt Gould area, and the potential impacts to banded ironstone formation (BIF) vegetation communities.

6. RECOMMENDATIONS

The level of Flora and Vegetation survey for this project has been defined as a Level 2 Survey, which consists of background research or a desktop study followed by a detailed or comprehensive survey. This has been determined from Table 2 of the EPA's Guidance Statement No. 51 (Environmental Protection Authority 2004), where the Bioregion Group is defined as Group 2, and the nature of the impact is considered to be moderate. It is recommended that a Level 2 Survey be conducted to:

- Describe and map plant communities (FCTs) present in the project area;
- Identify significant species and plant communities;
- Recommend management actions to mitigate impacts of exploratory drilling.

The level of investigation required for the proposal should be discussed with the Department of Environment and Conservation prior to the commencement of fieldwork.

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Appendix A: Declared Rare and Priority Flora Species Conservation Codes (DEC 2006)

R: Declared Rare Flora – Extant Taxa

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.

X: Declared Rare Flora – Presumed Extinct Taxa

Taxa which have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or of which all known wild populations have been destroyed more recently, and have been gazetted as such.

1: Priority One – Poorly Known Taxa

Taxa which are known from one or a few (generally <5) populations which are under threat, either due to small population size, or being on lands under immediate threat, e.g. road verges, urban areas, farmland, active mineral leases, etc., or the plants are under threat, e.g. from disease, grazing by feral animals, etc. May include taxa with threatened populations on protected lands. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.

2: Priority Two – Poorly Known Taxa

Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.

3: Priority Three – Poorly Known Taxa

Taxa which are known from several populations, and the taxa are not believed to be under immediate threat (i.e. not currently endangered), either due to the number of known populations (generally >5), or known populations being large, and either widespread or protected. Such taxa are under consideration for declaration as 'rare flora' but are in need of further survey.

4: Priority Four – Rare Taxa

Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5-10 years.

Appendix B: Definitions of Categories of Threatened Ecological Communities (Department of Environment and Conservation 2007d)

Presumed Totally Destroyed (PD)

An ecological community which has been adequately searched for but for which no representative occurrences have been located. The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future.

An ecological community will be listed as presumed totally destroyed if there are no recent records of the community being extant **and either** of the following applies (A or B):

A) Records within the last 50 years have not been confirmed despite thorough searches of known or likely habitats **or**

B) All occurrences recorded within the last 50 years have since been destroyed

Critically Endangered (CR)

An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated.

An ecological community will be listed as **Critically Endangered** when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future. This will be determined on the basis of the best available information, by it meeting **any one or more of** the following criteria (A, B or C):

A) The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 90% **and either or both** of the following apply (i or ii):

i) geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is imminent (within approximately 10 years);

ii) modification throughout its range is continuing such that in the immediate future (within approximately 10 years) the community is unlikely to be capable of being substantially rehabilitated.

B) Current distribution is limited, **and one or more** of the following apply (i, ii or iii):

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i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the immediate future (within approximately 10 years);

ii) there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes;

iii) there may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes.

C) The ecological community exists only as highly modified occurrences that may be capable of being rehabilitated if such work begins in the immediate future (within approximately 10 years).

Endangered (EN)

An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future.

An ecological community will be listed as **Endangered** when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. This will be determined on the basis of the best available information by it meeting **any one or more of** the following criteria (A, B, or C):

A) The geographic range, and/or total area occupied, and/or number of discrete occurrences have been reduced by at least 70% since European settlement **and either or both** of the following apply (i or ii):

i) the estimated geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is likely in the short term future (within approximately 20 years);

ii) modification throughout its range is continuing such that in the short term future (within approximately 20 years) the community is unlikely to be capable of being substantially restored or rehabilitated.

B) Current distribution is limited, **and one or more** of the following apply (i, ii or iii):

i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction

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throughout its range in the short term future (within approximately 20 years);

ii) there are few occurrences, each of which is small and/or isolated and all or most occurrences are very vulnerable to known threatening processes;

iii) there may be many occurrences but total area is small and all or most occurrences are small and/or isolated and very vulnerable to known threatening processes.

C) The ecological community exists only as very modified occurrences that may be capable of being substantially restored or rehabilitated if such work begins in the short-term future (within approximately 20 years).

Vulnerable (VU)

An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range.

An ecological community will be listed as **Vulnerable** when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction or significant modification in the medium to long term future. This will be determined on the basis of the best available information by it meeting **any one or more of** the following criteria (A, B or C):

A) The ecological community exists largely as modified occurrences that are likely to be capable of being substantially restored or rehabilitated.

B) The ecological community may already be modified and would be vulnerable to threatening processes, is restricted in area and/or range and/or is only found at a few locations.

C) The ecological community may be still widespread but is believed likely to move into a category of higher threat in the medium to long term future because of existing or impending threatening processes.

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APPENDIX 3: MOUNT GOULD DSO PROJECT FLORA AND VEGETATION ASSESSMENT (WOODMAN 2009)

ATLAS IRON LIMITED

MOUNT GOULD DSO PROJECT

FLORA AND VEGETATION ASSESSMENT



May 2009

woodmanenvironmentalconsulting

A.C.N. 088 055 903

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EXECUTIVE SUMMARY

Atlas Iron Limited (Atlas) is proposing to conduct preliminary exploration drilling for iron ore, with the view of mining the ore depending on the results of drilling, within tenement M52/236 ('Project area'), as part of its Mount Gould Direct Shipping Ore (DSO) Project. The Mount Gould DSO Project area ('Project area') is located at Mount Gould within the Mid-West Region, approximately 150 km north-east of Meekatharra, north of the Murchison River. Atlas initially commissioned Woodman Environmental Consulting (Woodman Environmental) in 2007 to conduct a desktop flora and vegetation study of the Project area. Following the completion of this study, Atlas commissioned Woodman Environmental in 2008 to undertake a detailed flora and vegetation survey of the Project area. The level of Flora and Vegetation survey for the Project area has been defined as a Level 2 Survey, which consists of background research/desktop study and reconnaissance survey, followed by either a detailed or comprehensive survey. The level of survey required has been determined from Table 2 of the Environmental Protection Authority's Guidance Statement No. 51, where the Bioregion Group is defined as Group 2, and the nature of the potential impact is considered to be moderate.

A total of 25 permanent 20 m by 20 m vegetation assessment quadrats were established over the Project area. All types of vegetation units discernable from aerial photographs (scale 1:10,000) were surveyed with at least one quadrat. Opportunistic recordings of other species were also noted in areas adjacent to quadrats, and when traversing between quadrats. Statistical analysis using PATN was undertaken to describe Floristic Community Types (FCTs) present in the Project area, utilising data from both Woodman Environmental and Department of Environment and Conservation quadrats, which were established in 2006. Indicator species analysis was also undertaken. Mapping of populations of *Eremophila warnesii* (P1), which is known from the summit of Mount Gould, was also undertaken.

A total of 94 discrete vascular flora taxa, from 28 families and 53 genera, were recorded from the Project area. Of these taxa, one introduced (weed) taxon was recorded. The families with the highest number of taxa were Poaceae (10 taxa), Myoporaceae (10), Mimosaceae (9) and Asteraceae (8). No Declared Rare Flora taxa were recorded within the Project area; however three Priority Flora taxa were recorded: *Eremophila warnesii*, *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) and *Rhodanthe sphaerocephala* (all P1). The populations of these taxa within the Project area are all ranked as highly significant in terms of the overall conservation of each taxon, as all three are known from less than five populations, and have restricted geographical distributions in the general region of Mount Gould. There is also very little data available regarding the size and condition of these populations. In particular, *H. gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) is only known from Mount Gould, where it is by no means abundant.

The floristic classification of the quadrats within the Project area defined 7 FCTs and sub-types. Most FCTs consisted of tall shrublands dominated by *Acacia aneura*, however one FCT on the summit and slopes of Mount Gould consisted of a hummock grassland

dominated by *Triodia melvillei*. Comparison of quadrat data from the Project area with datasets from the nearby Robinson Range and Jack Hills indicated that the FCTs described on the summit and upper slopes of Mount Gould, including the hummock grassland of *Triodia melvillei*, do not occur elsewhere, and are therefore of high regional conservation significance. Mount Gould itself is included as part of the Robinson Range vegetation complexes (banded ironstone formation) Priority Ecological Community, which is listed as Priority 1.

As no mining footprint has been developed for the Mount Gould DSO Project, no assessment of the impacts of any such proposal to significant flora and FCTs has been undertaken. It is of high importance that this be undertaken if mining is proposed, particularly given the high conservation significance of the Priority flora and FCTs present within the Project area.

The following recommendations are given:

- Utilize areas of existing disturbance for any future proposed drilling operations where possible;
- Survey of any proposed drilling in remnant vegetation on Mount Gould by an experienced botanist if drilling occurs within the vicinity of known Priority flora locations, or within likely habitat of Priority flora; and
- Additional regional survey for Priority flora taxa if impacts to populations of such taxa within the Project area as a result of clearing for drilling or mining operations are likely to be significant.

1. INTRODUCTION

1.1 Project Description

Atlas Iron Limited (Atlas) is proposing to conduct preliminary exploration drilling for iron ore, with the view of mining the ore depending on the results of drilling, within tenement M52/236 ('Project area'), located at Mount Gould. Mount Gould is located within the Mid-West Region, approximately 150 km north-east of Meekatharra, north of the Murchison River. The Mount Gould iron ore deposit was discovered in 1897 and regarded as a significant deposit due to its proximity to the enriched hematite deposit at Mount Hale, located in the Jack Hills to the south. In the late 1960's and early 1970's various geological surveys and mapping was carried out over the prospect and the presence of micaceous hematite was also noted. In 1986 Imdex Limited entered into an agreement with Endeavour Resources (who held the mining lease) to develop, mine and market the micaceous iron ore and during the period 1986-1995, Imdex conducted an extended program of geological mapping, drilling, costeaning and bulk sampling of the ore body. In 1995 Imdex lodged a Notice of Intent to mine 5000 tonnes and constructed roads, stockpiles and a crushing plant onsite, with ore transported to the Company's plant in Jandakot for final milling. In May 1998 the tenement was authorised for iron ore by Mount Gould Minerals Pty Ltd. In August 2007 Atlas Iron Limited acquired the tenement from Mount Gould Minerals Pty Ltd along with mining lease M20/118 located at Weld Range.

The Mid-West Region is currently attracting considerable interest with regard to proposed mining projects on Banded Ironstone Formation (BIF) ranges. This includes existing and proposed mines at Koolanooka, Mt Gibson, Minjar, Golden Grove (including Gossan Hill), Karara-Mungada, Weld Range and Jack Hills. The Department of Environment and Conservation (DEC) has recently conducted a series of vegetation assessments concentrating on BIFs throughout the Mid-West Region in response to these proposals, to enhance knowledge regarding the flora and vegetation on these formations, and develop management objectives for these formations.

Atlas initially commissioned Woodman Environmental Consulting (Woodman Environmental) in 2007 to conduct a desktop flora and vegetation study of the Project area (Woodman Environmental 2008). Following the completion of this study, Atlas commissioned Woodman Environmental in 2008 to undertake a detailed flora and vegetation survey of the Project area. This was undertaken in conjunction with a detailed survey of Atlas' Weld Range DSO Project area, located approximately 130 km south of the Project area, which has been presented as a separate report.

The level of Flora and Vegetation survey for the Project area has been defined as a Level 2 Survey, which consists of background research/desktop study and reconnaissance survey, followed by either a detailed or comprehensive survey. The level of survey required has been determined from Table 2 of the Environmental Protection Authority's (EPA) Guidance Statement No. 51 (EPA 2004), where the Bioregion Group is defined as Group 2, and the nature of the potential impact is considered to be moderate.

1.2 Aims

The aim of this study was to ascertain flora and vegetation values that may be impacted by the proposed drilling and future mining operations (if any) within the Project area. This included survey for Declared Rare Flora (DRF) and Priority Flora species that may be present within the Project area, and establishment of survey quadrats in all vegetation units. The information collected during the survey will assist Atlas in their decision-making with regard to minimising the potential impacts of drilling and mining-related activities to the flora and vegetation values of the Project area.

The tasks required to meet this aim were:

- Establish a series of 20 m x 20 m permanent quadrats within all vegetation units in the Project area;
- Undertake statistical analysis to define Floristic Community Types (FCTs) within the Project area;
- Produce a FCT map of the Project area;
- Search for flora species, particularly DRF and Priority Flora species that may be present within the Project area;
- Provide a report detailing FCTs and flora species present within the Project area; and
- Identify management measures to minimise the impact of any proposed disturbance on the flora and vegetation of the Project area.

2. BACKGROUND

2.1 Climate

The Project area is located close to the south-western boundary of the desert bioclimatic region, which is characterised by low and erratic rainfall that can occur in both summer and winter (Beard 1976). Figure 1 displays average monthly maximum and minimum temperatures, and average monthly rainfall, recorded for Meekatharra Airport, the nearest meteorological station to the Project area (Bureau of Meteorology 2009).

The average daily maximum temperatures at Meekatharra Airport peak in January, and lowest average minimum temperatures are experienced in July. The average annual rainfall for this station is 236.5 mm. Average monthly rainfall peaks in both summer and winter. The summer rainfall is influenced by tropical cyclones, which generally form between December and April, while during winter strong cold fronts from the south produce some rainfall.

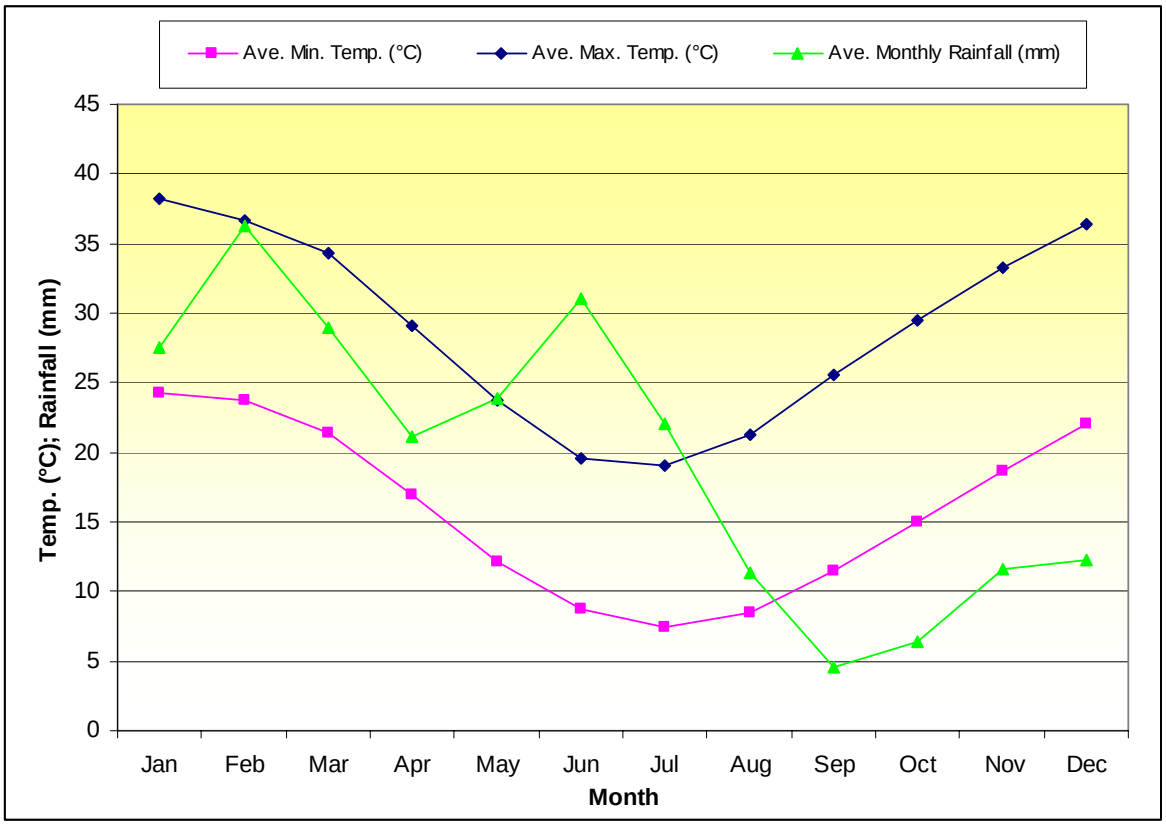


Figure 1: Average Maximum and Minimum Temperatures (°Celsius) and Average Rainfall (mm) for Meekatharra Airport (Bureau of Meteorology 2009)

2.2 Soils and Landforms

The Project area is located in the Murchison Bioregion (Austin Botanical District), which is formed of Archaean granite with infolded volcanics and meta-sediments of like age, composing the Yilgarn Block (Beard 1990). This region is generally undulating, with occasional ranges of low hills, and extensive sandplains in the eastern half.

Beard (1976) termed the central northern part of this region (where the Project area is situated) the Upper Murchison sub-region, which contains the Murchison River basin. This area has been strongly dissected, resulting in most of the Tertiary plateau surface being removed, and sandplains existing as small remnants. Most of the country is hilly and undulating, with shallow soils and exposures of granite in the hills, but also extensive plains at the lower levels (Beard 1976). The principle ranges are the Weld Range and Jack Hills, the latter located 20 km from the Project area.

Beard (1976) divided the Upper Murchison into eastern and western portions when describing dominant soil types; only the western portion is relevant to the Project area. Beard (1976) described five principal soil units in the western portion of the Upper Murchison; as described below:

1. Shallow, stony, earthy loams on hills and ranges, with extensive portions without soil cover;
2. Earthy loams overlying red-brown hardpan at shallow depth, on undulating pediments;
3. Shallow acid red earths and shallow earthy loams, often occurring in intimate micro-association and overlying red-brown hardpan within 75 cm of the surface, on extensive flat and gently-sloping plains with a scatter of surface gravels;
4. Hard alkaline and neutral red soils on alluvial flats that are frequently saline and flank river courses; and
5. Deep earthy loams in recent alluvia of river floodplains.

It is likely that the soils of the Project area consist primarily of soil unit 1, however units 2 and 3 could also potentially occur.

2.3 Flora and Vegetation Surveys

2.3.1 Sources of Information

Very few flora and vegetation surveys carried out to date have encompassed the Project area, and those have been conducted mainly at State and Regional levels. These have mainly been conducted by J. S. Beard, in his mapping and description of vegetation systems on a State wide level (Beard 1976; 1990), which was further expanded by Shepherd *et al.* (2002). An inventory and rangeland condition survey of the Murchison River catchment and surrounds, which includes Mount Gould, has also been undertaken (Curry *et al.* 1994). The Department of Environment and Conservation (DEC) undertook a survey of Mount Gould as part of a series of vegetation assessments concentrating on BIFs throughout the Mid-West Region, however this did not sample the entire Project area area.

Applicable DEC databases were interrogated as part of the initial desktop survey of the Project area in 2007 for the presence of known DRF and Priority Flora species, Threatened Ecological Communities (TECs) and Priority Ecological Communities (PECs). The GIS tool *NatureMap* (DEC 2009a) was then used to determine any additional records of DRF and Priority Flora taxa that may have been added to DEC databases since the initial interrogation. Commonwealth Department of Environment and Water Resources (DEWR) databases were also interrogated for factors of environmental significance. Appendix A presents the definition of DRF and Priority Flora codes (Atkins 2008), and Appendix B presents definitions and criteria for TECs and PECs (DEC 2007a).

2.3.2 Flora

Meissner *et al.* (2007) undertook a regional flora survey of Mount Gould, in conjunction with a survey of the Robinson Range (located approximately 80 km east of Mount Gould), during August 2006, as part of a wider series of flora surveys throughout the Mid-West for the DEC. A total of 50 permanent 20 m x 20 m quadrats were established during the survey, including 5 on Mount Gould, covering the major geographical, geomorphologic and floristic variation found in the study area. A total of 172 plant taxa from 81 genera and 40 families were recorded from the quadrats and adjacent areas. The most-well represented families included Asteraceae, Poaceae, Mimosaceae, Malvaceae and Amaranthaceae.

No DRF taxa were located during this survey, however the Priority taxa *Euphorbia sarcostemmoides*, *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) (initially referred to as *Halgania* ?*gustafsenii* var. *gustafsenii* (R. Meissner & B. Bayliss 743), *Pityrodia ipthima* (initially referred to as *Pityrodia* sp. Robinson Range (R. Meissner & B. Bayliss 725) (all P1) and *Baeckea* sp. Melita Station (H. Pringle 2738) (P3) were recorded. Of these, only *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) (P1) was recorded on Mount Gould. They also identified a single new taxon at the time of survey: *Indigofera fractiflexa* subsp. Mount Augustus (S. Patrick & A. Crawford SP4734), however this taxon is not currently considered to be of conservation significance. Additionally, six taxa were identified that currently require further collections and/or taxonomic review to determine whether they are conservation significant and represent distinct entities, as listed below:

- *Hibiscus* cf. *solanifolius* (R. Meissner & B. Bayliss 923)
- *Sida* aff. *atrovirens* (R. Meissner & B. Bayliss 1031)
- *Sida* aff. *intricata* (R. Meissner & B. Bayliss 1037)
- *Portulaca* aff. *oleracea* (R. Meissner & B. Bayliss 963)
- *Paspalidium* sp. (R. Meissner & B. Bayliss 956)
- *Solanum* aff. *ashbyae* (R. Meissner & B. Bayliss 1040)

Meissner & Caruso (2006) undertook a regional flora survey of the Jack Hills, located approximately 20 km south of the Project area, during August 2005, as part of a wider series of flora surveys throughout the Mid-West for the DEC. A total of 50 permanent 20 m x 20 m quadrats were established, covering the major geographical, geomorphologic and

floristic variation found in the study area. A total of 209 plant taxa from 98 genera and 43 families were recorded from the quadrats and adjacent areas. The most-well represented families included Asteraceae, Poaceae, Mimosaceae, Malvaceae and Myoporaceae. No DRF taxa were located during this survey, however the Priority taxa *Acacia* sp. Jack Hills (R. Meissner & R. Meissner & Y. Caruso 4) (initially referred to as *Acacia cockertoniana* ms) (P1), *Gunniopsis propinqua* and *Prostanthera ferricola* (initially referred to as *Prostanthera* sp. Murchison (G. Byrne 239)) (both P3), were recorded. They also identified the new taxon (at the time of survey) *Lobelia heterophylla* subsp. Pilbara (R. Meissner & Y. Caruso 1), however this taxon is not considered to be of conservation significance. Additionally, five taxa were identified that currently require further collections and/or taxonomic review to determine whether they are conservation significant and represent distinct entities, as listed below:

- *Abutilon* sp. (R. Meissner & Y. Caruso 136)
- *Glycine* sp. (R. Meissner & Y. Caruso 110)
- *Gunniopsis* aff. *divisa* (R Meissner & Y. Caruso 125)
- *Hibiscus* sp. (R. Meissner & Y. Caruso 123)
- *Indigofera* aff. *australis*

Mattiske Consulting Pty Ltd (2005) undertook a detailed flora and vegetation survey of the proposed iron ore mining area and associated infrastructure facilities at Murchison Metals Ltd's Jack Hills project area, located approximately 20 km south of the Project area, between 2004 and 2005. Some searching of Mount Gould was undertaken as part of this survey. A total of 215 plant taxa from 185 genera and 36 families were recorded during the survey. The most well-represented families included Mimosaceae, Myoporaceae, Poaceae, Chenopodiaceae and Asteraceae. No DRF taxa were located during this survey, however three Priority taxa were located: *Calytrix verruculosa* (P1), *Gunniopsis divisa* (P1) and *Verticordia jamiesonii* (P3). None of these species were recorded at Mount Gould (Mattiske Consulting Pty Ltd 2005).

A search of the DEC Threatened Flora Databases (Threatened Flora Database; Western Australian Herbarium (WAHerb) Specimen Database; Declared Rare and Priority Flora List) for the Project area was previously undertaken in 2007 (DEC 2007b). The search co-ordinates used were:

North-west corner:	-25° 33'	116° 59'
South-east corner:	-26° 04'	117° 37'

The WAHerb Specimen Database and the Declared Rare and Priority Flora Database provided information on DRF and Priority Flora species over the area covered by the search co-ordinates. The GIS tool *NatureMap* (DEC 2009a), which utilises the Threatened Flora Database and WAHerb Specimen Database, was then used to determine any additional records of DRF and Priority Flora taxa that may have been added to DEC databases since the initial interrogation. Information resulting from the database searches is presented in Table 1. These species may potentially occur within the Project area.

Table 1: DRF and Priority Flora Potentially Found Within or in the Vicinity of the Project area (DEC 2007b; DEC 2009a)

Taxon	Conservation Status
Acacia sp. Jack Hills (R. Meissner & Y. Caruso 4)	P1
Calytrix verruculosa	P1
Eremophila petrophila subsp. *densa*	P1
Eremophila warnesii	P1
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	P1
Lepidium xylodes	P1
Ptilotus lazaridis	P1
Stenanthemum mediale	P1
Murchisonia fragrans	P2
Gunniopsis propinqua	P3
Hemigenia tysonii	P3
Homalocalyx echinulatus	P3
Prostanthera ferricola	P3
Verticordia jamiesonii	P3

A search of the Department of the Environment, Water, Heritage and the Arts (DEWHA) database, with regard to taxa of significance as listed under the *Environmental Protection and Biodiversity Conservation Act 1999*, was performed for the Project area (DEWHA 2009). One Threatened Species, *Pityrodia augustensis* (DRF) (Mt Augustus Foxglove), was listed as potentially occurring in the Project area area (DEWHA 2009). This species is listed as Vulnerable under the *Environmental Protection and Biodiversity Conservation Act 1999*. This species is currently only known from the Mt Augustus area. As this species was not recorded within the search of the DEC's DRF and Priority Flora taxa databases, it is highly unlikely that it will be present within the Project area.

Two invasive taxa, *Cenchrus ciliaris* and *Prosopis* spp., were also listed as potentially occurring in the Project area (DEWHA 2009). *Prosopis* spp. are classified as P1 Declared Plants for the whole of Western Australia under the *Agriculture and Related Resources Protection Act 1976* (Department of Agriculture and Food 2009), meaning movement of plants or their seeds within the state, including on contaminated machinery and produce, is prohibited. *Prosopis* spp. are also listed as Weeds of National Significance (Thorp & Lynch 2000), and are under national management for the purpose of restricting their spread, and eradicating them from parts of Australia. *C. ciliaris* is not listed as a Declared Plant in Western Australia (Department of Agriculture and Food 2009) but is considered by the States and Territories to pose a particularly significant threat to biodiversity (DEWHA 2009).

2.3.3 Vegetation

The Project area is located within the northern section of the Murchison IBRA Region (Interim Biogeographic Regionalisation for Australia) (Environment Australia 2000), and specifically within the MUR2 – Western Murchison Subregion (Desmond, Cowan and Chant 2001). The subregion forms the northern part of the Murchison Terrains of the Yilgarn Craton and contains the headwaters of the Murchison and Wooramel Rivers which drain west towards the coast. Pastoralism occupies approximately 96% of the region and there are numerous mining interests.

The Project area is located within the Austin Botanical District within the Murchison Region, as defined by Beard (1990). The vegetation of district is predominantly mulga low woodland (*Acacia aneura*) on plains with scrub on hills. There is also tree steppe of *Eucalyptus* spp. and *Triodia basedowii* on the sand plains. Vegetation within the Murchison Region was broadly mapped and described by Beard at a scale of 1:1,000,000 (Beard 1976). Shepard *et al.* (2002) mapped and described vegetation associations related to physiognomy, based on the original Beard mapping. The Project area encompasses two vegetation types which are summarised in Table 2.

Curry *et al.* (1994) described Mount Gould as belonging to the Peak Hill Land System, which consists of rugged sinuous ranges and hills of banded ironstone and hematitic shale, with vegetation dominated by *Acacia aneura* and *A. tetragonophylla*, with scattered *Eremophila*, *Cassia* and *Solanum*. The Robinson Range (located approximately 60 km to the east of Mount Gould) was mapped as the same Land System, however the nearby Jack Hills (approximately 20 km south of Mount Gould), were mapped as a different (Weld) Land System.

The DEC TEC and PEC database was interrogated upon request (DEC 2007c). There are no occurrences of TECs within the search area. However, Mount Gould is included as part of the Robinson Range vegetation complexes (banded ironstone formation) PEC, which is listed as P1 (DEC 2008). There is the potential that this PEC may be listed as a TEC in the future.

Meissner *et al.* (2007) identified seven FCTs within the Robinson Range and Mount Gould areas, two of which were recorded on Mount Gould. These are summarised in Table 3. FCT 1 is found on Mount Gould and in the Robinson Range, while FCT 2 is restricted to Mount Gould. It appears that FCT 2, a spinifex (*Triodia*) community found at the summit of Mount Gould, differs to spinifex communities found on the Robinson Range (FCT 7) and Jack Hills (FCT 6 as described in Meissner & Caruso (2006)), primarily in the perennial shrub species found within the community. Neither of the FCTs described on Mount Gould appear to occur at the Jack Hills, located only 20 km south of Mount Gould (Meissner *et al.* 2007).

Table 2: Description, Pre-European Extent, Current Extent and Reservation Status of Vegetation Associations Related to Physiognomy in the Mount Gould Survey Area (Shepard *et al.* 2002)
(Areas in hectares unless indicated)

Vegetation Association	Description	Current Extent	% Remaining Since Pre – European Extent	IUCN Class 1-4 Reserves (%)	Other Reserves (%)	DEC pastoral leases
29	Sparse low woodland; mulga, discontinuous in scattered groups	7,782,264	100	0.3	0	2.4
202	Shrublands; mulga & *Acacia quadrimarginea* scrub	405,532	98.1	0	1.1	1.5

Table 3: Floristic Community Types (FCTs) Described on Mount Gould by Meissner *et al.* (2007)

FCT	Description	Location
1	Open to sparse shrublands of *Acacia aneura* over open to isolated shrublands of *Eremophila* spp. (*E. latrobei* subsp. *latrobei*, *E. jucunda* subsp. *jucunda*, *E. forrestii* subsp. *forrestii*), *Ptilotus obovatus* var. *obovatus* and *P. polystachyus* over forbland and grassland of *Dysphania rhadinostachya*, *Aristida contorta*, *Eriachne pulchella* and *Goodenia tenuiloba*.	Lower slopes of Mount Gould and Robinson Range
2	Isolated shrubland of *Acacia aneura* or *Grevillea berryana* over sparse to open shrubland of *Philotheca brucei* subsp. *cinerea*, *Eremophila latrobei* subsp. *latrobei* over hummock grassland of *Triodia melvillei*	Upper slopes and crests of Mount Gould

Meissner & Caruso (2006) identified six FCTs within the Jack Hills area. None of the FCTs defined are found within conservation reserves. FCT 6 (Shrublands of *Acacia* sp. Jack Hills (R. Meissner and Y. Caruso 4), *Philotheca brucei* subsp. *cinerea*, *Eremophila* spp. over hummock grasslands of *Triodia melvillei)* is believed to be a relictual FCT with high perennial species richness. This FCT is known from high altitudes between Mt Matthew and Mt Hale, and is now believed to be different to superficially similar FCTs found on Mount Gould and in the Robinson Range (Meissner *et al.* 2007).

A total of 18 plant communities were defined for the Jack Hills project area by Mattiske Consulting (2005) during surveys in 2005. Communities were described based on dominance of species within a vegetation unit. The majority of the project area was dominated by Low Open Woodlands of *Acacia aneura*, *Acacia kempeana*, *Acacia rhodophloia* and *Grevillea berryana* on broad plains and flats interspersed with minor flow lines dominated by Low Woodlands of *Acacia aneura*, *Acacia citrinoviridis*, *Acacia tetragonophylla*, *Acacia rhodophloia*, *Acacia pruinocarpa* and *Psydrax latifolia*. The project area encompassed a number of major and minor flowlines, rocky ridges, breakaways, gravel slopes and plains. Two spinifex communities described within the Jack Hills project area were observed on Mt Gould, however, this contradicts Meissner *et al.* (2007), who determined that communities located in the Jack Hills and Mount Gould are significantly different in terms of species composition, despite their geographical proximity (20 km apart). None of the plant communities described were considered to be Threatened Ecological Communities (Mattiske Consulting Pty Ltd 2005).

3. METHODS

3.1 Licences and Timing of Survey

Field surveys were undertaken from the 4th to 8th August, and from the 29th September to 3rd October 2008. The timing of surveys was designed to sample the Project area area over two seasons, as stipulated by the EPA Guidance Statement No. 51 (EPA 2004). Plant collections were taken under the following license numbers:

- Greg Woodman: SL008043
- David Coultas: SL008065
- Kim Kershaw SL008034

3.2 Aerial Photography Interpretation

Aerial photography of the Project area area was supplied to Woodman Environmental by Atlas at a scale of 1:10 000. Preliminary vegetation boundaries in the Project area were transcribed onto the aerial photography based on patterning and landforms. All vegetation patterns were targeted for establishment of flora quadrats to ensure that each identifiable vegetation unit and landform feature received survey effort.

3.3 Field Survey

A total of 25 permanent 20 m by 20 m vegetation assessment quadrats were established over the Project area. Each quadrat was established and assessed in accordance with the methods contained in procedures as presented by the Department of Conservation and Land Management (CALM) (2006a, b). All types of vegetation units discernable from aerial photographs (scale 1:10,000) were surveyed with at least one quadrat. The quadrats were established in the least disturbed vegetation available.

All quadrats were oriented to the four cardinal points, with a star picket used to mark the north-west corner, and fence droppers used to mark the remaining corners. Aluminium tags were used to mark the north-west corner with the quadrat number. GPS locations for each quadrat were taken using a Garmin GPS 72 (accurate to approximately 5 m) at the north-west corner. All co-ordinates were taken in GDA94, Zone 50. A photograph of each quadrat was also taken facing south-east from the north-west corner. No soil samples were collected for analysis during this survey.

The following data was recorded at each quadrat:

- Personnel
- Date
- GPS Location (GDA 94; Zone 51)
- Topography
- Soil Type and Colour

- Slope
- Condition of Vegetation (Government of Western Australia 2000)
- Vascular Plant Species Height and Cover
- Photograph facing south-east from star picket

Opportunistic recordings of other species were also noted in areas adjacent to quadrats, and when traversing between quadrats.

The Priority 1 species *Eremophila warnesii* is known from the summit of Mount Gould. When populations of this species were identified, the spatial distributions of the populations were defined by recording GPS co-ordinates around the edge of the populations. Estimates of the number of individuals within each population were also recorded. This was undertaken to attempt to discern the complete spatial distribution of this species within the Project area.

3.4 Plant Collection and Identification

All vascular plant species present within each quadrat were recorded during the field work in 2008. Specimens of unknown taxa were collected and pressed for identification at the W.A. Herbarium. All plant identification work was conducted by Frank Obbens and David Coultas. Species nomenclature follows Packowska & Chapman (2000), with all names checked against the MAX database to ensure their currency. The MAX database is a database maintained by the Department of Environment and Conservation (DEC) containing the current names of all plant taxa in Western Australia. The conservation status of each species was checked against conservation status codes presented on *Florabase* (DEC 2009b).

Specimens of significant flora species collected and Rare Flora Report Forms (RFRF) (as required by the DEC) will be submitted to the W.A. Herbarium and the DEC respectively upon the conclusion of this project.

3.5 Statistical Analysis

Statistical analysis and determination of FCTs was conducted using quadrat data only. Statistical analysis of the quadrat-derived data was conducted using methods similar to those used by Meissner *et al.* (2007). In the DEC studies (including Meissner *et al.* 2007) quadrat data was analysed statistically using three separate statistical packages and following a method utilised in previous regional floristic surveys (Gibson 2004 and references therein).

Classification and ordination analyses were conducted on a data matrix compiled from both Woodman Environmental and Meissner *et al.* (2007) quadrat data, with introduced, annual and singleton (occurring once in the dataset) taxa omitted prior to analysis. Only collections identifiable to at least species level were used in the analysis. Various taxa were grouped together within the data matrix for the analyses where taxonomy was unclear or where different infra-taxa were identified within the dataset and not correlated to

community type. Taxa where nomenclature had been updated between Woodman Environmental data and Meissner *et al.* (2007) datasets were aligned for the analysis.

Pattern analysis was conducted using PATN (V3.03) (Belbin 1989). The Bray-Curtis coefficient was used to generate an association matrix for classification and ordination analyses. Within PATN the agglomerative hierarchical clustering method using flexible UPGMA (ß=-0.1) was used to generate a species by site classification (Sneath & Sokal 1973) and two-way tables. Indicator species analysis (INDVAL) was conducted using PC-Ord (McCune & Mefford 1999) using the method of Dufrene & Legendre (1997). The INDVAL measures were used to determine the indicator species for each FCT and a Monte Carlo permutation test was used to test for the significance of the indicator species.

This analysis sought to expand upon the Meissner *et al.* (2007) Mount Gould dataset and identify FCTs across the entire Project area, utilising both Woodman Environmental data and Meissner *et al.* (2007) Mount Gould data. Therefore, only quadrats established within the Project area were initially analysed, to allow for the description of FCTs within the Project area. The analysis performed by Meissner *et al.* (2007), which utilised both Mount Gould and Robinson Range quadrat data, was then repeated with the addition of Woodman Environmental quadrat data, to assess distribution of FCTs identified within the Project area within a regional context. Additionally, Mount Gould quadrat data was analysed with Jack Hills quadrat data (Meissner & Caruso 2006) to attempt to provide further regional context.

3.6 Description of Floristic Community Types

The description of FCTs in the Project area generally follows the National Vegetation Information System (NVIS) model. This model follows nationally-agreed guidelines to describe and represent vegetation types, so that comparable and consistent data is produced nation-wide. With reference to the NVIS Hierarchy in Table 1 of the NVIS Australian Vegetation Attribute Manual (ESCAVI 2003), a FCT is the equivalent of a Sub-Association. Similar methods of describing FCTs have previously been used in the description of the vegetation of the Ravensthorpe Range (Craig *et al.* 2008).

3.7 Significant of Flora and Vegetation

3.7.1 Significance of Flora Taxa

The local distribution of flora taxa is defined as their known distribution within the Project area. The regional distribution refers to the known regional distribution of each taxon throughout Western Australia, in particular in the Murchison-Gascoyne Regions.

The regional significance of the local populations of conservation-significant flora taxa is determined by the location of the Project area with regards to the regional distribution of the taxa, and previously known records of these taxa either within or in close proximity to the Project area (Table 4).

Table 4:	**Significance of Local Populations to the Overall/Regional Conservation of Species**
Ranking	**Description**
High	• Known range of taxa either entirely located within the Project area area, or within the Project area area and to a radius of <5km of the Project area area; and/or • Taxa known from <10 discrete populations, including within the Project area area; and/or • Project area area on boundary of known regional distribution
Moderate	• Known range of taxa extends <50km; and/or • Taxa known from >10 discrete populations; and/or • Project area area may be on boundary of known regional distribution
Low	• Known range of taxa extends >50km; and/or • Taxa known from >20 discrete populations; and/or • Project area area not on boundary of known regional distribution

3.7.2 Significance of Vegetation

Woodman Environmental have developed conservation significance descriptions for FCTs in the Project area. The criteria used to determine conservation significance for each FCT is described in Table 5. Note that potential impacts to FCTs are not used in the determination of conservation significance of FCTs. Also, limited regional studies have been conducted in the Mid-West Region, being the surveys undertaken by Meissner & Caruso (2006) and Meissner *et al.* (2007). These surveys did not incorporate vegetation units that occur on flats and other non-BIF or rock-based substrate areas, and did not include spatial mapping of units, and therefore cannot be used for comparison with FCTs that were mapped on such areas in the Project area.

Factors used to determine conservation significance included the numbers and types of Priority Flora and other significant flora species known from within the FCT, and the inferred extent of the preferred soil type, substrate and topographical position within the region, where known. The mapped area of each FCT within the Project area was also considered in addition to the criteria presented in Table 5, with FCTs comprising a mapped area less than 10 % of the total area mapped (<61 ha) considered to be locally restricted.

Table 5:	**Descriptions of Conservation Significance Rankings of Floristic Community Types**
Conservation Significance Ranking	**Description**

1	• The FCT is likely to be widespread through the region as identified in the regional quadrat dataset (Meissner & Caruso 2006; Meissner *et al.* 2007), and/or the FCT occurs on landforms that are widespread and not restricted within the region;
	• Priority flora species/significant flora species are:
	  • unlikely to occur;
	  • are known to occur in limited amounts in the FCT; or
	  • are relatively widespread through the Project area area

2	• The FCT is likely to be widespread through the region as identified in the regional quadrat dataset, and/or the FCT occurs on landforms that are widespread and not restricted within the region; • Priority flora species/significant flora known to occur in the FCT
3	• The FCT is possibly restricted in the region (regional quadrat data may not be available); • The FCT occurs on landforms that are restricted in the region; • Priority flora species/significant flora species may occur in the FCT.
4	• The FCT is represented within the regional quadrat dataset outside of the Project area; • The FCT occurs on landforms that are not widespread and are restricted within the region; • Priority flora species (including P1)/significant flora species are known to occur in the FCT.
5	• The FCT is not represented or represented poorly within the regional quadrat dataset; • The FCT occurs on landforms that are restricted in the region; • Priority flora species (including P1 species)/significant flora species are known to occur in the FCT.

4. RESULTS

4.1 Flora

A total of 94 discrete vascular flora taxa, from 28 families and 53 genera, were recorded from the Project area. Of these taxa, one introduced (weed) taxon was recorded. The families with the highest number of taxa were Poaceae (10 taxa), Myoporaceae (10), Mimosaceae (9) and Asteraceae (8). Mean taxa richness per quadrat was 16.0 ± 5.1, with a range of 7 – 27 taxa per quadrat. Appendix C presents a full list of taxa recorded within the Project area by Woodman Environmental, while Appendix D presents a list of taxa (recorded in Woodman Environmental quadrats only) recorded within each FCT. Appendix E presents the raw data from each quadrat. The number of taxa recorded during this survey is more than double that recorded from Mount Gould by Meissner *et al.* (2007), who recorded 45 taxa from 5 quadrats, with a mean taxa richness of 17.8 ± 4.1, and a range of 12 – 23 taxa per quadrat. However, their survey only assessed Mount Gould itself and not the surrounding flats that were assessed during this survey.

4.1.1 Conservation Significant Flora Taxa

No DRF taxa were recorded within the Project area; however three Priority Flora taxa were recorded: *Eremophila warnesii*, *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) and *Rhodanthe sphaerocephala* (all P1). All recorded locations of these taxa are presented on Figure 2, including records from the survey of Mount Gould by Meissner *et al.* (2007), and historical records from the DEC's threatened flora database and the W.A. Herbarium specimen database.

Eremophila warnesii (P1) is a low, dense shrub to 0.5 m high, and is known from three W.A. Herbarium records: two from Yarlarweelor Station approximately 40 km east of the Project area, and one from Mount Clere Station, approximately 80 km north of the Project area (DEC 2009a). It was noted as being abundant at one of these locations, however no information is available for the two remaining locations. Chinnock (2007) notes that the type population of this species is located on the summit of Mount Gould, where it was found to occur in a narrow band. He also notes that this species is likely to be found on other hills in the area.

Two sub-populations of this species were recorded during this survey: one on the eastern peak of Mount Gould, and one on the western peak (Figure 2). *E. warnesii* was found growing on very steep, rocky, open slopes with no overstorey near the summits of each peak. The boundaries of the population on the eastern peak were traversed, and counts of individuals were undertaken. It is estimated that there are approximately 10,800 individuals in this population. The boundaries of the population on the eastern peak were not traversed due of time constraints, however this population appears much smaller than that on the eastern peak. It is estimated that less than 1,000 individuals occur in this population.



Plate 1: Population of *Eremophila warnesii* on the eastern peak of Mount Gould

Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743) (P1) is an erect shrub to 1 m, and is known only from six herbarium records, all from Mount Gould itself (DEC 2009a). This taxon was identified by Meissner *et al.* (2007) as potentially differing from other known variants of *H. gustafsenii*, with the phrase name *H. gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) erected in late 2008. It was also listed as Priority 1 at this time. This taxon was recorded in three quadrats during this survey (Figure 2), and appears to be distributed on the slopes of Mount Gould, where it is relatively common. No detailed mapping of this taxon was undertaken, as at the time of survey it was not a listed taxon of conservation significance.

Rhodanthe sphaerocephala (P1) is an erect annual herb to 0.25 m high, and was previously known from two areas: Belele Station, approximately 60 km south-east of the Project area, and Doolgunna and Three Rivers Stations, approximately 200 km east of the Project area. The collections from this survey are therefore significant, as it is the first record for the Mount Gould area. Six plants were recorded from Doolgunna Station, however no information is available for the other records. This species was recorded in two quadrats in 2008, both in open claypans with little to no overstorey (Figure 2). It was uncommon at both locations, however the area appeared to have received little rain prior to surveys being conducted; it is likely to be more abundant in more favourable conditions.

4.1.2 Other Flora of Interest

A collection of *Amaranthus interruptus* represents a significant extension of the known range, with the nearest records near Karijini National Park, approximately 400 km to the north (DEC 2009a). The collections of *Olearia stuartii*, *Tribulus adelacanthus* and *Abutilon otocarpum* fill significant locality holes in the known ranges of these species.

Collections of the above species will be submitted to the W.A. Herbarium upon conclusion of the project.

4.1.3 Significance of Flora

The three Priority flora taxa recorded within the Project area are all listed as Priority 1, and are therefore all of high conservation concern, given that Priority 1 flora are taxa that are known generally from less than 5 populations which are under threat, either due to small population size, or being on lands under immediate threat such as mineral leases, or are under threat from disease or grazing (Atkins 2008). Such taxa are under consideration for gazettal as DRF, but are in urgent need of further survey. Table 6 presents a summary of conservation significance rankings of flora within the Project area.

Table 6: Conservation Significance of Flora Taxa Populations within the Project area

Taxon	Conservation Status	Conservation Significance Ranking (From Table 4)
Eremophila warnesii	P1	High
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	P1	High
Rhodanthe sphaerocephala	P1	High

Eremophila warnesii (P1) is known from one large and one small population on the summit of Mount Gould within the Project area. The regional distribution of this species is restricted, with all known populations all occurring within 100 km of Mount Gould. The significance of the Project area populations of *E. warnesii* in terms of the overall conservation of the species is ranked High (Table 4); as less than 10 populations of this species are currently known, and the local population is on the boundary of its known range.

Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743) (P1) is known from a number of locations that probably represent a single population on the slopes of Mount Gould within the Project area. This population is the only known population of this taxon. The significance of the Project area population of this taxon in terms of the overall conservation of the taxon is therefore ranked High (Table 4), as a single population is currently known, and it is restricted to the Project area.

Rhodanthe sphaerocephala (P1) is known from two locations, which at the time of survey consisted of a few plants at each, within the Project area. The regional distribution of this species is moderately restricted, with known populations occurring over a 200 km range, with populations within the Project area representing the western-most population. The significance of the Project area populations of *R. sphaerocephala* in terms of the overall conservation of the species is ranked High (Table 4); as less than 10 populations of this species are currently known, and the local populations are on the boundary of its known range.

4.2 Floristic Community Types

A total of 40 perennial taxa were used during statistical analysis to determine FCTs within the Project area, including taxa recording during this survey and during the survey by Meissner *et al.* (2007). A number of taxa were amalgamated in the analysis due to taxonomic issues. In particular, *Solanum lasiophyllum*, *Solanum ashbyae* and *Solanum ashbyae/lasiophyllum* complex were amalgamated, because poor specimens meant that these taxa could not be distinguished confidently between quadrats. These taxa are collectively referred to as *Solanum lasiophyllum/ashbyae* in the description of FCTs below. *Acacia aneura* var. ?*aneura* and *Acacia aneura* var. *microcarpa* were also combined, and are referred to as *Acacia aneura* var. ?*aneura.*

A list of all taxa amalgamated in the analysis is presented in Appendix F. A summary dendogram of relationships between each quadrat is presented in Appendix G, with a summary matrix of species presence within quadrats presented in Appendix H. The summary dendogram shows that the first major division separates FCT 6, which consists of all quadrats located on sandplains, and a single quadrat located on a low ridge, from the remaining FCTs. These quadrats are distinguished by a greater representation from species group 5, and also no representation from a sub-set of species group 1, as shown in the summary matrix in Appendix H. Appendix I presents significant indicator species for each FCT.

The floristic classification of the 30 quadrats (five from Meissner *et al.* (2007); 25 from Woodman Environmental) defined seven FCTs and sub-types (Appendix G). The groupings of Meissner *et al.* (2007) quadrats have changed significantly compared to their analysis. The two Mount Gould quadrats that grouped together in Meissner *et al.* FCT 1 have been split, with one quadrat grouping in Woodman Environmental FCT 4, and one in Woodman Environmental FCT 5. Two of the three quadrats that grouped together in Meissner *et al.* FCT 2 have grouped together in Woodman Environmental FCT 5, while the third has migrated to group in Woodman Environmental FCT 4. This is a direct result of quadrats established by Woodman Environmental having greater similarity to the quadrat that migrated. Figure 2 presents the spatial distribution of each FCT within the Project area.

Generally the vegetation in the Project area was in Excellent to Good condition. Grazing by stock was more evident on the flats surrounding Mount Gould, with minor grazing from feral goats evident on the slopes and summit of Mount Gould. A number of disturbed areas exist within the Project area as a result of previous mining and pastoral activities (Figure 2), including an old pit and waste dump area, and a stockpiling area.

4.2.1 Floristic Community Types at Mount Gould

FCT 1: Open tall shrubland of *Acacia aneura* over sparse low shrubland of *Ptilotus obovatus* over open low forbland of *Goodenia tenuiloba*

The following common species were recorded:

Tall Shrubs: *Acacia aneura, Acacia ramulosa* var. *linophylla*
Low Shrubs: *Sida* sp. dark green fruits (S. van Leeuwen 2260), *Ptilotus obovatus, Solanum lasiophyllum/ashbyae*
Forbs: *Goodenia tenuiloba, Phyllanthus erwinii*

Landforms: Steep mid and lower slopes

Soils: Red-brown silty clay-loam soils with banded ironstone and quartz shale and boulders

FCT 1 was represented by a total of four quadrats, all established by Woodman Environmental. This FCT was mapped on the steep, shaley mid and lower slopes of Mount Gould (Figure 2). A defining characteristic of this FCT was the overall low perennial species richness, particularly in the mid stratum. Mean species richness per quadrat was 13.5. This FCT is closely related to FCT 2, which also has very low perennial species richness, however FCT 2 occurs on low rocky rises away from Mount Gould itself. The Priority flora taxon *Eremophila warnesii* (P1) was recorded in this FCT. Indicator species for this FCT are *Sida* sp. dark green fruits (S. van Leeuwen 2260) and *Solanum ashbyae/lasiophyllum* complex (Appendix I).



Plate 2: FCT 1 - Quadrat MG15 (Woodman Environmental)

FCT 2: Sparse tall shrubland of mixed *Acacia* species over sparse low shrubland of *Ptilotus obovatus* and *Eremophila* species over open low forbland of *Goodenia tenuiloba*

The following common species were recorded:

Tall Shrubs: *Acacia rhodophloia, Acacia aneura, Acacia ramulosa* var. *linophylla*
Low Shrubs: *Ptilotus obovatus, Eremophila latrobei* subsp. *latrobei, Eremophila fraseri* subsp. *parva, Eremophila* ?*jucunda*
Forbs: *Goodenia tenuiloba*

Landforms: Stony undulating plains

Soils: Red-brown silty clay-loam soils with banded ironstone and quartz stones

FCT 2 was represented by a total of two quadrats, both established by Woodman Environmental. This FCT was mapped on a stony, undulating plain to the north of Mount Gould (Figure 2). Very little of this habitat occurred in the Project area, hence the small sample size. Mean species richness per quadrat was 9.5. This FCT is closely related to FCT 1. The sole indicator species for this FCT is *Acacia rhodophloia* (Appendix I).



Plate 3: FCT 2 - Quadrat MG22 (Woodman Environmental)

FCT 3: Sparse tall shrubland or isolated shrubs of *Acacia aneura* over isolated mid shrubs of *Eremophila fraseri* subsp. *parva* over isolated low shrubs of *Ptilotus obovatus* over open low forbland of mixed species including *Ptilotus aervoides* and *Goodenia tenuiloba*

The following common species were recorded:

Tall Shrubs:	*Acacia aneura*
Mid shrubs:	*Eremophila fraseri* subsp. *parva*
Low Shrubs:	*Ptilotus obovatus*
Forbs:	*Goodenia tenuiloba, Ptilotus aervoides, Ptilotus helipteroides, Euphorbia boophthona, Euphorbia drummondii, Phyllanthus erwinii, Velleia glabrata, Helipterum craspedioides*
Grasses:	*Aristida contorta*

Landforms: Clay pans, clay flats

Soils: Red-brown clay-loam

FCT 3 was represented by a total of three quadrats, all established by Woodman Environmental. This FCT was mapped in claypans and on clay flats to the east of Mount Gould (Figure 2). This FCT varied greatly structurally, with two quadrats in claypans consisting of only isolated shrubs, while one quadrat possessed a sparse tall shrubland. Mean species richness per quadrat was 21.3, with the majority of taxa being ephemerals. This FCT is not closely related to any other FCT (Appendix G). The Priority flora species *Rhodanthe sphaerocephala* (P1) was only recorded in FCT 3. The sole indicator species for this FCT is *Phyllanthus erwinii* (Appendix I).




Plate 4: FCT 3 - Quadrat MG05 (left), MG06 (right) (Woodman Environmental)

FCT 4: Open tall shrubland or isolated shrubs of *Acacia aneura* over open to sparse mid shrubland of *Eremophila latrobei* subsp. *latrobei* and *Philotheca brucei* subsp. *cinerea* over open to sparse low shrubland and low tussock grassland of *Ptilotus obovatus* and *Cymbopogon ambiguus*

The following common species were recorded:

Tall Shrubs:	*Acacia aneura, Acacia rhodophloia, Acacia citrinoviridis*
Mid shrubs:	*Eremophila latrobei* subsp. *latrobei*, *Philotheca brucei* subsp. *cinerea*
Low Shrubs:	*Ptilotus obovatus, Solanum lasiophyllum/ashbyae* complex, *Corchorus crozophorifolius*, *Abutilon lepidum*
Forbs:	*Cheilanthes sieberi, Cheilanthes brownii, Phyllanthus erwinii*
Grasses:	*Cymbopogon ambiguus, Enneapogon caerulescens, Eriachne mucronata*

Landforms: Steep mid and upper slopes (occasionally lower slopes) and crests

Soils: Skeletal red-brown silty clay-loams over massive banded ironstone outcropping

FCT 4 was represented by the largest number of quadrats, with a total of 12 quadrats, (two Meissner *et al.*; 10 Woodman Environmental). This FCT was mapped on the steep upper slopes and crests of Mount Gould (Figure 2). Occasionally it extended down to the lower slopes (e.g. quadrat MG25). This FCT also varied greatly structurally. Typically, quadrats consisted of a tall open shrubland of *Acacia aneura*, or occasionally *A. citrinoviridis*, with a distinct open mid shrubland stratum of *Eremophila latrobei* subsp. *latrobei* and *Philotheca brucei* subsp. *cinerea*, and a sparse low shrubland stratum (e.g. MG25). However, a number of quadrats, particularly near the summit of the western peak of Mount Gould consisted of only isolated tall and mid shrubs, and possessed an open low shrubland and tussock or hummock grassland stratum of *Ptilotus obovatus*, *Eremophila warnesii* and *Cymbopogon obtectus* (e.g. MG23). Mean species richness per quadrat was 16.3. This FCT is related to FCT 5, which differs in having a greater representation of species group 4 (Appendix H). The Priority flora taxa *Eremophila warnesii* and *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) (both P1) were recorded in this FCT. Indicator species for this FCT are *Abutilon lepidum*, *Cheilanthes sieberi* and *Cymbopogon ambiguus* (Appendix I).



Plate 5: FCT 4 - Quadrat MG25 (left), Quadrat MG23 (right) (Woodman Environmental)

FCT 5: Isolated tall shrubland of *Acacia aneura* and/or *Grevillea berryana* over sparse low shubland of *Eremophila latrobei* subsp. *latrobei*, *Philotheca brucei* subsp. *cinerea* and *Ptilotus obovatus* over low hummock grassland of *Triodia melvillei*

The following common species were recorded:

Tall Shrubs:	*Acacia aneura, Grevillea berryana*
Low Shrubs:	*Ptilotus obovatus, Eremophila latrobei* subsp. *latrobei*, *Philotheca brucei* subsp. *cinerea*
Forbs:	*Goodenia tenuiloba*
Grasses:	*Triodia melvillei, Monacather paradoxus, Eriachne mucronata*

Landforms: Steep upper slopes and crests

Soils: Skeletal red-brown silty clay-loams over massive banded ironstone outcropping

FCT 5 was represented by a total of four quadrats, (three Meissner *et al.*; one Woodman Environmental). This FCT was mapped on the steep upper slopes and crests of Mount Gould (Figure 2). The presence of taxa from species group 4 generally characterised this FCT (Appendix H). The presence of *Triodia melvillei* in a low hummock grassland stratum was also characteristic, however this species was not recorded in one quadrat that grouped in this FCT, and was also recorded in several quadrats in the related FCT 4. Mean species richness was 16.5. Indicator species for this FCT are *Eremophila latrobei* subsp. *latrobei*, *Eriachne mucronata*, *Grevillea berryana*, *Monacather paradoxus* and *Triodia melvillei* (Appendix I)



Plate 6: FCT 5 - Quadrat MG09 (Woodman Environmental)

FCT 6: FCT 6 was split into two distinct sub-types based on soil and topography type, and representation of particular species groups (Appendix H).

FCT 6a: Open tall shrubland of *Acacia ramulosa* var. *linophylla* and *Acacia kempeana* over sparse mid shubland of *Eremophila forrestii* subsp. *forrestii* over isolated low shrubland of *Corchorus crozophorifolius* over sparse low grassland and forbland of mixed species including *Eriachne mucronata* and *Ptilotus aervoides*

The following common species were recorded:

Tall Shrubs:	*Acacia ramulosa* var. *linophylla, Acacia kempeana*
Mid Shrubs:	*Eremophila forrestii* subsp. *forrestii, Eremophila compacta* subsp. ?*fecunda, Senna artemesioides* subsp. *helmsii*
Low Shrubs:	*Corchorus crozophorifolius, Solanum ashbyae* complex, *Sida* ?*intricata, Abutilon otocarpum*
Forbs:	*Goodenia tenuiloba, Ptilotus aervoides, Phyllanthus erwinii, Euphorbia drummondii, Dysphania melanocarpa* forma *melanocarpa*
Grasses:	*Aristida contorta, Eriachne aristidea, Eriachne mucronata*

Landforms: Flat plains

Soils: Red-brown sandy and silty clay-loams

FCT 6a was represented by a total of four quadrats, all established by Woodman Environmental. This FCT was mapped on flat, sandy plains to the south and west of Mount Gould (Figure 2). The presence of taxa from species group 5, as well as a particular subset of species group 1, characterised this community (Appendix H). Mean species richness per quadrat was 19. FCT 6a is very closely related to FCT 6b, however FCT 6b is not represented by species group 5, and occurs on low ridges rather than flat plains. The best indicator species for this FCT are *Acacia kempeana, Eremophila forrestii* subsp. *forrestii* and *Sida* ?*intricata* (Appendix I).

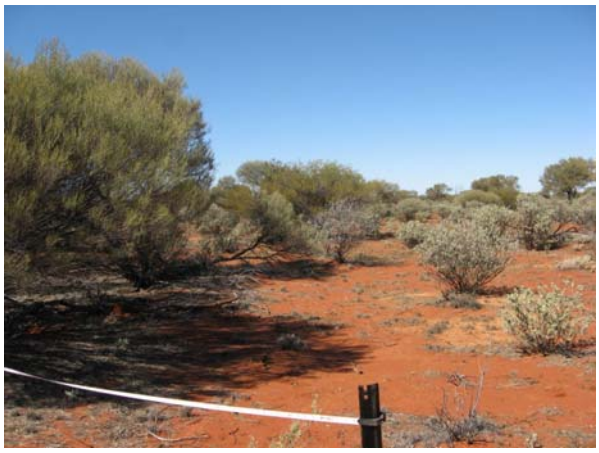


Plate 7: FCT 6a - Quadrat MG02 (Woodman Environmental)

FCT 6b: Tall sparse shrubland of *Acacia ramulosa* var. *linophylla* and *Acacia citrinoviridis* over open mid shubland of *Eremophila latrobei* subsp. *latrobei* over open low shrubland of *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) over sparse low forbland of *Goodenia tenuiloba*

Landforms: Steep low ridge

Soils: Red-brown silty clay-loam over massive banded ironstone and quartz outcropping

FCT 6b was only represented by a single quadrat established by Woodman Environmental. This FCT was mapped on a steep low ridge shaded by the western peak of Mount Gould, near the south-western lower slope of Mount Gould (Figure 2). The single quadrat in FCT 6b grouped with the quadrats in FCT 6a to comprise FCT 6, however FCT 6b is not represented by species group 5, whose representation characterises FCT 6a (Appendix H). FCTs 6a and 6b also occur on different landforms and soil types, and it is likely that if more quadrats were established on the low ridge system where FCT 6b has been mapped, these quadrats would group as a distinct FCT. There are no indicator species for this FCT as it is represented by a single quadrat. Fourteen taxa were recorded in the quadrat within FCT 3. The Priority flora taxon *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) (P1) was recorded in this FCT.



Plate 8: FCT 6b - Quadrat MG03 (Woodman Environmental)

4.2.2 Significance of Vegetation

There are no occurrences of TECs within the Project area. However, Mount Gould itself is included as part of the Robinson Range vegetation complexes (banded ironstone formation) PEC, which is listed as Priority 1 (DEC 2008).

A repeat of the analysis conducted by Meissner *et al.* (2007) with the addition of Woodman Environmental data confirms their findings that the FCTs on and around Mount Gould are significantly different to those on Robinson Range. With the exception of a single quadrat (Meissner *et al.* (2007) quadrat (MTGD02), all quadrats at Mount Gould were separated from those on Robinson Range at the first division of the summary dendogram. Quadrat MTGD02 originally grouped with a number of Robinson Range quadrats along with another Mount Gould quadrat (MTGD01) in the Meissner *et al.* (2007) analysis, and remained grouped with Robinson Range quadrats following the addition of Woodman Environmental data, while MTGD01 migrated to group with other Mount Gould quadrats. Despite the grouping of MTGD02 with Robinson Range quadrats, this is not considered to be sufficient evidence to suggest that the FCTs present at Mount Gould occur on Robinson Range. Further establishment of quadrats on Robinson Range would be required to confirm whether any FCTs from Mount Gould occur there. Appendices J and K present the summary dendogram of relationships between each quadrat, and the summary matrix of species presence within quadrats, from this combined dataset.

Following an analysis of the Mount Gould quadrat data with quadrat data from the nearby Jack Hills (Meissner & Caruso 2006), it is apparent that certain FCTs present within the Project area show greater similarity to those occurring on the Jack Hills than to those on the Robinson Range. While most Jack Hills quadrats did not group with Mount Gould quadrats, quadrats that grouped into Woodman Environmental FCTs 1 and 2 (found on mid and lower slopes and stony plains) have grouped with a number of Jack Hills quadrats that grouped into Meissner & Caruso (2006) FCTs 1 and 2 (found on crests and mid and lower slopes). It is therefore apparent that a single FCT may occur on lower and mid slopes and stony plains at both Mount Gould and Jack Hills. However, the FCTs found on the upper slopes and crests of Mount Gould do not appear to occur in the Jack Hills. Although two quadrats from the Jack Hills did group with those established on the upper slopes and crests of Mount Gould, this is not considered sufficient evidence to suggest that the FCTs on the upper slopes and crests of Mount Gould also occur on the Jack Hills. Appendices L and M present the summary dendogram of relationships between each quadrat, and the summary matrix of species presence within quadrats.

It is also worthy of note that both above analyses supports Meissner *et al.* (2007) in finding that the Jack Hills, Mount Gould and Robinson Range all possess distinct *Triodia*-dominated FCTs on upper slopes and crests. It is thought that these communities are relictual.

Table 7 presents the conservation significance rankings (as defined in Section 3.6.2) given to each of the FCTs mapped over the Project area. In general, FCTs mapped on the plains surrounding Mount Gould were given lower rankings of conservation significance in comparison to those on Mount Gould itself, primarily due to the inferred wider distribution of their soil types and habitats in the region, but also because of the fewer numbers of Priority Flora species known within these FCTs.

Table 7: Conservation Significance of Floristic Community Types (FCTs) Described within the Project area

FCT	Mapped Area (ha)	Comments	Significant Flora Species	Conservation Significance Ranking
1	196.7	FCT 1 mapped on steep mid and lower slopes which are restricted to Mount Gould in the Project area area, and are restricted in the region; Appear to be present elsewhere other than Mount Gould in the region based on previous regional studies (Meissner & Caruso 2006; Meissner *et al.* 2007); Part of a Priority 1 PEC.	*Eremophila warnesii* (P1)	3: Distribution of FCT 1 restricted to Mount Gould and Jack Hills regionally, and Mount Gould within the Project area area; Soil, substrate and topographical positions all restricted in region. Presence of significant flora species with P1 ranking; Significant flora species of very restricted distribution; Significant flora species not restricted to FCT 4.
2	26.6 (<10 % of Project area area mapped)	FCT 2 mapped on undulating stony plains which are restricted to north of Mount Gould within the Project area area, however are likely to be common and widespread throughout the region; Not analysed during previous regional studies; Not a listed TEC or PEC.	NA	1: FCT 2 likely to be widespread within the region according to known soil types, substrate and topographical positions.
3	82.4	FCT 3 mapped on clay flats and in clay pans which are restricted to the western section of the Project area, however are likely to be common and widespread throughout the region; Not analysed during previous regional studies; Not a listed TEC or PEC.	*Rhodanthe sphaerocephala* (P1).	2: FCT 3 likely to be widespread within the region according to known soil types, substrate and topographical positions; Presence of significant flora species with P1 ranking; Significant flora species of moderately restricted distribution; Significant flora species restricted to FCT 3.

Table 7: Conservation Significance of Floristic Community Types (FCTs) Described within the Project area

FCT	Mapped Area (ha)	Comments	Significant Flora Species	Conservation Significance Ranking
4	106.5	FCT 4 mapped on steep mid and upper slopes and crests which are restricted to Mount Gould in the Project area area, and are restricted in the region; Not present elsewhere other than Mount Gould in the region based on previous regional studies; Part of a Priority 1 PEC.	*Eremophila warnesii* (P1); *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) (P1).	5: Distribution of FCT 4 restricted to Mount Gould both regionally and within the Project area area; Soil, substrate and topographical positions all restricted in region; Presence of significant flora species with P1 ranking; Significant flora species of very restricted distribution; Significant flora species not restricted to FCT 4.
5	27.7 (<10 % of Project area area mapped)	FCT 5 mapped on steep upper slopes and crests which are restricted to Mount Gould in the Project area area, and are restricted in the region; Not present elsewhere other than Mount Gould in the region based on previous regional studies; Part of a Priority 1 PEC.	*Eremophila warnesii* (P1); *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) (P1).	5: Distribution of FCT 5 restricted to Mount Gould both regionally and within the Project area area; Soil, substrate and topographical positions all restricted in region; Presence of significant flora species with P1 ranking; Significant flora species of very restricted distribution; Significant flora species not restricted to FCT 5.
6a	151.7	FCT 6a mapped on flat plains which are distributed south and west of Mount Gould within the Project area area, however are likely to be common and widespread throughout the region; Not analysed during previous regional studies; Not a listed TEC or PEC.	NA	1: FCT 6a likely to be widespread within the region according to known soil types, substrate and topographical positions.

Table 7: Conservation Significance of Floristic Community Types (FCTs) Described within the Project area				
FCT	**Mapped Area (ha)**	**Comments**	**Significant Flora Species**	**Conservation Significance Ranking**
6b	10.6 (<10 % of Project area area mapped)	FCT 6b mapped on a steep low ridge at the foot of Mount Gould which is restricted to the south-western foot Mount Gould in the Project area area, and is restricted in the region; Not present elsewhere other than Mount Gould in the region based on previous regional studies; Part of a Priority 1 PEC.	*Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) (P1)	5: Distribution of FCT 6b restricted to Mount Gould both regionally and within the Project area area; Soil, substrate and topographical positions all restricted in region; Presence of significant flora species with P1 ranking; Significant flora species of very restricted distribution; Significant flora species not restricted to FCT 6b.

5. DISCUSSION

Three Priority Flora taxa were recorded within the Project area by Woodman Environmental: *Eremophila warnesii*, *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) and *Rhodanthe sphaerocephala* (all P1). The populations of these taxa within the Project area are all ranked as highly significant in terms of the overall conservation of each taxon (Table 6). All three are known from less than five populations, and have restricted geographical distributions in the general region of Mount Gould. There is also very little data available regarding the size and condition of these populations. In particular, *H. gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) is only known from the Project area, where it is by no means abundant. If significant numbers of individuals of these taxa are proposed to be impacted as a result of clearing for drilling or mining operations, additional survey may be required both within and outside of the Project area area, to assess the size and condition of any known populations, and to search for additional populations in likely habitat areas.

A total of seven FCTs and sub-types were described in the Project area. Comparison with quadrat datasets from the nearby Robinson Range and Jack Hills has revealed that a number of the FCTs on Mount Gould (FCTs 4, 5 and 6b) do not occur elsewhere, and therefore have high conservation significance (ranking 5; Table 7). FCT 1 appears to occur on lower and mid slopes on Mount Gould and the Jack Hills, however is still likely to be regionally restricted, and hence has moderate conservation significance (ranking 3; Table 7). Mount Gould itself is included as part of the Robinson Range vegetation complexes Priority 1 PEC, and therefore may be listed as a TEC in the near future. It is therefore important in the meantime that any clearing in the FCTs on Mount Gould is minimised as much as is feasible.

As no mining has been proposed for the Project area, no assessment of the impacts of any such proposal to significant flora and FCTs has been undertaken. It is of high importance that this be undertaken if mining is proposed, particularly given the high conservation significance of the Priority flora and FCTs present within the Project area.

6. RECOMMENDATIONS

The following recommendations are given:

- Utilise areas of existing disturbance for any future proposed drilling operations where possible;
- Survey of any proposed drilling in remnant vegetation on Mount Gould by an experienced botanist if drilling occurs within the vicinity of known Priority flora locations, or within likely habitat of Priority flora; and
- Additional regional survey for Priority flora taxa if impacts to populations of such taxa within the Project area as a result of clearing for drilling or mining operations are likely to be significant.

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Appendix A: Definitions of Conservation Status Codes (Atkins 2008)

R: Declared Rare Flora – Extant Taxa

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.

X: Declared Rare Flor a – Presumed Extinct Taxa

Taxa which have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or of which all known wild populations have been destroyed more recently, and have been gazetted as such.

1: Priority One – Poorly Known Taxa

Taxa which are known from one or a few (generally <5) populations which are under threat, either due to small population size, or being on lands under immediate threat, e.g. road verges, urban areas, farmland, active mineral leases, etc., or the plants are under threat, e.g. from disease, grazing by feral animals, etc. May include taxa with threatened populations on protected lands. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.

2: Priority Two – Poorly Known Taxa

Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.

3: Priority Three – Poorly Known Taxa

Taxa which are known from several populations, and the taxa are not believed to be under immediate threat (i.e. not currently endangered), either due to the number of known populations (generally >5), or known populations being large, and either widespread or protected. Such taxa are under consideration for declaration as 'rare flora' but are in need of further survey.

4: Priority Four – Rare Taxa

Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5-10 years.

Appendix B: Definitions, Categories and Criteria for Threatened Ecological Communities and Priority Ecological Communities (Department of Environment and Conservation 2007a)

DEFINITIONS, CATEGORIES AND CRITERIA FOR THREATENED AND PRIORITY ECOLOGICAL COMMUNITIES

1. GENERAL DEFINITIONS

Ecological Community
A naturally occurring biological assemblage that occurs in a particular type of habitat.

Note: The scale at which ecological communities are defined will often depend on the level of detail in the information source, therefore no particular scale is specified.

A **threatened ecological community** (TEC) is one which is found to fit into one of the following categories; "presumed totally destroyed", "critically endangered", "endangered" or "vulnerable".

Possible threatened ecological communities that do not meet survey criteria are added to DEC's Priority Ecological Community Lists under Priorities 1, 2 and 3. Ecological Communities that are adequately known, are rare but not threatened, or meet criteria for Near Threatened, or that have been recently removed from the threatened list, are placed in Priority 4. These ecological communities require regular monitoring. Conservation Dependent ecological communities are placed in Priority 5.

An **assemblage** is a defined group of biological entities.

Habitat is defined as the areas in which an organism and/or assemblage of organisms lives. It includes the abiotic factors (eg. substrate and topography), and the biotic factors.

Occurrence: a discrete example of an ecological community, separated from other examples of the same community by more than 20 metres of a different ecological community, an artificial surface or a totally destroyed community.

By ensuring that every discrete occurrence is recognised and recorded future changes in status can be readily monitored.

Adequately Surveyed is defined as follows:
"An ecological community that has been searched for thoroughly in most likely habitats, by relevant experts."

Community structure is defined as follows:
"The spatial organisation, construction and arrangement of the biological elements comprising a biological assemblage" (eg. *Eucalyptus salmonophloia* woodland over

scattered small shrubs over dense herbs; structure in a faunal assemblage could refer to trophic structure, eg. dominance by feeders on detritus as distinct from feeders on live plants).

Definitions of Modification and Destruction of an ecological community:

Modification: "changes to some or all of ecological processes (including abiotic processes such as hydrology), species composition and community structure as a
direct or indirect result of human activities. The level of damage involved could be ameliorated naturally or by human intervention."

Destruction: "modification such that reestablishment of ecological processes, species composition and community structure within the range of variability exhibited by the original community is unlikely within the foreseeable future even with positive human intervention."

Note: Modification and destruction are difficult concepts to quantify, and their application will be determined by scientific judgement. Examples of modification and total destruction are cited below:

Modification of ecological processes: The hydrology of Toolibin Lake has been altered by clearing of the catchment such that death of some of the original flora has occurred due to dependence on fresh water. The system may be bought back to a semblance of the original state by redirecting saline runoff and pumping waters of the rising underground watertable away to restore the hydrological balance. Total destruction of downstream lakes has occurred due to hydrology being altered to the point that few of the original flora or fauna species are able to tolerate the level of salinity and/or water logging.

Modification of structure: The understorey of a plant community may be altered by weed invasion due to nutrient enrichment by addition of fertiliser. Should the additional nutrients be removed from the system the balance may be restored, and the original plant species better able to compete. Total destruction may occur if additional nutrients continue to be added to the system causing the understorey to be completely replaced by weed species, and death of overstorey species due to inability to tolerate high nutrient levels.

Modification of species composition: Pollution may cause alteration of the invertebrate species present in a freshwater lake. Removal of pollutants may allow the return of the original inhabitant species. Addition of residual highly toxic substances may cause permanent changes to water quality, and total destruction of the community.

Threatening processes are defined as follows:
"Any process or activity that threatens to destroy or significantly modify the ecological community and/or affect the continuing evolutionary processes within any ecological community."

Examples of some of the continuing threatening processes in Western Australia include: general pollution; competition, predation and change induced in ecological communities as a result of introduced animals; competition and displacement of native plants by introduced species; hydrological changes; inappropriate fire regimes; diseases resulting from introduced microorganisms; direct human exploitation and disturbance of ecological communities.

Restoration is defined as returning an ecological community to its pre-disturbance or natural state in terms of abiotic conditions, community structure and species composition.

Rehabilitation is defined as the re-establishment of ecological attributes in a damaged ecological community although the community will remain modified.

2. DEFINITIONS AND CRITERIA FOR PRESUMED TOTALLY DESTROYED, CRITICALLY ENDANGERED, ENDANGERED AND VULNERABLE ECOLOGICAL COMMUNITIES

Presumed Totally Destroyed (PD)
An ecological community that has been adequately searched for but for which no representative occurrences have been located. The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future.

An ecological community will be listed as presumed totally destroyed if there are no recent records of the community being extant and either of the following applies (A or B):

A) Records within the last 50 years have not been confirmed despite thorough searches of known or likely habitats or

B) All occurrences recorded within the last 50 years have since been destroyed

Critically Endangered (CR)
An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated.

An ecological community will be listed as **Critically Endangered** when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future. This will be determined on the basis of the best available information, by it meeting **any one or more** of the following criteria (A, B or C):

A) The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 90% **and either or both** of the following apply (i or ii):

i) geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is imminent (within approximately 10 years);

ii) modification throughout its range is continuing such that in the immediate future (within approximately 10 years) the community is unlikely to be capable of being substantially rehabilitated.

B) Current distribution is limited, **and one or more** of the following apply (i, ii or iii):

i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the immediate future (within approximately 10 years);

ii) there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes;

iii) there may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes.

C) The ecological community exists only as highly modified occurrences that may be capable of being rehabilitated if such work begins in the immediate future (within approximately 10 years).

Endangered (EN)
An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future.

An ecological community will be listed as **Endangered** when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. This will be determined on the basis of the best available information by it meeting **any one or more** of the following criteria (A, B, or C):

A) The geographic range, and/or total area occupied, and/or number of discrete occurrences have been reduced by at least 70% since European settlement **and either or both** of the following apply (i or ii):

i) the estimated geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is likely in the short term future (within approximately 20 years);

ii) modification throughout its range is continuing such that in the short term future (within approximately 20 years) the community is unlikely to be capable of being substantially restored or rehabilitated.

B) Current distribution is limited, **and one or more** of the following apply (i, ii or iii):

i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the short term future (within approximately 20 years);

ii) there are few occurrences, each of which is small and/or isolated and all or most occurrences are very vulnerable to known threatening processes;

iii) there may be many occurrences but total area is small and all or most occurrences are small and/or isolated and very vulnerable to known threatening processes.

C) The ecological community exists only as very modified occurrences that may be capable of being substantially restored or rehabilitated if such work begins in the short-term future (within approximately 20 years).

Vulnerable (VU)
An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range.

An ecological community will be listed as **Vulnerable** when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction or significant modification in the medium to long-term future. This will be determined on the basis of the best available information by it meeting **any one or more** of the following criteria (A, B or C):

A) The ecological community exists largely as modified occurrences that are likely to be capable of being substantially restored or rehabilitated.

B) The ecological community may already be modified and would be vulnerable to threatening processes, is restricted in area and/or range and/or is only found at a few locations.

C) The ecological community may be still widespread but is believed likely to move into a category of higher threat in the medium to long term future because of existing or impending threatening processes.

3. DEFINITIONS AND CRITERIA FOR PRIORITY ECOLOGICAL COMMUNITIES

PRIORITY ECOLOGICAL COMMUNITY LIST

Possible threatened ecological communities that do not meet survey criteria or that are not adequately defined are added to the Priority Ecological Community Lists under Priorities 1, 2 and 3. These three categories are ranked in order of priority for survey and/or definition of the community, and evaluation of conservation status, so that consideration can be given to their declaration as threatened ecological communities. Ecological Communities that are adequately known, and are rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list, are placed in Priority 4. These ecological communities require regular monitoring. Conservation Dependent ecological communities are placed in Priority 5.

Priority One: Poorly-known ecological communities

Ecological communities with apparently few, small occurrences, all or most not actively managed for conservation (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) and for which current threats exist. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.

Priority Two: Poorly-known ecological communities

Communities that are known from few small occurrences, all or most of which are actively managed for conservation (e.g. within national parks, conservation parks, nature reserves, State forest, unallocated Crown land, water reserves, etc.) and not under imminent threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.

Priority Three: Poorly known ecological communities

(i) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or:
(ii) communities known from a few widespread occurrences, which are either large or within significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or;
(iii) communities made up of large, and/or widespread occurrences, that may or not be represented in the reserve system, but are under threat of modification across much

of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes.

Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.

Priority Four: Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring.

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

(b) Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.

(c) Ecological communities that have been removed from the list of threatened communities during the past five years.

Priority Five: Conservation Dependent ecological communities

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

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Appendix C: Vascular Plant Taxa Recorded From the Mount Gould DSO Project Area, 2008

note *denotes introduced species

Family	Species	Conservation Code
Adiantaceae (007)	*Cheilanthes brownii*	
	Cheilanthes sieberi	
Poaceae (031)	*Aristida holathera* var. *holathera*	
	Cymbopogon ambiguus	
	Digitaria brownii	
	Enneapogon caerulescens	
	Eragrostis ?eriopoda	
	Eriachne aristidea	
	Eriachne mucronata	
	Eriachne pulchella subsp. *dominii*	
	Eriachne pulchella subsp. *pulchella*	
	Triodia melvillei	
Cyperaceae (032)	*Bulbostylis* sp.	
Proteaceae (090)	*Grevillea berryana*	
	Hakea lorea subsp. *lorea*	
Chenopodiaceae (105)	*Dysphania melanocarpa* forma *melanocarpa*	
	Dysphania rhadinostachya subsp. *inflata*	
	Maireana carnosa	
	Maireana georgei	
	Salsola australis	
	Sclerolaena diacantha	
Amaranthaceae (106)	*Amaranthus interruptus*	
	Ptilotus aervoides	
	Ptilotus helipteroides var. *helipteroides*	
	Ptilotus obovatus	
	Ptilotus polystachyus var. ?*polystachyus*	
	Ptilotus rotundifolius	
	Ptilotus schwartzii	
Aizoaceae (110)	*Tetragonia cristata*	
Portulacaceae (111)	*Calandrinia polyandra*	
	Calandrinia sp.	
	**Portulaca ?oleracea*	

Appendix C: Vascular Plant Taxa Recorded From the Mount Gould DSO Project Area, 2008

note *denotes introduced species

Family	Species	Conservation Code
Brassicaceae (138)	*Lepidium oxytrichum*	
Mimosaceae (163)	*Acacia aneura* var. *?aneura*	
	Acacia aneura var. *?conifera*	
	Acacia ?ayersiana	
	Acacia citrinoviridis	
	Acacia cuthbertsonii subsp. *cuthbertsonii*	
	Acacia demissa	
	Acacia kempeana	
	Acacia ramulosa var. *linophylla*	
	Acacia rhodophloia	
Caesalpiniaceae (164)	*Senna artemisioides* subsp. *helmsii*	
	Senna sp. Meekatharra (E. Bailey 1-26)	
Papilionaceae (165)	*Swainsona affinis*	
Geraniaceae (167)	*Erodium cygnorum*	
Zygophyllaceae (173)	*Tribulus adelacanthus*	
	Tribulus suberosus	
	Zygophyllum ?iodocarpum	
Rutaceae (175)	*Philotheca brucei* subsp. *cinerea*	
Polygalaceae (183)	*Polygala isingii*	
Euphorbiaceae (185)	*Euphorbia australis*	
	Euphorbia boophthona	
	Euphorbia drummondii	
	Phyllanthus erwinii	
Sapindaceae (207)	*Dodonaea petiolaris*	
Tiliaceae (220)	*Corchorus crozophorifolius*	
Malvaceae (221)	*Abutilon lepidum*	
	Abutilon otocarpum	
	Sida ectogama	
	Sida ?intricata	
	Sida sp. dark green fruits (S. van Leeuwen 2260)	

Appendix C: Vascular Plant Taxa Recorded From the Mount Gould DSO Project Area, 2008

note *denotes introduced species

Family	Species	Conservation Code
Malvaceae (221) cont.	*Sida* sp. Golden calyces glabrous (H.N. Foote 32)	
	Sida sp. spiciform panicles (E. Leyland s.n. 14/8/90)	
Haloragaceae (276)	*Haloragis ?gossei*	
Apiaceae (281)	*Trachymene pilbarensis*	
Convolvulaceae (307)	*Evolvulus alsinoides* var. *villosicalyx*	
Boraginaceae (310)	*Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743)	P1
	Heliotropium heteranthum	
	Heliotropium inexplicitum	
	Trichodesma zeylanicum var. *?grandiflorum*	
Solanaceae (315)	*Nicotiana ?occidentalis* subsp. *obliqua*	
	Solanum lasiophyllum	
Myoporaceae (326)	*Eremophila compacta* subsp. *?fecunda*	
	Eremophila fraseri subsp. *?parva*	
	Eremophila forrestii subsp. *forrestii*	
	Eremophila ?jucunda	
	Eremophila lachnocalyx	
	Eremophila latrobei subsp. *latrobei*	
	Eremophila ?pendulina	
	Eremophila phyllopoda subsp. *phyllopoda*	
	Eremophila spathulata	
	Eremophila warnesii	P1
Goodeniaceae (341)	*Goodenia* sp.	
	Goodenia tenuiloba	
	Velleia glabrata	
Asteraceae (345)	*Brachyscome ciliaris*	
	Calotis hispidula	
	Cephalipterum drummondii	
	Helipterum craspedioides	
	Olearia stuartii	
	Rhodanthe maryonii	
	Rhodanthe sphaerocephala	P1
	Streptoglossa liatroides	

Appendix D: Vascular Plant Taxa Recorded in Each Floristic Community Type Within the Mount Gould DSO Project Area, 2008

note *denotes introduced species

	Floristic Community Type						
Taxon	**1**	**2**	**3**	**4**	**5**	**6a**	**6b**
Abutilon lepidum	X			X			
Abutilon otocarpum			X			X	
Acacia aneura var. *?aneura*	X	X	X	X		X	
Acacia aneura var. *?conifera*	X		X				
Acacia ?ayersiana			X				
Acacia citrinoviridis				X			X
Acacia cuthbertsonii subsp. *cuthbertsonii*			X				
Acacia kempeana						X	
Acacia ramulosa var. *linophylla*	X	X				X	X
Acacia rhodophloia	X	X		X			
Amaranthus interruptus				X	X		
Aristida contorta	X	X	X	X		X	X
Bulbostylis sp.					X		
Calandrinia polyandra						X	
Calandrinia sp.			X	X		X	
Calotis hispidula			X				
Cephalipterum drummondii			X				
Cheilanthes brownii				X	X		
Cheilanthes sieberi				X			
Corchorus crozophorifolius	X	X	X	X		X	X
Cymbopogon ambiguus				X			
Digitaria brownii				X			
Dodonaea petiolaris				X			
Dysphania melanocarpa forma *melanocarpa*			X			X	
Dysphania rhadinostachya subsp. *inflata*	X	X	X	X	X	X	
Enneapogon caerulescens	X			X	X		
Eragrostis ?eriopoda				X		X	
Eremophila compacta subsp. *?fecunda*						X	
Eremophila forrestii subsp. *forrestii*						X	
Eremophila fraseri subsp. *?parva*		X	X				
Eremophila ?jucunda		X					

Appendix D: Vascular Plant Taxa Recorded in Each Floristic Community Type Within the Mount Gould DSO Project Area, 2008

note *denotes introduced species

	Floristic Community Type						
Taxon	**1**	**2**	**3**	**4**	**5**	**6a**	**6b**
Eremophila lachnocalyx	X						
Eremophila latrobei subsp. *latrobei*	X	X		X	X		X
Eremophila ?pendulina	X						
Eremophila phyllopoda subsp. *phyllopoda*	X						
Eremophila warnesii				X			
Eriachne aristidea			X	X		X	
Eriachne mucronata	X			X	X	X	X
Eriachne pulchella subsp. dominii	X		X	X			X
Eriachne pulchella subsp. pulchella	X		X				
Erodium cygnorum			X	X			
Euphorbia australis	X			X			
Euphorbia boophthona		X	X	X	X	X	
Euphorbia drummondii			X			X	
Evolvulus alsinoides var. *villosicalyx*				X			
Goodenia sp.						X	
Goodenia tenuiloba	X	X	X	X		X	X
Grevillea berryana				X	X		
Hakea lorea subsp. *lorea*						X	
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)				X			X
Haloragis ?gossei	X						
Heliotropium heteranthum	X						
Heliotropium inexplicitum				X			
Helipterum craspedioides			X			X	
Lepidium oxytrichum				X			
Maireana carnosa			X				
Maireana georgei	X						
Nicotiana ?occidentalis subsp. *obliqua*			X	X			
Philotheca brucei subsp. *cinerea*				X	X		
Phyllanthus erwinii	X		X	X	X	X	X
Polygala isingii			X				
**Portulaca ?oleracea*	X		X	X			X

Appendix D: Vascular Plant Taxa Recorded in Each Floristic Community Type Within the Mount Gould DSO Project Area, 2008

note *denotes introduced species

	Floristic Community Type						
Taxon	**1**	**2**	**3**	**4**	**5**	**6a**	**6b**
Ptilotus aervoides	X		X			X	
Ptilotus helipteroides var. *helipteroides*			X			X	
Ptilotus obovatus	X	X	X	X	X		
Ptilotus polystachyus var. *?polystachyus*	X		X	X		X	
Ptilotus rotundifolius		X					
Ptilotus schwartzii			X				
Rhodanthe maryonii	X		X				
Rhodanthe sphaerocephala			X				
Salsola australis			X			X	
Sclerolaena diacantha	X		X				
Senna artemisioides subsp. *helmsii*			X	X		X	
Senna sp. Meekatharra (E. Bailey 1-26)			X				
Sida ectogama				X			
Sida ?intricata						X	
Sida sp. dark green fruits (S. van Leeuwen 2260)	X			X			
Sida sp. Golden calyces glabrous (H.N. Foote 32)				X			X
Sida sp. spiciform panicles (E. Leyland s.n. 14/8/90)	X			X			
Solanum lasiophyllum	X		X	X	X	X	X
Streptoglossa liatroides	X						
Tetragonia cristata			X			X	
Trachymene pilbarensis				X	X		
Tribulus adelacanthus		X					
Tribulus suberosus							X
Trichodesma zeylanicum var. *?grandiflorum*						X	
Triodia melvillei				X	X		
Velleia glabrata			X				
Zygophyllum ?iodocarpum			X				

Appendix E: Raw Quadrat Data from the Mount Gould DSO Project Area

Note:

Cover Classes:

D: > 70 % cover
M: 30-70 % cover
S: 10-30 % cover
V: < 10 % cover
I: Isolated plants
L: Isolated clumps

Site Name	Site Type	Dimensions	Establishment Date	Datum	Zone	Easting	Northing	FCT Code	Soil type	Soil Colour	Topography	Slope
MG01	Quadrat	20m x 20m	5/08/2008	GDA94	50	534010	7145412	1	silty clay loam	red brown	lowerslope	moderate

Species Name	**Av. Height**	**Cover Class**
Acacia aneura var. ?*aneura*	3.5	S
Acacia ramulosa var. *linophylla*	2	V
Corchorus crozophorifolius	0.3	I
Eriachne mucronata	0.3	V
Goodenia tenuiloba	0.1	S
Sida sp. dark green fruits (S. van Leeuwen 2260)	0.1	I
Solanum lasiophyllum	0.5	I

Site Name	Site Type	Dimensions	Establishment Date	Datum	Zone	Easting	Northing	FCT Code	Soil type	Soil Colour	Topography	Slope
MG02	Quadrat	20m x 20m	5/08/2008	GDA94	50	534089	7145157	6a	silty clay loam	red	flat	flat

Species Name	**Av. Height**	**Cover Class**
Abutilon otocarpum	0.2	I
Acacia kempeana	3	I
Acacia ramulosa var. *linophylla*	5	S
Aristida contorta	0.3	L
Calandrinia sp.	0.1	I
Corchorus crozophorifolius	0.5	I
Dysphania melanocarpa forma *melanocarpa*	0.1	I
Eremophila compacta subsp. ?*fecunda*	0.8	I
Eremophila forrestii subsp. *forrestii*	2	V
Eriachne aristidea	0.3	L
Eriachne mucronata	0.3	L
Euphorbia boophthona	0.1	I
Euphorbia drummondii	0.1	I
Goodenia tenuiloba	0.1	I
Hakea lorea subsp. *lorea*	0.2	I
Helipterum craspedioides	0.1	I
Phyllanthus erwinii	0.1	I
Ptilotus aervoides	0.1	V
Ptilotus polystachyus var. ?*polystachyus*	0.1	I
Salsola australis	0.1	I
Senna artemisioides subsp. *helmsii*	1.5	I
Sida ?intricata	0.1	I
Solanum lasiophyllum	0.5	I
Trichodesma zeylanicum var. ?*grandiflorum*	0.3	I

Site Name	Site Type	Dimensions	Establishment Date	Datum	Zone	Easting	Northing	FCT Code	Soil type	Soil Colour	Topography	Slope
MG03	Quadrat	20m x 20m	5/08/2008	GDA94	50	533383	7145423	6b	silty clay loam	red brown	lowerslope	steep

Species Name	**Av. Height**	**Cover Class**
Acacia citrinoviridis	3	I
Acacia ramulosa var. *linophylla*	2	I
Aristida contorta	0.3	L
Brachyscome ciliaris		
Corchorus crozophorifolius	0.3	I
Dodonaea petiolaris		
Eremophila latrobei subsp. *latrobei*	2	S
Eriachne mucronata	0.2	L
Eriachne pulchella subsp. *dominii*	0.1	L
Goodenia tenuiloba	0.1	V
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743) (P1)	0.5	S
Phyllanthus erwinii	0.1	I
**Portulaca ?oleracea*	0.1	I
Sida sp. Golden calyces glabrous (H.N. Foote 32)	0.1	I
Solanum lasiophyllum	0.5	I
Tribulus suberosus	0.3	I

Site Name	Site Type	Dimensions	Establishment Date	Datum	Zone	Easting	Northing	FCT Code	Soil type	Soil Colour	Topography	Slope
MG04	Quadrat	20m x 20m	5/08/2008	GDA94	50	532767	7145567	6a	silty clay loam	red brown	flat	flat

Species Name	**Av. Height**	**Cover Class**
Acacia aneura var. ?*aneura*	0.8	I
Acacia kempeana	3	S
Acacia ramulosa var. *linophylla*	2	I
Aristida contorta	0.1	L
Calandrinia sp.	0.1	I
Corchorus crozophorifolius	0.3	I
Eragrostis ?*eriopoda*	0.3	L
Eremophila forrestii subsp. *forrestii*	0.8	I
Eriachne aristidea	0.1	I
Eriachne mucronata	0.3	I
Euphorbia boophthona	0.1	I
Euphorbia drummondii	0.1	I
Goodenia sp.	0.1	I
Goodenia tenuiloba	0.1	I
Helipterum craspedioides	0.1	I
Phyllanthus erwinii	0.1	I
Ptilotus aervoides	0.1	I
Ptilotus polystachyus var. ?*polystachyus*	0.1	I
Senna artemisioides subsp. *helmsii*	1	I
Sida ?*intricata*	0.1	I
Solanum lasiophyllum	0.1	I
Tetragonia cristata	0.1	I

Site Name	Site Type	Dimensions	Establishment Date	Datum	Zone	Easting	Northing	FCT Code	Soil type	Soil Colour	Topography	Slope
MG05	Quadrat	20m x 20m	5/08/2008	GDA94	50	532873	7145628	3	clay loam	brown	closed depression	flat

Species Name	**Av. Height**	**Cover Class**
Aristida contorta	0.1	L
Calandrinia sp.	0.1	I
Calotis hispidula	0.1	I
Cephalipterum drummondii	0.1	I
Dysphania rhadinostachya subsp. *inflata*	0.1	I
Eremophila fraseri subsp. ?*parva*	2	I
Eriachne pulchella subsp. *dominii*	0.1	L
Erodium cygnorum	0.1	I
Euphorbia boophthona	0.1	I
Euphorbia drummondii	0.1	I
Goodenia tenuiloba	0.1	I
Helipterum craspedioides	0.1	I
Nicotiana ?*occidentalis* subsp. *obliqua*	0.1	I
Phyllanthus erwinii	0.1	I
Polygala isingii	0.1	I
**Portulaca* ?*oleracea*	0.1	I
Ptilotus aervoides	0.1	I
Ptilotus helipteroides var. *helipteroides*	0.1	I
Ptilotus obovatus	0.3	I
Rhodanthe maryonii	0.1	I
Rhodanthe sphaerocephala (P1)	0.1	I
Sclerolaena diacantha	0.1	I
Senna artemisioides subsp. *helmsii*	0.2	I
Senna sp. Meekatharra (E. Bailey 1-26)	0.5	I
Tetragonia cristata	1.4	I
Velleia glabrata	0.1	I
Zygophyllum ?*iodocarpum*	0.1	I

Site Name	Site Type	Dimensions	Establishment Date	Datum	Zone	Easting	Northing	FCT Code	Soil type	Soil Colour	Topography	Slope
MG06	Quadrat	20m x 20m	6/08/2008	GDA94	50	532900	7145880	3	clay loam	red brown	flat	flat

Species Name	**Av. Height**	**Cover Class**
Abutilon otocarpum	0.1	I
Acacia aneura var. ?*aneura*	4	V
Acacia aneura var. ?*conifera*	3	V
Acacia ?*ayersiana*	4	V
Acacia cuthbertsonii subsp. *cuthbertsonii*	2.5	V
Aristida contorta	0.1	L
Corchorus crozophorifolius	0.3	I
Dysphania melanocarpa forma *melanocarpa*	0.1	I
Dysphania rhadinostachya subsp. *inflata*	0.1	I
Eremophila fraseri subsp. ?*parva*	3	V
Eriachne aristidea	0.1	L
Euphorbia boophthona	0.1	I
Euphorbia drummondii	0.1	I
Phyllanthus erwinii	0.1	I
**Portulaca* ?*oleracea*	0.1	I
Ptilotus aervoides	0.1	I
Ptilotus polystachyus var. ?*polystachyus*	0.1	I
Salsola australis	0.1	I
Senna artemisioides subsp. *helmsii*	0.2	I
Solanum lasiophyllum	0.3	I

Site Name	Site Type	Dimensions	Establishment Date	Datum	Zone	Easting	Northing	FCT Code	Soil type	Soil Colour	Topography	Slope
MG07	Quadrat	20m x 20m	6/08/2008	GDA94	50	533788	7146335	4	silty clay loam	red brown	upperslope	very steep

Species Name	**Av. Height**	**Cover Class**
Abutilon lepidum	0.2	I
Acacia aneura var. ?*aneura*	4	S
Cheilanthes brownii	0.1	I
Cymbopogon ambiguus	0.5	L
Enneapogon caerulescens	0.1	L
Eremophila warnesii (P1)		
Phyllanthus erwinii	0.1	I
**Portulaca ?oleracea*	0.1	I
Ptilotus obovatus	0.3	I
Sida sp. Golden calyces glabrous (H.N. Foote 32)	0.1	I
Solanum lasiophyllum	0.5	I

Site Name	Site Type	Dimensions	Establishment Date	Datum	Zone	Easting	Northing	FCT Code	Soil type	Soil Colour	Topography	Slope
MG08	Quadrat	20m x 20m	6/08/2008	GDA94	50	533711	7146175	4	silty clay loam	red brown	upperslope	very steep

Species Name	**Av. Height**	**Cover Class**
Abutilon lepidum	0.2	I
Acacia citrinoviridis	3	S
Acacia rhodophloia	3	V
Aristida contorta	0.3	L
Calandrinia sp.	0.1	I
Cheilanthes brownii	0.1	I
Cheilanthes sieberi	0.1	I
Enneapogon caerulescens	0.1	L
Eremophila latrobei subsp. *latrobei*	1.8	S
Eriachne pulchella subsp. *dominii*	0.1	L
Erodium cygnorum	0.1	I
Euphorbia boophthona	0.1	I
Philotheca brucei subsp. *cinerea*	1	S
Phyllanthus erwinii	0.1	I
Ptilotus obovatus	0.5	V
Sida sp. Golden calyces glabrous (H.N. Foote 32)	0.3	I
Trachymene pilbarensis	0.1	I

Site Name	Site Type	Dimensions	Establishment Date	Datum	Zone	Easting	Northing	FCT Code	Soil type	Soil Colour	Topography	Slope
MG09	Quadrat	20m x 20m	6/08/2008	GDA94	50	533917	7146017	5	silty clay loam	red brown	upperslope	steep

Species Name	**Av. Height**	**Cover Class**
Amaranthus interruptus	0.2	I
Bulbostylis sp.	0.1	I
Cheilanthes brownii	0.1	I
Dysphania rhadinostachya subsp. *inflata*	0.1	I
Enneapogon caerulescens	0.1	L
Eremophila latrobei subsp. *latrobei*	1.5	I
Eriachne mucronata	0.2	L
Euphorbia boophthona	0.1	I
Grevillea berryana	5	V
Philotheca brucei subsp. *cinerea*	0.5	V
Phyllanthus erwinii	0.1	I
Ptilotus obovatus	0.2	I
Solanum lasiophyllum	0.3	I
Trachymene pilbarensis	0.1	I
Triodia melvillei	0.5	M

Site Name	Site Type	Dimensions	Establishment Date	Datum	Zone	Easting	Northing	FCT Code	Soil type	Soil Colour	Topography	Slope
MG10	Quadrat	20m x 20m	6/08/2008	GDA94	50	533944	7145930	4	silty clay loam	red brown	crest-upperslope	very steep

Species Name	**Av. Height**	**Cover Class**
Acacia aneura var. ?*aneura*	4	V
Acacia citrinoviridis	5	S
Acacia rhodophloia	3	V
Aristida contorta	0.2	L
Calandrinia sp.	0.1	I
Cheilanthes brownii	0.1	I
Cheilanthes sieberi	0.1	I
Corchorus crozophorifolius	0.1	L
Enneapogon caerulescens	0.2	L
Eragrostis ?eriopoda	0.2	L
Eremophila latrobei subsp. *latrobei*	2	S
Eriachne aristidea	0.1	L
Eriachne pulchella subsp. *dominii*	0.1	L
Erodium cygnorum	0.1	I
Goodenia tenuiloba	0.1	I
Philotheca brucei subsp. *cinerea*	1	S
Phyllanthus erwinii	0.1	I
Ptilotus obovatus	0.5	V
Sida sp. Golden calyces glabrous (H.N. Foote 32)	0.2	I

Site Name	Site Type	Dimensions	Establishment Date	Datum	Zone	Easting	Northing	FCT Code	Soil type	Soil Colour	Topography	Slope
MG11	Quadrat	20m x 20m	6/08/2008	GDA94	50	534364	7146535	4	silty clay loam	red brown	upperslope	very steep

Species Name	**Av. Height**	**Cover Class**
Abutilon lepidum	0.1	I
Acacia citrinoviridis	6	S
Amaranthus interruptus	0.1	I
Calandrinia sp.	0.1	I
Cheilanthes sieberi	0.1	I
Cymbopogon ambiguus	0.5	V
Enneapogon caerulescens	0.1	I
Eremophila latrobei subsp. *latrobei*	0.5	I
Lepidium oxytrichum	0.1	I
Nicotiana ?*occidentalis* subsp. *obliqua*	0.1	I
Phyllanthus erwinii	0.1	I
Ptilotus obovatus	0.5	M

Site Name	Site Type	Dimensions	Establishment Date	Datum	Zone	Easting	Northing	FCT Code	Soil type	Soil Colour	Topography	Slope
MG12	Quadrat	20m x 20m	7/08/2008	GDA94	50	534305	7146995	4	silty clay loam	red	upperslope	very steep

Species Name	**Av. Height**	**Cover Class**
Abutilon lepidum	0.1	I
Acacia aneura var. ?*aneura*	0.1	I
Amaranthus interruptus	0.1	I
Cheilanthes brownii	0.1	I
Cheilanthes sieberi	0.1	I
Corchorus crozophorifolius	0.1	I
Cymbopogon ambiguus	0.5	V
Enneapogon caerulescens	0.1	L
Eremophila warnesii (P1)	0.4	V
Eriachne mucronata	0.2	L
Euphorbia australis	0.1	I
Evolvulus alsinoides var. *villosicalyx*	0.1	I
Philotheca brucei subsp. *cinerea*	0.1	I
Phyllanthus erwinii	0.1	I
**Portulaca* ?*oleracea*	0.1	I
Ptilotus obovatus	0.4	V
Ptilotus polystachyus var. ?*polystachyus*	0.1	I
Senna artemisioides subsp. *helmsii*	0.1	I
Sida sp. spiciform panicles (E. Leyland s.n. 14/8/90)	0.3	I
Solanum lasiophyllum	0.1	I

Site Name	Site Type	Dimensions	Establishment Date	Datum	Zone	Easting	Northing	FCT Code	Soil type	Soil Colour	Topography	Slope
MG13	Quadrat	20m x 20m	7/08/2008	GDA94	50	534473	7146985	4	silty clay loam	red brown	upperslope	very steep

Species Name	**Av. Height**	**Cover Class**
Cheilanthes brownii	0.1	I
Corchorus crozophorifolius	0.2	I
Cymbopogon ambiguus	0.5	V
Enneapogon caerulescens	0.1	L
Eremophila warnesii (P1)	0.3	V
Eriachne mucronata	0.2	L
Evolvulus alsinoides var. *villosicalyx*	0.1	I
Olearia stuartii		
Phyllanthus erwinii	0.1	I
Ptilotus obovatus	0.3	I
Solanum lasiophyllum	0.1	I
Triodia melvillei	0.5	S

Site Name	Site Type	Dimensions	Establishment Date	Datum	Zone	Easting	Northing	FCT Code	Soil type	Soil Colour	Topography	Slope
MG14	Quadrat	20m x 20m	7/08/2008	GDA94	50	534161	7147057	4	silty clay loam	red brown	upperslope	very steep

Species Name	**Av. Height**	**Cover Class**
Abutilon lepidum	0.1	I
Acacia aneura var. ?*aneura*	3	S
Acacia rhodophloia	3	V
Aristida contorta	0.1	L
Cheilanthes sieberi	0.1	I
Corchorus crozophorifolius	0.1	I
Eremophila latrobei subsp. *latrobei*	1.8	S
Eriachne aristidea	0.1	L
Goodenia tenuiloba	0.1	I
Philotheca brucei subsp. *cinerea*	0.8	S
Phyllanthus erwinii	0.1	I
Ptilotus obovatus	0.5	V
Solanum lasiophyllum	0.1	I
Streptoglossa liatroides		

Site Name	Site Type	Dimensions	Establishment Date	Datum	Zone	Easting	Northing	FCT Code	Soil type	Soil Colour	Topography	Slope
MG15	Quadrat	20m x 20m	7/08/2008	GDA94	50	534142	7147212	1	silty clay loam	red brown	midslope	very steep

Species Name	**Av. Height**	**Cover Class**
Abutilon lepidum	0.1	I
Acacia aneura var. ?*aneura*	3	V
Acacia aneura var. ?*conifera*	3	I
Aristida contorta	0.1	I
Eremophila lachnocalyx	1.8	I
Eriachne pulchella subsp. *dominii*	0.1	I
Euphorbia australis	0.1	I
Maireana georgei	0.1	I
Phyllanthus erwinii	0.1	I
Ptilotus obovatus	0.5	V
Sclerolaena ?*diacantha*	0.1	I
Sida sp. dark green fruits (S. van Leeuwen 2260)	0.1	I
Solanum lasiophyllum	0.1	I
Streptoglossa liatroides	0.1	I

Site Name	Site Type	Dimensions	Establishment Date	Datum	Zone	Easting	Northing	FCT Code	Soil type	Soil Colour	Topography	Slope
MG16	Quadrat	20m x 20m	7/08/2008	GDA94	50	534580	7147683	1	silty clay loam	red brown	lowerslope	gentle

Species Name	**Av. Height**	**Cover Class**
Acacia aneura var. ?*aneura*	0.5	I
Acacia ramulosa var. *linophylla*	1.5	I
Acacia rhodophloia	3	S
Aristida contorta	0.1	L
Enneapogon caerulescens	0.1	L
Eremophila latrobei subsp. *latrobei*	2	V
Eremophila ?pendulina	1.2	V
Eremophila phyllopoda subsp. *phyllopoda*	1	V
Goodenia tenuiloba	0.1	S
Haloragis ?gossei	0.1	I
Heliotropium heteranthum	0.1	I
Phyllanthus erwinii	0.1	I
Ptilotus obovatus	0.5	V
Sida sp. dark green fruits (S. van Leeuwen 2260)	0.2	I
Solanum lasiophyllum	0.1	I

Site Name	Site Type	Dimensions	Establishment Date	Datum	Zone	Easting	Northing	FCT Code	Soil type	Soil Colour	Topography	Slope
MG17	Quadrat	20m x 20m	1/10/2008	GDA94	50	533448	7147992	6a	Sandy clay loam	Red	Plain	Flat

Species Name	**Av. Height**	**Cover Class**
Acacia kempeana	0.4	I
Acacia ramulosa var. *linophylla*	3	S
Aristida contorta	0.2	L
Calandrinia polyandra	0.1	I
Corchorus crozophorifolius	0.5	I
Dysphania melanocarpa forma *melanocarpa*	0.1	I
Eremophila forrestii subsp. *forrestii*	1.5	V
Eriachne aristidea	0.2	L
Euphorbia drummondii	0.1	I
Goodenia tenuiloba	0.1	I
Phyllanthus erwinii	0.1	I
Ptilotus aervoides	0.1	I
Ptilotus helipteroides var. *helipteroides*	0.1	I
Ptilotus polystachyus var. ?*polystachyus*	0.2	I
Sida ?*intricata*	0.1	I
Solanum lasiophyllum	1	I

Site Name	Site Type	Dimensions	Establishment Date	Datum	Zone	Easting	Northing	FCT Code	Soil type	Soil Colour	Topography	Slope
MG18	Quadrat	20m x 20m	1/10/2008	GDA94	50	533277	7147321	6a	Sandy clay loam	Red	Plain	Flat

Species Name	**Av. Height**	**Cover Class**
Abutilon otocarpum	0.2	I
Acacia kempeana	4	I
Acacia ramulosa var. *linophylla*	4	S
Aristida contorta	0.1	I
Corchorus crozophorifolius	0.2	I
Dysphania melanocarpa forma *melanocarpa*	0.1	I
Dysphania rhadinostachya subsp. *inflata*	0.1	I
Eremophila compacta subsp. ?*fecunda*	0.3	I
Eremophila forrestii subsp. *forrestii*	2	V
Eriachne aristidea	0.1	L
Eriachne mucronata	0.3	I
Phyllanthus erwinii	0.1	I
Ptilotus aervoides	0.1	I
Sida ?*intricata*	0.1	I

Site Name	Site Type	Dimensions	Establishment Date	Datum	Zone	Easting	Northing	FCT Code	Soil type	Soil Colour	Topography	Slope
MG19	Quadrat	20m x 20m	1/10/2008	GDA94	50	533616	7147468	1	Skeletal silty clay loam over quartz and ironstone stones	Red-Brown	Lower slope	Steep

Species Name	**Av. Height**	**Cover Class**
Acacia aneura var. ?*aneura*	3	I
Acacia ramulosa var. *linophylla*	2.5	V
Acacia rhodophloia	3	V
Aristida contorta	0.1	I
Corchorus crozophorifolius	0.3	I
Dysphania rhadinostachya subsp. *inflata*	0.1	I
Eriachne pulchella subsp. *pulchella*	0.1	I
Goodenia tenuiloba	0.1	V
Phyllanthus erwinii	0.1	I
**Portulaca* ?*oleracea*	0.1	I
Ptilotus aervoides	0.1	I
Ptilotus obovatus	0.3	I
Ptilotus polystachyus var. ?*polystachyus*	0.1	I
Rhodanthe maryonii	0.1	I
Sida sp. dark green fruits (S. van Leeuwen 2260)	0.1	I
Sida sp. spiciform panicles (E. Leyland s.n. 14/8/90)	0.1	I
Solanum lasiophyllum	0.1	I
Streptoglossa liatroides	0.1	I

Site Name	Site Type	Dimensions	Establishment Date	Datum	Zone	Easting	Northing	FCT Code	Soil type	Soil Colour	Topography	Slope
MG20	Quadrat	20m x 20m	1/10/2008	GDA94	50	533247	7147554	3	Clay-loam	Brown-red	Clay pan	Flat

Species Name	**Av. Height**	**Cover Class**
Acacia aneura var. ?*aneura*	0.1	I
Aristida contorta	0.1	L
Eriachne aristidea	0.1	I
Eriachne pulchella subsp. *pulchella*	0.1	I
Euphorbia boophthona	0.1	I
Euphorbia drummondii	0.1	I
Goodenia tenuiloba	0.1	I
Helipterum craspedioides	0.1	I
Maireana carnosa	0.1	I
Phyllanthus erwinii	0.1	I
Ptilotus aervoides	0.1	I
Ptilotus helipteroides var. *helipteroides*	0.1	I
Ptilotus obovatus	0.5	I
Ptilotus polystachyus var. ?*polystachyus*	0.1	I
Ptilotus schwartzii	0.1	I
Rhodanthe sphaerocephala (P1)	0.1	I
Velleia glabrata	0.1	I

Site Name	Site Type	Dimensions	Establishment Date	Datum	Zone	Easting	Northing	FCT Code	Soil type	Soil Colour	Topography	Slope
MG21	Quadrat	20m x 20m	1/10/2008	GDA94	50	534289	7148024	2	Silty clay loam over ironstone and quartz pebbles	Red-brown	Lower slope/undulating plain	Gentle

Species Name	**Av. Height**	**Cover Class**
Acacia aneura var. ?*aneura*	4	V
Acacia ramulosa var. *linophylla*	2.5	I
Acacia rhodophloia	0.5	I
Aristida contorta	0.1	I
Eremophila ?*jucunda*	0.3	I
Eremophila latrobei subsp. *latrobei*	0.3	I
Goodenia tenuiloba	0.1	V
Ptilotus obovatus	0.3	I
Tribulus adelacanthus	0.1	I

Site Name	Site Type	Dimensions	Establishment Date	Datum	Zone	Easting	Northing	FCT Code	Soil type	Soil Colour	Topography	Slope
MG22	Quadrat	20m x 20m	1/10/2008	GDA94	50	534812	7147869	2	Silty clay loam over ironstone and quartz rocks	Red-brown	Stony undulating plain	Gentle

Species Name	**Av. Height**	**Cover Class**
Acacia ramulosa var. *linophylla*	3	I
Acacia rhodophloia	3	V
Aristida contorta	0.1	I
Corchorus crozophorifolius	0.1	I
Dysphania rhadinostachya subsp. *inflata*	0.3	I
Eremophila fraseri subsp. ?*parva*	3	V
Euphorbia boophthona	0.1	I
Goodenia tenuiloba	0.1	V
Ptilotus obovatus	0.3	I
Ptilotus rotundifolius	1	I

Site Name	Site Type	Dimensions	Establishment Date	Datum	Zone	Easting	Northing	FCT Code	Soil type	Soil Colour	Topography	Slope
MG23	Quadrat	20m x 20m	2/10/2008	GDA94	50	534742	7146539	4	Skeletal silty clay loam over massive ironstone	Red-brown	Midslope	Very Steep

Species Name	**Av. Height**	**Cover Class**
Abutilon lepidum	0.1	I
Acacia aneura var. ?*aneura*	3	I
Amaranthus interruptus	0.1	I
Cymbopogon ambiguus	0.5	V
Digitaria brownii	0.1	I
Enneapogon caerulescens	0.1	L
Eremophila warnesii (P1)	0.3	V
Philotheca brucei subsp. *cinerea*	0.5	I
Phyllanthus erwinii	0.1	I
Ptilotus obovatus	0.3	V
Sida sp. spiciform panicles (E. Leyland s.n. 14/8/90)	0.1	I
Solanum lasiophyllum	0.3	I

Site Name	Site Type	Dimensions	Establishment Date	Datum	Zone	Easting	Northing	FCT Code	Soil type	Soil Colour	Topography	Slope
MG24	Quadrat	20m x 20m	2/10/2008	GDA94	50	534847	7146546	4	Skeletal silty clay loam over massive ironstone and conglomerate boulders	Red	Lower slope	Very steep

Species Name	**Av. Height**	**Cover Class**
Abutilon lepidum	0.1	I
Acacia aneura var. ?*aneura*	3	V
Acacia rhodophloia	3	V
Cheilanthes brownii	0.1	L
Cheilanthes sieberi	0.1	I
Corchorus crozophorifolius	0.4	I
Cymbopogon ambiguus	0.5	I
Dodonaea petiolaris	0.5	I
Dysphania rhadinostachya subsp. *inflata*	0.1	I
Eremophila latrobei subsp. *latrobei*	2	V
Eriachne mucronata	0.5	I
Evolvulus alsinoides var. *villosicalyx*	0.1	I
Goodenia tenuiloba	0.1	I
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743) (P1}	0.3	I
Heliotropium inexplicitum	0.1	I
Philotheca brucei subsp. *cinerea*	0.5	I
Phyllanthus erwinii	0.1	I
Ptilotus obovatus	0.5	V
Sida ectogama	0.2	I
Sida sp. Golden calyces glabrous (H.N. Foote 32)	0.2	I
Solanum lasiophyllum	0.1	I

Site Name	Site Type	Dimensions	Establishment Date	Datum	Zone	Easting	Northing	FCT Code	Soil type	Soil Colour	Topography	Slope
MG25	Quadrat	20m x 20m	1/10/2008	GDA94	50	534506	7146116	4	Skeletal silty clay loam over massive ironstone and ironstone boulders	Red	Lower slope	Steep

Species Name	**Av. Height**	**Cover Class**
Abutilon lepidum	0.1	I
Acacia aneura var. ?*aneura*	4	S
Amaranthus interruptus	0.1	I
Aristida contorta	0.2	I
Cheilanthes sieberi	0.1	I
Corchorus crozophorifolius	0.3	I
Cymbopogon ambiguus	0.5	L
Digitaria brownii	0.2	I
Dodonaea petiolaris	0.5	I
Dysphania rhadinostachya subsp. *inflata*	0.1	I
Enneapogon caerulescens	0.1	I
Eremophila latrobei subsp. *latrobei*	1	I
Eriachne ?*mucronata*	0.5	L
Euphorbia australis	0.1	I
Goodenia tenuiloba	0.1	I
Grevillea berryana	4	V
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743) (P1)	0.5	I
Philotheca brucei subsp. *cinerea*	1	I
Ptilotus obovatus	0.5	V
Sida ectogama	0.5	I
Sida sp. dark green fruits (S. van Leeuwen 2260)	0.1	I
Sida sp. spiciform panicles (E. Leyland s.n. 14/8/90)	0.3	I
Solanum lasiophyllum	0.8	I

Appendix F: Taxa amalgamated for the Mount Gould DSO Project Area Quadrat Analysis

Acacia aneura var. ?*aneura*
Acacia aneura var. *microcarpa*

Cheilanthes sieberi
Cheilanthes sieberi subsp. *sieberi*

Enneapogon caerulescens
Enneapogon caerulescens var. *caerulescens*

Eragrostis eriopoda
Eragrostis ?*eriopoda*

Eriachne ?*mucronata*
Eriachne mucronata

Hakea lorea
Hakea lorea subsp. *lorea*

Ptilotus obovatus
Ptilotus obovatus var. *obovatus*

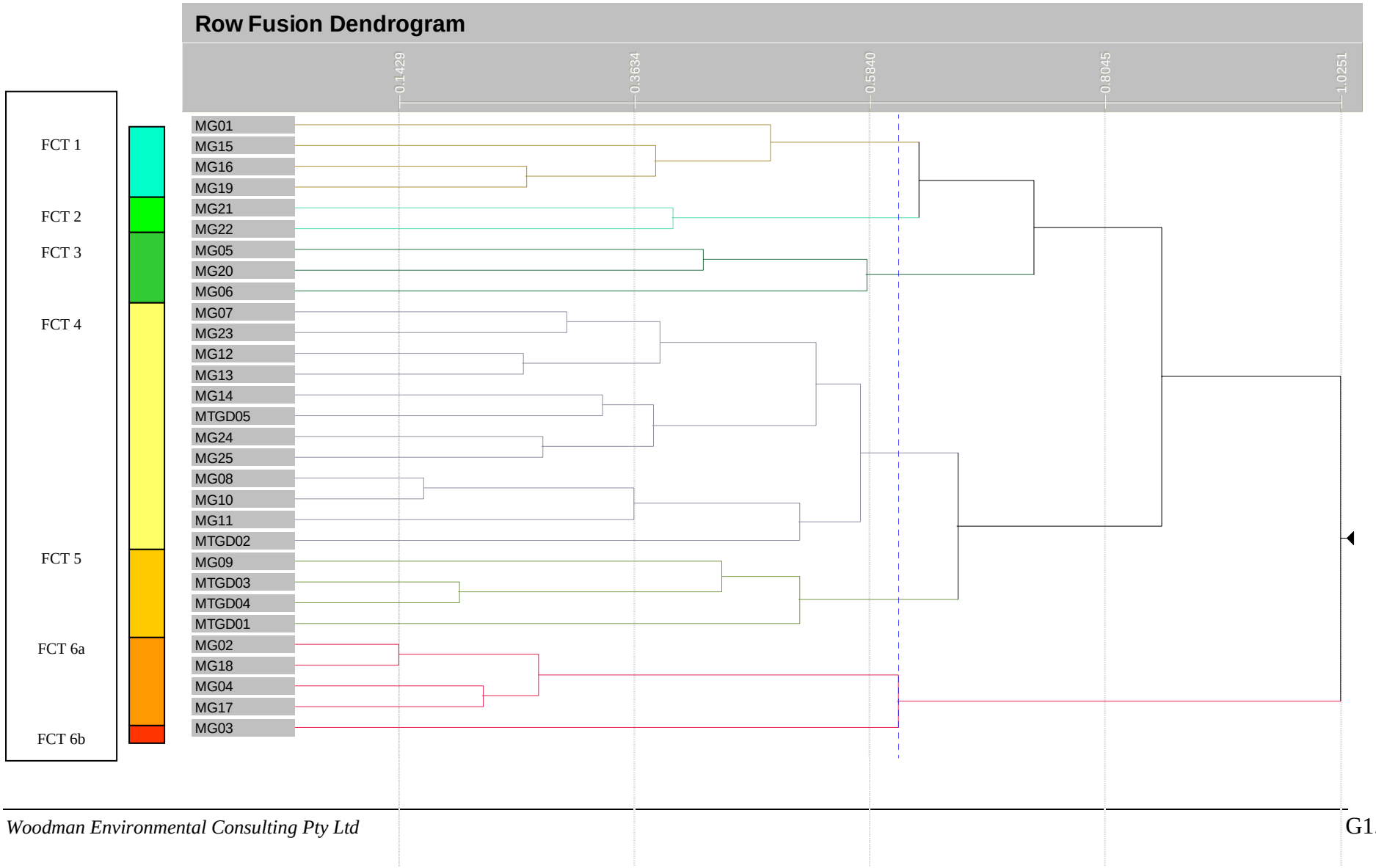
Ptilotus polystachyus forma *polystachyus*
Ptilotus polystachyus var. ?*polystachyus*

Sida aff. *atrovirens*
Sida atrovirens ms
Sida sp. dark green fruits (S. van Leeuwen 2260)

Solanum ashbyae
Solanum ashybii/lasiopetalum complex
Solanum lasiophyllum

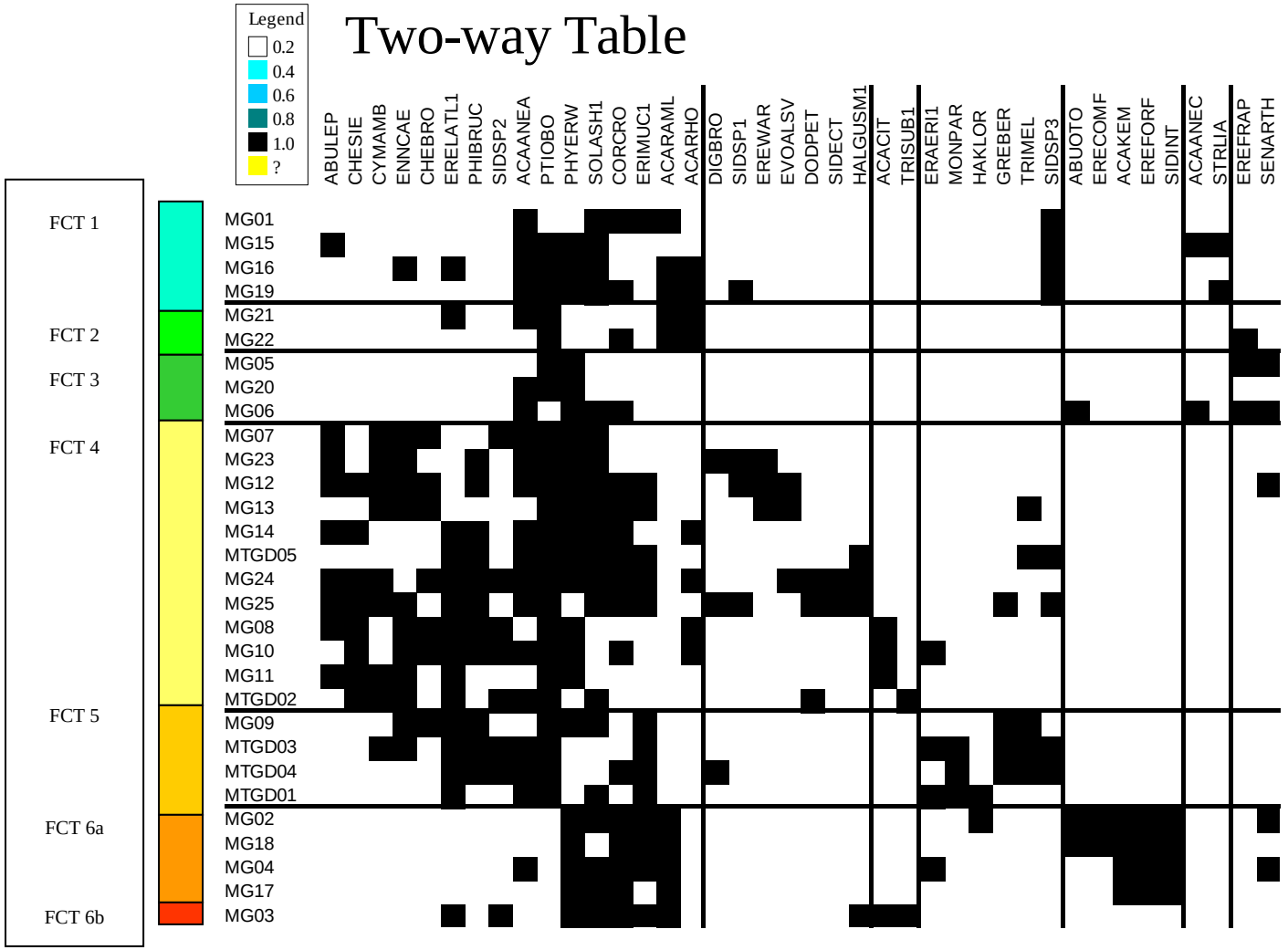
Appendix G: Summary Dendrogram of Floristic Community Types of the Mount Gould DSO Project Area

Note: Quadrats labeled MG are Woodman Environmental, MTGD are Meissner *et al.* (2007)



Appendix H: Summary Matrix of Species Presence within Quadrats in the Mount Gould DSO Project Area

Note: Quadrats labeled MG are Woodman Environmental, MTGD are Meissner *et al.* (2007)



Appendix I: Significant Indicator Species of the 7-group classification of the Mount Gould DSO Project Area, 2008

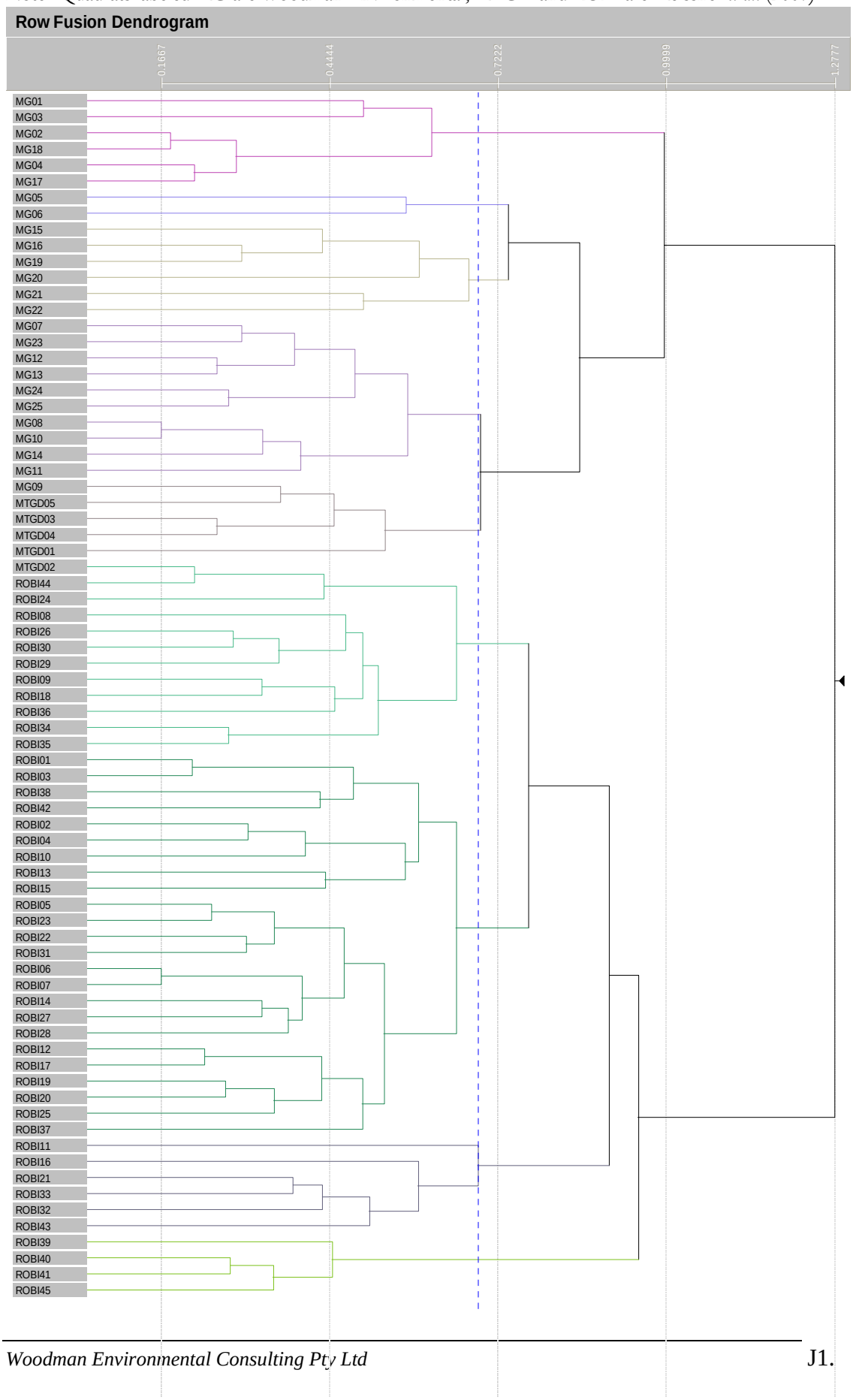
Note: Shading denotes highest indicator values per taxon. Indicator values (%) are shown only for taxa shown only for taxa which were significant at p < 0.05 (Monte Carlo permutation tests: * = p < 0.05; ** = p < 0.01; *** = p < 0.001)

Note: FCT 6b not included as it was represented by a single quadrat

	Floristic Community Type					
Taxon	**1**	**2**	**3**	**4**	**5**	**6a**
Sida sp. dark green fruits (S. van Leeuwen 2260)**	60	0	0	2	15	0
Solanum ashbyae/lasiophyllum complex*	30	0	3	17	8	17
*Acacia rhodophloia**	14	55	0	6	0	0
*Phyllanthus erwinii**	15	0	26	18	2	26
*Abutilon lepidum**	7	0	0	48	0	0
*Cheilanthes sieberi***	0	0	0	67	0	0
*Cymbopogon ambiguus**	0	0	0	48	7	0
Eremophila latrobei subsp. *latrobei***	3	10	0	18	41	0
*Eriachne mucronata**	3	0	0	7	41	23
*Grevillea berryana**	0	0	0	1	68	0
*Monacather paradoxus**	0	0	0	0	75	0
*Triodia melvillei**	0	0	0	3	61	0
*Acacia kempeana****	0	0	0	0	0	100
Eremophila forrestii subsp. *forrestii****	0	0	0	0	0	100
*Sida ?intricata****	0	0	0	0	0	100

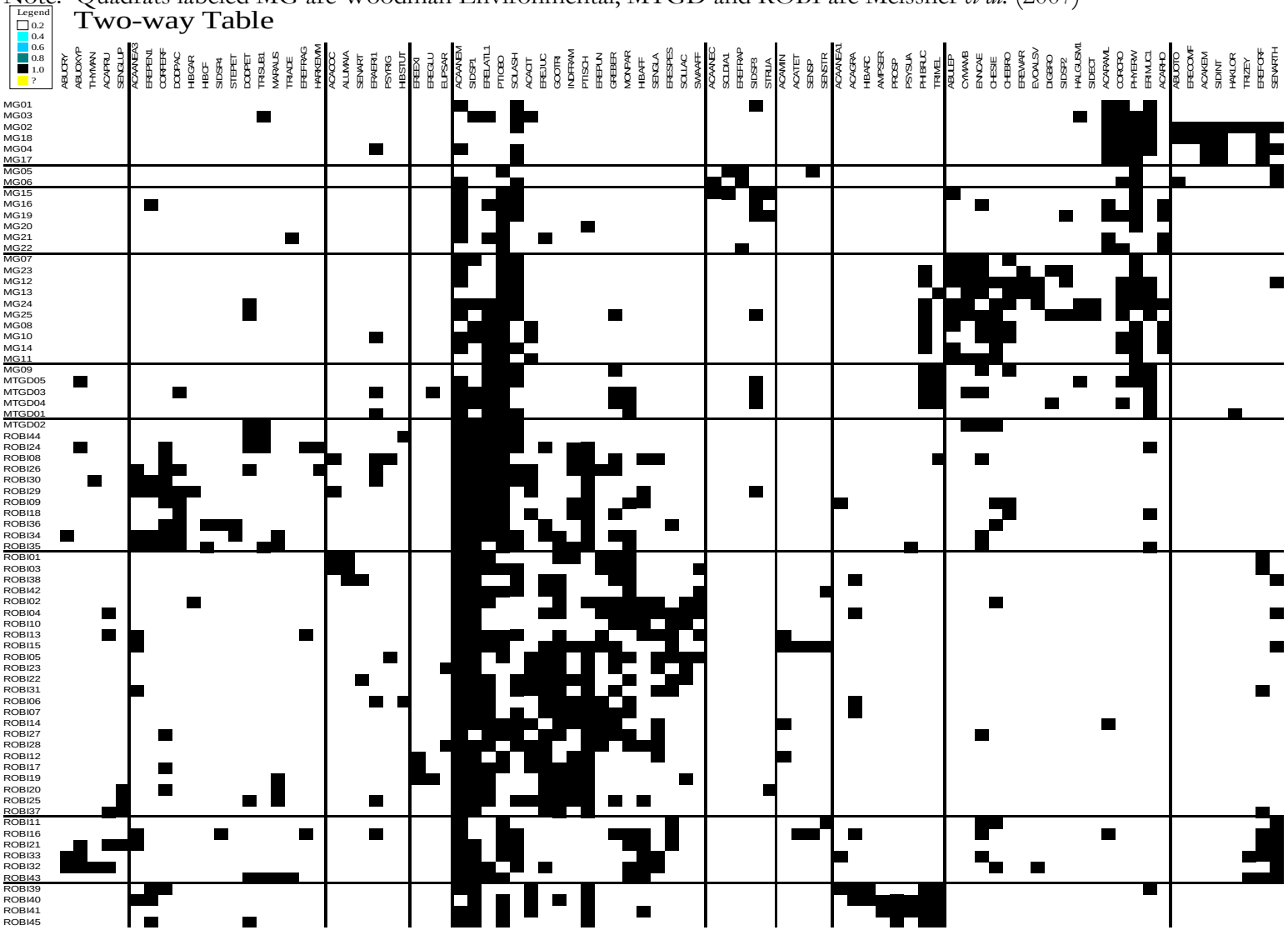
Appendix J: Summary Dendrogram of Analysis of Mount Gould and Robinson Range Quadrats

Note: Quadrats labeled MG are Woodman Environmental, MTGD and ROBI are Meissner *et al.* (2007)



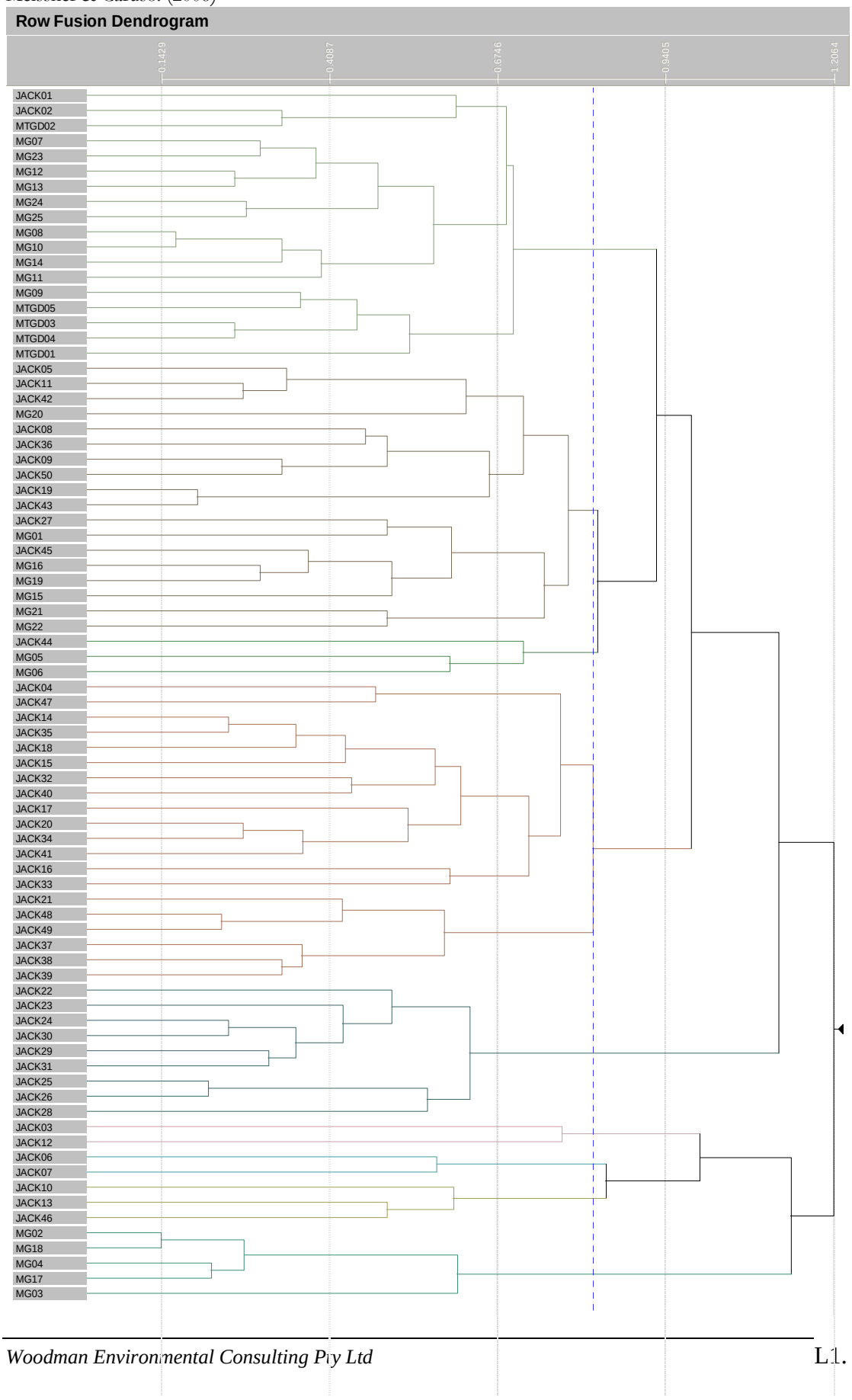
Appendix K: Summary Matrix of Species Presence within Mount Gould and Robinson Range Quadrats

Note: Quadrats labeled MG are Woodman Environmental, MTGD and ROBI are Meissner *et al.* (2007)



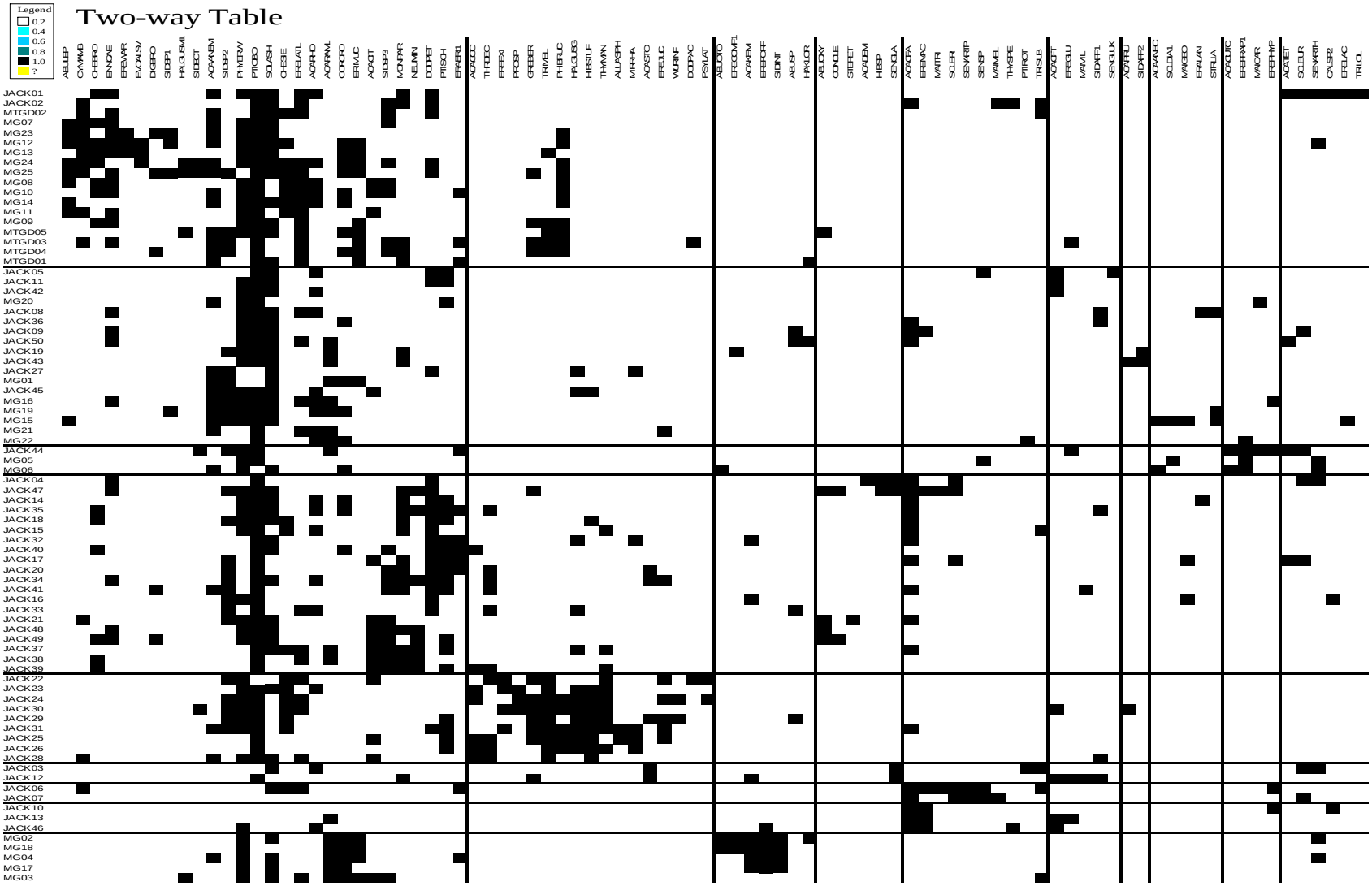
Appendix L: Summary Dendrogram of Analysis of Mount Gould and Jack Hills Quadrats

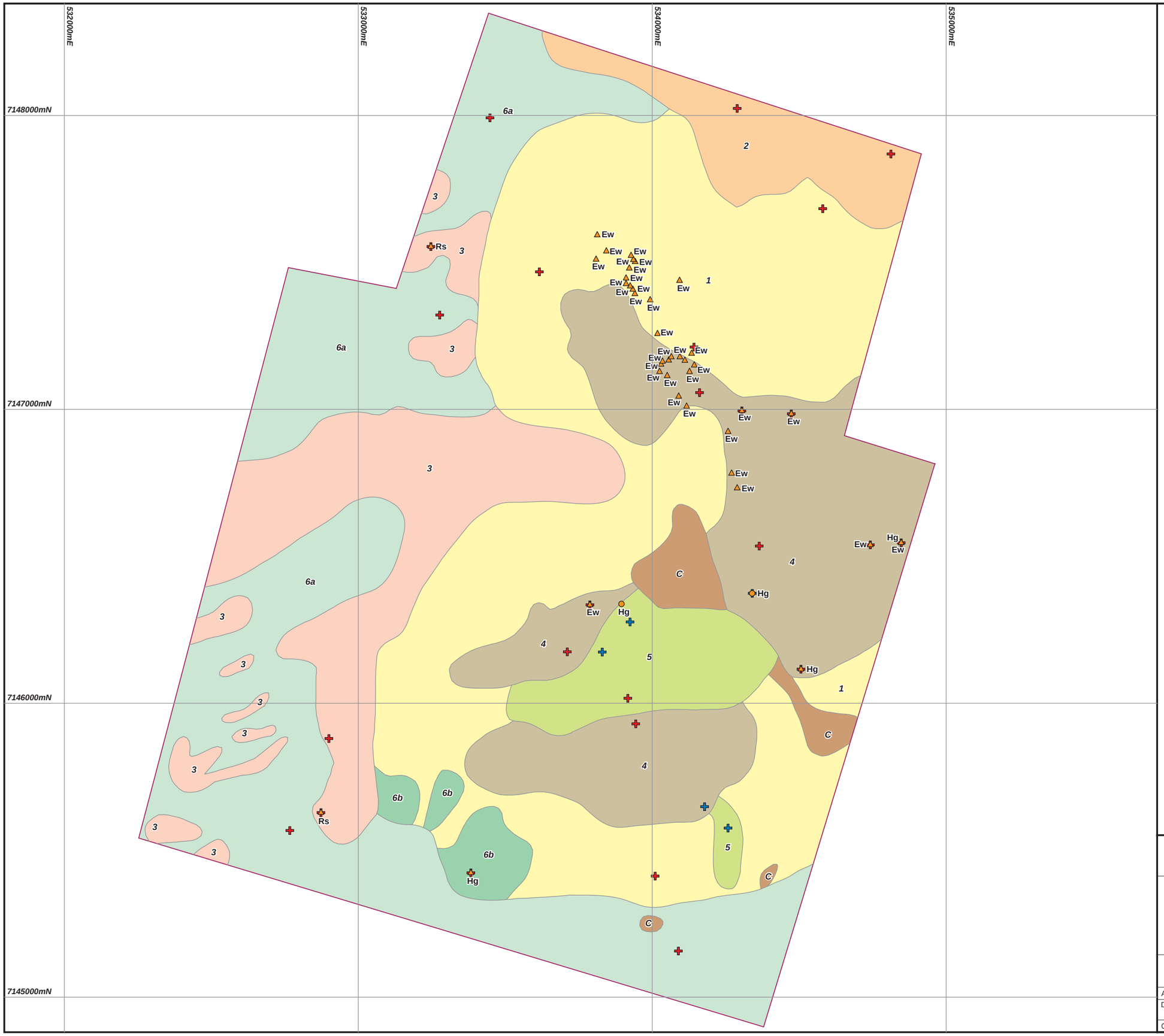
Note: Quadrats labeled MG are Woodman Environmental, MTGD are Meissner *et al.* (2007). JACK are Meissner & Caruso. (2006)



Appendix M: Summary Matrix of Species Presence within Mount Gould and Jack Hills Quadrats

Note: Quadrats labeled MG are Woodman Environmental, JACK are Meissner and Caruso (2006)





LEGEND

Floristic Community Types

1: Open tall shrubland of *Acacia aneura* over sparse low shrubland of *Ptilotus obovatus* over open low forbland of *Goodenia tenuiloba* on steep mid and lower slopes on banded ironstone and quartz shale

2: Sparse tall shrubland of mixed *Acacia* species over sparse low shrubland of *Ptilotus obovatus* and *Eremophila* species over open low forbland of *Goodenia tenuiloba* on stony undulating plains

3: Sparse tall shrubland or isolated shrubs of *Acacia aneura* over isolated mid shrubs of *Eremophila fraseri* subsp. *parva* over isolated low shrubs of *Ptilotus obovatus* over open low forbland of mixed species including *Ptilotus aervoides* and *Goodenia tenuiloba* in clay pans and on clay flats

4: Open tall shrubland or isolated shrubs of *Acacia aneura* over open to sparse mid shrubland of *Eremophila latrobei* subsp. *latrobei* and *Philotheca brucei* subsp. *cinerea* over open to sparse low shrubland and low tussock grassland of *Ptilotus obovatus* and *Cymbopogon ambiguus* on steep mid and upper slopes and crests on banded ironstone

5: Isolated tall shrubland of *Acacia aneura* and/or *Grevillea berryana* over sparse low shubland of *Eremophila latrobei* subsp. *latrobei*, *Philotheca brucei* subsp. *cinerea* and *Ptilotus obovatus* over low hummock grassland of *Triodia melvillei* on steep upperslopes and crests on banded ironstone

6a: Open tall shrubland of *Acacia ramulosa* var. *linophylla* and *Acacia kempeana* over sparse mid shubland of *Eremophila forrestii* subsp. *forrestii* over isolated low shrubland of *Corchorus crozophorifolius* over sparse low grassland and forbland of mixed species including *Eriachne mucronata* and *Ptilotus aervoides* on flat plains

6b: Tall sparse shrubland of *Acacia ramulosa* var. *linophylla* and *Acacia citrinoviridis* over open mid shubland of *Eremophila latrobei* subsp. *latrobei* over open low shrubland of *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) over sparse low forbland of *Goodenia tenuiloba* on a steep low ridge on banded ironstone

Recording Sites

Woodman Environmental quadrat

DEC quadrat

Declared Rare and Priority Flora Species

Ew: *Eremophila warnesii*	P1
Hg: *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743)	P1
Rs: *Rhodanthe sphaerocephala*	P1

0 100 200m

Scale

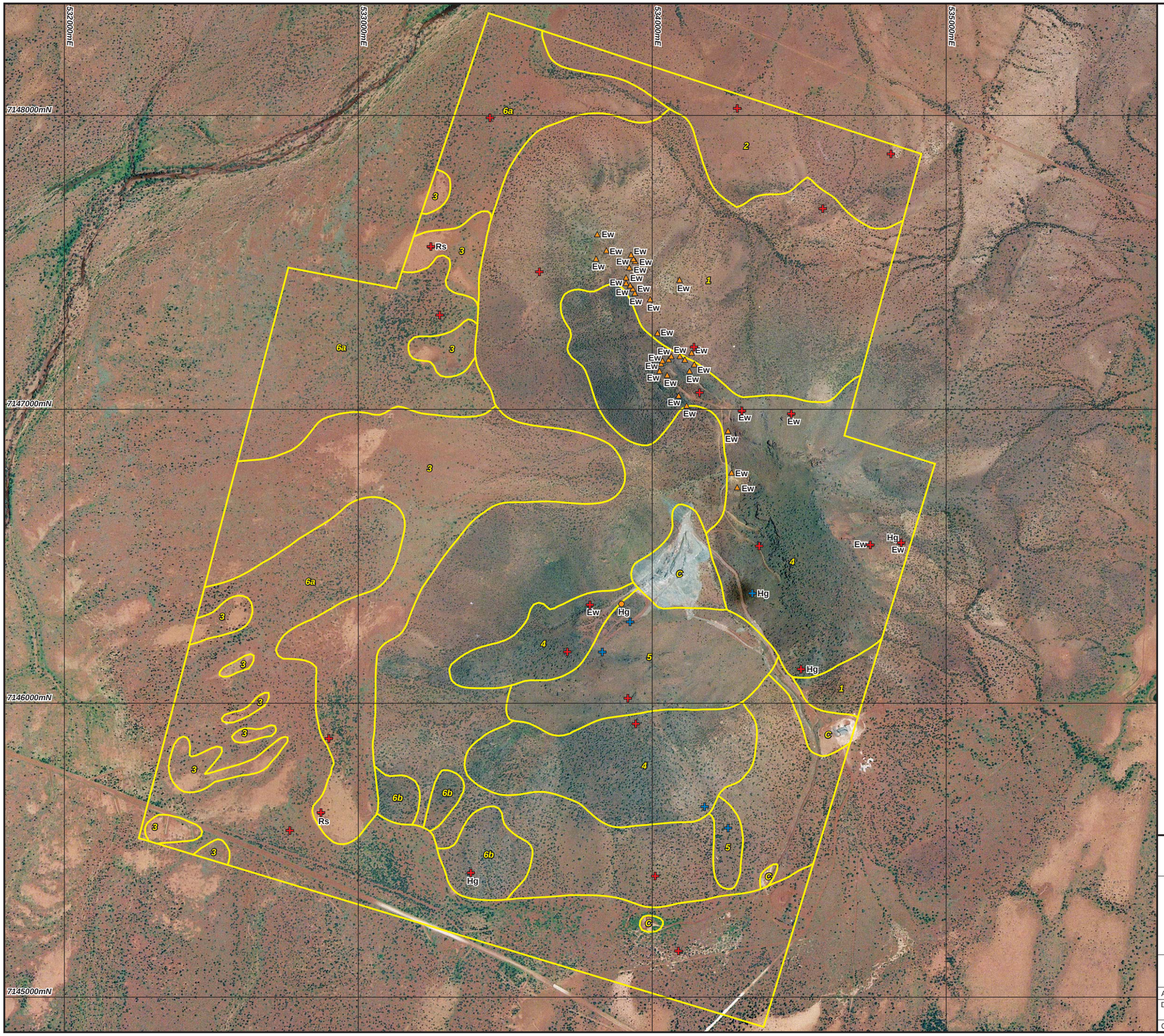
MGA94 Zone 50

Priority Rare	DEC	WEC
1	●	▲
2	●	▲
3	●	▲
4	●	▲

Mt Gould DSO Project Area Floristic Community Types and Significant Flora Taxa

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Author: D Coultas	WEC Ref: ATLAS08-10-01	Scale: 1:12,500
Drawn: CAD Resources ~ www.cadresources.com.au Tel: (08) 9246 3242 ~ Fax: (08) 9246 3202		Figure: **2a**
CAD Ref: g1627_MG_f01.dgn	Date: Apr 2009	Rev: A A3



LEGEND

Floristic Community Types

1: Open tall shrubland of *Acacia aneura* over sparse low shrubland of *Ptilotus obovatus* over open low forbland of *Goodenia tenuiloba* on steep mid and lower slopes on banded ironstone and quartz shale

2: Sparse tall shrubland of mixed *Acacia* species over sparse low shrubland of *Ptilotus obovatus* and *Eremophila* species over open low forbland of *Goodenia tenuiloba* on stony undulating plains

3: Sparse tall shrubland or isolated shrubs of *Acacia aneura* over isolated mid shrubs of *Eremophila fraseri* subsp. *parva* over isolated low shrubs of *Ptilotus obovatus* over open low forbland of mixed species including *Ptilotus aervoides* and *Goodenia tenuiloba* in clay pans and on clay flats

4: Open tall shrubland or isolated shrubs of *Acacia aneura* over open to sparse mid shrubland of *Eremophila latrobei* subsp. *latrobei* and *Philotheca brucei* subsp. *cinerea* over open to sparse low shrubland and low tussock grassland of *Ptilotus obovatus* and *Cymbopogon ambiguus* on steep mid and upper slopes and crests on banded ironstone

5: Isolated tall shrubland of *Acacia aneura* and/or *Grevillea berryana* over sparse low shubland of *Eremophila latrobei* subsp. *latrobei*, *Philotheca brucei* subsp. *cinerea* and *Ptilotus obovatus* over low hummock grassland of *Triodia melvillei* on steep upperslopes and crests on banded ironstone

6a: Open tall shrubland of *Acacia ramulosa* var. *linophylla* and *Acacia kempeana* over sparse mid shubland of *Eremophila forrestii* subsp. *forrestii* over isolated low shrubland of *Corchorus crozophorifolius* over sparse low grassland and forbland of mixed species including *Eriachne mucronata* and *Ptilotus aervoides* on flat plains

6b: Tall sparse shrubland of *Acacia ramulosa* var. *linophylla* and *Acacia citrinoviridis* over open mid shubland of *Eremophila latrobei* subsp. *latrobei* over open low shrubland of *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) over sparse low forbland of *Goodenia tenuiloba* on a steep low ridge on banded ironstone

Recording Sites

Woodman Environmental quadrat

DEC quadrat

Declared Rare and Priority Flora Species

Ew: *Eremophila warnesii*	P1
Hg: *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743)	P1
Rs: *Rhodanthe sphaerocephala*	P1

N

0 100 200m

Scale

MGA94 Zone 50

Priority Rare	DEC	WEC
1	●	▲
2	●	▲
3	●	▲
4	●	▲

Mt Gould DSO Project Area Floristic Community Types and Significant Flora Taxa Showing Aerial Photography

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Author: D Coultas	WEC Ref: ATLAS08-10-01	Scale: 1:12,500
Drawn: CAD Resources ~ www.cadresources.com.au Tel: (08) 9246 3242 ~ Fax: (08) 9246 3202		Figure: **2b**
CAD Ref: g1627_MG_f02.dgn	Date: Apr 2009	Rev: A A3

APPENDIX 4: MOUNT GOULD DSO PROJECT PROPOSED EXPLORATION DRILLING PROGRAMME - CONSERVATION SIGNIFICANT FLORA AND VEGETATION ASSESSMENT (WOODMAN 2010)

ATLAS IRON LIMITED

Mount Gould DSO Project

Proposed Exploration Drilling Programme

Conservation Significant Flora and Vegetation Assessment



November 2010

woodmanenvironmentalconsulting

A.C.N. 088 055 903

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A	Draft Report	AS	CG	26/10/2010
B	Client Comments Incorporated	AS	M. Rigo/B. Bow	16/11/2010

Report Number: Atlas10-25-01

DRAFT

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Table 2: Summary of Conservation Significant Flora Taxa to be Impacted and Flagged for Avoidance at Mount Gould, August 2010

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Appendices

Appendix A: Mount Gould Drill Line Survey Data and Recommendations

Appendix B: Definitions of Conservation Status Codes (Smith 2010)

Appendix C: Definitions of Priority Ecological Communities (DEC 2010a)

Figures

Figure 1: Location of Conservation Significant Flora on Proposed Drill Lines and Access Tracks – Mount Gould

DRAFT

1. INTRODUCTION

Atlas Iron Limited (Atlas) is proposing to conduct preliminary exploration drilling for iron ore as part of its Mount Gould Direct Shipping Ore (DSO) Project, within tenement M52/236, located at Mount Gould. Mount Gould is located within the Mid-West Region, approximately 150 km north-east of Meekatharra, north of the Murchison River.

Woodman Environmental Consulting (Woodman Environmental) previously conducted a desktop flora and vegetation study of the Mount Gould DSO Project area ('Project area'), and a detailed flora and vegetation survey of the Project area. The level of flora and vegetation survey for the Project area was a Level 2 Survey as defined by the Environmental Protection Authority Guidance Statement 51 (EPA 2004).

Atlas have identified exploration drill lines and access tracks that they propose to clear during late 2010 for an exploration drilling programme. The area to be cleared consists of approximately 7 km of proposed drill lines and 2.4 km of proposed access tracks. Atlas commissioned Woodman Environmental to undertake searching for conservation significant flora taxa within the areas of proposed disturbance to support a Programme Of Works ('POW') application for the drill programme. This report presents the results of this survey, with information in this report intended for use as supporting documentation for Atlas' POW application for the proposed exploration drilling, to be submitted to the Department of Minerals and Petroleum (DMP).

1.1 Background

A flora and vegetation survey of the Project area was undertaken by Woodman Environmental (2009) in Spring 2008. A total of 25 permanent quadrats were established over the Project area. A total of 94 discrete vascular flora taxa, from 28 families and 53 genera, were recorded from the Project area. Of these taxa, one introduced (weed) taxon was recorded. No Declared Rare Flora (DRF) taxa were recorded within the Project area. However, three taxa of conservation significance were recorded within the Project area (Table 1). The significance of the local population of each of these taxa at Mount Gould in terms of the taxon's regional conservation was also ranked and is also listed in Table 1.

Table 1: Conservation Significance of Flora Taxa Populations within the Project area

Taxon	Conservation Status	Conservation Significance Ranking (Woodman Environmental 2009)
Eremophila warnesii	P1	High
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	P1	High
Rhodanthe sphaerocephala	P1	High

Woodman Environmental (2009) identified seven Floristic Community Types (FCTs) and sub-types within the Mount Gould Project area. Most FCTs consisted of tall shrublands

dominated by *Acacia aneura*, however one FCT on the summit and slopes of Mount Gould consisted of a hummock grassland dominated by *Triodia melvillei*. The study did not identify any listed Threatened Ecological Communities (TECs) within the Project area. However, comparison of quadrat data from the Project area with datasets from the nearby Robinson Range and Jack Hills indicated that the FCTs described on the summit and upper slopes of Mount Gould, including the hummock grassland of *Triodia melvillei*, do not occur elsewhere, and are therefore of high regional conservation significance.

Mount Gould itself is included as part of the Robinson Range vegetation complexes (banded ironstone formation) Priority Ecological Community (PEC), which is listed as Priority 1. There is the potential that this PEC may be listed as a TEC in the future.

2. METHODS

All proposed drill lines and tracks provided to Woodman Environmental by Atlas Iron in GIS format(excluding Lines 28 – 33) were inspected by experienced botanists in the field from the 11th- 12th of August 2010. The areas inspected included 7 km of proposed drill lines and 2.4 km of proposed tracks surveyed to a width of 20 m. Lines 28 – 33 were not inspected as these lines were located in a cleared pit area and no vegetation was present.

During inspection of drill lines and proposed access track areas, any conservation significant flora taxa located at each pad or track location that could be practically left *in situ* were flagged with red and white flagging tape for avoidance, with GPS co-ordinates and number of individuals recorded. Individuals of these flora taxa that could not practically be avoided were also recorded and not flagged.

Calculations using GIS software were undertaken to determine the area of each FCT to be impacted. These calculations were based on the entire surveyed width of 20 m for both proposed drill lines and tracks being cleared.

3. RESULTS

3.1 Conservation Significant Flora

A total of two conservation significant flora taxa were recorded as occurring on drill lines and access tracks during the survey: *Eremophila warnesii* (P1) and *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) (P1). The results of the survey are summarised in Table 2. Appendix A presents the raw survey data, including information regarding location of conservation significant flora and recommended avoidance procedures for these flora taxa. Figure 1 displays locations of conservation significant flora in relation to the proposed drill lines and access tracks, including areas where avoidance of significant flora has been recommended in Appendix A. Counts of individuals presented in the 'Number Potentially to be Cleared' column in Table 2 and Appendix A are based on all drill lines and tracks provided by Atlas being cleared to the surveyed width of 20 m; these totals are therefore considered to be worst-case scenario, as it is unlikely that the entire surveyed area will require clearing. Final accurate totals of number of individuals to be cleared cannot be provided at this stage, as further information on the proposed clearing

footprint is required; the final totals of number of individuals to be cleared is also dependent on whether recommendations in Appendix A are accepted. Appendix B presents descriptions of conservation significance rankings (Smith 2010).

Table 2: Summary of Conservation Significant Flora Taxa to be Impacted and Flagged for Avoidance at Mount Gould, August 2010

Taxon	Drill Line Lines/Track	Number Potentially to be Cleared	Number Flagged for Avoidance
Eremophila warnesii	5	0	1
Eremophila warnesii	19	100	0
Eremophila warnesii	20	4	0
Eremophila warnesii	22	0	12
Eremophila warnesii	36	0	3
Eremophila warnesii	37	50	9
Eremophila warnesii	38	30	22
Eremophila warnesii	40	0	6
Eremophila warnesii	47	0	1
Eremophila warnesii	48	100	2
Eremophila warnesii	49	0	3
Eremophila warnesii	51	100	4
Eremophila warnesii	52	3	0
Eremophila warnesii	53	50	1
Eremophila warnesii	54	50	1
Eremophila warnesii	Track between 38-39	1	4
Eremophila warnesii	Track between 42-45	1	1
Eremophila warnesii	Track between 43-55	0	4
Eremophila warnesii	Track between 42-45 & Line 50	200	0
Total *Eremophila warnesii*		**689**	**74**
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	12	20	0
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	13	0	10
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	17	0	2
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	27	0	14
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	Track 1 (around summit of hill)	0	3
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	Track between 15-18	61	5
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	Track between 6-26	0	14
Total *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) (P1)		**81**	**48**

Eremophila warnesii (P1) is a low dense shrub to 0.5 m high, and is known from four WA Herbarium records: two from Yarlarweelor Station, one from Mount Clere Station and one from the western slopes of Mount Gould (DEC 2010b). It was noted as being abundant at one of these locations, however no information is available for the two remaining locations. Chinnock (2007) noted that the type population of this species is located on the summit of

Mount Gould, where it was found to occur in a narrow band. He also noted that this taxon is likely to be found on other hills in the area.

There are also locations of *E. warnesii* along the Meekathara - Mount Clere Road north of Meekathara, where it is common in places but relatively restricted. There are no other known locations of the taxon however it is poorly known and may be more widespread (Dr. Andrew Brown *pers. comm.*[1]).

E. warnesii was recorded within one large and one smaller population at Mount Gould by Woodman Environmental (2009), with a total of 36 locations recorded. The conservation significance of the local populations in terms of its regional conservation was given a ranking of 'High' due to: less than 10 populations of this taxon being currently known, and the local population being on the boundary of its known range (Woodman Environmental 2009).

During the current survey *E. warnesii* was recorded at a number of drill lines and tracks, with a total of 689 plants potentially to be cleared and 74 plants flagged for avoidance (Table 1).

Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743) (P1) is an erect shrub to 1 m. It is restricted to the Mount Gould area, with six WA Herbarium records, all from Mount Gould itself (DEC 2010b). The single population of this taxon at Mount Gould is the only known population, with a total of five locations recorded (Woodman Environmental 2009). The conservation significance of the local population in terms of its regional conservation was ranked 'High' due to it being the only known population.

This taxon was identified by Meissner *et al.* (2007) as potentially differing from other known variants of *H. gustafsenii*, with the phrase name *H. gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) erected in late 2008. It was also listed as Priority 1 at this time.

Numerous locations of *H. gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) were recorded during this survey. A total of 81 plants are located on areas proposed to be cleared and 48 plants have been flagged for avoidance (Table 1).

Rhodanthe sphaerocephala (P1) was previously recorded at Mount Gould by Woodman Environmental (2009), at two locations within FCT 3 (mapped on clay pans and clay flats). This taxon was not recorded on the drill lines or access tracks inspected; although the timing of the survey was not ideal for this taxon (flowering occurring in October), the habitat requirements for this taxon differs from the areas being targeted for drilling and therefore it is very unlikely that this taxon occurs on the drill lines and access tracks.

1-Andrew Brown: Coordinator of Threatened Flora, Species and Communities Branch, DEC

3.2 Floristic Community Types

Review of the proposed drill lines against the FCT mapping of the Mount Gould Project Area (Woodman Environmental 2009) has determined that three of the seven FCTs mapped within the Project area will potentially be impacted by the proposed drilling (Figure 1; Table 3). All of these FCTs were mapped on the lower slopes to crest of Mount Gould. These FCTs form part of the Priority 1 Mount Gould vegetation complexes (banded ironstone formation) PEC (DEC 2010a). Table 3 also presents the potential level of impact to each FCT in terms of area to be cleared (in hectares). Area totals are based on all drill lines and tracks provided by Atlas being cleared to the surveyed width of 20 m; these totals are therefore considered to be worst-case scenario, as it is unlikely that the entire surveyed area will require clearing. Final accurate areas of each FCT to be cleared cannot be provided at this stage, as further information on the proposed clearing footprint is required; the final areas of each FCT to be cleared are also dependent on whether recommendations in Appendix A are accepted. Appendix C presents descriptions of PEC conservation status rankings (DEC 2010a).

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Table 3: Floristic Community Types to be Impacted by the Proposed Mount Gould Exploration Drilling Programme

Floristic Community Type	Conservation Significance Ranking (Woodman Environmental 2009)	Floristic Community Type Description	Total Area Mapped (ha)	Area Potentially to be Impacted (ha)	Percentage of Mapped FCT Potentially to be Impacted
1	3	Open tall shrubland of *Acacia aneura* over sparse low shrubland of *Ptilotus obovatus* over open low forbland of *Goodenia tenuiloba*	196.73	0.87	0.44
4	5	Open tall shrubland or isolated shrubs of *Acacia aneura* over open to sparse mid shrubland of *Eremophila latrobei* and *Philotheca brucei* subsp. *cinerea* over open to sparse low shrubland and low tussock grassland of *Ptilotus obovatus* and *Cymbopogon ambiguus*	106.52	12.57	11.80
5	5	Open tall shrubland or isolated shrubs of *Acacia aneura* over open to sparse mid shrubland of *Eremophila latrobei* and *Philotheca brucei* subsp. *cinerea* over open to sparse low shrubland and low tussock grassland of *Ptilotus obovatus* and *Cymbopogon ambiguus*	27.65	5.26	19.02

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4. DISCUSSION AND CONCLUSIONS

The conservation significant flora taxa *Eremophila warnesii* (P1) and *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) (P1) have the potential to be impacted by the proposed drilling programme at Mount Gould. Both of these taxa are restricted in distribution, with the population of *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) at Mount Gould being the only known population. There is no current complete population census of either taxon at Mount Gould.

Of the five original locations of *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) (P1) recorded by Woodman Environmental (2009) at Mount Gould, four are in areas which will not be impacted by the proposed drilling programme. However, this is the only population of this taxon known, and therefore the conservation status of this taxon has the potential to be upgraded to DRF. The impact to 81 individuals of this highly restricted taxon has the potential to be a significant impact to the population at Mount Gould. The drill lines that will be affected include lines 12, 13, 27 and the track between lines 15 and 18. Appendix A presents comments noted at each drill line with regard to where clearing should be stopped and which drill lines are not to be cleared to avoid individuals of this taxon; Figure 1 presents the drill lines where clearing should be avoided.

There is a high level of potential impact to the number of *Eremophila warnesii* individuals, with 689 individuals potentially to be impacted (Table 1). The drill lines that will be affected are lines 19, 20, 21, 37, 39, 47, 48, 51, 52, 53, 54, the track between lines 38 and 39 and the proposed track to lines 48, 49 and 50 (Figure 1). Appendix A presents comments where clearing of drill lines should be stopped, and which drill lines should not be cleared; Figure 1 presents the drill lines where clearing should be avoided. The 2008 survey of Mount Gould recorded the majority of the population of this taxon on the northern slopes of Mount Gould (Woodman Environmental 2009), and these will not be impacted by the proposed drilling programme.

The FCTs which will be impacted by the proposed drilling are considered to have high conservation significance as they are not represented elsewhere or are restricted in the region, occur on landforms that are restricted in the region and are known to contain priority flora taxa (Woodman Environmental 2009). The FCTs also form part of a Priority 1 PEC and it is therefore important that any clearing of vegetation is kept to a minimum. A footprint of the size of the area to be cleared has not been accurately defined. In order to establish if clearing will significantly impact the conservation significance of this PEC, more detailed information on the areas to be cleared will need to be provided.

During this survey it was also noted that the vegetation on Mount Gould, in particular *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) (P1) individuals, were in poor condition, with many apparently dead individuals. When the FCT mapping was undertaken in spring 2008, the vegetation was in much better condition (Woodman Environmental 2009). Such changes are likely due to drought conditions over the past two

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years, and possibly grazing by kangaroos and feral goats. This reinforces the need to minimize, or avoid if practicable, any impacts to this taxon as a result of the proposed drilling, as the persistence of the population may also be threatened by these factors.

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5. RECOMMENDATIONS

The following recommendations are given for the proposed exploration drilling programme at Mount Gould:

- All machinery being used in the exploration drilling programme at Mount Gould should be clean and free of weeds and plant pathogens prior to arriving at site;
- All individuals of conservation significant flora flagged with red and white tape should be avoided during the clearing process where practicable;
- Clearing of vegetation should be limited to the surveyed drill lines and tracks and should only be undertaken when necessary, to ensure minimal impact to conservation significant flora and vegetation;
- Recommendations as per stopping of clearing on drill lines and tracks, altering tracks and not clearing some drill lines altogether should be undertaken as per Appendix A;
- Individuals of both *Eremophila warnesii* (P1), and in particular *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) (P1), should be avoided by the proposed drilling where practical to do so.
- If there is a requirement for any further clearing that was not surveyed by Woodman Environmental, the areas should be surveyed for conservation significant flora prior to clearing;
- Survey should be conducted using DGPS to undertake an accurate tally of the position and extent of clearing following completion of drilling operations;
- Rehabilitation of exploration areas should be conducted as soon as practical, following completion of drilling activities.

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Appendix A: Mount Gould Drill Line Survey Data and Recommendations

Drill Line/Track	Priority species	E	N	Number Potentially to be cleared	Number flagged for avoidance	Comments
Line 01	-	-	-	-	-	Not surveyed, in existing disturbance (pit)
Line 02	-	-	-	-	-	-
Line 03	-	-	-	-	-	-
Line 04	-	-	-	-	-	-
Line 05	*Eremophila warnesii*	533807	7146232		1	At northern end of line there is a population of *Eremophila warnesii* below the cliff face, this should not be impacted.
Line 06	-	-	-	-	-	-
Line 07	-	-	-	-	-	-
Line 08	-	-	-	-	-	-
Line 09	-	-	-	-	-	-
Line 10	-	-	-	-	-	-
Line 11	-	-	-	-	-	-
Line 12	*Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743)	533622	7145867	10	-	Recommended that drilling not occur south of the second GPS point as there is a large population of *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743)
		533633	7145843	10	-	
Line 13	*Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743)	533551	7145864	-	10	Recommended that drilling not be undertaken at southern end of this line as there is a large population of *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743)
Line 14	-	-	-	-	-	-
Line 15	-	-	-	-	-	-
Line 16	-	-	-	-	-	-
Line 17	*Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743)	533901	7146228		2	Plants are near a peg.
Line 18	-	-	-	-	-	-

Drill Line/Track	Priority species	E	N	Number Potentially to be cleared	Number flagged for avoidance	Comments
Line 19	*Eremophila warnesii*	533690	7146255	100	-	North of this GPS point are plants that will be impacted, recommended that drilling not be undertaken north of this GPS point
Line 20	*Eremophila warnesii*	533663	7146232	4	-	North of this GPS point are plants that will be impacted, recommended that drilling not be undertaken north of this GPS point
Line 21	-	-	-	-	-	-
Line 22	*Eremophila warnesii*	533584	7146207		12	Plants at northern end of line, recommended that clearing be stopped before this GPS point
Line 23	-	-	-	-	-	-
Line 24	-	-	-	-	-	-
Line 25	-	-	-	-	-	-
Line 26	-	-	-	-	-	Recommended that this line not be drilled, as track should not be cleared from line 27 to line 26 because of impacts to conservation significant flora
Line 27	*Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743)	533178	7146111	-	8	Recommended that this line not be drilled as there is a large population of *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743)
		533170	7146133	-	6	
Line 28	-	-	-	-	-	Not surveyed, in existing disturbance (pit)
Line 29	-	-	-	-	-	Not surveyed, in existing disturbance (pit)
Line 30	-	-	-	-	-	Not surveyed, in existing disturbance (pit)
Line 31	-	-	-	-	-	Not surveyed, in existing disturbance (pit)
Line 32	-	-	-	-	-	Not surveyed, in existing disturbance (pit)
Line 33	-	-	-	-	-	Not surveyed, in existing disturbance (pit)
Line 34	-	-	-	-	-	-
Line 35	-	-	-	-	-	-
Line 36	*Eremophila warnesii*	534077	7147039	-	2	-
		534101	7147048	-	1	
Line 37	*Eremophila warnesii*	534106	7147129	50		Recommended that no clearing occur east of the first GPS Point downslope, as large population of *Eremophila warnesii* here
		534078	7147119	-	3	
		534064	7147111	-	2	
		534061	7147101	-	4	

Drill Line/Track	Priority species	E	N	Number Potentially to be cleared	Number flagged for avoidance	Comments
Line 38	*Eremophila warnesii*	533990	7147110	-	2	Recommended that drilling not be undertaken east of second GPS Point. If drilling required, east of where this line intersects track between Line 38 and 39, use existing track as drill line. 30 *Eremophila warnesii* individuals will be impacted if existing track used; if not used, then 250+ *Eremophila warnesii* individuals will be impacted.
		534034	7147131	30	20	
Line 39	-	-	-	-	-	-
Line 40	*Eremophila warnesii*	534117	7147016	-	5	-
Line 40	*Eremophila warnesii*	534028	7146973	-	1	-
Line 41	-	-	-	-	-	-
Line 42	-	-	-	-	-	-
Line 43	-	-	-	-	-	-
Line 44	-	-	-	-	-	-
Line 45	-	-	-	-	-	-
Line 46	-	-	-	-	-	-
Line 47	*Eremophila warnesii*	534764	7146403	-	1	Recommended that drilling not occur at this GPS point
Line 48	*Eremophila warnesii*	534716	7146628	-	2	Recommended that no clearing occurs south of second GPS point to avoid impact to individuals
		534735	7146621	100	-	
Line 49	*Eremophila warnesii*	534762	7146628	-	1	-
		534782	7146638	-	1	
		534790	7146639	-	1	
Line 50	-	-	-	-	-	-
Line 51	*Eremophila warnesii*	534726	7146779	100	4	Recommended that no drilling occur north of this GPS point as more plants are located here
Line 52	*Eremophila warnesii*	534759	7146811	3		Cannot avoid plants, recommended that no drilling occur at the very northern end of the line
Line 53	*Eremophila warnesii*	534808	7146800	50	1	Recommended that no drilling occur north of this GPS point, as plants will be impacted
Line 54	*Eremophila warnesii*	534857	7146827	50	1	Recommended that no drilling occur north of this GPS point, as plants will be impacted
Line 55	-	-	-	-	-	-

Drill Line/Track	Priority species	E	N	Number Potentially to be cleared	Number flagged for avoidance	Comments
Track 1 (around summit of hill)	*Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743)	534475	7146305	-	1	-
		534483	7146296	-	1	
		534498	7146280	-	1	
Track between 15-18 (Track 5)	*Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743)	533566	7145857	1	3	Access between Lines 11 and 13 intersects a large population of *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743). Access must divert north around GPS co-ordinate
		533577	7145854	-	2	
		533599	7145862	20	-	
		533646	7145865	40	-	
Track between 38-39	*Eremophila warnesii*	534030	7147120	-	2	Recommended that access stay to the west of flagged individuals at this point as more individuals upslope
Track between 38-39	*Eremophila warnesii*	534021	7147123	1	-	-
		534020	7147133	-	2	
Track between 42-45 (Track 2)	*Eremophila warnesii*	534600	7146694	-	1	-
		534624	7146642	1	-	
Track between 43-55 (Track 4)	*Eremophila warnesii*	534624	7146684	-	1	-
		534679	7146693	-	1	
		534709	7146694	-	2	
Track between 6-26	*Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743)	533290	7146096	-	1	Recommended that the section of track between lines 25 and 27 not be cleared because numerous individuals will be impacted
		533220	7146117	-	1	
		533194	7146119	-	8	
		533153	7146122	-	4	
Track between track between 42-45 and Line 50	*Eremophila warnesii*	534743	7146599	200		Recommended that this track not be cleared; to avoid impacts to individuals, use a track from the northern end of each line, as no individuals were recorded there
Totals	***Eremophila warnesii***			**689**	**74**	
	***Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743)**			**81**	**48**	

Appendix B: Definitions of Conservation Status Codes (Smith 2010)

R: Declared Rare Flora – Extant Taxa

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.

X: Declared Rare Flor a – Presumed Extinct Taxa

Taxa which have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or of which all known wild populations have been destroyed more recently, and have been gazetted as such.

1: Priority One – Poorly Known Taxa

Taxa which are known from one or a few (generally <5) populations which are under threat, either due to small population size, or being on lands under immediate threat, e.g. road verges, urban areas, farmland, active mineral leases, etc., or the plants are under threat, e.g. from disease, grazing by feral animals, etc. May include taxa with threatened populations on protected lands. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.

2: Priority Two – Poorly Known Taxa

Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.

3: Priority Three – Poorly Known Taxa

Taxa which are known from several populations, and the taxa are not believed to be under immediate threat (i.e. not currently endangered), either due to the number of known populations (generally >5), or known populations being large, and either widespread or protected. Such taxa are under consideration for declaration as 'rare flora' but are in need of further survey.

4: Priority Four – Rare Taxa

Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5-10 years.

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Appendix C: Definitions of Priority Ecological Communities (DEC 2010a)

3. DEFINITIONS AND CRITERIA FOR PRIORITY ECOLOGICAL COMMUNITIES

PRIORITY ECOLOGICAL COMMUNITY LIST

Possible threatened ecological communities that do not meet survey criteria or that are not adequately defined are added to the Priority Ecological Community Lists under Priorities 1, 2 and 3. These three categories are ranked in order of priority for survey and/or definition of the community, and evaluation of conservation status, so that consideration can be given to their declaration as threatened ecological communities. Ecological Communities that are adequately known, and are rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list, are placed in Priority 4. These ecological communities require regular monitoring. Conservation Dependent ecological communities are placed in Priority 5.

Priority One: Poorly-known ecological communities

Ecological communities with apparently few, small occurrences, all or most not actively managed for conservation (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) and for which current threats exist. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.

Priority Two: Poorly-known ecological communities

Communities that are known from few small occurrences, all or most of which are actively managed for conservation (e.g. within national parks, conservation parks, nature reserves, State forest, unallocated Crown land, water reserves, etc.) and not under imminent threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.

Priority Three: Poorly known ecological communities

(i) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or:
(ii) communities known from a few widespread occurrences, which are either large or within significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or;
(iii) communities made up of large, and/or widespread occurrences, that may or not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes.

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Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.

Priority Four: Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring.

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

(b) Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.

(c) Ecological communities that have been removed from the list of threatened communities during the past five years.

Priority Five: Conservation Dependent ecological communities

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

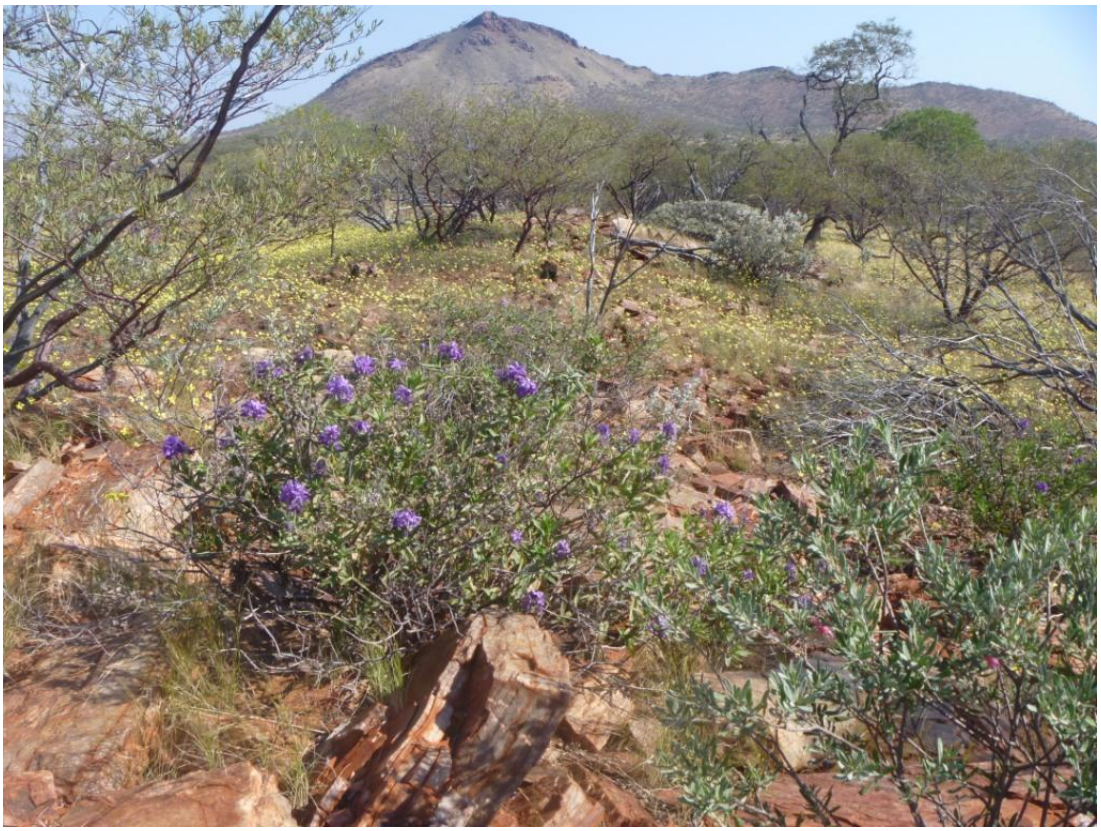
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APPENDIX 5: LOCAL AND REGIONAL SIGNIFICANT FLORA ASSESSMENT AND REGIONAL VEGETATION REVIEW (WOODMAN 2012)

ATLAS IRON LIMITED

MOUNT GOULD DSO PROJECT

LOCAL AND REGIONAL SIGNIFICANT FLORA ASSESSMENT AND REGIONAL VEGETATION REVIEW



April 2012

woodmanenvironmentalconsulting

A.C.N. 088 055 903

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Report Reference: Atlas11-23-01

Cover Photo: *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) (P1) with Mount Gould in the background (Woodman Environmental)

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EXECUTIVE SUMMARY

Atlas Iron Limited (Atlas) is proposing to conduct preliminary exploration drilling for iron ore as part of its Mount Gould Direct Shipping Ore (DSO) Project, within tenement M52/236, located at Mount Gould. Mount Gould is a large ironstone hill located on the privately leased Mount Gould Pastoral Station within the Mid-West Region, approximately 150 km north-west of Meekatharra, just north of the Murchison River.

Previous surveys of the Mount Gould Project area (Project area) identified populations of 4 conservation significant flora taxa within the Project area, as listed below:

* *Eremophila warnesii* (P1)
* *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) (P1)
* *Rhodanthe sphaerocephala* (P1)
* *Tribulus adelacanthus* (P3)

The populations of *E. warnesii* and *H. gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) are located on and near proposed exploration drill lines on Mount Gould, and could potentially be significantly impacted.

The vegetation on Mount Gould was listed as a Priority Ecological Community (PEC) in 2009, as Mount Gould Vegetation complexes (Priority 1). This ranking remains current. Based on current knowledge, the vegetation on Mount Gould, particularly near the summit, is not known from elsewhere, and hence could significantly constrain future development in the Project area.

As exploration drilling is proposed, with the potential for mining of the iron ore resource to also occur, Atlas commissioned Woodman Environmental Consulting Pty Ltd ('Woodman Environmental') to accurately map the distribution and record abundance of all conservation significant flora taxa within the Project area, to allow for impacts to these taxa as a result of proposed drilling or mining to be accurately assessed. Woodman Environmental were also commissioned to conduct a regional search for further populations of *E. warnesii* and *H. gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743), to provide additional contextual data when assessing any future proposed impacts to these taxa, and to conduct a review of relevant literature and available data to determine targets for survey for additional areas of the vegetation occurring on Mount Gould.

Both *E. warnesii* and *H. gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) were found to be relatively common in the Project area, particularly on Mount Gould. *E. warnesii* was generally restricted to the northern upper slopes of Mount Gould, while *H. gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) was most common on the steep lower slopes of Mount Gould, occasionally extending to the mid slopes, however numerous individuals were also somewhat unexpectedly recorded on gently sloping stony areas at the base of the western side of Mount Gould. *Tribulus adelacanthus* was also found to be relatively common in the Project area, being recorded at numerous locations, however was generally restricted to the gently sloping stony areas at the base of Mount Gould. *R. sphaerocephala* was recorded at only 4 locations in 2011; all were new locations, with the species not recorded 2 historical known locations.

Both *E. warnesii* and *H. gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) (both P1) were recorded during regional survey for these taxa. *E. warnesii* was recorded from 4 discreet areas during the regional survey, which are considered to represent 4 populations. These populations were distributed over a distance of approximately 60 km east-west, and 6 km north-south. One population is an extension of the population recorded within the Project area, with the remaining 3 populations recorded on Yarlarweelor Station. A total of 780 individuals were recorded across the 4 populations (excluding individuals within the Project area). *H. gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) was recorded only from the Mount Gould area during the regional survey, where 2 populations were identified (Figure 4b). One population is an extension of the population recorded within the Project area, with the second population located approximately 2 km north of Mount Gould. A total of 689 individuals were recorded across the 2 populations (excluding individuals within the Project area).

The regional populations of *E. warnesii* and *H. gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) taxa are very small compared to the population in the Project area. Therefore, if a large proportion of the population in the Project area were to be impacted in the future, the regional impacts to the taxon would still be considered high based on the results of this survey, and further regional survey may be required to prove the existence of other large populations. However, it is considered that there is a strong likelihood that there are significant numbers of individuals that were not recorded during this survey because of time constraints; a preliminary review of aerial photography in the vicinity of the recorded populations indicates that large areas of appropriate habitat occur. These habitat areas would be considered a primary target for further regional survey if required.

The review of information relating to the Mount Gould vegetation complexes PEC demonstrates that there is evidence that the vegetation present on Mount Gould as a whole differs from those on nearby ranges. A strong trend towards dissimilarity of specific vegetation units between Mount Gould and other nearby ranges has also been demonstrated. This indicates that the Mount Gould vegetation complexes PEC as currently defined is unlikely to occur anywhere else, as the vegetation complexes referred to in the PEC description are statistically different in terms of species composition from other nearby ranges. However, it is likely that specific vegetation units that form part of the vegetation complexes occur elsewhere, although this is unlikely to extend to the vegetation units that occur at the summit of Mount Gould, including vegetation units dominated by *Triodia melvillei*. These have been demonstrated to be dissimilar to superficially similar vegetation units on nearby ranges.

It is therefore important that the validity of further regional survey for the Mount Gould vegetation complexes PEC be discussed with the Department of Environment and Conservation prior to any survey being conducted. Further survey would only be worthwhile if the demonstration of occurrences of specific vegetation units elsewhere in the region is considered by the DEC to be appropriate when considering impacts within the Project area in a regional context. If this is not considered appropriate, then minimising disturbance to Mount Gould remains the only option to minimise impacts to the Mount Gould vegetation complexes PEC.

The following recommendations are given:

1. Conservation significant flora taxa located within the Project area should be avoided where possible during future proposed exploration and mining activities, particularly the highly restricted *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) and *Eremophila warnesii* (both P1)

2. A desktop impact assessment should be undertaken prior to any proposed future exploration and mining activities using data collected during this survey, to quantify local and regional impacts to conservation significant flora taxa, and determine whether further regional survey for conservation significant flora taxa is required.

3. The DEC should be engaged in discussions regarding further survey for the Mount Gould vegetation complexes PEC, to determine the validity of further survey, and if deemed valid, to agree on appropriate methods for further survey.

1. INTRODUCTION

1.1 Project and Survey Background

Atlas Iron Limited (Atlas) is proposing to conduct preliminary exploration drilling for iron ore as part of its Mount Gould Direct Shipping Ore (DSO) Project, within tenement M52/236, located at Mount Gould. Mount Gould is a large ironstone hill located on the privately leased Mount Gould Pastoral Station within the Mid-West Region, approximately 150 km north-west of Meekatharra, just north of the Murchison River. Woodman Environmental Consulting Pty Ltd ('Woodman Environmental') conducted a detailed flora and vegetation survey of the Project area in 2008 (Woodman Environmental 2009), as well as a targeted conservation significant flora survey of a number of proposed exploration drill lines in 2010 (Woodman Environmental 2010). A portion of the Project area was also sampled by the Department of Environment and Conservation (DEC) as part of a survey of Mount Gould and the Robinson Range (located 80 km east of Mount Gould) in 2006 (Meissner *et al.* 2009).

The above surveys identified populations of 4 conservation significant flora taxa within the Project area, as listed below:

* *Eremophila warnesii* (P1)
* *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) (P1)
* *Rhodanthe sphaerocephala* (P1)
* *Tribulus adelacanthus* (P3)

It is worthy of note that *Tribulus adelacanthus* (P3) was not listed as a Priority flora taxon at the time of survey by Woodman Environmental in 2008, and therefore was not reported as such (Woodman Environmental 2009). This taxon has been recently elevated to Priority 3 status, likely because there are only a handful of collections lodged at the W.A. Herbarium (DEC 2012a). Appendix A presents conservation codes for Western Australian flora (DEC 2012a).

Of the taxa listed above, the populations of *E. warnesii*, *H. gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) and *R. sphaerocephala* in the Project area were considered to be of High significance to the overall conservation significance of each taxon (Woodman Environmental 2009). This is still considered an accurate assessment; all taxa are known from few records with little information on abundance (DEC 2012a), with *H gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) only known from the Project area. The population of *T. adelacanthus* in the Project area was not assessed for significance by Woodman Environmental (2009), however it is considered that this population is significant with regard to the overall conservation significance of the taxon, as currently only 4 confirmed collections are lodged at the W.A. Herbarium (DEC 2012a).

In terms of potential impacts from future drilling or mining, *R. sphaerocephala* is only known from clay pans on the western boundary of the Project area, while *T. adelacanthus* is only known from stony undulating areas in the north-east corner of the Project area. It is therefore considered that neither of these taxa is likely to be significantly impacted by future mining or drilling. However, the populations of *E.*

warnesii and *H. gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) are located on and near proposed exploration drill lines on Mount Gould, and could potentially be significantly impacted.

Woodman Environmental (2009) identified seven Floristic Community Types (FCTs) (equivalent to a vegetation unit) and sub-types within the Project area. Most FCTs consisted of tall shrublands dominated by *Acacia aneura,* however one FCT on the summit and slopes of Mount Gould consisted of a hummock grassland dominated by *Triodia melvillei*. The study did not identify any listed Threatened Ecological Community (TEC) within the Project area. However, comparison of quadrat data from the Project area with datasets from the nearby Robinson Range and Jack Hills indicated that the FCTs described on the summit and upper slopes of Mount Gould, including the spinifex vegetation unit of *T. melvillei*, do not occur elsewhere, and are therefore of high regional conservation significance. This was supported by Meissner *et al.* (2009), who also described several FCTs at Mount Gould, and also noted that the spinifex vegetation unit near the summit of Mount Gould differed from superficially similar vegetation units from the Robinson Range and Jack Hills.

The vegetation on Mount Gould was listed as a Priority Ecological Community (PEC) in 2009, as Mount Gould Vegetation complexes (Priority 1) (DEC 2009). This ranking remains current (DEC 2011a). Based on current knowledge, the vegetation on Mount Gould, particularly near the summit, is not known from elsewhere, and hence could significantly constrain future development in the Project area.

As exploration drilling is proposed, with the potential for mining of the iron ore resource to also occur, Atlas commissioned Woodman Environmental Consulting Pty Ltd ('Woodman Environmental') to accurately map the distribution and record the abundance of all conservation significant flora taxa within the Project area, to allow for impacts to these taxa as a result of proposed drilling or mining to be accurately assessed. A regional search for further populations of the conservation significant flora taxa that could potentially be significant impacted by future exploration drilling and mining (*E. warnesii* and *H gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) was commissioned, to provide additional contextual data when assessing any future proposed impacts to these taxa. Woodman Environmental were also commissioned to conduct a review of relevant literature and available data to determine targets for survey for additional areas of the vegetation occurring on Mount Gould, and prepare a plan to undertake such a survey. This survey would provide additional contextual data when assessing any future proposed impacts to the PEC.

1.2 Objectives

The objectives of this survey and report are:

- Map and census all conservation significant flora taxa previously recorded in the Project area, and any other known or potential conservation significant flora taxa not previously recorded in the Project area;
- Review DEC databases, publicly available flora survey documents and any other relevant datasets to identify likely targets for survey for additional populations of the Priority flora taxa *Eremophila warnesii* and *Halgania gustafsenii* var.

Murchison (R. Meissner & B. Bayliss 743) (both P1) in the region surrounding the Project area;
- Survey identified likely areas in the region for the above conservation significant flora taxa;
- Prepare a report and maps presenting the results of the surveys in a format suitable for use in preparing impact assessments for future exploration and mining activities;
- Review Government databases, publicly available vegetation survey documents and other relevant datasets to identify likely targets for survey for additional areas of the vegetation units making up the Mount Gould Vegetation complexes PEC; and
- Prepare a proposed survey plan (as part of the aforementioned report) to undertake additional regional mapping of potential areas of vegetation equivalent to the Mount Gould Vegetation complexes PEC, based on information gained from the review above.

2. METHODS

2.1 Project Area Survey for Conservation Significant Taxa

Survey of the Project area for conservation significant flora was undertaken by experienced botanists from Woodman Environmental over 2 visits in 2011, from the 8th – 12th of August, and from the 12th – 16th September. Flora collecting permits for the botanists are listed below:

David Coultas: SL009406 (flora collecting permit); 149-1011 (DRF collecting permit)
Alison Saligari: SL009407 (flora collecting permit); 153 1011 (DRF collecting permit)
John Grantham: SL009434 (flora collecting permit)
Neal Henshaw: SL009410 (flora collecting permit)
Bethea Loudon: SL009414 (flora collecting permit); 64-1112 (DRF collecting permit)
Lisa McFarlane: SL009435 (flora collecting permit)

Prior to survey, a review of potential appropriate habitat areas for *Eremophila warnesii*, *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) and *Tribulus adelacanthus* was undertaken, with potential appropriate habitat determined using known locations of these taxa, as well as topographical and soil characteristics. Potential appropriate habitat areas were then traversed on foot in a grid pattern, with grid lines 30 m apart and varying in direction depending on the topography of the habitat. This distance was deemed desirable in terms of both time efficiency and data quality; *E. warnesii* and *H. gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) are shrubs that can usually be seen for some distance, however the terrain in the Project area is steep and undulating, meaning that in some instances visibility was restricted either side of the walked line, and hence lines were required to be relatively close together. *T. adelacantus* is also a small herb that can only be seen from relatively short (approximately 15 m) distances away. As *R. sphaerocephala* is only known from claypans on the eastern boundary of the Project area, only clay pan areas were targeted for searching for this taxon. All clay pan areas were inspected on foot, however because of the very bare and open nature and generally small size of the clay pans, a grid pattern was not followed; rather, all patches of ephemeral taxa seen were inspected.

Areas traversed during the survey are displayed on Figure 1. Approximately 370 ha of the Project area was inspected.

GPS co-ordinates of each Priority flora taxon individual, or clump of individuals when numerous individuals occurred within a few metres of each other, were recorded, along with the number of individuals occurring at the GPS co-ordinate. Any further taxa encountered that were considered to possibly represent a conservation significant flora taxon were also recorded in this fashion, with specimens collected for identification at the W.A. Herbarium. All conservation codes were checked for currency using the DEC's *Florabase* online database (DEC 2012a), as this contains the most up-to-date information on the conservation status of all taxa in Western Australia.

2.2 Regional Survey for Conservation Significant Taxa

Initially, all available existing data on the biology, habitat preference and known locations of *Eremophila warnesii* and *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) was sourced. This included obtaining specimen information and locality details from the W.A. Herbarium's specimen database and the DEC's Declared Endangered Flora (DEFL) database (DEC 2011b) (Appendix B). All locations of these taxa obtained were then overlayed on aerial photography of the region surrounding the Project area. The locations were then reviewed together with habitat preference information, to determine prospective locations for targeted searches. Other factors considered when selecting prospective locations for searches included proximity of access tracks, land tenure (e.g. pastoral station, nature reserve, Aboriginal reserve) and the presence of active mining or mineral exploration, as this could restrict access.

Targeted searches were undertaken by experienced botanists from Woodman Environmental from the 30th August to the 1st September 2011. Flora collecting permits for the botanists are listed below:

Bethea Loudon: SL009414 (flora collecting permit); 64-1112 (DRF collecting permit)
Kim Kershaw: SL009404 (flora collecting permit); 150-1011 (DRF collecting permit)

Attempts were made to visit as many of the areas identified as prospective prior to the field survey as possible, with further refinement of search areas undertaken in the field, based on factors such as topography and substrate. Most areas accessed were traversed on foot, with spacing of personnel dependent on factors such as density of vegetation and topography. Searching was also undertaken from the vehicle where appropriate. Figure 2 displays areas searched during the survey. Any populations discovered were recorded using similar methods to those outlined in Section 2.1, with voucher specimens collected at each population for lodgement at the W.A. Herbarium. The limit of any populations discovered was defined where possible, however, due to time constraints, this was not possible at all locations. If no individuals were found at known historical locations, attempts were made to survey any habitat in the vicinity (i.e. within approximately 500 m) of the locations, however this was also dependent on time constraints.

2.3 Limitations of Survey

The timing of the survey coincided with the peak flowering period for most taxa within the region (including both taxa targeted as part of regional searches), and is therefore considered to have been an appropriate survey time. The Mount Gould region is also likely to have received reasonable rainfall in the lead-up to the survey; Meekatharra, the nearest meteorological station to the Project area, received approximately 35 mm of rain in July, with a further 27 mm falling in August prior to the survey (Bureau of Meteorology 2011a). This is above the long-term average for both months (22 mm and 11.5 mm respectively) (Bureau of Meteorology 2011b). This resulted in the vegetation being in excellent condition, with all conservation significant taxa either in flower or at least in good condition for identification.

Because of time constraints, regional survey was generally concentrated on known locations of *Eremophila warnesii* and *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743), and on hills in the immediate vicinity of the Project area, which were considered the most prospective area for populations of the targeted conservation significant taxa to be located. Access was sought and granted to pastoral stations on which known locations of the above taxa and nearby prospective hills and ranges, with a number of tracks and roads identified and utilised. However, there were still significant prospective areas of ranges that could not be accessed in the time allocated for the survey. The large distances between known locations, and the difficulty in accessing several locations, also meant that limited time could be spent searching at each location.

Botanists from Woodman Environmental have had previous experience at Mount Gould, and were familiar with all conservation significant taxa known from the Project area prior to this survey. However, known locations of each taxon were visited prior to conducting the survey, to re-familiarise with the field appearance of each taxon. The botanists were therefore adequately experienced and skilled to undertake the survey.

2.4 Review of Mount Gould Vegetation Complexes PEC Information

As the description of the Mount Gould PEC specifically refers to vegetation complexes on Mount Gould, all publicly available relevant reports relating to vegetation units at and in the vicinity of Mount Gould were sourced and reviewed, to gain an understanding of the composition and distribution of these vegetation units, and hence identify areas potentially containing equivalent vegetation units to those of Mount Gould. The following reports were reviewed:

- Flora and Vegetation of Banded Iron Formations of the Yilgarn Craton: Jack Hills (Meissner & Caruso 2008);
- Flora and Vegetation of the Banded Iron Formation of the Yilgarn Craton: Robinson Ranges and Mount Gould (Meissner *et al*. (2009);
- Review of Differences in Communities on the Jack Hills Project Area (Mattiske Consulting Pty Ltd 2010);
- Report for Jack Hills – *Triodia melvillei* Community Assessment (GHD 2009);

- Patterns of Plant Diversity in Ironstone Ranges in Arid South Western Australia (Gibson *et al.* 2012);
- Vegetation units of the Ironstone Ranges of South Western Australia: Hotspots for Plant Diversity and Mineral Deposits (Gibson *et al.* 2010);
- Flora and Vegetation of the Jack Hills (Mattiske Consulting Pty Ltd 2005).

Section 3.3 provides a summary of current information regarding the vegetation complexes on Mount Gould, and details potential future survey based on this information.

3. RESULTS

3.1 Project Area Survey for Conservation Significant Taxa

All conservation significant flora taxa listed in Section 1.1 were recorded in the Project area during this survey. A summary of the results of this survey, with respect to each taxon, is presented in Table 1 below. Figures 3a-d displays point locations of each taxon, with these locations also presented in Appendix C. There were no additional conservation significant taxa recorded in the Project area during this survey.

Both *Eremophila warnesii* and *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) were found to be relatively common in the Project area, particularly on Mount Gould. *E. warnesii* was generally restricted to the northern upper slopes of Mount Gould, however several small patches of individuals were found on mid to lower slopes (Figure 3a). It often occurred at high densities over relatively large areas. *H. gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) was most common on the steep lower slopes of Mount Gould, occasionally extending to the mid slopes, however numerous individuals were also somewhat unexpectedly recorded on gently sloping stony areas at the base of the western side of Mount Gould (Figure 3b). This taxon also grew in relatively high densities on the lower slopes of Mount Gould, however occurred as scattered individuals on the gently sloping stony areas at the base of Mount Gould.

As for *E. warnesii* and *H. gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743), *Tribulus adelacanthus* was found to be relatively common in the Project area, being recorded at numerous locations, however was generally restricted to the gently sloping stony areas at the base of Mount Gould (Figure 3d). *R. sphaerocephala* was recorded at only 4 locations in 2011; all were new locations, with the species not recorded at the 2 known locations (previously recorded in 2008 (Woodman Environmental 2009)). As per the locations recorded in 2008, all 4 new locations were in clay pans (Figure 3c).

The populations of all taxa were generally considered to be healthy, however numerous dead *E. warnesii* individuals were noted, potentially related to previous drought stress as identified by Woodman Environmental (2010). No impacts as a result of grazing by stock or other herbivores (native or introduced) were noted.

Table 1: Summary of Results of Survey of Project Area, 2011

Taxon	Conservation Code	Total Number of Locations	Total Number of Individuals	Relative Abundance and Distribution in Project Area
Eremophila warnesii	P1	327	13,339	Common, mostly restricted to northern slopes (predominantly upper slopes) of Mount Gould
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	P1	1,028	12,833	Common; restricted to the north-eastern corner of Project area
Rhodanthe sphaerocephala	P1	4	20	Rare, restricted to clay pans on the western edge of the Project area
Tribulus adelacanthus	P3	183	2,126	Common, restricted to lower slopes of Mount Gould, and undulating stony areas in the north-eastern part of the Project area

3.2 Regional Survey for Conservation Significant Taxa

Both *Eremophila warnesii* and *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) (both P1) were recorded during regional survey for these taxa. Table 2 below summarises the results of the regional survey, while each taxon is discussed in detail below. Point locations of each taxon are presented in Appendix C, and are displayed on Figures 4a-b.

Table 2: Summary of Results of Regional Survey for *Eremophila warnesii* and *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743), 2011

Taxon	Conservation Code	Approximate Number of Populations Recorded	Total Number of Locations	Total Number of Individuals
Eremophila warnesii	P1	4	15	780
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	P1	2	75	689

E. warnesii was recorded from 4 discreet areas during the regional survey, which are considered to represent 4 populations (Figure 4a). These populations were distributed over a distance of approximately 60 km east-west, and 6 km north-south. One population is an extension of the population recorded within the Project area, which was originally identified in 1993 (DEC 2012a). The remaining 3 populations were recorded on Yarlarweelor Station; 1 was located at a known record of this taxon, a second was located in the vicinity of the same known record, with the final population located in the vicinity of another known record of this taxon, however not at the given coordinates of the record (Figure 4a). A further 3 of the 4 remaining known records of this taxon were visited, however no individuals were identified at these locations; this is discussed in Section 4.1. The remaining known location was determined to be potentially erroneous; this is also discussed further in Section 4.1.

A total of 780 individuals were recorded across the 4 populations (excluding individuals within the Project area). The 3 populations on Yarlarweelor Station are relatively small, with less than 120 individuals in each; however this may not represent the total extent of the populations, as only individuals in the vicinity of access tracks were counted. The population on Mount Gould is by far the largest (in excess of 13,000 individuals), however the majority of the population is in the Project area, with the proportion outside of the Project consisting of approximately 550 individuals.

E. warnesii was recorded on 2 widely different habitat types during the survey. The population in and just outside the Project area mostly occurs on skeletal soils on the steep rocky ironstone slopes of Mount Gould, where dense patches of individuals frequently occur. However, the remaining 3 populations on Yarlarweelor Station occur in minor drainage lines or on low floodplains, generally on deeper sandy clay loam soils, with individuals also generally more scattered. All populations were noted as having numerous dead individuals, potentially related to previous drought stress,

however were considered to be in healthy condition overall, with no signs of impact from grazing by stock or other herbivores observed.



Plate 1: *Eremophila warnesii* (P1), Yarlarweelor Station (Photos: Woodman Environmental)

H. gustafsenii var. Murchison (R. Meissner & B. Bayliss 743) was recorded only from the Mount Gould area during the regional survey, where 2 populations were identified (Figure 4b). One population is an extension of the population recorded within the Project area, with the second population located approximately 2 km north of Mount Gould. A total of 689 individuals were recorded across the 2 populations (excluding individuals within the Project area). The population north of Mount Gould is relatively small, with 191 individuals recorded; this may not represent the total extent of the population, as it occurs on a linear ridge that was not completely surveyed because of time constraints, however it is not expected that a large number of individuals would occur on the unsurveyed part of the ridge. The population on Mount Gould is by far the largest (in excess of 12,800 individuals), however the majority of the population is in the Project area, with the proportion outside of the Project consisting of approximately 498 individuals. All individuals were recorded on stony areas; the majority of individuals occur on the steep foot and mid slopes of Mount Gould, however a significant number occur on undulating stony areas, including low ridges. All populations were noted as being in healthy condition overall, with no signs of impact from grazing by stock or other herbivores observed.

Searching for this taxon was undertaken at the very northern end of the Jack Hills, namely on Mount Taylor, approximately 13 km south of Mount Gould. A collection of

a taxon thought to be *H. gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) was made on Mount Taylor, however this was subsequently identified as *H. gustafsenii* var. *gustafsenii* ms by W.A. Herbarium botanist Steve Dillon. No other populations were identified, including while conducting searches for *E. warnesii.* According to W.A. Herbarium and DEFL records, this taxon has previously only been collected from Mount Gould; the co-ordinates for 1 record plot just to the west of Mount Gould near the Mount Gould lock-up (Figure 4b), however the locality details stipulate 'Mount Gould', and therefore the co-ordinates are likely to be erroneous. A review of aerial photography also indicates that the co-ordinates for this record plot on a low floodplain (Figure 4b), which is unlikely to be suitable habitat, given all other individuals were recorded on stony areas. The location of this record was therefore not visited.



Plate 2: *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) (P1) (Photos: Woodman Environmental)

Additionally, further locations of *Tribulus adelacanthus* were also recorded during the regional survey, within the vicinity of Mount Gould. Point locations are presented in Appendix C.

3.3 Review of Mount Gould Vegetation Complexes PEC Information

The review of the reports listed in Section 2.4 has demonstrated that a relatively large amount of survey of the vegetation present on Mount Gould has already occurred, and also on nearby ironstone ranges of similar elevation and morphology to Mount Gould. This includes Woodman Environmental's survey of the Project area (Woodman

Environmental 2009) and the DEC's survey of Mount Gould and the Robinson Range (Meissner *et al.* 2009). Additionally, Mattiske Consulting Pty Ltd (2005) established quadrats on Mount Gould as part of regional surveys to provide regional context for vegetation units on the Jack Hills, for the Jack Hills Iron Ore Project. GHD (2009) also conducted survey on Mount Gould, as well as several other nearby ranges, as part of regional surveys for *Triodia melvillei*-dominated vegetation units for the Jack Hills Expansion Project.

Several studies have assessed the similarity of vegetation units across Mount Gould, the Jack Hills and the Robinson Range by comparing the similarity of individual quadrats to each other. According to the studies of both Meissner *et al.* (2009) and Woodman Environmental (2009), the vegetation units present on Mount Gould, particularly vegetation units at the summit, were dissimilar from those recorded on the Robinson Range. Both studies statistically analysed quadrat data from both Mount Gould and the Robinson Range, using the same method (classification of quadrats based on similarity in perennial species composition only). And while both studies found a trend towards similarity of lower slope vegetation units between Mount Gould and the Robinson Range, both studies found that several summit vegetation units were restricted to either Mount Gould or the Robinson Range based on quadrat groupings, including *Triodia melvillei*-dominated vegetation units. Further to this, Meissner *et al.* (2009) also found that the soil chemistry, surface rockiness and slope that the *Triodia melvillei*-dominated vegetation units on Mount Gould and the Robinson Range occurred on was very different, despite the similar topographical positions of the vegetation units.

Woodman Environmental (2009) also statistically analysed quadrat data from both Mount Gould and the Jack Hills, and demonstrated a similar trend, with 3 vegetation units described from the summit and slopes of Mount Gould, including a *Triodia melvillei*-dominated vegetation unit, appearing dissimilar from vegetation units present on the summits of the Jack Hills, with lower slope vegetation units again appearing similar. This trend was also noted by Meissner *et al.* (2009), however it was also noted that the analysis comparing Mount Gould and Jack Hills data was preliminary.

The trend towards dissimilarity between vegetation on ironstone ranges has also been documented by Gibson *et al.* (2012), who analysed species composition data from 24 ironstone ranges in arid south western Australia, including Mount Gould, the Robinson Range and the Jack Hills. They found that while ranges located closer together tended to be more similar to each other in terms of species composition, all 24 ranges were significantly different in terms of species composition (analysis was conducted using Permanova). This dissimilarity appears to be largely driven by the rapid turnover of regional perennial species pools (Gibson *et al.* 2012). A similar result was documented by Gibson *et al.* (2010), albeit on a smaller scale, with the study demonstrating high species composition change between 4 ironstone ranges located within 60 km of each other in the Goldfields area of Western Australia. The study found that much of this compositional change was not explained by climate and geology, which often drive compositional change, as all the ranges were similar in these respects. The compositional change is likely to be a result of historical biogeography and stochastic processes, in combination with other ecological factors.

The above results are contradicted to an extent by that of both Mattiske Consulting Pty Ltd (2005) and Mattiske Consulting Pty Ltd (2010). Mattiske Consulting Pty Ltd

(2005) mapped the same *Triodia melvillei*-dominated vegetation units on both Mount Gould and the Jack Hills. However, it is apparent that the sampling on Mount Gould was limited (several quadrats), and that the vegetation units were mapped based on structure rather than species composition, as no mention is made of any statistical analysis. This is therefore not considered to constitute sufficient evidence that the vegetation units on Mount Gould are present on the Jack Hills.

Mattiske Consulting Pty Ltd (2010) also determined that there were some similarities between *Triodia melvillei*-dominated vegetation units on the Jack Hills to that on Mount Gould, and on several other ranges in the region surrounding the Jack Hills. This incorporated data collected by GHD (2009) from the Robinson Ranges, the Kennedy Ranges, Mount Gould, and several other ranges in the region. The sampling of the regional ranges during this survey, including Mount Gould, was relatively limited (several quadrats on each range). One analysis undertaken (using similar methods described above for Meissner *et al.* 2009), although showing some alignment of quadrats from Jack Hills with those on other ranges (including Mount Gould), did not demonstrate any firm trends in similarity of quadrats from the other ranges, particularly Mount Gould quadrats. This probably reflects the limited sampling on the other ranges. A separate analysis used combined species lists from sites containing *Triodia melvillei* from each of the ranges, and compared these lists against each other. This analysis is insufficient in determining differences in vegetation units, as it essentially compared a 'total' species list from each range to each other, rather than multiple sub-samples of the vegetation (as provided by individual quadrat data). The similarity of vegetation across the ranges therefore cannot be inferred using this type of analysis. It is therefore considered that the assumptions of this study are unfounded based on the evidence provided.

4. DISCUSSION AND CONCLUSIONS

4.1 Project area and Regional Survey for Conservation Significant Taxa

Both *Eremophila warnesii* and *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743), whose populations within the Project area were considered of High conservation significance (Woodman Environmental 2009), were found to be common in the Project area. *E. warnesii* was recorded widely over Mount Gould itself, and was abundant in several areas, with over 13,000 individuals recorded. This species was also found to extend just outside the Project area on the slopes of Mount Gould, with 3 additional populations recorded on Yarlarweelor Station to the east of the Project area. However, based on current data, these populations are very small compared to the population in the Project area. Therefore, if a large proportion of the population in the Project area were to be impacted in the future, the regional impacts to the taxon would still be considered high based on the results of this survey, and further regional survey may be required to prove the existence of other large populations.

It is considered however that there is a strong likelihood that there are significant numbers of individuals that were not recorded during this survey because of time constraints, both within the existing recorded populations on Yarlarweelor Station, and in the vicinity of these populations. While *E. warnesii* was only expected to occur on

rocky areas based on the location of the population in the Project area, the 3 populations recorded on Yarlarweelor Station were located on low floodplains and in minor drainage lines. A preliminary review of aerial photography in the vicinity of the recorded populations indicates that this habitat is abundant in the area, and it is therefore considered likely that more individuals would occur in these habitat areas. These habitat areas would be considered a primary target for further regional survey if required.

The 3 populations of *E. warnesii* recorded on Yarlarweelor Station in 2011 were either at or in close proximity to historical records of the species (Figure 4a). However, no individuals could be found at 2 historical locations on Mount Clere Station (Figure 4a), despite relatively detailed searching. It is possible that the species could have become extinct at these locations, however it is more likely that the coordinates of the locations are erroneous. It is likely that if more time were dedicated to searching in the general vicinity of these locations, individuals would be discovered; these 2 records are therefore considered primary targets for further regional survey if required.

It is apparent following a review of the historical records of *E. warnesii* that the coordinates of 2 records from the DEFL and W.A. Herbarium databases are likely to be erroneous (Figure 4a). Based on the dates of records, DEFL records 32849 and 32850 (Appendix B) should be equivalent to W.A. Herbarium records PERTH 03792439 and PERTH 04031830 respectively. However, the coordinates of the DEFL records are different to those of the W.A. Herbarium records. In the case of DEFL record 32849, the coordinates match the locality details ('near Bogie Man Mill, Yarlarweelor') attached to W.A. Herbarium record PERTH 03792439, however these locality details do not match the coordinates of PERTH 03792439. Both locations were visited, with *E. warnesii* recorded at DEFL record 32849 only (PERTH 03792439 plots at Yarlarweelor Station homestead). The coordinates of PERTH 03792439 are therefore considered erroneous. In the case of DEFL record 32850, the coordinates do not match the locality details ('4 km E of Windarra Well, Yarlarweelor Station') attached to W.A. Herbarium record PERTH 04031830, whose coordinates closely match the locality details. DEFL record 32850 was therefore not visited, as it plots on nearby Moorarie Station, and is considered erroneous. However, W.A. Herbarium record PERTH 04031830 was visited, with *E. warnesii* recorded in the vicinity of this record.

H. gustafsenii var. Murchison (R. Meissner & B. Bayliss 743) was also recorded widely over Mount Gould, and also on stony undulating areas around the base of the mountain. This taxon was also abundant in several areas, with more than 12,500 individuals recorded. This species was also found to extend just outside the Project area on the lower slopes of Mount Gould, with 1 additional population recorded on low hills just north of Mount Gould. This population, plus the portion of the population outside the Project area, represents a very small percentage of the total number of known individuals based on current data. As for *E. warnesii*, if a large proportion of the population in the Project area were to be impacted in the future, the regional impacts to the taxon would still be considered high based on the results of this survey, and further regional survey may be required to prove the existence of other large populations.

It is considered likely however that there are further individuals that were not recorded during this survey because of time constraints, particularly given the discovery of a small population on low hills north of Mount Gould. A preliminary review of aerial

photography indicates that there are several other low linear ridges in the vicinity of Mount Gould, and it is therefore considered likely that more individuals would occur in these habitat areas. These habitat areas would be considered a primary target for further regional survey if required.

The collection of *H. gustafsenii* var. *gustafsenii* ms on Mount Taylor at the northern end of the nearby Jack Hills correlates with the results of DEC's survey of the Jack Hills (Meissner & Caruso 2008), where *H. gustafsenii* var. *gustafsenii* ms was recorded in quadrats established across the Jack Hills. *H. gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) is distinguished from *H. gustafsenii* var. *gustafsenii* ms by having sparsely silky hairs with sessile glands on the leaves and peduncles, as opposed to long silky hairs on the leaves and dense silky hairs on the peduncles for *H. gustafsenii* var. *gustafsenii* ms. The leaves of *H. gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) also appear bright green in the field, compared to grey-green for *H. gustafsenii* var. *gustafsenii* ms (Meissner & Caruso 2008). It is currently unclear as to whether *H. gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) warrants separation as a distinct taxon based on these characters, as they appear similar in many other morphological characters, with populations of the 2 taxa separated by less than 15 km. However, as a matter of precaution, the 2 taxa must be considered distinct based on current information. It is possible that *H. gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) may be an unusual morphotype of *H. gustafsenii* var. *gustafsenii*, rather than a distinct taxon; however, a comprehensive taxonomic study of all entities currently treated as *Halgania gustafsenii* is required to determine this. If this is determined to be the case, then further regional searching would not be required.

It is worthy of note that both *E. warnesii* and *H. gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) would both qualify for listing as Threatened (Declared Rare Flora – Extant) under the *Wildlife Conservation Act* 1950 in Western Australia based on current information, as they both meet International Union for Conservation of Nature (IUCN) Red List Criteria for at least the 'Vulnerable' category (IUCN 2001), and are therefore considered to be facing a high risk of extinction in the wild. However, to be listed as Threatened in Western Australia, it must be demonstrated that an appropriate amount of survey has been conducted to determine the distribution and abundance of a taxon. Appropriate survey effort is determined by the DEC's guidelines for nomination of a species as Threatened (DEC 2012b); under these guidelines, *E. warnesii* and *H. gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) would both require a minimum of 1 month of searching time to justify their listing as Threatened. It is considered that both taxa have not been sufficiently surveyed for to establish their complete distribution and abundance, as significant areas of potential habitat remain to be surveyed. Both taxa would therefore not qualify for listing as Threatened until further survey has been conducted.

Rhodanthe sphaerocephala was recorded at 4 point locations in 2011, however none of these represented locations where it was recorded in 2008. It is possible that this species naturally occurs in very low numbers in the Mount Gould area, and may require a significant rainfall event to facilitate widespread seed germination. There was some rainfall prior to survey, however the amount may have been low enough to facilitate only scattered germination.

Tribulus adelacanthus was found to be common in the Project area in undulating stony areas; this is despite it being recorded at only a single location in 2008 (Woodman Environmental 2009). In excess of 2,000 individuals were recorded at over 180 point locations; however, it is expected that significantly more individuals occurred at more locations. Unfortunately this species was senescing at the time of survey, and accurate identification of senescent individuals was often difficult, particularly as several other superficially similar *Tribulus* species were observed during the survey (e.g. *T. forrestii*, *T. astrocarpus*).

It is considered that the Project area has been surveyed adequately enough during this survey to negate the need for further field survey in the Project area for conservation significant flora taxa prior to any future exploration or mining activities. However, it is recommended that a desktop impact assessment be undertaken prior to any proposed future exploration and mining activities (when an exact impact area is known) using the data collected during this survey, to quantify local and regional impacts to conservation significant flora taxa, and potentially mitigate these impacts prior to disturbance.

4.2 Review of Mount Gould Vegetation Complexes PEC Information

The review of information relating to the Mount Gould vegetation complexes PEC presented in Section 3.3 provides strong evidence that the vegetation present on Mount Gould as a whole differs from those on nearby ranges. This is documented by Gibson *et al.* (2012), who demonstrated significant differences in species composition between each of 24 ironstone ranges, including Mount Gould and the nearby Jack Hills and Robinson Ranges. A strong trend towards dissimilarity of specific vegetation units between Mount Gould and other nearby ranges has also been demonstrated, with Meissner *et al.* (2009) and Woodman Environmental (2009) showing dissimilarity between floristic data from the Mount Gould summit and floristic data from the summits of the Jack Hills and the Robinson Range.

The main implication of these studies is that the Mount Gould vegetation complexes PEC as currently defined is unlikely to occur anywhere else, as the vegetation complexes referred to in the PEC description are statistically different in terms of species composition from other nearby ranges (Gibson *et al.* 2012). However, it is likely that the specific vegetation units that form part of the vegetation complexes occur elsewhere. For example, both Meissner *et al.* (2009) and Woodman Environmental (2009) show that vegetation units on the lower slopes of Mount Gould are likely to be synonymous with those on the lower slopes of the Robinson Range, and also possibly the Jack Hills (Woodman Environmental 2009). This does not appear to be the case for the vegetation units that occur at the summit of Mount Gould, including vegetation units dominated by *Triodia melvillei*, as these have been demonstrated to be dissimilar to superficially similar vegetation units on nearby ranges (Meissner *et al.* 2009; Woodman Environmental 2009).

With regard to potential impacts of the Project on the Mount Gould vegetation complexes PEC, it is important that the validity of further regional survey for the Mount Gould vegetation complexes PEC be discussed with the DEC prior to any survey being conducted. Further survey would only be worthwhile if the demonstration of occurrences of specific vegetation units elsewhere in the region is considered by the

DEC to be appropriate when considering impacts within the Project area in a regional context. If this is not considered appropriate, then minimising disturbance to Mount Gould remains the only option to minimise impacts to the Mount Gould vegetation complexes PEC. A detailed survey plan has therefore not been developed at this time, pending further discussions with the DEC.

If further survey for the vegetation units on Mount Gould is deemed valid by the DEC, it is considered that the vegetation units on the summit of Mount Gould, particularly the *Triodia melvillei*-dominated vegetation unit, would require the most significant survey effort, as these vegetation units are most likely to be significantly impacted. Both Meissner *et al.* (2009) and Woodman Environmental (2009) have demonstrated dissimilarity in the *Triodia melvillei*-dominated vegetation units on Mount Gould, the Robinson Range and Jack Hills; it is therefore proposed that other significant hills in the vicinity of Mount Gould be assessed for the presence of vegetation units similar to those on the summit of Mount Gould, particularly those that support *Triodia melvillei*. The likelihood of discovering further occurrences is considered low, as the Jack Hills and the Robinson Range are the largest ironstone ranges in the vicinity of Mount Gould, however a preliminary review of aerial photography indicates that there are several other large hills that could potentially support a *Triodia melvillei*-dominated vegetation unit. Several previous regional surveys (see Section 3.3) have analysed data from a relatively limited number of quadrats, thus limiting the statistical rigor of the analysis, and reducing the potential for identification of similar vegetation units on different ranges. It therefore is proposed that several quadrats be established within any occurrences found, to sample any variation within the vegetation unit. The most efficient method of accessing these hills may be to utilise a helicopter.

It is also considered prudent that the lower slope vegetation units on Mount Gould are surveyed for regionally. Although some similarity between these vegetation units and vegetation units on the Robinson Range and the Jack Hills has been demonstrated (Meissner *et al.* 2009; Woodman Environmental 2009), it is unclear as to the geographical extent of these vegetation units. These would also be sampled while sampling for the summit vegetation units on hills in the vicinity of Mount Gould. The Jack Hills in particular, and to a lesser extent the Robinson Range, could also be included as potential survey targets for these vegetation units.

5. RECOMMENDATIONS

The following recommendations are given:

1. Locations of all conservation significant flora taxa should be avoided where possible during future proposed exploration and mining activities, particularly the highly restricted *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) and *Eremophila warnesii* (both P1)

2. A desktop impact assessment should be undertaken prior to any proposed future exploration and mining activities (when an exact impact area is known) using data collected during this survey, to quantify local and regional impacts to conservation significant flora taxa, and determine whether further regional survey for conservation significant flora taxa is required.

3. The DEC should be engaged in discussions regarding further survey for the Mount Gould vegetation complexes PEC, to determine the validity of further survey, and if deemed valid, to agree on appropriate methods for further survey.

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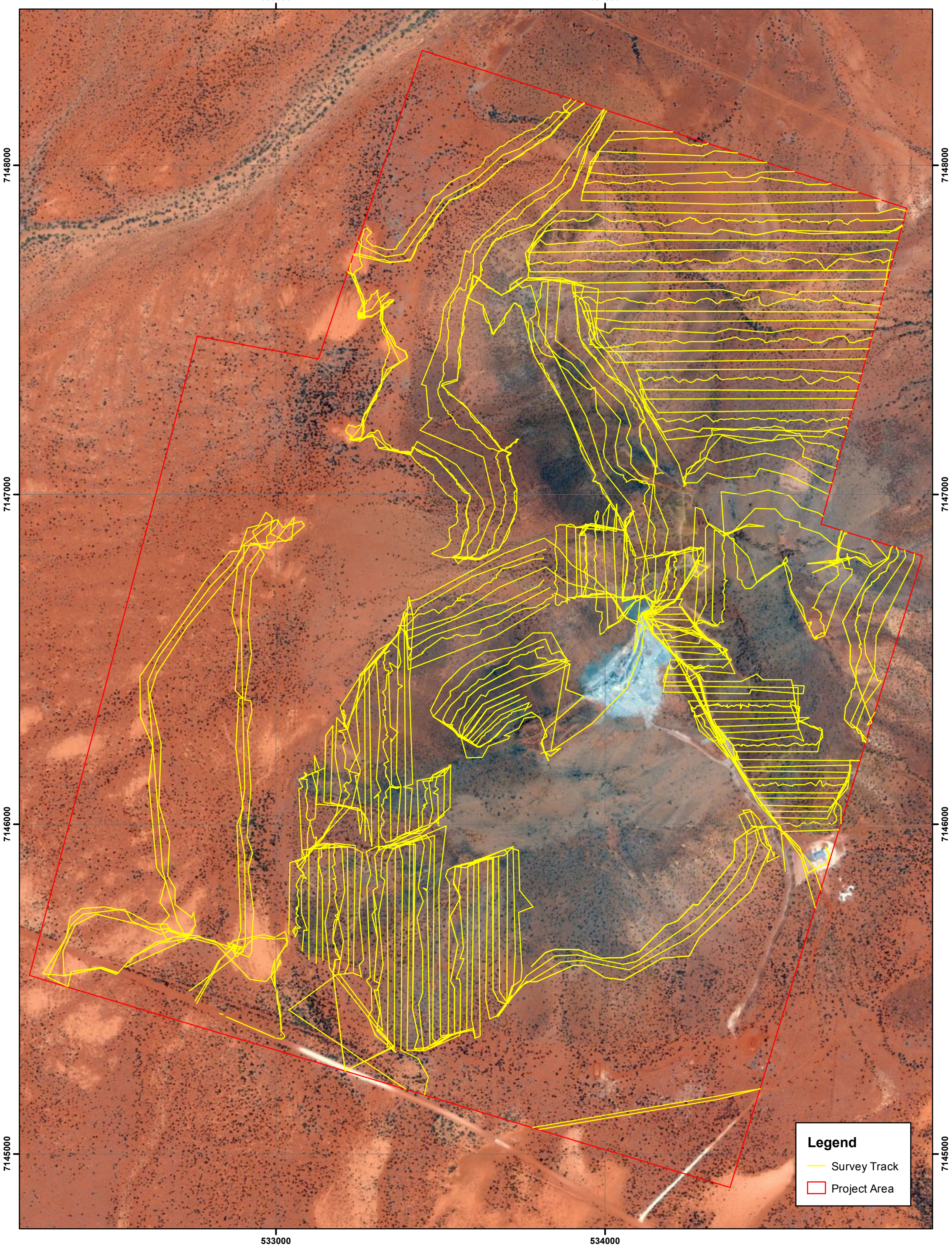
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woodmanenvironmentalconsulting This map should only be used in conjunction with WEC report Atlas11-23-01	**Mount Gould DSO Project** **Method of Survey of Project Area for Conservation Significant Flora, 2011**	Author: David Coultas	**Figure** 1
N		WEC Ref: Atlas11-23-01	
		Filename: Atlas11-23-01-f01.mxd	
	Revision: A - January 2012	Scale 1:10,000 (A3) Grid: MGA Zone 50	



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This map should only be used in conjunction with WEC report Atlas11-23-01

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Mount Gould DSO Project
Regional Areas Searched for Conservation Significant Flora, 2011

Revision: A - January 2012

Author: David Coultas

WEC Ref: Atlas11-23-01

Filename: Atlas11-23-01-f02.mxd

Scale 1:275,000 (A3) Grid: MGA Zone 50

Figure

2

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Legend

- Project Area
- *Eremophila warnesii* (P1)

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This map should only be used in conjunction with WEC report Atlas11-23-01

Mount Gould DSO Project
Distribution of *Eremophila warnesii* (P1) in the Project Area, 2011

Revision: A - January 2012

Author: David Coultas

WEC Ref: Atlas11-23-01

Filename: Atlas11-23-01-f03a.mxd

Scale 1:10,000 (A3) Grid: MGA Zone 50

Figure

3a

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Legend

- Project Area
- *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) (P1)

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This map should only be used in conjunction with WEC report Atlas11-23-01

Mount Gould DSO Project
Distribution of *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) (P1) in the Project Area, 2011

Revision: A - January 2012

Author: David Coultas

WEC Ref: Atlas11-23-01

Filename: Atlas11-23-01-f03b.mxd

Scale 1:10,000 (A3) Grid: MGA Zone 50

Figure

3b

533000 534000 535000

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Legend

- Project Area
- *Rhodanthe sphaerocephala* (P1) 2011
- *Rhodanthe sphaerocephala* (P1) 2008

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This map should only be used in conjunction with WEC report Atlas11-23-01

Mount Gould DSO Project
Distribution of
***Rhodanthe sphaerocephala* (P1)**
in the Project Area, 2011

Revision: A - January 2012

Author: David Coultas

WEC Ref: Atlas11-23-01

Filename: Atlas11-23-01-f03c.mxd

Scale 1:10,000 (A3) Grid: MGA Zone 50

Figure

3c

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Legend

- Project Area
- *Tribulus adelacanthus* (P1)

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This map should only be used in conjunction with WEC report Atlas11-23-01

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Mt Gould DSO Project
Distribution of
***Tribulus adelacanthus* (P1)**
in the Project Area, 2011

Revision: A - January 2012

Author: David Coultas

WEC Ref: Atlas11-23-01

Filename: Atlas11-23-01-f03d.mxd

Scale 1:10,000 (A3) Grid: MGA Zone 50

Figure

3d

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7230000 7220000 7210000 7200000 7190000 7180000 7170000 7160000 7150000 7140000 7130000

Murchison River

Legend

- Project Area
- Places
- Search Area

***Eremophila warnesii* (P1)**

- DEFL
- WA Herbarium
- Woodman Environmental (2011)

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This map should only be used in conjunction with WEC report Atlas11-23-01

Mount Gould DSO Project
Region Distribution of
***Eremophila warnesii* (P1), 2011**

Revision: A - January 2012

Author: David Coultas

WEC Ref: Atlas11-23-01

Filename: Atlas11-23-01-f04a.mxd

Scale 1:275,000 (A3) Grid: MGA Zone 50

Figure

4a

530000 532000 534000 536000 538000 540000

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Murchison River

Legend

- Project Area
- Places
- Search Area

***Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) (P1)**

- WA Herbarium
- Woodman Environmental (2011)

woodmanenvironmentalconsulting

N

This map should only be used in conjunction with WEC report Atlas11-23-01

Mount Gould DSO Project
Region Distribution of
***Halgania gustafsenii* var. Murchison**
(R. Meissner & B. Bayliss 743) (P1), 2011

Revision: A - January 2012

Author: David Coultas

WEC Ref: Atlas11-23-01

Filename: Atlas11-23-01-f04b.mxd

Scale 1:50,000 (A3) Grid: MGA Zone 50

Figure

4b

Appendix A: Conservation Codes for Western Australian Flora (DEC 2012)

Under the Wildlife Conservation Act, the Minister for the Environment may declare species of flora to be protected if they are considered to be in danger of extinction, rare or otherwise in need of special protection. Schedules 1 and 2 deal with those that are threatened and those that are presumed extinct, respectively.

T: Threatened Flora (Declared Rare Flora – Extant)

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

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

- CR: Critically Endangered – considered to be facing an extremely high risk of extinction in the wild
- EN: Endangered – considered to be facing a very high risk of extinction in the wild
- VU: Vulnerable – considered to be facing a high risk of extinction in the wild

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

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

Taxa that have not yet been adequately surveyed to be listed under Schedule 1 or 2 are added to the Priority Flora List under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened flora or fauna. Taxa that are adequately known, are rare but not threatened, or meet criteria for Near Threatened, or that have been recently removed from the threatened list for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring. Conservation Dependent species are placed in Priority 5.

1: Priority One – Poorly-known Taxa

Taxa that are known from one or a few collections or sight records (generally less than 5), 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 immediate 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 be 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 5 years for reasons other than taxonomy.

5: Priority 5 – 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 5 years.

Appendix B: Results of Search of the Department of Environment and Conservation's W.A. Herbarium Specimen database and Declared Endangered Flora List database (DEFL)

Part 1 – W.A. Herbarium Specimen Database

SHEET_NO	SPECIES	CONSCODE	SITE	VEGETATION	LOCALITY	LAT	LONG_	DATE_
PERTH 03792439	Eremophila warnesii	1			Near Bogie Man Mill, Yarlarweelor	-25.57666	117.99139	06 1972
PERTH 04031830	Eremophila warnesii	1	Red-brown clayey sand.	In open scrub.	4 km E of Windarra Well, Yarlarweelor Station	-25.75000	117.80000	10 08 1986
PERTH 07324863	Eremophila warnesii	1	Slopes of quartz ridge.		Mount Clere Station	-25.08333	117.58333	06 1970
PERTH 08204063	Eremophila warnesii	1	On upper western slopes. On stony and rocky brown loam.	With Eriostemon sp., Eremophila latrobei, Triodia sp. and Ptilotus obovatus.	W slopes of Mount Gould	-25.79898	117.34333	24 10 1993
PERTH 2629720	Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	1			Mount Gould, c. 150 km NW of Meekatharra	-25.80000	117.31639	01 08 1969
PERTH 2631741	Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	1	In saxosis.		Mount Gould, prope flume Murchison [near Murchison River]	-25.80000	117.31639	27 08 1960
PERTH 2629747	Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	1			Mount Gould, NW of Meekatharra	-25.80000	117.31639	01 07 1969

SHEET_NO	SPECIES	CONSCODE	SITE	VEGETATION	LOCALITY	LAT	LONG_	DATE_
PERTH 2631784	Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	1	Ironstone.		Mount Gould (foot)	-25.80000	117.31639	17 08 1972
PERTH 07528272	Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	1	NW aspect. Steep 1:5 upper slope, with a discontinuous fabric of ironstone ranging to 1 m. overlying strongly laminated phyllite/schist and below strongly dipping outcropping ironstone. Rock cover 70%.	Ptilotus obovatus var. obovatus Dwarf Scrub D over Eriachne mucronata and Iseilema dolichotrichum Open Low Grass.	Mount Gould on Mount Gould Station. On Carnarvon-Meekatharra Road, 154 km NW of Meekatharra	-25.80075	117.33811	04 07 2006
PERTH 07736320	Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	1	SW facing steep mid slope of haematite and banded ironstone. Very slightly rocky banded ironstone outcrop with red brown skeletal very sandy loam soils.	Isolated shrubs of Acacia aneura over open shrubland of Philotheca brucei subsp. cinerea and grassland of Triodia melvillei and Eriachne mucronata and Corchorus crozophorifolius.	Mount Gould, survery site MTGD 05, located halfway up main track on Mount Gould. Also ca 4.7 km W of Mount Gould Station and 1.5 km NW of Meekatharra - Landor Road	-25.80041	117.34256	19 08 2006

Part 2 – Declared Endangered Flora Database (DEFL)

SHEET	SPNAME	CONSVCODE	POPID1	POPID2	GDA94LAT	GDA94LONG	VESTING	PURPOSE1	PURPOSE2	STATUS	OWNERDATE
32849	Eremophila warnesii	1	1		-25.77842	117.87722	PLB	PAS	EXL		15/06/1972
32850	Eremophila warnesii	1	2		-25.85386	117.80156	PLB	PAS	EXL		10/08/1986
32852	Eremophila warnesii	1	3		-25.19431	117.71986	PLB	PAS			11/09/2000
35170	Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	1	1		-25.80075	117.33811	PLB	PAS	MIN		19/08/2006

Appendix C: Point Locations of Significant Flora Taxa Recorded During 2011 Survey

Taxon	GPS E	GPS N	No. of Individuals	Date Collected	Record Location
Eremophila warnesii	533387	7146643	3	09/08/2011	Project Area
Eremophila warnesii	533390	7146622	1	09/08/2011	Project Area
Eremophila warnesii	533416	7146679	6	09/08/2011	Project Area
Eremophila warnesii	533531	7146409	1	10/08/2011	Project Area
Eremophila warnesii	533569	7146326	1	10/08/2011	Project Area
Eremophila warnesii	533574	7146362	1	10/08/2011	Project Area
Eremophila warnesii	533579	7146204	26	10/08/2011	Project Area
Eremophila warnesii	533587	7146342	1	10/08/2011	Project Area
Eremophila warnesii	533593	7146287	3	10/08/2011	Project Area
Eremophila warnesii	533604	7146279	9	10/08/2011	Project Area
Eremophila warnesii	533604	7146253	2	10/08/2011	Project Area
Eremophila warnesii	533606	7146307	8	10/08/2011	Project Area
Eremophila warnesii	533611	7146288	5	10/08/2011	Project Area
Eremophila warnesii	533615	7146350	2	10/08/2011	Project Area
Eremophila warnesii	533617	7146268	10	10/08/2011	Project Area
Eremophila warnesii	533619	7146254	3	10/08/2011	Project Area
Eremophila warnesii	533625	7146302	13	10/08/2011	Project Area
Eremophila warnesii	533625	7146324	4	10/08/2011	Project Area
Eremophila warnesii	533628	7146266	35	10/08/2011	Project Area
Eremophila warnesii	533632	7146284	20	10/08/2011	Project Area
Eremophila warnesii	533633	7146270	50	10/08/2011	Project Area
Eremophila warnesii	533635	7146346	8	10/08/2011	Project Area
Eremophila warnesii	533635	7146370	14	10/08/2011	Project Area
Eremophila warnesii	533637	7146315	10	10/08/2011	Project Area
Eremophila warnesii	533639	7146291	15	10/08/2011	Project Area
Eremophila warnesii	533639	7146392	6	10/08/2011	Project Area
Eremophila warnesii	533643	7146255	44	10/08/2011	Project Area
Eremophila warnesii	533647	7146322	33	10/08/2011	Project Area
Eremophila warnesii	533647	7146284	65	10/08/2011	Project Area

Taxon	GPS E	GPS N	No. of Individuals	Date Collected	Record Location
Eremophila warnesii	533648	7146354	10	10/08/2011	Project Area
Eremophila warnesii	533650	7146301	20	10/08/2011	Project Area
Eremophila warnesii	533655	7146259	116	10/08/2011	Project Area
Eremophila warnesii	533656	7146292	60	10/08/2011	Project Area
Eremophila warnesii	533657	7146411	1	10/08/2011	Project Area
Eremophila warnesii	533658	7146335	34	10/08/2011	Project Area
Eremophila warnesii	533658	7146291	76	10/08/2011	Project Area
Eremophila warnesii	533659	7146242	2	10/08/2011	Project Area
Eremophila warnesii	533660	7146307	25	10/08/2011	Project Area
Eremophila warnesii	533663	7146385	15	10/08/2011	Project Area
Eremophila warnesii	533667	7146270	226	10/08/2011	Project Area
Eremophila warnesii	533667	7146301	60	10/08/2011	Project Area
Eremophila warnesii	533672	7146348	29	10/08/2011	Project Area
Eremophila warnesii	533672	7146366	60	10/08/2011	Project Area
Eremophila warnesii	533676	7146396	29	10/08/2011	Project Area
Eremophila warnesii	533677	7146328	10	10/08/2011	Project Area
Eremophila warnesii	533677	7146308	36	10/08/2011	Project Area
Eremophila warnesii	533686	7146290	114	10/08/2011	Project Area
Eremophila warnesii	533690	7146273	85	10/08/2011	Project Area
Eremophila warnesii	533691	7146337	30	10/08/2011	Project Area
Eremophila warnesii	533693	7146361	44	10/08/2011	Project Area
Eremophila warnesii	533695	7146324	75	10/08/2011	Project Area
Eremophila warnesii	533695	7146258	2	10/08/2011	Project Area
Eremophila warnesii	533696	7146323	62	10/08/2011	Project Area
Eremophila warnesii	533696	7146423	2	10/08/2011	Project Area
Eremophila warnesii	533698	7146377	76	10/08/2011	Project Area
Eremophila warnesii	533700	7146363	35	10/08/2011	Project Area
Eremophila warnesii	533704	7146309	205	10/08/2011	Project Area
Eremophila warnesii	533704	7146348	20	10/08/2011	Project Area
Eremophila warnesii	533705	7146406	38	10/08/2011	Project Area
Eremophila warnesii	533708	7146333	60	10/08/2011	Project Area

Taxon	GPS E	GPS N	No. of Individuals	Date Collected	Record Location
Eremophila warnesii	533711	7146271	19	10/08/2011	Project Area
Eremophila warnesii	533714	7146283	76	10/08/2011	Project Area
Eremophila warnesii	533715	7146375	41	10/08/2011	Project Area
Eremophila warnesii	533718	7146386	55	10/08/2011	Project Area
Eremophila warnesii	533718	7146357	40	10/08/2011	Project Area
Eremophila warnesii	533718	7146339	50	10/08/2011	Project Area
Eremophila warnesii	533721	7146290	62	10/08/2011	Project Area
Eremophila warnesii	533725	7146320	97	10/08/2011	Project Area
Eremophila warnesii	533726	7146361	20	10/08/2011	Project Area
Eremophila warnesii	533728	7146442	1	10/08/2011	Project Area
Eremophila warnesii	533731	7146392	15	10/08/2011	Project Area
Eremophila warnesii	533732	7146344	40	10/08/2011	Project Area
Eremophila warnesii	533733	7146380	43	10/08/2011	Project Area
Eremophila warnesii	533739	7146416	6	10/08/2011	Project Area
Eremophila warnesii	533739	7146297	9	10/08/2011	Project Area
Eremophila warnesii	533740	7146357	25	10/08/2011	Project Area
Eremophila warnesii	533740	7146346	35	10/08/2011	Project Area
Eremophila warnesii	533744	7146311	10	10/08/2011	Project Area
Eremophila warnesii	533746	7146381	36	10/08/2011	Project Area
Eremophila warnesii	533747	7146334	76	10/08/2011	Project Area
Eremophila warnesii	533752	7146362	20	10/08/2011	Project Area
Eremophila warnesii	533754	7146448	4	10/08/2011	Project Area
Eremophila warnesii	533757	7146404	2	10/08/2011	Project Area
Eremophila warnesii	533760	7146324	8	10/08/2011	Project Area
Eremophila warnesii	533761	7146371	1	10/08/2011	Project Area
Eremophila warnesii	533762	7146474	19	10/08/2011	Project Area
Eremophila warnesii	533763	7146356	30	10/08/2011	Project Area
Eremophila warnesii	533766	7146339	80	10/08/2011	Project Area
Eremophila warnesii	533769	7146428	6	10/08/2011	Project Area
Eremophila warnesii	533777	7146453	55	10/08/2011	Project Area
Eremophila warnesii	533784	7146480	130	10/08/2011	Project Area

Taxon	GPS E	GPS N	No. of Individuals	Date Collected	Record Location
Eremophila warnesii	533788	7146435	20	10/08/2011	Project Area
Eremophila warnesii	533790	7146524	31	10/08/2011	Project Area
Eremophila warnesii	533792	7146456	32	10/08/2011	Project Area
Eremophila warnesii	533795	7146512	39	10/08/2011	Project Area
Eremophila warnesii	533798	7146505	60	10/08/2011	Project Area
Eremophila warnesii	533801	7146578	4	10/08/2011	Project Area
Eremophila warnesii	533802	7146561	25	10/08/2011	Project Area
Eremophila warnesii	533805	7146457	25	10/08/2011	Project Area
Eremophila warnesii	533806	7146485	35	10/08/2011	Project Area
Eremophila warnesii	533808	7146504	40	10/08/2011	Project Area
Eremophila warnesii	533815	7146582	2	10/08/2011	Project Area
Eremophila warnesii	533816	7146445	3	10/08/2011	Project Area
Eremophila warnesii	533821	7146549	15	10/08/2011	Project Area
Eremophila warnesii	533824	7146493	50	10/08/2011	Project Area
Eremophila warnesii	533828	7146531	50	10/08/2011	Project Area
Eremophila warnesii	533828	7146469	8	10/08/2011	Project Area
Eremophila warnesii	533835	7146584	150	10/08/2011	Project Area
Eremophila warnesii	533838	7146515	60	10/08/2011	Project Area
Eremophila warnesii	533839	7146460	6	10/08/2011	Project Area
Eremophila warnesii	533843	7146568	65	10/08/2011	Project Area
Eremophila warnesii	533843	7146475	1	10/08/2011	Project Area
Eremophila warnesii	533849	7146528	20	10/08/2011	Project Area
Eremophila warnesii	533851	7146499	22	10/08/2011	Project Area
Eremophila warnesii	533853	7146550	82	10/08/2011	Project Area
Eremophila warnesii	533853	7146467	4	10/08/2011	Project Area
Eremophila warnesii	533860	7146485	8	10/08/2011	Project Area
Eremophila warnesii	533869	7146527	28	10/08/2011	Project Area
Eremophila warnesii	533880	7146415	1	10/08/2011	Project Area
Eremophila warnesii	533880	7146495	2	10/08/2011	Project Area
Eremophila warnesii	533582	7147600	24	11/08/2011	Project Area
Eremophila warnesii	533589	7147657	15	11/08/2011	Project Area

Taxon	GPS E	GPS N	No. of Individuals	Date Collected	Record Location
Eremophila warnesii	533589	7147740	1	11/08/2011	Project Area
Eremophila warnesii	533608	7147639	5	11/08/2011	Project Area
Eremophila warnesii	534292	7146467	35	11/08/2011	Project Area
Eremophila warnesii	534372	7146530	1	11/08/2011	Project Area
Eremophila warnesii	533852	7146698	1	13/09/2011	Project Area
Eremophila warnesii	533854	7146665	20	13/09/2011	Project Area
Eremophila warnesii	533882	7146675	3	13/09/2011	Project Area
Eremophila warnesii	534059	7146724	1	13/09/2011	Project Area
Eremophila warnesii	534086	7146728	2	13/09/2011	Project Area
Eremophila warnesii	534114	7146743	1	13/09/2011	Project Area
Eremophila warnesii	534728	7146600	100	13/09/2011	Project Area
Eremophila warnesii	534183	7146789	20	13/09/2011	Project Area
Eremophila warnesii	534210	7146772	6	13/09/2011	Project Area
Eremophila warnesii	534242	7146782	6	13/09/2011	Project Area
Eremophila warnesii	534281	7146803	3	13/09/2011	Project Area
Eremophila warnesii	534293	7146765	1	13/09/2011	Project Area
Eremophila warnesii	534296	7146781	4	13/09/2011	Project Area
Eremophila warnesii	534309	7146784	8	13/09/2011	Project Area
Eremophila warnesii	534723	7146609	20	13/09/2011	Project Area
Eremophila warnesii	534729	7146582	100	13/09/2011	Project Area
Eremophila warnesii	534740	7146546	30	13/09/2011	Project Area
Eremophila warnesii	534742	7146549	5	13/09/2011	Project Area
Eremophila warnesii	534754	7146414	2	13/09/2011	Project Area
Eremophila warnesii	534755	7146604	120	13/09/2011	Project Area
Eremophila warnesii	534764	7146580	30	13/09/2011	Project Area
Eremophila warnesii	534772	7146634	2	13/09/2011	Project Area
Eremophila warnesii	534776	7146546	77	13/09/2011	Project Area
Eremophila warnesii	534776	7146516	25	13/09/2011	Project Area
Eremophila warnesii	534788	7146546	50	13/09/2011	Project Area
Eremophila warnesii	534789	7146526	30	13/09/2011	Project Area
Eremophila warnesii	534799	7146611	3	13/09/2011	Project Area

Taxon	GPS E	GPS N	No. of Individuals	Date Collected	Record Location
Eremophila warnesii	534831	7146604	5	13/09/2011	Project Area
Eremophila warnesii	534857	7146785	1	13/09/2011	Project Area
Eremophila warnesii	533583	7147601	25	14/09/2011	Project Area
Eremophila warnesii	533598	7147665	25	14/09/2011	Project Area
Eremophila warnesii	533631	7147557	10	14/09/2011	Project Area
Eremophila warnesii	533642	7147630	15	14/09/2011	Project Area
Eremophila warnesii	533642	7147523	10	14/09/2011	Project Area
Eremophila warnesii	533664	7147496	2	14/09/2011	Project Area
Eremophila warnesii	533682	7147608	40	14/09/2011	Project Area
Eremophila warnesii	533684	7147518	100	14/09/2011	Project Area
Eremophila warnesii	533710	7147622	13	14/09/2011	Project Area
Eremophila warnesii	533728	7147649	16	14/09/2011	Project Area
Eremophila warnesii	533729	7147578	250	14/09/2011	Project Area
Eremophila warnesii	533746	7147628	40	14/09/2011	Project Area
Eremophila warnesii	533749	7147555	100	14/09/2011	Project Area
Eremophila warnesii	533757	7147536	22	14/09/2011	Project Area
Eremophila warnesii	533765	7147641	15	14/09/2011	Project Area
Eremophila warnesii	533775	7147631	24	14/09/2011	Project Area
Eremophila warnesii	533779	7147591	10	14/09/2011	Project Area
Eremophila warnesii	533780	7147604	35	14/09/2011	Project Area
Eremophila warnesii	533796	7147525	2	14/09/2011	Project Area
Eremophila warnesii	533799	7147650	4	14/09/2011	Project Area
Eremophila warnesii	533801	7147600	100	14/09/2011	Project Area
Eremophila warnesii	533827	7147584	8	14/09/2011	Project Area
Eremophila warnesii	533857	7147536	6	14/09/2011	Project Area
Eremophila warnesii	533862	7147569	6	14/09/2011	Project Area
Eremophila warnesii	533893	7147430	16	14/09/2011	Project Area
Eremophila warnesii	533899	7147629	31	14/09/2011	Project Area
Eremophila warnesii	533903	7147601	50	14/09/2011	Project Area
Eremophila warnesii	533909	7147578	100	14/09/2011	Project Area
Eremophila warnesii	533914	7147515	50	14/09/2011	Project Area

Taxon	GPS E	GPS N	No. of Individuals	Date Collected	Record Location
Eremophila warnesii	533916	7147546	80	14/09/2011	Project Area
Eremophila warnesii	533916	7147500	15	14/09/2011	Project Area
Eremophila warnesii	533921	7147407	27	14/09/2011	Project Area
Eremophila warnesii	533926	7147478	20	14/09/2011	Project Area
Eremophila warnesii	533932	7147591	20	14/09/2011	Project Area
Eremophila warnesii	533935	7147633	7	14/09/2011	Project Area
Eremophila warnesii	533937	7147448	10	14/09/2011	Project Area
Eremophila warnesii	533937	7147392	38	14/09/2011	Project Area
Eremophila warnesii	533947	7147555	20	14/09/2011	Project Area
Eremophila warnesii	533953	7147514	30	14/09/2011	Project Area
Eremophila warnesii	533966	7147419	1	14/09/2011	Project Area
Eremophila warnesii	533972	7147598	45	14/09/2011	Project Area
Eremophila warnesii	533972	7147570	10	14/09/2011	Project Area
Eremophila warnesii	533972	7147540	1	14/09/2011	Project Area
Eremophila warnesii	533972	7147519	13	14/09/2011	Project Area
Eremophila warnesii	533979	7147626	18	14/09/2011	Project Area
Eremophila warnesii	534000	7147371	20	14/09/2011	Project Area
Eremophila warnesii	534030	7147142	65	14/09/2011	Project Area
Eremophila warnesii	534037	7147167	20	14/09/2011	Project Area
Eremophila warnesii	534065	7147176	25	14/09/2011	Project Area
Eremophila warnesii	534076	7147149	35	14/09/2011	Project Area
Eremophila warnesii	534106	7147178	50	14/09/2011	Project Area
Eremophila warnesii	534109	7147156	40	14/09/2011	Project Area
Eremophila warnesii	534130	7147126	100	14/09/2011	Project Area
Eremophila warnesii	534142	7147109	10	14/09/2011	Project Area
Eremophila warnesii	534149	7147159	50	14/09/2011	Project Area
Eremophila warnesii	534262	7147038	30	14/09/2011	Project Area
Eremophila warnesii	534277	7146752	15	14/09/2011	Project Area
Eremophila warnesii	534278	7146736	31	14/09/2011	Project Area
Eremophila warnesii	534295	7146954	45	14/09/2011	Project Area
Eremophila warnesii	534297	7146821	2	14/09/2011	Project Area

Taxon	GPS E	GPS N	No. of Individuals	Date Collected	Record Location
Eremophila warnesii	534301	7146714	110	14/09/2011	Project Area
Eremophila warnesii	534304	7146696	15	14/09/2011	Project Area
Eremophila warnesii	534304	7146751	30	14/09/2011	Project Area
Eremophila warnesii	534307	7146735	100	14/09/2011	Project Area
Eremophila warnesii	534310	7146927	14	14/09/2011	Project Area
Eremophila warnesii	534326	7146783	10	14/09/2011	Project Area
Eremophila warnesii	534327	7146876	11	14/09/2011	Project Area
Eremophila warnesii	534330	7146713	43	14/09/2011	Project Area
Eremophila warnesii	534333	7146738	55	14/09/2011	Project Area
Eremophila warnesii	534334	7146758	40	14/09/2011	Project Area
Eremophila warnesii	534334	7146814	11	14/09/2011	Project Area
Eremophila warnesii	534345	7146893	2	14/09/2011	Project Area
Eremophila warnesii	534351	7146987	100	14/09/2011	Project Area
Eremophila warnesii	534351	7147005	100	14/09/2011	Project Area
Eremophila warnesii	534355	7146937	250	14/09/2011	Project Area
Eremophila warnesii	534355	7146948	150	14/09/2011	Project Area
Eremophila warnesii	534359	7146862	90	14/09/2011	Project Area
Eremophila warnesii	534360	7146746	55	14/09/2011	Project Area
Eremophila warnesii	534360	7146769	200	14/09/2011	Project Area
Eremophila warnesii	534360	7146909	75	14/09/2011	Project Area
Eremophila warnesii	534363	7146821	65	14/09/2011	Project Area
Eremophila warnesii	534376	7147051	60	14/09/2011	Project Area
Eremophila warnesii	534379	7147103	35	14/09/2011	Project Area
Eremophila warnesii	534391	7146887	15	14/09/2011	Project Area
Eremophila warnesii	534392	7146865	65	14/09/2011	Project Area
Eremophila warnesii	534392	7146837	28	14/09/2011	Project Area
Eremophila warnesii	534394	7146820	15	14/09/2011	Project Area
Eremophila warnesii	534400	7147002	250	14/09/2011	Project Area
Eremophila warnesii	534401	7146781	14	14/09/2011	Project Area
Eremophila warnesii	534410	7146840	37	14/09/2011	Project Area
Eremophila warnesii	534413	7146742	6	14/09/2011	Project Area

Taxon	GPS E	GPS N	No. of Individuals	Date Collected	Record Location
Eremophila warnesii	534413	7147055	12	14/09/2011	Project Area
Eremophila warnesii	534420	7146829	26	14/09/2011	Project Area
Eremophila warnesii	534426	7146907	100	14/09/2011	Project Area
Eremophila warnesii	534436	7146809	12	14/09/2011	Project Area
Eremophila warnesii	534436	7147008	100	14/09/2011	Project Area
Eremophila warnesii	534442	7146774	16	14/09/2011	Project Area
Eremophila warnesii	534452	7146959	120	14/09/2011	Project Area
Eremophila warnesii	534454	7147060	15	14/09/2011	Project Area
Eremophila warnesii	534473	7147016	100	14/09/2011	Project Area
Eremophila warnesii	534481	7146906	100	14/09/2011	Project Area
Eremophila warnesii	534482	7146959	60	14/09/2011	Project Area
Eremophila warnesii	534488	7147077	7	14/09/2011	Project Area
Eremophila warnesii	534529	7147004	200	14/09/2011	Project Area
Eremophila warnesii	534532	7146948	250	14/09/2011	Project Area
Eremophila warnesii	534535	7147059	100	14/09/2011	Project Area
Eremophila warnesii	534571	7146918	200	14/09/2011	Project Area
Eremophila warnesii	534573	7147102	30	14/09/2011	Project Area
Eremophila warnesii	534577	7147052	150	14/09/2011	Project Area
Eremophila warnesii	534600	7146961	250	14/09/2011	Project Area
Eremophila warnesii	534603	7146900	200	14/09/2011	Project Area
Eremophila warnesii	534605	7147036	200	14/09/2011	Project Area
Eremophila warnesii	534607	7147083	30	14/09/2011	Project Area
Eremophila warnesii	534614	7146793	200	14/09/2011	Project Area
Eremophila warnesii	534629	7147073	20	14/09/2011	Project Area
Eremophila warnesii	534637	7146800	200	14/09/2011	Project Area
Eremophila warnesii	534639	7146654	1 (dead)	14/09/2011	Project Area
Eremophila warnesii	534644	7147063	20	14/09/2011	Project Area
Eremophila warnesii	534647	7147022	100	14/09/2011	Project Area
Eremophila warnesii	534651	7146882	100	14/09/2011	Project Area
Eremophila warnesii	534654	7147104	9	14/09/2011	Project Area
Eremophila warnesii	534673	7147042	40	14/09/2011	Project Area

Taxon	GPS E	GPS N	No. of Individuals	Date Collected	Record Location
Eremophila warnesii	534677	7147090	12	14/09/2011	Project Area
Eremophila warnesii	534679	7147145	13	14/09/2011	Project Area
Eremophila warnesii	534681	7146608	3	14/09/2011	Project Area
Eremophila warnesii	534690	7146784	80	14/09/2011	Project Area
Eremophila warnesii	534693	7146849	100	14/09/2011	Project Area
Eremophila warnesii	534699	7146662	1	14/09/2011	Project Area
Eremophila warnesii	534702	7146753	1	14/09/2011	Project Area
Eremophila warnesii	534705	7146768	2	14/09/2011	Project Area
Eremophila warnesii	534709	7147133	6	14/09/2011	Project Area
Eremophila warnesii	534716	7146799	65	14/09/2011	Project Area
Eremophila warnesii	534717	7146725	2	14/09/2011	Project Area
Eremophila warnesii	534724	7146784	14	14/09/2011	Project Area
Eremophila warnesii	534729	7146838	100	14/09/2011	Project Area
Eremophila warnesii	534741	7146749	1	14/09/2011	Project Area
Eremophila warnesii	534771	7146821	50	14/09/2011	Project Area
Eremophila warnesii	534814	7146858	250	14/09/2011	Project Area
Eremophila warnesii	534842	7146834	150	14/09/2011	Project Area
Eremophila warnesii	533396	7146639	3	15/09/2011	Project Area
Eremophila warnesii	533420	7146641	1	15/09/2011	Project Area
Eremophila warnesii	533445	7146661	7	15/09/2011	Project Area
Eremophila warnesii	533561	7146688	11	15/09/2011	Project Area
Eremophila warnesii	533600	7146658	3	15/09/2011	Project Area
Eremophila warnesii	533624	7146678	25	15/09/2011	Project Area
Eremophila warnesii	533647	7146734	1	15/09/2011	Project Area
Eremophila warnesii	533657	7146693	25	15/09/2011	Project Area
Eremophila warnesii	533657	7146670	30	15/09/2011	Project Area
Eremophila warnesii	533668	7146748	1	15/09/2011	Project Area
Eremophila warnesii	533681	7146675	29	15/09/2011	Project Area
Eremophila warnesii	533708	7146684	15	15/09/2011	Project Area
Eremophila warnesii	533719	7146663	19	15/09/2011	Project Area
Eremophila warnesii	533748	7146672	13	15/09/2011	Project Area

Taxon	GPS E	GPS N	No. of Individuals	Date Collected	Record Location
Eremophila warnesii	533779	7147698	2	15/09/2011	Project Area
Eremophila warnesii	533790	7146724	1	15/09/2011	Project Area
Eremophila warnesii	533791	7146663	49	15/09/2011	Project Area
Eremophila warnesii	533817	7146654	45	15/09/2011	Project Area
Eremophila warnesii	533902	7147616	80	15/09/2011	Project Area
Eremophila warnesii	533917	7147593	45	15/09/2011	Project Area
Eremophila warnesii	533931	7147642	18	15/09/2011	Project Area
Eremophila warnesii	533934	7147618	35	15/09/2011	Project Area
Eremophila warnesii	533938	7147561	26	15/09/2011	Project Area
Eremophila warnesii	533943	7147532	31	15/09/2011	Project Area
Eremophila warnesii	533947	7147600	39	15/09/2011	Project Area
Eremophila warnesii	533948	7147516	21	15/09/2011	Project Area
Eremophila warnesii	533964	7147543	2	15/09/2011	Project Area
Eremophila warnesii	533965	7147620	17	15/09/2011	Project Area
Eremophila warnesii	533966	7147511	25	15/09/2011	Project Area
Eremophila warnesii	534010	7147494	1	15/09/2011	Project Area
Eremophila warnesii	534057	7147500	3	15/09/2011	Project Area
Eremophila warnesii	534117	7147441	16	15/09/2011	Project Area
Eremophila warnesii	534380	7147177	2	15/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533039	7145810	7	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533042	7145888	10	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533045	7145887	3	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533061	7145744	5	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533064	7145889	27	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533065	7145878	5	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533066	7145748	4	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533067	7145723	1	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533069	7145762	4	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533069	7145771	10	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533070	7146127	6	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533075	7145828	1	09/08/2011	Project Area

Taxon	GPS E	GPS N	No. of Individuals	Date Collected	Record Location
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533077	7145748	5	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533077	7145901	6	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533079	7146130	3	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533080	7145782	2	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533081	7145770	8	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533081	7145853	6	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533081	7145850	4	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533082	7145672	10	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533082	7146117	8	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533083	7145731	7	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533085	7146141	6	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533086	7145875	6	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533087	7145807	1	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533088	7145708	5	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533088	7145725	6	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533088	7146155	1	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533090	7145842	15	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533091	7145906	3	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533091	7145901	3	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533093	7145679	6	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533093	7146130	1	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533093	7146123	2	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533099	7145915	2	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533101	7145830	20	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533102	7145759	12	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533102	7145849	56	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533102	7145879	10	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533102	7145929	1	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533103	7145731	45	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533104	7145614	6	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533104	7145664	31	09/08/2011	Project Area

Taxon	GPS E	GPS N	No. of Individuals	Date Collected	Record Location
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533104	7145684	50	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533104	7145718	20	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533107	7146154	5	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533117	7146200	4	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533118	7145635	20	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533119	7145598	10	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533119	7145615	4	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533119	7145652	7	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533119	7145668	6	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533119	7145698	9	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533119	7146131	5	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533120	7146112	7	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533121	7145710	22	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533121	7145722	25	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533121	7145778	12	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533121	7145805	2	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533121	7145856	4	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533121	7145867	11	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533121	7145886	1	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533122	7145828	8	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533122	7145737	20	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533122	7145752	15	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533122	7145766	11	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533123	7146125	19	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533124	7145843	3	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533125	7145688	8	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533126	7145962	1	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533132	7146170	2	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533137	7145637	7	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533139	7145731	35	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533139	7145817	34	09/08/2011	Project Area

Taxon	GPS E	GPS N	No. of Individuals	Date Collected	Record Location
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533139	7145859	3	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533140	7145662	11	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533140	7145712	40	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533140	7145743	53	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533140	7145760	37	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533140	7145776	47	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533140	7145794	21	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533140	7145833	33	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533141	7145596	1	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533141	7145684	23	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533141	7145695	14	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533144	7145615	10	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533148	7146219	2	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533149	7146187	1	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533150	7146268	4	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533151	7146243	1	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533151	7146115	10	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533152	7146214	5	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533153	7146136	14	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533156	7145715	28	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533157	7145890	1	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533158	7145842	4	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533159	7145802	33	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533159	7145737	14	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533159	7145646	6	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533160	7145676	25	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533160	7145588	17	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533161	7145778	6	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533163	7145568	2	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533164	7145823	18	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533166	7146109	20	09/08/2011	Project Area

Taxon	GPS E	GPS N	No. of Individuals	Date Collected	Record Location
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533167	7146119	18	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533170	7146253	5	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533170	7146175	10	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533170	7146134	9	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533171	7146103	10	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533172	7146062	1	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533173	7146221	10	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533173	7146188	32	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533173	7145908	1	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533174	7146301	6	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533174	7146205	20	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533175	7145834	1	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533176	7146287	8	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533177	7146274	8	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533179	7145794	3	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533180	7145773	8	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533180	7145708	10	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533187	7146248	8	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533187	7146325	5	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533188	7146116	18	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533188	7146188	37	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533188	7146211	20	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533189	7145710	5	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533189	7146284	10	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533189	7146091	17	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533189	7146228	3	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533190	7145721	10	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533191	7145739	25+	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533192	7145679	2	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533192	7146081	1	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533193	7145726	13	09/08/2011	Project Area

Taxon	GPS E	GPS N	No. of Individuals	Date Collected	Record Location
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533193	7146136	14	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533193	7146162	26	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533194	7145692	4	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533197	7146105	15	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533197	7146156	8	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533198	7145838	3	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533202	7145814	1	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533202	7145779	5	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533203	7145579	4	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533203	7146233	1	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533204	7145763	10	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533206	7145791	2	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533206	7146333	3	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533206	7146341	8	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533207	7145745	10	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533207	7146348	5	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533208	7145548	1	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533208	7146209	30	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533210	7146362	6	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533211	7146253	1	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533214	7146107	20+	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533216	7145624	2	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533217	7145758	30	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533218	7146098	11	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533219	7145707	4	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533219	7145679	3	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533219	7145650	7	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533219	7146126	6	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533219	7146167	30+	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533220	7145842	19	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533220	7145816	10	09/08/2011	Project Area

Taxon	GPS E	GPS N	No. of Individuals	Date Collected	Record Location
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533221	7145743	54	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533224	7145793	23	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533224	7146090	2	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533238	7145593	2	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533239	7145803	2	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533239	7145745	42	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533239	7145713	3	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533240	7145812	4	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533240	7145780	38	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533240	7145683	4	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533240	7145656	3	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533240	7145630	1	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533240	7145567	7	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533241	7145675	3	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533241	7146118	3	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533242	7146082	3	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533243	7145780	2	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533243	7145643	1	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533244	7146341	27	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533244	7145550	1	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533246	7146077	9	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533247	7146295	32	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533248	7146115	2	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533250	7146271	17	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533250	7146400	12	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533251	7146369	26	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533253	7146170	2	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533254	7146223	4	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533256	7146154	4	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533256	7145756	20	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533256	7146155	2	09/08/2011	Project Area

Taxon	GPS E	GPS N	No. of Individuals	Date Collected	Record Location
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533258	7145980	2	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533258	7145733	52	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533259	7145917	3	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533259	7145787	7	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533259	7145714	11	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533259	7145650	8	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533259	7145616	5	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533260	7145690	15	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533260	7145674	23	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533262	7145907	4	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533263	7145811	5	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533264	7145586	5	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533269	7146277	8	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533269	7146404	6	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533270	7146192	3	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533270	7146222	6	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533270	7146297	10	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533270	7146313	9	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533270	7146355	12	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533271	7146089	7	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533271	7146172	2	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533271	7146210	2	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533271	7146259	3	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533272	7145978	3	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533272	7146076	3	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533272	7146329	7	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533272	7146344	7	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533272	7146384	18	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533272	7146446	3	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533273	7146370	20	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533282	7145983	1	09/08/2011	Project Area

Taxon	GPS E	GPS N	No. of Individuals	Date Collected	Record Location
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533285	7146395	4	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533287	7146090	3	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533287	7146458	5	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533287	7146474	2	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533288	7146285	10	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533288	7146374	37	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533288	7146378	15	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533289	7146222	4	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533289	7146255	2	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533289	7146304	18	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533289	7146325	14	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533289	7146347	30	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533290	7146192	4	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533291	7145961	2	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533291	7146001	2	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533292	7146100	4	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533295	7146032	2	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533296	7145590	8	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533297	7145540	1	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533304	7145503	1	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533305	7145490	4	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533305	7146035	2	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533306	7145489	1	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533306	7146505	14	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533308	7146195	6	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533308	7146094	3	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533308	7146004	2	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533309	7146369	18	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533309	7145978	2	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533310	7146289	12	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533311	7146339	29	09/08/2011	Project Area

Taxon	GPS E	GPS N	No. of Individuals	Date Collected	Record Location
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533311	7146212	11	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533312	7146483	6	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533313	7146427	4	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533313	7146250	3	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533314	7146267	3	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533315	7146316	27	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533316	7146445	2	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533317	7145979	1	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533321	7145961	1	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533324	7146402	1	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533328	7146514	3	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533328	7146368	9	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533330	7146532	5	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533331	7146481	9	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533331	7146329	30+	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533332	7146256	5	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533333	7146548	20+	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533333	7146306	20+	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533336	7146172	1	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533339	7146456	4	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533345	7146529	6	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533347	7146265	2	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533349	7146461	6	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533350	7146482	5	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533350	7146307	5	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533352	7146345	3	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533359	7146329	4	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533364	7146547	4	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533370	7146270	9	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533371	7146562	1	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533371	7146241	3	09/08/2011	Project Area

Taxon	GPS E	GPS N	No. of Individuals	Date Collected	Record Location
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533371	7146198	1	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533372	7146344	7	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533372	7146507	3	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533373	7146392	4	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533374	7146318	10	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533375	7146507	4	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533375	7146465	10	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533389	7146344	1	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533390	7146498	13	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533390	7146449	1	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533390	7146064	1	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533391	7146606	3	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533391	7146558	3	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533391	7146525	5	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533391	7146465	7	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533391	7146307	1	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533391	7146251	9	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533393	7146573	2	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533407	7146211	1	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533407	7146179	1	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533408	7146526	2	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533408	7146237	4	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533409	7146450	9	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533410	7146494	10	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533411	7146561	1	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533411	7146066	1	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533412	7146041	6	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533412	7146026	4	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533413	7146583	6	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533414	7146466	7	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533415	7146350	6	09/08/2011	Project Area

Taxon	GPS E	GPS N	No. of Individuals	Date Collected	Record Location
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533415	7146053	5	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533431	7146069	1	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533432	7146036	14	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533452	7146057	1	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533453	7146088	15+	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533468	7146048	5	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533474	7146044	14	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533483	7146048	3	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533487	7146018	2	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533489	7146043	2	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533495	7145997	1	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533511	7146031	1	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533533	7146074	2	09/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533276	7145920	1	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533279	7145630	9	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533281	7145573	2	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533281	7145732	35	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533281	7145760	3	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533281	7145790	16	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533282	7145499	7	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533282	7145558	6	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533282	7145670	10	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533283	7145531	9	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533286	7145707	4	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533291	7145727	3	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533294	7145789	1	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533294	7145801	1	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533299	7145685	1	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533299	7145709	11	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533300	7145655	1	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533300	7145834	1	10/08/2011	Project Area

Taxon	GPS E	GPS N	No. of Individuals	Date Collected	Record Location
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533302	7145751	7	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533303	7145719	15	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533303	7145769	3	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533303	7145774	5	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533304	7145575	3	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533304	7145743	4	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533305	7145805	1	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533306	7145738	3	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533306	7145826	5	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533307	7145562	11	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533308	7145655	2	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533309	7145814	3	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533315	7145727	6	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533315	7145741	12	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533317	7145466	2	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533317	7145718	25	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533318	7145774	8	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533321	7145768	16	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533322	7145524	6	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533322	7145558	12	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533323	7145492	7	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533323	7145590	4	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533323	7145671	15	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533324	7145433	2	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533325	7145798	17	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533326	7145582	14	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533328	7145416	8	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533330	7145613	4	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533333	7145601	15	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533334	7145733	10	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533336	7145764	5	10/08/2011	Project Area

Taxon	GPS E	GPS N	No. of Individuals	Date Collected	Record Location
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533337	7145829	4	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533339	7145456	37	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533339	7145496	65	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533339	7145795	9	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533340	7145671	4	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533341	7145514	45	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533341	7145575	66	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533341	7145643	4	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533341	7145702	10	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533345	7145439	33	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533349	7145417	14	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533358	7145470	12	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533358	7145812	1	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533359	7145647	1	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533360	7145460	18	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533360	7145575	7	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533360	7145637	1	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533360	7145666	2	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533360	7145699	2	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533361	7145425	24	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533361	7145489	16	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533361	7145529	18	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533361	7145558	10	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533361	7145746	1	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533361	7145854	3	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533362	7145395	5	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533362	7145411	11	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533362	7145446	32	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533363	7145511	20	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533363	7145540	24	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533363	7145599	14	10/08/2011	Project Area

Taxon	GPS E	GPS N	No. of Individuals	Date Collected	Record Location
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533377	7145840	3	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533378	7145635	11	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533379	7145378	11	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533379	7145614	20	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533380	7145465	22	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533380	7145489	35	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533380	7145700	19	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533380	7145719	4	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533380	7145776	2	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533380	7145803	2	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533381	7145539	50	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533382	7145557	32	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533382	7145581	16	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533382	7145658	2	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533383	7145445	57	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533383	7145516	63	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533384	7145400	7	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533384	7145419	41	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533398	7145426	23	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533399	7145604	12	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533400	7145477	63	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533400	7145446	41	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533401	7145682	2	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533401	7145561	38	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533401	7145542	40	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533401	7145402	20	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533402	7145730	3	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533402	7145520	71	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533407	7145625	16	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533415	7145438	20	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533418	7145655	10	10/08/2011	Project Area

Taxon	GPS E	GPS N	No. of Individuals	Date Collected	Record Location
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533419	7145607	25	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533420	7145527	20	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533421	7145777	3	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533421	7145458	10	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533422	7145749	4	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533423	7145684	10	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533423	7145635	25	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533423	7145549	20	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533424	7145571	25	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533424	7145488	25	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533424	7145409	10	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533426	7145749	15	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533426	7145703	16	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533428	7145811	1	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533433	7145818	3	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533434	7145677	5	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533434	7145478	15	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533437	7145708	3	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533438	7145534	30	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533439	7145556	30	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533440	7145583	20	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533440	7145410	10	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533441	7145751	20	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533441	7145640	21	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533442	7145516	16	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533444	7145611	20	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533446	7145361	5	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533447	7145809	2	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533455	7145743	13	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533455	7145394	15	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533459	7145687	9	10/08/2011	Project Area

Taxon	GPS E	GPS N	No. of Individuals	Date Collected	Record Location
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533459	7145624	40	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533459	7145583	53	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533459	7145527	60	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533460	7145654	15	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533461	7145555	24	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533461	7145499	90	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533461	7145458	7	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533462	7145721	13	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533462	7145424	1	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533465	7145353	3	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533478	7145582	57	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533478	7145543	48	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533479	7145667	37	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533479	7145634	43	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533479	7145524	27	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533479	7145495	47	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533479	7145362	1	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533480	7145700	21	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533480	7145461	3	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533481	7145612	54	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533481	7145384	5	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533482	7145718	4	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533482	7145479	10	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533497	7145691	87	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533498	7145773	3	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533498	7145614	48	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533498	7145585	48	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533499	7145784	4	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533499	7145712	37	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533500	7145737	12	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533500	7145674	50	10/08/2011	Project Area

Taxon	GPS E	GPS N	No. of Individuals	Date Collected	Record Location
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533500	7145647	31	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533500	7145550	77	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533501	7145480	19	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533502	7145823	3	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533502	7145536	20	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533502	7145499	33	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533503	7145870	2	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533512	7145957	3	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533517	7145509	10	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533517	7145539	23	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533517	7145648	23	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533519	7145560	17	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533521	7145850	18	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533522	7145604	8	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533522	7145690	52	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533522	7145793	19	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533523	7145626	22	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533523	7145719	28	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533525	7145824	14	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533526	7145754	8	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533527	7145867	2	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533533	7145522	1	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533533	7145709	10	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533534	7145536	10	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533538	7145602	15	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533541	7145817	9	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533542	7145542	10	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533543	7145530	10	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533544	7145658	10	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533544	7145686	5	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533544	7145871	2	10/08/2011	Project Area

Taxon	GPS E	GPS N	No. of Individuals	Date Collected	Record Location
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533546	7145801	25	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533547	7145746	20	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533547	7145847	5	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533549	7145632	10	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533556	7145753	6	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533558	7145780	5	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533559	7145802	10	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533561	7145779	5	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533564	7145869	15	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533565	7145880	10	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533570	7145722	5	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533570	7145844	10	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533578	7145551	4	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533578	7145762	33	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533579	7145496	5	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533580	7145520	16	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533581	7145865	57	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533583	7145831	29	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533599	7146201	3	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533600	7145774	5	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533600	7145864	31	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533602	7145852	21	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533603	7145824	5	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533603	7145837	18	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533603	7145882	2	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533605	7145354	3	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533616	7145863	61	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533618	7145395	3	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533618	7145780	8	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533619	7145744	26	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533619	7145808	7	10/08/2011	Project Area

Taxon	GPS E	GPS N	No. of Individuals	Date Collected	Record Location
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533620	7145515	2	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533621	7145360	16	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533621	7145700	27	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533621	7145726	18	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533621	7145759	7	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533621	7145839	46	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533622	7145660	18	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533622	7145685	27	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533622	7145884	23	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533622	7145895	3	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533640	7145884	23	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533640	7145866	36	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533640	7145660	14	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533641	7145743	33	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533641	7145732	27	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533642	7145845	51	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533643	7145761	7	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533644	7145712	7	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533645	7145687	35	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533646	7145640	7	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533658	7145856	8	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533659	7145873	4	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533659	7145840	20	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533659	7145757	6	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533662	7145703	3	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533662	7145682	20	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533662	7145659	7	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533663	7145736	2	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533674	7145854	2	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533675	7145611	1	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533677	7145758	2	10/08/2011	Project Area

Taxon	GPS E	GPS N	No. of Individuals	Date Collected	Record Location
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533677	7145680	6	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533683	7145653	10	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533699	7145651	3	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533771	7145762	1	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533780	7146582	2	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533851	7146232	10	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533886	7146250	4	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533899	7146280	1	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533949	7146307	3	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534276	7145677	1	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534392	7145905	7	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534417	7146015	2	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534425	7145876	2	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534426	7145848	5	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534434	7145867	1	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534435	7145914	6	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534443	7146001	1	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534447	7145945	4	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534471	7145880	3	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534480	7145996	1	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534488	7145991	2	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534498	7145909	10	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534510	7145905	11	10/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533409	7147120	5	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533424	7147140	2	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533427	7147100	4	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533443	7147338	4	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533446	7147152	1	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533460	7147075	5	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533461	7147193	8	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533462	7147298	5	11/08/2011	Project Area

Taxon	GPS E	GPS N	No. of Individuals	Date Collected	Record Location
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533474	7146823	4	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533482	7147113	3	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533482	7147042	11	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533482	7147133	6	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533483	7146082	6	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533483	7147418	2	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533496	7147298	2	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533504	7147330	1	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533507	7147271	7	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533508	7147017	10	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533509	7147085	5	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533509	7147397	17	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533510	7147360	7	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533525	7146895	10	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533527	7147110	10	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533529	7146994	2	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533529	7146866	5	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533530	7147242	13	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533531	7147168	15	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533534	7146084	8	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533538	7147057	14	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533541	7146813	1	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533547	7147290	2	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533549	7147349	16	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533550	7146970	13	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533551	7147032	5	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533556	7147205	22	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533557	7146078	18	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533561	7147389	1	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533566	7147278	10	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533567	7147075	10	11/08/2011	Project Area

Taxon	GPS E	GPS N	No. of Individuals	Date Collected	Record Location
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533569	7146866	10	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533579	7146083	11	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533580	7146969	5	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533580	7146894	4	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533583	7147136	8	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533588	7147003	1	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533588	7147253	37	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533588	7147031	6	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533591	7146825	2	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533592	7146078	1	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533593	7147196	25	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533604	7147227	8	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533607	7146882	15	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533612	7147170	40	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533615	7146804	5	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533627	7147211	17	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533635	7147092	3	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533637	7146871	2	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533644	7146902	5	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533645	7147141	17	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533652	7147179	12	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533656	7146842	10	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533657	7146958	6	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533666	7146884	12	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533674	7147152	4	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533679	7147065	20	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533689	7146936	5	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533696	7146973	8	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533697	7147006	8	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533712	7147071	11	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533713	7147127	3	11/08/2011	Project Area

Taxon	GPS E	GPS N	No. of Individuals	Date Collected	Record Location
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533717	7147050	9	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533722	7146931	1	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533725	7147010	2	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534146	7146646	2	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534161	7146614	15	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534165	7146581	18	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534173	7146562	4	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534176	7146436	11	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534177	7146424	10	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534180	7146627	5	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534183	7146642	2	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534183	7146603	2	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534184	7146578	6	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534185	7146405	6	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534190	7146481	3	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534190	7146546	10	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534198	7146497	4	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534199	7146398	4	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534202	7146575	1	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534208	7146563	3	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534210	7146477	7	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534210	7146459	9	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534211	7146439	1	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534212	7146540	31	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534213	7146420	3	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534213	7146598	14	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534223	7146522	10	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534224	7146483	1	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534224	7146442	7	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534224	7146575	6	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534226	7146399	4	11/08/2011	Project Area

Taxon	GPS E	GPS N	No. of Individuals	Date Collected	Record Location
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534228	7146600	2	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534233	7146456	2	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534235	7146558	16	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534238	7146520	5	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534239	7146576	4	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534240	7146505	6	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534241	7146419	3	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534244	7146439	2	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534246	7146559	2	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534248	7146438	3	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534254	7146446	2	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534255	7146399	1	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534255	7146521	8	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534258	7146541	12	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534262	7146483	10	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534263	7146348	5	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534265	7146378	3	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534271	7146353	3	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534271	7146328	5	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534273	7146401	7	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534277	7146498	15	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534279	7146303	1	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534281	7146421	13	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534281	7146332	18	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534284	7146360	5	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534285	7146399	1	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534288	7146378	10	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534288	7146330	3	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534305	7146301	3	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534310	7146386	10	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534311	7146479	4	11/08/2011	Project Area

Taxon	GPS E	GPS N	No. of Individuals	Date Collected	Record Location
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534313	7146400	24	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534317	7146359	9	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534318	7146508	1	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534318	7146344	12	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534324	7146439	7	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534325	7146283	30	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534330	7146404	23	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534330	7146422	62	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534333	7146377	20	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534334	7146267	3	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534341	7146342	4	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534342	7146301	27	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534343	7146406	4	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534344	7146321	5	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534344	7146365	25	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534344	7146253	3	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534346	7146461	3	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534348	7146441	7	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534354	7146401	14	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534354	7146382	10	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534359	7146284	2	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534361	7146423	20	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534363	7146337	8	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534364	7146318	4	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534369	7146360	20	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534369	7146458	1	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534370	7146443	5	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534373	7146378	5	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534376	7146402	7	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534377	7146279	1	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534384	7146340	13	11/08/2011	Project Area

Taxon	GPS E	GPS N	No. of Individuals	Date Collected	Record Location
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534386	7146319	5	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534386	7146240	24	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534387	7146440	11	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534389	7146378	10	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534389	7146360	35	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534390	7146299	22	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534390	7146265	3	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534393	7146418	26	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534396	7146279	5	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534398	7146220	14	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534400	7146364	26	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534400	7146343	14	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534403	7146245	19	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534407	7146200	11	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534407	7146318	11	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534412	7146384	5	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534412	7146359	5	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534413	7146241	30	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534415	7146279	6	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534418	7146205	25	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534422	7146164	1	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534422	7146260	30	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534425	7146401	2	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534427	7146222	25	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534429	7146281	20	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534430	7146300	31	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534430	7146144	3	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534430	7146242	26	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534431	7146201	11	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534432	7146158	14	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534437	7146400	2	11/08/2011	Project Area

Taxon	GPS E	GPS N	No. of Individuals	Date Collected	Record Location
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534439	7146178	44	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534442	7146317	7	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534444	7146259	5	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534444	7146244	40	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534444	7146360	2	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534446	7146278	10	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534446	7146202	32	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534449	7146122	5	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534449	7146223	38	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534452	7146161	19	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534452	7146420	5	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534459	7146318	5	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534464	7146148	10	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534465	7146101	13	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534467	7146163	10	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534467	7146279	8	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534467	7146200	12	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534468	7146178	48	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534468	7146260	15	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534468	7146241	29	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534469	7146117	10	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534474	7146300	39	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534474	7146221	49	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534479	7146161	18	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534480	7146104	44	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534482	7146201	19	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534482	7146140	15	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534483	7146279	10	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534483	7146117	19	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534486	7146259	12	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534493	7146185	14	11/08/2011	Project Area

Taxon	GPS E	GPS N	No. of Individuals	Date Collected	Record Location
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534494	7146222	35	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534496	7146204	9	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534497	7146242	23	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534499	7146302	8	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534500	7146281	14	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534501	7146141	30	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534501	7146258	20	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534502	7146159	2	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534502	7146103	16	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534503	7146320	21	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534506	7146126	27	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534509	7146200	26	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534514	7146283	2	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534515	7146178	34	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534517	7146157	11	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534519	7146317	10	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534520	7146220	6	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534521	7146139	15	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534522	7146200	17	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534523	7146240	2	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534524	7146100	3	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534531	7146159	3	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534531	7146061	3	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534531	7146114	16	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534534	7146203	8	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534535	7146177	7	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534549	7146199	4	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534549	7146097	33	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534569	7146117	23	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534572	7146045	1	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534575	7146059	1	11/08/2011	Project Area

Taxon	GPS E	GPS N	No. of Individuals	Date Collected	Record Location
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534575	7146100	45	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534582	7146199	10	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534583	7146158	56	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534583	7146180	105	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534583	7146117	45	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534586	7146138	20	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534594	7146158	64	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534597	7146199	3	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534601	7146119	100	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534602	7146099	27	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534605	7146005	9	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534609	7146160	52	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534609	7146201	7	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534611	7146180	34	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534619	7146138	50	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534621	7146127	70	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534623	7146180	6	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534627	7146159	47	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534630	7146186	1	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534636	7146120	29	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534641	7146178	3	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534646	7146161	22	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534646	7146145	35	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534656	7146144	7	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534667	7146166	4	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534691	7146000	1	11/08/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533849	7146745	7	13/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533849	7146835	19	13/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533852	7146698	5	13/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533862	7146909	1	13/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533882	7146768	3	13/09/2011	Project Area

Taxon	GPS E	GPS N	No. of Individuals	Date Collected	Record Location
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533882	7146832	17	13/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533884	7146906	1	13/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533910	7146858	7	13/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533911	7146820	4	13/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533911	7146901	2	13/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533912	7146790	2	13/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533914	7146754	6	13/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533932	7146885	3	13/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533968	7146794	2	13/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533969	7146854	1	13/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533973	7146901	1	13/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533973	7146950	15	13/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533996	7146957	7	13/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533996	7146937	7	13/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533997	7146816	3	13/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533998	7146750	3	13/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534000	7146791	8	13/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534013	7146974	5	13/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534028	7146892	7	13/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534029	7146944	27	13/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534029	7146911	23	13/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534036	7146973	15	13/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534059	7146920	30	13/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534085	7146952	50	13/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534090	7146742	4	13/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534090	7146770	42	13/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534092	7146798	55	13/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534092	7146811	1	13/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534122	7146788	25	13/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534123	7146804	10	13/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534126	7146767	40	13/09/2011	Project Area

Taxon	GPS E	GPS N	No. of Individuals	Date Collected	Record Location
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534151	7146799	16	13/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534156	7146778	30	13/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534179	7146820	11	13/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534207	7146788	38	13/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534210	7146825	1	13/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534214	7146806	15	13/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534274	7146839	1	13/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534796	7146308	2	13/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534831	7146604	1	13/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534839	7146438	3	13/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534850	7146631	2	13/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533670	7146811	10	14/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533692	7146822	9	14/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533830	7146855	1	14/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533979	7147130	1	14/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533988	7147097	1	14/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533994	7147000	9	14/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534014	7146977	7	14/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534020	7147040	3	14/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534025	7146956	14	14/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534053	7147006	4	14/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534063	7146987	6	14/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534066	7147039	7	14/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534074	7146857	2	14/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534080	7146964	30	14/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534087	7146932	15	14/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534095	7146907	30	14/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534115	7146974	20	14/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534115	7146839	3	14/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534130	7146942	80	14/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534143	7146911	61	14/09/2011	Project Area

Taxon	GPS E	GPS N	No. of Individuals	Date Collected	Record Location
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534151	7146862	8	14/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534177	7146835	5	14/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533403	7146472	32	15/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533404	7146531	1	15/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533405	7146508	26	15/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533408	7146612	3	15/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533413	7146585	15	15/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533413	7146566	5	15/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533431	7146543	2	15/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533446	7146522	30	15/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533449	7146599	10	15/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533457	7146495	50	15/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533459	7146583	3	15/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533476	7146651	2	15/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533487	7146580	2	15/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533493	7146560	17	15/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533494	7146509	35	15/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533512	7146604	4	15/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533516	7146656	10	15/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533517	7146564	4	15/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533523	7146627	14	15/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533523	7146522	16	15/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533535	7146616	2	15/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533561	7146688	6	15/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533567	7146757	4	15/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533600	7146658	4	15/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533606	7146780	1	15/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533611	7146651	5	15/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533612	7146619	2	15/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533620	7146623	2	15/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533622	7146755	1	15/09/2011	Project Area

Taxon	GPS E	GPS N	No. of Individuals	Date Collected	Record Location
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533623	7146720	3	15/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533638	7146797	2	15/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533643	7146603	4	15/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533645	7146690	9	15/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533657	7146744	1	15/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533657	7146670	4	15/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533659	7146778	5	15/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533681	7146675	2	15/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533683	7146617	24	15/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533694	7146728	16	15/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533696	7146796	9	15/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533708	7146654	27	15/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533708	7146684	2	15/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533715	7146602	11	15/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533737	7146700	3	15/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533749	7146623	19	15/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533771	7146820	17	15/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533776	7146690	7	15/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533784	7146766	34	15/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533790	7146724	2	15/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533791	7146663	2	15/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533810	7146833	3	15/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533814	7146745	2	15/09/2011	Project Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	533826	7146717	3	15/09/2011	Project Area
Rhodanthe sphaerocephala	532687	7145679	7	11/08/2011	Project Area
Rhodanthe sphaerocephala	532730	7145659	5	11/08/2011	Project Area
Rhodanthe sphaerocephala	532932	7146872	1	11/08/2011	Project Area
Rhodanthe sphaerocephala	532951	7146844	7	11/08/2011	Project Area
Tribulus adelacanthus	533206	7146307	20	09/08/2011	Project Area
Tribulus adelacanthus	533250	7146401	3	09/08/2011	Project Area
Tribulus adelacanthus	533285	7146395	50	09/08/2011	Project Area

Taxon	GPS E	GPS N	No. of Individuals	Date Collected	Record Location
Tribulus adelacanthus	533287	7146458	50	09/08/2011	Project Area
Tribulus adelacanthus	533287	7146474	30	09/08/2011	Project Area
Tribulus adelacanthus	533288	7146378	5	09/08/2011	Project Area
Tribulus adelacanthus	533288	7146430	10	09/08/2011	Project Area
Tribulus adelacanthus	533375	7146465	2	09/08/2011	Project Area
Tribulus adelacanthus	533391	7146369	5	09/08/2011	Project Area
Tribulus adelacanthus	533415	7146350	10	09/08/2011	Project Area
Tribulus adelacanthus	533382	7145658	10	10/08/2011	Project Area
Tribulus adelacanthus	533464	7145393	5	10/08/2011	Project Area
Tribulus adelacanthus	533576	7146372	1	10/08/2011	Project Area
Tribulus adelacanthus	533648	7146433	3	10/08/2011	Project Area
Tribulus adelacanthus	533757	7146482	10	10/08/2011	Project Area
Tribulus adelacanthus	533589	7147740	50+	11/08/2011	Project Area
Tribulus adelacanthus	533673	7148049	20	11/08/2011	Project Area
Tribulus adelacanthus	534555	7146305	1	11/08/2011	Project Area
Tribulus adelacanthus	534555	7146435	10	11/08/2011	Project Area
Tribulus adelacanthus	534635	7146100	6	11/08/2011	Project Area
Tribulus adelacanthus	533597	7147647	5	14/09/2011	Project Area
Tribulus adelacanthus	533623	7147650	10	14/09/2011	Project Area
Tribulus adelacanthus	533631	7147557	3	14/09/2011	Project Area
Tribulus adelacanthus	533642	7147630	5	14/09/2011	Project Area
Tribulus adelacanthus	533681	7147514	1	14/09/2011	Project Area
Tribulus adelacanthus	533699	7147550	3	14/09/2011	Project Area
Tribulus adelacanthus	533815	7146869	1	14/09/2011	Project Area
Tribulus adelacanthus	533817	7147372	1	14/09/2011	Project Area
Tribulus adelacanthus	533852	7146841	20	14/09/2011	Project Area
Tribulus adelacanthus	533854	7147399	3	14/09/2011	Project Area
Tribulus adelacanthus	533874	7146816	15	14/09/2011	Project Area
Tribulus adelacanthus	533912	7146783	20	14/09/2011	Project Area
Tribulus adelacanthus	533951	7146761	5	14/09/2011	Project Area
Tribulus adelacanthus	534417	7147199	2	14/09/2011	Project Area

Taxon	GPS E	GPS N	No. of Individuals	Date Collected	Record Location
Tribulus adelacanthus	534463	7147206	1	14/09/2011	Project Area
Tribulus adelacanthus	534511	7147210	2	14/09/2011	Project Area
Tribulus adelacanthus	534526	7147208	3	14/09/2011	Project Area
Tribulus adelacanthus	534552	7147193	1	14/09/2011	Project Area
Tribulus adelacanthus	533398	7146561	9	15/09/2011	Project Area
Tribulus adelacanthus	533413	7146585	2	15/09/2011	Project Area
Tribulus adelacanthus	533413	7146566	15	15/09/2011	Project Area
Tribulus adelacanthus	533439	7146575	16	15/09/2011	Project Area
Tribulus adelacanthus	533442	7146547	2	15/09/2011	Project Area
Tribulus adelacanthus	533470	7146604	6	15/09/2011	Project Area
Tribulus adelacanthus	533512	7146604	30	15/09/2011	Project Area
Tribulus adelacanthus	533517	7146585	4	15/09/2011	Project Area
Tribulus adelacanthus	533523	7146522	5	15/09/2011	Project Area
Tribulus adelacanthus	533535	7146616	50	15/09/2011	Project Area
Tribulus adelacanthus	533541	7146633	12	15/09/2011	Project Area
Tribulus adelacanthus	533574	7146630	25	15/09/2011	Project Area
Tribulus adelacanthus	533594	7146703	1	15/09/2011	Project Area
Tribulus adelacanthus	533620	7146623	7	15/09/2011	Project Area
Tribulus adelacanthus	533628	7146559	12	15/09/2011	Project Area
Tribulus adelacanthus	533654	7146639	2	15/09/2011	Project Area
Tribulus adelacanthus	533671	7146610	6	15/09/2011	Project Area
Tribulus adelacanthus	533684	7146582	25	15/09/2011	Project Area
Tribulus adelacanthus	533723	7146784	2	15/09/2011	Project Area
Tribulus adelacanthus	533734	7146609	20	15/09/2011	Project Area
Tribulus adelacanthus	533737	7146700	2	15/09/2011	Project Area
Tribulus adelacanthus	533749	7146623	10	15/09/2011	Project Area
Tribulus adelacanthus	533761	7147696	4	15/09/2011	Project Area
Tribulus adelacanthus	533771	7147656	2	15/09/2011	Project Area
Tribulus adelacanthus	533796	7146639	12	15/09/2011	Project Area
Tribulus adelacanthus	533812	7146807	5	15/09/2011	Project Area
Tribulus adelacanthus	533818	7146778	6	15/09/2011	Project Area

Taxon	GPS E	GPS N	No. of Individuals	Date Collected	Record Location
Tribulus adelacanthus	533823	7146837	1	15/09/2011	Project Area
Tribulus adelacanthus	533830	7146764	5	15/09/2011	Project Area
Tribulus adelacanthus	533897	7146748	10	15/09/2011	Project Area
Tribulus adelacanthus	533957	7148009	17	15/09/2011	Project Area
Tribulus adelacanthus	533963	7147922	4	15/09/2011	Project Area
Tribulus adelacanthus	533970	7147770	22	15/09/2011	Project Area
Tribulus adelacanthus	534009	7147799	4	15/09/2011	Project Area
Tribulus adelacanthus	534016	7147860	20	15/09/2011	Project Area
Tribulus adelacanthus	534029	7147885	5	15/09/2011	Project Area
Tribulus adelacanthus	534033	7147744	35	15/09/2011	Project Area
Tribulus adelacanthus	534042	7147751	20	15/09/2011	Project Area
Tribulus adelacanthus	534066	7147855	40	15/09/2011	Project Area
Tribulus adelacanthus	534077	7147800	2	15/09/2011	Project Area
Tribulus adelacanthus	534077	7147832	5	15/09/2011	Project Area
Tribulus adelacanthus	534085	7148019	3	15/09/2011	Project Area
Tribulus adelacanthus	534091	7147705	10	15/09/2011	Project Area
Tribulus adelacanthus	534099	7147038	3	15/09/2011	Project Area
Tribulus adelacanthus	534104	7147743	10	15/09/2011	Project Area
Tribulus adelacanthus	534151	7147890	3	15/09/2011	Project Area
Tribulus adelacanthus	534151	7147852	30	15/09/2011	Project Area
Tribulus adelacanthus	534161	7147710	4	15/09/2011	Project Area
Tribulus adelacanthus	534166	7148011	10	15/09/2011	Project Area
Tribulus adelacanthus	534178	7147977	15	15/09/2011	Project Area
Tribulus adelacanthus	534182	7147922	4	15/09/2011	Project Area
Tribulus adelacanthus	534185	7147860	10	15/09/2011	Project Area
Tribulus adelacanthus	534194	7147504	1	15/09/2011	Project Area
Tribulus adelacanthus	534198	7147622	30	15/09/2011	Project Area
Tribulus adelacanthus	534199	7147887	7	15/09/2011	Project Area
Tribulus adelacanthus	534216	7147858	10	15/09/2011	Project Area
Tribulus adelacanthus	534217	7147739	5	15/09/2011	Project Area
Tribulus adelacanthus	534224	7147770	2	15/09/2011	Project Area

Taxon	GPS E	GPS N	No. of Individuals	Date Collected	Record Location
Tribulus adelacanthus	534230	7147654	11	15/09/2011	Project Area
Tribulus adelacanthus	534234	7147981	10	15/09/2011	Project Area
Tribulus adelacanthus	534240	7148041	7	15/09/2011	Project Area
Tribulus adelacanthus	534250	7147622	15	15/09/2011	Project Area
Tribulus adelacanthus	534265	7148062	5	15/09/2011	Project Area
Tribulus adelacanthus	534269	7148009	10	15/09/2011	Project Area
Tribulus adelacanthus	534271	7147920	3	15/09/2011	Project Area
Tribulus adelacanthus	534277	7147862	5	15/09/2011	Project Area
Tribulus adelacanthus	534280	7147649	5	15/09/2011	Project Area
Tribulus adelacanthus	534291	7147979	10	15/09/2011	Project Area
Tribulus adelacanthus	534306	7147651	1	15/09/2011	Project Area
Tribulus adelacanthus	534334	7147258	5	15/09/2011	Project Area
Tribulus adelacanthus	534338	7147291	1	15/09/2011	Project Area
Tribulus adelacanthus	534344	7147886	4	15/09/2011	Project Area
Tribulus adelacanthus	534352	7147981	15	15/09/2011	Project Area
Tribulus adelacanthus	534360	7147290	3	15/09/2011	Project Area
Tribulus adelacanthus	534363	7148009	15	15/09/2011	Project Area
Tribulus adelacanthus	534363	7147860	15	15/09/2011	Project Area
Tribulus adelacanthus	534366	7147439	5	15/09/2011	Project Area
Tribulus adelacanthus	534366	7148041	5	15/09/2011	Project Area
Tribulus adelacanthus	534376	7147171	3	15/09/2011	Project Area
Tribulus adelacanthus	534376	7147591	5	15/09/2011	Project Area
Tribulus adelacanthus	534411	7147258	10	15/09/2011	Project Area
Tribulus adelacanthus	534417	7147439	13	15/09/2011	Project Area
Tribulus adelacanthus	534422	7147412	25	15/09/2011	Project Area
Tribulus adelacanthus	534431	7147653	15	15/09/2011	Project Area
Tribulus adelacanthus	534433	7147772	1	15/09/2011	Project Area
Tribulus adelacanthus	534438	7147289	16	15/09/2011	Project Area
Tribulus adelacanthus	534438	7147920	5	15/09/2011	Project Area
Tribulus adelacanthus	534441	7147352	10	15/09/2011	Project Area
Tribulus adelacanthus	534446	7147498	30	15/09/2011	Project Area

Taxon	GPS E	GPS N	No. of Individuals	Date Collected	Record Location
Tribulus adelacanthus	534456	7147380	15	15/09/2011	Project Area
Tribulus adelacanthus	534460	7147890	5	15/09/2011	Project Area
Tribulus adelacanthus	534465	7147620	20	15/09/2011	Project Area
Tribulus adelacanthus	534469	7147442	6	15/09/2011	Project Area
Tribulus adelacanthus	534471	7147410	25	15/09/2011	Project Area
Tribulus adelacanthus	534474	7147260	17	15/09/2011	Project Area
Tribulus adelacanthus	534484	7148008	10	15/09/2011	Project Area
Tribulus adelacanthus	534491	7147981	30	15/09/2011	Project Area
Tribulus adelacanthus	534494	7147289	10	15/09/2011	Project Area
Tribulus adelacanthus	534499	7147357	10	15/09/2011	Project Area
Tribulus adelacanthus	534505	7147651	2	15/09/2011	Project Area
Tribulus adelacanthus	534506	7147164	2	15/09/2011	Project Area
Tribulus adelacanthus	534522	7147413	18	15/09/2011	Project Area
Tribulus adelacanthus	534525	7147920	9	15/09/2011	Project Area
Tribulus adelacanthus	534526	7147292	10	15/09/2011	Project Area
Tribulus adelacanthus	534533	7147981	5	15/09/2011	Project Area
Tribulus adelacanthus	534534	7147857	1	15/09/2011	Project Area
Tribulus adelacanthus	534540	7147833	5	15/09/2011	Project Area
Tribulus adelacanthus	534546	7147502	28	15/09/2011	Project Area
Tribulus adelacanthus	534548	7147382	25	15/09/2011	Project Area
Tribulus adelacanthus	534549	7147261	15	15/09/2011	Project Area
Tribulus adelacanthus	534555	7147289	10	15/09/2011	Project Area
Tribulus adelacanthus	534557	7147889	30	15/09/2011	Project Area
Tribulus adelacanthus	534571	7147414	3	15/09/2011	Project Area
Tribulus adelacanthus	534578	7147260	10	15/09/2011	Project Area
Tribulus adelacanthus	534592	7147504	10	15/09/2011	Project Area
Tribulus adelacanthus	534601	7147922	6	15/09/2011	Project Area
Tribulus adelacanthus	534607	7147376	10	15/09/2011	Project Area
Tribulus adelacanthus	534627	7147260	5	15/09/2011	Project Area
Tribulus adelacanthus	534633	7147890	10	15/09/2011	Project Area
Tribulus adelacanthus	534633	7147860	150	15/09/2011	Project Area

Taxon	GPS E	GPS N	No. of Individuals	Date Collected	Record Location
Tribulus adelacanthus	534640	7147381	35	15/09/2011	Project Area
Tribulus adelacanthus	534645	7147742	10	15/09/2011	Project Area
Tribulus adelacanthus	534649	7147771	1	15/09/2011	Project Area
Tribulus adelacanthus	534655	7147354	7	15/09/2011	Project Area
Tribulus adelacanthus	534662	7147412	12	15/09/2011	Project Area
Tribulus adelacanthus	534678	7147261	6	15/09/2011	Project Area
Tribulus adelacanthus	534682	7147827	10	15/09/2011	Project Area
Tribulus adelacanthus	534696	7147918	8	15/09/2011	Project Area
Tribulus adelacanthus	534697	7147859	50	15/09/2011	Project Area
Tribulus adelacanthus	534701	7147887	9	15/09/2011	Project Area
Tribulus adelacanthus	534702	7147531	16	15/09/2011	Project Area
Tribulus adelacanthus	534706	7147565	5	15/09/2011	Project Area
Tribulus adelacanthus	534714	7147499	5	15/09/2011	Project Area
Tribulus adelacanthus	534719	7147380	15	15/09/2011	Project Area
Tribulus adelacanthus	534764	7147859	30	15/09/2011	Project Area
Tribulus adelacanthus	534769	7147556	3	15/09/2011	Project Area
Tribulus adelacanthus	534790	7147415	2	15/09/2011	Project Area
Tribulus adelacanthus	534796	7147616	30	15/09/2011	Project Area
Tribulus adelacanthus	534800	7147477	10	15/09/2011	Project Area
Tribulus adelacanthus	534808	7147506	30	15/09/2011	Project Area
Tribulus adelacanthus	534833	7147889	5	15/09/2011	Project Area
Tribulus adelacanthus	534851	7147862	10	15/09/2011	Project Area
Tribulus adelacanthus	534863	7147803	10	15/09/2011	Project Area
Tribulus adelacanthus	534868	7147739	15	15/09/2011	Project Area
Tribulus adelacanthus	534872	7147774	6	15/09/2011	Project Area
Eremophila warnesii	587805	7148641	70+	01/09/2011	Approx. 200m N along old track from Bogie Man Mill on Yarlarweelor Station
Eremophila warnesii	590877	7150425	7	01/09/2011	4 km NE of cattle yards at Bogieman Mill, Yarlarweelor Station
Eremophila warnesii	591196	7150819	10	01/09/2011	4.5km NE of cattle yards at Bogieman Mill, Yarlarweelor Station

Taxon	GPS E	GPS N	No. of Individuals	Date Collected	Record Location
Eremophila warnesii	591318	7150974	14	01/09/2011	4.7km NE of cattle yards at Bogieman Mill, Yarlarweelor Station
Eremophila warnesii	591565	7151290	6	01/09/2011	5.1km NE of cattle yards at Bogieman Mill, Yarlarweelor Station
Eremophila warnesii	591685	7151449	8	01/09/2011	5.3km NE of cattle yards at Bogieman Mill, Yarlarweelor Station
Eremophila warnesii	592055	7151922	1	01/09/2011	5.9km NE of cattle yards at Bogieman Mill, Yarlarweelor Station
Eremophila warnesii	592430	7152375	1	01/09/2011	6.5km NE of cattle yards at Bogieman Mill, Yarlarweelor Station
Eremophila warnesii	573439	7153384	111	01/09/2011	4 km W of Windarn Well, Yarlarweelor Station
Eremophila warnesii	534662	7146938	100	14/09/2011	Mount Gould, adjacent to Project area
Eremophila warnesii	534681	7147005	50	14/09/2011	Mount Gould, adjacent to Project area
Eremophila warnesii	534699	7146910	150	14/09/2011	Mount Gould, adjacent to Project area
Eremophila warnesii	534718	7146989	2	14/09/2011	Mount Gould, adjacent to Project area
Eremophila warnesii	534723	7146898	50	14/09/2011	Mount Gould, adjacent to Project area
Eremophila warnesii	534774	7146885	200	14/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	535773	7148701	116	30/08/2011	Low hills to north of Mount Gould
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	535824	7148815	30	30/08/2011	Low hills to north of Mount Gould
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	535874	7148860	39	30/08/2011	Low hills to north of Mount Gould
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	535923	7148947	6	30/08/2011	Low hills to north of Mount Gould
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534655	7145803	6	11/08/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534820	7146345	1	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534827	7146317	4	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534849	7146406	8	13/09/2011	Mount Gould, adjacent to Project area

Taxon	GPS E	GPS N	No. of Individuals	Date Collected	Record Location
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534857	7146322	17	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534859	7146366	5	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534860	7146437	9	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534873	7146390	9	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534874	7146477	4	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534878	7146355	12	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534881	7146507	3	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534893	7146281	8	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534900	7146440	3	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534900	7146343	1	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534902	7146461	3	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534905	7146575	3	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534910	7146350	3	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534922	7146525	3	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534926	7146432	9	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534932	7146664	4	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534943	7146558	6	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534948	7146277	4	13/09/2011	Mount Gould, adjacent to Project area

Taxon	GPS E	GPS N	No. of Individuals	Date Collected	Record Location
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534966	7146492	3	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534968	7146657	4	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534975	7146260	3	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534994	7146546	1	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	534998	7145985	2	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	535007	7146453	1	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	535012	7146246	6	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	535013	7146609	6	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	535019	7146473	6	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	535019	7146286	5	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	535024	7145986	1	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	535025	7146506	10	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	535032	7146533	4	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	535042	7146309	1	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	535047	7146392	4	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	535063	7146580	2	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	535063	7146491	5	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	535083	7146539	5	13/09/2011	Mount Gould, adjacent to Project area

Taxon	GPS E	GPS N	No. of Individuals	Date Collected	Record Location
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	535089	7146270	3	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	535091	7146670	20	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	535093	7146477	4	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	535101	7146391	5	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	535124	7146544	5	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	535140	7146642	10	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	535151	7146602	21	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	535156	7146517	2	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	535157	7146647	24	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	535169	7146731	6	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	535174	7146579	15	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	535177	7146691	10	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	535185	7146499	2	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	535188	7146721	23	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	535190	7146621	8	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	535202	7146759	15	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	535203	7146670	2	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	535207	7146568	9	13/09/2011	Mount Gould, adjacent to Project area

Taxon	GPS E	GPS N	No. of Individuals	Date Collected	Record Location
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	535208	7146693	15	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	535211	7146586	13	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	535227	7146743	7	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	535228	7146628	7	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	535234	7146662	4	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	535243	7146773	11	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	535253	7146709	13	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	535257	7146754	15	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	535259	7146800	6	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	535288	7146731	7	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	535295	7146786	14	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	535315	7146822	4	13/09/2011	Mount Gould, adjacent to Project area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	535328	7146780	4	13/09/2011	Mount Gould, adjacent to Project area
Tribulus adelacanthus	534266	7148102	5	15/09/2011	Mount Gould, adjacent to Project area
Tribulus adelacanthus	534309	7148100	10	15/09/2011	Mount Gould, adjacent to Project area
Tribulus adelacanthus	534421	7148097	3	15/09/2011	Mount Gould, adjacent to Project area
Tribulus adelacanthus	534469	7148040	3	15/09/2011	Mount Gould, adjacent to Project area
Tribulus adelacanthus	534476	7148079	10	15/09/2011	Mount Gould, adjacent to Project area

Taxon	GPS E	GPS N	No. of Individuals	Date Collected	Record Location
Tribulus adelacanthus	534485	7148103	15	15/09/2011	Mount Gould, adjacent to Project area
Tribulus adelacanthus	534535	7148098	30	15/09/2011	Mount Gould, adjacent to Project area
Tribulus adelacanthus	534561	7148006	10	15/09/2011	Mount Gould, adjacent to Project area
Tribulus adelacanthus	534562	7148040	6	15/09/2011	Mount Gould, adjacent to Project area
Tribulus adelacanthus	534588	7148063	10	15/09/2011	Mount Gould, adjacent to Project area
Tribulus adelacanthus	534591	7147980	20	15/09/2011	Mount Gould, adjacent to Project area
Tribulus adelacanthus	534605	7148099	5	15/09/2011	Mount Gould, adjacent to Project area
Tribulus adelacanthus	534658	7147978	15	15/09/2011	Mount Gould, adjacent to Project area
Tribulus adelacanthus	534690	7147944	30	15/09/2011	Mount Gould, adjacent to Project area
Tribulus adelacanthus	534718	7147980	10	15/09/2011	Mount Gould, adjacent to Project area
Tribulus adelacanthus	534801	7147380	7	15/09/2011	Mount Gould, adjacent to Project area
Tribulus adelacanthus	534840	7147559	10	15/09/2011	Mount Gould, adjacent to Project area
Tribulus adelacanthus	534859	7147620	25	15/09/2011	Mount Gould, adjacent to Project area
Tribulus adelacanthus	534891	7148038	2	15/09/2011	Mount Gould, adjacent to Project area
Tribulus adelacanthus	534902	7148023	1	15/09/2011	Mount Gould, adjacent to Project area
Tribulus adelacanthus	534904	7147920	9	15/09/2011	Mount Gould, adjacent to Project area
Tribulus adelacanthus	534925	7147890	7	15/09/2011	Mount Gould, adjacent to Project area
Tribulus adelacanthus	534931	7147858	5	15/09/2011	Mount Gould, adjacent to Project area

Taxon	GPS E	GPS N	No. of Individuals	Date Collected	Record Location
Tribulus adelacanthus	534934	7147830	5	15/09/2011	Mount Gould, adjacent to Project area

APPENDIX 6: MOUNT GOULD: FLORA AND VEGETATION ASSESSMENT (BIOLOGIC 2023)







Mount Gould: Flora and Vegetation Assessment

Biologic Environmental Survey

Report to MBS Environmental on behalf of Newcam Minerals

April 2023

Document Status				
Revision No.	**Author**	**Review / Approved for Issue**	**Approved for Issue to**	
			Name	**Date**
1	Carmel Winton, Emma Marsh	Clinton van den Bergh	Terryn Attwood	12/12/2022
Final	Heather White	Carmel Winton	Terryn Attwood	21/04/2023

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EXECUTIVE SUMMARY

MBS Environmental (MBS), on behalf of Newcam Minerals (Newcam), commissioned Biologic Environmental Survey Pty Ltd (Biologic) to undertake a detailed flora and vegetation assessment covering the Mount Gould Project at mining lease tenement M52/236, encompassing approximately 613 hectares (ha); hereafter referred to as the Survey Area (Figure 1.1). A supplementary survey area representing the Mount Gould Banded Ironstone Formation (BIF) Priority 1 Ecological Community (PEC) was concurrently surveyed with the Survey Area. The Survey Area and Mt Gould PEC are located approximately 150 kilometres (km) northwest of Meekatharra in the Murchison region of Western Australia

The field survey was undertaken by four Biologic personnel over 36 person days. The survey was completed over one sampling event, from the 24th of August to 1st of September 2022. A total of 42 quadrats, six relevés and 11 mapping notes were sampled across the Survey Area and Mt Gould PEC, as well as opportunistic sampling. An additional three mapping notes were taken in regional surveying areas; to provide habitat details where targeted searching was undertaken.

A total of 219 confirmed vascular flora taxa from 35 families and 85 genera were recorded from the Survey Area and Mt Gould PEC; comprising 211 native and eight introduced taxa. The desktop assessment identified 31 significant taxa which had potential to occur within the Survey Area. During the survey, four priority listed flora taxa were recorded within the Study Area:

- Priority 1: *Eremophila warnesii, Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743), *Rhodanthe sphaerocephala*; and
- Priority 3: *Tribulus adelacanthus.*

Eight confirmed introduced taxa were recorded within the Study Area. These taxa are not listed as Weeds of National Significance or Declared Pests under the *Biosecurity and Agriculture Management Act 2007*. Weeds were few across the Survey Area, with **Cenchrus ciliaris* (Buffel grass) having the most point locations with ten individuals identified from three locations in the Survey Area and Mt Gould PEC.

Twelve vegetation types were described from three broad landforms in the Survey Area and Mt Gould PEC; drainage/floodplain, hills, crests and slopes and Plains. The dominant landform of the Survey Area was hills, crests and slopes comprising 50.63% from seven vegetation types.

The vegetation types described from the Study Area are not considered to be analogous with the known Threatened Ecological Communities occurring in the Murchison region. Seven vegetation types throughout the Study Area were considered significant as representative or possibly representative of the Mt Gould BIF PEC. These were:

- Representative of the Mount Gould BIF PEC: H1 PhbcErlt Tm, H2 PtoErwErlc, and H3 AaAciAr;
- Possibly representative of the Mount Gould BIF PEC: S1 AaAinAf, S2 ArAptAin, S3 AinApt, and S4 AaGrbAf.

Six vegetation types supported priority flora taxa and thus hold significance in providing suitable habitat for these species. Three of these vegetation types are of greater significance as they hold optimal habitat for significant flora that is restricted or known from fewer than ten records. Five vegetation types are considered to have high local and high regional significance, they are:

- H1 PhbcErlt Tm: as a representation of the Mt Gould BIF PEC and corresponding to FCT 5 that was found to be significant and endemic to the Mt Gould BIF PEC;
- H2 PtoErwErlc: as a representation of the Mt Gould BIF PEC and optimal habitat for *Eremophila warnesii*;
- H3 AaAciAr: as a representation of the Mt Gould BIF PEC;
- S1 AaAinAf: as a possible representation of the Mt Gould BIF PEC and optimal habitat for endemic *Halgania gustafsenii* var. Murchison; and
- S3 AinApt: as a possible representation of the Mt Gould BIF PEC and optimal habitat for endemic *Halgania gustafsenii* var. Murchison;

The condition of the vegetation in the Survey Area ranged from excellent to degraded, with the majority considered to be in Excellent or Very Good condition (21.35% and 52.51% respectively). The main disturbances observed were associated with introduced flora and mining/ exploration related activities or historic infrastructure; including drill pads, tracks, camp remnants. There were some minor signs of goat and cattle grazing and trampling, and introduced taxa usually spread by livestock were low in number and extent, **Cenchrus ciliaris* and **Setaria verticillata*.

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1 INTRODUCTION

1.1 Background

MBS Environmental (MBS), on behalf of Newcam Minerals (Newcam), commissioned Biologic Environmental Survey Pty Ltd (Biologic) to undertake a detailed flora and vegetation assessment covering the Mount Gould Project at mining lease tenement M52/236, encompassing approximately 613 hectares (ha); hereafter referred to as the Survey Area (Figure 1.1). A supplementary survey area representing the Mount Gould Banded Ironstone Formation (BIF) Priority 1 Ecological Community (PEC) was concurrently surveyed with the Survey Area. The Mount Gould Priority Ecological Community represents a total of 1,683.76 ha and is hereafter referred to as the Mt Gould PEC throughout this report (Figure 1.1). This was assessed at the detailed flora and vegetation level for additional populations of significant flora, habitat for significant flora and/or additional communities representing the PEC occurring outside the Survey Area. The Mt Gould PEC intersects with the Survey Area and as such, the cumulative size of the areas surveyed totals 2,296.70 ha. For the purposes of clarity throughout this report, the Survey Area and the Mt Gould PEC will be presented and referred to separately with regards to area calculations and in discussion of floristic components. The Survey Area and Mt Gould PEC are located approximately 150 kilometres (km) northwest of Meekatharra in the Murchison region of Western Australia (Figure 1.1).

Newcam is currently developing the Mt Gould Project (the Project) at the Survey Area. Recent consultation with the Department of Mines, Industry Regulation and Safety (DMIRS) and the Department of Biodiversity, Conservation and Attractions (DBCA) has advised the existing baseline surveys for the Project are likely not adequate to support environmental approval applications due to the age of the original surveys (10+ years) and surveys not compliant with the Environmental Protection Authority's (EPA) 2016 Technical Guidance Statement as they were completed prior to this release.

Initial baseline studies of the Survey Area were completed between 2008 - 2012, and identified the Project intercepts the Mt Gould PEC Vegetation Complexes. Seven floristic community types (FCTs) were mapped, of which four were considered representative of the PEC. Four significant flora species were recorded within the Survey Area comprising three Priority 1 species and one Priority 3 species:

- Priority 1:
    - *Eremophila warnesii;*
    - *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743);
    - *Rhodanthe sphaerocephala*; and
- Priority 3:
    - *Tribulus adelacanthus.*

Feedback from DBCA on the initial design of the Mt Gould Project suggested the potential impacts to significant flora and communities of the Project are likely to be unacceptable and require review following the completion of an additional field survey.

1.2 Objectives

MBS engaged Biologic to address botanical knowledge gaps and update the baseline data for the Project. The scope of work (SoW) outlines the requirement to undertake surveys to verify and update the project data, identify further significant flora species and/or populations, review, and where necessary, redefine vegetation communities with the aim to decrease potential percentage impacts. This was completed over the combination of two SoW as outlined below.

1.2.1 SoW 1: Mt Gould Survey

Review relevant historical and contemporary documentation and reports relating to the survey area, including the baseline flora and vegetation reports for the Project which are:

- Mount Gould Flora and Vegetation Assessment Desktop Review (Woodman, 2008);
- Mount Gould DSO Project Flora and Vegetation Assessment (Woodman, 2009);
- Mount Gould Proposed Exploration Drilling Program Conservation Significant Flora and Vegetation Assessment (Woodman, 2010); and
- Mount Gould DSO Project Local and Regional Significant Flora Assessment and Regional Vegetation Review (Woodman Environmental, 2012).

Prior to mobilisation, undertake a Desktop assessment / gaps analysis to:

- Establish existing significant flora and ecological communities known in the DBCA databases;
- Verify the boundaries and descriptions of the existing vegetation types (also referred to as FCTs in existing reports for the area) of the survey area identified by the baseline surveys and determine if this remains valid or if further mapping and field survey is required;
- Where the desktop assessment has identified discrepancies in the boundaries of vegetation mapping in the baseline surveys, use aerial imagery to identify preliminary vegetation types to inform field mapping and approach;
- Verify the conservation status and currency of significant flora identified by the baseline studies;
- Identify the likelihood of occurrence (Assessment of Occurrence) of significant flora species additional to those species identified during the baseline surveys; and
- Where additional significant flora species are identified, using aerial imagery, determine areas of suitable habitat to target searches during the field survey.

Undertake a Detailed survey to redefine the vegetation types present within the Survey Area and establish better understanding of the vegetation types of the Mt Gould PEC, by:

- Describing and defining boundaries of vegetation types present, specifically:
    - Establish quadrats to record vegetation structure, compositions and condition in accordance with the EPA Guidance Statement (EPA, 2016b); and
    - Completing a statistical analysis to determine vegetation types consistent with the description of the Mt Gould PEC;
- Undertake a Targeted survey to verify the findings of the Desktop assessment by:
    - Check existing populations of significant flora for condition and extent where identified during the baseline surveys, completing spot targeted searches where required;

- Identify new populations of significant flora recording each individual, or population extent with boundaries and estimates on individual counts; and
- Record opportunistic observations such as weed species present.

1.2.2 SoW 2: Regional Survey

SoW 2 involves a regional Targeted survey to be undertaken in surrounding areas of like habitat, to:

- Identify the presence and/or potential occurrence of significant species and vegetation types of the Mt Gould PEC outside of the Survey Area; and
- Determine the boundaries and extent of any significant flora populations, or additional populations that occur outside of the Survey Area;

Following discussion between MBS, Newcam and Biologic on the 22 June 2022, Species Distribution Modelling (SDM) was proposed as an option for locating potential additional populations of the significant flora taxa that may be impacted with the development of the Project. The primary objective was to use SDM to locate potential new regional populations of the significant flora occurring within the Survey Area to decrease the percentage impact to the known populations. Biologic conducted species distribution modelling prior to mobilisation to better guide regional survey effort and satisfy the exploration of a greater search area.

1.3 Legislation & Compliance

This assessment was carried out in a manner consistent with the following documents developed by the Environmental Protection Authority (EPA):

- State *Biodiversity Conservation Act 2016* (BC Act);
- State *Environmental Protection Act 1986* (EP Act); and
- Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The EPA outline guidance for biological surveys in Western Australia. All aspects of botanical assessments at Biologic are compliant with the EPA Technical Guidance for Flora and Vegetation Surveys for Environmental Impact Assessment (EPA, 2016b), this extends to preparation, survey design, personnel, data analysis, reporting and client data submission. Additionally, Biologic is consistent with the values presented in the Environmental Factor Guidelines for flora and vegetation (EPA, 2016a) intended to protect the biological diversity and ecological integrity of Western Australian flora and vegetation during the Environmental Impact Assessment process (EIA).

1.3.1 Significant Flora & Vegetation

The state and commonwealth governments protect rare, endemic, new or special flora and vegetation communities at varying levels by classifying them under codes of conservation significance. These codes, jurisdiction and level of protection are detailed in Appendix A.

Significant flora may extend beyond the assigned codes and may include:

- Being identified as Threatened; Critically Endangered, Endangered or Vulnerable species (State listed BC Act and/or Commonwealth listed EPBC Act);
- Being listed as Priority flora species (DBCA, 2022d);
- Locally endemic or associated with a restricted habitat type (e.g., surface water or groundwater dependent ecosystems);
- New species or anomalous features that indicate a potential new species;
- Range extensions or representative of outer population extent (particularly at the extremes of range, recently discovered range extensions or isolated outliers of the main range);
- Unusual species; restricted subspecies, varieties, naturally occurring hybrids, or complex taxonomic groups; or
- Relictual status, being representative of taxonomic groups that no longer occur widely in the broader landscape.

Significant vegetation may extend beyond the assigned codes and may include:

- Being identified as Threatened Ecological Community (TEC); Critically Endangered, Endangered or Vulnerable ecological community (State listed BC Act and/or Commonwealth listed EPBC Act)
- Identified as a PEC (DBCA, 2022b);
- Restricted or endemic distribution;
- Degree of historical impact from threatening processes (such as mining or agricultural);
- A role as a refuge for significant flora; or
- Providing an important function required to maintain ecological integrity of a significant ecosystem.

1.3.2 Introduced Flora

Introduced flora can pose a threat to native vegetation and biodiversity. A database of declared pests is kept by the Department of Primary Industries and Regional Development (DPIRD). This database falls under State jurisdiction, legislated by the *Biosecurity and Agricultural Management Act 2007* (BAM Act) (DPIRD, 2007). They are carefully managed at both a state and commonwealth level and can be classified as either Weeds of National Significance (WoNS), Declared Pests (DPs) or according to the DBCAs Weed Prioritisation Process Appendix A.

Weeds of National Significance

The Commonwealth of Australia, in collaboration with the states and territories, has identified 32 WoNS based on an assessment process that prioritises these weeds according to their invasiveness, potential for spread, and environmental, social and economic impacts (DAWE, 2021 (Department of Agriculture, Water and the Environment)). A list of 20 WoNS was endorsed in 1999, and a further 12 were added in 2012.

Landowners and land managers at all levels are responsible for managing WoNS. State and territory governments are responsible for legislation, regulation, and administration of weeds. The WoNS were

selected as they require coordination among all levels of government, organisations, and individuals with weed management responsibilities.

Declared Pests

To protect Western Australian agriculture the DPIRD (formerly the Department of Agriculture and Food Western Australia, DAFWA) regulates harmful plants under the BAM Act. Plants that are prevented entry into the state or have control or keeping requirements within the state are known as DPs. The main purposes of the BAM Act and its regulations related to DPs are to prevent new plant pests from entering Western Australia, manage the impact and spread of those pests already present in the state and safely manage the use of agricultural chemicals.

The BAM Act has categorised the weeds of Western Australia into four main classifications:

- DPs (under Section 22 of the Act);
- Permitted (under Section 11 of the Act);
- Prohibited (under Section 12 of the Act); and
- Permitted requiring a permit (Section 73, BAM Regulations 2013).

Under the BAM Act, DPs mean prohibited pests (under Section 12 of the Act) and pests declared under Section 22 of the Act. All DPs listed under Section 22 (not including pests listed under Section 12 of the BAM Act; Prohibited Pests) are placed in one of three control categories, below and defined further in Appendix A:

- Category 1 (C1) – Exclusion;
- Category 2 (C2) – Eradication;
- Category 3 (C3) – Management.

Prohibited pests listed under Section 12 of the BAM Act are assigned separate control categories, listed below and outlined further in Appendix A:

- Category 1 (C1) – Exclusion; and
- Category 2 (C2) – Eradication.

Weed Prioritisation

In 2008, the former Department of Environment and Conservation (now DBCA) developed and implemented an integrated approach to weed management on DBCA-managed lands in WA, the Weed Prioritisation Process (Bettink & Keighery, 2008). It was updated in 2013 and further revised in 2016. DBCA prioritised weeds in each region, based on the:

- Invasiveness;
- Ecological impact;
- Potential and current distribution; and
- Feasibility of control.

The resulting priorities focus on weeds considered to be high impact, rapidly invasive and still at a population size that can feasibly be eradicated or contained to a manageable size. This means that

weed species that are already widespread may not be ranked as a high priority. The key priorities are centred on ‘Priority Alert’ weeds and weeds that receive a rating for ‘ecological impact’ and ‘invasiveness’.

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Lander - Meekatharra Rd

Legend

Survey Area

- Tenement M52/236
- Mt Gould PEC
- Local Road

IBRA Region

- Murchison

IBRA Subregion

- Eastern Murchison
- Western Murchison

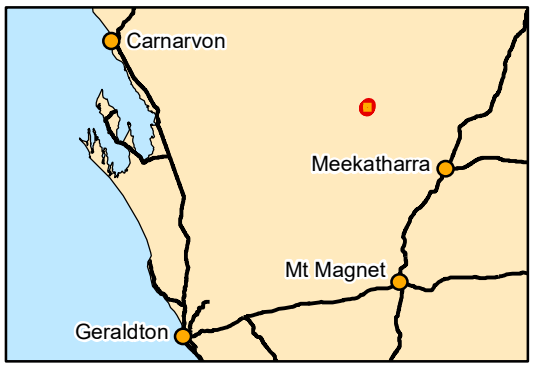
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MBS ENVIRONMENTAL

Mt Gould Detailed Flora and Vegetation Assessment

Figure 1.1: Survey Area and regional context

2 EXISTING ENVIRONMENT

2.1 Biogeography

The Interim Biogeographic Regionalisation for Australia (IBRA) is a bioregional framework that divides Australia into 85 bioregions and 419 subregions on the basis of climate, geology, landforms, vegetation and fauna (Thackway & Cresswell, 1995). The Survey Area is located within the Murchison bioregion (Figure 1.1), forming part of the Eremaean Botanical Province and characterised by low hills and mesas separated by flat colluvium and alluvial plains which support low mulga woodlands (Thackway & Cresswell, 1995).

There are two subregions of the Murchison; the Eastern Murchison (MUR01) and the Western Murchison (MUR02). The Survey Area is located within the Western Murchison. The Western Murchison subregion covers an area of approximately 7,847,996 ha and is characterised by mulga (*Acacia aneura* complex) low woodlands, often rich in ephemerals (usually with bunch grasses), on outcrop and fine textured Quaternary alluvial and eluvial surfaces (Desmond *et al.*, 2001).

2.2 Climate

The Murchison bioregion has an arid climate with bimodal rainfall that usually falls in winter (Desmond *et al.*, 2001) .The nearest active Bureau of Meteorology (BoM) weather station with long term climate data is Meekatharra Airport (station number 007045), located 150 km to the south-east. The mean annual rainfall recorded at Meekatharra Airport is 233.7 millimetres (mm) with the majority of rainfall received between January and June each year (BoM, 2022a) (Figure 2.1). However, it is important to consider that the Murchison is in the southern Eremaean Botanical Province and does not have a typical wet season as seen in more central areas of the Eremaean (like the Pilbara). The Murchison typically has unreliable, inconsistent and patchy rainfall. The highest maximum temperatures occur between November and March, with the highest mean maximum recorded in January (38.4°C). The lowest minimum temperatures occur between May and August, with the lowest mean minimum temperature recorded in July (7.5°C) (BoM, 2022a).

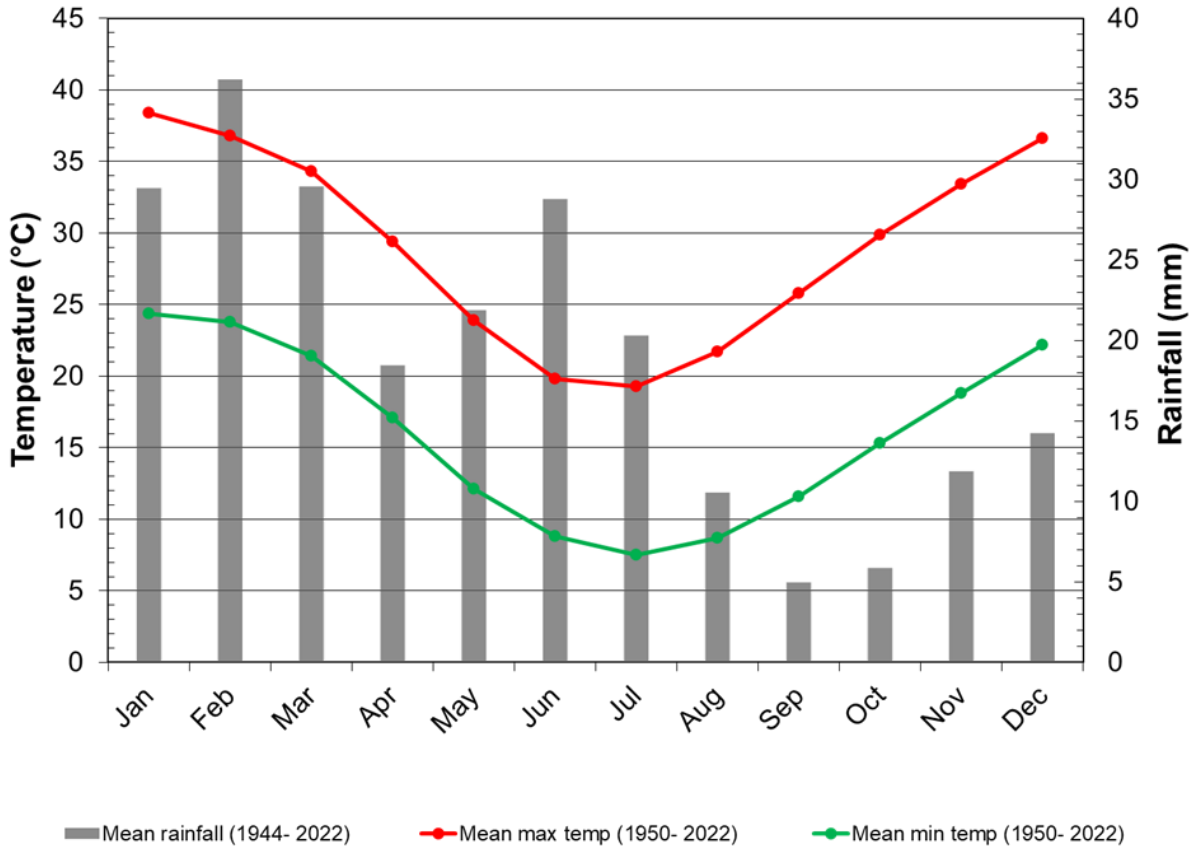


Figure 2.1: Long-term climatic data for Meekatharra Airport (BoM Station 007045) (BoM, 2022a)

2.3 Hydrology & Hydrogeology

The Survey Area and Mt Gould PEC are located in the catchment of the Murchison River, 11 km north at the closest point, with two minor creeks flanking the Mt Gould PEC; Gould creek to the west and Bedaburra creek to the east (Figure 2.2). Vegetation can be influenced by ground water and surface water including sheet-flow surface water. Groundwater originates from direct infiltration by rainfall and from surface water flows. Groundwater occurs throughout the Murchison but is most easily located and accessed near surface water drainage lines (alluvial channels). The most significant aquifers can be grouped into three types: alluvial aquifers that are either unconsolidated sedimentary aquifers or chemically deposited aquifers, consolidated sedimentary (or sedimentary rock) aquifers and fractured rock aquifers. Surface water can occur on drainage and creeklines but is not always restricted to these channel systems. Surface water can move across the landscape as sheet-water flow during times of excessive rainfall.

2.3.1 Groundwater Dependent Ecosystems (GDE)

Groundwater Dependent Ecosystems (GDEs) are ecosystems that rely upon groundwater for their continued existence (BoM, 2022b) GDEs can be represented by many different assemblages of biota which rely on groundwater, and as a result come in many forms. The three key types of GDE (BoM, 2022b) include;

1. Aquatic ecosystems: that rely on the surface expression of groundwater – this includes surface water ecosystems which may have a groundwater component, such as rivers, wetlands, and springs.

2. Terrestrial ecosystems: that rely on the subsurface presence of groundwater – this includes all vegetation ecosystems or Groundwater Dependent Vegetation (GDV).

3. Subterranean ecosystems - this includes cave and aquifer ecosystems.

Terrestrial GDEs are generally the easiest to define and can occur along creeks, rivers, seeps, wetlands and lakes with vegetation presence assisting in the definition of the GDE, Aboveground terrestrial GDEs are typically characterised by the presence of flora species that rely on groundwater (i.e., phreatophytes). Phreatophytes may be classified as either obligate or facultative phreatophytes depending on their reliance on groundwater (Eamus *et al.*, 2016):

- Obligate phreatophytes are flora species confined to habitats with access to groundwater.
- Facultative phreatophytes are flora species that can utilise groundwater to satisfy a proportion of their ecological water requirement (EWR) when it is available. However, some individuals may also satisfy their EWR by relying solely on uptake from upper unsaturated soils layers where groundwater is inaccessible.

The BoM has developed the Groundwater Dependent Ecosystems Atlas (GDE Atlas) as a national dataset of Australian GDEs to inform groundwater planning and management (BoM, 2022b). It is the first and only national inventory of GDEs in Australia.

The GDE Atlas contains information about three key types of ecosystems: Aquatic ecosystems, Terrestrial ecosystems, and Subterranean ecosystems. Importantly, the GDE Atlas also includes the national inflow-dependent landscapes layer which is derived from remotely sensed data. This layer indicates the likelihood that a landscape is accessing water in addition to rainfall (such as soil moisture, surface water or groundwater), and generally represents a potential GDE dataset for all areas not yet studied or investigated in any detail.

The GDE mapping in the GDE Atlas comes from two broad sources:

- National assessment – national-scale analysis based on a set of rules that describe potential for groundwater/ ecosystem interaction and available GIS data.
- Regional studies – more detailed analysis undertaken by various state and regional agencies using a range of different approaches including field work, analysis of satellite imagery and application of rules/conceptual models.

The BoM GDE Atlas indicates that the Survey Area and the Mt Gould PEC have low potential to support both terrestrial and aquatic. The Murchison River is 11 km to the south and has moderate potential to support GDEs. However, considering the topography and vegetation types of the Survey Area and the distance from the river, it is sufficient to not be considered in this assessment.

The BoM (2022b) defines Inflow Dependent Ecosystems (IDEs) as vegetation that is either groundwater dependent or is likely to be reliant on subsurface water in addition to rainfall, i.e., from soil water, surface

water or irrigation. The likelihood of a landscape using additional water is rated from 1 to 10, with ratings above six indicating that a landscape is likely to be inflow dependent (BoM, 2022b). Gould creek and Bedaburra creek flank the Survey Area and Mt Gould PEC, with both having IDE ratings that include a range of between 5 to 8 reflecting this area is likely to have inflow dependence (BoM, 2021). This indicates the importance of considering subsurface flows for the Survey Area and Mt Gould PEC.

2.3.2 Sheet-flow Dependent Ecosystems

Mulga is a large, variable and taxonomically complex group of plants allied to *Acacia aneura* that dominate significant areas of the vast Australian arid zone (Maslin *et al.*, 2012). The term Mulga is also used to describe vegetation communities in which these taxa predominate (Maslin *et al.*, 2012). A recent revision of the Mulga group (*Acacia aneura* and its close relatives) classified 12 separate entities, excluding informal variants, putative hybrids and intergrades (Maslin & Reid, 2012). The structure and patterning of mulga communities varies from strongly banded (groved) through to open shrublands and woodlands across the landscape (Page & Grierson, 2012). The bandings act as a sink for nutrients and water to infiltrate the soil and are readily available for uptake by the flora located within the banding. This banding and overland sheet-flow supports a diverse biota within the Mulga bands and plays an important ecological function which is well documented (Dawson & Ahern, 1973; Saco *et al.*, 2007; Winkworth, 1973).

The Survey Area contains two Land Systems subject to sheet-flow, with these being characterised by mulga groves within stony plains and hardpan plains; the Beringarra and the Cole Land Systems (see Section 2.6 and Figure 2.5). The Beringarra Land System includes major riverine plains with active lower floodplains, alluvial plains and wide drainage floors to the east of the Survey Area. The Cole Land System is characteristic of hardpan wash plains carrying sheet flow water off surrounding hills with the presence of mulga grooving (Hennig, 2009).

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Bedaburra Creek

Bedaburra Creek

Bedaburra Creek

Bedaburra Creek

Gould Creek

Landor - Meekatharra Rd

Legend

Survey Area

Tenement M52/236

Mt Gould PEC

Local Road

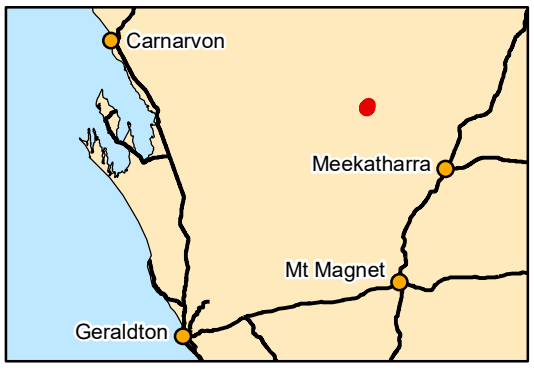
Minor Hydrology

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Projection: Transverse Mercator
Datum: GDA2020 Created 08/12/2022

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MBS ENVIRONMENTAL

Mt Gould Detailed Flora and Vegetation Assessment

Figure 2.2: Hydrology of the Survey Area

2.4 Geology

The Survey Area is located within the Archaean Yilgarn Craton, which is characterised by shallow alluvial valleys connected by stony pediments to low rocky hills of bedrock, or to breakaways over duricrust-capped bedrock (Curry *et al.*, 1994). Granitoid outcropping produces large monoliths and extensive uplands of flat pavements, while basaltic outcropping forms rugged, rounded hills. The Murchison Province occupies the north-western part of the Yilgarn Craton and is divided into six major crustal components, comprising two greenstone sequences (the Luke Creek and the overlying Mount Farmer Groups, which together form the Murchison super group) and four granitoid suites (Tille, 2006; Watkins & Hickman, 1990). Within this area, the Survey Area and Mt Gould PEC occur across two geological units; Narryer Terrane metagranitic unit and Narryer Terrane greenstones (Table 2.1; Figure 2.3).

Table 2.1: Geological units occurring within the Survey Area and Mt Gould PEC

Unit code: Unit name	Description	Extent	
		Survey Area	Mt Gould PEC
A-xmgn-g-YNA: Narryer Terrane metagranitic unit	Granitic gneiss and granitic rocks; minor granodiorite, muscovite granite, amphibolite, and ultramafic rocks	278.03 ha 45.3%	899 ha 53.4%
A-xmh-mi-YNA: Narryer Terrane greenstones	Gneisses interlayered with deformed and metamorphosed supracrustal rocks that include BIF, chert, quartz, mafic and ultramafic igneous rocks, and siliciclastic rocks, i.e., quartz mica schist, andalusite schist, metasandstone and metaconglomerates	334.93 ha 54.7%	784.77ha 46.6%
Total		**612.96 ha 100%**	**1,683.76 100%**

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7152000 7150000 7148000 7146000

Bedaburra Creek

Could Creek

Bedaburra Creek

Bedaburra Creek

Bedaburra Creek

Landor - Meekatharra Rd

Legend

Survey Area

- Tenement M52/236
- Mt Gould PEC
- Local Road
- Minor Hydrology

1:500k Interpreted Bedrock Geology

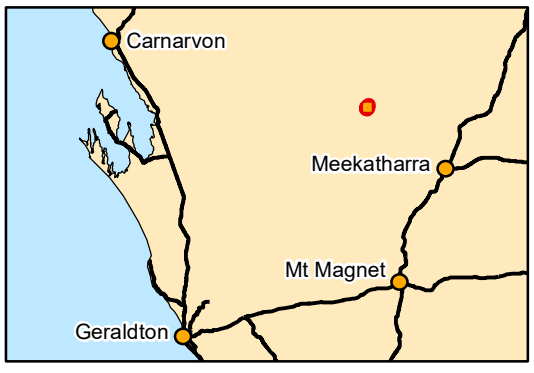
- A-xmgn-g-YNA; Narryer Terrane metagranitic unit
- A-xmh-mi-YNA; Narryer Terrane greenstones

0 500 1,000 Meters

Coordinate System: GDA2020 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA2020 Created 06/12/2022

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Scale: 1:25,000



MBS ENVIRONMENTAL

Mt Gould Detailed Flora and Vegetation Assessment

Figure 2.3: Geology of the Survey Area

2.5 Soils

The Atlas of Australian Soils was compiled by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) in the 1960s to provide a consistent national description of Australia's soils (CSIRO, 1992; Northcote *et al.*, 1960-1968). It comprises a series of ten maps published at a scale of 1:2,000,000 (with contributing data being mapped at scales from 1:250,000 to 1:500,000), along with explanatory notes. Based on this mapping, the Survey Area and Mt Gould PEC occur across two soil-landscape units which are characterised by stony shallow earthy loams, often stony, and red-brown hardpan (Table 2.2; Figure 2.4).

Table 2.2: Soil-landscape units occurring within the Survey Area and Mt Gould PEC

Unit code	Description	Extent	
		Survey Area	Mt Gould PEC
My50	Broad plains with a scatter of surface gravels: chief soils are shallow neutral red earths (Gn2.12) and shallow earthy loams (Um5.3) in intimate micro-association. They are underlain by a red-brown hardpan at depths of 6-30in. Occurs on sheet(s): 5	611.60h a 99.8%	1285.45 ha 76.3%
Mz24	Extensive plains similar to unit Mz23 of Sheet 6 but with small sand ridges: chief soils are acid red earths (Gn2.11)	1.37ha 0.2%	398.31 ha 23.7%
Total		**612.96 ha 100%**	**1,683.76 ha 100%**

532000
534000
536000
538000
7152000
7150000
7148000
7146000
Landor - Meekatharra Rd

Legend

Survey Area

- Tenement M52/236
- Mt Gould PEC
- Local Road

Soil Unit

- My50
- Mz24

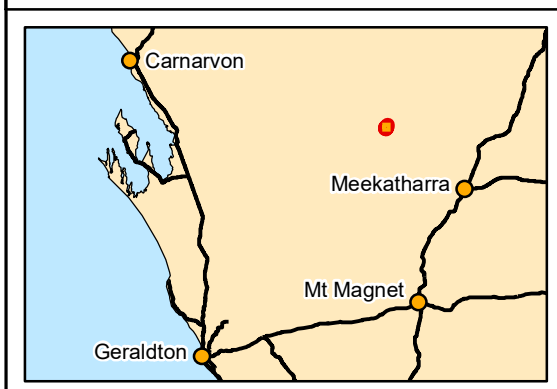
0 500 1,000 Meters

Coordinate System: GDA2020 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA2020 Created 08/12/2022

N

biologic Environmental Survey

Scale: 1:25,000



MBS ENVIRONMENTAL

Mt Gould Detailed Flora and Vegetation Assessment

Figure 2.4: Soils of the Survey Area

2.6 Land Systems

A regional survey was undertaken in the Murchison region between 1985 and 1988 by the Department of Agriculture (now DPIRD) and the Department of Land Administration (now Landgate), to develop a comprehensive description of biophysical resources and assess the vegetation composition and soil condition within the region (Curry *et al.*, 1994). Similar surveys have been conducted, some more recent than others within parts of the Murchison region to further characterise the region (Hennig, 2009; Mabbutt *et al.*, 1963). Information from these surveys has been used to classify and map the land systems of the Murchison region according to similarities in landform, soil, vegetation, geology and geomorphology. The most recent surveys available for this area have been used.

Based on this mapping, the Survey Area and Mt Gould PEC occur across three land systems: the Peak Hill, Cole and Beringarra land systems. The Beringarra System does not intersect the Survey Area, intersecting only with the Mt Gould PEC (Figure 2.5). The majority of the Survey Area occurs within the Peak Hill land system which is defined by hills and ridges (50%), lower slopes and interfluves (40%) and drainage floor / minor channels. The vegetation for this system is described as being dominated by *Acacia aneura*, *Acacia tetragonophylla* with scattered *Eremophila*, *Senna* and *Solanum* spp.(McKinnon, 1972).

Table 2.3 Land Systems mapped within the Survey Area and Mt Gould PEC

Land System	Description	Extent	
		Survey Area	Mt Gould PEC
Beringarra	Major riverine plains with active lower floodplains flanking channelled watercourses; supports mostly halophytic shrublands and mixed Acacia shrublands and low woodlands with minor perennial grasses	0 ha 0%	194.55 ha 11.5%
Cole	Hardpan wash plains with reticulate patterns of wanderrie banks and mulga groves and more concentrated drainage tracts, supporting mixed mulga and wanderrie shrublands.	152.83 ha 24.9%	177.62 ha 10.5%
Peak Hill	Rugged, sinuous ranges and rounded hills of banded ironstone and haematitic shale, supporting stunted mulga and cottonbush shrublands.	460.14 ha 75.1%	1311.60 ha 78.0%
Total		**612.96 ha 100%**	**1,683.76 ha 100%**

532000 534000 536000 538000

7152000 7150000 7148000 7146000

Landor - Meekatharra Rd

Legend

Survey Area

- Tenement M52/236
- Mt Gould PEC
- Local Road

Land System

- Beringarra System
- Cole System
- Peak Hill System
- Yandil System

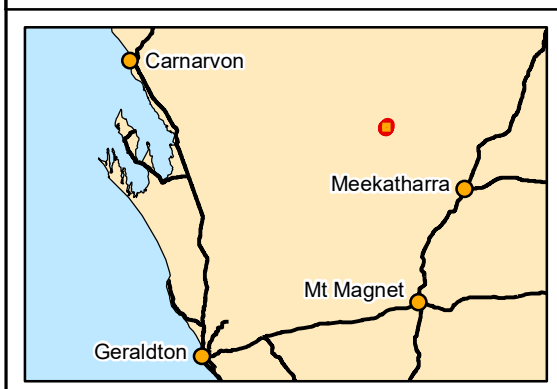
0 500 1,000 Meters

Coordinate System: GDA2020 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA2020 Created 08/12/2022

N

biologic Environmental Survey

Scale: 1:25,000



MBS ENVIRONMENTAL

Mt Gould Detailed Flora and Vegetation Assessment

Figure 2.5: Land systems of the Survey Area

2.7 Vegetation

2.7.1 Pre-European Vegetation

Pre-European vegetation mapping was originally undertaken by Beard at various scales (predominantly 1:1,000,000) across the State (Beard, 1976) and has since been updated to be consistent with Native Vegetation Information System (NVIS) descriptions at a scale of 1:250,000. State-wide vegetation statistics are available for these associations which lists pre-European extent, current extent, area in DBCA managed lands and is a useful tool to determine if a vegetation association is rare or otherwise significant. The Beard vegetation mapping (Beard, 1990) provides a broad context of Western Australian native vegetation. Three vegetation associations occur within the Survey Area and Mt Gould PEC (Table 2.4; Figure 2.6).

The largest vegetation association, covering 81.5% of the Survey Area, is Upper Murchison 202 association of wattle, tea tree & other species (*Acacia* spp. *Melaleuca* spp.), scrub, open scrub or sparse scrub. The other association within the Survey Area is Upper Murchison 29 (18.5%) and comprises Mulga (the *Acacia aneura* complex) and associated species low woodland, open low woodland or sparse woodland. The additional vegetation association (Upper Murchison 18) intersects with the Mt Gould PEC only and does not intersect with the Survey Area. This vegetation association is also defined by the *Acacia aneura* complex as a low sparse to open woodland and associated species.

Historically, land use in the vicinity of the Survey Area has been mining and pastoral agriculture grazing for cattle. These disturbances were noted throughout the assessment with the addition of goat and sheep historical grazing.

Table 2.4: Vegetation associations within the Survey Area and Mt Gould PEC

Vegetation Association	Description	Extent	
		Survey Area	Mt Gould PEC
UPPER MURCHISON_18	Mulga (*Acacia aneura*) and associated species. Low woodland, open low woodland or sparse woodland.	0 ha 0%	95.03 ha 5.7%
UPPER MURCHISON_29	Mulga (*Acacia aneura*) and associated species. Low woodland, open low woodland or sparse woodland.	113.25 ha 18.5%	258.22 ha 15.3%
UPPER MURCHISON_202	Wattle, tea tree & other species (*Acacia* spp. *Melaleuca* spp.). Scrub, open scrub or sparse scrub.	499.72 ha 81.5%	1330.52 ha 79.0%
Total		**612.96 ha 100%**	**1,683.76 ha 100%**

532000 534000 536000 538000

7152000 7150000 7148000 7146000

Landor - Meekatharra Rd

Legend

Survey Area

- Tenement M52/236
- Mt Gould PEC
- Local Road

Pre-European Vegetation

- Upper Murchison 18
- Upper Murchison 29
- Upper Murchison 202

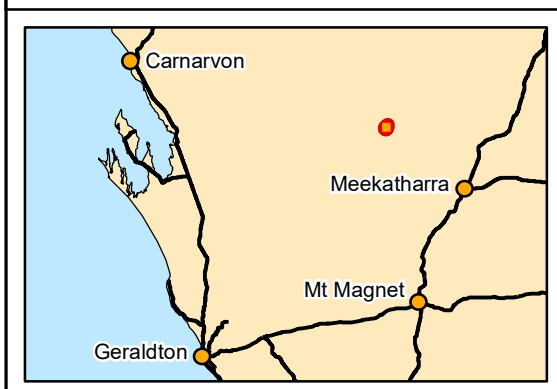
0 500 1,000 Meters

Coordinate System: GDA2020 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA2020 Created 06/12/2022

N

biologic Environmental Survey

Scale: 1:25,000



MBS ENVIRONMENTAL

Mt Gould Detailed Flora and Vegetation Assessment

Figure 2.6: Pre-European vegetation associations of the Survey Area

3 METHOD

3.1 Desktop Assessment

A desktop assessment, comprising database searches and a literature review, was undertaken prior to the field survey. The purpose of the desktop assessment was to identify vascular flora species potentially occurring in the Survey Area. This assessment also comprised Species Distribution Modelling to refine the regional search effort for the significant flora of the Survey Area.

3.1.1 Database Searches

Database searches were undertaken to generate a list of vascular flora taxa previously recorded within, and near, the Survey Area, including introduced species and taxa of conservation significance. Conservation codes for flora and vegetation of conservation significance are provided in Appendix A . Six databases were searched with varying buffers as deemed appropriate around a central coordinate location within the Survey Area (534000 mE, 7146000 mN) (Table 3.1).

Table 3.1: Details of database searches conducted

Provider	Reference	Database	Search Radius
Department of Biodiversity, Conservation and Attractions	DBCA (2022a)	NatureMap	40 km
	DBCA (2022b)	Threatened and Priority Ecological Communities	60 km
	DBCA (2022c)	Threatened and Priority Flora	60 km
Department of Climate Change, Energy, the Environment and Water (DCCEEW) (formerly the Department of Agriculture, Water, and the Environment (DAWE))	DCCEEW (2022)	Protected Matters Search (Matters of National Environmental Significance)	40 km
Atlas of Living Australia (ALA)	ALA (2022)	Occurrence search	40 km
Department of Primary Industry and Regional Development	DPIRD (2022)	Declared Pests Database (Western Australian Organism List (WAOL))[1]	Search of the entire Shire of Meekatharra

3.1.2 Literature Review

A review of available literature relevant to the Survey Area was undertaken to compile a list of vascular flora species with the potential to occur within the Survey Area (Appendix B). Fourteen assessments were reviewed, three encompassing/overlapping the Survey Area, and 11 from within 40-350 km (Table 3.2). Due to the sporadic historical surveying within the Murchison region, especially surrounding the Mt Gould area, the geographic extent of previous surveys reviewed was extended to capture additional information regarding conservation significant taxa and vegetation, as well as examination of surrounding Murchison vegetation associations.

Table 3.2: Literature sources used for the review

Report Title	Survey Type	Reference	Distance from Survey Area (km)
Mount Gould DSO Project	Detailed flora & vegetation survey	Woodman (2009)	Intersects
Mount Gould DSO Project Proposed Exploration Drilling Programme	Detailed flora & vegetation survey	Woodman (2010)	Intersects
Mount Gould Tenement	Desktop Assessment	Woodman (2008)	Intersects
Oakajee Port and Rail OPR Rail Development	Detailed flora & vegetation survey	ecologia (2010)	40 km S
Flora and vegetation of banded iron formations of the Yilgarn Craton: Jack Hills	Detailed flora survey	Meissner and Caruso (2008)	50 km SSW
Flora and vegetation of the banded iron formation of the Yilgarn Craton: Robinson Ranges and Mount Gould	Detailed flora survey	Meissner *et al.* (2009)	125 km NE and intersecting
Lake Annean	Reconnaissance flora & vegetation survey	MWH (2015)	160 km SE
Nanine Mining Area	Reconnaissance flora & vegetation survey	Spectrum (2020)	160 km SE
Golden Shamrock Prospect, Central Murchison Gold Project	Reconnaissance flora & vegetation survey	Native Vegetation Solutions (2018)	170 km SE
Gabanintha Tenements	Detailed flora & vegetation survey	Onshore (2019)	190 km SE
Gascoyne Resources Dalgaranga Tenements	Reconnaissance flora & vegetation survey	Native Vegetation Solutions (2016)	217 km S
An inventory and condition survey of the lower Murchison River area, Western Australia	Detailed flora & vegetation survey	Hennig (2009)	280 km W
Northern Goldfields Interconnect (NGI) Pipeline Project	Detailed flora & vegetation survey	Focused Vision (2020)	350 km SE
Proposed installation of a new communications tower in tenement L59/191	Targeted flora survey	Borger (2021)	350 km S

3.1.3 Species Distribution Modelling

Prior to mobilisation Biologic conducted Species Distribution Modelling (SDM) to guide the field effort of the August field survey and direct ground-truthing locations for targeted survey. The SDM allowed the assessment of a greater regional area than could be covered in a field assessment and highlighted potential areas of optimal habitat. SDM used the software package Maxent (Maximum Entropy) v.3.4.1. This software package is used to model species distributions by utilising a machine-learning approach to predict the potential probability of species occurrence based on a set of environmental parameters and occurrence records (Phillips *et al.*, 2004). Maxent models were developed for each species using the same geographic extent. The species occurrence records, obtained from the DBCA Threatened and Priority Flora, Western Australian Herbarium databases, previous known records provided from MBS, and environmental variables, based on land system, soil, surface geology, topography and vegetation maps, were used as inputs for the models. Final environmental variables used are detailed in Table 3.3 results discussed in Section 4.1.3.

Table 3.3: Environmental variables used in modelling

Environmental Variable	Description
Aspect	Geographic data analysis, raster data for bearing of slope
BIO8	Bioclimatic data for mean temperature of wettest quarter
BIO9	Bioclimatic data for mean temperature of driest quarter
BIO16	Bioclimatic data for precipitation of wettest quarter
BIO17	Bioclimatic data for precipitation of driest quarter
Elevation	Geographic data analysis, raster data for elevation above sea level
Slope	Geographic data analysis, raster data for gradient of slope
Soil clay (%)	Percentage of clay content of the soil at a depth of 0-5 cm
Soil Silt (%)	Percentage of silt content of the soil at a depth of 0-5 cm

3.2 Field Survey

3.2.1 Survey Timing & Personnel

The field survey was undertaken by four Biologic personnel over 36 person days. Senior botanist and project manager Carmel Winton lead the field survey together with technical lead, senior botanist Dr Rachel Meissner, and with the support of senior botanist Brian Morgan and botanist Emma Marsh. Biologic has a well-established and experienced botanical team with the team lead having over ten years' experience in botanical surveys in WA and the field team having combined survey experience of more than 50 years in Western Australian botanical survey. Dr Rachel Meissner has extensive experience in the Murchison region with BIF ranges of the Yilgarn Craton having worked for nine years on projects in this region. Specifically, Rachel contributed to the Robinson Range / Mount Gould project (Meissner *et al.*, 2009) and the Jack Hills project (Meissner & Caruso, 2008) for DBCA (formerly the Department of Environment and Conservation; DEC). All personnel were fully inducted to site, hold the current and relevant licencing, and have adequate experience for the bioregion (Table 3.4).

Table 3.4: Project team and licences

Biologic Personnel	Project Involvement	Licencing	Experience
Senior Botanist / Ecologists			
Carmel Winton	• Project Manager • Overall project lead & field lead • Specimen identifications • Reporting design and QA	FB62000134 TFL 134B-2021	10+ years
Dr Rachel Meissner	• Technical field lead • Specimen identifications	TBC	23 years
Brian Morgan	• Field team member	TBC	22 years
Botanists			
Emma Marsh	• Field team member • Specimen identifications • Reporting	FB62000233-4	3 years
Darcy Reith	• Reporting support	FB62000359	2 years

3.2.2 Weather & Climate

In the 12 months prior to the survey, mean minimum and maximum temperatures were comparable to long-term averages (LTA); however, were regularly warmer and dryer on average. Rainfall in the 12 months prior to the surveys was below long-term averages for most months, with the exception of February and March 2022 which recorded well above the long-term average for the month. Despite these wetter months the total rainfall for the 12 months prior to the survey was below average (189.4 mm compared to the LTA of 232.5 mm).

Observed temperatures during the survey were slightly above long-term averages on most days, with minimum temperature averaging 9.7°C (0.9°C below long-term average) and maximum temperature averaging 24.0°C (2.3°C above long-term average) (BoM, 2022a). No rainfall was recorded during the survey. Despite the lack of rainfall immediately prior to, and during the survey, conditions were considered suitable for a spring survey due to the high rainfall earlier in the year. Annual species comprised approximately half of total species observed (47.7%). This high percentage of annuals is a strong indication of adequate seasonal timing and suitable floristic sampling was achieved.

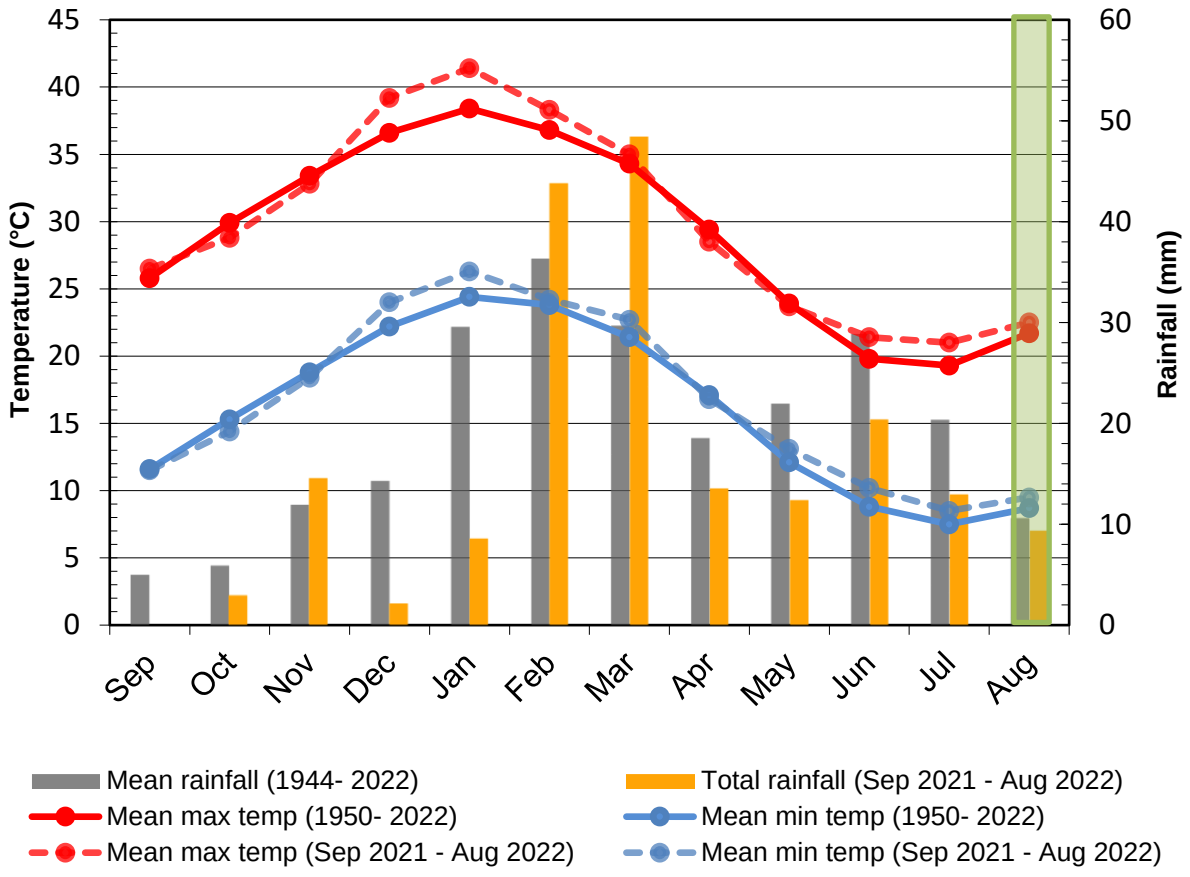


Figure 3.1:Long term and current climatic data for the Survey Area Meekatharra Airport (Station #007045), survey timing shown in green (BoM, 2022)

3.2.3 Detailed Flora Survey

A combination of quadrats, relevés, meandering traverses, and opportunistic sampling is appropriate for a detailed level flora survey as stipulated in the guidance statement (EPA, 2016b). The techniques are described in Table 3.5.

A total of 42 quadrats, six relevés and 11 mapping notes were sampled across the Survey Area and Mt Gould PEC, as well as opportunistic sampling. Twenty-six quadrats, six relevés and six mapping notes were located within the Survey Area (Figure 1.1). An additional three mapping notes were taken in regional surveying areas; to provide habitat details where targeted searching was undertaken. The survey was completed over one sampling event, from the 24th of August to 1st of September 2022.

Prior to field mobilisation site locations were selected using a combination of aerial imagery, surface geology layers, contour mapping and specialist knowledge of Murchison vegetation communities. Regional survey sites were selected with the addition of the SDM results. These sites were selected to be representative of the vegetation units at the Survey Area and Mt Gould PEC. Areas that looked unusual from the aerial imagery or appeared to represent potential habitat for significant flora and vegetation were targeted for site sampling. Survey effort is presented in Figure 3.2, quadrat site data presented in Appendix C and Site by Species Matrix included as Appendix D.

Table 3.5: Detailed field survey techniques

Approach	Description
Quadrat	A comprehensive and replicable survey technique for gathering information during a detailed flora and vegetation assessment. A clearly defined area of set proportions, giving a consistent assessment of flora and vegetation across the Survey Area. Each quadrat represents a vegetation type, and each vegetation type must be represented by a minimum of three quadrat sites. Information collected at each quadrat includes: • Site code, date, location, botanist; • A minimum of one photograph, one from the NW corner of the site; • Soil characteristics (texture and colour); • Geology (type, size and nature of any rocks, stones, gravel, or outcropping); • Topography (landform type and aspect); • Brief description of the vegetation structure in line with NVIS level V classifications (NVIS Technical Working Group, 2017) (Appendix E); • Vegetation condition (Appendix F); • Disturbances (including fire, invasive flora/fauna species); • Flora and vegetation information (including dominant cover, structure); and • Comprehensive recording of every vascular flora species within the quadrat boundary (including overhang from plants rooted outside the quadrat boundary), along with height, cover and number of individuals where necessary (20x20 m for a Murchison botanical survey).
Relevé	Relevés are an unbounded, lower intensity survey technique utilised in a detailed survey to: • Support vegetation mapping; • Support the survey effort and sampling intensity; • Provide assessment where quadrats are too dangerous to set up (such as steep gorges or embankments); or • Provide assessment where the landform does not support adequate area for a detailed quadrat. Information collected at each relevé is the same as that of a quadrat site, excluding the comprehensive collection of every species within the quadrat boundary.

Approach	Description
Traverse/ Meandering Traverse	A traverse is an unmarked route along which data is collected. Traverses are useful for identifying the boundaries and characteristics of vegetation types, selecting sites for detailed survey, and targeting significant flora or vegetation. Information recorded along a traverse may be the same as a relevé or less detailed, with the addition of noting vegetation changes and relationships between vegetation and substrate.
Mapping Notes	Mapping notes were used to ground-truth existing vegetation mapping and significant flora locations. They are a lower intensity, unbounded, survey technique. Information collected at each mapping note may vary in detail depending upon what is present and needed for that site. The following was recorded as a minimum: • Location co-ordinates; • Representative photograph; and • Brief description of the mapping note focus.
Opportunistic (Supplementary) Sampling	Flora and vegetation not recorded through other sampling methods are opportunistically sampled as encountered in the survey. Opportunistic sampling includes recording locations of significant, introduced and unknown species.
Targeted Sampling	Habitat likely to support significant flora or vegetation are targeted during the survey. Including areas with existing records of significant flora. Areas are selected based on existing records from database searches, geology, vegetation mapping and known Environmentally Sensitive Areas (ESAs; such as PEC/ TEC or GDE). Where possible, unusual, and restricted geological features are sampled. When potentially significant flora taxa are encountered during a survey, sufficient information is recorded in compliance with a Threatened and Priority Flora Report Form (TPRF) pursuant to the conditions of the flora taking licencing and authorisation to collect threatened flora.

3.2.4 Targeted Flora Survey

Prior to the survey, a list of conservation significant flora known to, or with the potential to occur within the Survey Area was compiled. Field personnel familiarised themselves with photographs, reference samples and descriptions of these taxa before conducting the survey. Once on the ground, personnel actively searched while traversing the Survey Area and in known locations or optimal habitat encountered in the field.

Targeted searching was undertaken for significant flora, as identified during the desktop assessment. Targeted taxa included taxa identified as Confirmed or considered Very Likely, Likely or Possible to occur within the Survey Area from the Assessment of Occurrence (see Section 3.2.8). The meandering targeted searches while traversing the Survey Area focussed on habitat considered likely to support significant flora. The existing records of significant flora in the Survey Area were targeted to assess for population health, counts and update the accuracy of the historical data.

When significant taxa, or potentially significant taxa, were encountered in the field the historical data was checked to see if this location previously recorded. If it was the population was assessed for health and accuracy of counts. If it were not an existing record, a GPS coordinate of the individual was taken when occurring in isolation, or a central GPS coordinate was taken for a small population (central coordinate with an approximate 20 m radius). Information collected at each location comprised:

- Number of individuals, for a small population;
- Condition and reproductive status of the plants in each population;
- Photographs and description of vegetation habitat; and

- Broad information on vegetation type and condition.
- Coordinates of either each plant (if few) or the extent of the population (if many) using a GPS.

Threatened and Priority Flora Report Forms will be provided to the Parks and Wildlife Division (Parks and Wildlife) of DBCA, as required under the flora collecting permits. Conservation significant flora specimens will be vouchered with the Western Australian Herbarium (WAH), where required and appropriate.

3.2.5 Flora

Results and discussion of significant species will be distinguished as those recorded within the Survey Area and those recorded outside. All records outside the Survey Area will be referred to collectively as the regional survey. The regional survey will include records within the section of the Mt Gould PEC that does not intersect with the Survey Area and other records observed outside the Survey Area.

Nomenclature & Specimen Identification

Flora nomenclature used in this report is consistent with the Western Australian Herbarium's plant census, provided on Florabase (WAH, 1998-). All species nomenclature is current at the time of report preparation. Specimens were identified by Dr Rachel Meissner, senior botanist Carmel Winton and botanist Emma Marsh supported by the Biologic botanical team using the appropriate taxonomic keys, Western Australian reference herbarium and, where required, relevant taxonomic experts at the Western Australian Herbarium.

Introduced Taxa

Whilst completing the detailed flora assessment and targeted searches, any introduced taxa were noted. Significant environmental weeds were a particular focus and refer to any WoNS or Declared Plant Pests in the BAM Act. Records of any introduced species identified in the Survey Area were recorded and searched with a minimum 20 m radius to establish population density and extent. Each record noted the estimated number of individual plants and approximate spatial extent of the population. Weed classification definitions are provided in Section 1.3.2 and Appendix A.

3.2.6 Vegetation

Vegetation was sampled using quadrats, relevés, and vegetation mapping notes, including information on disturbance and condition, as outlined in Section 3.2.3. The sampling methods were carried out in accordance with EPA guidelines (EPA, 2016c).

Vegetation Mapping

The current nationally adopted classification system for vegetation descriptions is the Native Vegetation Information System (NVIS) (NVIS Technical Working Group, 2017). NVIS seeks to manage national vegetation data to help improve vegetation planning and management within Australia including standardising scale and technical wording for vegetation associations. Vegetation types and condition is mapped in accordance with the scale for NVIS level V.

Vegetation assemblages were ground truthed during the survey, with site photographs and full descriptions recorded at each sampling site. The floristic data collected from the quadrats was statistically analysed (see Section 3.2.7) and new vegetation units were determined based on a combination of these statistics, floristic structural analysis and expert knowledge of the Murchison bioregion vegetation complexes. The vegetation boundaries were drawn interpreting the sampling data with aerial imagery, ground-truthing knowledge, geology and historical mapping and sampling data.

Vegetation Condition

Vegetation condition was defined within the Survey Area and Mt Gould PEC using the vegetation condition scale for the Eremaean Botanical Province in EPA (2016a), which has been adapted from Keighery (1994) and Trudgen (1988) (Appendix F). The vegetation condition was determined based on the level of disturbance observed in the sampling area. Condition was recorded at each quadrat and relevé, while additional notes were taken while traversing the Survey Area to broadly map vegetation condition boundaries. The vegetation condition mapping was digitised using GIS software, in the same manner as the vegetation mapping.

3.2.7 Floristic Data Analysis

Analysis of the field survey results was conducted to assist with delineating vegetation types and to assess survey adequacy. Floristic composition vegetation classification is a repeatable method and is considered more suitable for identification of significant vegetation as it focuses on the suite of species present within a quadrat (EPA, 2016b). During the survey, flora taxa were recorded using an estimate of the foliage cover of each species within each quadrat. All statistics were carried out using R (version 4.2.0; R Core Team, 2022), which is a commonly used and accepted method for delineating vegetation communities. Comprehensive site data for historical surveys was not available whist undertaking floristic data analysis and has not been included at the stage of writing.

Data Transformation & Reconciliation

Following the survey, the flora taxa list was reconciled to amalgamate selected taxa, e.g., varieties of the same species (Appendix G). Tentative species identifications indicated with the prefix of a query were grouped with confirmed taxa of the same name, for example *Eragrostis ?eriopoda* was grouped with *Eragrostis eriopoda*. In the instance the tentative identification was the only iteration of that taxon, it was included, for example *Amaranthus ?cuspidifolius*. Tentative genus identifications were removed from the analysis if multiple species of the same genus had already been recorded (e.g., *Sida* sp. indet.). If a tentative genus was the only observation of the genus, these were included in the analysis as is (e.g., *Cassytha* sp. indet.). Relevé sites were excluded from the analyses as records from these comprised presence/ absence data only. The final dataset used in the analyses comprised 198 flora taxa from 48 sample sites (Appendix G).

Hierarchical Clustering

To allow for disparity in cover between different strata, the cover values were standardised using a square root transformation. Singletons (taxa that were only recorded once) were removed from the

dataset. The cover code values for the floristic data recorded for each quadrat were compiled in R before a resemblance matrix was created. The similarity testing was undertaken using the Bray Curtis coefficient. Vegetation units were defined based on 40–80 % similarity and distinguished visually in a dendrogram (Appendix H).

The presence of annual taxa is strongly influenced by sporadic seasonal rainfall and can be highly variable in the Murchison. Weather conditions, water availability and landform all influence the presence of annual taxa. The relatively high proportion of annual or short-lived perennial taxa recorded (47.7%) was expected given the survey timing and the Survey Area received rain in the months preceding. Several permutations of the analysis were undertaken with differing combinations of data to compare which gave the clearest hierarchical cluster. Excluding weeds, annual taxa, and singletons, including perennials, perennial herbs and short-lived perennials provided the clearest grouping of sites for this data set (Appendix H).

Species Accumulation Curve

Species accumulation curves provide a visual overview of the observed number of flora taxa as the number of sample sites (quadrats) increases. When a curve approaches an asymptote (i.e., flattens), it suggests that sampling effort has been sufficient to collect the taxa comprising the floral assemblage at the locations sampled (Thompson *et al.*, 2003). The value at which the curve reaches an asymptote can also be used as an approximate measure of the total size of the species complement at that location (Thompson *et al.*, 2003). Additionally. estimator curves (Chao, Jacknife 1, Jacknife 2 and Bootstrap) were used to predict the number of taxa that may have actually been present. The species accumulation curves were created using the reconciled native flora taxa list for each quadrat sampled during the current spring detailed survey (Appendix G). These curves were based on presence absence data, with a random sample order and a maximum 999 permutations.

3.2.8 Assessment of Occurrence

Significant flora species identified in the database searches and previous reports are assessed per taxa for their likelihood of occurrence in the Survey Area. Prior to field mobilisation, Biologic utilises a decision matrix and botanical expertise to guide a preliminary occurrence assessment for likely presence of significant flora. Following the field assessment, ground-truthing of existing significant flora records and presence of potential habitat is reviewed to revise the occurrence assessment per taxa.

The Assessment of Occurrence decision matrix is outlined below in Table 3.6. The full occurrence assessment is provided in Appendix I and a summary of preliminary occurrence assessment is provided and discussed in Section 4.1.1 (Table 4.1). The detailed survey flora results present a summary of the revised occurrence assessment following ground-truthing of the field survey (Section 4.2.3, Appendix I).

Table 3.6: Assessment of occurrence decision matrix – Eremaean

Known Record's Proximity to the Survey Area	Habitat categories within the Survey Area			
	Core/ critical habitat present	Suitable habitat present/ within known distribution	Marginal habitat present/ adjacent to known distribution	Not present/ outside of known distribution
Within the Survey Area	Confirmed	Confirmed	Confirmed	Confirmed
Within <5 km	Highly Likely	Likely	Possible	Possible
Within 5-15 km	Likely	Possible	Possible	Unlikely
Within 15-40 km	Possible	Possible	Unlikely	Unlikely
Greater than 40 km	Possible	Unlikely	Unlikely	Highly Unlikely
Taxa considered locally/ regionally extinct	Unlikely	Unlikely	Highly Unlikely	Highly Unlikely

532000 534000 536000 538000

7152000 7150000 7148000 7146000

MTG-001 BIOB-005 MTG-002
MTG-003 BIOB-004
MTG-004
MTG-005 MTMN-003
MTG-051
MTG-007 MTG-006
MTG-010 MTG-009 MTG-008
MTG-013 MTG-011 MTG-012
MTGR-014
MTG-017 MTG-015 MTG-016
MTG-041 BIOB-009
MTG-018
MTGR-045 MTG-021
BIOB-008 BIOB-003
MTG-019 MTG-020 BIOB-007 MTG-027
BIOB-006
MTGR-046 MTGR-044 MTMN-006
MTG-023 MTG-024 MTG-022
MTG-026 MTGR-028
BIOB-002
MTG-030 MTG-031 MTG-025
MTG-029
MTG-040 MTG-032
MTG-033 MTG-034
MTG-036
MTG-037
MTGR-042 MTG-035
MTG-038 MTG-043 MTG-049
BIOB-001
MTG-048

Landor - Meekatharra Rd

Legend

Survey Area

- Tenement M52/236
- Mt Gould PEC
- Local Road

Site Type

- Mapping Note
- Quadrat
- Relevé
- Traverse

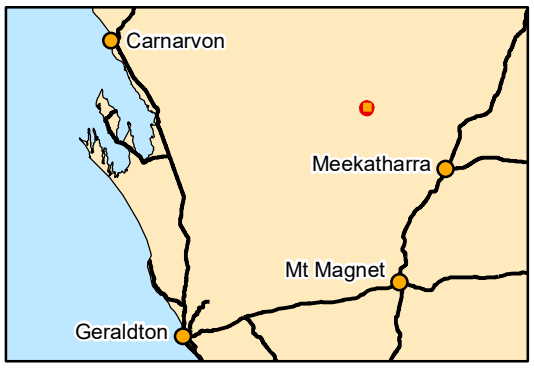
0 500 1,000 Meters

Coordinate System: GDA2020 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA2020 Created 08/12/2022

N

biologic Environmental Survey

Scale: 1:25,000



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Mt Gould Detailed Flora and Vegetation Assessment

Figure 3.2: Sample sites and traverses of the Survey Area

550000
600000
7200000
7150000
7100000

RRMN-004

Trillbar Rd

Moorarie - Trillbar Rd

Meekatharra - Mount Clere Rd

Landor - Meekatharra Rd

JHMN-008

JHMN-007

Legend

Survey Area

- Tenement M52/236
- Mt Gould PEC
- Local Road

Site Type

- Mapping Note
- Quadrat
- Relevé
- Traverse

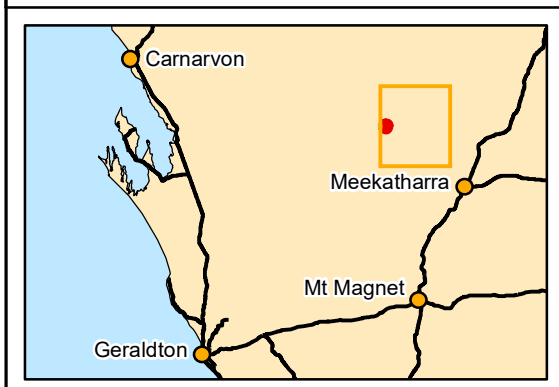
0 10 20 Km

Coordinate System: GDA2020 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA2020 Created 06/12/2022

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biologic Environmental Survey

Scale: 1:365,000



MBS ENVIRONMENTAL

Mt Gould Detailed Flora and Vegetation Assessment

Figure 3.4: Sample sites and traverses of the regional survey

4 RESULTS AND DISCUSSION

4.1 Desktop Assessment

A total of 588 vascular flora taxa from 75 families and 226 genera were identified by the desktop assessment as occurring within the 40 km search radius and have potential to occur within the Survey Area (Appendix J and Appendix K). The search area covers a wide variety of landforms, habitats and vegetation communities, as such, only a subset of the 588 vascular flora taxa is likely to occur in the Survey Area.

4.1.1 Significant Flora

The desktop assessment identified 31 significant flora taxa (those listed under the EPBC Act, BC Act, or DBCA's Priority List) within and occurring in the vicinity of the Survey Area (Table 3.1, Figure 4.1, Appendix I). The significant flora identified from the desktop assessment comprised:

- One Threatened flora tax: *Pityrodia augustensis*;
- Ten Priority 1 taxa;
- Four Priority 2 taxa;
- Thirteen Priority 3 taxa; and
- Three Priority 4 taxa.

The Threatened taxon, *Pityrodia augustensis* was returned from the EPBC database search. This database often provides a conservative and broad indication of significant taxa present for an area. Some taxa that are returned in the search may have little or no likelihood of occurring within the Survey Area. This Threatened taxon is known to occur primarily within the Mt Augustus locality and is Unlikely to occur in the Survey Area.

Of the 31 flora taxa identified by the desktop assessment four were previously recorded within the Survey Area (Table 4.1). Locations of each of these taxa were ground-truthed where possible to determine their presence/absence, and if present, the health of the population. All of these taxa were partly or wholly ground-truthed during the surveys; all four were found to be present at these locations (within the Survey Area). Prior to mobilisation the 31 taxa were assessed to determine occurrence likelihood within the Survey Area. This assessment utilised information observed from the database search results and literature review. The assessment of occurrence is presented at Appendix I and the review post survey is further discussed in Section 4.2.3.

Table 4.1: Desktop significant flora within the Survey Area

Taxon	Description	Approximate Distance from Survey Area
Confirmed		
Eremophila warnesii (P1)	Shrub, 0.07-0.5 m high. Fl. Purple, Aug. Red-brown clayey sand. Open scrub.	Within Survey Area

Taxon	Description	Approximate Distance from Survey Area
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743) (P1)	Shrub to 1m. Lower slopes of Mt Gould, ironstone. Sandy loam, clay soils, outcropping, can be quartz ridge. Flowers August-October; deep blue. Leaves superficially greener than the other known varieties.	Within Survey Area
Rhodanthe sphaerocephala (P1)	Erect annual, herb, to 0.25 m high, with ascending branches. Flowers in October.	Within Survey Area
Tribulus adelacanthus (P3)	Prostrate herb, plants villous; leaflet pairs 3-6; fruits 5-winged, lacking spines, 10-14 mm high.	Within Survey Area
Likely		
Ptilotus lazaridis (P3)	Herb or shrub, to 0.6 m high. Fl. Pink/red, Jul or Oct. Clay loam. Floodplains.	13.2 km S
Verticordia jamiesonii (P3)	Shrub, 0.2-0.6 m high. Fl. White/pink, Sep to Oct. Sandy clay soils. Lateritic breakaways.	8.0 km SE
Frankenia confusa (P4)	Low, diffuse shrub, to 0.75 m high, to 0.75 wide. Fl. Pink, Sep. Wet pale brown sand, brown clay, grey soil. Banks of rivers & waterholes, river floodplains.	13.2 km S

4.1.2 Species Distribution Modelling

Species Distribution Modelling (SDM) was used for the four significant taxa confirmed within the Survey Area to indicate potential habitat probability of presence. These significant taxa were:

- Priority 1:
  - *Eremophila warnesii;*
  - *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743);
  - *Rhodanthe sphaerocephala*; and
- Priority 3:
  - *Tribulus adelacanthus.*

The SDM results returned probability of potential habitat at BIF ranges in the vicinity of Mt Gould; specifically, the BIF ranges at Jack Hills to the west, the BIF range to the north from Mt Augustus to Peak Hill and Robinson Range to the east. This is expected as the geological, elevation and climate variables of these locations are comparable. Where possible, these areas were incorporated into the regional survey during the current assessment. The regional survey extended to areas of potential habitat in the Jack hills BIF range to assess the similarity between vegetation types. Areas of potential habitat at Mt Fraser, part of the Robinson Range BIF complex was attempted to be ground-truthed, however access and timing prevented a thorough assessment. Areas to the north were excluded from the field survey due to access difficulties and timing constraints. The cursory field assessment of Mt Fraser, knowledge gained from the literature review (Section 3.1.2), and expert knowledge of BIF ranges in the Yilgarn craton (Meissner, 2022) suggests that these areas are distinct and further populations of significant flora from the Survey Area will not be present in the BIF ranges from the modelling.

500000 550000 600000

7200000 7150000 7100000

Significant Flora

P1

- *Acacia* sp. Jack Hills (R. Meissner & Y. Caruso 4)
- *Eremophila margarethae* subsp. straight sepals (G. Cockerton & B. McLean LCH 31310)
- *Eremophila prolata*
- *Eremophila* sp. Ironstone (G. Cockerton & B. McLean LCH 31311)
- *Eremophila warnesii*
- *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743)
- *Lepidium xylodes*
- *Ptilotus tetrandrus*
- *Rhodanthe sphaerocephala*
- *Stenanthemum mediale*

P2

- *Angianthus microcephalus*
- *Indigofera fractiflexa* subsp. *augustensis*

P3

- *Calytrix praecipua*
- *Calytrix verruculosa*
- *Eremophila petrophila* subsp. *densa*
- *Gunniopsis divisa*
- *Hemigenia tysonii*
- *Hemigenia virescens*
- *Homalocalyx echinulatus*
- *Prostanthera ferricola*
- *Ptilotus lazaridis*
- *Tribulus adelacanthus*
- *Verticordia jamiesonii*

P4

- *Dodonaea amplisemina*
- *Frankenia confusa*
- *Goodenia berringbinensis*

Mt Clere - Woodlands Rd
Gascoyne River
Yarlarweelor Creek
Meekatharra - Mount Clere Rd
Nanular Creek
Milgun - Yarlarweelor Rd
Trillbar Rd
Dimble Creek
Goondle Creek
Bedaburra Creek
Mukalo Creek
Yunda Rd
Moorarie - Trillbar Rd
Murchison River
Beringarra - Mount Gould Rd
Gould Creek
Beringarra - Byro Rd
Pindabarn Creek
Judal-Mileura Rd
Whela Creek
Beringarra - Cue Rd
Mileura - Nookawarra Rd
Beringarra - Pindar Rd
Twelve Mile Creek

Legend

Survey Area

- Tenement M52/236
- Mt Gould PEC
- Local Road
- Major Surface Hydrology

0 10 20 Kilometers

Coordinate System: GDA2020 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA2020 Created 06/12/2022

N

biologic Environmental Survey

Scale: 1:550,000

Carnarvon
Meekatharra
Mt Magnet
Geraldton

MBS ENVIRONMENTAL

Mt Gould Detailed Flora and Vegetation Assessment

Figure 4.1: Significant flora from the desktop assessment

4.1.3 Significant Vegetation

The database searches indicated that no TECs occur within and surrounding (within 50 km) of the Survey Area. The database searches indicated one Priority Ecological Community (PEC), Mount Gould vegetation complex (banded ironstone formation) (P1), intersects with the Survey Area. An additional six PECs are known to occur within a 50 km radius of the Survey Area and are presented in Table 4.2 and Figure 4.2.

Woodman recognised seven vegetation types (referred to as FCT's) from the Mt Gould Project, of which four were considered significant (Woodman, 2009). The vegetation mapping and FCT descriptions have been included as Appendix L for ease of comparison. Three of the Woodman FCTs were identified to be representative of the Mount Gould vegetation complex BIF PEC (Woodman, 2009). One additional FCT was found to be significant as a refuge for significant flora. Analysis from Meissner *et al.* (2009) and Woodman (2009) recognises the vegetation types of the upper slopes and crests of Mt Gould to be distinct from the surrounding BIF ranges; specifically, those from Robinson Range to the east and Jack Hills to the south.

Table 4.2: Priority Ecological Communities (PECs) in the vicinity of the Survey Area

PEC name and description	Distance from Survey Area (km)
Priority 1	
Beringarra calcrete groundwater assemblage type on Murchison palaeodrainage on Beringarra Station: • Unique assemblages of invertebrates have been identified in the groundwater calcretes. • Threats: hydrological changes associated with mining	31 km SW
Jack Hills vegetation complexes (banded ironstone formation): • Threats: clearing for mining	10.6 km S
Mount Dugel/Mount Nairn vegetation complexes (banded ironstone formation): • Threats: clearing for mining	27.6 km W
Mount Gould vegetation complex (banded ironstone formation): • Threats: clearing for mining	Within Survey Area
Priority 3	
Frederick Land System: • Hardpan wash plains characterised by broad, reticulate mulga groves and Wanderrie banks supporting tall Acacia shrublands with grassy understorey • Threats: over grazing	34 km WNW
Jingle Land System: • Flood plains with Eucalypt woodlands and variable shrublands marginal to rivers. • Threats: over grazing, erosion	46.7 km NNW
Trillbar Land System: • Gently sloping stony plains with low rises of metamorphic rocks and gilgaied drainage foci; supports more or less saline shrublands of snakewood, mulga, bluebush and samphire with patches of tussock grassland. • Threats: over grazing	42.8 km NE

450000
500000
550000
7250000
7200000
7150000
7100000

Mount James Creek
Landor - Mt Augustus Rd
Aurillia Creek
Gascoyne River
Bubbagundy Creek
Dalgety Downs - Landor Rd
Jingle Creek
Landor River
Erong Creek
Black Adder Creek
Wheelo Creek
Nanular Creek
Bedaburra Creek
Trillbar Rd
Erong Rd
Coondle Creek
Wooramel River
Yunda Rd
Mukalo Creek
Moorarie - Trillbar Rd
Murchison River
Beringarra - Mount Gould Rd
Gould Creek
Yalgar River
Beringarra - Byro Rd
Beringarra - Pindar Rd
Judal Rd
Judal-Mileura Rd
Landor - Meekatharra Rd
Pindabarn Creek
Beringarra - Cue Rd
Whela Creek

Legend

Survey Area

- Tenement M52/236
- Mt Gould PEC
- Local Road
- Major Surface Hydrology

Significant Vegetation

TEC/PEC

- Beringarra Calcrete - Priority 1
- Jack Hills BIF - Priority 1
- Mount Dugel and Nairn BIF - Priority 1
- Mount Gould BIF - Priority 1
- Frederick Land System - Priority 3
- Jingle LS - Priority 3
- Jingle Land System - Priority 3
- Trillbar Land System - Priority 3

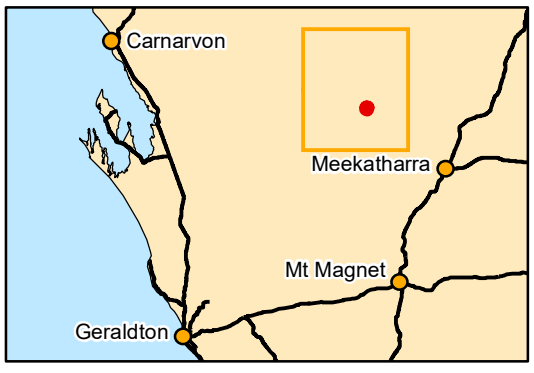
0 10 20 Kilometers

Coordinate System: GDA2020 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA2020 Created 06/12/2022

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biologic Environmental Survey

Scale: 1:550,000



MBS ENVIRONMENTAL

Mt Gould Detailed Flora and Vegetation Assessment

Figure 4.2: Significant vegetation from the desktop assessment

4.2 Detailed Assessment

4.2.1 Flora

Species richness

A total of 219 confirmed vascular flora taxa from 35 families and 85 genera were recorded from the Survey Area and Mt Gould PEC (Appendix M). The most species diverse family is Fabaceae, the Pea family with 29 taxa from seven genera. The most species rich genus is *Acacia*, the wattles with 18 taxa. The four most dominant families equate to 42.9 % of the total taxa recorded. Table 4.3 outlines species diversity by family and genera for the assessment at the Survey Area and Mt Gould PEC. Twelve of the 35 families recorded were represented by a single taxon, comprising 5.5 % of the total taxa recorded. Forty-six of the 85 genera recorded were represented by a single taxon, comprising 21 % of the total taxa recorded.

Table 4.3:Species diversity at the Survey Area and Mt Gould PEC

Classification	Taxa count	Classification	Taxa count
Most species rich families		**Most species rich genera**	
Fabaceae	7 genera from 29 taxa	*Acacia* (Fabaceae)	18 taxa
Poaceae	15 genera from 28 taxa	*Eremophila* (Scrophulariaceae)	14 taxa
Malvaceae	4 genera from 20 taxa	*Ptilotus* (Amaranthaceae)	13 taxa
Asteraceae	10 genera from 17 taxa	*Sida* (Malvaceae)	10 taxa

Twelve collections were unable to be conclusively determined to species or infraspecies level. Four of these collections were unable to be determined beyond family (all Poaceae) and eight were given a species name, preceded with a query, to represent the conservative identification (e.g. *Acacia* ?*cuthbertsonii*). Four of the collections with a query were the only representation of that taxa and accounted for two taxa, *Calandrinia* ?*polyandra* (three collections) and *Eriochloa* ?*pseudoacrotricha* (one collection). To conclusively identify some species the taxonomic key requires a specific representation of floristic material at particular stages of development, for example: mature seeds, calyx from the flower or fruiting body, juvenile phyllode resin. While the seasonal timing was adequate for this level of survey there were some collections that lacked the expression of floristic material that is needed for conclusive identification. Twenty-one taxa were observed as distinct in the field yet not collected due to insufficient floristic material. These taxa are represented in the species data with the suffix “sp. indet” to indicate presence at the site but indeterminate taxonomic identification. These taxa were mostly indeterminate due to being dead or sterile and are likely to have been represented in the species data by other observations or collections of that taxa. This naming convention and presence of indeterminate flora is in the expected range for a survey of this intensity and aligns with IBSA data standards and naming registers.

Significant Flora

Four priority listed taxa were recorded from the Survey Area (Figure 4.4 to Figure 4.5). All four taxa were previously known to occur within the Survey Area, they are:

- Priority 1:
  - *Eremophila warnesii;*
  - *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743);
  - *Rhodanthe sphaerocephala*; and
- Priority 3:
  - *Tribulus adelacanthus.*

Table 4.4 presents the counts of the individuals and their point locations in the Survey Area and the regional survey. These records of significant flora are the combined dataset of historical data conducted by Woodman Environmental Consulting (Woodman, 2009) in 2008 and the current assessment at the Survey Area and Mt Gould PEC. A subset of existing records of significant flora previously recorded by Woodman were ground truthed to assess condition and extent of populations and accuracy/currency of data during the current field survey. Presence and abundance of populations recorded by Woodman were consistent with field observations from the current survey. All historic records from Woodman are considered to represent the current presence and abundance of significant flora populations of the Survey Area and Mt Gould PEC.

Table 4.4: Significant flora counts across the Survey Area and regional survey

Significant flora	Counts		
	Survey Area	Regional Survey	Combined
Priority 1			
Eremophila warnesii	13,610 individuals from 335 locations	3,347 individuals from 68 locations	16,957
Halgania gustafsenii var. Murchison	12, 969 individuals from 1,054 locations	771 individuals from 85 locations	13,740
Rhodanthe sphaerocephala	48 individuals from 16 locations	56 individuals from 12 locations	104
Priority 3			
Tribulus adelacanthus	2,128 individuals from 185 locations	315 individuals from 42 locations	2,443

Three taxa were identified as having an affinity to a species indicated with a prefix of “aff.” before the species name. These taxa and taxonomic commentary are listed in Table 4.5. Taxa expressed with an affinity to another species are of potential significance due to the specimen having close resemblance to a species yet exhibiting specific taxonomic difference. Some expressions of affinity are known, and this forms the phrase name for a new species. Some expressions of affinity are representative of a species complex that needs formal taxonomic revision. None of the affiliated taxa have conservation significance rating assigned to them.

Three unconfirmed specimens are from genera of significant taxa identified by the desktop assessment. Two of these significant taxa remain Possible to occur post-survey (see Section 3.2.8) and the unconfirmed taxa recorded from the Survey Area may represent one or more of these significant taxa.

Table 4.5: Taxa of other significance

Taxa	Taxonomic comments
Sida aff. sp. dark green fruits (S. van Leeuwen 2260)	Stellate hairs on mericarps not curled hairs. Matches specimens collected more widely, including collected at Weld Range (Meissner, 2022; Meissner *et al.*, 2009)
Sida aff. intricata	Matches specimens from Robinson Range (Doolgunna Station), and Jack Hills – crisped/.silky hairs on mericarps not stellate hairs (Meissner, 2022; Meissner *et al.*, 2009)
Sida aff. sp. spiciform panicles (E. Leyland s.n. 14/8/90)	Leaf shape, stipules, indumentum inconsistent with spiciform panicles. Stellate hairs much smaller. Checked against similar specimens in the reserved collection at the WAH. Matches collection from Mt Gould which is possibly classified as different to Sida sp. spiciform panicles.

***Eremophila warnesii* (P1)**

Eremophila warnesii is a perennial shrub 0.07-0.5 m tall. Leaves alternate, petiolate, with thick, fine, white to pale grey tomentum. Flowers: corolla pale lilac, light purple spotted in tube below lower lip and flowering in August (Plate 4.1). This taxon is known to occur on red-brown clayey sand on open scrub (WAH, 1998-), and this taxon has been observed on ironstone ridges at elevation on Mt Gould.

There are currently nine records for this species in the databases of the WAH, all with a corresponding specimen held at the WAH (WAH, 1998-). This taxon was recorded from the Survey Area on the steep banded ironstone slope of Mt Gould often with northern aspect. The regional survey observed this taxon in open shrublands on red-brown sandy soil plains with no significant elevation (Figure 4.3 and Figure 4.6). This taxon is known from the Murchison and Gascoyne. A total of 16,957 individuals of *Eremophila warnesii* were recorded during the field survey at 403 locations, 80.26 % were observed in the Survey Area.



Plate 4.1: *Eremophila warnesii* (P1); habit and habitat variation, flower and leaf structure, Source: Biologic 2022, current survey

***Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) (P1)**

Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743) is a shrub up to 1 m tall. Leaves lanceolate nerved, cuticle and peduncle are sparsely silky with sessile glands, superficially greener than the other known varieties. Flowers are deep blue in colour and are produced from August to October (Plate 4.2). Known to occur only on the lower slopes of Mt Gould, predominantly western aspect and adjacent on ironstone outcropping, quartz ridges, sandy loam, and clay soils.

There are currently 11 records for this species in the WAH database (each of which has a corresponding specimen held at WAH) (WAH, 1998-). This taxon was recorded on the lower slopes and foothills of Mt Gould and was not recorded at any other locations outside of the Survey Area and Mt Gould PEC (Figure 4.4). All known records of this taxon are from the vicinity of Mt Gould with spacing less than 500 m between records. This is defined as a single population in the manual for significant flora collection (DBCA, 2017). A total of 13,740 individuals of *Halgania gustafsenii* var. Murchison were observed during the survey at 1,139 locations, 94.39 % were observed in the Survey Area.



Plate 4.2: *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) (P1); habit and habitat, flower and leaf structure, Source: Biologic 2022, current survey

***Rhodanthe sphaerocephala* (P1)**

Rhodanthe sphaerocephala is an erect annual, herb up to 0.25 m tall, with ascending branches. Flowers are bright yellow and compact (button-shaped) (Plate 4.3), Florabase has this taxon flowering in October following rainfall however it was observed flowering in August during the current field survey. This taxon is found on flat and claypan in clayey loam soils.

There are currently seven records for this species on the WAH database (each of which has a corresponding specimen held at WAH) (WAH, 1998-). This taxon was observed on open claypans flats/depressions from the survey (Figure 4.5 and Figure 4.7). This taxon has a known distribution from the Gascoyne and Murchison. Observations made during in the regional survey are indicative of a new population for this taxon. A total of 104 individuals of *Rhodanthe sphaerocephala* were recorded during the survey at 28 locations, 46.15 % were observed in the Survey Area.



Plate 4.3: *Rhodanthe sphaerocephala* (P1); habit and habitat, flower and leaf structure, Source: Biologic 2022, current survey

***Tribulus adelacanthus* (P3)**

Tribulus adelacanthus is a prostrate, villous herb up to 10-14 mm tall. Leaflet pairs are 3-6 in number and fruits are 5-winged, densely pubescent between wings, lacking spines but with hardened equivalent structures just below middle in dried condition (unknown in fresh state) (Plate 4.4). This taxon is known to occur on hillslopes, banded ironstones in red-brown shallow sandy loam soils.

There are currently 17 records for this species held on the WAH database (each of which has a corresponding specimen held at WAH) (WAH, 1998-). This taxon was observed on banded ironstone slopes, sandy clay plains and cobble flats during the field survey, (Figure 4.5 and Figure 4.7). This taxon has a broad distribution throughout the Gascoyne and Murchison. A total of 2,443 individuals of *Tribulus adelacanthus* were recorded during the survey at 227 locations, 87.1 % were observed in the Survey Area.



Plate 4.4: *Tribulus adelacanthus* (P3); habit and habitat, leaf, fruit, Source: Biologic 2022, current survey

532000 534000 536000 538000

7152000 7150000 7148000 7146000

Landor - Meekatharra Rd

Legend

Survey Area

- Tenement M52/236
- Mt Gould PEC
- Local Road

Significant Flora

Priority 1

- *Eremophila warnesii*

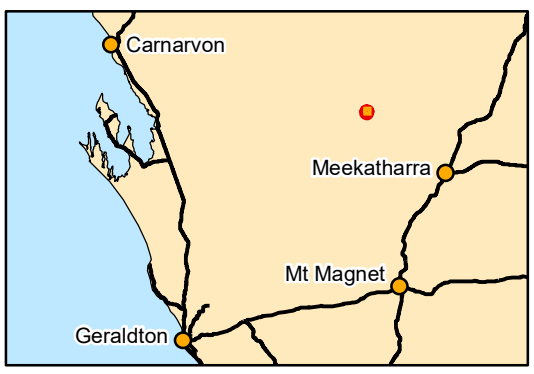
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Coordinate System: GDA2020 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA2020 Created 08/12/2022

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biologic Environmental Survey

Scale: 1:25,000



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Mt Gould Detailed Flora and Vegetation Assessment

Figure 4.3: Significant flora recorded in the Survey Area, *Eremophila warnesii* (P1)

532000
534000
536000
538000
7152000
7150000
7148000
7146000
Landor - Meekatharra Rd

Legend

Survey Area

- Tenement M52/236
- Mt Gould PEC
- Local Road

Significant Flora

Priority 1

- *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743)

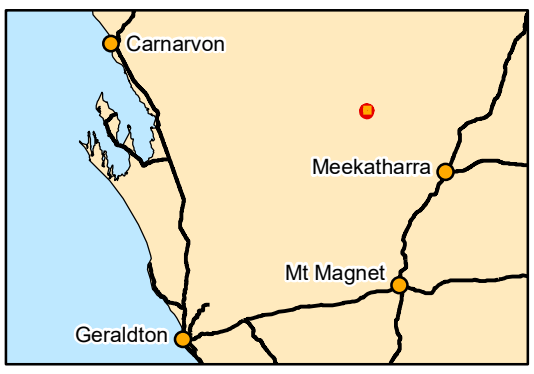
0 500 1,000 Meters

Coordinate System: GDA2020 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA2020 Created 08/12/2022

N

biologic Environmental Survey

Scale: 1:25,000



MBS ENVIRONMENTAL

Mt Gould Detailed Flora and Vegetation Assessment

Figure 4.4: Significant flora recorded in the Survey Area, *Halgania gustafsenii* var. Murchison (P1)

532000 534000 536000 538000

7152000 7150000 7148000 7146000

Landor - Meekatharra Rd

Legend

Survey Area

- Tenement M52/236
- Mt Gould PEC
- Local Road

Significant Flora

Priority 1

- *Rhodanthe sphaerocephala*

Priority 3

- *Tribulus adelacanthus*

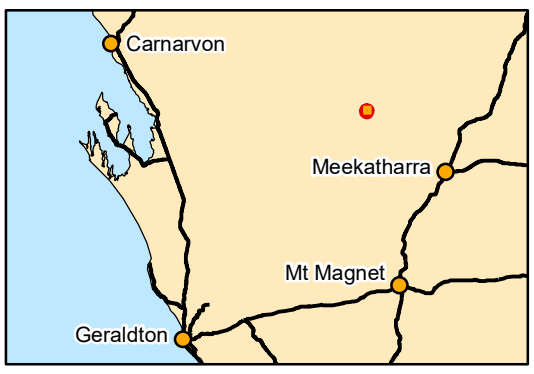
0 500 1,000 Meters

Coordinate System: GDA2020 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA2020 Created 08/12/2022

N

biologic Environmental Survey

Scale: 1:25,000



MBS ENVIRONMENTAL

Mt Gould Detailed Flora and Vegetation Assessment

Figure 4.5: Significant flora recorded in the Survey Area, *Rhodanthe sphaerocephala* (P1) and *Tribulus adelacanthus* (P3)

550000
600000
7200000
7150000
7100000
Trillbar Rd
Moorarie - Trillbar Rd
Meekatharra - Mount Clere Rd
Landor - Meekatharra Rd
Judal Rd
Judal-Mileura Rd

Legend

Survey Area

- Tenement M52/236
- Mt Gould PEC
- Local Road
- Traverse

Significant Flora

Priority 1

- *Eremophila warnesii*

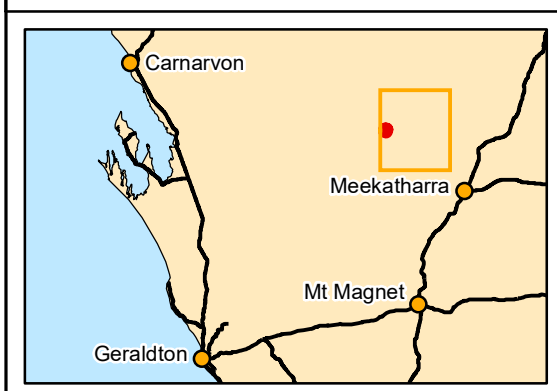
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Projection: Transverse Mercator
Datum: GDA2020 Created 12/12/2022

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biologic Environmental Survey

Scale: 1:365,000



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Figure 4.6: Significant flora of the regional survey, *Eremophila warnesii* (P1)

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Milgun - Yarlarweelor Rd
Trillbar Rd
Mooraric - Trillbar Rd
Meekatharra - Mount Clere Rd
Landor - Meekatharra Rd

Legend

Survey Area

- Tenement M52/236
- Mt Gould PEC
- Local Road
- Traverse

Significant Flora

Priority 1

- *Rhodanthe sphaerocephala*

Priority 3

- *Tribulus adelacanthus*

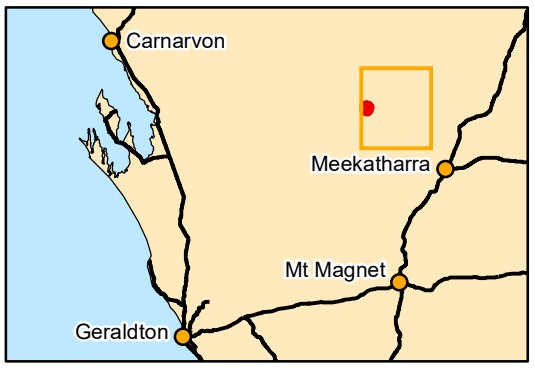
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Projection: Transverse Mercator
Datum: GDA2020 Created 12/12/2022

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Scale: 1:365,000



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Figure 4.7: Significant flora of the regional survey, *Rhodanthe sphaerocephala* (P1) and *Tribulus adelacanthus* (P3)

Introduced Flora

Eight confirmed introduced taxa were recorded from the Survey Area (Table 4.6, Figure 4.8). None of the introduced flora are listed as WoNS, a DP under the BAM Act, or as 'Priority Alert' weeds by Parks and Wildlife. Introduced flora were distributed primarily within drainage line, floodplain, and stony plain vegetation types, while the upper landscapes (i.e., hillcrests, summits, upper hillslopes) had lower introduced flora presence. Introduced flora are known to be more prevalent along drainage lines and floodplains, due to dispersal of seeds by water movement as well as the higher water availability these landforms provide for germination and growth (Hill *et al.*, 2005; van der Meulen & Sindel, 2008). Furthermore, spread via cattle is more prevalent on the lower landforms, compared to rocky, breakaway country and large hills and ranges.

Table 4.6: Introduced flora from the Survey Area and Mt Gould PEC

Family	Species	Observation
Convolvulaceae	**Cuscuta epithymum*	15 individuals from 1 location
	**Cuscuta planiflora*	15 individuals from 1 location
Cucurbitaceae	**Citrullus amarus*	2 individuals from 2 locations
	**Cucumis myriocarpus* subsp. *myriocarpus*	1 individual from 1 location
Poaceae	**Cenchrus ciliaris*	10 individuals from 3 locations
	**Setaria verticillate*	2 individuals from 1 location
Polygonaceae	**Rumex vesicarius*	4 individuals from 1 location
Zygophyllaceae	**Tribulus terrestris*	5 individuals from 1 location

532000 534000 536000 538000

7152000 7150000 7148000 7146000

Landor - Meekatharra Rd

Legend

Survey Area

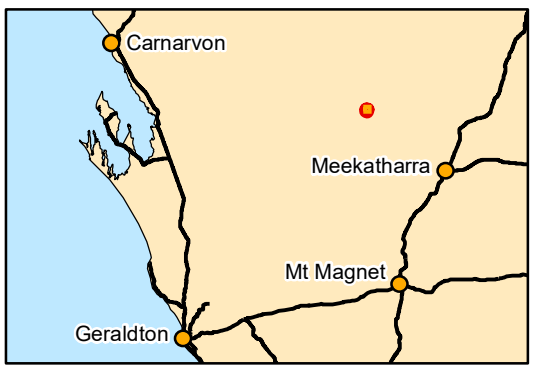
- Tenement M52/236
- Mt Gould PEC
- Local Road

Introduced Species

- **Cenchrus ciliaris*
- **Citrullus amarus*
- **Cucumis myriocarpus* subsp. *myriocarpus*
- **Cucumis* sp. *indet*
- **Cuscuta epithymum*
- **Cuscuta planiflora*
- **Rumex vesicarius*
- **Setaria verticillata*
- **Tribulus terrestris*

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Coordinate System: GDA2020 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA2020 Created 06/12/2022



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Scale: 1:25,000

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Figure 4.8: Introduced flora recorded in the Survey Area

4.2.2 Vegetation

Twelve vegetation types were described from three broad landforms in the Survey Area and Mt Gould PEC (Table 4.7, Table 4.8, Figure 4.9). These were derived from the dendrogram (hierarchical clustering), review of structural floristic assemblages, review of aerial imagery, and the interpretation of previous vegetation mapping for the Survey Area. The dominant landform of the Survey Area was hills, crests and slopes comprising 50.63% from seven vegetation types. Native vegetation covered 96.5 % of the Survey Area, with the remaining area mapped as 'Cleared' due to tracks or mining and mining related disturbances. The hierarchical clustering clearly defined vegetation types associated with hills, crests and upper slopes in the primary division from the vegetation types of the plains and lower slopes landforms. In subsequent division some vegetation types were clearly defined, and others were interpreted with structural floristics. Drainage and floodplain vegetation types were extracted from the groupings and defined using structural floristic analysis and aerial imagery.

Vegetation types of the Survey Area have been previously mapped (FCTs; Woodman (2009)). The corresponding historical FCTs are provided in Table 4.8 alongside the current vegetation types to assist data comparison. These have been matched using aerial imagery and floristic structure. Woodman found seven vegetation types (FCTs) and the current assessment recognised twelve vegetation types in the Survey Area and Mt Gould PEC. Some of the FCTs display characteristics from multiple vegetation types so some vegetation types have two corresponding FCTs. Since the historical mapping, a greater number of vegetation types and finer vegetation boundaries have been defined in the current mapping due to an increase in survey area size, improved aerial imagery and the refinement of the Mulga complex (*Acacia aneura*).

Table 4.7: Summary of vegetation type at the Survey Area and Mt Gould PEC

Broad landform / vegetation type	Summary	Extent	
		Survey Area	Mt Gould PEC
Drainage / Floodplain		**105.88 ha (17.28%)**	**163.94 ha (15.74%)**
D1 AaAptApr	Drainage areas/depressions, clearly defined by structural floristics and aerial imagery	10.79 ha (1.76%)	38.87 ha (2.31%)
F1 MacScdi	Floodplain areas, defined by structural floristics including presence/absence	45.29 ha (7.39%)	66.28 ha (3.94%)
F2 ArhErarArc	Floodplain areas, defined by structural floristics and aerial imagery	49.80 ha (8.13%)	58.79 ha (3.49%)
Hills, crests and slopes		**310.27 ha (50.63%)**	**470.90 ha (27.98%)**
H1 PhbcErlt Tm	Hill crests clearly defined by hierarchical clustering analysis	18.20 ha (2.97%)	18.20 ha (1.08%)
H2 PtoErwErlc	Crests and slopes defined by hierarchical clustering and refined with structural floristics	45.51 ha (7.42%)	48.63 ha (2.89%)
H3 AaAciAr	Crests and slopes defined by hierarchical clustering and refined with structural floristics	67.95 ha (11.09%)	67.95 ha (4.04%)
S1 AaAinAf	Slopes defined by hierarchical clustering and refined with structural floristics	77.46 ha (12.64%)	124.96 ha (7.42%)

Broad landform / vegetation type	Summary	Extent	
		Survey Area	Mt Gould PEC
S2 ArAptAin	Slopes defined by hierarchical clustering and refined with structural floristics	55.27 ha (9.02%)	116.15 ha (6.90%)
S3 AinApt	Slopes and foothills interpreted with hierarchical clustering and defined with structural floristics	44.18 ha (7.21%)	66.78 ha (3.97%)
S4 AaGrbAf	Slopes and foothills interpreted with hierarchical clustering and defined with structural floristics	1.70 ha (0.28%)	28.23 ha (1.68%)
Plains		**175.32 ha (28.6%)**	**858.14 ha (50.97%)**
P1 ErfrSeaPtro	Sandy/stony plains interpreted with hierarchical clustering and defined with structural floristics	32.68 ha (5.33%)	620.13 ha (36.83%)
P2 ArrAkApt	Sandy/stony plains clearly defined by hierarchical clustering analysis	142.64 ha (23.27%)	238.01 ha (14.14 %)

Table 4.8: Vegetation types with the Survey Area

Vegetation Code Description	Sample Sites	Extent	Features of Interest & Condition	Photo
Drainage / Floodplain				
D1 AaAptApr *Acacia aptaneura, Acacia pteraneura, Acacia pruinocarpa* tall open shrubland *Eremophila glutinosa, Eremophila phyllopoda* mid sparse shrubland over *Aristida contorta, Eriachne aristidea*, *Aristida holathera* low sparse to open tussock grassland	MTG-005, MTG-007, MTG-016, MTMN-003	**Survey Area** 10.79 ha 1.76% **Mt Gould PEC** 38.87 ha 2.31%	Forming from the minor drainage lines and depressions on slopes and plains. Significant flora present: *Eremophila warnesii* (P1), *Halgania gustafsenii* var. Murchison (P1) and *Tribulus adelacanthus* (P3). Equivalent FCT: not represented Overall Condition: Good to Very Good	
F1 MacScdi *Senna* sp. Meekatharra (E. Bailey 1-26), *Senna artemisioides* low isolated clumps of shrubs over *Maireana carnosa, Sclerolaena diacantha* low isolated clumps of chenopod shrubs over *Aristida contorta* low sparse tussock grassland	MTG-017, MTG-036	**Survey Area** 45.29 ha 7.39% **Mt Gould PEC** 66.28 ha 3.94%	Claypan on plains. Presents optimal habitat for *Rhodanthe sphaerocephala.* Equivalent FCT: 3 Overall Condition: Good to Very Good	

Vegetation Code Description	Sample Sites	Extent	Features of Interest & Condition	Photo
F2 ArhErarArc *Acacia kempeana, Acacia ramulosa*, (+/- *Acacia aptaneura*) tall open shrubland over *Eremophila forrestii, Eremophila fraseri* mid sparse shrubland over *Aristida holathera, Eriachne aristidea, Aristida contorta* low open tussock grassland	MTG-038, MTG-041	**Survey Area** 49.80 ha 8.13% **Mt Gould PEC** 58.79 ha 3.49%	Sandy clay plains on foothills of Survey area. Significant flora present: *Halgania gustafsenii* var. Murchison (P1) and *Tribulus adelacanthus* (P3). Equivalent FCT: 6a Overall Condition: Good to Very Good	
Hills, crests and slopes				
H1 PhbcErlt Tm *Grevillea berryana, Hakea loreus* tall isolated clumps of shrubs over *Philotheca brucei, Eremophila latrobei* low sparse shrubland over *Triodia melvillei* low open hummock grassland	MTG-032, MTG-040, MTGR-044	**Survey Area** 18.20 ha 2.97% **Mt Gould PEC** 18.20 ha 1.08%	Crest of southern hill. Significant flora present: *Eremophila warnesii* (P1). Representative of the Mt Gould PEC. Equivalent FCT: 5 Overall Condition: Excellent	

Vegetation Code Description	Sample Sites	Extent	Features of Interest & Condition	Photo
H2 PtoErwErlc *Acacia aptaneura*, (+/- *Acacia rhodophloia*) tall open to sparse shrubland over *Ptilotus obovatus*, (+/- *Eremophila warnesii, Eremophila lachnocalyx*) low sparse shrubland over *Aristida contorta, Digitaria brownii, Enneapogon caerulescens* low sparse tussock grassland	MTG-015, MTG-022, MTG-026	**Survey Area** 45.51 ha 7.42% **Mt Gould PEC** 48.63 ha 2.89%	Crests and slopes to upper slopes of Mt Gould, mostly northern aspect. Presents optimal habitat for *Eremophila warnesii* (P1). Other significant flora present: *Halgania gustafsenii* var. Murchison (P1) and *Tribulus adelacanthus* (P3). Representative of the Mt Gould PEC. Equivalent FCT: 4 Overall Condition: Very Good to Excellent	
H3 AaAciAr *Acacia aptaneura,* (+/- *Acacia citrinoviridis, Acacia rhodophloia*) tall sparse shrubland over *Ptilotus obovatus, Eremophila latrobei, Corchorus crozophorifolius* low sparse shrubland over *Aristida contorta, Digitaria brownii, Paspalidium clementii* isolated clumps of tussock grasses	MTG-020, MTG-025, MTG-034, MTGR-046	**Survey Area** 67.95 ha 11.09% **Mt Gould PEC** 67.95 ha 4.04%	Crests and slopes to upper slopes of Mt Gould, mostly southern and western aspect. Significant flora present: *Eremophila warnesii* (P1), *Halgania gustafsenii* var. Murchison (P1) and *Tribulus adelacanthus* (P3). Representative of the Mt Gould PEC. Equivalent FCT: 4 Overall Condition: Very Good to Excellent	

Vegetation Code Description	Sample Sites	Extent	Features of Interest & Condition	Photo
S1 AaAinAf *Acacia aptaneura, Acacia incurvaneura, Acacia fuscaneura* tall sparse to open shrubland over *Ptilotus polystachyus, Solanum lasiophyllum, Ptilotus obovatus* isolated clumps of shrubs over *Aristida contorta, Eriachne aristidea, Eragrostis eriopoda* isolated clumps of tussock grasses	MTG-024, MTG-033, MTG-035, MTG-037, MTG-043	**Survey Area** 77.46 ha 12.64% **Mt Gould PEC** 124.96 ha 7.42%	Lower slopes and foothills of Mt Gould, mostly southern aspect. Presents optimal habitat for *Halgania gustafsenii* var. Murchison (P1). Other significant flora present: *Eremophila warnesii* (P1) and *Tribulus adelacanthus* (P3). Possible representative of the Mt Gould PEC. Equivalent FCT: 1 and 6b Overall Condition:	
S2 ArAptAin *Acacia rhodophloia, Acacia pteraneura* (+/- *Acacia incurvaneura*) tall sparse to open shrubland over *Ptilotus obovatus, Eremophila latrobei*, (+/- *Halgania gustafsenii*) low sparse shrubland over *Aristida contorta* low sparse tussock grassland	MTG-019, MTG-021, MTG-027, MTG-029, MTG-031, MTGR-028, MTGR-045	**Survey Area** 55.27 ha 9.02% **Mt Gould PEC** 116.15 ha 6.90%	Lower slopes and foothills of Mt Gould, mostly northern aspect. Significant flora present: *Eremophila warnesii* (P1), *Halgania gustafsenii* var. Murchison (P1) and *Tribulus adelacanthus* (P3). Possible representative of the Mt Gould PEC. Equivalent FCT: 1 Overall Condition:	

Vegetation Code Description	Sample Sites	Extent	Features of Interest & Condition	Photo
S3 AinApt *Acacia incurvaneura, Acacia pteraneura* tall sparse shrubland over *Ptilotus obovatus, Eremophila lachnocalyx* low isolated clumps of shrubs over *Aristida contorta, Eriachne aristidea*, *Eragrostis eriopoda* isolated clumps of tussock grasses	MTG-049, MTMN-006	**Survey Area** 44.18 ha 7.21% **Mt Gould PEC** 66.78 ha 3.97%	Lower slopes and foothills of Mt Gould, mostly eastern aspect. Presents optimal habitat for *Halgania gustafsenii* var. Murchison (P1). Other significant flora present: *Eremophila warnesii* (P1) and *Tribulus adelacanthus* (P3). Possible representative of the Mt Gould PEC. Equivalent FCT: 1 Overall Condition:	
S4 AaGrbAf *Acacia aptaneura, Grevillea berryana*, *Acacia fuscaneura* tall sparse to open shrubland over *Eremophila latrobei, Ptilotus obovatus, Ptilotus helipteroides* low isolated clumps of shrubs over *Aristida contorta, Paspalidium clementii, Eriachne aristidea* low isolated to sparse tussock grasses	MTG-006, MTG-008	**Survey Area** 1.70 ha 0.28% **Mt Gould PEC** 28.23 ha 1.68%	Bands of ironstone crests follow the bedrock geology associated with the northern extent of the PEC. Significant flora present: *Halgania gustafsenii* var. Murchison (P1) and *Tribulus adelacanthus* (P3). Possible representative of the Mt Gould PEC. Equivalent FCT: not represented Overall Condition:	

Vegetation Code Description	Sample Sites	Extent	Features of Interest & Condition	Photo
Plains				
P1 ErfrSeaPtro *Grevillea berryana, Acacia pteraneura, Acacia rhodophloia* tall sparse shrubland over *Eremophila fraseri, Senna artemisioides, Ptilotus rotundifolius* mid sparse shrubland over *Aristida contorta, Eriachne aristidea, Eriachne pulchella* low open tussock grassland	MTG-001, MTG-002, MTG-003, MTG-004, MTG-009, MTG-010, MTG-011, MTG-012, MTG-023, MTG-051, MTGR-014	**Survey Area** 32.68 ha 5.33% **Mt Gould PEC** 620.13 ha 36.83%	Stony plains of the northern Mt Gould PEC. Presents optimal habitat for *Tribulus adelacanthus* (P3). Other significant flora present: *Halgania gustafsenii* var. Murchison (P1). Equivalent FCT: 2 and 6a Overall Condition: Good to Very Good	
P2 ArrAkApt *Acacia ramulosa, Acacia kempeana* (+/- *Acacia pteraneura*) tall sparse to open shrubland over *Eremophila forrestii, Ptilotus polystachyus, Corchorus crozophorifolius* low sparse shrubland over *Aristida holathera, Eriachne aristidea, Aristida contorta* low sparse to open tussock grassland	MTG-013, MTG-018, MTG-030, MTG-048, MTGR-042	**Survey Area** 142.64 ha 23.27% **Mt Gould PEC** 238.01 ha 14.14 %	Stony and sandy plains of the foothills of the Survey Area. Presents optimal habitat for *Tribulus adelacanthus* (P3). Other significant flora present: *Eremophila warnesii* (P1) and *Halgania gustafsenii* var. Murchison (P1). Equivalent FCT: 2 and 6a Overall Condition: Poor to Excellent	

Vegetation Code Description	Sample Sites	Extent	Features of Interest & Condition	Photo
Other				
Cleared – tracks and roads	N/A	**Survey Area** 21.47 ha 3.50% **Mt Gould PEC** 37.99 ha 2.26%	N/A	N/A
Unsurveyed	N/A	**Survey Area** 0 ha 0% **Mt Gould PEC** 152.76 ha 9.07%	N/A	N/A
Total		**Survey Area:** 612.96 ha | 100% **Mt Gould PEC:** 1,683.76 ha | 100%		

Significant Vegetation

No TECs are known to occur in the vicinity of the Survey Area and no vegetation types resemble TECs for the Murchison bioregion. Seven PECs are known from within and in the vicinity of the Survey Area (Table 4.9). One PEC, the Mt Gould BIF PEC significantly intersects the Survey Area. Three of the vegetation types described and delineated from the Survey Area are considered to be representative of the Mt Gould BIF PEC and four vegetation types are possibly representative of the Mt Gould BIF PEC (Table 4.9, Table 4.8), these vegetation types are:

- Representative of the Mount Gould BIF PEC:
  - H1 PhbcErlt Tm;
  - H2 PtoErwErlc; and
  - H3 AaAciAr;
- Possibly Representative of the Mount Gould BIF PEC:
  - S1 AaAinAf;
  - S2 ArAptAin;
  - S3 AinApt; and
  - S4 AaGrbAf.

It is unlikely any of the other vegetation types are representative of other PECs in the vicinity of the Survey Area (Table 4.9, Table 4.8).

The three vegetation types representative of the Mt Gould PEC have floristic structure very similar to the FCTs described in the historical vegetation mapping that are considered analogous with the Mt Gould BIF PEC (Woodman, 2009). The vegetation descriptions share almost the same dominant species in the vegetation structure with similar recorded vegetative cover. The main differences can be attributed to updated species taxonomy and vegetation classification (*Acacia aneura* complex and NVIS standards introduced in 2016).

Table 4.9: Assessment of PEC occurrence within Survey Area

PEC name	Present in Survey Area	Reasoning
Priority 1		
Beringarra calcrete groundwater assemblage type on Murchison palaeodrainage on Beringarra Station	No	Survey Area does not intersect; however, Survey Area is adjacent to the Beringarra Land System. No calcrete substrate presents in the Survey Area. The PEC also refers to invertebrate assemblage within the groundwater, and does not include aboveground terrestrial flora and vegetation.
Jack Hills vegetation complexes (banded ironstone formation)	No	Survey Area not located at Jack hills
Mount Dugel/Mount Nairn vegetation complexes (banded ironstone formation)	No	Survey Area not located at Mount Dugel/Mount Nairn

PEC name	Present in Survey Area	Reasoning
Mount Gould vegetation complex (banded ironstone formation)	Yes	The Survey Area encompasses Mount Gould. BIF present in the bedrock geology of the Survey Area as part of the Narryer Terrane Greenstones geological unit (Table 2.1, Figure 2.3). Vegetation types H1 PhbcErlt Tm, H2 PtoErwErlc; and H3 AaAciAr; are representative of the Mount Gould BIF PEC. Vegetation types S1 AaAinAf, S2 ArAptAin, S3 AinApt; and S4 AaGrbAf. may be representative of the Mount Gould BIF PEC.
Priority 3		
Frederick Land System	No	Survey Area does not intersect the Frederick Land System
Jingle Land System	No	Survey Area does not intersect the Jingle Land System
Trillbar Land System	No	Survey Area does not intersect the Trillbar Land System

Each vegetation type recorded significant flora located within it, however six vegetation types present optimal habitat for significant flora and are recognised as significant as a refuge habitat for significant flora (Table 4.10). Specifically:

- H2 PtoErwErlc for *Eremophila warnesii*;
- S1 AaAinAf and S3 AinApt for *Halgania gustafsenii* var. Murchison;
- F1 MacScdi for *Rhodanthe sphaerocephala;* and
- P1 ErfrSeaPtro and P2 ArrAkApt for *Tribulus adelacanthus.*

Table 4.10:Vegetation types forming habitat for significant flora

Vegetation types	***Eremophila warnesii* (P1)**	***Halgania gustafsenii* var. Murchison (P1)**	***Rhodanthe sphaerocephala* (P1)**	***Tribulus adelacanthus* (P3)**
Drainage / Floodplain				
D1 AaAptApr	Present	Present	-	Present
F1 MacScdi	-	-	**Optimal habitat**	-
F2 ArhErarArcl	-	Present	-	Present
Hills, crests and slopes				
H1 PhbcErlt Tm	Present	-	-	-
H2 PtoErwErlc	**Optimal habitat**	Present	-	Present
H3 AaAciAr	Present	Present	-	Present
S1 AaAinAf	Present	**Optimal habitat**	-	Present
S2 ArAptAin	Present	Present	-	Present
S3 AinApt	Present	**Optimal habitat**	-	Present
S4 AaGrbAf.	-	Present	-	Present
Plains				
P1 ErfrSeaPtro	-	Present	-	**Optimal habitat**
P2 ArrAkApt	Present	Present	-	**Optimal habitat**

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Landor - Meekatharra Rd

Legend

Survey Area

- Tenement M52/236
- Mt Gould PEC
- Local Road

Vegetation Type

Drainage/Floodplain

- D1 AaAptApr
- F1 MacScdi
- F2 ArhErarArc

Hillcrests and Slopes

- H1 PhbcErlt Tm
- H2 PtoErwErlc
- H3 AaAciAr
- S1 AaAinAf
- S2 ArAptAin
- S3 AinApt
- S4 AaGrbAf

Plains

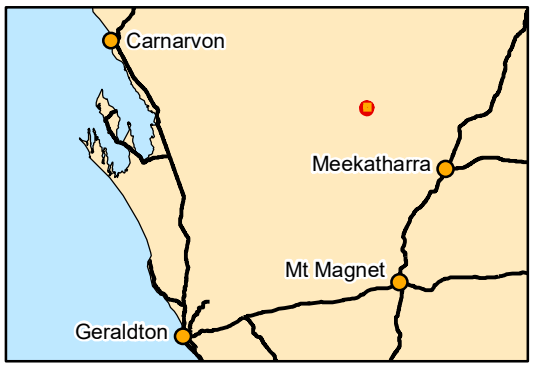
- P1 ErfrSeaPtro
- P2 ArrAkApt

Others

- Cleared or Disturbed
- Unsurveyed

0 500 1,000 Meters

Coordinate System: GDA2020 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA2020 Created 08/12/2022



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biologic Environmental Survey

Scale: 1:25,000

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Figure 4.9: Vegetation types in the Survey Area

Vegetation Condition

The condition of the vegetation in the Survey Area ranged from excellent to degraded, with the majority considered to be in excellent or very good condition (21.35% and 52.51% respectively) (Table 4.11 and Figure 4.10). The main disturbances observed were associated with introduced flora and mining/ exploration related activities or historic infrastructure; including drill pads, tracks, camp remnants. There were some minor signs of goat and cattle grazing and trampling, and introduced taxa usually spread by livestock were low in number and extent, **Cenchrus ciliaris* and **Setaria verticillata*.

The Survey Area is influenced by mining activities, access tracks intersect several locations across the Survey Area associated with mining exploration and historic mine activity particularly in the middle of the two Mt Gould peaks. This is likely to have contributed to localised lowering of condition immediately adjacent to the tracks due to increased levels of dust, erosion, scree deposits and clearing of vegetation. Some areas within the Survey Area are degraded or cleared (accumulatively 3.5%). Degraded areas are areas of vegetation that have undergone significant disturbances, still containing some presence of native taxa, however the structure is beyond restoration without intensive rehabilitation. Cleared areas were areas that presented with no vegetation and comprised of roads, tracks, bare rock and drilling pads.

Table 4.11: Vegetation condition extent in the Survey Area

Condition	Extent		Comment
	Survey Area	Mt Gould PEC	
Excellent	130.84 ha 21.35%	182.58 ha 10.84%	No discernable disturbance
Very Good	321.88 ha 52.51%	1078.7 ha 64.07%	Very minimal evidence of disturbance, from mining activities and exploration drilling. Little to no evidence of cattle, goat or pig grazing or trampling disturbance.
Good	134.39 ha 21.93%	211.0 ha 12.53%	Minor weed presence (diversity and cover) usually associated with mining activities and exploration, where transference of seed has caused minor weed presence. Cattle or feral animal grazing disturbance noted.
Poor	4.37 ha 0.71%	20.83 ha 1.24%	High weed presence (diversity and cover) usually associated with mining activities and/or roads and tracks and the historical introduction of agricultural weeds. Significant cattle or feral animal grazing disturbance noted.
Degraded	7.42 ha 1.21%	12.02 ha 0.71%	Areas comprised of high disturbance that no longer resembles native/expected vegetation structure such as re-vegetated areas, previous mining infrastructure.
Cleared	14.04 ha 2.29%	25.97 ha 1.54%	Cleared areas (roads, tracks, bare rock and drill pads)
Not Surveyed	0 ha 0%	152.76 ha 9.07%	Restricted or excluded access to these areas due to heritage restrictions.

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Landor - Meekatharra Rd

Legend

Survey Area

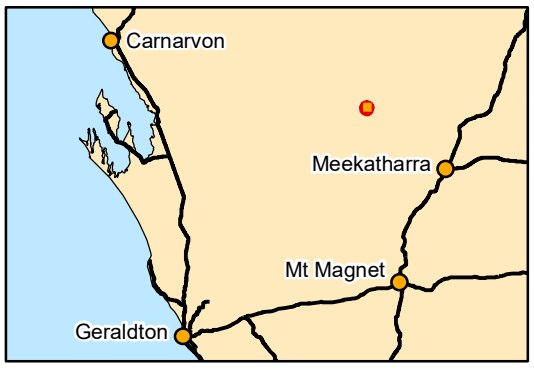
- Tenement M52/236
- Mt Gould PEC
- Local Road

Vegetation Condition

- Excellent
- Very Good
- Good
- Poor
- Degraded
- Cleared
- N/A

0 500 1,000 Meters

Coordinate System: GDA2020 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA2020 Created 07/12/2022



N

biologic Environmental Survey

Scale: 1:25,000

MBS ENVIRONMENTAL

Mt Gould Detailed Flora and Vegetation Assessment

Figure 4.10: Vegetation condition in the Survey Area

4.2.3 Local and regional significance

Twenty-eight BIF ranges including Mt Gould as part of the Jack hills complex were identified in a strategic review of the BIF ranges in the Midwest and Goldfields (DBCA, 2007). This report considered the Jack Hills complex a priority area for conservation where threats include mining with significant potential loss through cumulative impacts. The community types of the Jack Hills BIF complex, including Mt Gould are recognised as endemic to the respective ranges (DBCA, 2007). Considering this endemism and cumulative threats of mining the ranges, the vegetation types representative of the Mount Gould BIF PEC are considered to be high local and high regional significance. The vegetation types possibly representative of the Mount Gould BIF PEC are considered of moderate local and low regional significance.

Vegetation types holding refuge for significant flora habitat should also be examined when considering local and regional significance. Six vegetation types were optimal habitat for significant flora. Three of these vegetation types are of greater significance as they hold optimal habitat for significant flora that is restricted or known from fewer than ten records. The population of *Eremophila warnesii* occurring at Mt Gould is a considerably different habitat type for the taxon (usually recorded from sandy plains) and only occurs on this BIF range in the Yilgarn craton. This taxon has a limited distribution in the broader area. Habitats for *Eremophila warnesii* hold high local and high regional significance. The vegetation types supporting *Halgania gustafsenii* var. Murchison are also considered to hold high local and high regional significance due to the endemism of this taxon. The other three vegetation types supporting optimal habitat for significant flora are considered to have moderate local and low regional significance as these taxa have a broader regional distribution and are known from more populations.

Local and regional significance of vegetation types can be considered as follows:

- High local and high regional significance
    - H1 PhbcErlt Tm: as a representation of the Mt Gould BIF PEC and corresponding to FTC 5 that was found to be significant and endemic to the Mt Gould BIF PEC;
    - H2 PtoErwErlc: as a representation of the Mt Gould BIF PEC, corresponding to FTC 4 and optimal habitat for *Eremophila warnesii*;
    - H3 AaAciAr: as a representation of the Mt Gould BIF PEC, corresponding to FTC 4;
    - S1 AaAinAf: as a possible representation of the Mt Gould BIF PEC, corresponding to FTC 1 and FCT 6b and optimal habitat for endemic *Halgania gustafsenii* var. Murchison; and
    - S3 AinApt: as a possible representation of the Mt Gould BIF PEC, corresponding to FTC 1 and optimal habitat for endemic *Halgania gustafsenii* var. Murchison;
- Moderate local and low regional significance:
    - S2 ArAptAin; as a possible representation of the Mt Gould BIF PEC, corresponding to FTC 1;
    - S4 AaGrbAf : as a possible representation of the Mt Gould BIF PEC;
    - F1 MacScdi: optimal habitat for *Rhodanthe sphaerocephala;*

- P1 ErfrSeaPtro: optimal habitat for *Tribulus adelacanthus*, corresponding to FTC 2 and FCT 6a*;* and
- P2 ArrAkApt: optimal habitat for *Tribulus adelacanthus*, corresponding to FTC 2 and FCT 6a.

4.2.4 Review of Occurrence Assessment

Four significant flora taxa were known to occur in the Survey Area prior to mobilisation and were all recorded during the field survey and their likelihoods post-survey are unchanged. Four taxa considered Likely to occur prior to mobilisation have been downgraded to Possible, ten taxa considered Possible to occur have been downgraded to Unlikely post-survey. Refer to Table 4.12 for post-survey occurrence reasoning per taxa, and Appendix I for full details of significant flora occurrence including descriptions, flowering periods, growth form and optimal habitat. Likelihoods were downgraded if species would have been flowering during survey times (March, October, and/ or November), were medium-large shrubs/ trees that were easily observable and identifiable without flowering or fruiting material, or where limited or no suitable habitat was present within the Survey Area.

Table 4.12: Summary of post-survey review of assessment of occurrence

Taxon	Pre-survey Likelihood	Post-survey Likelihood	Reasoning
Angianthus microcephalus (P2)	Likely	Possible	May not have been present during surveys, as taxon is an annual. Suitable habitat limited in Survey Area. Decreased likelihood due to adequate seasonal timing to see presence.
Ptilotus lazaridis (P3)	Likely	Possible	Suitable habitat limited in Survey Area. Decreased likelihood due to adequate seasonal timing and perennial flora. No indeterminate genera likely to be these taxa.
Verticordia jamiesonii (P3)	Likely	Possible	
Frankenia confusa (P4)	Likely	Possible	
Stenanthemum mediale (P1)	Possible	Unlikely	May not have been present during surveys, as taxon is an annual. Suitable habitat present in Survey Area. Decreased likelihood due to adequate seasonal timing and survey effort to see presence. Northern extent of range
Indigofera fractiflexa subsp. *augustensis* (P2)	Possible	Unlikely	Perennial flora, habitat present. Adequate survey timing and thorough survey effort. These taxa would have been seen if present. No indeterminate genera likely to be these taxa.
Calytrix praecipua (P3)	Possible	Unlikely	
Eremophila petrophila subsp. *densa* (P3)	Possible	Unlikely	
Hemigenia virescens (P3)	Possible	Unlikely	
Homalocalyx echinulatus (P3)	Possible	Unlikely	
Prostanthera ferricola (P3)	Possible	Unlikely	
Dodonaea amplisemina (P4)	Possible	Unlikely	
Goodenia berringbinensis (P4)	Possible	Unlikely	May not have been present during surveys, as taxon is an annual. Suitable habitat limited in Survey Area. Decreased likelihood due to adequate seasonal timing and survey effort to see presence.

4.2.5 Sampling adequacy

At total of 59 sampling sites were recorded across the Survey Area and Mt Gould PEC (42 quadrats, six relevés and 11 mapping notes) totalling 0.03 sites sampled per hectare of native vegetation. The sampling intensity of 0.03 sites per ha represents a comparable survey effort for the survey area, where the sampling intensity of Woodman was 0.04 sites per hectare. The sampling intensity of current survey increases to 0.06 sites her hectare when only considering the Survey Area. These surveys all have slightly different, but intersecting, survey areas. Meissner does not stipulate the exact survey area, rather the survey targeted crests and hill slopes of Mt Gould. Woodman extended to include the plains and foothills of the tenement M52/236 and the current survey extends to include the Mt Gould PEC boundary.

Table 4.13: Comparison of survey intensity and effort

Survey	Survey Area	Total			
		Area	Taxa	Sample sites	Sites/ha
Meissner *et al.* (2009)	Mt Gould crest and upper slopes	-	45	5	-
Woodman (2009)	Tenement M52/236	613 ha	94	25	0.04
Current Survey	Combined Tenement M52/236 and Mt Gould PEC	2,296 ha	219	59	0.03
	Tenement M52/236	613 ha	-	38	0.06

The species accumulation curve for the Survey Area produced a curve that steadily increases, with estimators starting to plateau reaching asymptote (Figure 4.11). Richness estimators indicated that the survey was approximately 78.44 % (Jacknife 1) to 88.54 % (Bootstrap) adequate, with an observed value of 174 vascular flora taxa (confirmed native vascular flora taxa recorded from quadrats) (Table 4.14). The survey adequacy increases to approximately 94.14 % adequacy (based on Bootstrap estimate) when the 11 additional native observations, not observed from quadrats, are included in the assessment (Table 4.14). The sampling conducted at the Survey Area and Mt Gould PEC was adequate for this level of assessment.

Table 4.14: Expected native species richness for the Survey Area

Treatment	Results	Richness Estimate	
		Based on SOBS (174)	Based on Total^{+} (185)
Chao 1	215.85 ± 15.73	80.06 %	85.70 %
Jacknife 1	221.83 ± 12.95	78.44 %	83.40 %
Bootstrap	196.52 ± 7.78	88.54 %	94.14 %
SOBS^	174		

^Species observed. $^{+}$Total includes opportunistic and relevé native taxa not found in quadrats

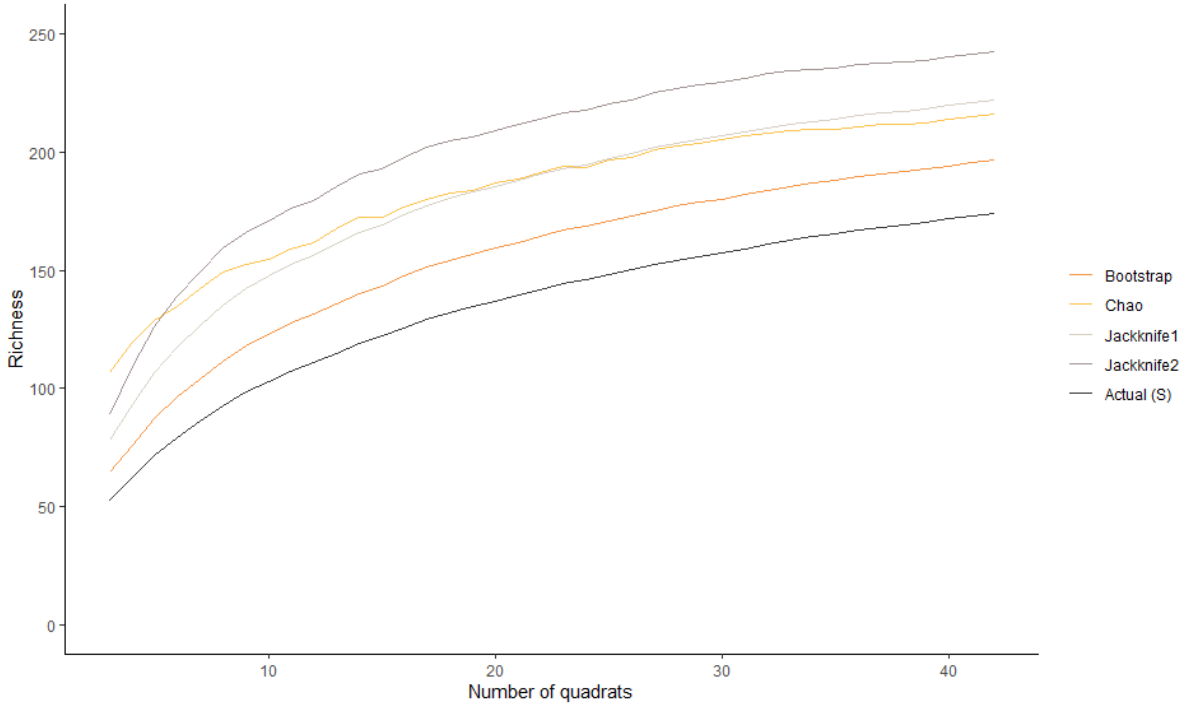


Figure 4.11: Species accumulation curve for the Survey Area and Mt Gould PEC

4.3 Constraints and Limitations

The EPA (2016d) outlines several potential limitations to flora surveys. These aspects are assessed and discussed in Table 4.15. No major limitations or constraints were identified for the survey.

Table 4.15: Survey limitations and constraints

Limitation	Constraint	Comment
Availability of contextual information at a regional and local scale	No	Sufficient contextual information was available for the Survey Area, including broad information on land systems and vegetation associations. The Survey Area has been previously surveyed by Woodman in 2009 with good survey effort and seasonal timing. Botanical survey work has been carried out by DBCA in 2006 on the BIF formations of the Yilgarn craton providing context for the Survey Area. The data, and reports were all available for this assessment.
Competency/ experience of the team carrying out the survey, including experience in the bioregion surveyed	No	Field survey was led by a Senior Botanist with over ten years' experience. The lead botanist met the minimum requirements (i.e., five years field experience in the Murchison region) to manage a flora and vegetation field survey in the Murchison bioregion (EPA, 2016b).
Proportion of flora recorded and/or collected, any identification issues	No	The survey intensity (Detailed) was designed to capture most of the flora within the Survey Area. A small number of taxa (12 taxa or 5.5 %) observed and collected from the field were difficult to confidently identify to species or infraspecies level. These unconfirmed taxa were from many different genera and families, as well as different lifeforms (annual/ perennial, tree/ shrub/ herb/ grass/ sedge). It is unlikely (but still possible) that any of these unconfirmed taxa represent significant flora.

Limitation	Constraint	Comment
Was the appropriate area fully surveyed (effort and extent)	No	The Survey Area was traversed and surveyed on foot with all major vegetation units visited. A portion (9 %) of the Mt Gould PEC was not surveyed as it did not represent the targeted significant vegetation (Mount Gould BIF PEC). This is not considered to be a constraint as the scope of the survey was to assess for further evidence of significant vegetation outside of the Survey Area. The survey intensity and coverage (related to quadrat sampling) align with the EPA's guidance for a Detailed survey and species accumulation curves suggest that the survey captured up to 94 % of the expected native species richness. Where possible, a minimum of three quadrats were established and sampled within each vegetation type, with additional quadrats assigned to larger units or to ensure spatial coverage. Four vegetation types were represented by only two quadrats: F1 MacScdi, F2 ArhErarArc, S3 AinApt, S4 AaGrdAf. However, this is not considered a constraint as these are small vegetation types and not represented widely across the Survey Area and Mt Gould PEC. The SDM used to direct the regional survey effort returned indication of potential habitat on BIF ranges within the extent of the modelling. With availability of different data (absence data) or variables this may have returned more refined data. This is not considered a constraint given the previous analysis of BIF ranges available for Mt Gould ruling out these ranges as potential habitat for *Halgania gustafsenii* var. Murchison and the vegetation types resembling the Mt Gould BIF PEC (Meissner *et al.*, 2009; Woodman, 2009)
Access restrictions within the survey area	No	The Survey Area was accessed via mining, exploration and pastoral tracks which provided access across most of the Survey Area. Most of the Survey Area was traversed with the survey completed on foot and via vehicle. Walking traverses were limited to a maximum distance of 2 km. Some areas of crests and very steep upper hill slope were avoided due to safety concerns associated with traversing on steep terrain. The regional survey was somewhat restricted in the accessibility. The SDM proposed potential habitat in the surrounding BIF ranges, however the route and distance to access them was not practicable for the survey timing, many being over 100 km away with no direct track to them. Two locations with access via station tracks were ground-truthed (Jack Hills and Mt Fraser at Robinson Range).
Survey timing, rainfall, season of survey	No	The survey timing was adequate for this level of survey. The survey was undertaken during a period which is considered to be optimal, 6-8 weeks post rainfall for the Eremaean region (EPA, 2016b). Adequate rainfall was received prior to the field survey. Statistically, there was a high percentage of annual taxa observed (47.7 %) and the species richness curve indicates 83-94 % of flora is thought to be observed during the survey.

5 CONCLUSION

A detailed flora and vegetation assessment was completed for the Mt Gould Project at the Survey Area and Mt Gould PEC. The field survey was completed over one sampling event in adequate seasonal timing by four Biologic personnel over 36 person days. All vegetation types were ground-truthed and sampled with no substantial limitations to the field survey. The survey and reporting have been completed in line with EPA guidelines, with survey adequacy being consistent with the level of a detailed survey. The key findings of the survey are:

- Forty-two quadrats, six relevés and 11 mapping notes were sampled across the Survey Area and Mt Gould PEC, as well as opportunistic sampling. An additional three mapping notes were taken in regional surveying areas;
- Confirmed vascular flora taxa totals 219 from 35 families and 85 genera comprising 211 native and eight introduced taxa;
- Four priority listed flora taxa were recorded within the Survey Area and Mt Gould PEC:
    - P1: *Eremophila warnesii* – 13,610 individuals from 335 locations in the Survey Area and 3,347 individuals from 68 locations in the regional survey;
    - P1: *Halgania gustafsenii* var. Murchison – 12,969 individuals from 1,054 locations in the Survey Area and 771 individuals from 85 locations in the regional survey;
    - P1: *Rhodanthe sphaerocephala* – 48 individuals from 16 locations in the Survey Area and 56 individuals from 12 locations in the regional survey and
    - P3: *Tribulus adelacanthus* – 2,128 individuals from 185 locations in the Survey Area and 315 individuals from 42 locations in the regional survey;
- Three taxa considered of “other” significance with aff. nomenclature;
- Eight confirmed introduced taxa were recorded within the Survey Area, none of which are listed as WoNS or Declared Pests;
- Twelve vegetation types were described from three broad landforms in the Survey Area and Mt Gould PEC;
- No TECs were recognised in the vegetation types of the Survey Area or Mt Gould PEC;
- Seven vegetation types throughout the Study Area were considered significant as representative or possible representative of the Mt Gould BIF PEC. These were:
    - Representative of the Mount Gould BIF PEC: H1 PhbcErlt Tm, H2 PtoErwErlc, and H3 AaAciAr;
    - Possibly representative of the Mount Gould BIF PEC: S1 AaAinAf, S2 ArAptAin, S3 AinApt, and S4 AaGrbAf.
- Six vegetation types supported priority flora taxa and thus hold significance in providing suitable habitat for these species.
- Five vegetation types are considered to have high local and high regional significance, they are:

- H1 PhbcErlt Tm: as a representation of the Mt Gould BIF PEC and corresponding to FTC 5 that was found to be significant and endemic to the Mt Gould BIF PEC;
- H2 PtoErwErlc: as a representation of the Mt Gould BIF PEC and optimal habitat for *Eremophila warnesii*;
- H3 AaAciAr: as a representation of the Mt Gould BIF PEC;
- S1 AaAinAf: as a possible representation of the Mt Gould BIF PEC and optimal habitat for endemic *Halgania gustafsenii* var. Murchison; and
- S3 AinApt: as a possible representation of the Mt Gould BIF PEC and optimal habitat for endemic *Halgania gustafsenii* var. Murchison;

- The condition of the vegetation in the Survey Area ranged from excellent to degraded, with the majority considered to be in Excellent or Very Good condition (21.35% and 52.51% respectively).

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7 APPENDICIES

Appendix A: State and Commonwealth conservation codes

Environment Protection and Biodiversity Conservation Act 1999

Category	Definition
Threatened Flora Species	
Extinct (EX)	A native species is eligible to be included in the Extinct category at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.
Extinct in the Wild (EW)	A native species is eligible to be included in the Extinct in the Wild category at a particular time if, at that time: (a) it is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or (b) it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
Critically Endangered (CR)	A native species is eligible to be included in the critically endangered category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
Endangered (EN)	A native species is eligible to be included in the endangered category at a particular time if, at that time: (a) it is not critically endangered; and (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
Vulnerable (VU)	A native species is eligible to be included in the vulnerable category at a particular time if, at that time: (a) it is not critically endangered or endangered; and (b) it is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.
Conservation Dependent (CD)	A native species is eligible to be included in the Conservation Dependent category at a particular time if, at that time: (a) the species is the focus of a specific conservation program the cessation of which would result in the species becoming Vulnerable, Endangered or Critically Endangered; or (b) the following subparagraphs are satisfied (i) the species is a species of fish; (ii) the species is the focus of a plan of management that provides for management actions necessary to stop the decline of, and support the recovery of, the species so that its chances of long-term survival in nature are maximised; (iii) the plan of management is in force under a law of the Commonwealth or of a State or Territory; and (iv) cessation of the plan of management would adversely affect the conservation status of the species.

Category	Definition
Threatened Ecological Communities (TEC)	
Critically Endangered	An ecological community is eligible to be included in the critically endangered category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
Endangered	An ecological community is eligible to be included in the endangered category at a particular time if, at that time: (a) it is not critically endangered; and (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
Vulnerable	An ecological community is eligible to be included in the vulnerable category at a particular time if, at that time: (a) it is not critically endangered nor endangered; and (b) it is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.

Biodiversity Conservation Act 2016

Category	Definition
Threatened Flora Species	
Critically Endangered (CR)	Threatened species considered to be "facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines". Published under schedule 1 of the *Wildlife Conservation (Rare Flora) Notice 2018* for critically endangered flora.
Endangered (EN)	Threatened species considered to be "facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines". Published under schedule 2 of the *Wildlife Conservation (Rare Flora) Notice 2018* for endangered flora.
Vulnerable (VU)	Threatened species considered to be "facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with criteria set out in the ministerial guidelines". Published under schedule 3 of the Wildlife Conservation (Rare Flora) Notice 2018 for vulnerable flora.
Extinct (EX)	Species where "there is no reasonable doubt that the last member of the species has died", and listing is otherwise in accordance with the ministerial guidelines (section 24 of the BC Act). Published as presumed extinct under schedule 4 of the Wildlife Conservation (Rare Flora) Notice 2018 for extinct flora.
Extinct in the Wild (EW)	Species that "is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; and it has not been recorded in its known habitat or expected habitat, at appropriate seasons, anywhere in its past range, despite surveys over a time frame appropriate to its life cycle and form", and listing is otherwise in accordance with the ministerial guidelines (section 25 of the BC Act). Currently there are no threatened flora species listed as extinct in the wild.

Category	Definition
Threatened Ecological Communities (TEC)	
Critically Endangered (CR)	An ecological community is eligible for listing in the category of critically endangered ecological community at a particular time if, at that time — (a) it is facing an extremely high risk of becoming eligible for listing as a collapsed ecological community in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines; and (b) listing in that category is otherwise in accordance with the ministerial guidelines.
Endangered (EN)	An ecological community is eligible for listing in the category of endangered ecological community at a particular time if, at that time — (a) it is not a critically endangered ecological community; and (b) it is facing a very high risk of becoming eligible for listing as a collapsed ecological community in the near future, as determined in accordance with criteria set out in the ministerial guidelines; and (c) listing in that category is otherwise in accordance with the ministerial guidelines.
Vulnerable (VU)	An ecological community is eligible for listing in the category of vulnerable ecological community at a particular time if, at that time — (a) it is not a critically endangered ecological community or an endangered ecological community; and (b) it is facing a high risk of becoming eligible for listing as a collapsed ecological community in the medium-term future, as determined in accordance with criteria set out in the ministerial guidelines; and (c) listing in that category is otherwise in accordance with the ministerial guidelines.
Collapsed	An ecological community is eligible for listing as a collapsed ecological community at a particular time if, at that time — (a) there is no reasonable doubt that the last occurrence of the ecological community has collapsed; or (b) the ecological community has been so extensively modified throughout its range that no occurrence of it is likely to recover — (i) its species composition or structure; or (ii) its species composition and structure.

Department of Biodiversity, Conservation and Attractions Priority Definitions

Category	Definition
Priority Flora Species	
Priority 1 (P1)	**Poorly-known Species** Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g., agricultural, or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.
Priority 2 (P2)	**Poorly-known Species** Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g., national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.
Priority 3 (P3)	**Poorly-known Species** Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.
Priority 4 (P4)	**Rare, Near Threatened and other species in need of monitoring** (a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands. (b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for vulnerable but are not listed as Conservation Dependent. (c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

Category	Definition
Priority Ecological Communities (PEC)	
Priority 1 (P1)	**Poorly-known ecological communities** Ecological communities that are known from very few occurrences with a very restricted distribution (generally ≤5 occurrences or a total area of ≤ 100ha). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat (e.g., within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist. May include communities with occurrences on protected lands. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.
Priority 2 (P2)	**Poorly-known Ecological Communities** Communities that are known from few occurrences with a restricted distribution (generally ≤10 occurrences or a total area of ≤200ha). At least some occurrences are not believed to be under immediate threat (within approximately 10 years) of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.
Priority 3 (P3)	**Poorly-known Ecological Communities** (i) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or: (ii) communities known from a few widespread occurrences, which are either large or with significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat (within approximately 10 years), or; (iii) communities made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, inappropriate fire regimes, clearing, hydrological change etc. Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.

Category	Definition
Priority 4 (P4)	**Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring.** (i) Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. These communities are usually represented on conservation lands. (ii) Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for a higher threat category. (iii) Ecological communities that have been removed from the list of threatened communities during the past five years.
Priority 5 (P5)	**Conservation Dependent Ecological Communities** Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

Introduced flora

Legal Status Definitions of Listed Plants in Western Australia

Legal status	Definition
Declared Pest, Prohibited – s12	Prohibited organisms are declared pests by virtue of section 22(1) and many only be imported and keep subject to permits
Declared Pest – s22(2)	Declared pests must satisfy any applicable import requirements when imported and may be subject to control keeping requirements
Permitted – s11	Permitted organisms must satisfy applicable import requirements and import permits (where required)
Permitted Requires Permit – r73	Regulation 73 permitted organisms may be subject to restriction under legislation other and the BAM Act (2007)
Unlisted	Unlisted organisms are prohibited in WA
Control Categories	**Definition**
C1 Exclusion	Organisms should be excluded from parts or all of WA
C2 Eradication	Organisms should be eradicated from all or parts of WA
C3 Management	Organisms should have some form of management applied that will alleviate the harmful impact of the organism, reduce the numbers or distribution of the organism or prevent or contain the spread of the organism
Unassigned	Declared pests that are recognised a having a harmful impact under certain circumstances where their subsequent control requirements are determined by a plan or other legislative arrangements under the Act
Keeping Categories	**Definition**
Prohibited Keeping	Can only be kept under a permit or public display, education or scientific purposes
Restricted Keeping	Kept under a permit by private individuals due to low risk of becoming a problem for the environment
Exempt Keeping	No permit or conditions are required for keeping. Organism may be subject to restrictions under the Wildlife Conservation Act (1950)

Appendix B: Key findings from literature review

		Flora and vegetation of banded iron formations of the Yilgarn Craton: Jack Hills	Flora and vegetation of the banded iron formation of the Yilgarn Craton: Robinson Ranges and Mount Gould	Mount Gould DSO Project: Flora and Vegetation Assessment	Oakajee Port and Rail OPR Rail Development Vegetation and Flora Assessment	Mount Gould Tenement Flora and Vegetation Assessment Desktop Review
Survey Details	**Reference**	Meissner and Caruso (2008)	Meissner *et al.* (2009)	Woodman (2009)	ecologia (2010)	Woodman (2008)
	Type	Detailed flora survey	Detailed Flora Survey	Detailed flora & vegetation survey	Detailed flora & vegetation survey	Desktop Assessment
	Client	Conservation Science Western Australia (Journal)	Department of Environment and Conservation	Atlas Iron Pty Ltd	Oakajee Port and Rail Pty Ltd	Atlas Iron Pty Ltd
	Location	140 km WNW of Meekatharra. 40 km from the Beringarra-Cue Road	140 km north of Meekatharra; beginning near the Great Northern Highway and extending west to Mount Padbury	150 km north-west of Meekatharra, just north of the Murchison River	24 km north of Geraldton	150 km north-west of Meekatharra, just north of the Murchison River
	Size (ha)	Not specified	200 km in length	Not specified	2,364 ha	2 ha
	Timing	August 2005	August 2006	August and September 2008	April – June 2009, August – October 2009 and March 2010	March 2008
Methods	**Desktop Assessment (Yes/No)**	Yes	Yes	Yes	Yes	Yes
	Quadrat #	50	50	25	605	n/a
	Relevé #	n /a	n/a	n/a	n/a	n/a
	Targeted Searching (Yes/No)	No	No	Yes	Yes – 1,250 km of transects walked to record flora	No
	Other Methods	n/a	n/a	n/a	n/a	n/a
Results	**Taxa**	208	170	94	1016	n/a
	Families	43	40	28	84	n/a
	Genera	98	81	53	322	n/a
	Vegetation Types	6	7	7	72 (including 48 subunits)	Between 6-8 floristic community types had previously been described by historical surveys
	Vegetation Condition	n/a	n/a	Excellent – Good	Pristine – Degraded (majority in Excellent/Good condition)	n/a
	Weeds #	3	1	2	62	2
Significant Findings	**Threatened/ Priority Flora**	*Homalocalyx echinulatus* (P3)	*Euphorbia sarcostemmoides* (P1)	*Eremophila warnesii* (P1) *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) (P1) *Rhodanthe sphaerocephala* (P1)	Three Threatened (*Caladenia hoffmanii*, *Philotheca wonganensis* and *Drummondita ericoides*) and 57 Priority flora species were recorded	Nine taxa were returned from database searches (Five P1, One P2 and Three P3 species)
	Threatened/ Priority Ecological Communities	None recorded	None recorded	Mount Gould Vegetation Assemblages (P1) PEC	1.Jack Hills vegetation complexes (Banded Ironstone Formation) (P1) 2.Plant assemblages of the Moresby Range system (P1) 3.Tallering Peak vegetation complexes (P1) 4.Weld Range vegetation complexes (Banded Ironstone Formation) (P1) All PECs	None recorded
	WoNS and DPP Weeds	None recorded	None recorded	None recorded	**Carthamus lanatus* **Echium plantagineum* **Emex australis*	*Prosopis* spp.
	Range Extensions	*Actinobole drummondianum* *Calandrinia disperma* *Petalostylis labicheoides* *Rhodanthe polycephala* *Trachymene ceratocarpa* *Triodia melvillei*	*Halgania odontocarpa forma octoforma* *Hibbertia arcuate* *Philotheca brucei* subsp. cinerea Micromyrtus sulphurea	None recorded	29 species were recorded from within the Survey Area as representing range extensions	None recorded
	Other significant findings	Three new taxa were identified: *Prostanthera ferricola* *Lobelia heterophylla* subsp. Pilbara (R.Meissner & Y.Caruso 1) *Acacia* sp. Jack Hills (R. Meissner & Y. Caruso 4)	Two new taxa were identified: *Pityrodia iphthima* *Indigofera fractiflexa* subsp. Mount Augustus (S. Patrick & A. Crawford SP4734) Several other species of taxonomic interest but not identified beyond genus.	Determined that a number of the FCTs on Mount Gould (FCTs 4, 5 and 6b) do not occur elsewhere, and therefore, have high conservation significance.	19 taxa collected during surveying could not be confirmed due to insufficient material and may represent new species.	n/a
Other	**Limitations of survey**	None recorded	None recorded	None recorded	Access issues and incompleteness to an extent (due to length and linear shape of Survey Area some smaller vegetation units may have been missed from aerial and on ground analysis)	None recorded

		Mount Gould DSO Project Proposed Exploration Drilling Programme Conservation Significant Flora and Vegetation Assessment	Detailed Flora and Vegetation Survey Gabanintha Tenements	Lake Annean Flora and Fauna Assessment	Northern Goldfields Interconnect (NGI) Pipeline Project, Detailed Flora and Vegetation Assessment	Reconnaissance Flora and Vegetation Survey Golden Shamrock Prospect, Central Murchison Gold Project
Survey Details	**Reference**	Woodman (2010)	Onshore (2019)	MWH (2015)	Focused Vision (2020)	Native Vegetation Solutions (2018)
	Type	Detailed flora & vegetation survey	Detailed flora & vegetation survey	Reconnaissance flora & vegetation survey	Detailed flora & vegetation survey	Reconnaissance flora & vegetation survey
	Client	Atlas Iron Pty Ltd	Australian Vanadium	Metals X Limited	APA Northern Goldfields Interconnection Pty Ltd (APA)	WestGold Resources Limited (Big Bell Gold Operations Pty Ltd).
	Location	150 km north-west of Meekatharra, just north of the Murchison River	45 km southeast of Meekatharra in the Murchison region	35 km to the south-southwest of Meekatharra	50 km east of Geraldton, connecting into the existing Goldfields Gas Pipeline approximately 40 km south of Leinster	32 km southwest of Meekatharra
	Size (ha)	9.4 km of proposed drill-lines/access tracks	Not specified	1,573 ha	580 km in length (pipeline corridor)	49.1 ha
	Timing	August 2010	March – April and September 2017	July 2015	September – October 2020	March 2018
Methods	**Desktop Assessment (Yes/No)**	Yes	Yes	Yes	Yes	Yes
	Quadrat #	n/a	84	n/a	128	n/a
	Relevé #	n/a	Number not provided	29	9	Number not specified
	Targeted Searching (Yes/No)	Yes	Yes	Yes	Yes	No
	Other Methods	n/a	n/a	n/a	Opportunistic sampling and traverses	n/a
Results	**Taxa**	2 (conservation significant)	273	105	501	60
	Families	2	40	28	58	18
	Genera	2	104	50	197	35
	Vegetation Types	3	28 (17 broad floristic formations)	14	34 (32 in Survey Area and 2 just outside)	3
	Vegetation Condition	n/a	Excellent – Completely Degraded	Excellent – Completely Degraded (majority in Very Good/Good)	Excellent – Completely Degraded (majority in Very Good)	Good
	Weeds #	n/a	4	3	30	4
Significant Findings	**Threatened/ Priority Flora**	*Eremophila warnesii* (P1) *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) (P1)	*Acacia speckii* (P4) *Dodonaea amplisemina* (P4) *Goodenia berringbinensis* (P4) *Hibiscus krichauffianus* (P3) *Nicotiana heterantha* (P1) *Ptilotus lazaridis* (P3) *Ptilotus luteolus* (P3)	None recorded	*Eucalyptus beardiana* (T) *Dicrastylis linearifolia* (P3) *Gnephosis cassiniana* (P3) *Petrophile ?pauciflora* (P3) *Ptilotus beardii* (P3) *Acacia speckii* (P4)	None recorded
	Threatened/ Priority Ecological Communities	Mount Gould vegetation complexes (banded ironstone formation) (P1) PEC	None recorded	None recorded	Eucalypt Woodlands of the Western Australian Wheatbelt (P3) PEC Yalgoo vegetation complexes (Banded Ironstone Formation (P1) PEC	None recorded
	WoNS and DPP Weeds	None recorded	None recorded	None recorded	**Echium plantagineum* **Rumex hypogaeus*	None recorded
	Range Extensions	None recorded	*Abutilon malvifolium;* *Hibiscus verdcourtii;* *Lipocarpha microcephala;* *Marsilea costulifera;* *Nicotiana heterantha* (P1) *Sida trichopoda.*	None recorded	None recorded	None recorded
	Other significant findings	*E. warnesii* was recorded at a number of drill lines and tracks, with a total of 689 plants potentially to be cleared and 74 plants flagged for avoidance. A total of 81 *H. gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) re located on areas proposed to be cleared and 48 plants have been flagged for avoidance.	n/a	The Survey Area supports groundwater dependent and surface water or sheet flow dependent vegetation. The samphire communities occurring along the margins and along the small rises within Lake Annean are considered groundwater dependent ecosystems.	Five of the recorded flora were found to be undescribed (phrase name) species	n/a
Other	**Limitations of survey**	None recorded	None recorded	Only moderate mapping ability for some vegetation types weas reported.	Access within the Survey Area	None recorded

		Level 1 Flora and Vegetation Survey Gascoyne Resources Dalgaranga Tenements	Targeted flora survey of the proposed installation of a new communications tower in tenement L59/191	Nanine Ming Area Reconnaissance Flora & Level 1 Fauna Assessment	An inventory and condition survey of the lower Murchison River area, Western Australia
Survey Details	**Reference**	Native Vegetation Solutions (2016)	Borger (2021)	Spectrum (2020)	Hennig (2009)
	Type	Reconnaissance flora & vegetation survey	Targeted flora survey	Reconnaissance flora & vegetation survey	Detailed flora & vegetation survey
	Client	Clack Lindbeck & Associated Pty Ltd	Karara Mining Limited	WestGold Resources Limited	DPIRD
	Location	59.6 km northwest of Mount Magnet and 73 km southwest of Cue	60 km north of Perenjori in the Midwest of Western Australia	30 km south of Meekatharra in the Murchison region	Murchison River and surrounds
	Size (ha)	2,051 ha	6 ha	555 ha	1,303,933 ha
	Timing	June 2016	April 2021	April 2020	Late Spring 2022 and Autumn 2033
Methods	**Desktop Assessment (Yes/No)**	Yes	Yes	Yes	Yes
	Quadrat #	n/a	n/a	n/a	112 Inventory sites (50 m radius from one particular point)
	Relevé #	Number not specified	n/a	10	n/a
	Targeted Searching (Yes/No)	No	Yes	No	n/a
	Other Methods	n/a	Walking traverses and vegetation mapping notes	Opportunistic traverses and sampling	Traverses
Results	**Taxa**	130	28	68	265
	Families	27	18	19	43
	Genera	49	22	34	110
	Vegetation Types	11	3	5	27 (11 broad vegetation groups)
	Vegetation Condition	Very Good - Good	n/a	Very Good	Good-Very Good
	Weeds #	2	0	3	11
Significant Findings	**Threatened/ Priority Flora**	None recorded	*Acacia karina* (P1) *Allocasuarina tessellata* (P3) *Chamelaucium* sp. Warriedar (P1) *Grevillea scabrida* (P3) *Grevillea subtiliflora* (P3) *Lepidosperma* sp. Blue Hills (P1)	None recorded	*Chamelaucium* sp. Coolcalalaya (A.H. Burbidge 4233) (P1) *Melaleuca oldfieldii* (P2) *Grevillea costata* (P3)
	Threatened/ Priority Ecological Communities	None recorded	None recorded	None recorded	None recorded
	WoNS and DPP Weeds	None recorded	None recorded	None recorded	Nona recorded
	Range Extensions	None recorded	None recorded	*Hakea leucoptera* subsp. *sericipes* *Rhagodia drummondii*	None recorded
	Other significant findings	n/a	Four of the six priority flora were very common within the survey area and likely to be well represented in the adjacent bushland. The two priority species which are less common (*Grevillea scabrida* P3 and *G. subtiliflora* P3) will be either not impacted or minimally impacted.	One specimen, *Tecticornia* sp. nov, was recorded as a potential new species and is associated with a restricted salt-lake vegetation type:	n/a
Other	**Limitations of survey**	None recorded	Herbs and grasses were recently germinated which made identification difficult	None recorded	None recorded

Appendix C: Floristic sample site data

Mt Gould

Site MTG-001



Date	28/08/2022
Described by	EM & RM
Type	Quadrat 20m x 20m
Location	MGA Zone 50
	535883mE, 7150581mN
	117.3578 E, -25.762386 S
Veg Condition	Good
Soil	Silty Clay Loam
Rock Type	Ironstone, Chert, Quartz
Fire Age	>10 yrs
Habitat	Hillslope
Vegetation	*Acacia demissa*, *Acacia tetragonophylla*, *Acacia rhodophloia* mid sparse shrubland over *Senna artemisioides* low isolated shrubs over *Aristida contorta* low open tussock grassland

SPECIES LIST

Name	Cover	Height
Acacia aptaneura	0.1	4
Acacia demissa	1	2
Acacia rhodophloia	1	1
Acacia tetragonophylla	0.1	3
Aristida contorta	20	0.1
Boerhavia coccinea	0.01	0.01
Calandrinia eremaea	0.1	0.01
Calocephalus beardii	0.01	0.01
Eriachne aristidea	0.1	0.1
Goodenia tenuiloba	1	0.2
Grevillea berryana	0.1	2
Leichhardtia australis	0.1	0.2
Monachather paradoxus	0.1	0.3
Paspalidium sp. indet	0.1	0.1
Portulaca oleracea	0.1	0.01
Salsola australis	0.1	0.05
Senna artemisioides subsp. *helmsii*	1	1.1
Senna glaucifolia	0.25	1
Solanum lasiophyllum	0.5	0.4
Stenopetalum anfractum	0.1	0.2

Mt Gould

Site MTG-002



Date	28/08/2022
Described by	EM & RM
Type	Quadrat 20m x 20m
Location	MGA Zone 50 536980mE, 7150594mN 117.3687 E, -25.762242S
Veg Condition	Good
Soil	Sandy Loam
Rock Type	Chert, Ironstone, Quartz
Fire Age	>10 yrs
Habitat	Stony Plain
Vegetation	*Acacia aptaneura* tall sparse shrubland over *Senna artemisioides*, *Psydrax latifolia* low sparse shrubland over *Aristida contorta* low open tussock grassland

SPECIES LIST

Name	Cover	Height
Acacia aneura	1	1.7
Acacia aptaneura	5	5
Acacia tetragonophylla	0.2	1.3
Aristida contorta	25	1
Aristida holathera var. *holathera*	0.1	0.2
Bulbostylis barbata	0.01	0.05
Calandrinia monosperma	0.5	1
Calandrinia stagnensis	0.1	0.01
Eremophila forrestii subsp. *forrestii*	0.5	0.4
Eremophila latrobei subsp. *latrobei*	0.2	1.2
Eriachne aristidea	0.1	0.1
Eriachne helmsii	0.2	0.6
Eriachne pulchella subsp. *pulchella*	0.1	0.05
Euphorbia boophthona	0.1	0.05
Goodenia tenuiloba	0.1	0.1
Ipomoea calobra	0.1	2
Monachather paradoxus	1	0.5
Psydrax latifolia	2	2.5
Salsola australis	0.1	0.05
Senna artemisioides subsp. *helmsii*	0.5	1.5
Sida aff. *intricata*	0.1	0.01
Sida ectogama	0.1	0.4
Solanum lasiophyllum	0.1	0.05
Stenopetalum anfractum	0.01	0.05

Mt Gould

Site MTG-003



Date	28/08/2022
Described by	EM & RM
Type	Quadrat 20m x 20m
Location	MGA Zone 50
	536267mE, 7150022mN
	117.3616 E, -25.767428 S
Veg Condition	Good
Soil	Sandy Clay Loam
Rock Type	Ironstone, Quartz
Fire Age	>10 yrs
Habitat	Footslope
Vegetation	*Acacia pruinocarpa*, *Acacia rhodophloia*, *Acacia demissa*, *Acacia pteraneura* tall sparse shrubland over *Ptilotus rotundifolius* mid isolated shrubs over *Aristida contorta*, *Enneapogon caerulescens* low isolated tussock grasses and *Goodenia tenuiloba* sparse herbland

SPECIES LIST

Name	Cover	Height
Acacia demissa	5	2.5
Acacia pruinocarpa	8	12
Acacia pteraneura	2	4.5
Acacia rhodophloia	10	4
Aristida contorta	0.5	0.2
Aristida holathera var. *holathera*	0.1	0.3
Calandrinia monosperma	0.1	0.1
Enneapogon caerulescens	0.5	0.2
Eremophila latrobei subsp. *latrobei*	0.1	1
Euphorbia sp. Indet	0.1	0.1
Goodenia tenuiloba	0.5	0.2
Hibiscus burtonii	0.1	0.2
Ptilotus aervoides	0.1	0.1
Ptilotus exaltatus	0.1	0.1
Ptilotus helipteroides	0.1	0.1
Ptilotus rotundifolius	1	1.2
Salsola australis	0.1	0.3
Senna stricta	0.5	1.4
Sida ?sp. Dark green fruits (S. van Leeuwen 2260)	0.1	0.2
Tribulus adelacanthus	0.1	0.1

Mt Gould

Site MTG-004



Date	29/08/2022
Described by	CW & BM
Type	Quadrat 20m x 20m
Location	MGA Zone 50
	535905mE; 7149675mN
	117.3580 E, -25.770565 S
Veg Condition	Very Good
Soil	Clayey Sand
Rock Type	Quartz, Ironstone
Fire Age	5-10 yrs
Habitat	Stony Plain
Vegetation	*Grevillea berryana*, *Acacia aneura* tall sparse shrubland over *Eremophila phyllopoda*, *Ptilotus rotundifolius* low sparse shrubland over *Aristida contorta* low isolated tussock grasses

SPECIES LIST

Name	Cover	Height
Acacia aneura	1	1.4
Acacia fuscaneura	0.1	0.3
Acacia rhodophloia	0.1	1.1
Aristida contorta	0.1	0.3
Boerhavia sp. indet	0.1	0.1
Calandrinia eremaea	0.1	0.1
Calandrinia schistorhiza	0.1	0.1
Eremophila phyllopoda subsp. *phyllopoda*	2	0.6
Goodenia tenuiloba	0.1	0.1
Grevillea berryana	1	2.5
Ptilotus exaltatus	0.1	0.4
Ptilotus rotundifolius	0.1	0.1
Senna artemisioides subsp. *helmsii*	0.1	0.1
Tribulus adelacanthus	0.1	0.1

Mt Gould

Site MTG-005



Date	28/08/2022
Described by	CW
Type	Quadrat 20m x 20m
Location	MGA Zone 50
	535750mE; 7149417mN
	117.3565 E, -25.772901 S
Veg Condition	Very Good
Soil	Clayey Sand
Rock Type	Chert, Ironstone
Fire Age	3-5 yrs
Habitat	Drainage Area/ Floodplain
Vegetation	*Acacia ramulosa*, *Acacia aptaneura*, *Acacia ayersiana* tall open shrubland over *Eremophila glutinosa* mid sparse shrubland over *Goodenia tenuiloba* low sparse herbland

SPECIES LIST

Name	Cover	Height
Abutilon cryptopetalum	0.1	0.2
Acacia aptaneura	3	5
Acacia ayersiana	2	8
Acacia cuthbertsonii subsp. *cuthbertsonii*	2	4
Acacia pruinocarpa	1	7
Acacia ramulosa var. *ramulosa*	6	2.5
Acacia thomae	0.1	2
Aristida contorta	1	0.3
Aristida holathera var. *holathera*	0.1	0.3
Boerhavia sp. indet	0.1	0.2
Calandrinia eremaea	0.1	0.1
Calandrinia schistorhiza	0.1	0.1
Calotis hispidula	0.1	0.1
**Cenchrus ciliaris*	0.1	0.6
**Cuscuta planiflora*	0.1	0.1
Dendrophyllanthus erwinii	0.1	0.3
Digitaria brownii	0.1	0.3
Digitaria ctenantha	0.1	0.2
Dysphania melanocarpa	0.1	0.1
Dysphania rhadinostachya subsp. *rhadinostachya*	0.1	0.2
Eragrostis setifolia	0.1	0.3
Eremophila fraseri	0.1	0.3
Eremophila glutinosa	0.1	1.1

Eremophila latrobei subsp. *latrobei*	0.1	0.7
Eremophila phyllopoda subsp. *phyllopoda*	0.1	0.5
Eriachne aristidea	0.1	0.4
Eriachne helmsii	0.1	0.7
Eriachne pulchella	0.1	0.2
Euphorbia boophthona	0.1	0.2
Euploca moorei	0.1	0.2
Glycine canescens	0.1	0
Goodenia tenuiloba	4	0.2
Helipterum craspedioides	0.1	0.6
Hibiscus burtonii	0.1	0.4
Ipomoea calobra	0.1	0
Leichhardtia australis	0.1	0
Monachather paradoxus	0.1	0.4
Nicotiana rosulata	0.1	0.2
Paspalidium clementii	0.1	0.2
Polygala glaucifolia	0.1	0.1
Portulaca oleracea	0.1	0.1
Psydrax rigidula	2	5
Ptilotus exaltatus	0.1	0.5
Ptilotus obovatus	0.1	0.4
Ptilotus polystachyus	0.1	0.5
Salsola australis	0.1	0.4
Senna artemisioides subsp. *helmsii*	0.1	0.5
Setaria sp. indet	0.1	0.1
Solanum lasiophyllum	0.1	0.5
Trachymene pilbarensis	0.1	0.4
Trichodesma zeylanicum	0.1	0.8

Mt Gould

Site MTG-006



Date 27/08/2022

Described by CW & BM

Type Quadrat 20m x 20m

Location MGA Zone 50

536175mE, 7148893mN

117.3607 E, -25.777626 S

Veg Condition Excellent

Soil Sandy Clay Loam

Rock Type Ironstone

Fire Age 5-10 yrs,>10 yrs

Habitat Hillcrest/ Upper Hillslope

Vegetation *Acacia aptaneura*, *Grevillea berryana* tall sparse shrubland over *Goodenia tenuiloba* sparse herbland

SPECIES LIST

Name	Cover	Height
Abutilon oxycarpum subsp. Prostrate (A.A. Mitchell PRP1266)	0.1	0.15
Acacia aptaneura	5	3.2
Acacia rhodophloia	0.1	2.8
Aristida contorta	0.1	0.3
Aristida holathera var. *holathera*	0.1	0.3
Boerhavia sp. indet	0.1	0.1
Calotis hispidula	0.1	0.1
Cheilanthes brownii	0.1	0.06
Dendrophyllanthus erwinii	0.1	0.1
Dodonaea petiolaris	0.1	0.7
Dysphania melanocarpa	0.1	0.1
Dysphania rhadinostachya subsp. *rhadinostachya*	0.1	0.2
Enneapogon caerulescens	0.1	0.3
Eremophila latrobei subsp. *latrobei*	0.1	0.7
Eriachne aristidea	0.1	0.2
Erodium cygnorum	0.1	0.1
Euphorbia boophthona	0.1	0.1
Euploca sp. Indet	0.1	0.15
Goodenia tenuiloba	1	0.3
Grevillea berryana	0.25	2.2
Leichhardtia australis	0.1	0
Lepidium oxytrichum	0.1	0.1
Paspalidium clementii	0.1	0.1

Portulaca oleracea	0.1	0.1
Ptilotus chamaecladus	0.1	0.1
Ptilotus helipteroides	0.1	0.1
Ptilotus obovatus	0.1	0.4
Ptilotus polystachyus	0.1	0.5
Salsola australis	1	0.4
Sida aff. sp. dark green fruits (S. van Leeuwen 2260)	0.1	0.2
Solanum ashbyae	0.1	0.6
Trachymene pilbarensis	0.1	0.25
Tribulus suberosus	0.1	0.5
Tribulus terrestris	0.1	0.1

Mt Gould

Site MTG-007



Date	27/08/2022
Described by	CW & BM
Type	Quadrat 20m x 20m
Location	MGA Zone 50 535440mE, 7148830mN 117.3534 E, -25.778207 S
Veg Condition	Very Good
Soil	Sand
Rock Type	Quartz
Fire Age	5-10 yrs
Habitat	Minor Drainage Line
Vegetation	*Acacia pteraneura, Acacia pruinocarpa* tall, isolated shrubs over *Ptilotus polystachyus* low isolated clumps of shrubs over *Aristida contorta* low open tussock grassland

SPECIES LIST

Name	Cover	Height
Abutilon cryptopetalum	0.1	0.6
Abutilon oxycarpum subsp. Prostrate (A.A. Mitchell PRP1266)	0.1	0.3
Acacia pruinocarpa	1	3
Acacia pteraneura	0.1	4.2
Acacia rhodophloia	0.1	2
Aristida contorta	12	0.3
Arivela viscosa	0.1	0.5
Boerhavia sp. indet	0.1	0.1
Calotis hispidula	0.1	0.1
*Chenopodiacea*e sp. indet	0.1	0.2
Digitaria brownii	0.1	0.6
Dysphania melanocarpa	0.1	0.1
Dysphania rhadinostachya subsp. *rhadinostachya*	0.1	0.4
Enneapogon caerulescens	0.1	0.3
Eragrostis pergracilis	0.1	0.8
Eragrostis setifolia	0.1	0.6
Eremophila phyllopoda subsp. *phyllopoda*	0.1	0.5
Eriachne aristidea	0.1	0.1
Eriachne helmsii	0.1	0.6
Eriachne pulchella subsp. *pulchella*	0.1	0.2
Erodium cygnorum	0.1	0.2
Euphorbia boophthona	0.1	0.1
Euphorbia drummondii	0.1	0.1

Goodenia tenuiloba	0.1	0.4
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	0.1	0.2
Helipterum craspedioides	0.1	0.2
Hibiscus burtonii	0.1	0.4
Hibiscus sp. Gardneri (A.L. Payne PRP 1435)	0.1	0.4
Monachather paradoxus	0.1	0.7
Nicotiana occidentalis	0.1	0.1
Paspalidium clementii	0.1	0.2
Portulaca oleracea	0.1	0.1
Ptilotus chamaecladus	0.1	0.1
Ptilotus exaltatus	0.1	0.4
Ptilotus helipteroides	0.1	0.2
Ptilotus polystachyus	0.1	0.3
Salsola australis	0.1	0.3
Senna artemisioides subsp. *helmsii*	0.1	0.4
Senna glaucifolia	0.1	0.9
Sida aff. sp. dark green fruits (S. van Leeuwen 2260)	0.1	0.2
Solanum lasiophyllum	0.1	0.4
Tribulus astrocarpus	0.1	0.1

Mt Gould

Site MTG-008



Date	27/08/2022
Described by	CW & BM
Type	Quadrat 20m x 20m
Location	MGA Zone 50
	535707mE, 7148518mN
	117.3561 E, -25.781022 S
Veg Condition	Very Good
Soil	Clayey Sand
Rock Type	Ironstone
Fire Age	5-10 yrs,3-5 yrs
Habitat	Claypan
Vegetation	*Acacia cuthbertsonii*, *Acacia fuscaneura* tall open shrubland over *Acacia tetragonophylla*, *Ptilotus obovatus* low isolated shrubs over *Aristida contorta* low isolated tussock grasses

SPECIES LIST

Name	Cover	Height
Acacia cuthbertsonii subsp. *cuthbertsonii*	7	3.5
Acacia fuscaneura	5	4
Acacia tetragonophylla	0.5	0.6
Amaranthus cuspidifolius	0.1	0.2
Aristida contorta	1.5	0.2
Calandrinia monosperma	0.1	0.1
Enneapogon caerulescens	0.1	0.3
Eremophila exilifolia	0.1	0.5
Eremophila latrobei subsp. *latrobei*	0.1	0.2
Eriachne aristidea	0.1	0.4
Eriachne pulchella subsp. *pulchella*	0.1	0.2
Euploca heterantha	0.1	0.1
Goodenia tenuiloba	1	0.2
Hakea preissii	2	2
Haloragis trigonocarpa	0.1	0.2
Indigofera monophylla	0.1	0.2
Ipomoea calobra	0.1	0
Leichhardtia australis	0.1	0
Paspalidium clementii	0.1	0.2
Psydrax latifolia	0.1	0.3
Psydrax suaveolens	0.1	1.3
Ptilotus aervoides	0.1	0.2
Ptilotus exaltatus	0.1	0.3
Ptilotus helipteroides	0.1	0.2

Ptilotus obovatus	0.1	0.5
Salsola australis	0.1	0.1
Senna artemisioides subsp. *helmsii*	0.1	0.4
Sida sp. dark green fruits (S. van Leeuwen 2260)	0.1	0.4
Solanum lasiophyllum	0.1	0.2
Tribulus adelacanthus	0.1	0.2

Mt Gould

Site MTG-009



Date	27/08/2022
Described by	EM & RM
Type	Quadrat 20m x 20m
Location	MGA Zone 50 534762mE, 7148588mN 117.3467 E, -25.780411 S
Veg Condition	Very Good
Soil	Sandy Clay Loam
Rock Type	Ironstone, Chert, Quartz
Fire Age	>10 yrs
Habitat	Stony Plain
Vegetation	*Acacia rhodophloia* mid sparse shrubland over *Eremophila fraseri* mid isolated shrubs over *Aristida contorta* low sparse tussock grassland

SPECIES LIST

Name	Cover	Height
Acacia rhodophloia	5	2
Aristida contorta	6	0.3
Calandrinia stagnensis	0.5	0.1
Eremophila fraseri subsp. *fraseri*	1.5	1.2
Eriachne pulchella subsp. *pulchella*	0.1	0.1
Euphorbia boophthona	0.2	0.1
Euploca heterantha	0.1	0.1
Goodenia tenuiloba	0.1	0.2
Goodenia triodiophila	0.1	0.2
Hibiscus sturtii var. *forrestii*	0.1	0.2
Leichhardtia australis	0.1	0
Senna glaucifolia	0.1	1.1
Solanum lasiophyllum	0.1	0.1
Stenopetalum anfractum	0.1	0.1

Mt Gould

Site MTG-010



Date	27/08/2022
Described by	EM & RM
Type	Quadrat 20m x 20m
Location	MGA Zone 50 534106mE, 7148555mN 117.3401 E, -25.780724 S
Veg Condition	Poor
Soil	Sandy Clay Loam
Rock Type	Ironstone, Chert, Quartz
Fire Age	>10 yrs
Habitat	Stony Plain
Vegetation	*Acacia incurvaneura* tall sparse shrubland over *Acacia cuthbertsonii* mid sparse shrubland over dead *Goodenia tenuiloba* herbland

SPECIES LIST

Name	Cover	Height
Acacia cuthbertsonii subsp. *cuthbertsonii*	5	1
Acacia incurvaneura	8	3
Aristida contorta	0.1	0.2
Eragrostis eriopoda	0.1	0.3
Goodenia tenuiloba	0.1	0.1

Mt Gould

Site MTG-011



Date	25/08/2022
Described by	CW & BM
Type	Quadrat 20m x 20m
Location	MGA Zone 50
	535231mE, 7148101mN
	117.3513 E, -25.784797 S
Veg Condition	Excellent
Soil	Clayey Sand
Rock Type	Quartz
Fire Age	3-5 yrs
Habitat	Hillslope
Vegetation	*Acacia pteraneura* tall, isolated clumps of shrubs over *Ptilotus rotundifolius*, *Eremophila fraseri* mid isolated shrubs over *Aristida contorta* (dead) low sparse tussock grasses

SPECIES LIST

Name	Cover	Height
Acacia pteraneura	1.5	2.8
Aristida contorta	0.1	0.3
Boraginaceae sp. indet	0.1	0.4
Calandrinia monosperma	0.1	0.1
Eremophila fraseri subsp. *fraseri*	1	0.6
Eremophila macmillaniana	0.1	0.9
Euploca inexplicita	0.1	0.1
Goodenia tenuiloba	0.1	0.4
Poaceae sp. indet 1	0.1	0.1
Poaceae sp. indet 2	0.1	0.1
Portulaca sp. indet	0.1	0.1
Ptilotus aervoides	0.1	0.1
Ptilotus helipteroides	0.1	0.1
Ptilotus obovatus	0.1	0.2
Ptilotus rotundifolius	0.1	0.9
Ptilotus sp. indet	0.1	0.4
Senna sp. Meekatharra (E. Bailey 1-26)	0.1	0.3
Sida aff. sp. dark green fruits (S. van Leeuwen 2260)	0.1	0.2
Solanum lasiophyllum	0.1	0.1
Stenopetalum ? anfractum	0.1	0.3
Tripogonella loliiformis	0.1	0.1

Mt Gould

Site MTG-012



Date	25/08/2022
Described by	EM & RM
Type	Quadrat 20m x 20m
Location	MGA Zone 50
	535847mE, 7148007mN
	117.3575 E, -25.785630 S
Veg Condition	Very Good
Soil	Sandy Clay Loam
Rock Type	Ironstone, Chert, Quartz
Fire Age	>10 yrs
Habitat	Footslope
Vegetation	*Eremophila phyllopoda* mid sparse shrubland over *Aristida contorta* low open tussock grassland

SPECIES LIST

Name	Cover	Height
Acacia incurvaneura	5	3
Acacia tetragonophylla	1	0.4
Aristida contorta	30	0.1
Calandrinia monosperma	0.1	0.01
Eremophila macmillaniana	5	1.2
Eriachne pulchella subsp. *pulchella*	0.1	0.05
Euphorbia boophthona	0.1	0.01
Goodenia tenuiloba	2	0.1
Portulaca oleracea	0.1	0.01
Ptilotus helipteroides	0.1	0.01
Ptilotus polystachyus	0.1	0.01
Ptilotus rotundifolius	0.1	0.1
Ptilotus sp. indet	0.1	0.01
Salsola australis	0.1	0.2

Mt Gould

Site MTG-013



Date	26/08/2022
Described by	EM & RM
Type	Quadrat 20m x 20m
Location	MGA Zone 50
	533495mE, 7148074mN
	117.3340 E, -25.785081 S
Veg Condition	Very Good
Soil	Sandy Clay Loam
Rock Type	Ironstone
Fire Age	>10 yrs
Habitat	Sandy/ Stony Plain
Vegetation	*Grevillea berryana* tall, isolated shrubs over *Acacia ramulosa* tall open shrubland over *Ptilotus polystachyus* low sparse shrubland over *Aristida holathera* low isolated tussock grasses

SPECIES LIST

Name	Cover	Height
Acacia ramulosa var. *ramulosa*	20	3
Aristida holathera var. *holathera*	2	0.6
Brunonia australis	0.1	0.3
**Cenchrus ciliaris*	0.1	0.5
Eremophila forrestii subsp. *forrestii*	1	1.2
Eriachne aristidea	0.1	0.6
Goodenia tenuiloba	2	0.2
Ipomoea calobra	0.1	0
Monachather paradoxus	0.2	1
Ptilotus polystachyus	6	0.8
**Setaria verticillata*	4	0.7
Sida aff. Intricata	0.5	0.1
Solanum lasiophyllum	0.5	0.4
Trichodesma zeylanicum	0.1	0.3

Mt Gould

Site MTG-015



Date	27/08/2022
Described by	EM & RM
Type	Quadrat 20m x 20m
Location	MGA Zone 50
	533652mE, 7147586mN
	117.3356 E, -25.789487 S
Veg Condition	Excellent
Soil	Sandy Clay Loam
Rock Type	Chert, Ironstone, Quartz
Fire Age	>10 yrs
Habitat	Hillcrest/ Upper Hillslope
Vegetation	*Acacia aptaneura*, *Acacia rhodophloia* tall open shrubland over *Ptilotus obovatus, Eremophila warnesii* (P1) low sparse shrubland over *Aristida contorta*, *Digitaria brownii* low sparse tussock grassland over *Goodenia tenuiloba* isolated clumps of herbs

SPECIES LIST

Name	Cover	Height
Abutilon lepidum	0.1	0.1
Abutilon oxycarpum subsp. Prostrate (A.A. Mitchell PRP1266)	0.1	0.01
Acacia aptaneura	5	4
Acacia rhodophloia	5	3
Aristida contorta	5	0.2
Arivela viscosa	0.5	0.4
Cheilanthes brownii	0.1	0.01
Dendrophyllanthus erwinii	0.1	0.01
Digitaria brownii	1	0.2
Dysphania rhadinostachya subsp. *rhadinostachya*	0.5	0.1
Enneapogon caerulescens	0.5	0.1
Eremophila latrobei subsp. *latrobei*	0.5	1.2
Eremophila warnesii	5	0.6
Eriachne aristidea	2	0.3
Eriachne pulchella subsp. *pulchella*	0.2	0.1
Euploca inexplicita	0.1	0.05
Goodenia tenuiloba	1	0.2
Paspalidium basicladum	0.1	0.1
Ptilotus aervoides	0.1	0.01
Ptilotus exaltatus	0.1	0.05
Ptilotus helipteroides	0.1	0.05
Ptilotus obovatus	5	0.4

Ptilotus polystachyus	1	0.4
Rhodanthe maryonii	0.1	0.05
Salsola australis	0.1	0.1
Solanum lasiophyllum	0.1	0.05
Tribulus adelacanthus	0.1	0.01

Mt Gould

Site MTG-016



Date	29/08/2022
Described by	EM & RM
Type	Quadrat 10m x 30m
Location	MGA Zone 50
	534382mE, 7147604mN
	117.3429 E, -25.789303 S
Veg Condition	Very Good
Soil	Sandy Clay Loam
Rock Type	Chert, Ironstone, Quartz
Fire Age	>10 yrs
Habitat	Minor Drainage Line
Vegetation	*Acacia aptaneura* tall open shrubland over Dodonaea petiolaris, *Eremophila glutinosa* mid sparse shrubland over *Goodenia tenuiloba*

SPECIES LIST

Name	Cover	Height
Abutilon oxycarpum subsp. Prostrate (A.A. Mitchell PRP1266)	0.1	0.05
Acacia aptaneura	40	4.5
Acacia rhodophloia	2	5
Aristida contorta	0.1	0.2
Arivela viscosa	0.1	0.2
Corchorus crozophorifolius	0.1	0.3
Dendrophyllanthus erwinii	0.1	0.01
Dodonaea petiolaris	1	1.2
Dysphania rhadinostachya subsp. *rhadinostachya*	0.1	0.3
Eragrostis eriopoda	0.1	0.4
Eremophila glutinosa	1	1.4
Eriachne aristidea	0.5	0.2
Eriachne helmsii	0.3	0.3
Eriachne pulchella subsp. *pulchella*	0.1	0.05
Euphorbia boophthona	0.1	0.1
Euploca inexplicita	0.1	0.1
Euploca moorei	0.1	0.1
Goodenia tenuiloba	5	0.1
Grevillea berryana	2	4
Hibiscus burtonii	0.2	0.2
Indigofera monophylla	0.1	0.3
Philotheca brucei subsp. *cinerea*	2	1.2
Ptilotus polystachyus	0.1	0.05

Sida ?sp. Dark green fruits (S. van Leeuwen 2260)	0.1	0.2
Sida sp. Golden calyces glabrous (H.N. Foote 32)	0.2	0.3
Solanum ashbyae	0.1	0.4
Solanum lasiophyllum	0.1	0.2
Tribulus suberosus	0.1	0.6
Trichodesma zeylanicum	0.1	0.1

Mt Gould

Site MTG-017



Date	26/08/2022
Described by	CW & BM
Type	Quadrat 20m x 20m
Location	MGA Zone 50
	533228mE, 7147556mN
	117.3314 E, -25.789771 S
Veg Condition	Very Good
Soil	Clayey Sand
Rock Type	Chert
Fire Age	5-10 yrs
Habitat	Claypan
Vegetation	*Acacia tetragonophylla* mid isolated clumps of shrubs over *Senna* sp. Meekatharra (E. Bailey 1-26), *Ptilotus obovatus* low isolated shrubs over *Maireana carnosa* isolated chenopod shrubs over *Aristida contorta* low sparse tussock grassland

SPECIES LIST

Name	Cover	Height
Acacia tetragonophylla	0.5	1.2
Aristida contorta	1	0.2
Eragrostis pergracilis	0.1	0.1
Eriachne aristidea	0.1	0.3
Eriachne pulchella subsp. *pulchella*	0.1	0.1
Goodenia tenuiloba	0.1	0.2
Lepidium echinatum	0.1	0.1
Maireana carnosa	0.1	0.1
Poaceae sp. indet	0.1	0.1
Ptilotus helipteroides	0.1	0.1
Ptilotus polystachyus	0.1	0.2
Ptilotus schwartzii	0.1	0.3
Roepera sp. indet	0.1	0.1
Senna sp. Meekatharra (E. Bailey 1-26)	0.1	0.5
Stenopetalum anfractum	0.1	0.3
Trianthema glossostigmum	0.1	0.1
Tribulus astrocarpus	0.1	0.1

Mt Gould

Site MTG-018



Date	26/08/2022
Described by	CW & BM
Type	Quadrat 20m x 20m
Location	MGA Zone 50
	532810mE, 7147306mN
	117.3272 E, -25.792033 S
Veg Condition	Very Good
Soil	Sand
Rock Type	None Discernible
Fire Age	>10 yrs
Habitat	Sand Plain
Vegetation	*Acacia pteraneura* tall, isolated shrubs over *Acacia kempeana*, *Acacia ramulosa* mid sparse shrubland over *Eremophila forrestii* sparse low shrubland over *Eriachne aristidea*, *Aristida holathera*, *Aristida contorta* low open tussock grassland

SPECIES LIST

Name	Cover	Height
Acacia kempeana	1	3
Acacia pteraneura	0.1	5
Acacia ramulosa var. *ramulosa*	1	3
Aristida contorta	1	0.3
Aristida holathera var. *holathera*	5	0.6
Boerhavia sp. indet	0.1	0.2
Calandrinia sp. Indet	0.1	0.02
Corchorus crozophorifolius	0.1	0.7
Eragrostis eriopoda	0.1	0.5
Eremophila forrestii subsp. *forrestii*	0.25	0.8
Eriachne aristidea	15	0.5
Goodenia tenuiloba	0.5	0.3
Portulaca oleracea	0.1	0.1
Ptilotus polystachyus	0.1	0.2
Ptilotus sp. indet	0.1	0.1
Solanum lasiophyllum	0.1	0.4
Trachymene pilbarensis	0.1	0.1
Tribulus forrestii	0.1	0.2

Mt Gould

Site MTG-019



Date	27/08/2022
Described by	EM & RM
Type	Quadrat 20m x 20m
Location	MGA Zone 50 533583mE, 7147166mN 117.3349 E, -25.793282 S
Veg Condition	Very Good
Soil	Sandy Clay Loam
Rock Type	Ironstone, Quartz
Fire Age	>10 yrs
Habitat	Hillslope
Vegetation	*Acacia fuscaneura*, *Acacia rhodophloia* tall open shrubland over *Halgania gustafsenii* low isolated shrubs over *Goodenia tenuiloba* sparse

SPECIES LIST

Name	Cover	Height
Acacia fuscaneura	15	4.5
Acacia rhodophloia	2	3
Aristida contorta	0.5	0.1
Eragrostis eriopoda	0.5	0.2
Eremophila glutinosa	0.1	0.1
Eremophila latrobei subsp. *latrobei*	0.5	0.6
Eriachne pulchella subsp. *pulchella*	0.1	0.05
Goodenia tenuiloba	1	0.1
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	1	0.5
Hibiscus burtonii	0.1	0.2
Ptilotus helipteroides	0.1	0.5
Ptilotus obovatus	0.5	0.3
Ptilotus polystachyus	0.1	0.2
Senna artemisioides subsp. *helmsii*	0.1	0.1
Sida sp. dark green fruits (S. van Leeuwen 2260)	0.1	0.1
Solanum lasiophyllum	0.1	0.1
Tribulus adelacanthus	0.1	0.1

Mt Gould

Site MTG-020



Date	28/08/2022
Described by	CW & BM
Type	Quadrat 20m x 20m
Location	MGA Zone 50
	534051mE, 7147044mN
	117.3396 E, -25.794373 S
Veg Condition	Excellent
Soil	Sandy Clay Loam
Rock Type	Ironstone
Fire Age	>10 yrs
Habitat	Hillslope
Vegetation	*Acacia aptaneura*, Acacia rhodophloia tall sparse shrubland over *Eremophila latrobei* mid isolated shrubs over *Philotheca brucei* low isolated shrubs over *Aristida contorta* low sparse tussock grassland over *Goodenia tenuiloba* sparse herbland

SPECIES LIST

Name	Cover	Height
Abutilon lepidum	0.1	0.1
Acacia aptaneura	3	5
Acacia rhodophloia	2.5	3
Aristida contorta	1	0.25
Arivela viscosa	0.1	0.5
**Citrullus amarus*	0.1	0.1
Corchorus crozophorifolius	0.1	0.3
Dendrophyllanthus erwinii	0.1	0.1
Digitaria brownii	0.1	0.4
Dysphania melanocarpa	0.1	0.1
Dysphania rhadinostachya subsp. *rhadinostachya*	0.1	0.1
Enneapogon caerulescens	0.1	0.3
Eremophila latrobei subsp. *latrobei*	0.5	1.7
Eriachne aristidea	0.1	0.2
Eriachne pulchella	0.1	0.15
Euphorbia boophthona	0.1	0.15
Euploca inexplicita	0.1	0.15
Goodenia tenuiloba	1	0.3
Grevillea striata	0.1	3.5
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	0.1	0.6
Haloragis trigonocarpa	0.1	0.1
Helipterum craspedioides	0.1	0.15
Iseilema dolichotrichum	0.1	0.1

Lepidium oxytrichum	0.1	0.1
Maireana planifolia	0.1	0.3
Nicotiana rosulata	0.1	0.2
Paspalidium clementii	0.1	0.05
Philotheca brucei subsp. *cinerea*	0.5	0.8
Portulaca oleracea	0.1	0.1
Ptilotus aervoides	0.1	0.05
Ptilotus exaltatus	0.1	0.1
Ptilotus helipteroides	0.1	0.1
Ptilotus obovatus	0.1	0.05
Ptilotus xerophilus	0.1	0.15
Rhodanthe maryonii	0.1	0.1
Sida aff. sp. spiciform panicles (E. Leyland s.n. 14/8/90)	0.1	0.4
Sida sp. dark green fruits (S. van Leeuwen 2260)	0.1	0.25
Sida sp. Golden calyces glabrous (H.N. Foote 32)	0.1	0.03
Solanum ashbyae	0.1	0.1
Solanum lasiophyllum	0.1	0.3
Thysanotus manglesianus	0.1	0.5

Mt Gould

Site MTG-021



Date	29/08/2022
Described by	EM & RM
Type	Quadrat 20m x 20m
Location	MGA Zone 50
	534413mE, 7147251mN
	117.3432 E, -25.792493 S
Veg Condition	Excellent
Soil	Sandy Clay Loam
Rock Type	Ironstone, Chert
Fire Age	>10 yrs
Habitat	Hillslope
Vegetation	*Acacia rhodophloia* tall shrubland over *Ptilotus obovatus* low open shrubland over *Goodenia tenuiloba* sparse herbland

SPECIES LIST

Name	Cover	Height
Acacia aptaneura	0.1	4
Acacia rhodophloia	40	4
Arivela viscosa	0.2	0.3
Corchorus crozophorifolius	0.1	0.2
Dysphania rhadinostachya subsp. *rhadinostachya*	0.1	0.1
Eremophila latrobei subsp. *latrobei*	1	5
Goodenia tenuiloba	25	0.2
Paspalidium basicladum	0.1	0.1
Ptilotus aervoides	0.1	0.01
Ptilotus exaltatus	0.1	0.1
Ptilotus obovatus	15	0.4
Ptilotus polystachyus	0.1	0.1
Sida sp. Golden calyces glabrous (H.N. Foote 32)	0.2	0.2
Solanum lasiophyllum	0.1	0.05

Mt Gould

Site MTG-022



Date	28/08/2022
Described by	CW & BM
Type	Quadrat 20m x 20m
Location	MGA Zone 50
	534251mE, 7146881mN
	117.3416 E, -25.795842 S
Veg Condition	Very Good
Soil	Clayey Sand
Rock Type	Chert, Ironstone
Fire Age	5-10 yrs
Habitat	Hillslope
Vegetation	*Acacia aptaneura* tall, isolated shrubs over *Ptilotus obovatus*, *Atriplex codonocarpa* low sparse shrubland over *Salsola australis, Goodenia tenuiloba, Dysphania melanocarpa* low sparse herbland

SPECIES LIST

Name	Cover	Height
Abutilon cryptopetalum	0.1	0.2
Abutilon lepidum	0.1	0.1
Acacia aptaneura	2	4
Aristida contorta	0.1	0.2
Arivela viscosa	0.1	0.4
Atriplex codonocarpa	0.1	0.5
Boerhavia sp. indet	0.1	0.1
Corchorus crozophorifolius	0.1	0.3
Dendrophyllanthus erwinii	0.1	0.1
Dysphania melanocarpa	0.1	0.2
Enneapogon caerulescens	0.1	0.3
Enneapogon polyphyllus	0.1	0.1
Eragrostis pergracilis	0.1	0.6
Eriachne aristidea	0.1	0.1
Eriachne pulchella	0.1	0.1
Euphorbia australis var. *subtomentosa*	0.1	0.1
Goodenia tenuiloba	0.1	0.1
Iseilema dolichotrichum	0.1	0.1
Lepidium oxytrichum	0.1	0.1
Maireana planifolia	0.1	0.4
Paspalidium basicladum	0.1	0.1
Paspalidium clementii	0.1	0.1
Portulaca oleracea	0.1	0.2
Ptilotus exaltatus	0.1	0.1
Ptilotus gaudichaudii	0.1	0.2
Ptilotus obovatus	2.5	0.4

Ptilotus polystachyus	0.1	0.3
Ptilotus xerophilus	0.1	0.1
Rhodanthe maryonii	0.1	0.2
**Rumex vesicarius*	0.1	0.2
Salsola australis	0.1	0.2
Sclerolaena eriacantha	0.1	0.2
Sida ectogama	0.1	0.3
Sida sp. dark green fruits (S. van Leeuwen 2260)	0.1	0.1
Solanum lasiophyllum	0.1	0.2
Streptoglossa liatroides	0.1	0.1

Mt Gould

Site MTG-023



Date	26/08/2022
Described by	EM & RM
Type	Quadrat 20m x 20m
Location	MGA Zone 50
	532786mE, 7146727mN
	117.3270 E, -25.797266 S
Veg Condition	Good
Soil	Sandy Clay Loam
Rock Type	Ironstone
Fire Age	>10 yrs
Habitat	Sandy/ Stony Plain
Vegetation	*Acacia pteraneura* tall, isolated clumps of shrubs over *Senna artemisioides*, *Eremophila fraseri* mid isolated shrubs over *Aristida contorta*, *Eragrostis eriopoda* low sparse tussock grassland

SPECIES LIST

Name	Cover	Height
Acacia ? cuthbertsonii	0.2	1.2
Acacia pteraneura	2	6
Aristida contorta	8	0.3
Aristida holathera var. *holathera*	0.1	0.5
Corchorus crozophorifolius	0.1	0.3
Digitaria brownii	0.1	0.4
Eragrostis eriopoda	0.5	0.4
Eremophila fraseri subsp. *fraseri*	0.2	1
Eriachne aristidea	0.1	0.2
Euphorbia drummondii	0.1	0.1
Euploca inexplicita	0.1	0.1
Goodenia tenuiloba	0.5	0.1
Monachather paradoxus	0.1	0.4
Poaceae sp. indet	0.1	0.3
Ptilotus obovatus	0.1	0.4
Ptilotus polystachyus	0.1	0.5
Salsola australis	0.1	0.1
Senna artemisioides subsp. *helmsii*	2	1.2
Sida platycalyx	0.2	0.3
Stenopetalum anfractum	0.1	0.2

Mt Gould

Site MTG-024



Date	26/08/2022
Described by	EM & RM
Type	Quadrat 20m x 20m
Location	MGA Zone 50
	533188mE, 7146768mN
	117.3310 E, -25.796881 S
Veg Condition	Good
Soil	Sandy Clay Loam
Rock Type	Chert, Ironstone
Fire Age	>10 yrs
Habitat	Stony Plain
Vegetation	*Acacia aptaneura* tall open shrubland over *Corchorus crozophorifolius* low isolated shrubs over *Aristida holathera*, *Aristida contorta* low open tussock grassland

SPECIES LIST

Name	Cover	Height
Acacia aptaneura	20	4
Aristida contorta	5	0.2
Aristida holathera var. *holathera*	5	0.5
Corchorus crozophorifolius	1	0.3
Digitaria brownii	2	0.2
Eragrostis eriopoda	1	0.2
Eriachne aristidea	5	0.3
Eriochloa ? pseudoacrotricha	0.2	0.5
Euphorbia drummondii	0.1	0.01
Goodenia tenuiloba	1	0.2
Hibiscus burtonii	0.1	0.01
Monachather paradoxus	0.1	0.4
Poaceae sp. indet	0.1	0.05
Ptilotus helipteroides	0.1	0.1
Ptilotus polystachyus	0.1	0.2
Solanum lasiophyllum	0.1	0.2
Stenopetalum anfractum	0.1	0.05
Tribulus astrocarpus	0.1	0.01

Mt Gould

Site MTG-025



Date	27/08/2022
Described by	CW & BM
Type	Quadrat 20m x 20m
Location	MGA Zone 50
	534417mE, 7146461mN
	117.3433 E, -25.799629 S
Veg Condition	Very Good
Soil	Clayey Sand
Rock Type	Banded ironstone, Ironstone
Fire Age	5-10 yrs
Habitat	Hillcrest/ Upper Hillslope
Vegetation	*Acacia citrinoviridis*, *Acacia aptaneura* tall, isolated shrubs over *Ptilotus obovatus*, *Corchorus crozophorifolius, Eremophila latrobei* low sparse shrubland over *Dysphania rhadinostachya*, *Rhodanthe maryonii, Dysphania melanocarpa* sparse herbland

SPECIES LIST

Name	Cover	Height
Abutilon lepidum	0.1	0.4
Abutilon otocarpum	0.1	0.2
Abutilon oxycarpum subsp. Prostrate (A.A. Mitchell PRP1266)	0.1	0.2
Acacia aptaneura	0.1	3.5
Amaranthus cuspidifolius	0.1	0.3
Aristida contorta	0.1	0.2
Arivela viscosa	0.1	0.4
Boerhavia coccinea	0.1	0.1
Calandrinia eremaea	0.1	0.1
Cheilanthes sieberi subsp. *sieberi*	0.1	0.1
Corchorus crozophorifolius	1	0.4
Cymbopogon ambiguus	0.1	0.4
Dendrophyllanthus erwinii	0.1	0.1
Digitaria brownii	0.1	0.3
Dodonaea pachyneura	0.1	0.4
Dysphania melanocarpa	0.1	0.1
Dysphania rhadinostachya subsp. *rhadinostachya*	0.1	0.2
Enneapogon caerulescens	0.1	0.2
Eremophila latrobei subsp. *latrobei*	0.1	0.6
Eriachne mucronata	0.1	0.4
Eriachne pulchella subsp. *pulchella*	0.1	0.1
Erodium cygnorum	0.1	0.1

Euphorbia boophthona	0.1	0.1
Goodenia tenuiloba	0.1	0.2
Lepidium oxytrichum	0.1	0.1
Nicotiana rosulata	0.1	0.1
Paspalidium clementii	0.1	0.1
Portulaca oleracea	0.1	0.1
Ptilotus chamaecladus	0.1	0.2
Ptilotus obovatus	8	0.5
Ptilotus polystachyus	0.1	0.3
Rhodanthe maryonii	0.1	0.1
Salsola australis	0.1	0.2
Sida ectogama	0.1	0.1
Sida sp. Golden calyces glabrous (H.N. Foote 32)	0.1	0.1
Solanum ashbyae	0.1	0.2
Solanum lasiophyllum	0.1	0.2
Taplinia saxatilis	0.1	0.1
Trachymene pilbarensis	0.1	0.2
Triodia melvillei	0.1	0.4

Mt Gould

Site MTG-026



Date	29/08/2022
Described by	CW & BM
Type	Quadrat 20m x 20m
Location	MGA Zone 50
	534738mE, 7146595mN
	117.3465 E, -25.798406 S
Veg Condition	Excellent
Soil	Clayey Sand
Rock Type	Ironstone, Chert, Granite
Fire Age	5-10 yrs
Habitat	Hillcrest/ Upper Hillslope
Vegetation	*Acacia aptaneura* tall, isolated shrubs over *Ptilotus obovatus, Eremophila warnesii* low sparse shrubland over *Aristida contorta, Enneapogon caerulescens, Digitaria brownii* isolated low tussock grasses

SPECIES LIST

Name	Cover	Height
Abutilon lepidum	0.1	0.2
Abutilon oxycarpum subsp. Prostrate (A.A. Mitchell PRP1266)	0.1	0.1
Acacia aptaneura	0.1	3
Amaranthus cuspidifolius	0.1	0.2
Aristida contorta	0.1	0.3
Arivela viscosa	0.1	0.4
Boerhavia coccinea	0.1	0.1
Corchorus crozophorifolius	0.1	0.3
Cucumis myriocarpus subsp. *myriocarpus*	0.1	0.1
Dendrophyllanthus erwinii	0.1	0.1
Digitaria brownii	0.1	0.2
Dysphania melanocarpa	0.1	0.1
Dysphania rhadinostachya subsp. *rhadinostachya*	0.1	0.1
Enneapogon caerulescens	0.1	0.1
Eremophila warnesii	0.1	0.3
Eriachne pulchella	0.1	0.1
Goodenia tenuiloba	0.1	0.4
Iseilema dolichotrichum	0.1	0.1
Lepidium oxytrichum	0.1	0.1
Nicotiana rosulata	0.1	0.3
Paspalidium clementii	0.1	0.1
Poaceae sp. indet 1	0.1	0.2

Poaceae sp. indet 2	0.1	0.1
Portulaca oleracea	0.1	0.1
Ptilotus chamaecladus	0.1	0.1
Ptilotus exaltatus	0.1	0.3
Ptilotus helipteroides	0.1	0.1
Ptilotus obovatus	4	0.3
Ptilotus polystachyus	0.1	0.2
Ptilotus xerophilus	0.1	0.3
Salsola australis	0.1	0.2
Senna artemisioides subsp. *helmsii*	0.1	0.2
Sida sp. spiciform panicles (E. Leyland s.n. 14/8/90)	0.1	0.4
Solanum ashbyae	0.1	0.1
Solanum lasiophyllum	0.1	0.4
Streptoglossa liatroides	0.1	0.1

Mt Gould

Site MTG-027



Date	29/08/2022
Described by	CW & BM
Type	Quadrat 20m x 20m
Location	MGA Zone 50
	534912mE, 7147052mN
	117.3482 E, -25.794279 S
Veg Condition	Excellent
Soil	Sandy Clay Loam
Rock Type	Banded ironstone, Granite, Ironstone, Quartzite
Fire Age	>10 yrs
Habitat	Hillslope
Vegetation	*Acacia rhodophloia*, *Acacia pteraneura* tall sparse shrubland over *Eremophila latrobei* mid sparse shrubland over *Goodenia tenuiloba* low isolated clumps of herbs

SPECIES LIST

Name	Cover	Height
Acacia pteraneura	1	4
Acacia rhodophloia	6	3
Aristida contorta	0.1	0.3
Aristida holathera var. *holathera*	0.1	0.4
Arivela viscosa	0.1	0.2
Corchorus crozophorifolius	0.1	0.1
Eragrostis eriopoda	0.1	0.3
Eremophila latrobei subsp. *latrobei*	1.5	1.9
Eriachne aristidea	0.1	0.2
Euploca moorei	0.1	0.2
Goodenia tenuiloba	0.5	0.3
Hibiscus burtonii	0.1	0.3
Ptilotus obovatus	0.1	0.2
Sida sp. dark green fruits		
(S. van Leeuwen 2260)	0.1	0.2
Sida sp. Golden calyces glabrous		
(H.N. Foote 32)	0.1	0.3
Solanum ashbyae	0.1	0.1
Trachymene pilbarensis	0.1	0.6
Tribulus adelacanthus	0.1	0.1

Mt Gould

Site MTG-029



Date	29/08/2022
Described by	CW & BM
Type	Quadrat 20m x 20m
Location	MGA Zone 50
	535321mE, 7146320mN
	117.3523 E, -25.800882 S
Veg Condition	Very Good
Soil	Sand
Rock Type	Quartz, Ironstone
Fire Age	5-10 yrs
Habitat	Stony Plain
Vegetation	*Acacia rhodophloia*, *Acacia pteraneura* tall sparse shrubland over *Ptilotus obovatus* low sparse shrubland over *Aristida contorta* low isolated tussock grasses

SPECIES LIST

Name	Cover	Height
Acacia aptaneura	1.5	3
Acacia rhodophloia	3	0.1
Aristida contorta	0.1	0.1
Eragrostis eriopoda	0.1	0.3
Eremophila glutinosa	0.1	0.3
Goodenia tenuiloba	0.1	0.1
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743) (P1)	0.1	0.1
Portulaca oleracea	0.1	0.1
Ptilotus exaltatus	0.1	0.4
Ptilotus obovatus	0.1	0.3
Ptilotus schwartzii	0.1	0.4
Sida sp. dark green fruits (S. van Leeuwen 2260)	0.1	0.6
Solanum ashbyae	0.1	0.4
Solanum lasiophyllum	0.4	0.4
Tripogonella loliiformis	0.1	0.1

Mt Gould

Site MTG-030

Photo unavailable

Date	26/08/2022
Described by	EM & RM
Type	Quadrat 20m x 20m
Location	MGA Zone 50
	532872mE, 7146444mN
	117.3279 E, -25.799819 S
Veg Condition	Very Good
Soil	Sandy Clay Loam
Rock Type	Ironstone
Fire Age	>10 yrs
Habitat	Sandy/ Stony Plain
Vegetation	*Acacia ramulosa* tall open shrubland over *Aristida contorta, Aristida holathera, Eriachne aristidea* low open tussock grassland over *Goodenia tenuiloba* sparse herbland

SPECIES LIST

Name	Cover	Height
Acacia aptaneura	0.1	4.5
Acacia ramulosa var. *ramulosa*	6	3.5
Aristida contorta	12	0.4
Aristida holathera var. *holathera*	2	0.5
Corchorus crozophorifolius	0.1	0.2
Digitaria brownii	0.1	0.3
Dysphania rhadinostachya subsp. *rhadinostachya*	0.1	0.1
Eremophila forrestii subsp. *forrestii*	5	1.8
Eriachne aristidea	2	0.4
Eriachne helmsii	0.1	0.6
Eriachne pulchella subsp. *pulchella*	0.1	0.1
Goodenia tenuiloba	23	0.2
Hibiscus sturtii var. *forrestii*	0.1	0.2
Ipomoea calobra	0.1	0
Monachather paradoxus	0.1	0.5
Portulaca oleracea	0.1	0.1
Ptilotus polystachyus	0.5	0.6
Senna artemisioides subsp. *helmsii*	0.1	1
Sida platycalyx	0.1	0.3
Solanum lasiophyllum	0.2	0.7
Tribulus astrocarpus	0.1	0.1

Mt Gould

Site MTG-031



Date	26/08/2022
Described by	EM & RM
Type	Quadrat 20m x 20m
Location	MGA Zone 50
	533425mE, 7146406mN
	117.3334 E, -25.800147 S
Veg Condition	Very Good
Soil	Sandy Clay Loam
Rock Type	Ironstone, Chert, Quartz, Granite
Fire Age	>10 yrs
Habitat	Hillslope
Vegetation	*Acacia rhodophloia* tall open shrubland over *Aristida contorta* low sparse tussock grassland over *Goodenia tenuiloba* open herbland

SPECIES LIST

Name	Cover	Height
Acacia rhodophloia	30	2.5
Aristida contorta	5	0.1
Aristida holathera var. *holathera*	0.1	0.3
Arivela viscosa	0.1	0.2
Calandrinia monosperma	0.1	0.1
Corchorus crozophorifolius	0.1	0.1
Digitaria brownii	0.1	0.3
Eriachne aristidea	0.1	0.1
Eriachne pulchella subsp. *pulchella*	0.1	0.01
Euploca inexplicita	0.1	0.05
Euploca moorei	0.1	0.05
Goodenia tenuiloba	10	0.2
Hibiscus burtonii	0.1	0.05
Hibiscus sturtii	0.1	0.1
Ptilotus aervoides	0.2	0.1
Ptilotus exaltatus	0.1	0.2
Ptilotus polystachyus	0.1	0.05
Solanum lasiophyllum	0.1	0.05
Stenopetalum sp. indet	0.3	0.2

Mt Gould

Site MTG-032



Date	26/08/2022
Described by	EM & RM
Type	Quadrat 20m x 20m
Location	MGA Zone 50
	534011mE, 7146122mN
	117.3392 E, -25.802698 S
Veg Condition	Excellent
Soil	Sandy Clay Loam
Rock Type	Banded ironstone, Ironstone
Fire Age	>10 yrs
Habitat	Hillcrest/ Upper Hillslope
Vegetation	*Grevillea berryana* tall sparse shrubland over *Eremophila latrobei, Philotheca brucei* mid sparse shrubland over *Triodia melvillei* low hummock grassland

SPECIES LIST

Name	Cover	Height
Amaranthus cuspidifolius	0.1	0.2
Aristida contorta	0.1	0.1
Boerhavia coccinea	0.1	0.01
Dendrophyllanthus erwinii	0.1	0.1
Digitaria brownii	0.5	0.5
Dysphania rhadinostachya subsp. *rhadinostachya*	0.5	0.2
Dysphania saxatilis	0.1	0.2
Eremophila jucunda subsp. *jucunda*	0.5	4
Eremophila latrobei subsp. *latrobei*	5	0.8
Eriachne aristidea	0.2	0.1
Eriachne mucronata	0.5	0.3
Eriachne pulchella subsp. *pulchella*	0.2	0.05
Erodium cygnorum	0.1	0.05
Euphorbia boophthona	0.1	0.1
Goodenia tenuiloba	0.5	0.1
Grevillea berryana	10	5
Philotheca brucei subsp. *cinerea*	5	0.8
Ptilotus exaltatus	0.1	0.3
Ptilotus helipteroides	0.1	0.1
Ptilotus obovatus	1	0.3
Ptilotus polystachyus	0.1	0.3
Salsola australis	0.1	0.2
Schoenia cassiniana	0.1	0.1

Senna artemisioides subsp. *helmsii*	0.2	0.5
Sida ?sp. Dark green fruits (S. van Leeuwen 2260)	0.5	0.2
Trachymene pilbarensis	1	0.1
Trichodesma zeylanicum	0.1	1
Triodia melvillei	40	0.5

Mt Gould

Site MTG-033



Date	29/08/2022
Described by	EM & RM
Type	Quadrat 20m x 20m
Location	MGA Zone 50
	533207mE, 7145906mN
	117.3312 E, -25.804668 S
Veg Condition	Good
Soil	Sandy Clay Loam
Rock Type	Ironstone, Banded ironstone
Fire Age	>10 yrs
Habitat	Hillslope
Vegetation	*Acacia aptaneura* mid-tall open shrubland over *Eriachne aristidea, Eriachne pulchella* and *Goodenia tenuiloba* sparse tussock grassland / herbland

SPECIES LIST

Name	Cover	Height
Acacia aptaneura	25	4
Aristida holathera var. *holathera*	0.1	0.3
Arivela viscosa	0.1	0.2
Boerhavia repleta	0.1	0.01
Corchorus crozophorifolius	0.1	0.2
Dysphania rhadinostachya subsp. *rhadinostachya*	0.1	0.1
Eriachne aristidea	5	0.2
Eriachne pulchella subsp. *pulchella*	10	0.1
Goodenia tenuiloba	10	0.2
Ptilotus exaltatus	0.1	0.01
Ptilotus helipteroides	0.1	0.1
Ptilotus polystachyus	0.1	0.1
Solanum lasiophyllum	0.4	0.05
Tribulus suberosus	0.1	0.3

Mt Gould

Site MTG-034



Date	26/08/2022
Described by	EM & RM
Type	Quadrat 20m x 20m
Location	MGA Zone 50
	533891mE, 7145893mN
	117.3380 E, -25.804771 S
Veg Condition	Very Good
Soil	Sandy Clay Loam
Rock Type	Ironstone, Banded ironstone
Fire Age	>10 yrs
Habitat	Hillcrest/ Upper Hillslope
Vegetation	*Acacia citrinoviridis* tall open shrubland over *Eremophila latrobei* mid sparse shrubland over *Ptilotus obovatus, Sida* sp. Golden calyces low open shrubland over *Eriachne mucronata* low tussock grassland

SPECIES LIST

Name	Cover	Height
Acacia aptaneura	1	1
Acacia citrinoviridis	30	5
Aristida contorta	0.1	0.2
Arivela viscosa	0.1	0.2
Boerhavia coccinea	0.1	0.05
Calandrinia eremaea	0.1	0.01
Calotis hispidula	0.1	0.05
Cheilanthes sieberi subsp. *sieberi*	0.1	0.1
Corchorus crozophorifolius	1	0.6
Cucumis sp. indet	0.1	0
Dendrophyllanthus erwinii	0.1	0.01
Digitaria brownii	0.1	0.5
Dysphania melanocarpa	0.1	0.01
Dysphania rhadinostachya subsp. *rhadinostachya*	0.1	0.5
Eragrostis eriopoda	1	0.3
Eremophila latrobei subsp. *latrobei*	10	1.5
Eriachne aristidea	2	0.5
Eriachne mucronata	40	0.3
Erodium cygnorum	0.5	0.2
Euploca sp. indet	0.1	0.1
Goodenia tenuiloba	10	0.5
Nicotiana occidentalis	0.1	0.5
Paspalidium clementii	0.1	0.05

Portulaca oleracea	0.1	0.01
Ptilotus aervoides	0.1	0.05
Ptilotus helipteroides	0.1	0.02
Ptilotus obovatus	5	0.5
Ptilotus polystachyus	0.5	0.5
Rhodanthe maryonii	0.1	0.01
Salsola australis	0.1	0.2
Sida sp. Golden calyces glabrous (H.N. Foote 32)	5	0.4
Solanum lasiophyllum	0.1	0.1
Taplinia saxatilis	0.5	0.2
Trachymene pilbarensis	0.1	0.2

Mt Gould

Site MTG-035



Date	29/08/2022
Described by	EM & RM
Type	Quadrat 20m x 20m
Location	MGA Zone 50
	534756mE, 7145638mN
	117.3467 E, -25.807051 S
Veg Condition	Good
Soil	Sandy Clay Loam
Rock Type	Ironstone, Chert, Quartz
Fire Age	>10 yrs
Habitat	Sandy/ Stony Plain
Vegetation	*Acacia aptaneura* mid-tall sparse shrubland over *Eragrostis setifolia, Aristida holathera* low sparse tussock grassland

SPECIES LIST

Name	Cover	Height
Abutilon otocarpum	0.1	0.1
Acacia aptaneura	5	4
Aristida contorta	0.5	0.2
Aristida holathera var. *holathera*	2	0.4
Corchorus crozophorifolius	0.1	0.2
Digitaria brownii	0.1	0.3
Eragrostis eriopoda	4	0.4
Eriachne aristidea	0.1	0.3
Eriachne pulchella subsp. *pulchella*	0.1	0.1
Euphorbia boophthona	0.1	0.1
Euploca inexplicita	0.1	0.1
Goodenia tenuiloba	0.5	0.2
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	0.1	0.22
Hibiscus burtonii	0.1	0.5
Monachather paradoxus	0.1	0.3
Ptilotus exaltatus	0.1	0.1
Ptilotus polystachyus	0.2	0.6
Salsola australis	0.1	0.1
Sida aff. intricata	0.1	0.1
Sida aff. sp. dark green fruits (S. van Leeuwen 2260)	0.1	0.3
Solanum lasiophyllum	0.1	0.2

Mt Gould

Site MTG-036



Date	29/08/2022
Described by	EM & RM
Type	Quadrat 20m x 20m
Location	MGA Zone 50
	532418mE, 7145753mN
	117.3233 E, -25.806065 S
Veg Condition	Very Good
Soil	Clay Loam
Rock Type	None Discernible
Fire Age	>10 yrs
Habitat	Claypan
Vegetation	*Senna artemisioides* mid isolated shrubs over *Aristida contorta* isolated clumps of tussock grasses over *Goodenia tenuiloba* isolated herbs

SPECIES LIST

Name	Cover	Height
Aristida contorta	1	0.2
Calandrinia sp. indet	0.1	0.1
Eriachne pulchella subsp. *pulchella*	0.1	0.1
Euploca inexplicita	0.1	0.1
Goodenia glabrata	0.1	0.1
Goodenia tenuiloba	0.5	0.3
Hakea loreus subsp. *loreus*	0.2	1.2
Rhodanthe chlorocephala subsp. *splendida*	0.1	0.1
Rhodanthe sphaerocephala (P1)	0.1	0.1
Roepera sp. indet	0.1	0.1
Salsola australis	0.1	0.1
Sclerolaena diacantha	0.1	0.1
Senna artemisioides subsp. *helmsii*	0.5	1.2
Sida platycalyx	0.1	0.1
Tribulus astrocarpus	0.1	0.1

Mt Gould

Site MTG-037



Date	26/08/2022
Described by	CW & BM
Type	Quadrat 20m x 20m
Location	MGA Zone 50 533130mE, 7145663mN 117.3305 E, -25.806862 S
Veg Condition	Excellent
Soil	Sandy Clay Loam
Rock Type	Banded ironstone
Fire Age	>10 yrs
Habitat	Hillslope
Vegetation	*Acacia fuscaneura* tall sparse shrubland over *Eremophila latrobei* mid sparse shrubland over *Goodenia tenuiloba* low isolated clumps of herbs.

SPECIES LIST

Name	Cover	Height
Acacia aptaneura	7	3.5
Aristida contorta	0.1	0.3
Eragrostis eriopoda	0.1	0.3
Eremophila latrobei subsp. *latrobei*	1.5	1.8
Eriachne pulchella subsp. *pulchella*	0.1	0.1
Goodenia tenuiloba	1.5	0.25
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743) (P1)	0.2	0.5
Ptilotus helipteroides	0.1	0.2
Ptilotus polystachyus	0.1	0.3
Ptilotus sp. indet 1	0.3	0.35
Ptilotus sp. indet 2	0.1	0.4
Sida sp. Golden calyces glabrous (H.N. Foote 32)	0.1	0.3
Tribulus suberosus	0.5	0.6

Mt Gould

Site MTG-038



Date	28/08/2022
Described by	EM & RM
Type	Quadrat 20m x 20m
Location	MGA Zone 50
	533017mE, 7145467mN
	117.3293 E, -25.808632 S
Veg Condition	Good
Soil	Clay Loam
Rock Type	None Discernible
Fire Age	>10 yrs
Habitat	Drainage Area/ Floodplain
Vegetation	*Acacia aptaneura* tall sparse shrubland over *Senna artemisioides, Eremophila fraseri* mid sparse shrubland over *Aristida contorta* low tussock grassland with *Goodenia tenuiloba, Trachymene pilbarensis* open herbland

SPECIES LIST

Name	Cover	Height
Abutilon fraseri	0.1	0.2
Acacia aptaneura	15	12.5
Acacia kempeana	0.1	1.3
Acacia rhodophloia x *kempeana*	2	3.5
Aristida holathera var. *holathera*	0.2	0.5
Brunonia australis	0.1	0.3
Calandrinia eremaea	0.1	0.1
Calandrinia ptychosperma	0.2	0.1
Calandrinia stagnensis	0.1	0.1
Calocephalus multiflorus	0.1	0.1
Calotis hispidula	0.1	0.2
Corchorus crozophorifolius	0.1	0.3
Dendrophyllanthus erwinii	0.1	0.1
Digitaria brownii	0.1	0.5
Dysphania rhadinostachya subsp. *rhadinostachya*	0.1	0.2
Enneapogon caerulescens	0.1	0.3
Eremophila fraseri	1	0.8
Eriachne pulchella subsp. *pulchella*	0.1	0.1
Euphorbia drummondii	0.1	0.1
Euploca inexplicita	0.1	0.1
Goodenia berardiana	2	0.4
Goodenia glabrata	0.5	0.3
Hakea loreus subsp. *loreus*	0.1	4

Haloragis trigonocarpa	0.1	0.1
Ipomoea calobra	0.1	0
Leichhardtia australis	0.1	0
Myriocephalus rudallii	0.1	0.1
Nicotiana cavicola	0.1	0.4
Polygala glaucifolia	0.1	0.1
Portulaca oleracea	0.1	0.1
Psydrax rigidula	0.1	1.3
Ptilotus aervoides	0.1	0.1
Ptilotus gaudichaudii	0.1	0.3
Ptilotus helipteroides	0.1	0.2
Ptilotus xerophilus	0.1	0.4
Rhodanthe charsleyae	0.1	0.4
Rhodanthe maryonii	0.2	0.2
Salsola australis	0.1	0.2
Senna artemisioides subsp. *helmsii*	2	3
Solanum lasiophyllum	0.2	0.6
Swainsona pterostylis	0.1	0.4
Wahlenbergia tumidifructa	0.1	0.3

Mt Gould

Site MTG-040



Date	27/08/2022
Described by	CW & BM
Type	Quadrat 20m x 20m
Location	MGA Zone 50
	533861mE, 7146065mN
	117.3377 E, -25.803214 S
Veg Condition	Excellent
Soil	Clayey Sand
Rock Type	Banded ironstone, Ironstone
Fire Age	5-10 yrs
Habitat	Hillcrest/ Upper Hillslope
Vegetation	*Grevillea berryana, Hakea loreus* tall, isolated shrubs over *Eremophila glutinosa* low isolated shrubs over *Triodia melvillei* low open hummock grassland

SPECIES LIST

Name	Cover	Height
Aristida contorta	0.1	0.1
Aristida holathera var. *holathera*	0.1	0.4
Dendrophyllanthus erwinii	0.1	0.1
Dysphania rhadinostachya subsp. *rhadinostachya*	0.1	0.1
Eragrostis eriopoda	0.1	0.4
Eremophila glutinosa	0.1	0.4
Eriachne aristidea	0.1	0.3
Eriachne mucronata	1	0.1
Eriachne pulchella subsp. *pulchella*	0.1	0.2
Euphorbia australis var. *australis*	0.1	0.1
Goodenia tenuiloba	0.1	0.4
Grevillea berryana	0.25	2.5
Hakea loreus subsp. *loreus*	0.25	2.8
Hibiscus burtonii	0.1	0.2
Ptilotus polystachyus	0.1	0.4
Senna artemisioides subsp. *helmsii*	0.1	0.1
Solanum lasiophyllum	0.1	0.5
Trachymene pilbarensis	0.1	0.3
Trichodesma zeylanicum	0.1	0.1
Triodia melvillei	18	0.4

Mt Gould

Site MTG-041



Date	27/08/2022
Described by	EM & RM
Type	Quadrat 20m x 20m
Location	MGA Zone 50
	533207mE, 7147333mN
	117.3312 E, -25.791777 S
Veg Condition	Very Good
Soil	Sandy Loam
Rock Type	None Discernible
Fire Age	>10 yrs
Habitat	Drainage Area/ Floodplain
Vegetation	*Acacia ramulosa* tall open shrubland over *Eremophila forrestii* mid sparse shrubland over *Aristida holathera, Eriachne aristidea* low open tussock grassland over *Goodenia tenuiloba* sparse herbland

SPECIES LIST

Name	Cover	Height
Abutilon lepidum	0.1	0.05
Acacia fuscaneura	5	6
Acacia kempeana	5	4
Acacia ramulosa var. *ramulosa*	25	3.5
Acacia tetragonophylla	0.5	3
Aristida contorta	0.5	0.2
Aristida holathera var. *holathera*	10	0.1
Calandrinia stagnensis	0.5	0.1
Calotis multicaulis	1	0.2
Dendrophyllanthus erwinii	0.1	0.05
Dysphania rhadinostachya subsp. *rhadinostachya*	0.1	0.2
Eremophila forrestii subsp. *forrestii*	5	2
Eriachne aristidea	10	0.4
Eriachne helmsii	0.1	0.6
Erodium cygnorum	0.1	0.4
Euphorbia drummondii	0.1	0.005
Euploca moorei	0.1	0.05
Goodenia tenuiloba	5	0.6
Helipterum craspedioides	0.1	0.3
Indigofera monophylla	0.1	0.3
Ipomoea calobra	0.1	0.05
Nicotiana cavicola	0.1	0.3
Portulaca oleracea	0.1	0.05

Ptilotus aervoides	0.1	0.01
Ptilotus obovatus	0.1	0.4
Ptilotus polystachyus	0.2	0.6
Sida aff. intricata	0.5	0.1
Sida platycalyx	1	0.3
Sida sp. indet	0.1	0.01
Solanum lasiophyllum	0.5	0.7
Trachymene pilbarensis	0.1	0.3
Tribulus astrocarpus	0.1	0.01
Trichodesma zeylanicum	1	0.8

Mt Gould

Site MTG-043



Date	29/08/2022
Described by	EM & RM
Type	Quadrat 20m x 20m
Location	MGA Zone 50
	533440mE, 7145467mN
	117.3335 E, -25.808621 S
Veg Condition	Very Good
Soil	Sandy Clay Loam
Rock Type	Banded ironstone
Fire Age	>10 yrs
Habitat	Hillcrest/ Upper Hillslope
Vegetation	*Acacia citrinoviridis, Acacia rhodophloia* tall sparse shrubland over *Ptilotus polystachyus, Eremophila latrobei* sparse mid shrubland over *Goodenia tenuiloba* sparse herbland

SPECIES LIST

Name	Cover	Height
Acacia citrinoviridis	15	7.5
Acacia rhodophloia	1	2
Calandrinia ? polyandra	0.1	0.1
Calandrinia eremaea	0.1	0.1
Cuscuta epithymum	0.1	0.1
Dodonaea petiolaris	0.1	1.3
Eremophila latrobei subsp. *latrobei*	2	1.5
Eriachne aristidea	0.1	0.2
Eriachne helmsii	0.1	0.6
Eriachne pulchella subsp. *pulchella*	0.2	0.1
Euploca moorei	0.1	0.1
Goodenia tenuiloba	2	0.3
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743) (P1)	0.1	0.2
Hibiscus burtonii	0.1	0.4
Paspalidium clementii	0.1	0.3
Ptilotus helipteroides	0.1	0.2
Ptilotus obovatus	0.2	0.4
Ptilotus polystachyus	0.5	0.6
Sida sp. Golden calyces glabrous (H.N. Foote 32)	2	0.3
Taplinia saxatilis	0.1	0.1
Tribulus suberosus	0.1	0.4

Mt Gould

Site MTG-048



Date	29/08/2022
Described by	CW & BM
Type	Quadrat 20m x 20m
Location	MGA Zone 50
	534115mE, 7145165mN
	117.3403 E, -25.811333 S
Veg Condition	Very Good
Soil	Loamy Sand
Rock Type	None Discernible
Fire Age	>10 yrs
Habitat	Sand Plain
Vegetation	*Acacia kempeana, Acacia ramulosa* tall sparse shrubland over *Eremophila forrestii, Ptilotus obovatus* low sparse shrubland over *Eriachne aristidae, Aristida holathera, Aristida contorta* low sparse tussock grassland over *Ptilotus polystachyus, Ptilotus chamaecladus* low sparse herbland

SPECIES LIST

Name	Cover	Height
Abutilon otocarpum	0.1	0.6
Abutilon oxycarpum subsp. Prostrate (A.A. Mitchell PRP1266)	0.1	0.1
Acacia kempeana	2	3
Acacia ramulosa var. *ramulosa*	4	4.3
Aristida contorta	0.1	0.25
Aristida holathera var. *holathera*	3	0.6
Arivela viscosa	0.1	0.4
Calandrinia ? polyandra	0.1	0.12
Calotis hispidula	0.1	0.05
**Cenchrus ciliaris*	0.1	0.4
Corchorus crozophorifolius	0.1	1.2
Dysphania melanocarpa	0.1	0.1
Dysphania rhadinostachya subsp. *rhadinostachya*	0.1	0.1
Eragrostis lanipes	2	0.45
Eremophila forrestii subsp. *forrestii*	1	1.4
Eriachne aristidea	3	0.4
Eriachne helmsii	0.1	0.6
Euphorbia drummondii	0.1	0.3
Goodenia tenuiloba	0.1	0.4
Helipterum craspedioides	0.1	0.12
Ipomoea calobra	0.1	1

Monachather paradoxus	0.1	0.5
Nicotiana cavicola	0.1	0.4
Panicum australiense var. *australiense*	0.1	0.05
Ptilotus chamaecladus	0.1	0.1
Ptilotus exaltatus	0.1	0.3
Ptilotus obovatus	0.1	0.45
Ptilotus polystachyus	1	0.6
Rhodanthe maryonii	0.1	0.1
Salsola australis	0.1	0.3
Senna artemisioides subsp. *helmsii*	0.1	0.25
Sida aff. *intricata*	0.1	0.1
Solanum lasiophyllum	0.1	0.5
Swainsona beasleyana	0.1	0.15
Tetragonia cristata	0.1	0.1
Tribulus astrocarpus	0.1	0.1
Tribulus forrestii	0.1	0.1
Trichodesma zeylanicum	0.1	0.8

Mt Gould

Site MTG-049



Date	29/08/2022
Described by	CW & BM
Type	Quadrat 20m x 20m
Location	MGA Zone 50
	533966mE, 7145464mN
	117.3388 E, -25.808641 S
Veg Condition	Good
Soil	Sand
Rock Type	Chert, Ironstone, Granite
Fire Age	5-10 yrs
Habitat	Hillslope
Vegetation	*Acacia incurvaneura* tall sparse shrubland over *Ptilotus obovatus* low isolated shrubs over *Goodenia tenuiloba* low sparse herbland

SPECIES LIST

Name	Cover	Height
Acacia incurvaneura	4	3
Aristida contorta	0.1	0.2
Eragrostis eriopoda	0.1	0.3
Eriachne aristidea	0.1	0.2
Eriachne helmsii	0.1	0.4
Goodenia tenuiloba	1	0.3
Nicotiana occidentalis	0.1	0.2
Paspalidium clementii	0.1	0.1
Ptilotus exaltatus	0.1	0.2
Ptilotus obovatus	0.1	0.2
Ptilotus polystachyus	0.1	0.2
Sida sp. Golden calyces glabrous (H.N. Foote 32)	0.1	0.4
Solanum ashbyae	0.1	0.5
Solanum lasiophyllum	0.1	0.1

Mt Gould

Site MTG-051



Date	27/08/2022
Described by	EM & RM
Type	Quadrat 20m x 20m
Location	MGA Zone 50
	535086mE, 7149263mN
	117.3499 E, -25.774307 S
Veg Condition	Very Good
Soil	Sandy Clay Loam
Rock Type	Quartz, Ironstone, Chert
Fire Age	>10 yrs
Habitat	Stony Plain
Vegetation	*Acacia kempeana* mid isolated shrubs over *Eremophila exilifolia, Eremophila fraseri* low sparse shrubland over *Aristida contorta* low open tussock grassland

SPECIES LIST

Name	Cover	Height
Acacia kempeana	1.5	1.3
Aristida contorta	15	0.3
Calandrinia monosperma	0.1	0.1
Calandrinia stagnensis	0.5	0.1
Eremophila exilifolia	4	1.2
Eremophila fraseri subsp. *fraseri*	0.2	1.1
Eriachne aristidea	0.1	0.5
Eriachne pulchella subsp. *pulchella*	0.1	0.1
Euphorbia boophthona	1	0.2
Euploca heterantha	0.1	0.1
Goodenia tenuiloba	0.1	0.2
Grevillea berryana	0.1	0.3
Hibiscus burtonii	0.1	0.2
Monachather paradoxus	0.1	0.6
Portulaca oleracea	0.1	0.1
Ptilotus polystachyus	0.1	0.3
Senna glaucifolia	0.1	0.4
Solanum lasiophyllum	0.1	0.1
Tribulus adelacanthus	0.1	0.1

Mt Gould

Site MTGR-014



Date	29/08/2022
Described by	EM & RM
Type	Relevé
Location	MGA Zone 50
	534337mE, 7147932mN
	117.3424 E, -25.786346 S
Veg Condition	Good
Soil	Sandy Clay Loam
Rock Type	Chert, Ironstone, Quartz
Fire Age	>10 yrs
Habitat	Footslope
Vegetation	*Grevillea berryana* isolated tall shrubs over Acacia rhodophloia mid open shrubland over *Eremophila fraseri* low isolated shrubs

SPECIES LIST

Name	Cover	Height
Acacia aptaneura	0.1	4
Acacia cuthbertsonii subsp. *cuthbertsonii*	0.1	1.2
Acacia demissa	0.1	2
Acacia rhodophloia	0.1	2.2
Aristida contorta	0.1	0.2
Eremophila fraseri	0.1	1.2
Eremophila jucunda subsp. *jucunda*	0.1	1.2
Goodenia tenuiloba	0.1	0.1
Grevillea berryana	0.1	2
Ptilotus obovatus	0.1	0.4
Ptilotus rotundifolius	0.1	0.6
Senna artemisioides subsp. *helmsii*	0.1	1.8
Solanum lasiophyllum	0.1	0.4

Mt Gould

Site MTGR-028



Date	29/08/2022
Described by	CW & BM
Type	Relevé
Location	MGA Zone 50 53542mE, 7146612mN 117.3533 E, -25.798240 S
Veg Condition	Excellent
Soil	Sand
Rock Type	Chert, Granite, Quartz, Ironstone
Fire Age	5-10 yrs
Habitat	Hillslope
Vegetation	*Acacia rhodophloia, Acacia pteraneura* tall sparse shrubland over *Ptilotus obovatus* low sparse shrubland over *Aristida contorta* low isolated tussock grasses

SPECIES LIST

Name	Cover	Height
Acacia pteraneura	0.1	4
Acacia rhodophloia	0.1	2.2
Aristida contorta	0.1	0.3
Eremophila fraseri subsp. *parva*	0.1	1.2
Eriachne aristidea	0.1	0.3
Goodenia tenuiloba	0.1	0.1
Ptilotus obovatus	0.1	0.4
Sida sp. dark green fruits (S. van Leeuwen 2260)	0.1	0.4

Mt Gould

Site MTGR-042



Date	29/08/2022
Described by	EM & RM
Type	Relevé
Location	MGA Zone 50 533207mE, 7145553mN 117.3312 E, -25.807855 S
Veg Condition	Good
Soil	Sandy Loam
Rock Type	Ironstone
Fire Age	>10 yrs
Habitat	Sandy/ Stony Plain
Vegetation	*Acacia ramulosa* mid sparse shrubland over *Ptilotus polystachyus* low isolated shrubs over *Aristida holathera, Aristida contorta, Eriachne aristidea* low sparse tussock grassland

SPECIES LIST

Name	Cover	Height
Abutilon otocarpum	0.1	0.4
Acacia aptaneura	0.1	4
Acacia ramulosa var. *ramulosa*	0.1	2
Aristida contorta	0.1	0.2
Aristida holathera var. *holathera*	0.1	0.1
Corchorus crozophorifolius	0.1	1
Eriachne aristidea	0.1	0.3
Goodenia tenuiloba	0.1	0.1
Ptilotus chamaecladus	0.1	0.3
Ptilotus polystachyus	0.1	0.5
Salsola australis	0.1	0.3
Solanum lasiophyllum	0.1	0.4

Mt Gould

Site MTGR-044



Date	28/08/2022
Described by	CW & BM
Type	Relevé
Location	MGA Zone 50 534401 mE, 7146859mN 117.3431 E, -25.796035 S
Veg Condition	Excellent
Soil	Sandy Clay Loam
Rock Type	Ironstone
Fire Age	>10 yrs
Habitat	Boulders/ Rockpiles
Vegetation	*Ptilotus obovatus, Eremophila warnesii, Philotheca brucei* low sparse shrubland over *Digitaria brownii, Triodia melvillei* low sparse tussock/hummock grassland

SPECIES LIST

Name	Cover	Height
Abutilon oxycarpum subsp. Prostrate (A.A. Mitchell PRP1266)	0.1	0.3
Digitaria brownii	0.1	0.3
Eremophila warnesii (P1)	1	0.3
Glycine canescens	0.1	0.1
Olearia stuartii	0.1	1
Philotheca brucei subsp. *cinerea*	1	0.6
Ptilotus obovatus	1	0.6
Triodia melvillei	1	0.5

Mt Gould

Site MTGR-045



Date	29/08/2022
Described by	EM & RM
Type	Relevé
Location	MGA Zone 50 534311mE, 7147233mN 117.3422 E, -25.792656 S
Veg Condition	Very Good
Soil	Sandy Clay Loam
Rock Type	Ironstone, Granite
Fire Age	>10 yrs
Habitat	Hillslope
Vegetation	*Acacia incurvaneura* tall open shrubland over *Eremophila lachnocalyx* mid open shrubland

SPECIES LIST

Name	Cover	Height
Acacia aptaneura	0.1	4
Eremophila lachnocalyx	1.2	2
Maireana georgei	5	0.4
Scaevola spinescens	0.1	1

Mt Gould

Site MTGR-046



Date	28/08/2022
Described by	CW
Type	Relevé
Location	MGA Zone 50 534191mE, 7146871mN 117.3410 E, -25.795930 S
Veg Condition	Excellent
Soil	Sandy Clay Loam
Rock Type	Ironstone, Granite
Fire Age	
Habitat	Hillslope
Vegetation	*Grevillea berryana, Acacia aptaneura* tall, isolated shrubs over *Ptilotus obovatus* low sparse shrubland over *Aristida contorta* low isolated tussock grasses

SPECIES LIST

Name

Acacia aptaneura

Acacia rhodophloia

Aristida contorta

Goodenia tenuiloba

Grevillea berryana

Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743) (P1)

Ptilotus obovatus

Appendix D: Site by species matrix

Taxon	MTG-001	MTG-002	MTG-003	MTG-004	MTG-005	MTG-006	MTG-007	MTG-008	MTG-009	MTG-010	MTG-011	MTG-012	MTG-013	MTG-015	MTG-016	MTG-017	MTG-018	MTG-019	MTG-020	MTG-021	MTG-022	MTG-023	MTG-024	MTG-025	MTG-026
Abutilon cryptopetalum					1		1														1				
Abutilon fraseri																									
Abutilon lepidum														1					1		1			1	1
Abutilon otocarpum																								1	
Abutilon oxycarpum subsp. Prostrate (A.A. Mitchell PRP1266)						1	1							1	1									1	1
Acacia ?cuthbertsonii																						1			
Acacia aneura		1		1																					
Acacia aptaneura	1	1			1	1								1	1				1	1	1		1	1	1
Acacia ayersiana					1																				
Acacia citrinoviridis																									
Acacia cuthbertsonii subsp. *cuthbertsonii*					1			1		1															
Acacia demissa	1		1																						
Acacia fuscaneura				1				1										1							
Acacia incurvaneura										1		1													
Acacia kempeana																	1								
Acacia macraneura																									
Acacia pruinocarpa			1		1		1																		
Acacia pteraneura			1				1				1						1					1			
Acacia ramulosa var. *ramulosa*					1								1				1								
Acacia rhodophloia	1		1	1		1	1		1					1	1			1	1	1					
Acacia rhodophloia x *kempeana*																									
Acacia tetragonophylla	1	1						1				1				1									
Acacia thomae					1																				
Amaranthus cuspidifolius								1																1	1
Aristida contorta	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1		1	1	1	1	1
Aristida holathera var. *holathera*		1	1		1	1							1				1					1	1		
Arivela viscosa							1							1	1				1	1	1			1	1
Atriplex codonocarpa																					1				
Boerhavia coccinea	1																							1	1
Boerhavia repleta																									
Boerhavia sp. indet				1	1	1	1										1				1				
Boraginaceae sp. indet											1														
Brunonia australis													1												
Bulbostylis barbata		1																							
Calandrinia ?polyandra																									
Calandrinia eremaea	1			1	1																			1	
Calandrinia monosperma		1	1					1			1	1													
Calandrinia ptychosperma																									
Calandrinia schistorhiza				1	1																				
Calandrinia sp. indet																	1								
Calandrinia stagnensis		1							1																
Calocephalus beardii	1																								
Calocephalus francisii																									
Calocephalus multiflorus																									
Calotis hispidula					1	1	1																		
Calotis multicaulis																									
Cenchrus ciliaris					1								1												
Cheilanthes brownii						1								1											
Cheilanthes sieberi subsp. *sieberi*																								1	
Chenopodiaceae sp. indet							1																		
Citrullus amarus																			1						
Corchorus crozophorifolius															1		1		1	1	1	1	1	1	1
Cucumis myriocarpus subsp. *myriocarpus*																									1
Cucumis sp. indet																									
Cuscuta epithymum																									
Cuscuta planiflora					1																				
Cymbopogon ambiguus																								1	
Dendrophyllanthus erwinii					1	1								1	1				1		1			1	1
Digitaria brownii					1		1							1					1			1	1	1	1
Digitaria ctenantha					1																				
Dodonaea pachyneura																								1	
Dodonaea petiolaris						1									1										
Dysphania melanocarpa					1	1	1												1		1			1	1
Dysphania rhadinostachya subsp. *rhadinostachya*					1	1	1							1	1				1	1				1	1
Dysphania saxatilis																									
Enneapogon caerulescens			1			1	1	1						1					1		1			1	1
Enneapogon polyphyllus																					1				
Eragrostis eriopoda										1					1		1	1				1	1		
Eragrostis lanipes																									
Eragrostis pergracilis							1									1					1				
Eragrostis setifolia					1		1																		
Eremophila ?forrestii																									
Eremophila exilifolia								1																	
Eremophila forrestii subsp. *forrestii*		1											1				1								

Taxon	MTG-027	MTG-029	MTG-030	MTG-031	MTG-032	MTG-033	MTG-034	MTG-035	MTG-036	MTG-037	MTG-038	MTG-040	MTG-041	MTG-043	MTG-048	MTG-049	MTG-051	MTGR-014	MTGR-028	MTGR-042	MTGR-044	MTGR-045	MTGR-046	Opps
Abutilon cryptopetalum																								
Abutilon fraseri											1													
Abutilon lepidum													1											
Abutilon otocarpum								1							1					1				
Abutilon oxycarpum subsp. Prostrate (A.A. Mitchell PRP1266)															1						1			
Acacia ?cuthbertsonii																								
Acacia aneura																								
Acacia aptaneura		1	1			1	1	1		1	1							1		1		1	1	
Acacia ayersiana																								
Acacia citrinoviridis							1							1										
Acacia cuthbertsonii subsp. *cuthbertsonii*																		1						1
Acacia demissa																		1						1
Acacia fuscaneura													1											
Acacia incurvaneura																1								
Acacia kempeana											1		1		1		1							
Acacia macraneura																								1
Acacia pruinocarpa																								1
Acacia pteraneura	1																		1					
Acacia ramulosa var. *ramulosa*			1										1		1					1				1
Acacia rhodophloia	1	1		1										1				1	1				1	
Acacia rhodophloia x *kempeana*											1													
Acacia tetragonophylla													1											
Acacia thomae																								
Amaranthus cuspidifolius					1																			
Aristida contorta	1	1	1	1	1		1	1	1	1		1	1		1	1	1	1	1	1			1	
Aristida holathera var. *holathera*	1		1	1		1		1			1	1	1		1					1				1
Arivela viscosa	1			1		1	1								1									
Atriplex codonocarpa																								
Boerhavia coccinea					1		1																	
Boerhavia repleta						1																		
Boerhavia sp. indet																								
Boraginaceae sp. indet																								
Brunonia australis											1													1
Bulbostylis barbata																								
Calandrinia ?polyandra														1	1									
Calandrinia eremaea							1				1			1										
Calandrinia monosperma				1													1							
Calandrinia ptychosperma											1													
Calandrinia schistorhiza																								1
Calandrinia sp. indet									1															
Calandrinia stagnensis											1		1				1							
Calocephalus beardii																								
Calocephalus francisii																								1
Calocephalus multiflorus											1													
Calotis hispidula							1				1				1									
Calotis multicaulis													1											
Cenchrus ciliaris															1									
Cheilanthes brownii																								
Cheilanthes sieberi subsp. *sieberi*							1																	
Chenopodiaceae sp. indet																								
Citrullus amarus																								
Corchorus crozophorifolius	1		1	1		1	1	1			1				1					1				1
Cucumis myriocarpus subsp. *myriocarpus*																								
Cucumis sp. indet							1																	
Cuscuta epithymum														1										
Cuscuta planiflora																								
Cymbopogon ambiguus																								
Dendrophyllanthus erwinii					1		1				1	1	1											
Digitaria brownii			1	1	1		1	1			1										1			
Digitaria ctenantha																								
Dodonaea pachyneura																								1
Dodonaea petiolaris														1										
Dysphania melanocarpa							1								1									
Dysphania rhadinostachya subsp. *rhadinostachya*			1		1	1	1				1	1	1		1									
Dysphania saxatilis					1																			
Enneapogon caerulescens											1													
Enneapogon polyphyllus																								
Eragrostis eriopoda	1	1					1	1		1		1				1								
Eragrostis lanipes															1									
Eragrostis pergracilis																								
Eragrostis setifolia																								
Eremophila ?forrestii																								1
Eremophila exilifolia																	1							1
Eremophila forrestii subsp. *forrestii*			1										1		1									

Taxon	MTG-001	MTG-002	MTG-003	MTG-004	MTG-005	MTG-006	MTG-007	MTG-008	MTG-009	MTG-010	MTG-011	MTG-012	MTG-013	MTG-015	MTG-016	MTG-017	MTG-018	MTG-019	MTG-020	MTG-021	MTG-022	MTG-023	MTG-024	MTG-025	MTG-026
Eremophila fraseri					1																				
Eremophila fraseri subsp. *fraseri*									1		1											1			
Eremophila fraseri subsp. *parva*																									
Eremophila glutinosa					1										1			1							
Eremophila jucunda subsp. *jucunda*																									
Eremophila lachnocalyx																									
Eremophila latrobei subsp. *latrobei*		1	1		1	1		1						1				1	1	1				1	
Eremophila macmillaniana											1	1													
Eremophila maitlandii																									
Eremophila phyllopoda subsp. *phyllopoda*				1	1		1																		
Eremophila warnesii														1											1
Eriachne aristidea	1	1			1	1	1	1					1	1	1	1	1		1		1	1	1		
Eriachne helmsii		1			1		1								1										
Eriachne mucronata																								1	
Eriachne pulchella					1														1		1				1
Eriachne pulchella subsp. *pulchella*		1					1	1	1			1		1	1	1		1						1	
Eriochloa ?pseudoacrotricha																							1		
Erodium cygnorum						1	1																	1	
Euphorbia australis var. *australis*																									
Euphorbia australis var. *subtomentosa*																					1				
Euphorbia boophthona		1			1	1	1		1			1			1				1					1	
Euphorbia drummondii							1															1	1		
Euphorbia sp. indet			1																						
Euploca heterantha								1	1																
Euploca inexplicita											1			1	1				1			1			
Euploca moorei					1										1										
Euploca sp. indet						1																			
Glycine canescens					1																				
Goodenia berardiana																									
Goodenia glabrata																									
Goodenia tenuiloba	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Goodenia triodiophila									1																
Grevillea berryana	1			1		1									1										
Grevillea striata																			1						
Hakea loreus subsp. *loreus*																									
Hakea preissii								1																	
Hakea recurva subsp. *arida*																									
Halgania gustafsenii var. *gustafsenii*																									
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)							1											1	1						
Haloragis trigonocarpa								1											1						
Heliotropium ammophilum																									
Helipterum craspedioides					1		1												1						
Hibiscus burtonii			1		1		1								1			1					1		
Hibiscus sp. Gardneri (A.L. Payne PRP 1435)							1																		
Hibiscus sturtii																									
Hibiscus sturtii var. *forrestii*									1																
Indigofera monophylla								1							1										
Ipomoea calobra		1			1			1					1												
Iseilema dolichotrichum																			1		1				1
Leichhardtia australis	1				1	1		1	1																
Lepidium echinatum																1									
Lepidium oxytrichum						1													1		1			1	1
Lepidium platypetalum																									
Maireana carnosa																1									
Maireana georgei																									
Maireana planifolia																			1		1				
Monachather paradoxus	1	1			1		1						1									1	1		
Muelleranthus trifoliolatus																									
Myriocephalus rudallii																									
Nicotiana cavicola																									
Nicotiana occidentalis							1																		
Nicotiana rosulata					1														1					1	1
Olearia stuartii																									
Panicum australiense var. *australiense*																									
Paspalidium basicladum														1						1	1				
Paspalidium clementii					1	1	1	1											1		1			1	1
Paspalidium sp. indet	1																								
Philotheca brucei subsp. *cinerea*															1				1						
Poaceae sp. indet 1											1					1									
Poaceae sp. indet 2																						1	1		
Poaceae sp. indet 3											1														

Taxon	MTG-027	MTG-029	MTG-030	MTG-031	MTG-032	MTG-033	MTG-034	MTG-035	MTG-036	MTG-037	MTG-038	MTG-040	MTG-041	MTG-043	MTG-048	MTG-049	MTG-051	MTGR-014	MTGR-028	MTGR-042	MTGR-044	MTGR-045	MTGR-046	Opps
Eremophila fraseri											1							1						
Eremophila fraseri subsp. *fraseri*																	1							
Eremophila fraseri subsp. *parva*																			1					
Eremophila glutinosa		1										1												1
Eremophila jucunda subsp. *jucunda*					1													1						
Eremophila lachnocalyx																						1		1
Eremophila latrobei subsp. *latrobei*	1				1		1			1				1										
Eremophila macmillaniana																								
Eremophila maitlandii																								1
Eremophila phyllopoda subsp. *phyllopoda*																								
Eremophila warnesii																					1			1
Eriachne aristidea	1		1	1	1	1	1	1				1	1	1	1	1	1		1	1				
Eriachne helmsii			1										1	1	1	1								
Eriachne mucronata					1		1					1												
Eriachne pulchella																								
Eriachne pulchella subsp. *pulchella*			1	1	1	1		1	1	1	1	1		1			1							1
Eriochloa ?pseudoacrotricha																								
Erodium cygnorum					1		1						1											
Euphorbia australis var. *australis*												1												1
Euphorbia australis var. *subtomentosa*																								
Euphorbia boophthona					1			1									1							
Euphorbia drummondii											1		1		1									
Euphorbia sp. indet																								
Euploca heterantha																	1							
Euploca inexplicita				1				1	1		1													
Euploca moorei	1			1									1	1										
Euploca sp. indet							1																	
Glycine canescens																					1			
Goodenia berardiana											1													1
Goodenia glabrata									1		1													
Goodenia tenuiloba	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1			1	
Goodenia triodiophila																								
Grevillea berryana					1							1					1	1					1	1
Grevillea striata																								
Hakea loreus subsp. *loreus*									1		1	1												
Hakea preissii																								1
Hakea recurva subsp. *arida*																								1
Halgania gustafsenii var. *gustafsenii*																								1
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)		1						1		1				1									1	1
Haloragis trigonocarpa											1													
Heliotropium ammophilum																								1
Helipterum craspedioides													1		1									
Hibiscus burtonii	1			1				1				1		1			1							
Hibiscus sp. Gardneri (A.L. Payne PRP 1435)																								
Hibiscus sturtii				1																				
Hibiscus sturtii var. *forrestii*			1																					
Indigofera monophylla													1											1
Ipomoea calobra			1								1		1		1									
Iseilema dolichotrichum																								
Leichhardtia australis											1													
Lepidium echinatum																								
Lepidium oxytrichum																								
Lepidium platypetalum																								1
Maireana carnosa																								1
Maireana georgei																						1		
Maireana planifolia																								
Monachather paradoxus			1					1							1		1							
Muelleranthus trifoliolatus																								1
Myriocephalus rudallii											1													
Nicotiana cavicola											1		1		1									
Nicotiana occidentalis							1									1								
Nicotiana rosulata																								
Olearia stuartii																					1			
Panicum australiense var. *australiense*															1									
Paspalidium basicladum																								
Paspalidium clementii							1							1		1								
Paspalidium sp. indet																								
Philotheca brucei subsp. *cinerea*					1																1			
Poaceae sp. indet 1																								
Poaceae sp. indet 2																								
Poaceae sp. indet 3																								

Taxon	MTG-001	MTG-002	MTG-003	MTG-004	MTG-005	MTG-006	MTG-007	MTG-008	MTG-009	MTG-010	MTG-011	MTG-012	MTG-013	MTG-015	MTG-016	MTG-017	MTG-018	MTG-019	MTG-020	MTG-021	MTG-022	MTG-023	MTG-024	MTG-025	MTG-026
Poaceae sp. indet 4																									1
Poaceae sp. indet 5																									1
Polygala glaucifolia					1																				
Portulaca oleracea	1				1	1	1					1					1		1		1			1	1
Portulaca sp. indet											1														
Psydrax latifolia		1						1																	
Psydrax rigidula					1																				
Psydrax suaveolens								1																	
Ptilotus aervoides			1					1			1			1					1	1					
Ptilotus chamaecladus						1	1																	1	1
Ptilotus exaltatus			1	1	1		1	1						1					1	1	1				1
Ptilotus gaudichaudii																					1				
Ptilotus helipteroides			1			1	1	1			1	1		1		1		1	1				1		1
Ptilotus obovatus					1	1		1			1			1				1	1	1	1	1		1	1
Ptilotus polystachyus					1	1	1					1	1	1	1	1	1	1		1	1	1	1	1	1
Ptilotus rotundifolius			1	1							1	1													
Ptilotus schwartzii																1									
Ptilotus sp. indet											1	1					1								
Ptilotus sp. Indet 1																									
Ptilotus sp. Indet 2																									
Ptilotus xerophilus																			1		1				1
Rhodanthe charsleyae																									
Rhodanthe chlorocephala subsp. *splendida*																									
Rhodanthe forrestii																									
Rhodanthe maryonii														1					1		1			1	
Rhodanthe sphaerocephala																									
Roebuckiella cheilocarpa var. *cheilocarpa*																									
Roepera sp. indet																1									
Rumex vesicarius																					1				
Salsola australis	1	1	1		1	1	1	1				1		1							1	1		1	1
Scaevola spinescens																									
Schoenia cassiniana																									
Sclerolaena diacantha																									
Sclerolaena eriacantha																					1				
Senna artemisioides subsp. *helmsii*	1	1		1	1		1	1										1				1			1
Senna glaucifolia	1						1		1																
Senna glutinosa subsp. x *luerssenii*																									
Senna sp. Meekatharra (E. Bailey 1-26)											1					1									
Senna stricta			1																						
Setaria sp. indet					1																				
Setaria verticillata													1												
Sida ?sp. Dark green fruits (S. van Leeuwen 2260)			1												1										
Sida aff. *intricata*		1											1												
Sida aff. sp. dark green fruits (S. van Leeuwen 2260)						1	1				1														
Sida aff. sp. spiciform panicles (E. Leyland s.n. 14/8/90)																			1						
Sida ectogama		1																			1			1	
Sida platycalyx																						1			
Sida sp. dark green fruits (S. van Leeuwen 2260)								1										1	1		1				
Sida sp. Golden calyces glabrous (H.N. Foote 32)															1				1	1				1	
Sida sp. indet																									
Sida sp. spiciform panicles (E. Leyland s.n. 14/8/90)																									1
Solanum ashbyae						1									1				1					1	1
Solanum lasiophyllum	1	1			1		1	1	1		1		1	1	1		1	1	1	1	1		1	1	1
Stenopetalum ?*anfractum*											1														
Stenopetalum anfractum	1	1							1							1						1	1		
Stenopetalum sp. indet																									
Streptoglossa liatroides																					1				1
Swainsona beasleyana																									
Swainsona pterostylis																									
Taplinia saxatilis																								1	
Tephrosia sphaerospora																									
Tetragonia cristata																									
Thysanotus manglesianus																			1						
Trachymene pilbarensis					1	1											1							1	
Trianthema glossostigmum																1									
Tribulus adelacanthus			1	1				1						1				1							
Tribulus astrocarpus							1									1							1		
Tribulus forrestii																	1								

Taxon	MTG-027	MTG-029	MTG-030	MTG-031	MTG-032	MTG-033	MTG-034	MTG-035	MTG-036	MTG-037	MTG-038	MTG-040	MTG-041	MTG-043	MTG-048	MTG-049	MTG-051	MTGR-014	MTGR-028	MTGR-042	MTGR-044	MTGR-045	MTGR-046	Opps
Poaceae sp. indet 4																								
Poaceae sp. indet 5																								
Polygala glaucifolia											1													
Portulaca oleracea		1	1				1				1		1				1							
Portulaca sp. indet																								
Psydrax latifolia																								1
Psydrax rigidula											1													1
Psydrax suaveolens																								
Ptilotus aervoides				1			1				1		1											1
Ptilotus chamaecladus															1					1				1
Ptilotus exaltatus		1		1	1	1		1							1	1								
Ptilotus gaudichaudii											1													
Ptilotus helipteroides					1	1	1			1	1			1										1
Ptilotus obovatus	1	1			1		1						1	1	1	1		1	1		1		1	1
Ptilotus polystachyus			1	1	1	1	1	1		1		1	1	1	1	1	1			1				1
Ptilotus rotundifolius																		1						
Ptilotus schwartzii		1																						
Ptilotus sp. indet																								
Ptilotus sp. Indet 1										1														
Ptilotus sp. Indet 2										1														
Ptilotus xerophilus											1													
Rhodanthe charsleyae											1													1
Rhodanthe chlorocephala subsp. *splendida*									1															1
Rhodanthe forrestii																								1
Rhodanthe maryonii							1				1				1									
Rhodanthe sphaerocephala									1															1
Roebuckiella cheilocarpa var. *cheilocarpa*																								1
Roepera sp. indet									1															
Rumex vesicarius																								
Salsola australis					1		1	1	1		1				1					1				
Scaevola spinescens																						1		
Schoenia cassiniana					1																			
Sclerolaena diacantha									1															
Sclerolaena eriacantha																								1
Senna artemisioides subsp. *helmsii*			1		1				1		1	1			1			1						
Senna glaucifolia																	1							
Senna glutinosa subsp. x *luerssenii*																								1
Senna sp. Meekatharra (E. Bailey 1-26)																								
Senna stricta																								
Setaria sp. indet																								
Setaria verticillata																								
Sida ?sp. Dark green fruits (S. van Leeuwen 2260)					1																			
Sida aff. *intricata*								1					1		1									
Sida aff. sp. dark green fruits (S. van Leeuwen 2260)								1																
Sida aff. sp. spiciform panicles (E. Leyland s.n. 14/8/90)																								
Sida ectogama																								
Sida platycalyx			1						1				1											
Sida sp. dark green fruits (S. van Leeuwen 2260)	1	1																	1					
Sida sp. Golden calyces glabrous (H.N. Foote 32)	1						1			1				1		1								
Sida sp. indet													1											
Sida sp. spiciform panicles (E. Leyland s.n. 14/8/90)																								1
Solanum ashbyae	1	1														1								1
Solanum lasiophyllum		1	1	1		1	1	1			1	1	1		1	1	1	1		1				
Stenopetalum ?anfractum																								
Stenopetalum anfractum																								
Stenopetalum sp. indet				1																				
Streptoglossa liatroides																								1
Swainsona beasleyana															1									
Swainsona pterostylis											1													1
Taplinia saxatilis							1							1										
Tephrosia sphaerospora																								1
Tetragonia cristata															1									1
Thysanotus manglesianus																								
Trachymene pilbarensis	1				1		1					1	1											
Trianthema glossostigmum																								
Tribulus adelacanthus	1																1							1
Tribulus astrocarpus			1						1				1		1									
Tribulus forrestii															1									

Taxon	MTG-001	MTG-002	MTG-003	MTG-004	MTG-005	MTG-006	MTG-007	MTG-008	MTG-009	MTG-010	MTG-011	MTG-012	MTG-013	MTG-015	MTG-016	MTG-017	MTG-018	MTG-019	MTG-020	MTG-021	MTG-022	MTG-023	MTG-024	MTG-025	MTG-026
Tribulus suberosus						1									1										
Tribulus terrestris						1																			
Trichodesma zeylanicum					1								1		1										
Triodia melvillei																								1	
Tripogonella loliiformis											1														
Wahlenbergia tumidifructa																									

Taxon	MTG-027	MTG-029	MTG-030	MTG-031	MTG-032	MTG-033	MTG-034	MTG-035	MTG-036	MTG-037	MTG-038	MTG-040	MTG-041	MTG-043	MTG-048	MTG-049	MTG-051	MTGR-014	MTGR-028	MTGR-042	MTGR-044	MTGR-045	MTGR-046	Opps
Tribulus suberosus						1				1				1										1
Tribulus terrestris																								
Trichodesma zeylanicum					1							1	1		1									1
Triodia melvillei					1							1									1			
Tripogonella loliiformis		1																						
Wahlenbergia tumidifructa											1													1

Appendix E: Vegetation structural definition

NVIS Vegetation Structural Classifications

Cover Characteristics							
Foliage cover *	70-100	30-70	10-30	<10	≈0	0-5	unknown
Crown cover **	>80	50-80	20-50	0.25-20	<0.25	0-5	unknown
% Crown cover ***	>80	50-80	20-50	0.25-20	<0.25	0-5	unknown
Cover code	d	c	i	r	bi	bc	unknown

Growth Form	Height ranges (m)	Structural Formation Classes						
tree, palm	>30 Tall 10-30 Mid <10 Low	closed forest	open forest	woodland	open woodland	isolated trees	isolated clumps of trees	trees
tree mallee	10-30 Tall <10 Mid <3 Low	closed mallee forest	open mallee forest	mallee woodland	open mallee woodland	isolated mallee trees	isolated clumps of mallee trees	mallee trees
shrub, cycad, grass-tree, fern	>2 Tall 1-2 Mid <1 Low	closed shrubland	shrubland	open shrubland	sparse shrubland	isolated shrubs	isolated clumps of shrubs	shrubs
mallee shrub	10-30 Tall <10 Mid <3 Low	closed mallee shrubland	mallee shrubland	open mallee shrubland	sparse mallee shrubland	isolated mallee shrubs	isolated clumps of mallee shrubs	mallee shrubs

Growth Form	Height ranges (m)	Structural Formation Classes						
heath shrub	>2 Tall 1-2 Mid <1 Low	closed heathland	heathland	open heathland	sparse heathland	isolated heath shrubs	isolated clumps of heath shrubs	heath shrubs
chenopod shrub	>2 Tall 1-2 Mid <1 Low	closed chenopod shrubland	chenopod shrubland	open chenopod shrubland	sparse chenopod shrubland	isolated chenopod shrubs	isolated clumps of chenopod shrubs	chenopod shrubs
samphire shrub	>0.5 Low <0.5 Low	closed samphire shrubland	samphire shrubland	open samphire shrubland	sparse samphire shrubland	isolated samphire shrubs	isolated clumps of samphire shrubs	samphire shrubs
hummock grass	>2 Tall <2 Tall	closed hummock grassland	hummock grassland	open hummock grassland	sparse hummock grassland	isolated hummock grasses	isolated clumps of hummock grasses	hummock grasses
tussock grass	>0.5 Mid <0.5 Low	closed tussock grassland	tussock grassland	open tussock grassland	sparse tussock grassland	isolated tussock grasses	isolated clumps of tussock grasses	tussock grasses
other grass	>0.5 Mid <0.5 Low	closed grassland	grassland	open grassland	sparse grassland	isolated grasses	isolated clumps of grasses	other grasses
sedge	>0.5 Mid <0.5 Low	closed sedgeland	sedgeland	open sedgeland	sparse sedgeland	isolated sedges	isolated clumps of sedges	sedges
rush	>0.5 Mid <0.5 Low	closed rushland	rushland	open rushland	sparse rushland	isolated rushes	isolated clumps of rushes	rushes
forb	>0.5 Mid <0.5 Low	closed forbland	forbland	open forbland	sparse forbland	isolated forbs	isolated clumps of forbs	forbs

Growth Form	Height ranges (m)	Structural Formation Classes						
fern	>2 Tall	closed fernland	fernland	open fernland	sparse fernland	isolated ferns	isolated clumpsof ferns	ferns
	1-2 Tall							
	<1 Low							
bryophyte	<0.5	closed bryophyte land	bryophyte land	open bryophyte land	sparse bryophyte land	isolated bryophytes	isolated clumps of bryophytes	bryophytes
lichen	<0.5	closed lichenland	lichenland	open lichenland	sparse lichenland	isolated lichens	isolated clumps of lichens	lichens
vine	>30 Tall	closed vineland	vineland	open vineland	sparse vineland	isolated vines	isolated clumps of vines	vines
	10-30 Med							
	<10 Low							
aquatic	<1 Tall	closed aquatic bed	aquatic bed	open aquatic bed	sparse aquatics	isolated aquatics	isolated clumps of aquatics	aquatics
	0-0.5 Low							
seagrass	<1 Tall	closed seagrass bed	Seagrass bed	open seagrass bed	sparse seagrass bed	isolated seagrasses	isolated clumps of seagrasses	seagrasses
	0-0.5 Low							

From: NVIS Structural Formation Terminology (Australian Vegetation Attribute Manual Version 7.0 November 2017 https://www.environment.gov.au/land/publications/australian-vegetation-attribute-manual-version-7)

* Foliage Cover is defined for each stratum as 'the proportion of the ground, which would be shaded if sunshine came from directly overhead'. It includes branches and leaves and is obtained by multiplying Crown Cover with Crown type (Hnatiuk *et al.*, 2009). It is applied to a stratum in a plot, rather than an individual crown, with the NVIS measure for a vegetation type ideally being a summary of several plots. Foliage Projective Cover, which considers only the vertical projection of photosynthetic components (generally leaves), can be measured by line interception methods for tree, shrub and ground layer vegetation (Specht & Specht, 1999).

** Crown Cover (canopy cover) as per Hnatiuk *et al.* (2009). Although relationships between this attribute and Foliage Cover are dependent on season, species, species age etc., the crown cover category classes have been adopted as the defining measure.

*** The percentage cover is defined as the percentage of a strictly defined plot area, covered by vegetation. This can be an estimate and is a less precise measure than using, for example, a point intercept transect method on ground layer, or overstorey vegetative cover. That is, for precisely measured values (e.g. crown densitometer or point intercept transects) the value measured would be 'foliage' cover. Where less precise or qualitative measures are used these will most probably be recorded as 'percentage' cover.

Appendix F: Vegetation condition rating scale

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

Appendix G: Reconciled species list

Non-reconciled taxon	Reconciled taxon
Abutilon cryptopetalum	*Abutilon cryptopetalum*
Abutilon fraseri	*Abutilon fraseri*
Abutilon lepidum	*Abutilon lepidum*
Abutilon otocarpum	*Abutilon otocarpum*
Abutilon oxycarpum subsp. Prostrate (A.A. Mitchell PRP 1266)	*Abutilon oxycarpum* subsp. Prostrate (A.A. Mitchell PRP 1266)
Acacia ?cuthbertsonii	*Acacia cuthbertsonii*
Acacia aneura	*Acacia aneura*
Acacia aptaneura	*Acacia aptaneura*
Acacia ayersiana	*Acacia ayersiana*
Acacia citrinoviridis	*Acacia citrinoviridis*
Acacia cuthbertsonii subsp. *cuthbertsonii*	*Acacia cuthbertsonii*
Acacia demissa	*Acacia demissa*
Acacia fuscaneura	*Acacia fuscaneura*
Acacia incurvaneura	*Acacia incurvaneura*
Acacia kempeana	*Acacia kempeana*
Acacia pruinocarpa	*Acacia pruinocarpa*
Acacia pteraneura	*Acacia pteraneura*
Acacia ramulosa var. *ramulosa*	*Acacia ramulosa* var. *ramulosa*
Acacia rhodophloia	*Acacia rhodophloia*
Acacia rhodophloia x *kempeana*	*Acacia rhodophloia*
Acacia tetragonophylla	*Acacia tetragonophylla*
Acacia thomae	*Acacia thomae*
Amaranthus cuspidifolius	*Amaranthus cuspidifolius*
Aristida contorta	*Aristida contorta*
Aristida holathera var. *holathera*	*Aristida holathera* var. *holathera*
Arivela viscosa	*Arivela viscosa*
Atriplex codonocarpa	*Atriplex codonocarpa*
Boerhavia coccinea	*Boerhavia coccinea*
Boerhavia repleta	*Boerhavia repleta*
Boerhavia sp. indet	*Boerhavia* sp. indet
Boraginaceae sp. indet	Removed
Brunonia australis	*Brunonia australis*
Bulbostylis barbata	*Bulbostylis barbata*
Calandrinia ?polyandra	*Calandrinia ?polyandra*
Calandrinia eremaea	*Calandrinia eremaea*
Calandrinia monosperma	*Calandrinia monosperma*
Calandrinia ptychosperma	*Calandrinia ptychosperma*
Calandrinia schistorhiza	*Calandrinia schistorhiza*
Calandrinia sp. indet	*Calandrinia* sp. indet
Calandrinia stagnensis	*Calandrinia stagnensis*
Calocephalus beardii	*Calocephalus beardii*
Calocephalus multiflorus	*Calocephalus multiflorus*
Calotis hispidula	*Calotis hispidula*

Non-reconciled taxon	Reconciled taxon
Calotis multicaulis	*Calotis multicaulis*
Cenchrus ciliaris	*Cenchrus ciliaris*
Cheilanthes brownii	*Cheilanthes brownii*
Cheilanthes sieberi subsp. *sieberi*	*Cheilanthes sieberi* subsp. *sieberi*
Chenopodiaceae sp. indet	Removed
Citrullus amarus	*Citrullus amarus*
Corchorus crozophorifolius	*Corchorus crozophorifolius*
Cucumis myriocarpus subsp. *myriocarpus*	*Cucumis myriocarpus* subsp. *myriocarpus*
Cucumis sp. indet	*Cucumis* sp. indet
Cuscuta epithymum	*Cuscuta epithymum*
Cuscuta planiflora	*Cuscuta planiflora*
Cymbopogon ambiguus	*Cymbopogon ambiguus*
Dendrophyllanthus erwinii	*Dendrophyllanthus erwinii*
Digitaria brownii	*Digitaria brownii*
Digitaria ctenantha	*Digitaria ctenantha*
Dodonaea pachyneura	*Dodonaea pachyneura*
Dodonaea petiolaris	*Dodonaea petiolaris*
Dysphania melanocarpa	*Dysphania melanocarpa*
Dysphania rhadinostachya subsp. *rhadinostachya*	*Dysphania rhadinostachya* subsp. *rhadinostachya*
Dysphania saxatilis	*Dysphania saxatilis*
Enneapogon caerulescens	*Enneapogon caerulescens*
Enneapogon polyphyllus	*Enneapogon polyphyllus*
Eragrostis eriopoda	*Eragrostis eriopoda*
Eragrostis lanipes	*Eragrostis lanipes*
Eragrostis pergracilis	*Eragrostis pergracilis*
Eragrostis setifolia	*Eragrostis setifolia*
Eremophila exilifolia	*Eremophila exilifolia*
Eremophila forrestii subsp. *forrestii*	*Eremophila forrestii*
Eremophila fraseri	*Eremophila fraseri*
Eremophila fraseri subsp. *fraseri*	*Eremophila fraseri*
Eremophila fraseri subsp. *parva*	*Eremophila fraseri*
Eremophila glutinosa	*Eremophila glutinosa*
Eremophila jucunda subsp. *jucunda*	*Eremophila jucunda* subsp. *jucunda*
Eremophila lachnocalyx	*Eremophila lachnocalyx*
Eremophila latrobei subsp. *latrobei*	*Eremophila latrobei* subsp. *latrobei*
Eremophila phyllopoda subsp. *phyllopoda*	*Eremophila phyllopoda* subsp. *phyllopoda*
Eremophila warnesii	*Eremophila warnesii*
Eremophila macmillaniana	*Eremophila macmillaniana*
Eriachne aristidea	*Eriachne aristidea*
Eriachne helmsii	*Eriachne helmsii*
Eriachne mucronata	*Eriachne mucronata*
Eriachne pulchella	*Eriachne pulchella*
Eriachne pulchella subsp. *pulchella*	*Eriachne pulchella*
Eriochloa ?pseudoacrotricha	*Eriochloa ?pseudoacrotricha*

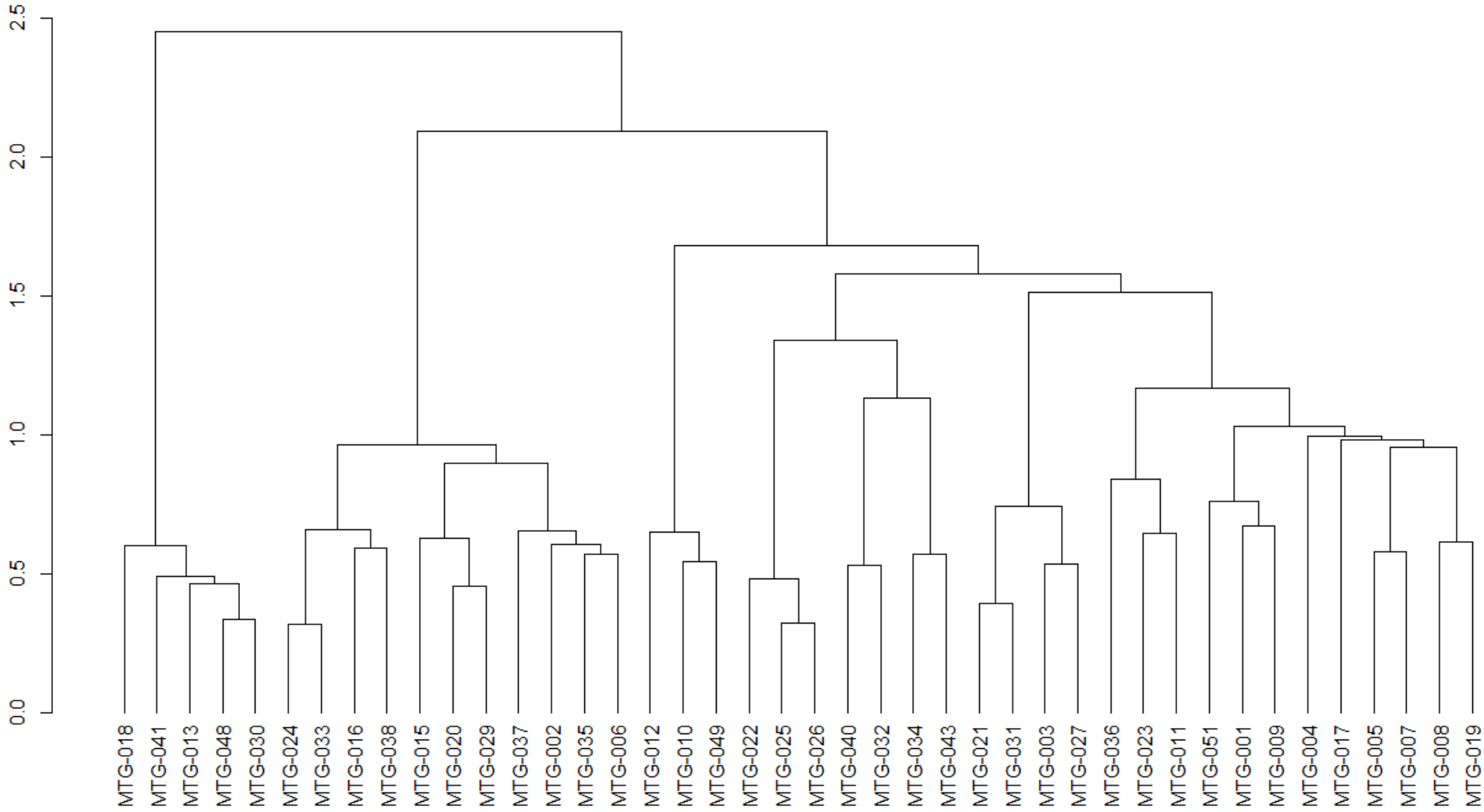
Non-reconciled taxon	Reconciled taxon
Erodium cygnorum	*Erodium cygnorum*
Euphorbia australis var. *australis*	*Euphorbia australis*
Euphorbia australis var. *subtomentosa*	*Euphorbia australis*
Euphorbia boophthona	*Euphorbia boophthona*
Euphorbia drummondii	*Euphorbia drummondii*
Euphorbia sp. indet	*Euphorbia* sp. indet
Euploca heterantha	*Euploca heterantha*
Euploca inexplicita	*Euploca inexplicita*
Euploca moorei	*Euploca moorei*
Euploca sp. indet	*Euploca* sp. indet
Glycine canescens	*Glycine canescens*
Goodenia berardiana	*Goodenia berardiana*
Goodenia glabrata	*Goodenia glabrata*
Goodenia tenuiloba	*Goodenia tenuiloba*
Goodenia triodiophila	*Goodenia triodiophila*
Grevillea berryana	*Grevillea berryana*
Grevillea striata	*Grevillea striata*
Hakea loreus subsp. *loreus*	*Hakea loreus* subsp. *loreus*
Hakea preissii	*Hakea preissii*
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	*Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743)
Haloragis trigonocarpa	*Haloragis trigonocarpa*
Helipterum craspedioides	*Helipterum craspedioides*
Hibiscus burtonii	*Hibiscus burtonii*
Hibiscus sp. Gardneri (A.L. Payne PRP 1435)	*Hibiscus* sp. Gardneri (A.L. Payne PRP 1435)
Hibiscus sturtii	*Hibiscus sturtii*
Hibiscus sturtii var. *forrestii*	*Hibiscus sturtii*
Indigofera monophylla	*Indigofera monophylla*
Ipomoea calobra	*Ipomoea calobra*
Iseilema dolichotrichum	*Iseilema dolichotrichum*
Leichhardtia australis	*Leichhardtia australis*
Lepidium echinatum	*Lepidium echinatum*
Lepidium oxytrichum	*Lepidium oxytrichum*
Maireana carnosa	*Maireana carnosa*
Maireana georgei	*Maireana georgei*
Maireana planifolia	*Maireana planifolia*
Monachather paradoxus	*Monachather paradoxus*
Myriocephalus rudallii	*Myriocephalus rudallii*
Nicotiana cavicola	*Nicotiana cavicola*
Nicotiana occidentalis	*Nicotiana occidentalis*
Nicotiana rosulata	*Nicotiana rosulata*
Olearia stuartii	*Olearia stuartii*
Panicum australiense var. *australiense*	*Panicum australiense* var. *australiense*
Paspalidium basicladum	*Paspalidium basicladum*

Non-reconciled taxon	Reconciled taxon
Paspalidium clementii	*Paspalidium clementii*
Paspalidium sp. indet	*Paspalidium* sp. indet
Philotheca brucei subsp. *cinerea*	*Philotheca brucei* subsp. *cinerea*
Poaceae sp. indet. 1	Removed
Poaceae sp. indet. 2	Removed
Poaceae sp. indet. 3	Removed
Poaceae sp. indet. 4	Removed
Poaceae sp. indet. 5	Removed
Polygala glaucifolia	*Polygala glaucifolia*
Portulaca oleracea	*Portulaca oleracea*
Portulaca sp. indet	*Portulaca* sp. indet
Psydrax latifolia	*Psydrax latifolia*
Psydrax rigidula	*Psydrax rigidula*
Psydrax suaveolens	*Psydrax suaveolens*
Ptilotus aervoides	*Ptilotus aervoides*
Ptilotus chamaecladus	*Ptilotus chamaecladus*
Ptilotus exaltatus	*Ptilotus exaltatus*
Ptilotus gaudichaudii	*Ptilotus gaudichaudii*
Ptilotus helipteroides	*Ptilotus helipteroides*
Ptilotus obovatus	*Ptilotus obovatus*
Ptilotus polystachyus	*Ptilotus polystachyus*
Ptilotus rotundifolius	*Ptilotus rotundifolius*
Ptilotus schwartzii	*Ptilotus schwartzii*
Ptilotus sp. indet	*Ptilotus* sp. indet
Ptilotus sp. indet 1	*Ptilotus* sp. indet
Ptilotus sp. indet 2	Removed
Ptilotus xerophilus	*Ptilotus xerophilus*
Rhodanthe charsleyae	*Rhodanthe charsleyae*
Rhodanthe chlorocephala subsp. *splendida*	*Rhodanthe chlorocephala* subsp. *splendida*
Rhodanthe maryonii	*Rhodanthe maryonii*
Rhodanthe sphaerocephala	*Rhodanthe sphaerocephala*
Roepera sp. indet	*Roepera* sp. indet
Rumex vesicarius	*Rumex vesicarius*
Salsola australis	*Salsola australis*
Scaevola spinescens	*Scaevola spinescens*
Schoenia cassiniana	*Schoenia cassiniana*
Sclerolaena diacantha	*Sclerolaena diacantha*
Sclerolaena eriacantha	*Sclerolaena eriacantha*
Senna artemisioides subsp. *helmsii*	*Senna artemisioides* subsp. *helmsii*
Senna glaucifolia	*Senna glaucifolia*
Senna stricta	*Senna stricta*
Senna sp. Meekatharra (E. Bailey 1-26)	*Senna* sp. Meekatharra (E. Bailey 1-26)
Setaria sp. indet	*Setaria* sp. indet
Setaria verticillata	*Setaria verticillata*

Non-reconciled taxon	Reconciled taxon
Sida ?sp. dark green fruits (S. van Leeuwen 2260)	*Sida* sp. dark green fruits (S.van Leeuwen 2260)
Sida aff. *intricata*	*Sida* aff. *intricata*
Sida aff. sp. dark green fruits (S. van Leeuwen 2260)	*Sida* sp. dark green fruits (S.van Leeuwen 2260)
Sida aff. sp. spiciform panicles (E. Leyland s.n. 14/8/90)	*Sida* sp. spiciform panicles (E. Leyland s.n. 14/8/90)
Sida ectogama	*Sida ectogama*
Sida platycalyx	*Sida platycalyx*
Sida sp. dark green fruits (S.van Leeuwen 2260)	*Sida* sp. dark green fruits (S.van Leeuwen 2260)
Sida sp. Golden calyces glabrous (H.N. Foote 32)	*Sida* sp. Golden calyces glabrous (H.N. Foote 32)
Sida sp. indet	*Sida* sp. indet
Sida sp. spiciform panicles (E. Leyland s.n. 14/8/90)	*Sida* sp. spiciform panicles (E. Leyland s.n. 14/8/90)
Solanum lasiophyllum	*Solanum lasiophyllum*
Solanum ashbyae	*Solanum ashbyae*
Stenopetalum ?anfractum	*Stenopetalum anfractum*
Stenopetalum anfractum	*Stenopetalum anfractum*
Stenopetalum sp. indet	*Stenopetalum* sp. indet
Streptoglossa liatroides	*Streptoglossa liatroides*
Swainsona beasleyana	*Swainsona beasleyana*
Swainsona pterostylis	*Swainsona pterostylis*
Taplinia saxatilis	*Taplinia saxatilis*
Tetragonia cristata	*Tetragonia cristata*
Thysanotus manglesianus	*Thysanotus manglesianus*
Trachymene pilbarensis	*Trachymene pilbarensis*
Trianthema glossostigmum	*Trianthema glossostigmum*
Tribulus adelacanthus	*Tribulus adelacanthus*
Tribulus forrestii	*Tribulus forrestii*
Tribulus suberosus	*Tribulus suberosus*
Tribulus terrestris	*Tribulus terrestris*
Tribulus astrocarpus	*Tribulus astrocarpus*
Trichodesma zeylanicum	*Trichodesma zeylanicum*
Triodia melvillei	*Triodia melvillei*
Tripogonella loliiformis	*Tripogonella loliiformis*
Wahlenbergia tumidifructa	*Wahlenbergia tumidifructa*

Appendix H: Dendrogram outputs

WR. AR. T1. T2 Inc. SLPerennialsEtc



Appendix I: Significant flora assessment of occurrence

Taxon	Conservation Status			Habit and Habitat	Habitat within Survey Area	Within Current known Distribution	Distance to Nearest Record (SA1)	Distance to Nearest Record (SA2)	Likelihood Pre-Survey	Likelihood Post-Survey
	DBCA	BC Act	EPBC Act							
Eremophila warnesii	P1			Shrub, 0.07-0.5 m high. Leaves alternate, petiolate, with very thick, fine, white to pale grey tomentum. Flowers: corolla pale lilac, light purple spotted in tube below lower lip, Aug. 1 per axil, sessile. Fruit conical to ampulliform 6-7 by 3-4 mm; exocarp adhering dendritic tomentose.	Yes	Yes	Within Survey Area	0.4 Km S	Confirmed	Confirmed
Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	P1			Shrub to 1 m. Lower slopes of Mt Gould, ironstone. Sandy loam, clay soils, outcropping, can be quartz ridge. Flowers August-October; deep blue. Leaves lanceolate nerved, cuticle and peduncle sparsely hairy with sessile glands; superficially greener than the other known varieties.	Yes	Yes	Within Survey Area	Within Survey Area	Confirmed	Confirmed
Rhodanthe sphaerocephala	P1			Erect annual, herb, to 0.25 m high, with ascending branches. Fl. Oct. Clayey loam. On flats.	Yes	Yes	Within Survey Area	0.1 Km ESE	Confirmed	Confirmed
Tribulus adelacanthus	P3			Prostrate herb, plants villous; leaflet pairs 3-6; fruits 5-winged, lacking spines, 10-14 mm high. Fruits, densely pubescent between wings, lacking spines, but with hardened equivalent structures just below middle in dried condition (unknown in fresh state). Style and stigma 1.8–2.3 mm long. Hillslope, banded ironstone. Red brown shallow sandy loam soils.	Yes	Yes	Within Survey Area	Within Survey Area	Confirmed	Confirmed
Angianthus microcephalus	P2			Small decumbent or ascending compact annual, herb, up to 20 cm high. Pappus of flattened plumose bristles. Major axes 5-30(-44.5) cm long. Florets 1 per capitulum, flat capitular bracts absent or rarely 1 per capitulum. Fl. yellow, Sep to Dec; hemispherical, terminal heads. Leaves ovate/lanceolate, hairy, less than 5mm long. Sandy or clayey or loam soils. Salt swamps & pans, alluvial plain adjacent to river.	Yes	Yes	13.2 km S	13.2 Km S	Likely	Possible
Ptilotus lazaridis	P3			Herb or shrub, open, sprawling or woody climbing, to 0.6 m high. Fl. pink/red, Jul or Oct. Stems several, more or less erect, glabrous. Leaves present, 3-20 mm long, 0.5-3 mm wide,	Yes	Yes	13.2 Km S	13.2 Km S	Likely	Possible

Taxon	Conservation Status			Habit and Habitat	Habitat within Survey Area	Within Current known Distribution	Distance to Nearest Record (SA1)	Distance to Nearest Record (SA2)	Likelihood Pre-Survey	Likelihood Post-Survey
	DBCA	BC Act	EPBC Act							
				glabrous; basal rosette absent; cauline leaves alternate. Spikes pink or magenta, hemispherical, solitary, with densely arranged flowers. Bracts (2.8-)3-3.5(-4) mm long, coloured, glabrous, awned or mucronate, with a prominent midrib. Bracteoles (3.8-)4-4.5(-5) mm long, coloured, hairy, awned or mucronate, with a prominent midrib. Outer tepals 12-15(-16) mm long, not entire. Inner tepals 11.5-14.5(-15.5) mm long. Style (8-)8.5-9.2(-9.5) mm long, straight, obliquely fixed to ovary. Clay loam or clay sand. Floodplains, drainage lines						
Verticordia jamiesonii	P3			Erect Shrub. Single stemmed multi-branching, 0.2-0.6 m high. Fl. white/pink, Sep to Oct. Leaves dull green with white spots, oblong in shape, semi-circular in cross-section 1–3 mm (0.04–0.1 in) long with their edges rather translucent and irregular; calyptra red; sepals and petals cream. Sandy clay, clay, loam, skeletal soils. Breakaways and slopes. Laterite, sandstone, granite, sometimes quartz	Yes	Yes	8.4 Km ESE	8.0 Km SE	Likely	Possible
Frankenia confusa	P4			Low, diffuse shrub, to 0.75 m high, to 0.75 m wide. Leaves oblong to ovate or obovate, more or less flat. Petiolate, the petiole often winged and ciliate. Upper leaves with cordate bases. Calyx glabrous or shortly pubescent or with scattered hairs. Fl. Pale to deep pink/ white. Sep.	Yes	Yes	13.2 Km S	13.2 Km S	Likely	Possible
Acacia sp. Jack Hills (R. Meissner & Y. Caruso 4)	P1			Small tree or tall shrub 1-3 m. Multi-stemmed shrub with bright green phyllodes. Fibrous grey bark. Hilltop/ hillslope of upper BIF ranges. Outcrops, cliff summit. Red or brown skeletal sandy soil over BIF and chert. Associated species *of Acacia aneura, Eremophila phyllopoda, Eremophila margarethae, Senna glutinosa* subsp. *chatelainiana, Goodenia* spp., hummock grass of *Triodia melvillei*.	Yes	Yes	24.0 Km S	24.0 Km S	Possible	Possible

Taxon	Conservation Status			Habit and Habitat	Habitat within Survey Area	Within Current known Distribution	Distance to Nearest Record (SA1)	Distance to Nearest Record (SA2)	Likelihood Pre-Survey	Likelihood Post-Survey
	DBCA	BC Act	EPBC Act							
Eremophila margarethae subsp. straight sepals (G. Cockerton & B. McLean LCH 31310)	P1			Tall shrub to 1.5 m high x 1 m wide. Grey lanceolate leaves which have the same appearance on both sides. Small purple flowers with the typical 2 upper and 3 lower fused petals, calyx lobes are narrowly triangular to 15 mm long x 4 mm wide with dense branched hairs on both the inner and outer surfaces. Known from a single record.	Yes	Yes	27.5 Km S	27.3 Km S	Possible	Possible
Eremophila sp. Ironstone (G. Cockerton & B. McLean LCH 31311)	P1			Spreading low shrub 0.3 m high x 0.5 m wide, leaves lanceolate, serrate margins, dark green with complete cover of glossy clear resin, 5 mm wide x 12 to 1 mm long. Plant resinous but not noticeably fragrant. Flowers purple with 2 upper and 3 lower fused petals. Sepals large, leafy, 10 mm wide x 2-15 mm long, broadly triangular, undulate, entire, acuminate, centrifixed to calyx with margins connected to and extending down the pedicle. Ironstone.	Yes	Yes	27.1 Km S	26.9 Km S	Possible	Possible
Ptilotus tetrandrus	P1			Annual, herb, 0.15-0.3 m high. Fl. Oct. Stems several, more or less erect, glabrescent, with nodose hairs. Leaves present, 8-45 mm long, 1.5-5 mm wide, glabrescent, with nodose hairs; basal rosette absent; cauline leaves alternate. Spikes green or brown, cylindrical, solitary, with loosely arranged flowers. Bracts 3.5-4 mm long, coloured, glabrous, not awned or mucronate, with an obscure midrib. Bracteoles 2-2.5 mm long, colourless, glabrous, not awned or mucronate, with an obscure midrib. Outer tepals (4.5-)5.2-5.5(-6) mm long, entire. Inner tepals (4.1-)4.2-4.5(-5) mm long, with a basal tuft of hairs on inner face. Style (3.7-)4-4.5(-5) mm long, straight, obliquely fixed to ovary. Loamy sand. Swale.	Yes	Yes	23.6 Km S	23.5 Km S	Possible	Possible
Indigofera fractiflexa subsp. augustensis	P2			Shrub up to 1 m. 9 leaflets with sharp apical point. Recurved spines or stipules at nodes, long smooth, round pods, greyish brown. Stems smooth, reddish. Pink flowers. Hillcrest,	Yes	Yes	39.4 Km SSW	39.5 Km SSW	Possible	Unlikely

Taxon	Conservation Status			Habit and Habitat	Habitat within Survey Area	Within Current known Distribution	Distance to Nearest Record (SA1)	Distance to Nearest Record (SA2)	Likelihood Pre-Survey	Likelihood Post-Survey
	DBCA	BC Act	EPBC Act							
				hillslope, gully floor. Banded ironstone, sandy loam, silty loam, red sand, skeletal soil.						
Lepidium xylodes	P2			Erect woody shrub, 0.4-1.5 m high, Stem with obtuse hairs longer than wide, or the hairs acicular. Becoming spinescent. Fl. white/cream, Aug or Nov. Petals narrow, claw somewhat cucullate, not pseudo-tubular. Stamens 6. Silicula dehiscent. Floodplain or river system. Gravelly loam, clayey sand.	Yes	Yes	28.1 Km ESE	27.4 Km ESE	Possible	Possible
Calytrix praecipua	P3			Shrub, sometimes open and spreading. 0.3-0.7 m high. Leaves glandular, pungent, subangular. Calyx edges dark brown. Fl. Pink/pale purple-white, Jun to Jul or Sep to Nov. Skeletal sandy soils over granite, laterite, sandstone or weathered banded ironstone. Breakaways, outcrops, creek line.	Yes	Yes	49.8 WNW	49.7 Km WNW	Possible	Unlikely
Calytrix verruculosa	P3			Shrub, 0.4-1 m high. Leaves alternate. Stipules not prominent, less than 0.75 mm long, usually 1-paired (sometimes 2-paired in floral leaves) Stamens 1-seriate (in occasional flowers partly 2-seriate) Hypanthium more than 6 mm long, Glabrous. Apex of bracteole or cheiridium lobe acuminate to long acuminate. Anther connective prominent but apparently not restricting anther movement; branchlets minutely verrucose Fl. pink/white, Aug or Oct. Hilltop, slope, valley, hardpan plain. Sandy clay, clayey loam, sandy loam.	Yes	Adjacent	26.0 Km S	25.8 Km SSW	Possible	Possible
Hemigenia tysonii	P3			Upright shrub, to 0.8 m high. Leaves grey-green; corolla pale mauve with dull reddish spots around white throat and 2 pale yellow lines along lower side of throat. Fl. purple-blue-pink/white, May or Jul to Dec. Red sand, sandy clay, lateritic sand, gravel, red loam, banded ironstone. Flats, sand dunes, hills.	Yes	Yes	27.8 Km S	27.6 Km S	Possible	Unlikely
Hemigenia virescens	P3			Prostrate sprawling shrubs (<50 cm). Stems, cross section more or less circular. Leaves 4-6 mm long, 0.8-1 mm wide, opposite or whorled,	Yes	Yes	42.9 Km SSE	43.0 Km SSE	Possible	Unlikely

Taxon	Conservation Status			Habit and Habitat	Habitat within Survey Area	Within Current known Distribution	Distance to Nearest Record (SA1)	Distance to Nearest Record (SA2)	Likelihood Pre-Survey	Likelihood Post-Survey
	DBCA	BC Act	EPBC Act							
				entire, with dendritic, gland tipped hairs on leaves, pedicel, corolla & calyx. Margins entire. Bracts present. 3.5. mm long Pedicel present, 1-1.5 mm long, peltate scales hairs present. Calyx with five lobes, 2.5 mm long, not accrescent. Corolla white or cream or mauve, purple, lilac or violet, 13 mm long. Dots or stripes in throat present, four stamens, style 8 mm long, filament 3.5-4 mm long, anthers 1.2 mm long. Appendage present. Brown-red sand, rocky gravel. Flowering time July, August.						
Homalocalyx echinulatus	P3			Shrub, 0.45-1 m high. Sepals, persistent, 3.5-43 mm long, total length of the cheiridium 1.5-2 times the length of the lobes. Hypanthium pubescent. Fl. Pink/ magenta, Jun to Sep. Laterite or banded ironstone, sometimes with quartz and chert. Breakaways, hillslope, sandstone hills. Sandy loam, sandy clay or skeletal soils.	No	Yes	25.2 Km S	25.1 Km SSW	Possible	Unlikely
Prostanthera ferricola	P3			Erect, openly branched shrub, 0.3-1 m high. Leaves decussate, aromatic, moderately to densely hairy. Leaves 5.5–10 mm long, 1.5–2.5 mm wide; corolla 18–20 mm long, corolla tube 15–18 mm long; pistil 20–21 mm long. Flowers racemose; large, deep purple to bright mauve to white; August, late winter to early spring. Gently inclined mid to upper slopes of hills, rocky crests, outcrops Shallow red-brown skeletal sandy loam or sandy clay on banded ironstone, laterite, basalt or quartz.	Yes	Yes	27.9 Km S	27.7 Km SSW	Possible	Unlikely
Dodonaea amplisemina	P4			Dioecious, multi-stemmed shrub, 0.3-1 m high. Leaves simple, or pinnatifid, the lobes then shorter than width of lamina. Glossy sheen, usually Glabrous with a distinctive smell. Branches divaricate; sepals 4–6, margins with villose hairs 0.5 mm long; filaments 0.1–0.2 mm long; capsule (4.5)7–9.5 mm long excluding appendages, appendages 2–6 mm long; seeds	Yes	Adjacent	33.4 km SSE	33.5 Km SSE	Possible	Unlikely

Taxon	Conservation Status			Habit and Habitat	Habitat within Survey Area	Within Current known Distribution	Distance to Nearest Record (SA1)	Distance to Nearest Record (SA2)	Likelihood Pre-Survey	Likelihood Post-Survey
	DBCA	BC Act	EPBC Act							
				shiny, 3.1–3.8 mm long. Stamens 8; leaves 3–35(56) mm long, 1–13 mm wide. Three horned, brown/red capsule, 1–8 mm wide. Globose, not prominently winged. Rocky hills. Red-brown sandy clay, or clay-loam on basalt and gabbro and banded ironstone or on dolerite and quartzite.						
Goodenia berringbinensis	P4			Ascending annual, herb, 0.1-0.3 m high. Rosette of spathulate basal leaves up to 1 cm long and flower stems up to 2 cm long. Both aquatic and terrestrial leaves. Fl. Yellow with maroon centre, Oct. Drainage lines, floodplains or crabhole/ clay pan. Red sandy loam, clay over ironstone.	Yes	Yes	38.8 Km SSW	39.0 Km SSW	Possible	Unlikely
Eremophila prolata	P1			Erect shrub, 1-1.5 m high. Fl. blue-purple/red, Aug to Sep. Red stony clay. Flats & rises.	Yes	Adjacent	47.1 Km NE	43.5 NE	Unlikely	Unlikely
Stenanthemum mediale	P1			Erect low domed shrub, ca 0.35 m high, leaves entire. Fl. Apr to Aug. Red clayey sand on BIF or outcropping.	Yes	Adjacent (northern extent)	25.6 Km S	25.5 Km S	Possible	Unlikely
Eremophila petrophila subsp. densa	P3			Erect shrub, 1.3-2.2 m high. Fl. blue-purple, Aug to Sep. Stony sandy loam or clay. Flats.	Yes	Adjacent	32.5 Km NNW	30.9 Km NW	Possible	Unlikely
Maireana murrayana	P3			Erect shrub, ca 0.3 m high. Red clayey sand, dissected sandstone	Yes	Yes	62.5 Km WNW	62.9 Km WNW	Unlikely	Unlikely
Maireana prosthecochaeta	P3			Open, densely-leaved shrub, 0.3-0.6 m high. Laterite. Hills, salty places.	Yes	Yes	84.5 Km SW	80.9 Km SW	Unlikely	Highly Unlikely
Neotysonia phyllostegia	P1			Annual, herb, spreading to prostrate. Terminal globular flower heads; yellow; Sep or Nov. Little known for this taxon, last known records from 1910, two collections at the WAH. This is the only species of the genus. This genus is in the Gnaphalieae tribe of the Asteraceae family.	Unknown	No	116.0 Km SW	116.5 Km SW	Highly Unlikely	Highly Unlikely
Thysanotus fragrans	P2			Perennial herb growing in tufts, somewhat prostrate ascending. Flowers white/pale pink to purple in August - September; Leaves dull, grey/blue-green, linear channelled leaves; reddish at base. Sandplains or creek banks; sand.	Yes	No	282.8 Km SW	283.4 Km SW	Highly Unlikely	Highly Unlikely

Taxon	Conservation Status			Habit and Habitat	Habitat within Survey Area	Within Current known Distribution	Distance to Nearest Record (SA1)	Distance to Nearest Record (SA2)	Likelihood Pre-Survey	Likelihood Post-Survey
	DBCA	BC Act	EPBC Act							
Gunniopsis divisa	P3			Annual, herb, 0.05-0.1 m high. Fl. white, Aug. Loam, quartz. Roadsides.	Yes	No	43.0 Km SSW	43.2 km SSW	Highly Unlikely	Highly Unlikely
Pityrodia augustensis	T	VU	VU	Bushy shrub, ca 1 m high. Fl. purple/purple-red, Aug to Sep. Amongst rocks on slopes or in drainage lines. Considered endemic to Mt Augustus.	Yes	No	155.3 Km NW	153.8 Km NW	Highly Unlikely	Highly Unlikely

Appendix J: Database search results

Family	Taxon	Source						Conservation Status			Introduced
		NM	ALA	WAH	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
Acanthaceae	*Dicladanthera forrestii*		●								
Aizoaceae	*Gunniopsis divisa*		●	●	●			P3			
	Gunniopsis propinqua	●	●								
	Tetragonia cristata	●	●								
	Trianthema glossostigmum	●	●								
	Trianthema oxycalyptrum		●								
	Trianthema oxycalyptrum var. *oxycalyptrum*	●									
Alismataceae	*Sagittaria platyphylla*						●				Yes
Amaranthaceae	*Alternanthera angustifolia*		●								
	Alternanthera nodiflora		●								
	Amaranthus cuspidifolius	●	●								
	Amaranthus interruptus		●								
	Amaranthus mitchellii		●								
	Gomphrena verecunda	●									
	Ptilotus aervoides	●	●								
	Ptilotus chamaecladus	●	●								
	Ptilotus divaricatus		●								
	Ptilotus drummondii	●	●								
	Ptilotus eremita		●								
	Ptilotus exaltatus	●									
	Ptilotus exaltatus var. *exaltatus*	●									
	Ptilotus gaudichaudii	●	●								
	Ptilotus gaudichaudii subsp. *gaudichaudii*	●									
	Ptilotus gomphrenoides		●								
	Ptilotus helipteroides	●	●								
	Ptilotus lazaridis	●	●	●	●			P3			
	Ptilotus nobilis		●								
	Ptilotus obovatus	●	●								

Family	Taxon	Source						Conservation Status			Introduced
		NM	ALA	WAH	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	Ptilotus polystachyus	●	●								
	Ptilotus roei	●	●								
	Ptilotus rotundifolius	●	●								
	Ptilotus schwartzii	●	●								
	Ptilotus tetrandrus	●			●			P1			
	Ptilotus xerophilus		●								
Apiaceae	*Daucus glochidiatus*	●	●								
Apocynaceae	*Calotropis procera*						●				Yes
	Cryptostegia madagascariensis						●				Yes
Araceae	*Pistia stratiotes*						●				Yes
	Zantedeschia aethiopica						●				Yes
Araliaceae	*Hydrocotyle ranunculoides*						●				Yes
	Trachymene ceratocarpa	●									
	Trachymene cyanopetala		●								
	Trachymene ornata	●	●								
	Trachymene pilbarensis	●	●								
Asparagaceae	*Asparagus asparagoides*						●				Yes
	Thysanotus exfimbriatus	●	●								
	Thysanotus fragrans		●					P2			
	Thysanotus manglesianus	●	●								
	Thysanotus speckii	●	●								
Asphodelaceae	*Bulbine semibarbata*	●									
Asteraceae	*Actinobole drummondianum*	●									
	Actinobole oldfieldianum	●	●								
	Actinobole uliginosum	●	●								
	Angianthus microcephalus	●	●	●				P2			
	Angianthus milnei	●	●								
	Brachyscome ciliaris	●	●								

Family	Taxon	Source						Conservation Status			Introduced
		NM	ALA	WAH	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	Brachyscome iberidifolia	●	●								
	Calocephalus beardii	●	●								
	Calocephalus francisii	●	●								
	Calocephalus knappii		●								
	Calocephalus multiflorus	●	●								
	Calotis breviradiata		●								
	Calotis hispidula	●	●								
	Calotis multicaulis	●	●								
	Calotis plumulifera		●								
	Calotis porphyroglossa		●								
	Centipeda thespidioides		●								
	Cephalipterum drummondii		●								
	Chondrilla juncea						●				Yes
	Chthonocephalus pseudevax	●	●								
	Chthonocephalus viscosus	●									
	Dielitzia tysonii	●	●								
	Erymophyllum ramosum		●								
	Erymophyllum ramosum subsp. *ramosum*	●									
	Gnephosis arachnoidea	●	●								
	Gnephosis brevifolia	●	●								
	Gnephosis eriocarpa		●								
	Gnephosis tenuissima	●	●								
	Helipterum craspedioides	●	●								
	Hyalochlamys globifera		●								
	Hyalosperma glutinosum subsp. *venustum*	●									
	Lawrencella davenportii	●									
	Millotia perpusilla		●								
	Minuria cunninghamii	●									

Family	Taxon	Source						Conservation Status			Introduced
		NM	ALA	WAH	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	Minuria leptophylla	●	●								
	Myriocephalus oldfieldii		●								
	Myriocephalus pygmaeus	●	●								
	Myriocephalus rudallii	●	●								
	Neotysonia phyllostegia		●					P1			
	Olearia fluvialis	●	●								
	Olearia stuartii		●								
	Onopordum acaulon						●				Yes
	Pluchea dentex	●	●								
	Pluchea rubelliflora	●	●								
	Podolepis gardneri	●	●								
	Podolepis kendallii	●	●								
	Pogonolepis stricta	●	●								
	Pterocaulon sphacelatum	●	●								
	Rhodanthe battii	●	●								
	Rhodanthe charsleyae	●	●								
	Rhodanthe chlorocephala		●								
	Rhodanthe chlorocephala subsp. *splendida*	●									
	Rhodanthe citrina	●	●								
	Rhodanthe condensata		●								
	Rhodanthe floribunda	●	●								
	Rhodanthe humboldtiana		●								
	Rhodanthe maryonii	●	●								
	Rhodanthe polycephala	●	●								
	Rhodanthe propinqua	●	●								
	Rhodanthe sphaerocephala	●	●	●				P1			
	Rhodanthe sterilescens	●	●								
	Rhodanthe stricta		●								

Family	Taxon	Source						Conservation Status			Introduced
		NM	ALA	WAH	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	Roebuckiella cheilocarpa	●	●								
	Roebuckiella ciliocarpa	●	●								
	Roebuckiella cuneata	●	●								
	Roebuckiella similis		●								
	Schoenia ayersii	●									
	Schoenia cassiniana	●	●								
	Senecio glossanthus	●	●								
	Silybum marianum						●				Yes
	Streptoglossa cylindriceps		●								
	Streptoglossa liatroides	●	●								
	Taplinia saxatilis	●	●								
	Xanthium spinosum						●				Yes
	Xanthium strumarium						●				Yes
Boraginaceae	*Cynoglossum* sp. Inland Ranges (C.A. Gardner 14499)	●									
	Echium plantagineum						●				Yes
	Euploca cunninghamii	●									
	Euploca heteranthum	●	●								
	Euploca inexplicitum	●	●								
	Halgania anagalloides	●	●								
	Halgania gustafsenii		●								
	Halgania gustafsenii var. *gustafsenii*	●									
	Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743)	●		●	●			P1			
	Heliotropium ammophilum	●	●								
	Omphalolappula concava	●	●								
	Trichodesma zeylanicum	●	●								
Brassicaceae	*Cuphonotus andraeanus*		●								
	Lepidium echinatum	●	●								
	Lepidium oxytrichum	●	●								

Family	Taxon	Source						Conservation Status			Introduced
		NM	ALA	WAH	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	Lepidium xylodes	●	●	●	●			P1			
	Menkea villosula	●	●								
	Stenopetalum anfractum	●	●								
	Stenopetalum filifolium	●	●								
Cactaceae	*Austrocylindropuntia cylindrica*						●				Yes
	Austrocylindropuntia subulata						●				Yes
	Cylindropuntia fulgida						●				Yes
	Cylindropuntia imbricata						●				Yes
	Cylindropuntia kleiniae						●				Yes
	Cylindropuntia pallida						●				Yes
	Cylindropuntia tunicata						●				Yes
	Opuntia elata						●				Yes
	Opuntia elatior						●				Yes
	Opuntia engelmannii						●				Yes
	Opuntia ficus-indica						●				Yes
	Opuntia microdasys						●				Yes
	Opuntia monacantha						●				Yes
	Opuntia polyacantha						●				Yes
	Opuntia puberula						●				Yes
	Opuntia stricta						●				Yes
	Opuntia tomentosa						●				Yes
Campanulaceae	*Isotoma petraea*		●								
	Lobelia heterophylla		●								
	Lobelia heterophylla subsp. *pilbarensis*	●									
	Lobelia winfridae	●	●								
	Wahlenbergia caryophylloides	●	●								
	Wahlenbergia tumidifructa	●	●								
Caryophyllaceae	*Spergularia bocconei*	●	●								

Family	Taxon	Source						Conservation Status			Introduced
		NM	ALA	WAH	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
Celastraceae	*Stackhousia muricata*	●	●								
	Stackhousia muricata subsp. annual (W.R. Barker 2172)	●									
Centrolepidaceae	*Centrolepis cephaloformis*		●								
	Centrolepis cephaloformis subsp. *cephaloformis*	●									
	Centrolepis eremica	●	●								
Chenopodiaceae	*Atriplex amnicola*		●								
	Atriplex cinerea		●								
	Atriplex codonocarpa		●								
	Chenopodium gaudichaudianum	●	●								
	Dissocarpus paradoxus		●								
	Dysphania glandulosa		●								
	Dysphania glomulifera		●								
	Dysphania glomulifera subsp. *eremaea*	●									
	Dysphania kalpari		●								
	Dysphania melanocarpa	●	●								
	Dysphania plantaginella		●								
	Dysphania rhadinostachya	●	●								
	Dysphania rhadinostachya subsp. *inflata*	●									
	Dysphania rhadinostachya subsp. *rhadinostachya*	●									
	Eremophea spinosa		●								
	Eriochiton sclerolaenoides		●								
	Maireana amoena	●									
	Maireana carnosa	●	●								
	Maireana convexa		●								
	Maireana georgei	●	●								
	Maireana melanocoma	●	●								
	Maireana murrayana		●					P3			
	Maireana planifolia		●								

Family	Taxon	Source						Conservation Status			Introduced
		NM	ALA	WAH	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	Maireana prosthecochaeta		●					P3			
	Maireana thesioides		●								
	Maireana triptera	●	●								
	Maireana villosa	●	●								
	Rhagodia eremaea	●	●								
	Salsola australis		●								
	Sclerolaena costata		●								
	Sclerolaena cuneata		●								
	Sclerolaena eriacantha	●	●								
	Sclerolaena eurotioides	●	●								
	Sclerolaena tridens		●								
	Tecticornia indica		●								
Cleomaceae	*Areocleome oxalidea*		●								
Colchicaceae	*Wurmbea densiflora*		●								
	Wurmbea inframediana	●	●								
	Wurmbea tenella	●	●								
Collemataceae	*Collema coccophorum*		●								
Convolvulaceae	*Convolvulus clementii*	●	●								
	Cuscuta epithymum	●	●								Yes
	Cuscuta planiflora	●	●								
	Evolvulus alsinoides		●								
	Evolvulus alsinoides var. *villosicalyx*	●									
	Ipomoea calobra		●								
Crassulaceae	*Crassula colorata*		●								
	Crassula colorata var. *acuminata*	●									
Cucurbitaceae	*Coccinia grandis*						●				Yes
	Cucumis myriocarpus		●								
Cyperaceae	*Bulbostylis barbata*	●	●								

Family	Taxon	Source						Conservation Status			Introduced
		NM	ALA	WAH	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	Cyperus alterniflorus		●								
	Cyperus betchei		●								
	Cyperus betchei subsp. *commiscens*	●									
	Cyperus iria	●	●								
	Cyperus leptocarpus	●	●								
	Cyperus rigidellus	●	●								
	Cyperus vaginatus		●								
	Eleocharis pallens		●								
	Fimbristylis dichotoma		●								
	Isolepis congrua	●	●								
	Schoenoplectiella dissachantha	●	●								
	Schoenus humilis	●	●								
	Schoenus variicellae		●								
Droseraceae	*Drosera finlaysoniana*		●								
Elatinaceae	*Bergia trimera*		●								
Euphorbiaceae	*Euphorbia australis*		●								
	Euphorbia australis var. *subtomentosa*	●									
	Euphorbia boophthona	●	●								
	Euphorbia drummondii	●	●								
	Euphorbia porcata	●	●								
	Euphorbia tannensis	●	●								
	Jatropha gossypiifolia						●				Yes
Fabaceae	*Acacia aneura*	●	●								
	Acacia aptaneura	●	●								
	Acacia ayersiana		●								
	Acacia citrinoviridis	●	●								
	Acacia craspedocarpa	●	●								
	Acacia cuthbertsonii		●								

Family	Taxon	Source						Conservation Status			Introduced
		NM	ALA	WAH	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	Acacia cuthbertsonii subsp. *cuthbertsonii*	●									
	Acacia cyperophylla		●								
	Acacia cyperophylla var. *cyperophylla*	●									
	Acacia demissa	●	●								
	Acacia distans	●	●								
	Acacia fuscaneura		●								
	Acacia incurvaneura	●	●								
	Acacia kempeana	●	●								
	Acacia macraneura	●	●								
	Acacia microcalyx	●	●								
	Acacia minyura		●								
	Acacia palustris	●	●								
	Acacia pruinocarpa	●	●								
	Acacia pteraneura	●	●								
	Acacia pyrifolia		●								
	Acacia pyrifolia var. *pyrifolia*	●									
	Acacia quadrimarginea		●								
	Acacia ramulosa		●								
	Acacia ramulosa var. *linophylla*	●									
	Acacia rhodophloia	●	●								
	Acacia scleroclada		●								
	Acacia sclerosperma		●								
	Acacia sclerosperma subsp. *sclerosperma*	●									
	Acacia sibilans	●	●								
	Acacia sibirica	●	●								
	Acacia sp. Jack Hills (R. Meissner & Y. Caruso 4)	●		●	●			P1			
	Acacia synchronicia	●	●								
	Acacia tetragonophylla	●	●								

Family	Taxon	Source						Conservation Status			Introduced
		NM	ALA	WAH	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	Acacia thoma	●	●								
	Acacia tysonii	●	●								
	Acacia xiphophylla	●	●								
	Alhagi maurorum						●				Yes
	Bossiaea spinescens	●									
	Chorizema racemosum	●	●								
	Gastrolobium laytonii		●								
	Glycine canescens		●								
	Glycine sp. (R.Meissner & Y.Caruso 110)	●									
	Indigofera australis		●								
	Indigofera fractiflexa		●								
	Indigofera fractiflexa subsp. *augustensis*			●				P2			
	Indigofera monophylla		●								
	Lotus australis		●								
	Lotus cruentus		●								
	Mirbelia ramulosa		●								
	Mirbelia rhagodioides	●	●								
	Muelleranthus obovatus	●	●								
	Muelleranthus trifoliolatus	●	●								
	Parkinsonia aculeata						●				Yes
	Petalostylis labicheoides	●									
	Prosopis glandulosa						●				Yes
	Senna alata						●				Yes
	Senna artemisioides		●								
	Senna artemisioides subsp. *petiolaris x stricta*	●									
	Senna glaucifolia	●	●								
	Senna glutinosa		●								
	Senna glutinosa subsp. *chatelainiana*	●									

Family	Taxon	Source						Conservation Status			Introduced
		NM	ALA	WAH	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	Senna hamersleyensis		●								
	Senna obtusifolia						●				Yes
	Senna sp. Meekatharra (E. Bailey 1-26)	●									
	Swainsona affinis	●	●								
	Swainsona beasleyana	●	●								
	Swainsona elegans		●								
	Swainsona gracilis	●	●								
	Swainsona leeana	●									
	Swainsona oroboides	●	●								
	Swainsona pedunculata		●								
	Swainsona pterostylis	●	●								
	Swainsona rotunda		●								
	Swainsona tenuis	●									
	Trigonella suavissima		●								
	Ulex europaeus						●				Yes
	Vachellia farnesiana		●								
Frankeniaceae	*Frankenia confusa*	●	●	●	●			P4			
	Frankenia laxiflora	●									
	Frankenia setosa		●								
Funariaceae	*Funaria microstoma*		●								
	Goniomitrium enerve		●								
Geraniaceae	*Erodium cygnorum*	●	●								
Gigaspermaceae	*Gigaspermum repens*	●	●								
Goodeniaceae	*Brunonia australis*	●	●								
	Goodenia berardiana	●	●								
	Goodenia berringbinensis		●	●				P4			
	Goodenia capillosa	●	●								
	Goodenia glabrata		●								

Family	Taxon	Source						Conservation Status			Introduced
		NM	ALA	WAH	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	Goodenia havilandii	●	●								
	Goodenia lamprosperma	●	●								
	Goodenia occidentalis	●	●								
	Goodenia prostrata		●								
	Goodenia tenuiloba	●	●								
	Goodenia wilunensis		●								
	Scaevola amblyanthera		●								
	Scaevola cunninghamii	●	●								
	Scaevola spinescens	●	●								
Haloragaceae	*Haloragis trigonocarpa*	●	●								
Iridaceae	*Moraea flaccida*						●				Yes
	Moraea miniata						●				Yes
Juncaceae	*Juncus bufonius*	●	●								Yes
Juncaginaceae	*Triglochin nana*		●								
Lamiaceae	*Hemigenia tysonii*	●	●	●				P3			
	Hemigenia virescens		●	●				P3			
	Pityrodia augustensis					●		T	VU	VU	
	Prostanthera ferricola	●	●	●				P3			
	Prostanthera wilkieana	●									
	Teucrium teucriiflorum		●								
Loranthaceae	*Amyema fitzgeraldii*		●								
	Amyema nestor	●									
Lythraceae	*Ammannia multiflora*		●								
Malvaceae	*Abutilon fraseri*	●									
	Abutilon lepidum	●	●								
	Abutilon otocarpum		●								
	Abutilon oxycarpum	●	●								
	Abutilon oxycarpum subsp. Prostrate (A.A. Mitchell PRP 1266)	●									

Family	Taxon	Source						Conservation Status			Introduced
		NM	ALA	WAH	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	Corchorus crozophorifolius	●	●								
	Hibiscus burtonii		●								
	Hibiscus sp. (R.Meissner & Y.Caruso 123)	●									
	Hibiscus sturtii		●								
	Hibiscus sturtii var. *forrestii*	●									
	Lawrencia glomerata		●								
	Lawrencia sp. small fruits (Symon 2338)		●								
	Sida brownii	●	●								
	Sida ectogama	●	●								
	Sida intricata	●	●								
	Sida kingii	●									
	Sida phaeotricha		●								
	Sida sp. dark green fruits (S. van Leeuwen 2260)	●	●								
	Sida sp. Golden calyces glabrous (H.N. Foote 32)	●									
	Sida sp. spiciform panicles (E. Leyland s.n. 14/8/90)	●	●								
Marsileaceae	*Marsilea drummondii*		●								
	Marsilea mutica		●								
Montiaceae	*Calandrinia brevipedata*		●								
	Calandrinia creethiae	●	●								
	Calandrinia disperma	●	●								
	Calandrinia eremaea complex (RM & JW 2414)	●	●								
	Calandrinia monosperma	●	●								
	Calandrinia polyandra	●	●								
	Calandrinia ptychosperma	●	●								
	Calandrinia pumila		●								
	Calandrinia remota	●	●								
	Calandrinia schistorhiza		●								
	Calandrinia translucens	●	●								

Family	Taxon	Source						Conservation Status			Introduced
		NM	ALA	WAH	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
Myrtaceae	*Aluta aspera*		●								
	Aluta aspera subsp. *hesperia*	●									
	Calytrix amethystina	●	●								
	Calytrix desolata	●	●								
	Calytrix praecipua		●	●				P3			
	Calytrix verruculosa	●	●	●	●			P3			
	Corymbia lenziana		●								
	Eucalyptus victrix		●								
	Homalocalyx echinulatus	●	●	●				P3			
	Melaleuca glomerata		●								
	Pileanthus peduncularis		●								
	Thryptomene decussata	●	●								
	Verticordia jamiesonii	●	●	●	●			P3			
Nyctaginaceae	*Boerhavia coccinea*		●								
	Boerhavia repleta		●								
	Commicarpus australis		●								
Ophioglossaceae	*Ophioglossum lusitanicum*		●								
Pedaliaceae	*Josephinia eugeniae*	●	●								
Phrymaceae	*Peplidium* sp. C Evol. Fl. Fauna Arid Aust. (N.T. Burbidge & A. Kanis 8158)	●									
Phyllanthaceae	*Dendrophyllanthus erwinii*		●								
	Phyllanthus lacunarius		●								
	Synostemon crassifolius		●								
Pittosporaceae	*Pittosporum angustifolium*	●	●								
Plantaginaceae	*Plantago debilis*	●	●								
	Plantago hispida	●									
	Stemodia florulenta	●	●								
	Stemodia viscosa	●									

Family	Taxon	Source						Conservation Status			Introduced
		NM	ALA	WAH	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
Poaceae	*Aristida contorta*	●	●								
	Aristida holathera		●								
	Austrostipa nitida		●								
	Cenchrus ciliaris	●	●								Yes
	Cymbopogon ambiguus	●	●								
	Cynodon prostratus		●								
	Dactyloctenium radulans		●								
	Dichanthium sericeum		●								
	Digitaria brownii	●	●								
	Diplachne fusca		●								
	Elytrophorus spicatus		●								
	Enneapogon caerulescens	●	●								
	Enneapogon polyphyllus		●								
	Enteropogon ramosus		●								
	Eragrostis dielsii	●	●								
	Eragrostis elongata		●								
	Eragrostis eriopoda	●	●								
	Eragrostis lanipes	●	●								
	Eragrostis leptocarpa		●								
	Eragrostis pergracilis	●	●								
	Eragrostis setifolia		●								
	Eragrostis xerophila		●								
	Eriachne aristidea	●	●								
	Eriachne flaccida		●								
	Eriachne helmsii	●									
	Eriachne mucronata	●	●								
	Eriachne ovata		●								
	Eriachne pulchella	●	●								

Family	Taxon	Source						Conservation Status			Introduced
		NM	ALA	WAH	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	Eriachne pulchella subsp. *dominii*	●									
	Eriachne pulchella subsp. *pulchella*	●									
	Eriochloa pseudoacrotricha		●								
	Eulalia aurea		●								
	Iseilema dolichotrichum	●	●								
	Lachnagrostis filiformis		●								
	Leptochloa digitata		●								
	Monachather paradoxus	●	●								
	Neurachne minor	●	●								
	Panicum decompositum	●	●								
	Panicum laevinode		●								
	Paspalidium basicladum	●	●								
	Paspalidium clementii	●	●								
	Rostraria pumila		●								Yes
	Setaria dielsii	●									Yes
	Setaria verticillata		●								Yes
	Sporobolus actinocladus	●	●								
	Sporobolus mitchellii		●								
	Themeda triandra		●								
	Tragus australianus		●								
	Triodia longiceps	●									
	Triodia melvillei	●	●								
	Tripogonella loliiformis		●								
	Urochloa subquadripara		●								
	Yakirra australiensis	●	●								
Polygalaceae	*Polygala glaucifolia*	●	●								
	Polygala isingii	●	●								
Portulacaceae	*Portulaca cyclophylla*		●								

Family	Taxon	Source						Conservation Status			Introduced
		NM	ALA	WAH	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	Portulaca oleracea	●	●								
Pottiaceae	*Microbryum davallianum*		●								
Primulaceae	*Lysimachia arvensis*	●	●								
Proteaceae	*Grevillea berryana*	●	●								
	Grevillea deflexa	●	●								
	Grevillea nematophylla		●								
	Grevillea nematophylla subsp. *supraplana*	●									
	Hakea loreus	●	●								
	Hakea loreus subsp. *loreus*	●									
	Hakea preissii	●	●								
	Hakea recurva		●								
Pteridaceae	*Cheilanthes brownii*	●	●								
	Cheilanthes lasiophylla		●								
	Cheilanthes sieberi		●								
	Cheilanthes sieberi subsp. *sieberi*	●									
Rhamnaceae	*Stenanthemum mediale*	●	●	●	●			P1			
	Stenanthemum petraeum	●									
	Ziziphus mauritiana						●				Yes
Rosaceae	*Rubus anglocandicans*						●				Yes
	Rubus laudatus						●				Yes
	Rubus rugosus						●				Yes
	Rubus ulmifolius						●				Yes
Rubiaceae	*Psydrax latifolia*	●	●								
	Psydrax rigidula	●	●								
	Psydrax suaveolens	●	●								
	Synaptantha tillaeacea		●								
	Synaptantha tillaeacea var. *tillaeacea*	●									
Ruppiaceae	*Ruppia maritima*		●								

Family	Taxon	Source						Conservation Status			Introduced
		NM	ALA	WAH	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	Ruppia megacarpa		●								
Rutaceae	*Philotheca brucei*		●								
	Philotheca brucei subsp. *cinerea*	●									
	Philotheca sericea	●	●								
Santalaceae	*Santalum acuminatum*		●								
	Santalum lanceolatum	●	●								
	Santalum spicatum	●	●								
Sapindaceae	*Dodonaea amplisemina*		●	●				P4			
	Dodonaea pachyneura	●	●								
	Dodonaea petiolaris	●	●								
	Dodonaea rigida		●								
	Dodonaea viscosa		●								
Scrophulariaceae	*Eremophila clarkei*		●								
	Eremophila compacta		●								
	Eremophila compacta subsp. *fecunda*	●									
	Eremophila exilifolia	●	●								
	Eremophila forrestii	●	●								
	Eremophila forrestii subsp. *forrestii*	●									
	Eremophila fraseri	●	●								
	Eremophila fraseri subsp. *fraseri*	●									
	Eremophila fraseri subsp. *parva*	●									
	Eremophila galeata		●								
	Eremophila georgei		●								
	Eremophila gilesii		●								
	Eremophila glutinosa	●	●								
	Eremophila jucunda		●								
	Eremophila jucunda subsp. *jucunda*	●									
	Eremophila laanii		●								

Family	Taxon	Source						Conservation Status			Introduced
		NM	ALA	WAH	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	Eremophila lachnocalyx	●	●								
	Eremophila latrobei		●								
	Eremophila latrobei subsp. *latrobei*	●									
	Eremophila longifolia	●	●								
	Eremophila mackinlayi		●								
	Eremophila macmillaniana	●	●								
	Eremophila maculata		●								
	Eremophila maculata subsp. *brevifolia*	●									
	Eremophila malacoides	●	●								
	Eremophila margarethae		●								
	Eremophila margarethae subsp. straight sepals (G. Cockerton & B. McLean LCH 31310)	●		●				P1			
	Eremophila pantonii	●	●								
	Eremophila petrophila		●								
	Eremophila petrophila subsp. *densa*	●		●	●			P3			
	Eremophila phyllopoda		●								
	Eremophila phyllopoda subsp. *phyllopoda*	●									
	Eremophila platycalyx		●								
	Eremophila prolata		●	●				P1			
	Eremophila sp. Ironstone (G. Cockerton & B. McLean LCH 31311)	●		●				P1			
	Eremophila spathulata	●	●								
	Eremophila spuria	●	●								
	Eremophila strongylophylla	●	●								
	Eremophila warnesii	●	●	●	●			P1			
	Eremophila youngii		●								
Solanaceae	*Nicotiana gascoynica*		●								
	Nicotiana glauca		●								
	Nicotiana obliqua	●									

Family	Taxon	Source						Conservation Status			Introduced
		NM	ALA	WAH	TPFL	EPBC	WAOL	DBCA	BC Act	EPBC Act	
	Nicotiana occidentalis		●								
	Nicotiana rosulata	●	●								
	Solanum ashbyae	●	●								
	Solanum austropiceum	●	●								
	Solanum elaeagnifolium						●				Yes
	Solanum lasiophyllum	●	●								
	Solanum linnaeanum						●				Yes
	Solanum sturtianum		●								
Surianaceae	*Stylobasium spathulatum*	●	●								
Tamaricaceae	*Tamarix aphylla*						●				Yes
Thymelaeaceae	*Pimelea microcephala*		●								
Urticaceae	*Parietaria cardiostegia*		●								
Verbenaceae	*Lantana camara*						●				Yes
Zygophyllaceae	*Roepera aurantiaca*		●								
	Roepera eichleri	●	●								
	Roepera kochii	●	●								
	Roepera ovata		●								
	Roepera similis	●									
	Tribulus adelacanthus	●	●	●				P3			
	Tribulus astrocarpus	●	●								
	Tribulus forrestii	●	●								
	Tribulus platypterus		●								
	Tribulus suberosus	●	●								
	Tribulus terrestris		●								Yes

Appendix K: Introduced flora database results

Family	Taxon	Source				Declared Plant Pests (DPP)	Weed of National Significance (WoNS)	Ecological Impact	Invasiveness
		NM	ALA	EPBC	WAOL				
Alismataceae	*Sagittaria platyphylla*				●	Yes	Yes	Not assessed	Not assessed
Apocynaceae	*Calotropis procera*				●	Yes	No	Not assessed	Not assessed
	Cryptostegia madagascariensis				●	Yes	No	Not assessed	Not assessed
Araceae	*Pistia stratiotes*				●	Yes	No	Not assessed	Not assessed
	Zantedeschia aethiopica				●	Yes	No	Not assessed	Not assessed
Araliaceae	*Hydrocotyle ranunculoides*				●	Yes	No	Not assessed	Not assessed
Asparagaceae	*Asparagus asparagoides*				●	Yes	Yes	Not assessed	Not assessed
Asteraceae	*Chondrilla juncea*				●	Yes	No	Not assessed	Not assessed
	Onopordum acaulon				●	Yes	No	Not assessed	Not assessed
	Silybum marianum				●	Yes	No	Not assessed	Not assessed
	Xanthium spinosum				●	Yes	No	Not assessed	Not assessed
	Xanthium strumarium				●	Yes	No	Not assessed	Not assessed
Boraginaceae	*Echium plantagineum*				●	Yes	No	Not assessed	Not assessed
Cactaceae	*Austrocylindropuntia cylindrica*				●	Yes	No	Not assessed	Not assessed
	Austrocylindropuntia subulata				●	Yes	No	Not assessed	Not assessed
	Cylindropuntia fulgida				●	Yes	No	High	Slow
	Cylindropuntia imbricata				●	Yes	No	High	Slow
	Cylindropuntia kleiniae				●	Yes	No	Not assessed	Not assessed
	Cylindropuntia pallida				●	Yes	No	Not assessed	Not assessed
	Cylindropuntia tunicata				●	Yes	No	Not assessed	Not assessed
	Opuntia elata				●	Yes	No	Not assessed	Not assessed
	Opuntia elatior				●	Yes	No	Not assessed	Not assessed
	Opuntia engelmannii				●	Yes	No	Not assessed	Not assessed
	Opuntia ficus-indica				●	Yes	No	Not assessed	Not assessed
	Opuntia microdasys				●	Yes	No	Not assessed	Not assessed
	Opuntia monacantha				●	Yes	No	Not assessed	Not assessed
	Opuntia polyacantha				●	Yes	No	Not assessed	Not assessed
	Opuntia puberula				●	Yes	No	Not assessed	Not assessed
	Opuntia stricta				●	Yes	No	High	Rapid
	Opuntia tomentosa				●	Yes	No	Not assessed	Not assessed
Convolvulaceae	*Cuscuta epithymum*	●	●			Yes	No	Not assessed	Not assessed
Cucurbitaceae	*Coccinia grandis*				●	Yes	No	Not assessed	Not assessed
Euphorbiaceae	*Euphorbia drummondii*	●	●			No	No	Not assessed	Not assessed
	Jatropha gossypiifolia				●	Yes	No	Not assessed	Not assessed

Family	Taxon	Source				Declared Plant Pests (DPP)	Weed of National Significance (WoNS)	Ecological Impact	Invasiveness
		NM	ALA	EPBC	WAOL				
Fabaceae	*Alhagi maurorum*				●	Yes	No	Not assessed	Not assessed
	Parkinsonia aculeata				●	Yes	Yes	High	Rapid
	Prosopis glandulosa				●	Yes	No	Not assessed	Not assessed
	Senna alata				●	Yes	No	Not assessed	Not assessed
	Senna obtusifolia				●	Yes	No	Not assessed	Not assessed
	Ulex europaeus				●	Yes	Yes	Not assessed	Not assessed
	Vachellia farnesiana		●			Yes	No	Not assessed	Not assessed
Iridaceae	*Moraea flaccida*				●	Yes	No	Not assessed	Not assessed
	Moraea miniata				●	Yes	No	Not assessed	Not assessed
Juncaceae	*Juncus bufonius*	●	●			No	No	Not assessed	Not assessed
Poaceae	*Rostraria pumila*		●			No	No	Not assessed	Not assessed
Rhamnaceae	*Ziziphus mauritiana*				●	Yes	No	Not assessed	Not assessed
Rosaceae	*Rubus anglocandicans*				●	Yes	No	Not assessed	Not assessed
	Rubus laudatus				●	Yes	No	Not assessed	Not assessed
	Rubus rugosus				●	Yes	No	Not assessed	Not assessed
	Rubus ulmifolius				●	Yes	No	Not assessed	Not assessed
Solanaceae	*Solanum elaeagnifolium*				●	Yes	Yes	Not assessed	Not assessed
	Solanum linnaeanum				●	Yes	No	Not assessed	Not assessed
Tamaricaceae	*Tamarix aphylla*				●	Yes	Yes	High	Rapid
Verbenaceae	*Lantana camara*				●	Yes	Yes	Not assessed	Not assessed
Zygophyllaceae	*Tribulus terrestris*		●			No	No	Not assessed	Not assessed

Appendix L: Significant vegetation from the literature review

4.2.1 Floristic Community Types at Mount Gould

FCT 1: Open tall shrubland of *Acacia aneura* over sparse low shrubland of *Ptilotus obovatus* over open low forbland of *Goodenia tenuiloba*

The following common species were recorded:

Tall Shrubs: *Acacia aneura, Acacia ramulosa* var. *linophylla*
Low Shrubs: *Sida* sp. dark green fruits (S. van Leeuwen 2260), *Ptilotus obovatus, Solanum lasiophyllum/ashbyae*
Forbs: *Goodenia tenuiloba, Phyllanthus erwinii*

Landforms: Steep mid and lower slopes

Soils: Red-brown silty clay-loam soils with banded ironstone and quartz shale and boulders

FCT 1 was represented by a total of four quadrats, all established by Woodman Environmental. This FCT was mapped on the steep, shaley mid and lower slopes of Mount Gould (Figure 2). A defining characteristic of this FCT was the overall low perennial species richness, particularly in the mid stratum. Mean species richness per quadrat was 13.5. This FCT is closely related to FCT 2, which also has very low perennial species richness, however FCT 2 occurs on low rocky rises away from Mount Gould itself. The Priority flora taxon *Eremophila warnesii* (P1) was recorded in this FCT. Indicator species for this FCT are *Sida* sp. dark green fruits (S. van Leeuwen 2260) and *Solanum ashbyae/lasiophyllum* complex (Appendix I).



Plate 2: FCT 1 - Quadrat MG15 (Woodman Environmental)

FCT 2: Sparse tall shrubland of mixed *Acacia* species over sparse low shrubland of *Ptilotus obovatus* and *Eremophila* species over open low forbland of *Goodenia tenuiloba*

The following common species were recorded:

Tall Shrubs: *Acacia rhodophloia, Acacia aneura, Acacia ramulosa* var. *linophylla*
Low Shrubs: *Ptilotus obovatus, Eremophila latrobei* subsp. *latrobei, Eremophila fraseri* subsp. *parva, Eremophila* ?*jucunda*
Forbs: *Goodenia tenuiloba*

Landforms: Stony undulating plains

Soils: Red-brown silty clay-loam soils with banded ironstone and quartz stones

FCT 2 was represented by a total of two quadrats, both established by Woodman Environmental. This FCT was mapped on a stony, undulating plain to the north of Mount Gould (Figure 2). Very little of this habitat occurred in the Project area, hence the small sample size. Mean species richness per quadrat was 9.5. This FCT is closely related to FCT 1. The sole indicator species for this FCT is *Acacia rhodophloia* (Appendix I).



Plate 3: FCT 2 - Quadrat MG22 (Woodman Environmental)

FCT 3: Sparse tall shrubland or isolated shrubs of *Acacia aneura* over isolated mid shrubs of *Eremophila fraseri* subsp. *parva* over isolated low shrubs of *Ptilotus obovatus* over open low forbland of mixed species including *Ptilotus aervoides* and *Goodenia tenuiloba*

The following common species were recorded:

Tall Shrubs:	*Acacia aneura*
Mid shrubs:	*Eremophila fraseri* subsp. *parva*
Low Shrubs:	*Ptilotus obovatus*
Forbs:	*Goodenia tenuiloba, Ptilotus aervoides, Ptilotus helipteroides, Euphorbia boophthona, Euphorbia drummondii, Phyllanthus erwinii, Velleia glabrata, Helipterum craspedioides*
Grasses:	*Aristida contorta*

Landforms: Clay pans, clay flats

Soils: Red-brown clay-loam

FCT 3 was represented by a total of three quadrats, all established by Woodman Environmental. This FCT was mapped in claypans and on clay flats to the east of Mount Gould (Figure 2). This FCT varied greatly structurally, with two quadrats in claypans consisting of only isolated shrubs, while one quadrat possessed a sparse tall shrubland. Mean species richness per quadrat was 21.3, with the majority of taxa being ephemerals. This FCT is not closely related to any other FCT (Appendix G). The Priority flora species *Rhodanthe sphaerocephala* (P1) was only recorded in FCT 3. The sole indicator species for this FCT is *Phyllanthus erwinii* (Appendix I).




Plate 4: FCT 3 - Quadrat MG05 (left), MG06 (right) (Woodman Environmental)

FCT 4: Open tall shrubland or isolated shrubs of *Acacia aneura* over open to sparse mid shrubland of *Eremophila latrobei* subsp. *latrobei* and *Philotheca brucei* subsp. *cinerea* over open to sparse low shrubland and low tussock grassland of *Ptilotus obovatus* and *Cymbopogon ambiguus*

The following common species were recorded:

Tall Shrubs:	*Acacia aneura, Acacia rhodophloia, Acacia citrinoviridis*
Mid shrubs:	*Eremophila latrobei* subsp. *latrobei*, *Philotheca brucei* subsp. *cinerea*
Low Shrubs:	*Ptilotus obovatus, Solanum lasiophyllum/ashbyae* complex, *Corchorus crozophorifolius*, *Abutilon lepidum*
Forbs:	*Cheilanthes sieberi, Cheilanthes brownii, Phyllanthus erwinii*
Grasses:	*Cymbopogon ambiguus, Enneapogon caerulescens, Eriachne mucronata*

Landforms: Steep mid and upper slopes (occasionally lower slopes) and crests

Soils: Skeletal red-brown silty clay-loams over massive banded ironstone outcropping

FCT 4 was represented by the largest number of quadrats, with a total of 12 quadrats, (two Meissner *et al.*; 10 Woodman Environmental). This FCT was mapped on the steep upper slopes and crests of Mount Gould (Figure 2). Occasionally it extended down to the lower slopes (e.g. quadrat MG25). This FCT also varied greatly structurally. Typically, quadrats consisted of a tall open shrubland of *Acacia aneura*, or occasionally *A. citrinoviridis*, with a distinct open mid shrubland stratum of *Eremophila latrobei* subsp. *latrobei* and *Philotheca brucei* subsp. *cinerea*, and a sparse low shrubland stratum (e.g. MG25). However, a number of quadrats, particularly near the summit of the western peak of Mount Gould consisted of only isolated tall and mid shrubs, and possessed an open low shrubland and tussock or hummock grassland stratum of *Ptilotus obovatus*, *Eremophila warnesii* and *Cymbopogon obtectus* (e.g. MG23). Mean species richness per quadrat was 16.3. This FCT is related to FCT 5, which differs in having a greater representation of species group 4 (Appendix H). The Priority flora taxa *Eremophila warnesii* and *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) (both P1) were recorded in this FCT. Indicator species for this FCT are *Abutilon lepidum*, *Cheilanthes sieberi* and *Cymbopogon ambiguus* (Appendix I).



Plate 5: FCT 4 - Quadrat MG25 (left), Quadrat MG23 (right) (Woodman Environmental)

FCT 5: Isolated tall shrubland of *Acacia aneura* and/or *Grevillea berryana* over sparse low shubland of *Eremophila latrobei* subsp. *latrobei*, *Philotheca brucei* subsp. *cinerea* and *Ptilotus obovatus* over low hummock grassland of *Triodia melvillei*

The following common species were recorded:

Tall Shrubs:	*Acacia aneura, Grevillea berryana*
Low Shrubs:	*Ptilotus obovatus, Eremophila latrobei* subsp. *latrobei*, *Philotheca brucei* subsp. *cinerea*
Forbs:	*Goodenia tenuiloba*
Grasses:	*Triodia melvillei, Monacather paradoxus, Eriachne mucronata*

Landforms: Steep upper slopes and crests

Soils: Skeletal red-brown silty clay-loams over massive banded ironstone outcropping

FCT 5 was represented by a total of four quadrats, (three Meissner *et al.*; one Woodman Environmental). This FCT was mapped on the steep upper slopes and crests of Mount Gould (Figure 2). The presence of taxa from species group 4 generally characterised this FCT (Appendix H). The presence of *Triodia melvillei* in a low hummock grassland stratum was also characteristic, however this species was not recorded in one quadrat that grouped in this FCT, and was also recorded in several quadrats in the related FCT 4. Mean species richness was 16.5. Indicator species for this FCT are *Eremophila latrobei* subsp. *latrobei*, *Eriachne mucronata*, *Grevillea berryana*, *Monacather paradoxus* and *Triodia melvillei* (Appendix I)



Plate 6: FCT 5 - Quadrat MG09 (Woodman Environmental)

FCT 6: FCT 6 was split into two distinct sub-types based on soil and topography type, and representation of particular species groups (Appendix H).

FCT 6a: Open tall shrubland of *Acacia ramulosa* var. *linophylla* and *Acacia kempeana* over sparse mid shubland of *Eremophila forrestii* subsp. *forrestii* over isolated low shrubland of *Corchorus crozophorifolius* over sparse low grassland and forbland of mixed species including *Eriachne mucronata* and *Ptilotus aervoides*

The following common species were recorded:

Tall Shrubs: *Acacia ramulosa* var. *linophylla, Acacia kempeana*
Mid Shrubs: *Eremophila forrestii* subsp. *forrestii, Eremophila compacta* subsp. ?*fecunda, Senna artemesioides* subsp. *helmsii*
Low Shrubs: *Corchorus crozophorifolius, Solanum ashbyae* complex, *Sida* ?*intricata, Abutilon otocarpum*
Forbs: *Goodenia tenuiloba, Ptilotus aervoides, Phyllanthus erwinii, Euphorbia drummondii, Dysphania melanocarpa* forma *melanocarpa*
Grasses: *Aristida contorta, Eriachne aristidea, Eriachne mucronata*

Landforms: Flat plains

Soils: Red-brown sandy and silty clay-loams

FCT 6a was represented by a total of four quadrats, all established by Woodman Environmental. This FCT was mapped on flat, sandy plains to the south and west of Mount Gould (Figure 2). The presence of taxa from species group 5, as well as a particular subset of species group 1, characterised this community (Appendix H). Mean species richness per quadrat was 19. FCT 6a is very closely related to FCT 6b, however FCT 6b is not represented by species group 5, and occurs on low ridges rather than flat plains. The best indicator species for this FCT are *Acacia kempeana, Eremophila forrestii* subsp. *forrestii* and *Sida* ?*intricata* (Appendix I).

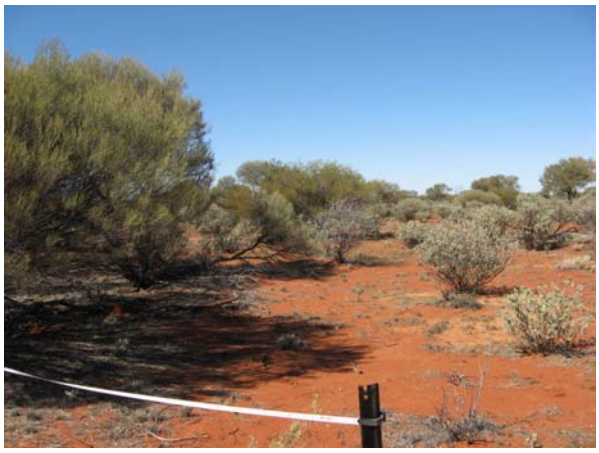


Plate 7: FCT 6a - Quadrat MG02 (Woodman Environmental)

FCT 6b: Tall sparse shrubland of *Acacia ramulosa* var. *linophylla* and *Acacia citrinoviridis* over open mid shubland of *Eremophila latrobei* subsp. *latrobei* over open low shrubland of *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) over sparse low forbland of *Goodenia tenuiloba*

Landforms: Steep low ridge

Soils: Red-brown silty clay-loam over massive banded ironstone and quartz outcropping

FCT 6b was only represented by a single quadrat established by Woodman Environmental. This FCT was mapped on a steep low ridge shaded by the western peak of Mount Gould, near the south-western lower slope of Mount Gould (Figure 2). The single quadrat in FCT 6b grouped with the quadrats in FCT 6a to comprise FCT 6, however FCT 6b is not represented by species group 5, whose representation characterises FCT 6a (Appendix H). FCTs 6a and 6b also occur on different landforms and soil types, and it is likely that if more quadrats were established on the low ridge system where FCT 6b has been mapped, these quadrats would group as a distinct FCT. There are no indicator species for this FCT as it is represented by a single quadrat. Fourteen taxa were recorded in the quadrat within FCT 3. The Priority flora taxon *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) (P1) was recorded in this FCT.



Plate 8: FCT 6b - Quadrat MG03 (Woodman Environmental)

Table 7: Conservation Significance of Floristic Community Types (FCTs) Described within the Project area

FCT	Mapped Area (ha)	Comments	Significant Flora Species	Conservation Significance Ranking
1	196.7	FCT 1 mapped on steep mid and lower slopes which are restricted to Mount Gould in the Project area area, and are restricted in the region; Appear to be present elsewhere other than Mount Gould in the region based on previous regional studies (Meissner & Caruso 2006; Meissner *et al.* 2007); Part of a Priority 1 PEC.	*Eremophila warnesii* (P1)	3: Distribution of FCT 1 restricted to Mount Gould and Jack Hills regionally, and Mount Gould within the Project area area; Soil, substrate and topographical positions all restricted in region. Presence of significant flora species with P1 ranking; Significant flora species of very restricted distribution; Significant flora species not restricted to FCT 4.
2	26.6 (<10 % of Project area area mapped)	FCT 2 mapped on undulating stony plains which are restricted to north of Mount Gould within the Project area area, however are likely to be common and widespread throughout the region; Not analysed during previous regional studies; Not a listed TEC or PEC.	NA	1: FCT 2 likely to be widespread within the region according to known soil types, substrate and topographical positions.
3	82.4	FCT 3 mapped on clay flats and in clay pans which are restricted to the western section of the Project area, however are likely to be common and widespread throughout the region; Not analysed during previous regional studies; Not a listed TEC or PEC.	*Rhodanthe sphaerocephala* (P1).	2: FCT 3 likely to be widespread within the region according to known soil types, substrate and topographical positions; Presence of significant flora species with P1 ranking; Significant flora species of moderately restricted distribution; Significant flora species restricted to FCT 3.

Table 7: Conservation Significance of Floristic Community Types (FCTs) Described within the Project area

FCT	Mapped Area (ha)	Comments	Significant Flora Species	Conservation Significance Ranking
4	106.5	FCT 4 mapped on steep mid and upper slopes and crests which are restricted to Mount Gould in the Project area area, and are restricted in the region; Not present elsewhere other than Mount Gould in the region based on previous regional studies; Part of a Priority 1 PEC.	*Eremophila warnesii* (P1); *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) (P1).	5: Distribution of FCT 4 restricted to Mount Gould both regionally and within the Project area area; Soil, substrate and topographical positions all restricted in region; Presence of significant flora species with P1 ranking; Significant flora species of very restricted distribution; Significant flora species not restricted to FCT 4.
5	27.7 (<10 % of Project area area mapped)	FCT 5 mapped on steep upper slopes and crests which are restricted to Mount Gould in the Project area area, and are restricted in the region; Not present elsewhere other than Mount Gould in the region based on previous regional studies; Part of a Priority 1 PEC.	*Eremophila warnesii* (P1); *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) (P1).	5: Distribution of FCT 5 restricted to Mount Gould both regionally and within the Project area area; Soil, substrate and topographical positions all restricted in region; Presence of significant flora species with P1 ranking; Significant flora species of very restricted distribution; Significant flora species not restricted to FCT 5.
6a	151.7	FCT 6a mapped on flat plains which are distributed south and west of Mount Gould within the Project area area, however are likely to be common and widespread throughout the region; Not analysed during previous regional studies; Not a listed TEC or PEC.	NA	1: FCT 6a likely to be widespread within the region according to known soil types, substrate and topographical positions.

Table 7: Conservation Significance of Floristic Community Types (FCTs) Described within the Project area

FCT	Mapped Area (ha)	Comments	Significant Flora Species	Conservation Significance Ranking
6b	10.6 (<10 % of Project area area mapped)	FCT 6b mapped on a steep low ridge at the foot of Mount Gould which is restricted to the south-western foot Mount Gould in the Project area area, and is restricted in the region; Not present elsewhere other than Mount Gould in the region based on previous regional studies; Part of a Priority 1 PEC.	*Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) (P1)	5: Distribution of FCT 6b restricted to Mount Gould both regionally and within the Project area area; Soil, substrate and topographical positions all restricted in region; Presence of significant flora species with P1 ranking; Significant flora species of very restricted distribution; Significant flora species not restricted to FCT 6b.

532000mE
533000mE
534000mE
535000mE
7148000mN
7147000mN
7146000mN
7145000mN
6a
3
2
Rs
Ew
1
4
C
Hg
5
6b

LEGEND

Floristic Community Types

1: Open tall shrubland of *Acacia aneura* over sparse low shrubland of *Ptilotus obovatus* over open low forbland of *Goodenia tenuiloba* on steep mid and lower slopes on banded ironstone and quartz shale

2: Sparse tall shrubland of mixed *Acacia* species over sparse low shrubland of *Ptilotus obovatus* and *Eremophila* species over open low forbland of *Goodenia tenuiloba* on stony undulating plains

3: Sparse tall shrubland or isolated shrubs of *Acacia aneura* over isolated mid shrubs of *Eremophila fraseri* subsp. *parva* over isolated low shrubs of *Ptilotus obovatus* over open low forbland of mixed species including *Ptilotus aervoides* and *Goodenia tenuiloba* in clay pans and on clay flats

4: Open tall shrubland or isolated shrubs of *Acacia aneura* over open to sparse mid shrubland of *Eremophila latrobei* subsp. *latrobei* and *Philotheca brucei* subsp. *cinerea* over open to sparse low shrubland and low tussock grassland of *Ptilotus obovatus* and *Cymbopogon ambiguus* on steep mid and upper slopes and crests on banded ironstone

5: Isolated tall shrubland of *Acacia aneura* and/or *Grevillea berryana* over sparse low shubland of *Eremophila latrobei* subsp. *latrobei*, *Philotheca brucei* subsp. *cinerea* and *Ptilotus obovatus* over low hummock grassland of *Triodia melvillei* on steep upperslopes and crests on banded ironstone

6a: Open tall shrubland of *Acacia ramulosa* var. *linophylla* and *Acacia kempeana* over sparse mid shubland of *Eremophila forrestii* subsp. *forrestii* over isolated low shrubland of *Corchorus crozophorifolius* over sparse low grassland and forbland of mixed species including *Eriachne mucronata* and *Ptilotus aervoides* on flat plains

6b: Tall sparse shrubland of *Acacia ramulosa* var. *linophylla* and *Acacia citrinoviridis* over open mid shubland of *Eremophila latrobei* subsp. *latrobei* over open low shrubland of *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) over sparse low forbland of *Goodenia tenuiloba* on a steep low ridge on banded ironstone

Recording Sites

Woodman Environmental quadrat
DEC quadrat

Declared Rare and Priority Flora Species

Ew:	*Eremophila warnesii*	P1
Hg:	*Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743)	P1
Rs:	*Rhodanthe sphaerocephala*	P1

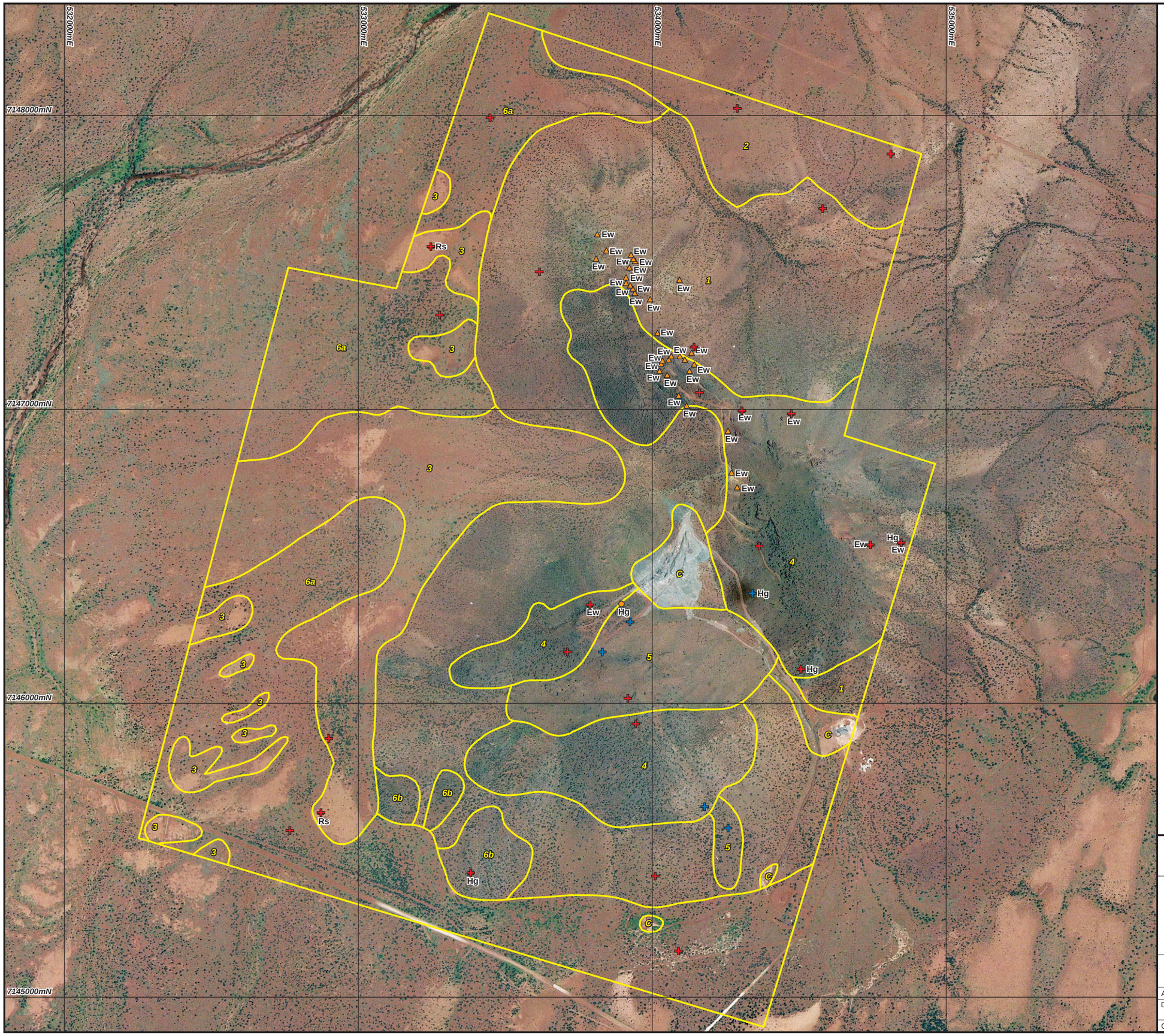
0 100 200m
Scale
MGA94 Zone 50

Priority Rare	DEC	WEC
1	●	▲
2	●	▲
3	●	▲
4	●	▲

Mt Gould DSO Project Area Floristic Community Types and Significant Flora Taxa

woodmanenvironmentalconsulting
PO Box 50, Applecross W.A. 6953, A.C.N.088 055 903
Tel: (08) 9315 4688 ~ Fax: (08) 9315 4699

Author: D Coultas	WEC Ref: ATLAS08-10-01	Scale: 1:12,500
Drawn: CAD Resources ~ www.cadresources.com.au Tel: (08) 9246 3242 ~ Fax: (08) 9246 3202		Figure: 2a
CAD Ref: g1627_MG_f01.dgn	Date: Apr 2009	Rev: A A3



LEGEND

Floristic Community Types

1: Open tall shrubland of *Acacia aneura* over sparse low shrubland of *Ptilotus obovatus* over open low forbland of *Goodenia tenuiloba* on steep mid and lower slopes on banded ironstone and quartz shale

2: Sparse tall shrubland of mixed *Acacia* species over sparse low shrubland of *Ptilotus obovatus* and *Eremophila* species over open low forbland of *Goodenia tenuiloba* on stony undulating plains

3: Sparse tall shrubland or isolated shrubs of *Acacia aneura* over isolated mid shrubs of *Eremophila fraseri* subsp. *parva* over isolated low shrubs of *Ptilotus obovatus* over open low forbland of mixed species including *Ptilotus aervoides* and *Goodenia tenuiloba* in clay pans and on clay flats

4: Open tall shrubland or isolated shrubs of *Acacia aneura* over open to sparse mid shrubland of *Eremophila latrobei* subsp. *latrobei* and *Philotheca brucei* subsp. *cinerea* over open to sparse low shrubland and low tussock grassland of *Ptilotus obovatus* and *Cymbopogon ambiguus* on steep mid and upper slopes and crests on banded ironstone

5: Isolated tall shrubland of *Acacia aneura* and/or *Grevillea berryana* over sparse low shubland of *Eremophila latrobei* subsp. *latrobei*, *Philotheca brucei* subsp. *cinerea* and *Ptilotus obovatus* over low hummock grassland of *Triodia melvillei* on steep upperslopes and crests on banded ironstone

6a: Open tall shrubland of *Acacia ramulosa* var. *linophylla* and *Acacia kempeana* over sparse mid shubland of *Eremophila forrestii* subsp. *forrestii* over isolated low shrubland of *Corchorus crozophorifolius* over sparse low grassland and forbland of mixed species including *Eriachne mucronata* and *Ptilotus aervoides* on flat plains

6b: Tall sparse shrubland of *Acacia ramulosa* var. *linophylla* and *Acacia citrinoviridis* over open mid shubland of *Eremophila latrobei* subsp. *latrobei* over open low shrubland of *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) over sparse low forbland of *Goodenia tenuiloba* on a steep low ridge on banded ironstone

Recording Sites

Woodman Environmental quadrat

DEC quadrat

Declared Rare and Priority Flora Species

Ew: *Eremophila warnesii*	P1
Hg: *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743)	P1
Rs: *Rhodanthe sphaerocephala*	P1

N

0 100 200m

Scale

MGA94 Zone 50

Priority Rare	DEC	WEC
1	●	▲
2	●	▲
3	●	▲
4	●	▲

Mt Gould DSO Project Area Floristic Community Types and Significant Flora Taxa Showing Aerial Photography

woodmanenvironmentalconsulting
PO Box 50, Applecross W.A. 6953, A.C.N.088 055 903
Tel: (08) 9315 4688 ~ Fax: (08) 9315 4699

Author: D Coultas	WEC Ref: ATLAS08-10-01	Scale: 1:12,500
Drawn: CAD Resources ~ www.cadresources.com.au Tel: (08) 9246 3242 ~ Fax: (08) 9246 3202		Figure: **2b**
CAD Ref: g1627_MG_f02.dgn	Date: Apr 2009	Rev: A A3

Appendix M: Flora composition

Family	Taxon
Aizoaceae	*Tetragonia cristata*
	Trianthema glossostigmum
Amaranthaceae	*Amaranthus cuspidifolius*
	Ptilotus aervoides
	Ptilotus chamaecladus
	Ptilotus exaltatus
	Ptilotus gaudichaudii
	Ptilotus helipteroides
	Ptilotus obovatus
	Ptilotus polystachyus
	Ptilotus rotundifolius
	Ptilotus schwartzii
	Ptilotus sp. indet
	Ptilotus sp. indet 1
	Ptilotus sp. indet 2
	Ptilotus xerophilus
Apocynaceae	*Leichhardtia australis*
Araliaceae	*Trachymene pilbarensis*
Asparagaceae	*Thysanotus manglesianus*
Asteraceae	*Calocephalus beardii*
	Calocephalus francisii
	Calocephalus multiflorus
	Calotis hispidula
	Calotis multicaulis
	Helipterum craspedioides
	Myriocephalus rudallii
	Olearia stuartii
	Rhodanthe charsleyae
	Rhodanthe chlorocephala subsp. *splendida*
	Rhodanthe forrestii
	Rhodanthe maryonii
	Rhodanthe sphaerocephala (Priority 1)
	Roebuckiella cheilocarpa var. *cheilocarpa*
	Schoenia cassiniana
	Streptoglossa liatroides
	Taplinia saxatilis
Boraginaceae	*Boraginaceae* sp. indet
	Euploca heterantha
	Euploca inexplicita
	Euploca moorei
	Euploca sp. indet
	Halgania gustafsenii var. *gustafsenii*
	Halgania gustafsenii var. Murchison (R. Meissner & B. Bayliss 743) (Priority 1)

Family	Taxon
	Heliotropium ammophilum
	Trichodesma zeylanicum
Brassicaceae	*Lepidium echinatum*
	Lepidium oxytrichum
	Lepidium platypetalum
	Stenopetalum ?anfractum
	Stenopetalum anfractum
	Stenopetalum sp. indet
Campanulaceae	*Wahlenbergia tumidifructa*
Chenopodiaceae	*Atriplex codonocarpa*
	Chenopodiaceae sp. indet
	Dysphania melanocarpa
	Dysphania rhadinostachya subsp. *rhadinostachya*
	Dysphania saxatilis
	Maireana carnosa
	Maireana georgei
	Maireana planifolia
	Salsola australis
	Sclerolaena diacantha
	Sclerolaena eriacantha
Cleomaceae	*Arivela viscosa*
Convolvulaceae	**Cuscuta epithymum*
	**Cuscuta planiflora*
	Ipomoea calobra
Cucurbitaceae	*Citrullus amarus*
	Cucumis myriocarpus subsp. *myriocarpus*
	Cucumis sp. indet
Cyperaceae	*Bulbostylis barbata*
Euphorbiaceae	*Euphorbia australis* var. *australis*
	Euphorbia australis var. *subtomentosa*
	Euphorbia boophthona
	Euphorbia drummondii
	Euphorbia sp. indet
Fabaceae	*Acacia ?cuthbertsonii*
	Acacia aneura
	Acacia aptaneura
	Acacia ayersiana
	Acacia citrinoviridis
	Acacia cuthbertsonii subsp. *cuthbertsonii*
	Acacia demissa
	Acacia fuscaneura
	Acacia incurvaneura
	Acacia kempeana

Family	Taxon
	Acacia macraneura
	Acacia pruinocarpa
	Acacia pteraneura
	Acacia ramulosa var. *ramulosa*
	Acacia rhodophloia
	Acacia rhodophloia x *kempeana*
	Acacia tetragonophylla
	Acacia thomae
	Glycine canescens
	Indigofera monophylla
	Muelleranthus trifoliolatus
	Senna artemisioides subsp. *helmsii*
	Senna glaucifolia
	Senna glutinosa subsp. x *luerssenii*
	Senna sp. Meekatharra (E. Bailey 1-26)
	Senna stricta
	Swainsona beasleyana
	Swainsona pterostylis
	Tephrosia sphaerospora
Geraniaceae	*Erodium cygnorum*
Goodeniaceae	*Brunonia australis*
	Goodenia berardiana
	Goodenia glabrata
	Goodenia tenuiloba
	Goodenia triodiophila
	Scaevola spinescens
Haloragaceae	*Haloragis trigonocarpa*
Malvaceae	*Abutilon cryptopetalum*
	Abutilon fraseri
	Abutilon lepidum
	Abutilon otocarpum
	Abutilon oxycarpum subsp. Prostrate (A.A. Mitchell PRP1266)
	Corchorus crozophorifolius
	Hibiscus burtonii
	Hibiscus sp. Gardneri (A.L. Payne PRP 1435)
	Hibiscus sturtii
	Hibiscus sturtii var. *forrestii*
	Sida ?sp. dark green fruits (S. van Leeuwen 2260)
	Sida aff. *intricata*
	Sida aff. sp. dark green fruits (S. van Leeuwen 2260)
	Sida aff. sp. spiciform panicles (E. Leyland s.n. 14/8/90)
	Sida ectogama
	Sida platycalyx
	Sida sp. dark green fruits (S. van Leeuwen 2260)

Family	Taxon
	Sida sp. Golden calyces glabrous (H.N. Foote 32)
	Sida sp. indet
	Sida sp. spiciform panicles (E. Leyland s.n. 14/8/90)
Montiaceae	*Calandrinia ?polyandra*
	Calandrinia eremaea
	Calandrinia monosperma
	Calandrinia ptychosperma
	Calandrinia schistorhiza
	Calandrinia sp. indet
	Calandrinia stagnensis
Nyctaginaceae	*Boerhavia coccinea*
	Boerhavia repleta
	Boerhavia sp. indet
Phyllanthaceae	*Dendrophyllanthus erwinii*
Poaceae	*Poaceae* sp. indet 1
	Poaceae sp. indet 2
	Poaceae sp. indet 3
	Poaceae sp. indet 4
	Poaceae sp. indet 5
	Aristida contorta
	Aristida holathera var. *holathera*
	**Cenchrus ciliaris*
	Cymbopogon ambiguus
	Digitaria brownii
	Digitaria ctenantha
	Enneapogon caerulescens
	Enneapogon polyphyllus
	Eragrostis eriopoda
	Eragrostis lanipes
	Eragrostis pergracilis
	Eragrostis setifolia
	Eriachne aristidea
	Eriachne helmsii
	Eriachne mucronata
	Eriachne pulchella
	Eriachne pulchella subsp. *pulchella*
	Eriochloa ? pseudoacrotricha
	Iseilema dolichotrichum
	Monachather paradoxus
	Panicum australiense var. *australiense*
	Paspalidium basicladum
	Paspalidium clementii
	Paspalidium sp. indet

Family	Taxon
	Setaria sp. indet
	**Setaria verticillata*
	Triodia melvillei
	Tripogonella loliiformis
Polygalaceae	*Polygala glaucifolia*
	**Rumex vesicarius*
Portulacaceae	*Portulaca oleracea*
	Portulaca sp. indet
Proteaceae	*Grevillea berryana*
	Grevillea striata
	Hakea loreus subsp. *loreus*
	Hakea preissii
	Hakea recurva subsp. *arida*
Pteridaceae	*Cheilanthes brownii*
	Cheilanthes sieberi subsp. *sieberi*
Rubiaceae	*Psydrax latifolia*
	Psydrax rigidula
	Psydrax suaveolens
Rutaceae	*Philotheca brucei* subsp. *cinerea*
Sapindaceae	*Dodonaea pachyneura*
	Dodonaea petiolaris
Scrophulariaceae	*Eremophila ? forrestii*
	Eremophila exilifolia
	Eremophila forrestii subsp. *forrestii*
	Eremophila fraseri
	Eremophila fraseri subsp. *fraseri*
	Eremophila fraseri subsp. *parva*
	Eremophila glutinosa
	Eremophila jucunda subsp. *jucunda*
	Eremophila lachnocalyx
	Eremophila latrobei subsp. *latrobei*
	Eremophila macmillaniana
	Eremophila maitlandii
	Eremophila phyllopoda subsp. *phyllopoda*
	Eremophila warnesii (Priority 1)
Solanaceae	*Nicotiana cavicola*
	Nicotiana occidentalis
	Nicotiana rosulata
	Solanum ashbyae
	Solanum lasiophyllum
Zygophyllaceae	*Roepera* sp. indet
	Tribulus adelacanthus (Priority 3)

Family	Taxon
	Tribulus astrocarpus
	Tribulus forrestii
	Tribulus suberosus
	**Tribulus terrestris*

APPENDIX 7: TARGETED FLORA SURVEY - MINING TENEMENT M 52/236-I (EMERGE 2024A)

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Emerge Environmental Services Pty Ltd ABN 57144772510 trading as Emerge Associates

Document Reference: EP23-037(02)—010A SCM

Emerge contact: Rachel Weber

6 November 2024

Attention: Newcam Minerals
C/- MBS Environmental
4 Cook Street
West Perth WA 6005

Delivered by email to: TAttwood@mbsenvironmental.com.au

Dear Terryn

EREMOPHILA WARNESII TARGETED FLORA SURVEY – MOUNT GOULD IRON PROJECT REGION

1 INTRODUCTION

Newcam Minerals have established the Mount Gould Iron Project within mining tenement M 52/236-I (herein referred to as the 'site'). The site extends over 612.97 hectares (ha), and is located within the Mount Gould Station pastoral lease, as shown in **Figure 1**.

Flora and vegetation assessments have previously been undertaken within the site and adjacent Mount Gould Station (Woodman Environmental 2009, 2012; Biologic 2022), which have recorded four priority flora species:

- *Eremophila warnesii* (P1)
- *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) (P1)
- *Rhodanthe sphaerocephala* (P1)
- *Tribulus adelacanthus* (P3)[1].

It is understood development of the Mount Gould Iron Project will impact a number of *Eremophila warnesii i*ndividuals within the site. The previous surveys recorded 13,610 individuals within and immediately adjacent to the site and an additional 3,347 individuals within the broader region (Woodman Environmental 2009, 2012; Biologic 2022).

Emerge Associates (Emerge) were engaged to undertake a targeted flora survey to determine whether further populations of *Eremophila warnesii* occur within the broader region.

[1] Refer Department of Biodiversity Conservation and Attractions (DBCA) 2019, *Conservation Codes for Western Australian Flora and Fauna - last updated 3 January 2019*.

2 METHODS

2.1 Field survey

Two botanists from Emerge visited the site and broader region between 28 and 30 November 2023 to conduct the targeted survey.

In addition to the targeted survey undertaken in November, previous surveys undertaken by botanists from Emerge in May and August 2023 during searches for other priority species included areas of interest for *Eremophila warnesii*.

Searches were conducted for *E. warnesii* within the broader region in areas of potentially suitable habitat on Mount Gould Station, Moorarie Station and Yarlaweelor Station. Habitat suitability was informed by assessments made by the species habitat descriptions provided on Florabase (Western Australian Herbarium 2023) and *A Field Guide to the Eremophilas of Western Australia* (Brown and Buirchell 2011), assessments made by the field survey team and predictive modelling undertaken by Emerge.

Locations of *E. warnesii* individuals were recorded as points and polygons using handheld GPS receivers with a precision ±5-10 metres (m). Point locations represented between 1 and 900 individuals and polygons were used where plants were present in patches at densities too high to record as points. Due to time constraints the number of plants within each patch was estimated based on extrapolation of counts in a sample of the patch.

2.2 Limitations

The survey was undertaken by suitably experienced botanists, and at an appropriate time of the year to detect the target species. The flowering period of *Eremophila warnesii* is stated as June to October (Brown and Buirchell 2011; Western Australian Herbarium 2023). However, individuals within the known population in the site were observed to be flowering during the November survey and sterile individuals were distinct and readily detectable. All parts of the site could be accessed as required.

Spatial accuracy of *E. warnesii* individuals recorded was limited to the precision of the GPS receiver. The boundaries of patches were determined based on a combination of interpolation of aerial imagery and notes taken in the field. The number of *E. warnesii* individuals within patches was estimated and provides an indication only.

3 RESULTS

A total of 6,570 previously undocumented individuals of *Eremophila warnesii* were recorded during the targeted survey. All of these individuals were recorded within Yarlaweelor Station, where the species has previously been recorded.

In addition to the individual records, three patches were recorded. It is conservatively estimated that a total of 9,500 *E. warnesii* individuals occur in these three patches, with an overall estimated total of 16,070 individuals recorded during the survey. The locations of *E. warnesii* individuals and patches are shown in **Figure 2.**

Representative images of the habit and flowers of the species are shown below in **Plate 1** to **Plate 2**.



Plate 1: Eremophila warnesii (P1) habit



Plate 2: Eremophila warnesii (P1) flower

4 DISCUSSION

During the current survey the botanists were able to record *E. warnesii* individuals approximately 20 m either side of the transects they were traversing, as the distinctive shrub form of the species was clearly visible. Where plants occurred at high densities, time constraints meant that plants were mapped as patches with individuals in each patch estimated. Although not precise, this allowed for an indicative number of *E. warnesii* plants to be recorded.

Juvenile *E. warnesii* plants were observed growing in high densities underneath mature *E. warnesii* individuals and also under other native species, particularly *Acacia* spp. The population within the western patch at Yarlaweelor Station visibly extended to the north and south of the areas traversed during the November survey. In addition, the population within the eastern patch is likely to extend to the north-east. Since the entirety of the areas were not surveyed during the current survey and due to the high number of juvenile plants, it is likely that additional *E. warnesii* individuals occur adjacent to the recorded areas. Intensive survey effort would be required to characterise the entire population area.

Incorporating the results from the current and previous surveys, a total of 19,417 *Eremophila warnesii* individuals have been recorded within the broader region (Woodman Environmental 2009, 2012; Biologic 2022).

The individuals recorded during the survey occur within the known typical habitat for the species which is described as 'red sand with open scrub' (Brown and Buirchell 2011; Western Australian Herbarium 2023). This differs from the habitat where the species persists in the site, which is on the side of steep mountain slopes.

Emerge's predictive modelling indicated that elevated landforms to the east and west of the site contained suitable habitat for *Eremophila warnesii*. This was influenced by the large population within the same landform on Mount Gould. Previous surveys searching for other priority species in May and August indicated that the areas of interest to the west of the site were not suitable habitat for *E. warnesii* and so were not traversed in November. An area of interest in Yarlaweelor Station was traversed and suitable habitat was not observed. Due to time constraints, similar landforms where predictive mapping indicated suitable habitat was present on Buttah Station and Mount Padbury Station to the east were not visited.

Summary and closing

A total of 6,570 individuals of *Eremophila warnesii* (P1) were recorded during the targeted survey, with a further 9,500 individuals estimated to occur within three patches. Incorporating results from current and previous surveys there are 19,417 records for the species in the broader area. Further undocumented individuals are likely to occur within Yarlaweelor Station.

We trust that this letter provides sufficient details on the *E. warnesii* targeted survey. Should you have any queries or require further information, please do not hesitate to contact the undersigned.

Yours sincerely
Emerge Associates



Rachel Weber
SENIOR ENVIRONMENTAL CONSULTANT, TEAM LEADER – ECOLOGY

cc: none

Encl: Figure 1: Map Reference Plan
Figure 2: Regional areas searched for *Eremophila warnesii* – Area 1
Figure 3: Regional areas searched for *Eremophila warnesii* – Area 2 (Mount Gould Station)
Figure 4: Regional areas searched for *Eremophila warnesii* – Area 3 (Yarlaweelor Station)
Figure 5: Regional areas searched for *Eremophila warnesii* – Area 3 (Yarlaweelor Station)

General References

Biologic 2022, Mount Gould: Flora and Vegetation Assessment, Revision 1.

Brown, A. and Buirchell, B. 2011, A Field Guide to the Eremophilas of Western Australia, Simon Nevill Publications.

Department of Biodiversity, Conservation and Attractions (DBCA) 2017, Threatened and Priority Flora Report Form - Field Manual.

Department of Biodiversity Conservation and Attractions (DBCA) 2019, Conservation Codes for Western Australian Flora and Fauna - last updated 3 January 2019.

Western Australian Herbarium 2023, Florabase, Department of Biodiversity, Conservation and Attractions (DBCA), <https://florabase.dpaw.wa.gov.au/>.

Woodman Environmental 2009, Mount Gould DSO Project - Flora and Vegetation Assessment, Atlas08-10-01, Revision 0.

Woodman Environmental 2012, Mount Gould DSO Project - Local and Regional Significant Flora Assessment and Regional Vegetation Review, Atlas11-23-01, Revision 0.

Figures

Figure 1: Map Reference Plan

Figure 2: Regional areas searched for Eremophila warnesii – Area 1

Figure 3: Regional areas searched for Eremophila warnesii – Area 2 (Mount Gould Station)

Figure 4: Regional areas searched for Eremophila warnesii – Area 3 (Yarlaweelor Station)

Figure 5: Regional areas searched for Eremophila warnesii – Area 3 (Yarlaweelor Station)

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500000 520000 540000 560000 580000 600000 620000

7180000

7160000

7140000

7120000

Figure 2

Figure 3

Figure 4

Figure 5

Site boundary
Target area
GPS tracklog (May 2023)
GPS tracklog (August 2023)
Helicopter track (August 2023)
GPS tracklog (November 2023)

Figure 1: **Map Reference Plan**

Project: Targeted Flora Survey - *Eremophila warnesii*
Mount Gould Iron Project
Client: Newcam Minerals

Plan Number:
EP23-037(02)--F19
Drawn: SCM
Date: 21/12/2023
Checked: SCM
Approved: RAW
Date: 21/12/2023

N

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Kilometers
Scale: 1:350,000@A3
GDA2020 MGA Zone 50

emerge ASSOCIATES

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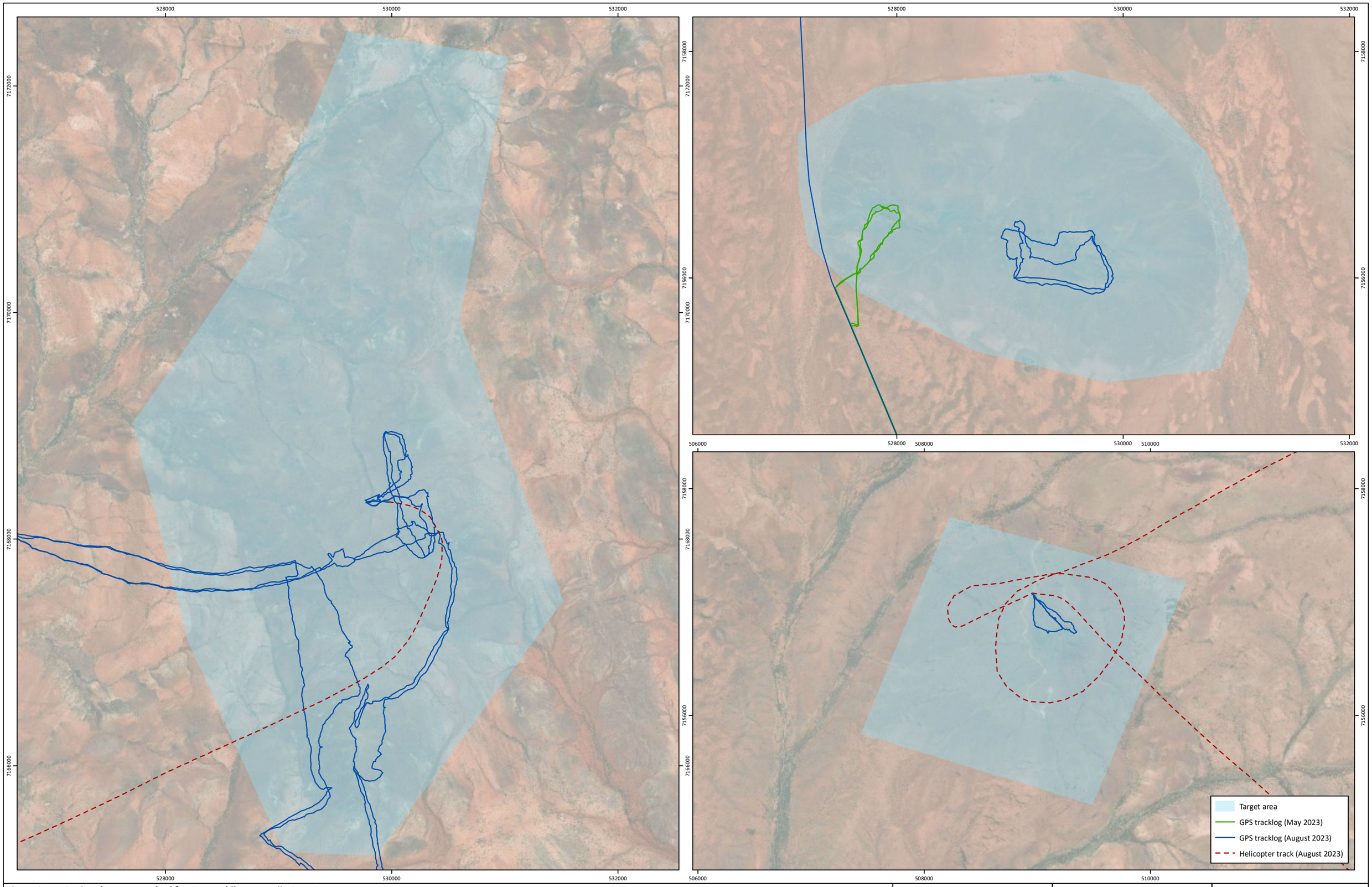


Figure 2: **Regional areas searched for *Eremophila warnesii* - Area 1**

Project: Targeted Flora Survey - *Eremophila warnesii*
Mount Gould Iron Project
Client: Newcam Minerals

Plan Number:
EP23-037(02)--F20
Drawn: SCM
Date: 21/12/2023
Checked: SCM
Approved: RAW
Date: 21/12/2023

N

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Metres
Scale: 1:30,000@A3
GDA2020 MGA Zone 50

emerge ASSOCIATES

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530000 535000 540000 545000 550000

7145000

7140000

7135000

Site boundary

GPS tracklog (November 2023)

Figure 3: **Regional areas searched for *Eremophila warnesii* - Area 2 (Mount Gould Station)**

Project: Targeted Flora Survey - *Eremophila warnesii*
Mount Gould Iron Project
Client: Newcam Minerals

Plan Number:
EP23-037(02)--F21
Drawn: SCM
Date: 21/12/2023
Checked: SCM
Approved: RAW
Date: 21/12/2023

N

0 1 2 3
Kilometers
Scale: 1:75,000@A3
GDA2020 MGA Zone 50

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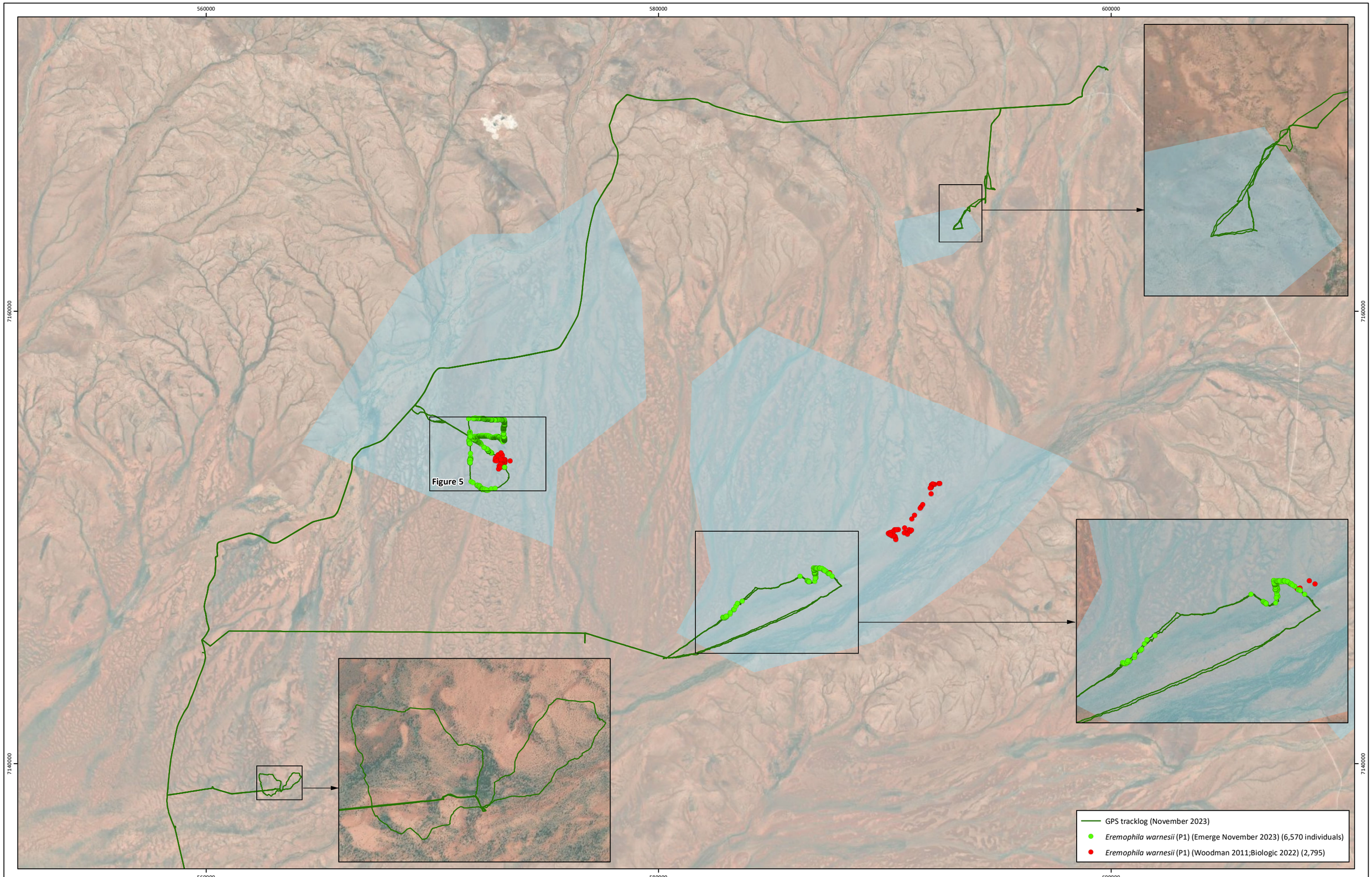


Figure 4: **Regional areas searched for *Eremophila warnesii* - Area 3 (Yarlaweelor Station)**

Project: Targeted Flora Survey - *Eremophila warnesii*
Mount Gould Iron Project
Client: Newcam Minerals

Plan Number:
EP23-037(02)--F22
Drawn: SCM
Date: 21/12/2023
Checked: SCM
Approved: RAW
Date: 21/12/2023

N

0 3 6
Kilometers
Scale: 1:150,000@A3
GDA2020 MGA Zone 50

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570000 571000 572000 573000 574000 575000

7155000 7154000 7153000

Eremophila warnesii patch (9,500 individuals)
GPS tracklog (November 2023)
Eremophila warnesii (P1) (Emerge November 2023) (6,391)
Eremophila warnesii (P1) (Woodman 2011;Biologic 2022) (1,757)

Figure 5: **Regional areas searched for *Eremophila warnesii* - Area 3 (Yarlaweelor Station)**

Project: Targeted Flora Survey - *Eremophila warnesii*
Mount Gould Iron Project
Client: Newcam Minerals

Plan Number:
EP23-037(02)--F23
Drawn: SCM
Date: 21/12/2023
Checked: SCM
Approved: RAW
Date: 21/12/2023

N

0 250 500
Meters
Scale: 1:13,000@A3
GDA2020 MGA Zone 50

emerge ASSOCIATES

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APPENDIX 8: TARGETED FLORA SURVEY - HAUL ROAD AND SCREE DEPOSIT (EMERGE 2024B)

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Document Reference: EP23-037(02)—014 SCM

Emerge contact: Tom Atkinson

29 July 2024

Attention: Newcam Minerals
C/- MBS Environmental
4 Cook Street
West Perth WA 6005

Delivered by email to: BEaton@mbsenvironmental.com.au; Andrew@newcamminerals.com

Dear Beau

TARGETED FLORA SURVEY – HAUL ROAD AND SCREE DEPOSIT

1 INTRODUCTION

Newcam Minerals are operating the Mount Gould Iron Project within mining tenement M 52/236-I (herein referred to as the 'site'). The site extends over 612.97 hectares (ha), and is located within the Mount Gould Station pastoral lease, as shown in **Figure 1**.

Flora and vegetation assessments have previously been undertaken within the site and adjacent Mount Gould Station (Woodman Environmental 2009, 2012; Biologic 2022), which recorded a Priority 1[1] flora species, *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743)[2]. The previous surveys recorded the species as abundance counts, varying between one and 64 individuals.

Emerge Associates (Emerge) were engaged to undertake a targeted flora survey within the footprint of the haul road and the scree deposit within the site. The scope of work was to record any plants present as an individual count, to determine whether further undocumented *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) individuals occur within the two survey footprints.

2 METHODS

2.1 Field survey

Two botanists from Emerge visited the site on 4 July 2024 to conduct the targeted survey.

Searches were conducted for *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) on foot within the footprint of the haul road and the scree deposit.

2.2 Limitations

The survey was undertaken by suitably experienced botanists, and at an appropriate time of the year to detect the target species. The flowering period of *Halgania gustafsenii* var. Murchison (R.

[1] Refer Department of Biodiversity, Conservation and Attractions (DBCA) 2023, *Conservation codes for Western Australian Flora and Fauna 2023*.
[2] This species has since been upgraded to threatened ('endangered') pursuant to the *Biodiversity Conservation Act 2016*.

Meissner & B. Bayliss 743) is reported as August – October (Biologic 2022). However, many individuals were observed to be flowering during the current survey and sterile individuals were otherwise distinct and readily detectable. All parts of the site could be accessed as required.

Records were located using handheld GPS receivers with a precision ±5-10 metres (m).

3 RESULTS

A total of 595 individuals of *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) were recorded of which 373 relate to the haul road (**Figure 2**) and 222 relate to the scree deposits (**Figure 3**).

4 DISCUSSION

Due to the distinctive habit and flowers of the species it is readily detectable. Few, if any, individuals are likely to have remained undetected within the areas surveyed.

Surveyor's pegs noted in the field were used to guide the haul road survey. As a consequence, 19 individuals were recorded outside of the reported survey boundary (**Figure 2**). These individuals were included in haul road total on the assumption the surveyor's pegs defined the footprint correctly and with greater accuracy than the spatial data presented in map figures.

In the larger of the scree deposit survey areas, a majority of vegetation had been cleared prior to the survey as shown in **Plate 1**. Some 318 *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) individuals had been recorded in previous surveys within this cleared portion of the scree deposit (Woodman Environmental 2009, 2012; Biologic 2022). No individuals were recorded in the recently cleared area during the current survey.



Plate 1: Cleared area (on left) and remnant vegetation (on right) within scree deposit

Summary and closing

A total of 595 individuals of *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) were recorded during the targeted survey. All individuals present are considered to have been recorded. Recent clearing may have reduced the number of individuals within the scree deposit survey by approximately 300 individuals, based on the records from previous surveys.

We trust that this letter provides sufficient details on the targeted survey. Should you have any queries or require further information, please do not hesitate to contact the undersigned.

Yours sincerely
Emerge Associates



Tom Atkinson
PRINCIPAL ENVIRONMENTAL CONSULTANT - ECOLOGY

cc: Andrew Swiericzuk, Newcam Minerals

Encl: Figure 1: Site Location
Figure 2: *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) (EN) Records – Haul Road
Figure 3: *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) (EN) Records – Scree Deposit

General References

Biologic 2022, Mount Gould: Flora and Vegetation Assessment, Revision 1.

Department of Biodiversity, Conservation and Attractions (DBCA) 2023, Conservation codes for Western Australian Flora and Fauna 2023.

Woodman Environmental 2009, Mount Gould DSO Project - Flora and Vegetation Assessment, Atlas08-10-01, Revision 0.

Woodman Environmental 2012, Mount Gould DSO Project - Local and Regional Significant Flora Assessment and Regional Vegetation Review, Atlas11-23-01, Revision 0.

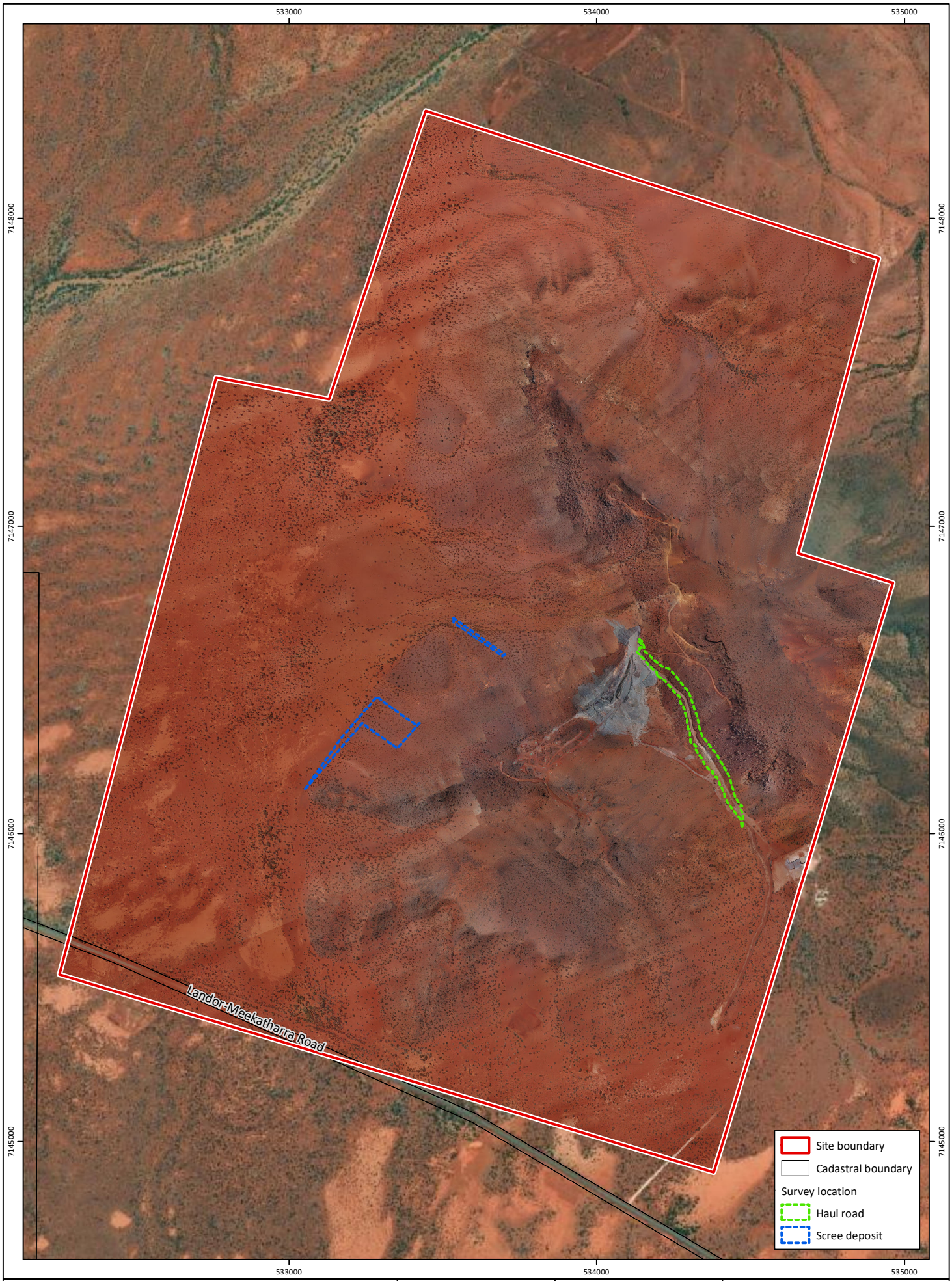


Figure 1: ***Halgania gustafsenii*** **var. Murchison (R. Meissner and B. Bayliss 743) (EN) Survey Area**

Project: Targeted Flora Survey
Mount Gould Iron Project

Client: Newcam Minerals

Plan Number: EP23-037(02)--F26

Drawn:	SCM
Date:	26/07/2024
Checked:	SCM
Approved:	TAA
Date:	29/07/2024

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0 200 400
Metres

Scale: 1:16,000@A4

GDA2020 MGA Zone 50

emerge ASSOCIATES

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Figure 2: ***Halgania gustafsenii*** **var. Murchison (R. Meissner and B. Bayliss 743) (EN) Records - Haul Road**

Project: Targeted Flora Survey
Mount Gould Iron Project

Client: Newcam Minerals

Plan Number: EP23-037(02)--F27

Drawn:	SCM
Date:	26/07/2024
Checked:	SCM
Approved:	TAA
Date:	29/07/2024

N

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Metres

Scale: 1:2,500@A4

GDA2020 MGA Zone 50

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Figure 3: ***Halgania gustafsenii*** **var. Murchison (R. Meissner and B. Bayliss 743) (EN) Records - Scree Deposit**

Project: Targeted Flora Survey
Mount Gould Iron Project

Client: Newcam Minerals

Plan Number:
EP23-037(02)--F28

Drawn:	SCM
Date:	26/07/2024
Checked:	SCM
Approved:	TAA
Date:	29/07/2024

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Metres

Scale: 1:4,000@A4

GDA2020 MGA Zone 50

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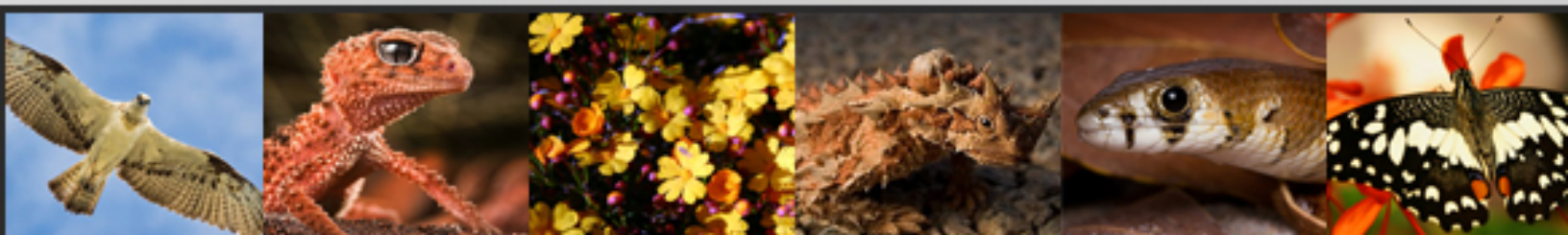
APPENDIX 9: MOUNT GOULD VERTEBRATE FAUNA STUDY (BIOLOGIC 2012A)

biologic

Mount Gould Short-range Endemic Invertebrate Survey Report

Atlas Iron Ltd

July 2012



DOCUMENT STATUS				
Version No.	Author	Review / Approved for Issue	Approved for Issue to	
			Name	Date
1	Brad Durrant	Morgan O'Connell	Clare Grosser	01/06/2012
2	Brad Durrant	Morgan O'Connell	Clare Grosser	17/07/2012

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EXECUTIVE SUMMARY

Biologic Environmental Survey (Biologic) was commissioned by Atlas Iron Ltd (Atlas) to undertake a short-range endemic (SRE) survey to support the environmental approval for the Mount Gould tenement (52/236), hereafter referred to as the Study Area. The Study Area is approximately 610 hectares (ha) and is located approximately 150 kilometres (km) north-west of the township of Meekatharra, in the Murchison region in Western Australia. Mount Gould is an isolated feature in the landscape, with a number of habitats (outcropping, ironstone bouldering and spinifex communities) that are regarded as prospective for SRE fauna, largely as they are not found in the surrounding area.

The objective of this survey was to conduct a Level 2 SRE invertebrate fauna survey within the *Study Area*.

The database searches recorded no previous records of SRE taxa in the Study Area, and only one species in the surrounding area (the land snail *Pupoides* cf. *adelaidae*) that was also recorded in this survey.

Forty sites were chosen in the Study Area, 20 SRE sites and 20 reference sites, covering all habitats prospective for SRE fauna (SRE sites) and habitats not prospective (reference sites).

Of the eight taxa recorded in the Study Area (seven from this survey and one from previous work), only two can be considered Potential SREs, the pseudoscorpion *Synsphyronus* 'PSE010', and the trapdoor spider *Idiommatta* 'MYG254'. *Synsphyronus* 'PSE010' is known to occur outside of the Study Area but still regarded as limited to the local area. *Idiommatta* 'MYG254', which was collected in a dry pit trap during vertebrate survey work, was a mature male, likely in search of a mate. This species is regarded as a Potential SRE, however, whether the population of this species (burrows) is present in the Study Area, or this individual has wandered in from outside the Study Area in search of a mate, is unknown. It is likely that this species occurs in the surrounding plains, and outside of the Study Area.

All other taxa recorded are either known to be widespread or are unlikely to be restricted. As well, all taxa recorded (other than singletons) were found in a variety of habitats (including exposed habitats), and not restricted to a particular habitat type (including *Synsphyronus* 'PSE010').

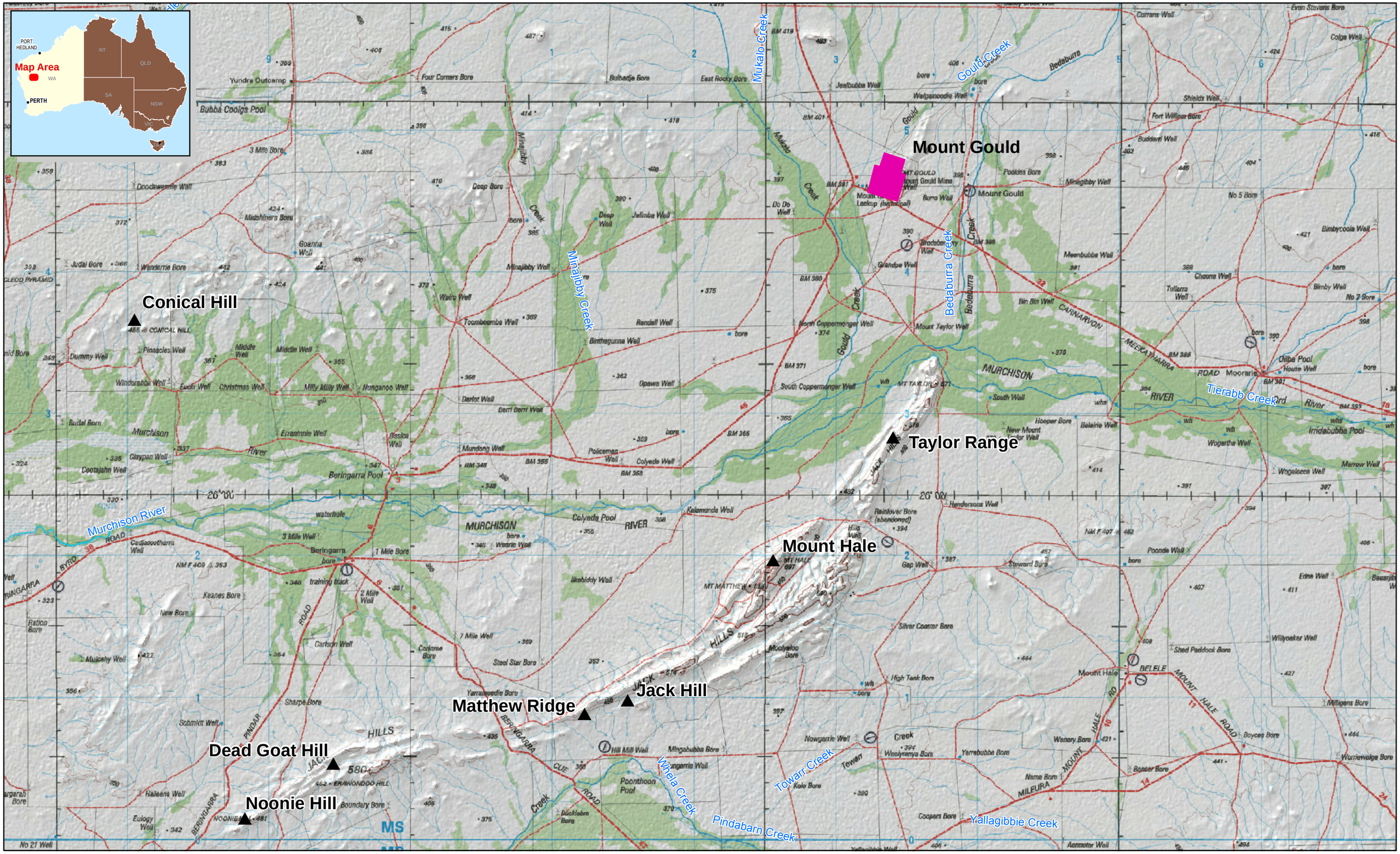
The isolated nature of Mt Gould is what is largely driving the SRE prospectivity of the habitats in the Study Area, however, the species recorded within these habitats were also found in other, non-prospective, habitats, including areas more exposed, and many beyond the Study Area in the adjacent Jack Hills. The only Potential SRE known from Mount Gould, that has not been recorded elsewhere, is the trapdoor spider *Idiommatta* 'MYG254', which may require further survey work to establish where the species occurs with respect to the Study Area.

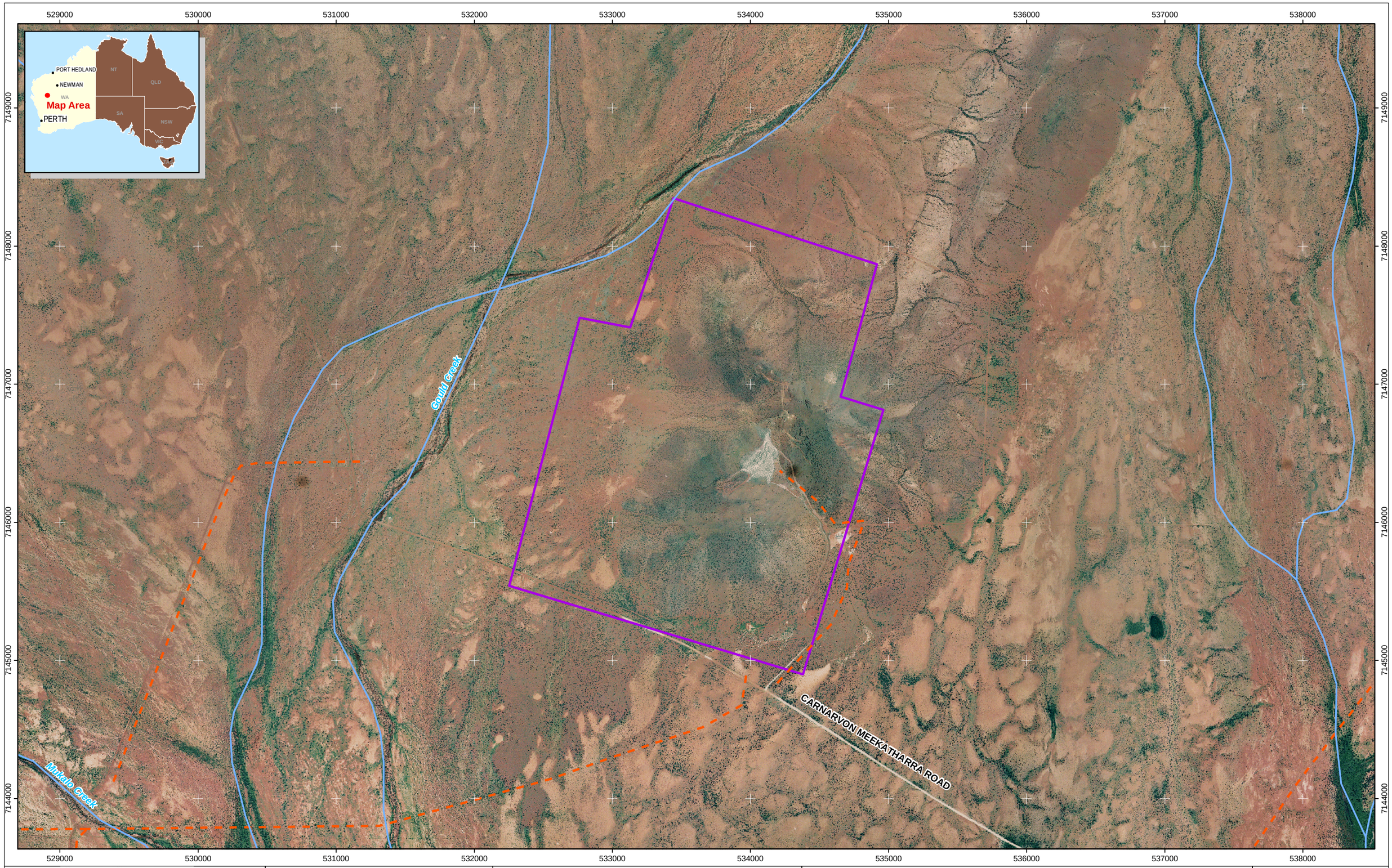
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The objective of this survey was to conduct a Level 2 SRE invertebrate fauna survey within the Study Area (Figure 1.2) with the following aims:

- Undertake a SRE literature review for the Study Area and the surrounding area. The literature review should include a summary of previous fauna survey results, literature review and search of relevant specimen databases;
- Undertake a SRE survey of the Study Area. Surveys are to be undertaken in accordance with EPA (2009), Sampling of Short Range Endemic Fauna for Environmental Impact Assessment in Western Australia. Methodology should target all SRE species within the Study Area and include any reference sites as required in adjacent areas (taking into consideration previous survey work completed).
- Prepare a SRE report detailing the results of the survey.


PORT HEDLAND
Map Area
WA
NT
QLD
SA
NSW
PERTH
Mount Gould
Conical Hill
Taylor Range
Mount Hale
Matthew Ridge
Jack Hill
Dead Goat Hill
Noonie Hill
Mukalo Creek
Gould Creek
Bedaburra Creek
Minajibby Creek
Tierabb Creek
Murchison River
Towarr Creek
Wirela Creek
Pindabarn Creek
Yallagibbie Creek
Yundra Outcamp
Bubba Cooliga Pool
Four Corners Bore
Bulbadja Bore
East Rocky Bore
Jealbubba Well
Walgainoodie Well
Bedaburra
Currans Well
Evan Stevens Bore
Colga Well
Shields Well
Fort William Bore
Buddarri Well
Pookies Bore
Minegibby Well
No 5 Bore
Bimbycoola Well
Meenbubba Well
Choona Well
Tullarra Well
Bimby Well
No 2 Bore
Olibe Pool
House Well
Moorarie
Irridabubba Pool
Wogartha Well
Wogaleece Well
Marrow Well
Doodawennie Well
3 Mile Bore
Midshiners Bore
Goanna Well
Judal Bore
Wandarrie Bore
Deep Bore
Jalimba Well
Minajibby Well
Wairo Well
Toomboomba Well
Randall Well
Binthagunna Well
Opawa Well
Derlot Well
Berri Berri Well
Dummy Well
Pinnacles Well
Middle Well
Windorabba Well
Euda Well
Christmas Well
Milly Milly Well
Nunganoo Well
Budal Bore
Murchison
Erraninnie Well
Ossica Well
Glaypan Well
Cootajahn Well
Beringarra Pool
Mundong Well
Policeman Well
Colyeda Well
Waterhole
Colyeda Pool
Kalamunda Well
3 Mile Well
Beringarra
1 Mile Bore
Cadjacootharra Well
NM F 409
training track
2 Mile Well
Keanes Bore
New Bore
Ration Bore
Carlson Well
7 Mile Well
Steel Star Bore
Corktree Bore
Yarrameedie Bore
Sharpe Bore
Schmitt Well
Hill Mill Well
Mingabubba Bore
Poonthoon Pool
Buckleabn Bore
Halleens Well
Eulogy Well
Boundary Bore
No 21 Well
Ilkabiddy Well
Mt Matthew
Rainbover Bore (abandoned)
Hills Well
Gap Well
Steward Bore
Silver Coaster Bore
Moolyaloo Bore
High Tank Bore
Shed Paddock Bore
Willyoaker Well
Milligens Bore
Hendersons Well
Poonde Well
Etna Well
Nowgarrie Well
Woolyramya Bore
Yerrabubba Bore
Kolo Bore
Coopers Bore
Nama Bore
Boyces Bore
Bonser Bore
Wanery Bore
Aermotor Well
Warriewolga Bore
Mt Gould Mine
Mount Gould Leakup (historical)
Burro Well
Do Do Well
Grandpa Well
Brodabbery Well
North Coppermonger Well
South Coppermonger Well
Mount Taylor Well
Bin Bin Well
South Well
New Mount Taylor Well
Hooper Bore
Belairie Well
Jack Hill
Mt Hale
Gap Well
Mount Hale
Beleele
Mount Hale Road
Carnarvon
Meekatharra
Road
River
Murchison
Creek
Gould
Bedaburra
Minajibby
Mukalo
Jack
Hills
Pindar
Beringarra
Cue
Road
Byrd
Mileura
Mount Hale Road
Hale Rd
Mount
Creek
Tower
Creek
Gould
Creek
Bedaburra
Creek
Minajibby
Creek
Mukalo
Creek



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ATLAS IRON
MT GOULD
Study Area

Figure 1.2

Legend

- Study Area
- Track
- Watercourse

Griffin Spatial & Mapping
2 Epacris Elbow Pelican Point
Bunbury WA 6230
griffinspatial@bigpond.com
+61 (0) 8 9725 3213

2. ENVIRONMENT

2.1 Biogeography

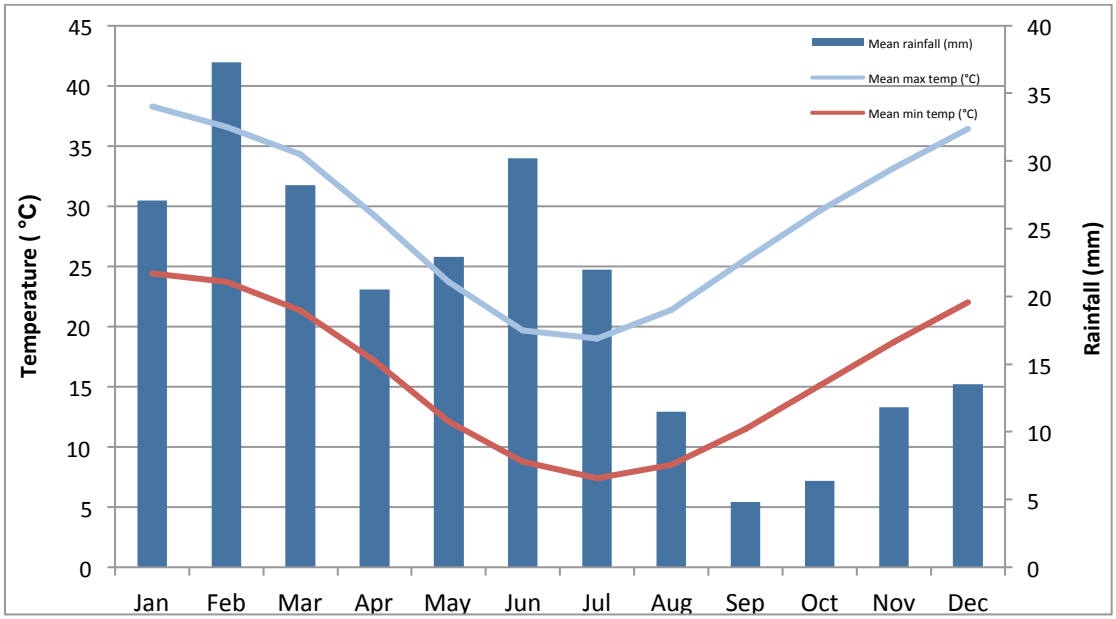
Broadly, the Study Area falls on the northern fringe of the Murchison biogeographical region as defined by the Interim Biogeographic Regionalisation of Australia (Thackway and Cresswell 1995). The Murchison Bioregion falls within the Bioregion Group 2 classification (EPA 2004). Bioregions within Group 2 have "native vegetation that is largely contiguous but is used for commercial grazing." The Murchison is subdivided into two subregions, and the Study Area lies in the Western Murchison subregion (MUR-2).

The general features of the Western Murchison subregion are summarised by Desmond *et al*. (2001). The subregion is characterised by low Mulga woodlands rich in ephemerals and bunch grasses on granitic outcrops and extensive hardpan washplains. It contains the headwaters of the Murchison and Wooramel Rivers. The landscape comprises low hills, mesas of duricrust, separated by flat colluvium and alluvial plains. The dominant land use is grazing and exploration.

2.2 Climate

The Murchison region has an arid climate with winter rainfall (Figure 2.1). The mean average annual rainfall is 210 mm, ranging from 190 mm in the northeast to 240 mm in the southwest (BOM, 2012). Summers are hot and dry, with average daytime temperatures reaching 38°C in January and winters are mild with cool nights.

Figure 2.1: Average climate data for Meekatharra (BOM 2012)



2.3 Landforms

The local topography is dominated by Jack Hills, an 80km long range consisting of folded and metamorphosed supracrustal rocks, including banded ironstone. Jack Hills are the most northern occurrence of the banded ironstone formation (BIF) ranges, occurring across the Murchison, Midwest and Goldfields. Mount Gould is an outlier of the Jack Hills range, occurring approximately 12 km north of the main range. The area surrounding Mount Gould consists of relatively flat, undulating plains.

2.4 Vegetation

The vegetation of the Mount Gould Study Area has been classified and mapped by Woodman Environmental Consulting (Woodman 2011) (Figure 2.2). Six Floristic Community Types (FCTs) are recognised from the area:

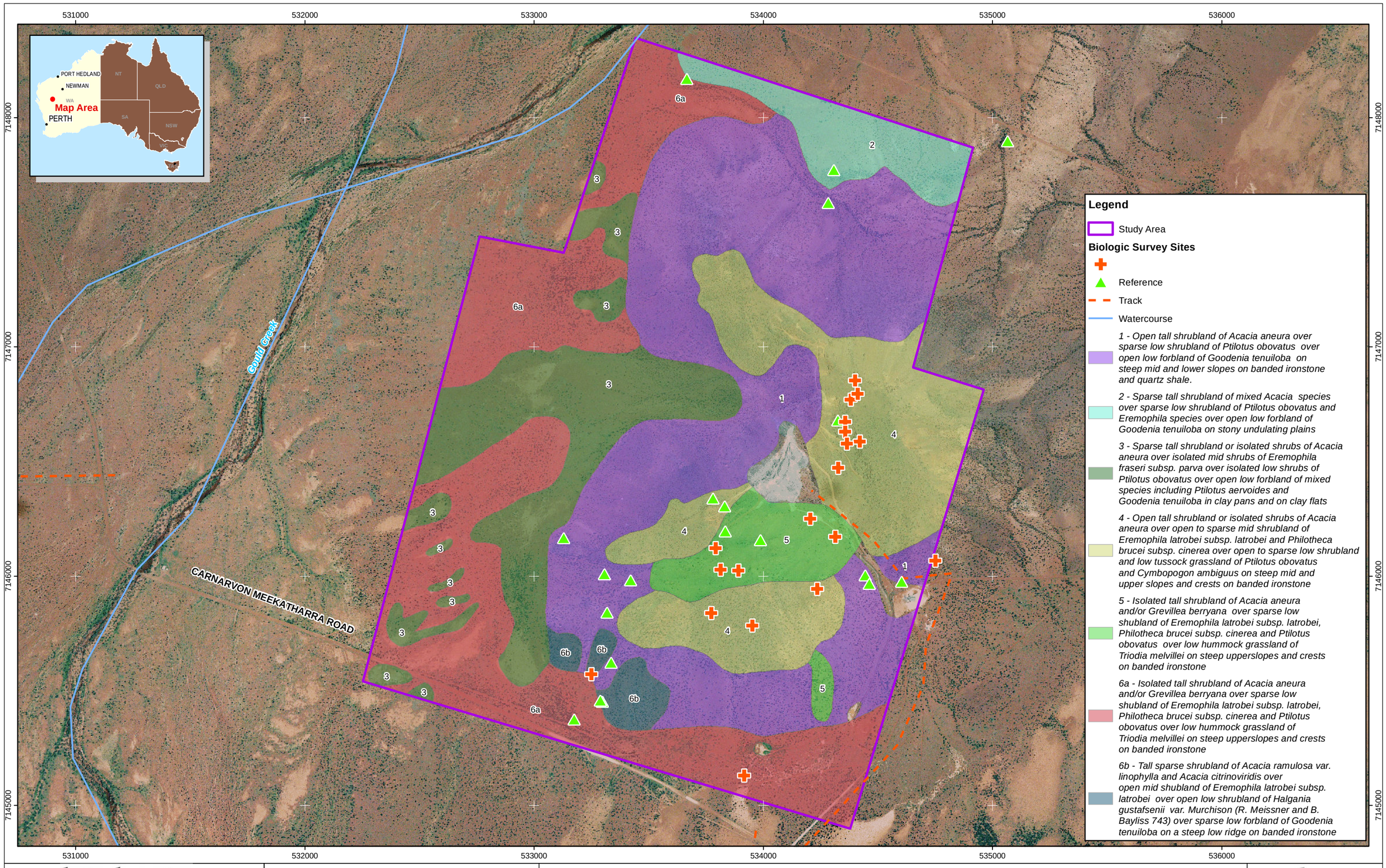
- FCT1: Open tall shrubland of *Acacia aneura* over sparse low shrubland of *Ptilotus obovatus* over open low forbland of *Goodenia tenuiloba* on steep mid and lower slopes on banded ironstone and quartz shale;
- FCT2: Sparse tall shrubland of mixed *Acacia* species over sparse low shrubland of *Ptilotus obovatus* and *Eremophila* species over open low forbland of *Goodenia tenuiloba* on stony undulating plains;
- FCT3: Sparse tall shrubland or isolated shrubs of *Acacia aneura* over isolated mid shrubs of *Eremophila fraseri* subsp*. parva* over isolated low shrubs of *Ptilotus obovatus* over open low forbland of mixed species including *Ptilotus aervoides* and *Goodenia tenuiloba* in clay pans and on clay flats;
- FCT4: Open tall shrubland or isolated shrubs of *Acacia aneura* over open to sparse mid shrubland of *Eremophila latrobei* subsp. *latrobei* and *Philotheca brucei* subsp. *cinerea* over open to sparse low shrubland and low tussock grassland of *Ptilotus obovatus* and *Cymbopogon ambiguus* on steep mid and upper slopes and crests on banded ironstone;
- FCT5: Isolated tall shrubland of *Acacia aneura* and/or *Grevillea berryana* over sparse low shrubland of *Eremophila latrobei* subsp. *latrobei*, *Philotheca brucei*; subsp. *cinerea* and *Ptilotus obovatus,* over low hummock grassland of *Triodia melvillei* on steep upperslopes and crests on banded ironstone;
- FCT6a:Open tall shrubland of *Acacia ramulosa* var. *linophylla* and *A. kempeana* over sparse mid shubland of *Eremophila forrestii* subsp. *forrestii* over isolated low shrubland of

Corchorus crozophorifolius over sparse low grassland and forbland of mixed species including *Eriachne mucronata* and *Ptilotus aervoides* on flat plains; and

- FCT6b:Tall sparse shrubland of *Acacia ramulosa* var. *linophylla* and *A. citrinoviridis* over open mid shubland of *Eremophila latrobei* subsp. *latrobei* over open low shrubland of *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) over sparse low forbland of *Goodenia tenuiloba* on a steep low ridge on banded ironstone.

The vegetation at Mount Gould includes a significant ecological community, the Mount Gould Vegetation Complexes (banded ironstone formation), listed as a Priority 1 Ecology Community (PEC) by the DEC. Priority 1 PECs are described as:

"Ecological communities that are known from very few occurrences with a very restricted distribution (generally < 5 occurrences or a total area of < 100 ha). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat or for which current threats exist" (DEC, 2010).



biologic
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ATLAS IRON

MT GOULD

Vegetation Communities (Woodman 2012)

Figure 2.2

Griffin Spatial & Mapping
2 Epacris Elbow Pelican Point
Bunbury WA 6230
griffinspatial@bigpond.com
+61 (0) 8 9725 3213

2.5 Land Systems

Curry *et al*. (1994) classified and mapped the Land Systems of the Murchison region, including the area containing Mount Gould. Land Types and Land Systems are classified according to similarities in landform, soil, vegetation, geology and geomorphology and the combination of these factors can provide an indication of the fauna habitats present at a site. The Study Area is dominated by the Peak Hill Land System (Pea) and flanked by the Cole (Col) and Beringarra (Ber) Land Systems. These are detailed in Table 2.1, and summarised below. The percentage provided in Table 2.1 indicates the percentage of that particular habitat type within each of the different Land Systems, and is not specific to the Study Area.

- Peak Hill System (Pea): rugged sinuous ranges and rounded hills of Proterozoic banded ironstone and hematitic shale, supporting stunted mulga and cottonbush shrublands;
- Beringarra Land System (Ber): Major riverine plains with active lower floodplains flanking channelled watercourses, supports mostly halophytic shrublands and mixed *Acacia* shrublands and low woodlands with minor perennial grasses; and
- Cole Land System (Col): Hardpan wash plains with reticulate patterns of wanderrie banks and mulga groves and more concentrated drainage tracts, supporting mixed mulga and wanderrie shrublands.

Table 2.1: Land Systems present within the Study Area.

Landform	Landform and Soil	Vegetation
Peak Hill Land System		
Hills and ridges (50%)	Rough hills and ridges, generally covered with dense ironstone mantles and frequent outcropping. Skeletal soils, confined to pockets of shallow loamy sands.	Very scattered mixed shrublands with *Acacia* spp. co-dominant. Shrubs include *Acacia aneura*, *A. tetragonopyhlla*, *Eremophila latrobei*, *E. exilifolia*, *Senna desolata*, *Solanum* spp. Perennial grasses: *Eriachne* spp., *Eragrostis* spp.
Lower slopes and interfluves (40%)	Gently sloping footslopes or rounded interfluxes flanking hills and ridges, covered in moderately dense ironstone mantles. Soils are dark red loamy sands.	Very scattered mixed shrublands dominated by *Acacia grasbyi*. Trees (to 6m): *A. pruinocarpa*, *A. aneura*, *A. aff. citrinoviridis*. Mid shrubs (1-2m): *A. grasbyi*, *Senna desolata*, *Eremophila latrobei*. Low shrubs (<1m): *Senna helmsii*, *Ptilotus obovatus*, *P. rotundifolius*, *Euphorbia boophthona*.

Landform	Landform and Soil	Vegetation
Drainage floors and minor channels (10%)	Narrow dendritic channels to 10m wide grading into broad saline alluvial fans and minor valley floors. Soils are dark red loamy sands with ironstone fragments.	Scattered mixed shrublands dominated by *Acacia aneura*, *A. tetragonophylla* or *A. victoriae*. Mixed shrubs (1-2m): *Eremophila* spp. Low shrubs (<1m): *Ptiolus obovatus*, *Senna* spp., *Solanum lasiophylum*.
Berringgara Land System		
Hardpan plains (30%)	Almost flat alluvial plains. Soils are hardpan loams and red earths.	Scattered to moderately close mixed shrublands dominated by *Acacia aneura*.
Alluvial plains (40%)	Very gently sloping saline alluvial plains. Soils are generally deep crusted or hard setting duplexes with occasional red earths.	Patchy mixed shrublands, often dominated by *Acacia victoriae*, *Senna desolata*, *Eremophila pterocarpa* or *Hakea preissii*.
Floodplains and inter-channel zones (20%)	Almost flat, active floodplains with locally cracking or gilgai surfaces. Soils are variable crusted duplexes and yellowish-red to brown clays.	Moderately closed to closed woodlands with upper storey of *Acacia distans* or low shrublands dominated by *Atriplex amnicola* and *Maeriana pyramida*.
Wide drainage floors (5%)	Flat drainage zones, with occasional anastomosing channels. Soils are yellowish red to brown clays and duplex types.	Moderately close woodlands and tall shrublands. Trees (6-8m): *Acacia distans, A. aneura, Eucalyptus coolibah*. Tall shrubs (>2m): *A. tetragonophylla*, *A. victoriae*, *Eremophila fraseri, E. lanata*. Mid shrubs (1-2m): *E. fraseri, Scaevola spinescens*.
Channels (5%)	Riverbeds and seasonal watercourses up to 100m wide and incised to 3m. Channels carry bedloads of coarse sand. Soils on banks are reddish brown alluvial silty clays and fine sandy loams.	Major channel beds unvegetated, otherwise moderately close to closed mixed woodlands with dense under shrubs on banks of major channels and floors of minor channels. Trees include *Casuarina obesa, Eucalyptus camaldulensis, E. coolibah.*
Cole Land System		
Sand sheets (5%)	Isolated tracts of slightly elevated sand plain. Soils are earthy sands.	Scattered tall shrublands dominated by *Acacia aneura*, *A. ramulosa* or *Eremophila forrestii* with a grassy layer prominent in places. Trees include *Acacia kempeana, A aneura, A. ramulosa, Grevillea* sp.

Landform	Landform and Soil	Vegetation
Wanderrie banks (25%)	Complex networks of interconnecting wanderrie banks. Soils are earthy sands.	Scattered tall shrublands dominated by *Acacia aneura, A. ramulosa, Eremophila forrestii* with a grassy layer prominent. Trees include *Acacia kempeana, A aneura, A. ramulosa, Grevillea* sp.
Hardpan plains (45%)	Level plains carrying sheet flow between sandy banks and groves.	Very scattered to scattered tall shrublands dominated by *Acacia aneura*. Trees and shrubs include *Acacia aneura, A. pruinocarpa, A. quadrimarginea, Grevillea striata, Hakea subera, A kempeana, Eremophila fraseri*.
Mulga groves (<5%)	Numerous *Acacia* groves up to 100m wide some with sandy accumulations and grading into wanderrie banks. Soils are dark red hardpan sandy clay loams or sandy clays.	Moderately close to closed low Mulga woodland dominated by *Acacia aneura, A. tetragonophylla or Eremophila fraseri.* Trees include *A. aneura, A. pruinocarpa, A. tetragonophylla, A. distans, Psydrax latifolia, Grevillea striata*.
Broad drainage zones (20%)	Very gently incised plains mostly occurring as broad, unchannelled tracts. Soils are mostly yellowish red or red earths or loams.	Scattered to moderately close tall shrublands dominated by *Acacia aneura* or *A. tetragonophylla*. Trees and shrubs include *A. aneura, A. kempeana, A. tetragonophylla, A. grasbyi, Eremophila fraseri, E. forrestii.*

3. ASSESSMENT METHODOLOGY

3.1 Database review

Two online databases and two WA Museum databases were searched for terrestrial SRE records:

- Department of Environment and Conservation's (DEC) NatureMap (accessed 14/03/2012);
- Atlas of Living Australia (ALA) (accessed 14/03/2012);
- WA Museum Arachnid database (accessed 15/03/2012); and the
- WA Museum Mollusc database (accessed 15/03/2012).

DEC's NatureMap allows a maximum of a 40 km radius around a precise centroid, defined as above. For the ALA a 50 km radius around a centroid (Mt Gould: 25.803159°S 117.339858°E) was used. ALA allows access to the biodiversity records of the Online Zoological Collections of the Australian Museum (OZCAM), which accesses collection data from the following institutions:

- Museum of Victoria;
- Museum and Art Gallery of the Northern Territory;
- South Australian Museum;
- Commonwealth Scientific and Industrial Research Organisation (CSIRO);
- Australian National Wildlife Collection;
- Western Australian Museum;
- Queen Victoria Museum and Art Gallery;
- Tasmanian Museum and Art Gallery; and
- Queensland Museum.

The WA Museum arachnid and mollusc databases was searched using a bounding box 100km x 100km. This search differs from the ALA search in that OZCAM does not have access to the entire WA Museum database.

3.2 Review of previous studies

No previous SRE studies have taken place at Mt Gould, but vertebrate fauna survey work has taken place (Biologic 2012). As part of this survey work, any SRE specimens captured in dry pit traps were collected for inclusion in this report.

3.3 Field survey methods

A single season survey was carried out in the Study Area, comprising a variety of active foraging techniques (hand foraging, litter sifting, soil sifting and vegetation beating) and targeting the primary SRE taxonomic groups (trapdoor spiders (mygalomorphae), scorpions, millipedes, pseudoscorpions and land snails). Isopods were also collected, as they are easy to collect and are usually the second most prevalent group in SRE surveys, behind pseudoscorpions, and, as such, usually provide robust data to help illustrate continuity of habitats.

3.3.1 Site selection

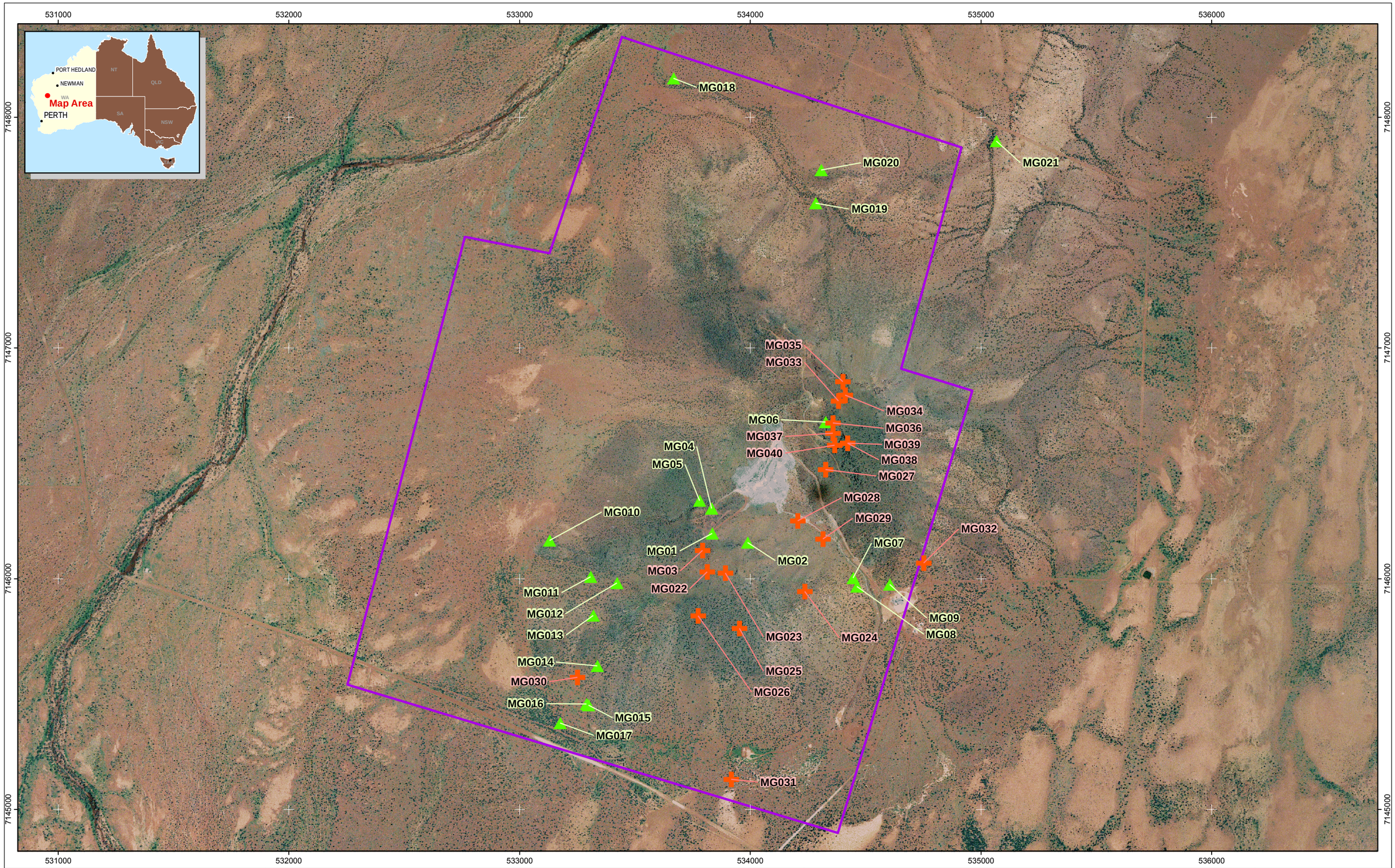
Sites were chosen according to Guidance Statement 20 (EPA 2009) and Biologic's SRE Prospectivity Assessment Guidelines (Appendix A), and in conjunction with the vegetation mapping by Woodman (2011). Habitats considered prospective for SRE terrestrial invertebrates at Mt Gould are listed below, along with the level of Prospectivity. A more detailed assessment of these habitats is provided in Appendix B. Forty sites were chosen in the Study Area (Figure 3.1) 20 SRE sites and 20 reference sites.

Table 3.1: SRE habitat types surveyed

Habitat Type	Description	SRE Prospectivity
Mixed *Acacia*	Tall, mixed *Acacia* shrubland.	3: possible (Figure 3.2)
Rocky Outcrops	South-west facing outcrops	4: likely (Figure 3.3)
Bouldering	Boulders at peak	3: possible (Figure 3.4)
Spinifex	*Triodia melvilliei* community	4: likely (Figure 3.5)

Table 3.2: Reference (non-SRE) habitat types surveyed

Habitat Type	Description	SRE Prospectivity
Exposed slopes	Slight and/or not facing South	1: highly unlikely (Figure 3.6)
Mulga plains	Stoney and sandy plains	1: highly unlikely (Figure 3.7)
Exposed outcrops	Not facing South	1: highly unlikely (Figure 3.8)
Minor drainage line	Exposed, with minor vegetation change	2: unlikely (Figure 3.9)



biologic
ENVIRONMENTAL SCIENCE

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ATLAS IRON
MT GOULD
Survey Sites
Figure 2.1

Legend

- Study Area

Biologic Survey Sites

- SRE Site
- Reference Site

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Plate 3.1: Mixed *Acacia* shrubland



Plate 3.2: Outcropping; south-facing



Plate 3.3: Ironstone bouldering



Plate 3.4: Spinifex communities



Plate 3.5: Exposed slopes



Plate 3.6: Mulga plains



Plate 3.7: Exposed outcropping



Plate 3.8: Minor drainage line



3.3.2 Sampling techniques

The sampling methodology adopted was carried out in accordance with the following documents:

- Environmental Protection Authority (EPA) Position Statement No. 3 'Terrestrial Biological Surveys as an Element of Biodiversity Protection' (EPA 2002);
- Guidance Statement No. 56 'Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia' (EPA 2004); and
- Guidance Statement No. 20 'Sampling of Short Range Endemic Fauna for Environmental Impact Assessment in Western Australia' No. 20. (EPA 2009).

Active foraging was undertaken at each site for 1.5 person hours and involved the following techniques:

- Active searching/rock turning: Rocky habitats were actively searched for rock dwelling species of pseudoscorpions, scorpions and isopods.
- Leaf litter searching: Leaf litter was placed in a leaf litter reducer (leaf litter sieve) at the site and agitated so that any small species fall through onto a sheet, or a tray, for collection. This targets most SRE species but particularly pseudoscorpions, millipedes, snails and scorpions.
- Soil searching: Soil is collected from the base of large, and or, significant trees and vegetation. Soil up to 30 centimetres (cm) deep is put through a soil sieve and specimens collected. This technique primarily targets aestivating snails and millipedes.

3.3.3 Identification of Specimens

All specimens were lodged with the WA Museum. The pseudoscorpions were identified by Dr Mieke Burger and Dr Mark Harvey, the land snail by Corey Whisson and the isopods by Dr Simon Judd.

3.3.4 Habitat Assessment

Biologic carried out a habitat assessment at each of the 40 survey sites. These assessments were based on various aspects of the habitat, related largely to its protective qualities, e.g. topography and aspect, and vegetation, leaf litter, soil and rock type and availability.

3.3.5 Limitations

3.3.5.1 General limitations

The EPA (2009) identified several key limitations with respect to the assessment of SRE invertebrates, including:

- Lack of a complete taxonomic framework for many groups, which directly affects the determination of whether a taxa can be regarded as an SRE or not. Within this report five types of SRE taxa are recognised, so as to clearly identify those that have these taxonomic limitations. Of these five, only the first three (Known SRE, Potential SRE and Indet. SRE) are regarded as significant, with Unknown SREs and Non-SREs not considered further:
    - **Known SRE**: a taxon that is known to be a short-range endemic (SRE);
    - **Possible SRE**: a taxon or specimen that is not a Known SRE but belongs to a higher taxonomic group (e.g. genus or family) that indicates it may have a restricted distribution;
        - **Potential SRE**: a taxon that can be identified to species level and belongs to a higher taxonomic group that indicates it may have a restricted distribution, but lacks distributional data to state clearly whether it is or not;
        - **Indetermined SRE (Indet. SRE)**: a specimen that cannot be placed to species level, usually due to the specimen not having the required morphological state for species determination (i.e. a female or a juvenile), but belongs to a higher taxonomic group that indicates it may have a restricted distribution;
    - **Unknown SRE**: a taxon or specimen that belongs to a SRE group, is not known to occur outside of the Study Area, but it is not possible to determine its SRE status based on species, genus or family level identification; and
    - **Non-SRE**: a taxon that is either known to occur widely or is determined as unlikely to have a restricted distribution.
- Lack of sufficient taxonomic expertise to provide identifications for many groups within the timeframe required by project proposals;
- Difficulty sampling many taxa, which can be exacerbated by the lack of experience and knowledge of survey personnel. These difficulties usually result in sampling data that has severe limitations in its use, particularly with respect to quantitative analysis, but also with respect to assessing the likelihood of a taxon occurring in sites where it wasn't recorded. Any weight placed on the absence of a species at a site needs to be placed in this context; and
- Ecological and habitat knowledge of most taxa is incomplete, or based on broad assumptions.

3.3.5.2 Limitations specific to this survey

- Site selection was conducted in conjunction with vegetation mapping by Woodman (2011). However, there were some discrepancies between the boundaries and extent of some vegetation communities on the map and that on the ground, particularly the

spinifex and the mixed *Acacia* habitats. This needs to be taken into account when extrapolating SRE species distributions based on vegetation.

- The general area around Mount Gould received substantial rainfall one month prior to the survey being conducted. However, the Study Area appeared dry and the vegetation had not responded to the rainfall, in comparison with the surrounding area. Therefore, no microhabitats containing moisture were recorded during the habitat assessments. This is likely to have affected the level of activity of SRE taxa and hence the sampling efficiency.

4. RESULTS

4.1 Previous Studies at Mt Gould

Vertebrate fauna survey work conducted by Biologic (2012) recorded one mature male trapdoor spider in a dry pit trap at the peak of the southern hill, within the spinifex community. This occurrence is close to site MG03 of this survey. This species was identified as *Idiommatta* 'MYG254' (Family Barychelidae), which has not been previously recorded elsewhere. The WA Museum, and this report, regards this species as a **Potential SRE**.

While recording a mature male trapdoor spider is significant, the fact that only one specimen was captured during the dry pit trapping needs to be considered. Mature male trapdoor spiders generally only disperse when in search of a mate, and this is normally done en masse, often associated with a rain event, and can occur over large distances. The fact that no other specimens were recorded may mean that this specimen has wandered a considerable distance, and may not be a resident of Mount Gould. Conversely, it may be that the individual has ventured from the surrounding plains, which do form part of the Study Area.

4.2 Database Searches

The database search reported 31 target taxa, 27 from the WA Museum Arachnology database, two from the WA Museum Mollusc database, one from DEC's Naturemap and one from ALA, although the records of this particular species was also picked up within the WA Museum database search (Appendix B). No SRE taxa were previously known from the Study Area.

Of these taxa, only one was recorded in this survey, the land snail *Pupoides* cf. *adelaidae*. As well, some of the pseudoscorpion taxa in the database may well be conspecific with those recorded in the Study Area, but the taxonomic resolution is poor.

The other record of note is the presence of the mygalomorph *Idiosoma nigrum* at Jack Hills, which is regarded as likely the most northern occurrence of the species. *Idiosoma nigrum* is a Schedule 1 (Wildlife Conservation Act 1950) threatened trapdoor spider, which occurs through the northern Wheatbelt and Midwest regions. This species was not recorded at Mount Gould.

4.3 Field Survey

Twenty nine specimens of the target SRE taxa were collected from the 40 survey sites, 26 pseudoscorpions, three isopods and one land snail. These specimens comprised seven species (as discussed below) of which only one is considered a Potential SRE.

4.3.1 Pseudoscorpions

Twenty six specimens of pseudoscorpion were recorded in the *Study Area* comprising five possible species from four genera, and from two separate families (Garypidae and Olpiidae).

4.3.1.1 Synsphyronus

The first species, *Synsphyronus* 'PSE010' (Family Garypidae), was recorded at eight sites throughout the *Study Area* (Figure 4.1), with 15 specimens collected (five males, two females and eight juveniles). The WA Museum has commented that many species of *Synsphyronus* may represent a short-range endemic species (Harvey 1987), particularly species found in ground habitats such as under rocks and in soil, with the tree-dwelling species tending to be much more widely distributed, and less likely to be short-range endemics. The specimens recorded in this survey were all ground-dwelling but were found in a variety of microhabitats, including leaf litter, under rocks, and in the soil under spinifex. It was also found at a number of different habitat types; within spinifex, outcropping and boulders and on exposed slopes.

This species has also been recorded at Jack Hills, more than 100km to the south, but the current known range is still less than 8000km^2, which is still within the most recent definition of what constitutes a SRE species (Harvey 2002). Within the context of this survey we can regard this species as a **Potential SRE** which occurs outside of the Study Area.

4.3.1.2 Austrohorus

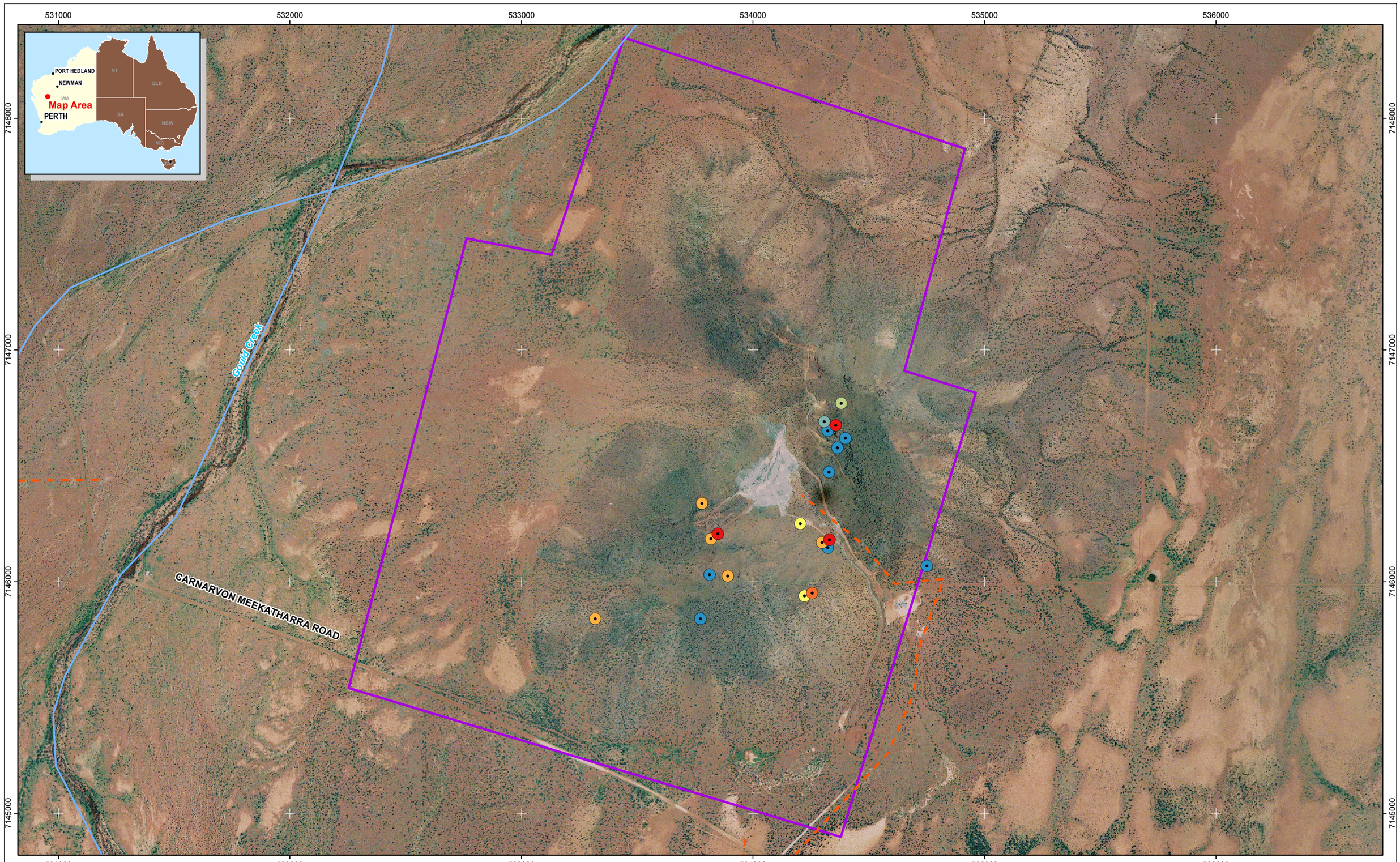
The second species was recorded as *Austrohorus* sp. (Family Olpiidae), which was recorded at two sites, with two specimens collected (one male and one juvenile). This species was found at two different habitats, the boulders and a spinifex site, indicating a lack of habitat preference, and therefore can regarded as less likely to be a restricted species.

The WA Museum has stated that based on their current levels of knowledge, it is not possible to state whether this species is a short-range endemic. As such, this species can be regarded as an **Unknown SRE.**

4.3.1.3 Beierolpium

The third species was *Beierolpium* 'sp. 8/4' (Family Olpiidae), recorded at one site, with two specimens collected (one male and one female).

An additional *Beierolpium* juvenile specimen was collected from one site, though it appears that this individual may be of a separate species from *Beierolpium* 'sp. 8/4' due to the presence of different morphological features than expected. Specimens recorded at a single site (also known as singletons) are difficult to assess as they do not allow statements to be made about distribution or habitat preference.



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Species Locations
Figure 3.1

Legend

- **Study Area**

Species Locations

- Isopod *Buddelundia* sp.
- Land Snail *Pupoides `cf. adelaidae`*
- Pseudoscorpion *Indolpium* sp.
- Pseudoscorpion *Austrohorus*
- Pseudoscorpion *Beierolpium* `sp. 8/4`
- Pseudoscorpion *Beierolpium* `sp. juv.`
- Pseudoscorpion *Synsphyronus `PSE010`*

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The WA Museum has stated that further taxonomic work is required on this genus before firm species identifications can be conducted and, as such, it is difficult to determine whether either of these two taxa are SREs. As such, both these specimens are regarded as **Unknown SREs**.

4.3.1.4 Indolpium

The fifth species, *Indolpium* sp. (Family Olpiidae), was recorded at five sites with six specimens collected (three males, one female and two juveniles). This species was recorded within a number of different habitats, including three sites that were exposed (reference sites) and two spinifex sites.

The WA Museum has commented that similar specimens have been collected from this region of WA and based on their current levels of knowledge it is unlikely that these specimens represent SRE species, and as such are regarded as **Non-SRE**.

4.3.2 Land Snails

One dead juvenile specimen closely resembling *Pupoides adelaidae* (Adams & Angas, 1864), and therefore referred to as *Pupoides* cf. *adelaidae* (Family Pupillidae), was collected. This species has a wide geographic distribution that appears to extend from New South Wales and north-western Victoria, across southern South Australia into the wheatbelt areas of Western Australia and as far to the north-west as Morawa (Solem, 1986; Solem, 1991). It may possibly also extend from Shark Bay north to North West Cape on the west coast of Western Australia (Solem, 1986).

This species was only recorded once and, as such, little can be said with respect to habitat preference or distribution within the Study Area. Along with the WA Museum comments, this species can be regarded as a **Non-SRE**.

4.3.3 Isopods

Three females of the genus *Buddelundia* (Family Armadillidae) were recorded from three sites, all comprising the one taxon. Due to only females being collected they are difficult to identify to species level and, as such, difficult to determine the SRE status of the taxon. However, the taxon does belong to a species-group within *Buddelundia,* which consists of species widespread throughout the arid regions of the south-west of Western Australia.

This species was recorded in three different habitats, outcropping, exposed outcropping and spinifex. Given this, and alongside the difficulty to determine its SRE status, this species can be regarded as an **Unknown SRE**.

4.4 Habitat Assessment

The habitats considered most prospective for SRE fauna at Mount Gould were chosen based on three factors; isolation, protection and habitat diversity.

4.4.1 Mixed *Acacia* shrubland

Woodman (2011) indicated the presence of three isolated pockets of tall, mixed *Acacia* shrubland (Figure 2.2) within the Study Area, surrounded by Mulga shrubland. This habitat was chosen largely due to its apparent isolation, but also its potential for greater habitat diversity, compared to the surrounding Mulga habitat, and possible protective qualities (shade and leaf litter). However, the structural and protective differences between the areas of mixed *Acacia* and the Mulga shrubland were minor, and are unlikely to represent a significant habitat change. As well the mixed *Acacia* shrubland areas were very small, and not well defined.

The survey work illustrated this overall lack of prospectivity, with no SRE specimens collected in eight sites (six reference and two SRE) within the mixed *Acacia* and Mulga shrublands. As such the mixed *Acacia* shrubland can be regarded as unlikely to have any SRE fauna restricted to it.

4.4.2 Outcropping and minor breakaway areas:

This habitat is isolated in the region (with some similar habitat occurring at Jack Hills) and provides a high level of protection from exposure (particularly when south or east facing), however habitat diversity is usually limited, likely due to the limited availability of soil. The isolation and protective qualities means there are likely to be SRE taxa associated with these habitats.

The survey work recorded similar results between reference and SRE outcropping sites, the difference being SRE sites were south-facing and the reference sites were more exposed. The six SRE sites recorded three pseudoscorpions and one isopod, and the four reference sites recorded two pseudoscorpions and one isopod. None of these species were restricted to this particular habitat.

4.4.3 Spinifex hummock grasslands

Restricted to the upper slopes and crests of Mount Gould, and are absent on the surrounding plains, however small areas of similar habitat occur on the slopes and crests of Jack Hills. This habitat is dominated by *Triodia melvillei* hummock grasslands with, or without, a shrubland containing mostly Mulga. Although not regarded as a “typical” SRE habitat, its isolation locally (at Mount Gould), as well as regionally, indicates it may be prospective for fauna with restricted distributions. The spinifex hummocks provided protection from exposure, and the soil underneath was markedly cooler than the areas that were exposed. There also

appeared to be a noticeable increase in invertebrate activity in the cooler areas of the hummocks.

A comparison can be made between this habitat and the exposed slope habitat, which was also surveyed at six sites as a reference habitat. The only difference between the two being the presence of spinifex hummocks, rather than grass hummocks, and the exposed slopes tended to have more Mulga present. The survey work recorded five pseudoscorpions and one isopod from the six spinifex sites, and only two pseudoscorpions from the six exposed slope sites. This appears to indicate the spinifex is an important part of the Mount Gould Study Area, providing protected spots in otherwise exposed habitats. However, no species recorded was limited to the spinifex, but most species were recorded within it.

4.4.4 Bouldering

The exposed ironstone at the peak of the south hill provides similar protection to the outcropping, although the lack of aspect makes it more exposed.

Four sites were surveyed within this habitat, with two pseudoscorpions and one land snail recorded. While this was the only habitat to record *Pupoides* cf. *adelaidae*, this taxon is regarded as very likely to be widespread and, as such, the lack of specimens is most likely a sampling artefact, and not an indication of its habitat preference or rarity. Neither of the two species of pseudoscorpion are restricted to this habitat, with both occurring at different habitat types.

5. CONCLUSION

Of the eight taxa recorded in the Study Area (seven from this survey and one from previous work), only two can be considered Potential SREs, the pseudoscorpion *Synsphyronus* 'PSE010', and the trapdoor spider *Idiommatta* 'MYG254'. *Synsphyronus* 'PSE010' is known to occur outside of the Study Area but still regarded as limited to the local area. *Idiommatta* 'MYG254', which was collected in a dry pit trap during vertebrate survey work, was a mature male, likely in search of a mate. This species is regarded as a Potential SRE, however, whether the population of this species (burrows) is present in the Study Area, or this individual has wandered in from outside the Study Area in search of a mate, is unknown. It is likely that this species occurs in the surrounding plains, and outside of the Study Area.

Four of the remaining taxa are regarded as Unknown SREs, largely due to a lack of taxonomic certainty, and the final two taxa recorded are known to be widespread. As well all taxa recorded (other than singletons) were found in a variety of habitats (including exposed habitats), and not restricted to a particular habitat type (including *Synsphyronus* 'PSE010').

The habitat assessment found that there is little difference in SRE prospectivity between the mixed *Acacia* shrubland and the Mulga shrubland, as the degree of isolation is limited on the ground. Similarly the survey work showed that both habitats were highly depauperate for SRE fauna.

The outcropping and boulder habitats were more prospective, and more isolated regionally, but there appeared to be little difference in fauna collected in exposed outcropping (reference) compared to south-facing outcropping (SRE).

The spinifex appeared to be the most prospective habitat, with the hummocks providing cooler microhabitats underneath where invertebrate, and SRE, activity was increased. However no species recorded were restricted to this habitat, although it does appear to play an important role in the Study Area as the most widespread prospective habitat.

Mount Gould is an isolated feature in the landscape, with a number of habitats which are not found in the surrounding area, however the species recorded within these habitats were also found in other habitats, and many beyond the Study Area in the adjacent Jack Hills. The only Potential SRE known from Mount Gould, that has not been recorded elsewhere, is the trapdoor spider *Idiommatta* 'MYG254', which may require further survey work to establish where the species occurs with respect to the Study Area.

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Appendix A Biologic's SRE Prospectivity Assessment Guidelines

Biologic's habitat assesments are aimed at determining the significance of each site (from a SRE perspective), and the likelihood that a site, or habitat, contains SRE taxa that will not be found at any other site or habitat. The assessment is based on three factors; isolation, protection and habitat complexity, and is briefly outlined below.

Isolation: based on the level of connectivity between sites that share similar habitat characteristics. Isolation is the most important factor when it comes to the level of risk, as any fauna with limited dispersal characteristics, regardless of the habitat preference, will likely be, at least, an isolated population. Examples include islands and mountain tops (e.g. Mt Meharry in the Pilbara), which have been shown to harbour significant species.

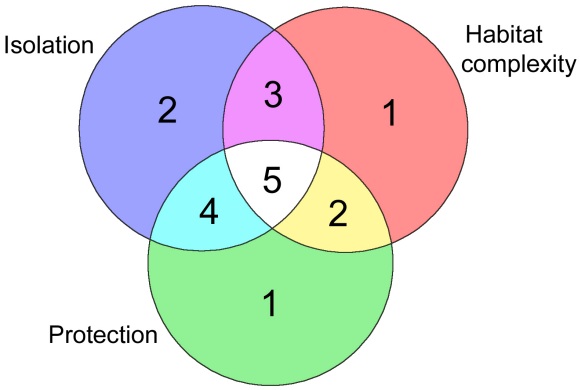
Habitat complexity: this factor drives species richness at a site, i.e. the more complex a site is, the more species it will contain. Complexity, with respect to SREs, is based around a number of microhabitat types:

- Leaf litter: both depth and structural variation
- Rocky substrates: loose rocks and crevices
- Vegetation variation: flora richness and structural variation
- Soil: depth and structural variation.

Examples include deep gullies and gorges, where many of these areas contain most of the above microhabitat types, and therefore tend to be the richest areas.

Protection: this primarily covers protection from exposure, particularly with respect to arid regions; however, protection from disturbances are also very important for the long term viability of SRE habitats and communities, i.e. protection from fire, flood and invasive species.

Protection is provided at two levels; the site level, where the structural composition of the site (aspect, slope etc) can provide protection from exposure and disturbance by providing physical barriers (e.g. gorges and gullies); and the habitat level, where certain microhabitat characteristics, associated with habitat complexity, provide more direct protection, particularly from exposure (i.e. leaf litter, rocky substrates, canopy cover and soil depth).



Likelihood of SRE taxa occurrence
1: Highly Unlikely
2: Unlikely
3: Possible
4: Likely
5: Highly Likely

Habitat assessment diagram

Appendix B Database Results

SRE GROUP	SPECIES	LOCATION
Mygalomorphae	*Aurecocrypta* `chichester`	Jack Hills
Mygalomorphae	*Aurecocrypta* `chichester`	Matthew Ridge
Mygalomorphae	Nemesiidae `sp.`	Matthew Ridge
Mygalomorphae	Nemesiidae `indet. juv.`	Taylor Range
Millipede	*Antichiropus* `Dead Goat Hill`	Dead Goat Hill
Millipede	*Antichiropus* `sp. check (male)`	Dead Goat Hill
Millipede	Polyzoniida `sp.`	Taylor Range
Pseudoscorpion	*Oratemnus* `sp.`	Dead Goat Hill
Pseudoscorpion	*Tyrannochthonius aridus*	Taylor Range
Pseudoscorpion	*Tyrannochthonius aridus*	Matthew Ridge
Pseudoscorpion	*Tyrannochthonius aridus*	Jack Hills
Pseudoscorpion	*Synsphyronus* `sp.`	Jack Hills
Pseudoscorpion	*Synsphyronus* `sp. (nymph)`	Jack Hills
Pseudoscorpion	*Synsphyronus* `8/3 long pedipalps`	Jack Hills
Pseudoscorpion	Olpiidae `sp. (nymph)`	Taylor Range
Pseudoscorpion	*Austrohorus* `sp. A`	Jack Hills
Pseudoscorpion	*Austrohorus* `sp.`	Dead Goat Hill
Pseudoscorpion	*Austrohorus* `sp. B`	Jack Hills
Pseudoscorpion	*Beierolpium* `sp. 8/4`	Jack Hills
Pseudoscorpion	*Beierolpium* `sp. 8/2`	Taylor Range
Pseudoscorpion	*Beierolpium* `sp.`	Dead Goat Hill
Pseudoscorpion	*Beierolpium* `sp. nov. 8/4 small`	Jack Hills
Pseudoscorpion	*Beierolpium* `sp. 8/3`	Jack Hills
Pseudoscorpion	*Indolpium* `sp.`	Jack Hills
Pseudoscorpion	*Indolpium* `sp. (female)`	Jack Hills

SRE GROUP	SPECIES	LOCATION
Pseudoscorpion	*Indolpium* `sp. (nymph)`	Jack Hills
Pseudoscorpion	*Indolpium* `sp. (tritonymph)`	Jack Hills
Scorpion	*Lychas* 'MML1'	Jack Hills
Scorpion	*Lychas splendens*	Jack Hills
Scorpion	*Urodacus* `jack hills`	Jack Hills
Land Snail	*Gastrocopta bannertonensis*	Jack Hills
Land Snail	*Pupoides* cf. *adelaidae*	Jack Hills

Appendix C Survey Sites and Habitats

SITE	SRE/REFERENCE	LATITUDE	LONGITUDE	HABITAT
MG001	Reference	25°48' 7.31"S	117°20' 15.06"E	Exposed outcrop
MG002	Reference	25°48' 8.56"S	117°20' 20.58"E	Exposed outcrop
MG003	Impact	25°48' 9.68"S	117°20' 13.55"E	Outcrop: Sth face
MG004	Reference	25°48' 3.78"S	117°20' 14.94"E	Exposed outcrop
MG005	Reference	25°48' 2.68"S	117°20' 13.11"E	Exposed outcrop
MG006	Reference	25°47' 51.56"S	117°20' 32.67"E	Exposed slope
MG007	Reference	25°48' 13.51"S	117°20' 37.00"E	Exposed slope
MG008	Reference	25°48' 14.71"S	117°20' 37.63"E	Exposed slope
MG009	Reference	25°48' 14.4"S	117°20' 42.7"E	Exposed slope
MG010	Reference	25°48' 8.34"S	117°19' 49.75"E	Exposed slope
MG011	Reference	25°48' 13.43"S	117°19' 56.14"E	Mulga plains
MG012	Reference	25°48' 14.3"S	117°20' 0.27"E	Mulga plains
MG013	Reference	25°48' 18.89"S	117°19' 56.56"E	Exposed slope
MG014	Reference	25°48' 26.0"S	117°19' 57.23"E	Mulga plains
MG015	Reference	25°48' 31.53"S	117°19' 55.87"E	Mulga plains
MG016	Reference	25°48' 31.37"S	117°19' 55.55"E	Mulga plains
MG017	Reference	25°48' 34.04"S	117°19' 51.45"E	Mulga plains
MG018	Reference	25°47' 03.18"S	117°20' 8.85"E	Drainage line
MG019	Reference	25°47' 20.74"S	117°20' 31.04"E	Drainage line
MG020	Reference	25°47' 16.06"S	117°20' 31.90"E	Exposed slope

SITE	SRE/REFERENCE	LATITUDE	LONGITUDE	HABITAT
MG021	Reference	25°47' 11.91"S	117°20' 59.12"E	Drainage line
MG022	Impact	25°48' 12.72"S	117°20' 14.32"E	Spinifex: peak
MG023	Impact	25°48' 12.86"S	117°20' 17.13"E	Spinifex: peak
MG024	Impact	25°48' 15.43"S	117°20' 29.49"E	Boulders: peak
MG025	Impact	25°48' 20.67"S	117°20' 19.32"E	Boulders: peak
MG026	Impact	25°48' 18.89"S	117°20' 12.90"E	Boulders: peak
MG027	Impact	25°47' 58.26"S	117°20' 32.70"E	Spinifex: Sth face
MG028	Impact	25°48' 5.48"S	117°20' 28.36"E	Spinifex: NE face
MG029	Impact	25°48' 8.04"S	117°20' 32.29"E	Spinifex: NE face
MG030	Impact	25°48' 27.62"S	117°19' 54.12"E	Mixed *Acacia*
MG031	Impact	25°48' 41.91"S	117°20' 18.13"E	Mixed *Acacia*
MG032	Impact	25°48' 11.38"S	117°20' 47.98"E	Outcrop: Sth face
MG033	Impact	25°47' 48.57"S	117°20' 34.65"E	Spinifex: Sth face
MG034	Impact	25°47' 47.75"S	117°20' 35.73"E	Spinifex: Sth face
MG035	Impact	25°47' 45.85"S	117°20' 35.35"E	Boulders: peak
MG036	Impact	25°47' 51.7"S	117°20' 33.79"E	Outcrop: Sth face
MG037	Impact	25°47' 53.11"S	117°20' 33.8"E	Outcrop: Sth face
MG038	Impact	25°47' 54.52"S	117°20' 36.1"E	Outcrop: Sth face
MG039	Impact	25°47' 54.52"S	117°20' 36.1"E	Outcrop: Sth face
MG040	Impact	25°47' 54.83"S	117°20' 34.08"E	Outcrop: Sth face

Appendix D Species List and Locations at Mount Gould

SITE NUMBER	SRE GROUP	SPECIES
MG001	Isopod	*Buddelundia* sp.
MG001	Pseudoscorpion	*Indolpium* sp.
MG005	Pseudoscorpion	*Indolpium* sp.
MG006	Pseudoscorpion	Olpiidae `sp. juv.`
MG006	Pseudoscorpion	*Synsphyronus* `PSE010`
MG013	Pseudoscorpion	*Indolpium* sp.
MG022	Pseudoscorpion	*Synsphyronus* `PSE010`
MG023	Pseudoscorpion	*Indolpium* sp.
MG024	Pseudoscorpion	*Austrohorus* sp.
MG024	Land Snail	*Pupoides* `cf. *adelaidae*`
MG026	Pseudoscorpion	*Synsphyronus* `PSE010`
MG027	Pseudoscorpion	*Synsphyronus* `PSE010`
MG028	Pseudoscorpion	*Austrohorus* sp.
MG029	Isopod	*Buddelundia* sp.
MG029	Pseudoscorpion	*Indolpium* sp.
MG029	Pseudoscorpion	*Synsphyronus* `PSE010`
MG032	Pseudoscorpion	*Synsphyronus* `PSE010`
MG033	Pseudoscorpion	Olpiidae `sp. 8/4`
MG036	Isopod	*Buddelundia* sp.
MG038	Pseudoscorpion	*Synsphyronus* `PSE010`
MG040	Pseudoscorpion	*Synsphyronus* `PSE010`

Appendix E Isopod Identification Report

Dr Simon Judd
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Carine
Western Australia, 6020.
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Tel: 0429 020 042

28th March 2012

Biologic
50B Angove Street
North Perth.
WA. 6006.

Attn: Brad Durrant

RE: MOUNT GOULD ISOPOD IDENTIFICATION.

I have completed my examination of the three specimens from Mount Gould. There was a single species of *Buddelundia* (Armadillidae) present. Only females were collected. I have compared this material to the limited amount of material I have from the Murchison Region. I have previously examined specimens from Jack Hills which would have made a useful comparison but unfortunately these specimens were unavailable. I have retained the specimens for further taxonomic work and for eventual lodgement at the WAM. My reference numbers are as follows: MG001-2183; MG029-2184, & MG036-2185.

This species is part of a group of *Buddelundia* that includes *Buddelundia sulcata*, *Buddelundia binotata* and possibly the type species *Buddelundia labiata.* These species are all very similar and are widespread in the drier regions outside of the south-west of Western Australia. I have two *Buddelundia* species from Weld Range and Meka Station (south of Mount Gould) which are both morphologically different to the species collected here.

I have a single female specimen from Robinson Range (108 kms to the ENE) which is tentatively the same species. I cannot make a more positive determination because no males specimen were present. Very similar species are found further east at Lake Way and at Yeelirrie. I have not allocated this species a number because I have very little material from the Murchison and its terrestrial isopods are largely unknown. I need more to more material from the area to work up a reference collection. Molecular analysis is probably necessary to resolve many of the species in this group of *Buddelundia*. These specimens will be very useful in this regard.

There is no evidence to suggest that this species does not occur more widely in the Mount Gould area.

End of report. Please contact me if you require further information.

Yours sincerely,

Simon Judd

Appendix F Arachnid and Mollusc Identification Report

Terrestrial Invertebrates from Mt Gould, Western Australia

Report to *Biologic*

16 March 2012

Mieke A. Burger, Corey Whisson & Mark S. Harvey

Department of Terrestrial Zoology, Western Australian Museum,
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Summary

The samples submitted to the Western Australian Museum on the 28th February 2012 included pseudoscorpions from the families Garypidae (*Synsphyronus*) and Olpiidae (*Austrohorus*, *Beierolpium*, *Indolpium*); and a land snail from the family Pupillidae (*Pupoides*).

The land snail is most likely from a widespread species that occurs in four states of Australia. For the pseudoscorpions, the current level of taxonomy means that most of specimens were not able to be assigned to a particular species and therefore their distributions are not known. But based on our current knowledge, *Synsphyronus* `PSE010` has potential to be a short-range endemic species.

Short-Range Endemism

The terrestrial invertebrate fauna of inland Australia contains a plethora of species, and just the arthropods were recently estimated to consist of more than 250,000 species (Yeates, Harvey et al. 2004; Chapman 2009). The vast majority of these are found within the Insecta and Arachnida, although significant numbers of millipedes are to be expected. For many years, the prospect of including invertebrates in assessments of biological systems subject to alteration proved daunting and were largely ignored as being too diverse and too difficult to comprehend to satisfy the rapid turn-around needed for environmental surveys.

In a recent publication, the issue of Short-Range Endemism in the Australian invertebrate fauna was examined (Harvey 2002), and series of major groups were nominated as having a very high proportion of individual species that satisfied a certain set of criteria. The main criterion nominated for inclusion as a Short-Range Endemic (SRE) was that the species had a naturally small range of less than 10,000 km^2. Harvey (2002) found that those species possessed a series of ecological and life-history traits, including:

- poor powers of dispersal;
- confinement to discontinuous habitats;
- usually highly seasonal, only active during cooler, wetter periods; and
- low levels of fecundity.

The Western Australian (WA) fauna contains a number of SRE taxa, including millipedes, land snails, trap-door spiders, some pseudoscorpions, slaters, and onychophorans and these represent focal groups in Environmental Impact Assessment studies in the state (EPA 2009). The south coast region is relatively well known compared with other regions of the state (Framenau, Moir et al. 2008), but there are many poorly known species and gaps in our understanding of the distributions of many species.

Methods

Terrestrial invertebrates collected by *Biologic* from the Mt Gould area were submitted to the WA Museum on 28th February 2012. The specimens were examined at the WA museum using Leica dissecting microscopes (MZ6, MZ16).

CLASS ARACHNIDA

ORDER PSEUDOSCORPIONES

The WA pseudoscorpion fauna is fairly diverse with representatives of 17 different families. They are found in a variety of biotopes, but can be most commonly collected from either the bark of trees, from the underside of rocks, or from leaf litter habitats. The material from this survey included 26 individuals from two families: Garypidae and Olpiidae (Appendix 1).

Family Garypidae

Synsphyronus `PSE010` (family Garypidae)

Five males, 2 females, and 8 juveniles of an undescribed species of *Synsphyronus* were collected from Mt Gould. Many species of *Synsphyronus* may represent short-range endemic species (Harvey 1987), but these species are generally found in ground habitats such as under rocks, the tree-dwelling species tend to be much more widely distributed, and are not short-range endemics. This species has been previously recorded from just over 100 km south of this area (records dating from between 2006 to 2011), but the extent of the range does not go wider than 8 000 km^2 (see Figure 1) which indicates the possibility of this species being a short-range endemic. Specimens from the two populations (may only be separated by sampling bias) are not distinct from each other morphologically, but perhaps more sampling and/or molecular analysis would be able to add evidence for them being the same species and whether this species is more widely distributed.

Family Olpiidae

Austrohorus sp. (family Olpiidae)

One male and one juvenile specimen of *Austrohorus* sp. were collected during this survey (Appendix 1). Based on our current levels of knowledge, it is not possible to state whether this species is a short-range endemic.

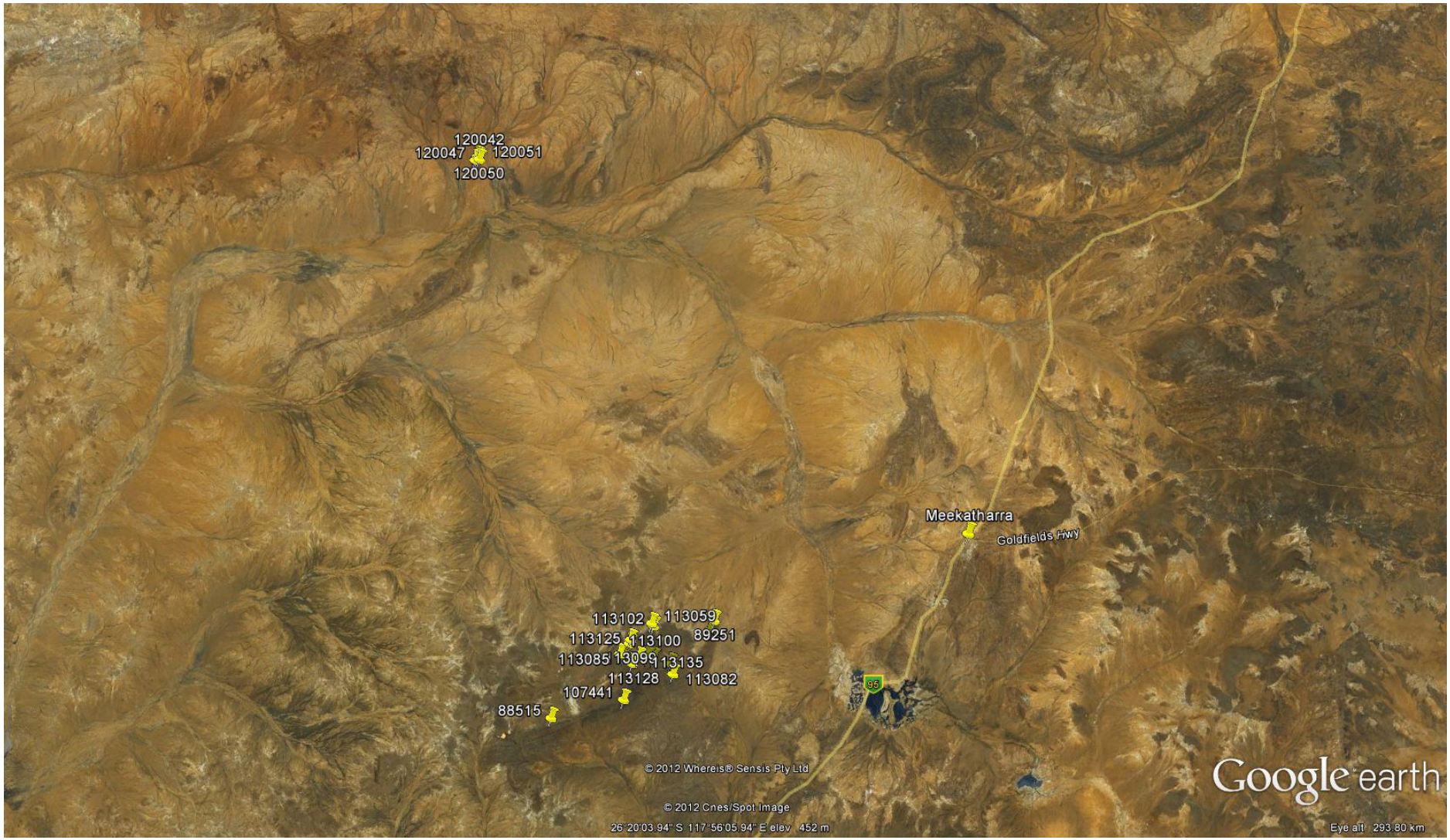


Figure 1. Current distribution of *Synsphyronus* `PSE010`. Numbered pins represent WAM registration numbers. The northern cluster includes specimens from this report (WAMTS021) and the southern cluster includes previous records. The average distance between these two clusters is ~ 120 km.

***Beierolpium* `sp. 8/4` (family Olpiidae)**

The 8/4 representation associated with this genus refers to the number of trichobothria (sensory hairs) on the fixed and movable fingers, which is one of the characters that would coincide with species distinction in this genus. A single male and a single female specimen were collected during this survey (Appendix 1). An additional juvenile specimen of *Beierolpium* was collected from this area. This individual appeared like it might be from a separate species due to the difference in trichobothria count (7/2) compared to what would normally be expected from a tritonymph juvenile from Beierolpium sp. 8/4 (which would be 7/3).The systematic status of members of this genus has not been fully assessed. At present it is not possible to firmly establish the identity of these species until a complete systematic revision of the WA members of *Beierolpium* is undertaken.

***Indolpium* sp. (family Olpiidae)**

Three males, one female, and one juvenile specimen of *Indolpium* were collected during the survey (Appendix 1). Similar specimens have been collected from this region of WA and based on our current levels of knowledge it is unlikely that these specimens represent SRE species.

CLASS GASTROPODA

ORDER STYLOMMATOPHORA

Family Pupillidae

Pupoides cf. *adelaidae* (Adams & Angas, 1864)

The dead-taken juvenile specimen (WAM S83239, MG024) most closely resembles *Pupoides adelaidae*. That species has a wide geographic distribution that appears to extend from New South Wales and north-western Victoria, across southern South Australia into the wheatbelt areas of Western Australia and as far to the north-west as Morawa (Solem, 1986; Solem,1991). It may possibly also extend from Shark Bay north to North West Cape on the west coast of Western Australia (Solem, 1986).

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Appendix 1. Specimen data for pseuodscorpions and snail collected from Mt Gould

REGNO	FLDNO	CLASS	ORDER	**FAMILY**	**GENUS**	SPECIES	LATITUDE	LONGITUDE	M	F	Juv.	TOTAL
T120042	MG006	Arachnida	Pseudoscorpiones	Garypidae	*Synsphyronus*	`PSE010`	25°47`51.56"S	117°20`32.67"E			1	1
T120044	MG022	Arachnida	Pseudoscorpiones	Garypidae	*Synsphyronus*	`PSE010`	25°48`12.72"S	117°20`14.32"E		1	1	2
T120047	MG026	Arachnida	Pseudoscorpiones	Garypidae	*Synsphyronus*	`PSE010`	25°48`18.89"S	117°20`12.9"E			3	3
T120048	MG027	Arachnida	Pseudoscorpiones	Garypidae	*Synsphyronus*	`PSE010`	25°47`58.26"S	117°20`32.76"E			1	1
T120050	MG029	Arachnida	Pseudoscorpiones	Garypidae	*Synsphyronus*	`PSE010`	25°48`8.04"S	117°20`32.29"E	3		1	4
T120051	MG032	Arachnida	Pseudoscorpiones	Garypidae	*Synsphyronus*	`PSE010`	25°48`11.38"S	117°20`47.98"E	1		1	2
T120053	MG038	Arachnida	Pseudoscorpiones	Garypidae	*Synsphyronus*	`PSE010`	25°47`53.5"S	117°20`35.3"E	1			1
T120054	MG040	Arachnida	Pseudoscorpiones	Garypidae	*Synsphyronus*	`PSE010`	25°47`54.83"S	117°20`34.08"E		1		1
T120046	MG024	Arachnida	Pseudoscorpiones	Olpiidae	*Austrohorus*		25°48`15.43"S	117°20`29.49"E			1	1
T120049	MG028	Arachnida	Pseudoscorpiones	Olpiidae	*Austrohorus*		25°48`5.48"S	117°20`28.36"E	1			1
T120052	MG033	Arachnida	Pseudoscorpiones	Olpiidae	*Beierolpium*	`sp. 8/4`	25°47`48.57"S	117°20`34.65"E	1	1		2
T121681	MG006	Arachnida	Pseudoscorpiones	Olpiidae	*Beierolpium*	`sp. juv.`	25°47`51.56"S	117°20`32.67"E			1	1
T120040	MG001	Arachnida	Pseudoscorpiones	Olpiidae	*Indolpium*		25°48`7.31"S	117°20`15.06"E	1	1		2
T120041	MG005	Arachnida	Pseudoscorpiones	Olpiidae	*Indolpium*		25°48`2.68"S	117°20`13.11"E				1
T120043	MG013	Arachnida	Pseudoscorpiones	Olpiidae	*Indolpium*		25°48`18.89"S	117°19`56.56"E	1			1
T120045	MG023	Arachnida	Pseudoscorpiones	Olpiidae	*Indolpium*		25°48`12.86"S	117°20`17.13"E	1			1
T121682	MG029	Arachnida	Pseudoscorpiones	Olpiidae	*Indolpium*		25°48`8.04"S	117°20`32.29"E			1	1
S83239	MG024	Gastropoda	Stylommatophora	Pupillidae	*Pupoides*	`cf. *adelaidae*`	25°48`15.43"S	117°20`29.49"E			1	1

APPENDIX 10: MOUNT GOULD SHORT-RANGE ENDEMIC INVERTEBRATE SURVEY REPORT (BIOLOGIC 2012B)

biologic

Mount Gould

Vertebrate Fauna Study

Atlas Iron Pty Ltd

January 2012



DOCUMENT STATUS				
Revision No.	Author	Review / Approved for Issue	Approved for Issue to	
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EXECUTIVE SUMMARY

Biologic Environmental Survey (Biologic) was commissioned by Atlas Iron Pty Ltd (Atlas) to undertake a Level 2 fauna study of the Mount Gould Study Area; hereafter referred to as the Study Area. The study comprised:

1) A desktop survey and comprehensive review of previous fauna surveys within the Study Area;
2) A two season, baseline vertebrate fauna survey of the Study Area; and
3) A habitat assessment of the Study Area**,** with a particular emphasis on habitats considered likely to support conservation significant fauna.

Field surveys were conducted by Biologic in the Study Area in May 2011 and October 2011. Trapping, opportunistic surveys and targeted fauna survey techniques were used in combination with ANABAT detectors and infra-red motion cameras traps to survey the full suite of fauna that may occur in the Study Area.

Analysis of the databases and reports showed that a total of 268 vertebrate fauna taxa have the potential to occur within the Study Area. In total, 125 fauna species were recorded during the surveys comprising 15 native and seven introduced mammal, 75 bird, 27 reptile and one amphibian species.

Overall, a total of 14 conservation significant species (including species of local significance) either occur, or are considered likely to occur within the Study Area, either as a resident or as a visitor on seasonal basis.

Eight conservation significant species were recorded within the Study Area:

- Peregrine Falcon (*Falco peregrinus*) – listed under Schedule 4 of the *Wildlife Conservation Act 1950* (WC Act);
- Bush Stone-curlew (*Burhinus grallarius*) – listed as Priority 4 by the Department of Environment and Conservation (DEC);
- Australian Bustard (*Ardeotis australis*) – listed as Priority 4 by the DEC;
- Rainbow Bee-eater (*Merops ornatus*) – listed as Migratory under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act);
- Woolley's Pseudantechinus (*Pseudantechinus woolleyae*) – listed as Banded Iron Formation (BIF) Dependent by DEC;
- Little Woodswallow (*Artamus minor*) – listed as BIF Dependent by DEC;
- Painted Finch (*Emblema pictum*) – locally significant (restricted range); and

- Little Broad-nosed Bat (*Scotorepens greyii*) – locally significant (limit of range).

An additional two conservation significant species have been recorded nearby at Jack Hills (located approximately 12 km south of the Study Area), and its immediate surrounds, during previous fauna surveys:

- Long-tailed Dunnart (*Sminthopsis longicaudata*) – listed as Priority 4 by the DEC;
- Major Mitchell's Cockatoo (*Lophochroa leadbeateri*) - listed under Schedule 4 of the WC Act 1950.

Seven major fauna habitats are present within the Study Area. Of these, three habitats (Spinifex Hummock Grasslands on Ironstone Hills and Ridges, Open Mulga shrublands over Tussock Grassland on Ironstone Hills and Ridges, and Breakaway systems containing deep crevices, caves and rock ledges) are considered to have high conservation value for fauna. This assessment is based on those habitats likely to support conservation significant fauna, or habitats that are an uncommon feature across the landscape. Disturbances to such habitats are recommended to be avoided or minimised where possible.

1 INTRODUCTION

1.1 Background

Atlas Iron Pty Ltd (Atlas) proposes to develop the Mount Gould mine, a previously granted mining lease (M52/236). The project is located at Mount Gould, approximately 150 km north-west of Meekatharra, in the Murchison region of Western Australia (Figure 1.1).

Biologic was commissioned by Atlas to undertake a Level 2 Vertebrate Fauna Survey of the Mount Gould area (referred to as the Study Area) to assist in gaining environmental approvals for the proposed project.

1.2 Approach to Survey

The objectives of this fauna study were to:

- Undertake a review of previous fauna assessments and surveys, comprising a review of publicly available literature, data and map-based information, including a summary of previous fauna survey results (in the vicinity of the Study Area), and data compiled from relevant databases (e.g. Western Australian Museum, Australian Museum, Naturebase and Department of Environment and Conservation [DEC]);
- Conduct a two season Level 2 vertebrate survey within the Mount Gould Study Area (see Figure 1.2), specifically targeting species or habitat likely to support species listed as:
    - Threatened or Migratory Fauna listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act);
    - Scheduled fauna listed under the latest WA Wildlife Conservation (Specially Protected Fauna) Notice of the *Wildlife Conservation Act 1950* (WC Act);
    - Priority Fauna recognised by the DEC; and
    - Fauna listed on the Internation Union for the Conservation of Nature (IUCN) Red List;
- Conduct a habitat assessment of the Study Area, with a particular emphasis on habitats considered likely to support conservation significant fauna and mapping of any significant fauna habitats;
- Compile an inventory of vertebrate fauna recorded or expected to occur, with respect to the fauna habitats present; and

- Document the characteristics of the fauna assemblage of the Study Area including significance at the international, national, state, regional and local level.

1.3 Legislative Framework

Within Western Australia, all native fauna is protected under the *Wildlife Conservation Act 1950* and any action that has the potential to impact on native fauna needs to be approved by relevant State and/or Federal departments as dictated by the State *Environmental Protection Act 1986* and the Federal *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Some species of fauna that are determined to be at risk of extinction or decline are afforded extra protection under these Acts. For the purposes of this report, these species are called *conservation significant species*. A summary of applicable legislation and status codes is provided in Table 1.1. Additional information on Status Codes is provided in Appendix A.

A number of migratory bird and marine species are prioritised for conservation under the EPBC Act or international agreements (Table 1.1). In addition the International Union for Conservation of Nature (IUCN) compiles a 'Red List' upon which species at risk of extinction are listed.

Some species, for which there is insufficient information to determine their status, are listed as Priority species by the DEC. Until information is available to determine that they are not at risk of extinction or decline, these species cannot be specifically listed under the EPBC Act or WC Act, but are generally considered by the Environmental Protection Authority (EPA)/DEC as of conservation significance for all development related approvals.

For the purposes of this report, some species may be identified as having 'local' significance. Locally significant fauna may include short-range endemic species, species that have declining populations or declining distributions, species at the extremes of their range, isolated outlying populations, species which may be undescribed (EPA, 2004), or species that are generally uncommon in the Murchison region but are not considered rare or threatened at a State or National level.

In addition to the above species, DEC has listed several vertebrate fauna species it considers to be significantly dependent on banded ironstone formation (BIF) ranges in the region (DEC, 2007). Vertebrate species were determined to be significantly dependent on the ironstone ridges if they were found to occur on the ridges and slopes but were absent from the surrounding plains.

Figure 1.1: Location of the Study Area - Mount Gould.

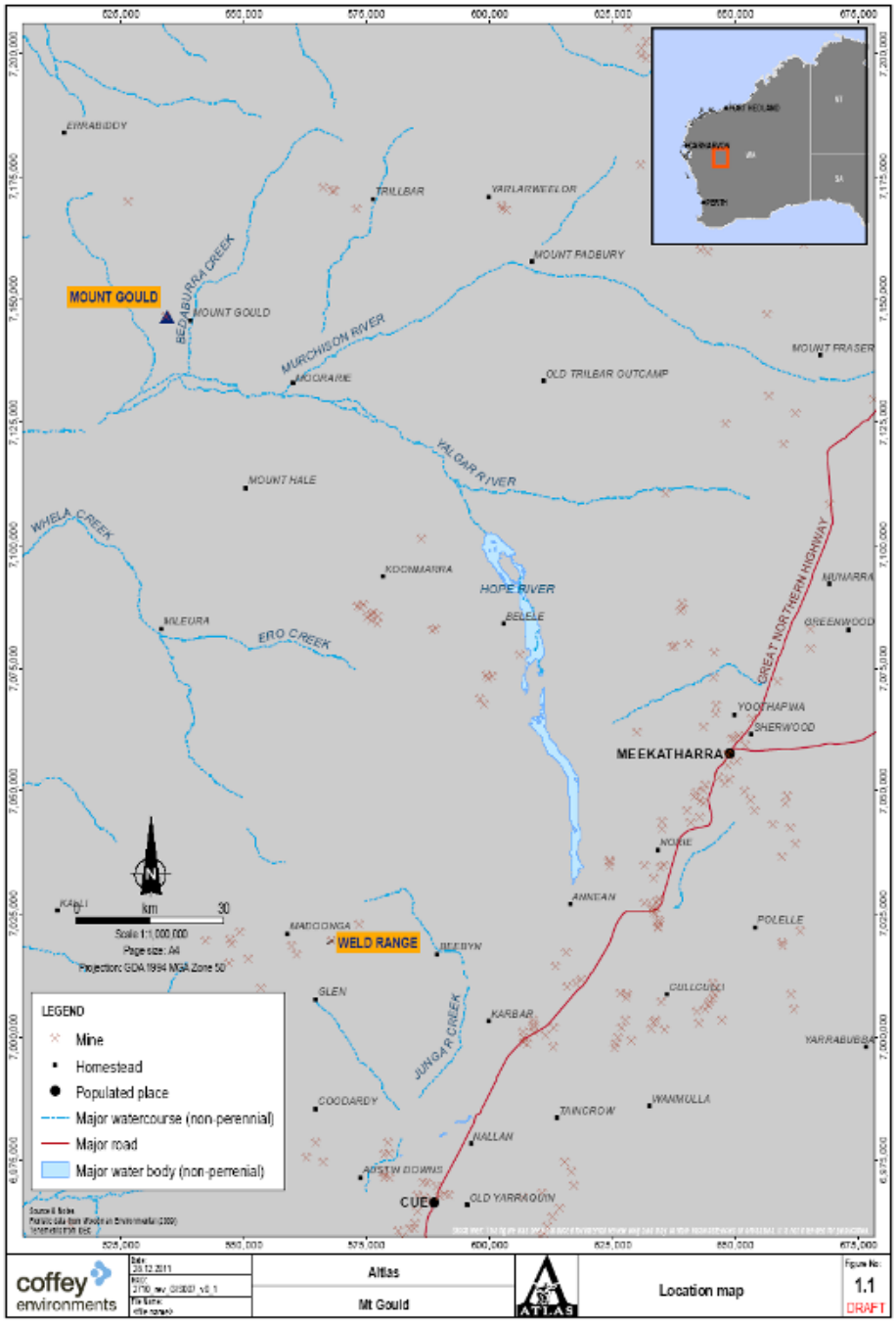


Figure 1.2: The Mount Gould Study Area – Mining Lease M52/236.

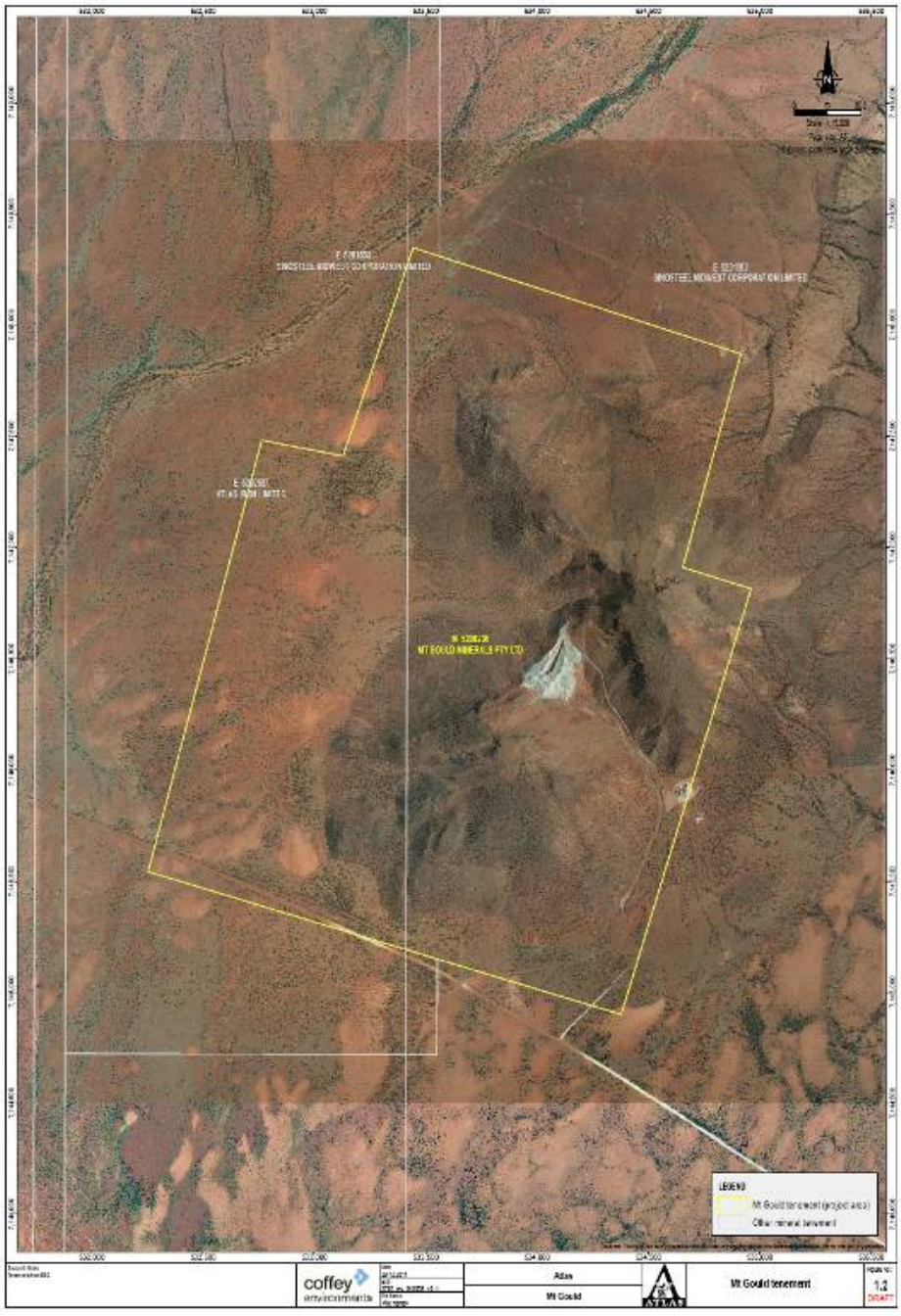


Table 1.1: Conservation Significance Assessment Guidelines.

Level	Act	Status Codes
International	Taxa listed under the following International Conventions: o Japan – Australia Migratory Bird Agreement (JAMBA) o China – Australia Migratory Bird Agreement (CAMBA) o Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention) Additional may be listed as Migratory under the federal *Environment Protection and Biodiversity Conservation Act 1999*. The IUCN lists species at risk of extinction under nine categories.	EPBC Migratory IUCN Extinct IUCN Extinct in the Wild IUCN Critically Endangered IUCN Endangered IUCN Vulnerable IUCN Near Threatened IUCN Least Concern IUCN Data Deficient IUCN Not Evaluated
Federal	***Environment Protection and Biodiversity Conservation Act 1999***. The Department of Environment, Water, Heritage and the Arts lists Threatened fauna, which are determined by the Threatened Species Scientific Committee according to criteria set out in the Act. The Act lists fauna that are considered to be of conservation significance under one of six categories.	Extinct Extinct in the Wild Critically Endangered Endangered Vulnerable Conservation Dependent Migratory
State	***Wildlife Conservation Act 1950***. At a state level, native fauna species are protected under the *Wildlife Conservation Act 1950*. Species in need of conservation are given a ranking ranging from Critically Endangered to Vulnerable.	Schedule 1 Schedule 2 Schedule 3 Schedule 4
State	**DEC Priority list**. The DEC produces a list of Priority species and ecological communities (PECs) that have not been assigned statutory protection under the *Wildlife Conservation Act 1950*. This system gives a ranking from Priority 1 to Priority 5.	Priority 1 Priority 2 Priority 3 Priority 4 Priority 5
Local	**DEC BIF Dependent Fauna Species.** DEC has listed several vertebrate fauna species it considers to be significantly dependent on banded ironstone formation ranges in the region.	Listed as significantly dependent

2 ENVIRONMENT

2.1 Biogeography

Broadly, the Study Area falls on the northern fringe of the Murchison biogeographical region as defined by the Interim Biogeographic Regionalisation of Australia (Thackway and Cresswell, 1995). The Murchison Bioregion falls within the Bioregion Group 2 classification (EPA, 2004). Bioregions within Group 2 have "native vegetation that is largely contiguous but is used for commercial grazing." The Murchison is subdivided into two subregions, and the Study Area lies in the Western Murchison subregion (MUR-2).

The general features of the Western Murchison subregion are summarised by Desmond *et al.* (2001). The subregion is characterised by low Mulga woodlands rich in ephemerals and bunch grasses on granitic outcrops and extensive hardpan washplains. It contains the headwaters of the Murchison and Wooramel Rivers. The landscape comprises low hills, mesas of duricrust, separated by flat colluvium and alluvial plains. The dominant land use is grazing (of native pastures) and there are several mining interests.

2.2 Climate

The Murchison region has an arid climate with winter rainfall. The mean average annual rainfall is 210 mm, ranging from 190 mm in the northeast to 240 mm in the southwest (BOM, 2011). Summers are hot and dry, with average daytime temperatures reaching 38°C in January and winters are mild with cool nights.

2.3 Existing Land Use

Pastoralism and mining are major industries in the Murchison region (reference ?). The Mount Gould Study Area lies on Mount Gould Station, with active mining occurring nearby at Jack Hills. Mount Gould contains the interpreted strike extension to iron ore currently being mined and exported from Jack Hills by Crosslands Resources. A small mining operation has been previously conducted at Mount Gould, with a small open pit and waste dump present on its lower slopes.

2.4 Landforms

The local topography is dominated by Jack Hills, an 80km long range consisting of folded and metamorphosed supracrustal rocks, including banded ironstone (reference ?). Jack Hills are the most northern occurrence of the banded ironstone formation (BIF) ranges, occurring across the Murchison, Midwest and Goldfields. Mount Gould is an outlier of the Jack Hills range, occurring approximately 12 km north of the main range. The area surrounding Mount Gould consists of relatively flat, undulating plains.

2.5 Land Systems

Curry *et al*. (1994) classified and mapped the Land Systems of the Murchison region, including the area containing Mount Gould. Land Types and Land Systems are classified according to similarities in landform, soil, vegetation, geology and geomorphology. Land Systems provide an indication of the fauna habitats present at a site. The Study Area is dominated by the Peak Hill Land System (Pea) and flanked by the Cole (Col) and Beringarra (Ber) Land Systems (see Figure 2.1). These are detailed in Table 2.1:

- Peak Hill System (Pea): rugged sinuous ranges and rounded hills of Proterozoic banded ironstone and hematitic shale, supporting stunted mulga and cottonbush shrublands;
- Beringarra Land System (Ber): Major riverine plains with active lower floodplains flanking channelled watercourses, supports mostly halophytic shrublands and mixed *Acacia* shrublands and low woodlands with minor perennial grasses; and
- Cole Land System (Col): Hardpan wash plains with reticulate patterns of wanderrie banks and mulga groves and more concentrated drainage tracts, supporting mixed mulga and wanderrie shrublands.

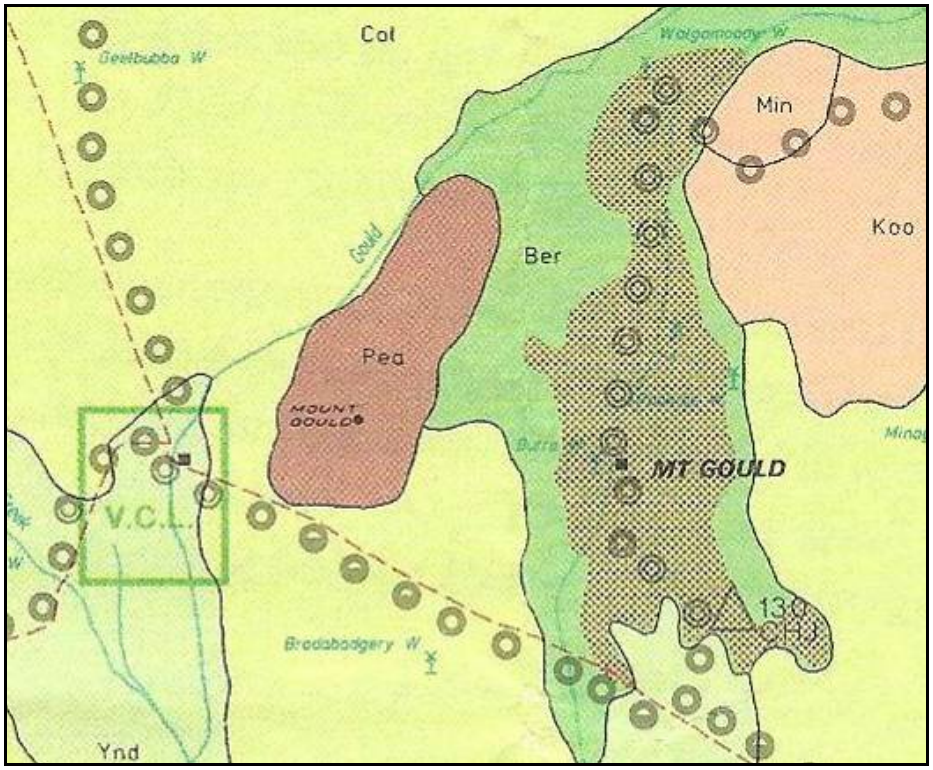
Table 2.1. Land Systems present within the Study Area.

Landform	Landform and Soil	Vegetation
Peak Hill Land System		
Hills and ridges (50%)	Rough hills and ridges, generally covered with dense ironstone mantles and frequent outcropping. Skeletal soils, confined to pockets of shallow loamy sands.	Very scattered mixed shrublands with Acacia spp. co-dominant. Shrubs include *Acacia aneura*, *A. tetragonopyhlla*, *Eremophila latrobei*, *E. exilifolia*, *Senna desolata*, *Solanum* spp. Perennial grasses: Eriachne spp., Eragrostis spp.
Lower slopes and interfluves (40%)	Gently sloping footslopes or rounded interfluxes flanking hills and ridges, covered in moderately dense ironstone mantles. Soils are dark red loamy sands.	Very scattered mixed shrublands dominated by *Acacia grasbyi*. Trees (to 6m): *A. pruinocarpa*, *A. aneura*, *A. aff. citrinoviridis*. Mid shrubs (1-2m): *A. grasbyi*, *Senna desolata*, *Eremophila latrobei*. Low shrubs (<1m): *Senna helmsii*, *Ptilotus obovatus*, *P. rotundifolius*, *Euphorbia boophthona*.
Drainage floors and minor channels (10%)	Narrow dendritic channels to 10m wide grading into broad saline alluvial fans and minor valley floors. Soils are dark red loamy sands with ironstone fragments.	Scattered mixed shrublands dominated by *Acacia aneura*, *A. tetragonophylla* or *A. victoriae*. Mixed shrubs (1-2m*)*: Eremophila spp. Low shrubs (<1m): *Ptiolus obovatus*, *Senna* spp., *Solanum lasiophylum*.

Landform	Landform and Soil	Vegetation
Berringgara Land System		
Hardpan plains (30%)	Almost flat alluvial plains. Soils are hardpan loams and red earths.	Scattered to moderately close mixed shrublands dominated by *Acacia aneura*.
Alluvial plains (40%)	Very gently sloping saline alluvial plains. Soils are generally deep crusted or hard setting duplexes with occasional red earths.	Patchy mixed shrublands, often dominated by *Acacia victoriae*, *Senna desolata*, *Eremophila pterocarpa* or *Hakea preissii*.
Floodplains and inter-channel zones (20%)	Almost flat, active floodplains with locally cracking or gilgai surfaces. Soils are variable crusted duplexes and yellowish-red to brown clays.	Moderately closed to closed woodlands with upper storey of *Acacia distans* or low shrublands dominated by *Atriplex amnicola* and *Maeriana pyramida*.
Wide drainage floors (5%)	Flat drainage zones, with occasional anastomosing channels. Soils are yellowish red to brown clays and duplex types.	Moderately close woodlands and tall shrublands. Trees (6-8m): *Acacia distans, A. aneura, Eucalyptus coolibah*. Tall shrubs (>2m): *A. tetragonophylla*, *A. victoriae*, *Eremophila fraseri, E. lanata*. Mid shrubs (1-2m): *E. fraseri, Scaevola spinescens*.
Channels (5%)	Riverbeds and seasonal watercourses up to 100m wide and incised to 3m. Channels carry bedloads of coarse sand. Soils on banks are reddish brown alluvial silty clays and fine sandy loams.	Major channel beds unvegetated, otherwise moderately close to closed mixed woodlands with dense under shrubs on banks of major channels and floors of minor channels. Trees include *Casuarina obesa, Eucalyptus camaldulensis, E. coolibah.*
Cole Land System		
Sand sheets (5%)	Isolated tracts of slightly elevated sand plain. Soils are earthy sands.	Scattered tall shrublands dominated by *Acacia aneura*, *A. ramulosa* or *Eremophila forrestii* with a grassy layer prominent in places. Trees include *Acacia kempeana, A aneura, A. ramulosa, Grevillea* sp.
Wanderrie banks (25%)	Complex networks of interconnecting wanderrie banks. Soils are earthy sands.	Scattered tall shrublands dominated by *Acacia aneura, A. ramulosa, Eremophila forrestii* with a grassy layer prominent. Trees include *Acacia kempeana, A aneura, A. ramulosa, Grevillea* sp.

Landform	Landform and Soil	Vegetation
Hardpan plains (45%)	Level plains carrying sheet flow between sandy banks and groves.	Very scattered to scattered tall shrublands dominated by *Acacia aneura*. Trees and shrubs include *Acacia aneura, A. pruinocarpa, A. quadrimarginea, Grevillea striata, Hakea subera, A kempeana, Eremophila fraseri*.
Mulga groves (<5%)	Numerous accurate groves up to 100m wide some with sandy accumulations and grading into wanderrie banks. Soils are dark red hardpan sandy clay loams or sandy clays.	Moderately close to closed low Mulga woodland dominated by *Acacia aneura, A. tetragonophylla or Eremophila fraseri.* Trees include *A. aneura, A. pruinocarpa, A. tetragonophylla, A. distans, Psydrax latifolia, Grevillea striata*.
Broad drainage zones (20%)	Very gently incised plains mostly occurring as broad, unchannelled tracts. Soils are mostly yellowish red or red earths or loams.	Scattered to moderately close tall shrublands dominated by *Acacia aneura* or *A. tetragonophylla*. Trees and shrubs include *A. aneura, A. kempeana, A. tetragonophylla, A. grasbyi, Eremophila fraseri, E. forrestii.*

Figure 2.1: Land Systems in the Mount Gould area.



2.6 Vegetation

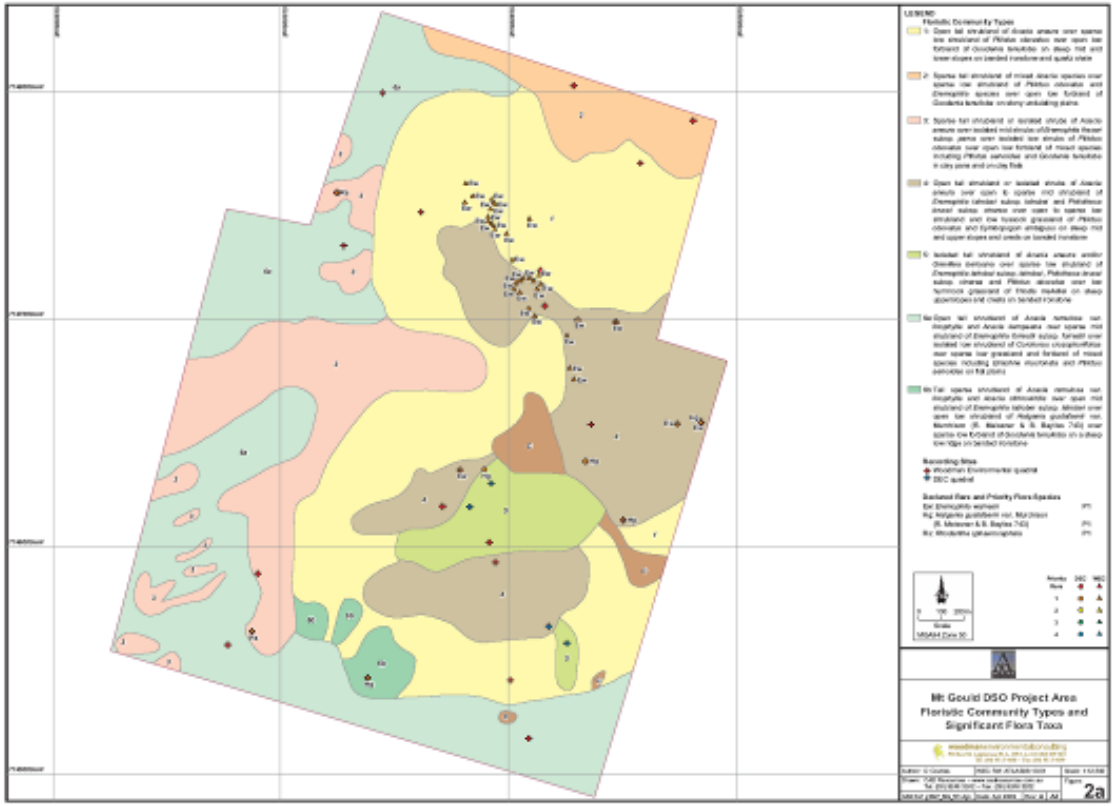
The vegetation of the Mount Gould Study Area has been classified and mapped by Woodman Environmental Consulting (Woodman Environmental Consulting, 2011) (Figure 2.2). Six Floristic Community Types (FCTs) are recognised from the area:

- FCT1: Open tall shrubland of *Acacia aneura* over sparse low shrubland of *Ptilotus obovatus* over open low forbland of *Goodenia tenuiloba* on steep mid and lower slopes on banded ironstone and quartz shale;
- FCT2: Sparse tall shrubland of mixed *Acacia* species over sparse low shrubland of *Ptilotus obovatus* and *Eremophila* species over open low forbland of *Goodenia tenuiloba* on stony undulating plains;
- FCT3: Sparse tall shrubland or isolated shrubs of *Acacia aneura* over isolated mid shrubs of *Eremophila fraseri* subsp*. parva* over isolated low shrubs of *Ptilotus obovatus* over open low forbland of mixed species including *Ptilotus aervoides* and *Goodenia tenuiloba* in clay pans and on clay flats;
- FCT4: Open tall shrubland or isolated shrubs of *Acacia aneura* over open to sparse mid shrubland of *Eremophila latrobei* subsp. *latrobei* and *Philotheca brucei* subsp. *cinerea* over open to sparse low shrubland and low tussock grassland of *Ptilotus obovatus* and *Cymbopogon ambiguus* on steep mid and upper slopes and crests on banded ironstone;
- FCT5: Isolated tall shrubland of *Acacia aneura* and/or *Grevillea berryana* over sparse low shrubland of *Eremophila latrobei* subsp. *latrobei* , *Philotheca brucei*; subsp. *cinerea* and *Ptilotus obovatus* over low hummock grassland of *Triodia melvillei* on steep upperslopes and crests on banded ironstone;
- FCT6a:Open tall shrubland of *Acacia ramulosa* var*. linophylla* and *A. kempeana* over sparse mid shubland of *Eremophila forrestii* subsp. *forrestii* over isolated low shrubland of *Corchorus crozophorifolius* over sparse low grassland and forbland of mixed species including *Eriachne mucronata* and *Ptilotus aervoides* on flat plains; and
- FCT6b:Tall sparse shrubland of *Acacia ramulosa* var*. linophylla* and *A. citrinoviridis* over open mid shubland of *Eremophila latrobei* subsp. *latrobei* over open low shrubland of *Halgania gustafsenii* var. Murchison (R. Meissner & B. Bayliss 743) over sparse low forbland of *Goodenia tenuiloba* on a steep low ridge on banded ironstone.

The vegetation at Mount Gould includes a significant ecological community, the Mount Gould Vegetation Complexes (banded ironstone formation), listed as a Priority 1 Ecology Community (PEC) by the DEC. Priority 1 PECs are described as:

"Ecological communities that are known from very few occurrences with a very restricted distribution (generally < 5 occurrences or a total area of < 100 ha). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat or for which current threats exist" (DEC, 2010).

Figure 2.2: Vegetation in the Mount Gould area.



2.7 Previous Surveys

A large number of mining projects are currently proposed and/or are in the process of development within the Midwest region, particularly on BIF Ranges. This includes existing and proposed mines at Koolanooka, Mt Gibson, Minjar, Golden Grove, Karara-Mungada, Weld Range and Jack Hills. In response to elevated mining interest in the region, the DEC has recently conducted a series of flora and vegetation assessments concentrating on BIFs throughout the Midwest, aiming to enhance knowledge and develop management objectives for the BIF Ranges.

As a result of proposed mining activity within the Jack Hills and Mount Gould area, a number of fauna surveys have been conducted, including both vertebrate and invertebrate species. These are discussed in further detail in Section 3.2 below.

3 METHODOLOGY

3.1 Survey Design

The fauna survey was designed to meet the requirements of applicable State and Federal legislation and carried out in a manner compliant with EPA requirements for the environmental surveying and reporting of fauna in Western Australia. These are:

- *Environmental Protection Act 1986* (WA) (EP Act);
- *Wildlife Conservation Act 1950* (WA) (WC Act);
- *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth EPBC Act, 1999);
- *Terrestrial Biological Surveys as an Element of Biodiversity Protection. Position Statement No. 3* (EPA, 2002); *Guidance for the Assessment of Environmental Factors: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia. No. 56.* (EPA, 2004); and
- Technical Guide - Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment. (EPA and DEC, 2010).

The field survey was conducted under DEC Regulation 17 (Licence to take Fauna for Scientific Purposes), issued to JM Turpin, licence number SF007941, valid from 18/04/2011 to 17/04/2012.

3.2 Literature and Database Review

A review of all reports containing information on the vertebrate fauna of the local area and relevant fauna reports from the surrounding region was conducted (Table 3.1).

Table 3.1: Literature reviewed

Survey Title	Consultant	Year	Type
Surveys adjacent to the Mount Gould Study Area			
Jack Hills Mine Expansion Vertebrate Fauna Assessment	ecologia	2006 - 2007	Level 2
Jack Hills Iron Ore Project: Vegetation and Fauna Assessment	MBS	2005	Level 2
Jack Hills Project Area 2006 Fauna Survey	Western Wildlife	2006	Level 2
Regional surveys			
Weld Range Vertebrate Fauna Assessment	ecologia	2006 - 2007	Level 2
Weld Range Fauna Survey	BCE	2008	Level 1
Oakajee Port and Rail OPR Rail Proposal Terrestrial Fauna Assessment	ecologia	2007-2009	Level 2

Three fauna databases (Table 3.2) were searched to determine records of species previously recorded in the Study Area (NatureMap and Birdata), or likely to occur based on bioclimatic modelling (Protected Matters Database).

Table 3.2: Databases used for the review

Provider	Database	Parameters
Department of Sustainability, Environment, Water, Population and the Communities (SEWPaC, 2011)	Protected Matters Database Search Tool. Accessed 20 March 2011.	Point -25.79624, 117.34354, 119.62420 with a 10km buffer
Department of Environment	NatureMap. Accessed 20 March 2011.	117° 20'32"E, 25° 47'36"S with a 40km buffer.
Birds Australia	Birdata. Accessed 20 March 2011.	One degree square containing the point -25.79624, 117.34354.

3.3 Field Assessment

3.3.1 Timing

The Phase 1 survey was undertaken between the 6th and 17th May 2011. The Phase 2 survey was undertaken between the 4th and 14th October 2011.

3.3.2 Climatic Conditions

The closest climate recording site to Mount Gould is located at Meekatharra, approximately 150 km to the southeast. Data from the Meekatharra Meteorological Office was used to describe weather conditions experienced during both survey phases. Additionally some recordings were also made at Mount Gould Station, which generally experiences daily temperatures of approximately 3 degrees higher than those experienced at Meekatharra (T. Penns, pers. com.; J. Turpin, pers. obs.).

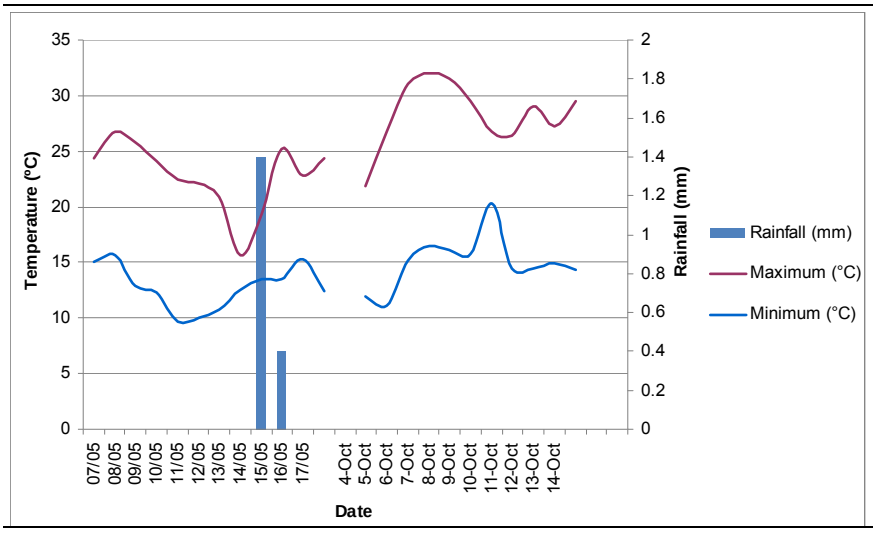
The weather during the initial survey period (May 2011) ranged from warm to cool, with rainfall recorded on the 14th and 15th May. Daily maxima at Meekatharra ranged from 15.7°C to 26.8°C (mean of 22.8°C) and daily minima ranged from 9.7°C to 15.6°C (mean of 12.8°C) (Table 3.3) (BOM, 2011). During the second survey phase (October 2011) conditions were warm and generally dry. Daily maxima at Meekatharra ranged from 21.9°C to 32.0°C (mean of 28.3°C) and daily minima ranged from 11.1°C to 20.3°C (mean of 15.0°C) (BOM, 2011).

In the five months preceding the first phase of survey, Meekatharra received 345.6 mm of rainfall, significantly more than the long-term average of 126.7 mm for the same time period. This was due to several periods of cyclonic activity across north-western Western Australia during the 2010/2011 cyclone season. Between survey phases, Meekatharra received 75.2 mm of rainfall, less than the 109.3mm average for the same time period.

Table 3.3: Weather Recorded at Meekatharra (Source BOM, 2011)

Date	Temperature		Rain	Date	Temperature		Rain
Phase 1	Min (°C)	Max (°C)	(mm)	Phase 2	Min (°C)	Max (°C)	(mm)
6/05/2011	15.1	24.4	0	4/10/11	11.9	21.9	3.2
7/05/2011	15.6	26.8	0	5/10/11	11.1	26.8	0
8/05/2011	12.9	25.8	0	6/10/11	15.2	31.0	0
9/05/2011	12.3	24.1	0	7/10/11	16.5	32.0	0
10/05/2011	9.7	22.5	0	8/10/11	16.1	31.5	0
11/05/2011	10	22.1	0	9/10/11	15.8	29.5	0
12/05/2011	10.7	20.9	0	10/10/11	20.3	26.7	0
13/05/2011	12.6	15.7	0	11/10/11	14.4	26.4	0
14/05/2011	13.5	19.3	1.4	12/10/11	14.4	29.0	0
15/05/2011	13.5	25.2	0.4	13/10/11	14.9	27.2	0
16/05/2011	15.3	22.8	0	14/10/11	14.3	29.5	0
17/05/2011	12.4	24.4	0				

Figure 3.1: Daily temperatures at Meekatharra during the surveys (from BOM 2011)



3.3.3 Trapping

A combination of pitfall traps, funnel traps, Elliott traps and motion sensitive cameras were used to survey for ground-dwelling mammals, reptiles and amphibians. Six fauna survey sites (containing a combination of the above traps) were established in each of the major fauna habitats present during the first phase of survey. These six sites were re-sampled during the second phase of surveying, with a seventh site also established.

Each fauna survey site contained:

- Pitfall traps: a 20 L bucket, dug in to the ground, and bisected by a 5 m long, 30 cm high fence impermeable to ground fauna. In rocky habitats, where the substrate limited digging, a 50 cm length of stormwater PVC pipe was installed instead of a 20 L bucket. Each site contained 10 pitfall traps;
- Funnel traps; one trap placed at each end of the pit trap fence. Most sites contained 20 funnel traps;
- Elliott traps: placed in a line extending throughout the trapping site, spaced approximately 25 m apart. Most sites contained 20 funnel traps; and
- Motion cameras: at least one motion sensitive camera was established at each fauna site.

The locations of fauna survey sites (Sites 1 to 7) are shown on Figure 3.2. Table 3.4 lists the location, trap effort and habitat description for each fauna survey site. Location details of each trap are listed in Appendix B, and photos of each trapping site are provided in Appendix C.

During the first survey phase each survey site (and therefore each fauna trap) was open for six nights. During the second survey phase, sites were open for a minimum of seven nights. The survey effort at each site is shown in Table 3.4.

3.3.4 Bird surveys

Twenty minute set-time surveys of birds were undertaken at all sites. Species presence and abundance data were collected from a 2 ha area within habitat representative of the trapping site. Surveys were completed prior to 10 am, before increasing temperatures resulted in reduced activity.

Incidental records of all birds were taken while working within the Study Area. This was particularly important to record raptors that are generally active during the hotter part of the day.

Figure 3.2: Fauna Sampling Locations.

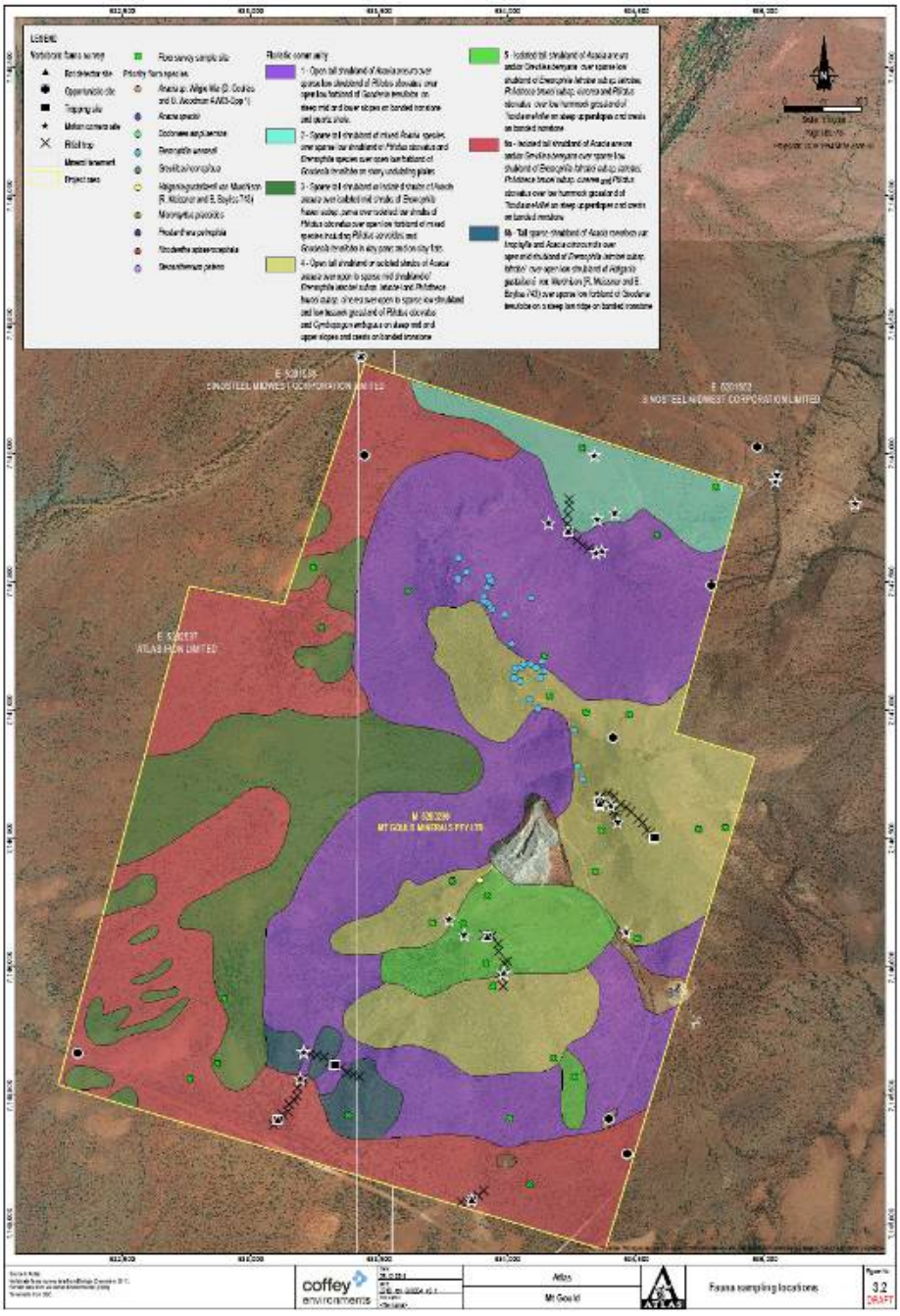


Table 3.4: Fauna Survey Sites (Zone 50J, P = Survey Phase)

Site	Description / Habitat	Easting	Northing	Pit Traps		Elliot Traps		Funnel Traps		Motion Camera		Nights Operated		Trap Effort		Active Search
	Trapping Sites			**P 1**	**P 2**	**P 1**	**P 2**	**P 1**	**P 2**	**P 1**	**P 2**	**P 1**	**P 2**	**P1**	**P2**	**Minutes**
1	Mid Slope, *Acacia* over Spinifex	534571	7146503	10	10	20	15	20	20	-	-	6	7	300	315	200
2	Breakaway	534357	7146636	10	10	20	15	20	15	3	1	6	7	300	280	220
3	Ironstone Ridge Top, Spinifex	533921	7146119	10	10	20	20	20	20	2	2	6	8	300	400	180
4	Plain – mixed Acacia shrubland	533106	7145405	10	10	10	10	10	10	1	-	6	8	180	240	180
5	Lower Slope / Foothills	533328	7145618	10	10	20	20	20	20	1	1	6	7	300	350	180
6	Drainage Line / Stony Plain	534234	7147699	10	10	10	20	10	20	2	4	6	7	180	350	220
7	Mixed Acacia Sandplain	533860	7145095	-	5	-	-	-	5	-	1	-	6	0	60	100
	TOTAL SURVEY EFFORT			60	65	100	100	100	110	9	9	6	7	1560	1995	
	Bat Detector Sites															
B1	Dam	535700	7146027									1				
B2	Homestead	539283	7146030									1				
B3	Drainage line – Mt Gould Creek	533430	7148379									3				
B4	Fauna Trapping Site 2 - Cave	534357	7146636									3	3			
B5	Fauna Trapping Site 3	533921	7146119										1			
B6	Fauna Trapping Site 4	533106	7145405										2			
B7	Fauna Trapping Site 6	534234	7147699										1			
B8	Fauna Trapping Site 7	533860	7145095										1			
	Opportunistic Sites															
Opp1	Mount Gould Summit	534409	7146893													420
Opp2	Plain	534392	7145410													180
Opp3	Sandplain	533443	7147994													180
Opp4	Stony Plain / drainage line	534791	7147487													180
Opp5	Mount Gould Creek	533430	7148379													360
Opp6	Old Homestead	534464	7145273													200
Opp7	Open Mulga	532327	7145664													120
Opp8	*Acacia pruinocarpa* drainage	534969	7148026													240

3.3.5 Bat surveys

Bats were sampled using both an ANABAT detector (SD1, Titley Electronics, Phase 1) and Song Meter Detector (SM2, Wildlife Acoustics, Phase 2). Detectors were placed within a variety of habitats suitable to support bat fauna, including habitat potentially supporting significant species. Acoustic bat recordings were identified by Mr Bob Bullen (Bat Call WA). The locations of bat survey sites are listed in Table 3.4 and shown on Figure 3.2.

3.3.6 Motion sensitive cameras

Motion sensitive cameras were used to survey for mammals, particularly targeting macropods and small mammals such as dasyurids and rodents (including introduced species). Cameras were placed mostly within rocky habitats (such as caves, rock ledges and overhangs) and baited with universal bait (peanut butter, sardines and oats). Motion Sensitive Cameras were placed at a total of 25 sites (Appendix B).

3.3.7 Opportunistic fauna surveys

Surveys conducted by hand in a given habitat are termed opportunistic surveys. The aim of these surveys is to discover more cryptic or trap-shy species that would otherwise not be recorded by the trapping survey. This technique is an important component of comprehensive fauna surveys. Experienced herpetologists targeted such species by investigating microhabitats during surveying. Fifteen opportunistic surveys were conducted in all fauna habitats, both at trapping sites and at numerous opportunistic survey sites (Table 3.4 and Figure 3.2).

3.3.8 Nocturnal surveys

Nocturnal surveys were conducted in the hours just after sunset on the nights of the 8th, 9th and 10th October 2011. Nocturnal surveys were conducted throughout the Study Area, by vehicle and on foot. One vehicle, with two personnel, traversed the Study Area searching the roads for fauna. Nocturnal searches targeted fauna that may be largely absent during the day (such as night birds), as well as mammals, amphibians and reptiles. A total of 15 survey hours of nocturnal searching was completed over the three nights.

3.3.9 Supplementary Data

At all times while surveying, any observations of species not previously recorded during the survey, rare or conservation significant fauna or other fauna of interest were documented. These records included tracks, scats and any other traces of fauna, as well as incidental sightings of live animals.

3.3.10 Habitat assessment

Fauna habitats were described and assessed for their conservation significance, i.e representation within the Study Area or the region and the likelihood that they support conservation significant fauna. All major fauna habitats present within the Study Area were sampled and scored (High, Medium or Low) according to the criteria shown in Table 3.5.

Table 3.5: Fauna habitat significance assessment criteria

Score	Criteria
High	1) Habitat supports EPBC or WC Act listed threatened fauna, OR 2) Habitat for EPBC or WC Act species is present in the Study Area, and there are records of that species within 50 km of the Study Area. If limited surveys have been undertaken in the vicinity of the Study Area then a precautionary approach will be used and the species will be considered likely to be present, OR 3) Uncommon habitat is critical habitat for a population of DEC listed Priority fauna. For example, if habitat is limited in the region and the habitat in the Study Area forms a significant portion of the known habitat for a Priority species, it would be scored as High significance.
Medium	1) Habitat supports DEC listed Priority fauna that are largely restricted to that habitat type within the Study Area. OR 2) Habitat supports EPBC listed Migratory fauna. OR 3) Habitat supports a particularly diverse and uncommon faunal assemblage. Habitat that occurs throughout region, and does not occur in small or isolated areas, is excluded.
Low	Habitat is widespread, common, and does not solely support any conservation significant fauna.

3.4 Taxonomy and Nomenclature

The latest checklist of Western Australian mammals, reptiles and amphibians was used to determine current taxonomy and nomenclature of these groups (Western Australian Museum, 2009). For birds, the current checklist of Australian birds, maintained by Birds Australia, was used. The bird list is based on the most recent review of the systematics and taxonomy of Australian birds by Christidis and Boles (2008).

3.5 Survey team

The project was undertaken by:

- Mr Jeff Turpin — Project Manager / Senior Ecologist
- Mr Mike Griffiths — Senior Zoologist
- Mr Simon Cherriman — Senior Zoologist
- Mr Tim Gamblin — Senior Zoologist
- Ms Gillian Basnett — Zoologist

Biologic wishes to acknowledge the assistance of Mr Bob Bullen of Bat Call WA, who analysed bat recordings from both survey phases.

3.6 Potential Limitations and Constraints

EPA Guidance Statement No. 56 (EPA, 2004) outlines several potential limitations to fauna surveys. These are presented and discussed in Table 3.6.

Table 3.6: Survey limitations and constraints

Potential limitation or constraint	Applicability to this survey
Experience of personnel.	The senior field personnel involved in the survey each had five or more years of fauna survey experience.
Scope (what faunal groups were sampled and whether any constraints affect this).	All fauna groups were sampled. Wet and cool conditions during May reduced capture rates, but additional targeted and opportunistic surveys supplemented the fauna data. The lack of significant rainfall meant amphibians were under sampled. Birds, mammals and reptiles were sufficiently sampled.
Proportion of fauna identified.	All fauna were identified at the point of capture.
Sources of information (recent or historic) and availability of contextual information.	A number of surveys have been undertaken in the vicinity of the Study Area and the surrounding region. Results of these and other local fauna surveys are available on NatureMap. Numerous fauna consultant reports were available at the time of writing.
Proportion of the task achieved.	A comprehensive survey of the Study Area was completed.
Disturbances (e.g. fire or flood).	No major disturbances affected the survey however a small number of traps were disturbed by groups of cattle.
Intensity of survey.	Survey intensity was adequate to record information on conservation significant fauna of the Study Area.
Completeness of survey.	The Level 2 fauna survey is complete.
Resources (e.g. degree of expertise available).	All resources required to complete the survey to a high standard were available.
Remoteness or access issues.	None. More remote areas of the Study Area were accessed on foot.

4 RESULTS

4.1 Desktop Review

Analysis of the databases and reports outlined in Section 3 showed that a total of 268 vertebrate fauna taxa have the potential to occur within the Study Area. The greatest potential diversity is in the birds (166 species), followed by reptiles (68 species), mammals (28 species, including introduced species) and amphibians (6 species).

Prior to this survey, several vertebrate fauna surveys have been undertaken in the vicinity of the Study Area. Vertebrate fauna surveys have been conducted nearby at Jack Hills, approximately 15km south of Mount Gould (ecologia, 2009a; MBS, 2005a; MBS, 2005b; Western Wildlife, 2006). Fauna surveys have also been conducted at Weld Range (ecologia, 2009b; BCE, 2008), approximately 100km south of Jack Hills, and also in the area in between these two ranges (ecologia, 2010).

A summary of results from previous studies undertaken in the local area are presented in **Error! Reference source not found.** Results from the current survey are included for comparison. Appendix D contains species lists from all surveys conducted to date.

Table 4.1: Summary of previous surveys in the local, and adjacent, area.

Survey	Jack Hills	Jack Hills	Jack Hills	Jack Hills	Weld Range	Weld Range	Mount Gould Fauna Survey (this survey)
Consultant	ecologia	MBS	MBS	Western Wildlife	ecologia	Bamford Consulting	Biologic
Year	2006/2007	2005	2005	2006	2006/2007	2008	2011
Type	Two-phase Level 2	Level 1	Single phase Level 2	Single phase Level 2	Two-phase Level 2	Level 1	Two phase Level 2
Mammals -native	13	NA	9	11	16	4	15
Mammals -introduced	4	4	5	2	6	1	7
Birds	67	45	46	56	79	52	90
Reptiles	23	8	24	30	44	9	27
Amphibians	0	0	4	0	1	1	1
Total	107	57	88	99	146	67	140
Number Significant Fauna recorded	7	1	5	5	7	2	8
Significant Fauna recorded	Long-tailed Dunnart, Rainbow Bee-eater, *Scotorepens greyi*, Painted Finch, Slender Blue-tongue, Woolley's Pseudantechinus, Little Woodswallow	Rainbow Bee-eater	Long-tailed Dunnart, *Scotorepens greyi*, Bush Stone-curlew Slender Blue-tongue, Little Woodswallow	Bush Stone-curlew, Peregrine Falcon, Woolley's Pseudantechinus Slender Blue-tongue, Little Woodswallow	Bush Stone-curlew ,Long-tailed Dunnart, *Lerista eupdoa*, Peregrine Falcon Slender-billed Thornbill, Woolley's Pseudantechinus, Little Woodswallow	Woolley's Pseudantechinus, Little Woodswallow	Bush Stone-curlew, Peregrine Falcon, Australian Bustard, Rainbow Bee-eater, Painted Finch, Woolley's Pseudantechinus, *Scotorepens greyii*, Little Woodswallow
Distance from Mount Gould	15 km (south)	15 km (south)	15 km (south)	15 km (south)	100 km (south)	100 km (south)	NA

4.2 Fauna Recorded from the Study Area.

In total, 125 fauna species were recorded from the Study Area comprising 15 native and seven introduced mammal, 75 bird, 27 reptile and one amphibian species (see Appendix D and Appendix E). An additional 15 bird species were recorded from habitats adjacent to the Study Area bringing the total number of species recorded during the surveys to 140.

Eight conservation significant fauna species were recorded during the 2011 surveys (discussed in detail in Section 4.3). These were:

- Peregrine Falcon (*Falco peregrinus*, Schedule 4 WC Act);
- Australian Bustard (*Ardeotis australis*, DEC Priority 4)
- Bush Stone-curlew (*Burhinus grallarius*, DEC Priority 4);
- Rainbow Bee-eater (*Merops ornatus*, EPBC Migratory);
- Woolley's Pseudantechinus (*Pseudantechinus woolleyae*, DEC BIF Dependent);
- Little Woodswallow (*Artamus minor*, DEC BIF Dependent);
- Painted Finch (*Emblema pictum*, locally restricted); and
- Little Broad-nosed Bat (*Scotorepens greyii*, locally restricted).

The species inventory for the site also includes three species not previously recorded in the area: *Delma tincta*, the Inland Freetail-bat (*Mormopterus* sp. 3) and the Australian Bustard (Priority 4).

4.2.1 Native mammals

Of the 18 species of native mammals expected to occur in the Study Area, 15 species were recorded. The Euro (*Macropus robustus*) was observed singly or in pairs on the ridges and slopes of Mount Gould. The Red Kangaroo (*Macropus rufus*) was observed in low numbers on the surrounding plains. Woolley's Pseudantechinus (*Pseudantechinus woolleyae*) was recorded from several areas - by motion cameras, pitfall and Elliot Traps - from caves, rock crevices and rocky outcrops on the ridges and slopes of Mount Gould. Two native rodents, the Sandy Inland Mouse (*Pseudomys hermannsburgensis*) and Spinifex Hopping-mouse (*Notomys alexis*) were recorded from sandplain habitats, while the Stripe-faced Dunnart (*Sminthopsis macroura*) was recorded from stony and sandy plains. An Echidna (*Tachyglossus aculeatus*) was observed from a rocky outcrop and scats attributable to this species were recorded throughout the Study Area. Two bat species were observed from a cave (*Taphozous hilli* and *Vespadelus findlaysoni*). In total eight bat species were recorded in the Study Area, identified by the ANABAT detector or via observation (see Appendix D).

Seven introduced mammal species were recorded. A small herd of Feral Goats (*Capra hircus*) was recorded from the upper slopes of Mount Gould. The Feral Cat (**Felis catus*) was observed and recorded on motion cameras, while scats and tracks attributable the Dingo (**Canis lupus dingo*), Camel (**Camelus dromedarius*), Rabbit (**Oryctolagus cuniculus*), Cattle (**Bos taurus*) and Sheep (**Ovis aries*) were also recorded.

Historic evidence of the past occupation of four locally extinct native mammal species was also recorded. Very old scats from the Black-footed Rock-Wallaby (*Petrogale lateralis*) were recorded from a ledge within a cave on the slopes of Mount Gould. Additionally old abandoned shelters constructed by the Stick-nest Rat (*Leporillus* sp.) were recorded from the same cave. Abandoned burrow systems of the Boodie (*Bettongia lesueur*) were recorded from the plains surrounding Mount Gould. Numerous old pebble-mounds constructed by the Western Pebble-mound Mouse (*Pseudomys chapmani*) were recorded on the lower slopes and stony plains surrounding Mount Gould. These four mammal species are considered to be locally extinct in the region and are discussed in further detail in Section 4.4.3. The Western Pebble-mound Mouse appears to be relatively common in the adjacent Pilbara region; however, there have been no recent records of this species from the Murchison.

4.2.2 Birds

One-hundred and sixty-six bird species may occur in the Study Area, of which 75?? species were recorded during this survey. During systematic surveys, the most frequently recorded species were Budgerigar (*Melopsittacus undulatus*), Diamond Dove (*Geopelia cuneata*), Zebra Finch (*Taeniopygia guttata*), Masked Woodswallow (*Artamus personatus*), Yellow-throated Miner (*Manorina flavigula*) and Grey-crowned Babbler (*Pomatostomus temporalis*). Singletons (birds recorded as a single individual during this survey) were Collared Sparrowhawk (*Accipiter cirrocephalus*), Australian Bustard (*Ardeotis australis*), Southern Boobook (*Ninox novaeseelandiae*), Red-browed Pardalote (*Pardalotus rubricatus*), Striated Pardalote (*Pardalotus striatus*), Brown Songlark (*Cincloramphus cruralis*) and Mistletoebird (*Dicaeum hirundinaceum*, see Appendix E).

Several species observed are considered uncommon in the region including the Peregrine Falcon, Bush Stone-curlew, Bourke's Parrot (*Neopsephotus bourkii*) and Painted Finch. A large number of waterbirds were recorded from the Murchison River, which lies to the south of the Study Area. Details of all bird species recorded from the region are provided in Appendix D.

Several bird species were recorded nesting in the Study Area. These were the Peregrine Falcon (two nests located on cliff faces), Nankeen Kestrel (*Falco cenchroides*, six nests located on small cliffs and breakaways), Yellow-throated Miner (nesting within Mulga

shrubland), Black-faced Woodswallow (nesting within Mulga shrubland), Masked Woodswallow (nesting within Mulga Shrubland), Painted Finch (two nest located within Spinifex Hummock Grassland), Little Button-quail (*Turnix velox*, nesting within Spinifex Hummock Grassland), Zebra Finch (many nests recorded across Study Area) and Diamond Dove (many nests recorded across Study Area, particularly within Mulga shrubland).

4.2.3 Reptiles

Sixty eight reptile species potentially occur in the Study Area, of which 27 species were recorded during the survey. The most commonly trapped reptile species (using systematic trapping data only) were *Ctenophorus caudicinctus* (101 individuals), *Ctenotus severus* (122 individuals), *Gehyra variegata* (46 individuals) and *Lerista timida* (44 individuals). Two species recorded during the current survey had not been previously recorded in the local area; *Delma tincta* and *Ramphotyphlops grypus* (see Appendix E).

4.2.4 Amphibians

One of the six potentially occurring amphibians was recorded during the survey; Desert Tree Frog (*Litoria rubella*). Additional species are expected; however, they would only be recorded during periods of rainfall.

4.3 Fauna Habitats

Seven major fauna habitats were identified within the Study Area. For the purposes of this report fauna habitats are aligned approximately with vegetation communities as defined by Woodman Environmental Consulting (2011). The major fauna habitats are listed below with the corresponding Floristic Community Type. Habitat descriptions are presented in Table 4.2.

1. **Spinifex Hummock Grasslands on Ironstone Hills and Ridges**: includes hill crests and slopes supporting *Acacia aneura* and/or *Grevillea berryana* over sparse low shubland of *Eremophila latrobei* subsp. *latrobei*, *Philotheca brucei*; subsp. *cinerea* and *Ptilotus obovatus* over low hummock grassland of *Triodia melvillei* (FCT5). The hill crests (such as Mount Gould summit) also contain extensive ironstone outcropping, boulder piles and cliff faces;
2. **Open Mulga shrublands over Tussock Grassland on Ironstone Hills and Ridges:** Open tall shrubland or isolated shrubs of *Acacia aneura* over open to sparse mid shrubland of *Eremophila latrobei* subsp. *latrobei* and *Philotheca brucei* subsp. *cinerea* over open to sparse low shrubland and low tussock grassland of *Ptilotus obovatus* and *Cymbopogon ambiguus* on steep mid and upper slopes and crests on banded ironstone (FCT4);
3. **Stony lower slopes and plains below hill systems**: Open tall shrubland of *Acacia aneura* occasionally with *A. ramulosa* var. *linophylla* and *A. citrinoviridis* over sparse low shrubland of *Ptilotus obovatus* over open low forbland of *Goodenia tenuiloba* on mid and lower slopes on banded ironstone and quartz shale (FCT1 and FCT6B);
4. **Mixed *Acacia* shrublands on sandplain**: Open tall shrubland of *Acacia ramulosa* var. *linophylla* and *A. kempeana* over sparse mid shubland of *Eremophila forrestii* subsp. *forrestii* over isolated low shrubland of *Corchorus crozophorifolius* over sparse low grassland and forbland of mixed species including *Eriachne mucronata* and *Ptilotus aervoides* on flat plains (FCT6a);
5. **Sparse Mulga shrublands on hardpan**: Sparse tall shrubland or isolated shrubs of *Acacia aneura* over isolated mid shrubs of *Eremophila fraseri* subsp. *parva* over isolated low shrubs of *Ptilotus obovatus* over open low forbland of mixed species including *Ptilotus aervoides* and *Goodenia tenuiloba* in clay pans and on clay flats (FCT3);
6. **Sparse *Acacia* shrublands on stony undulating plains**: Sparse tall shrubland of mixed *Acacia* species over sparse low shrubland of *Ptilotus obovatus* and

Eremophila species over open low forbland of *Goodenia tenuiloba* on stony undulating plains (FCT2); and

7. **Breakaway systems containing deep crevices, caves and rock ledges**. Occurs on the steep slopes of Mount Gould, generally in small areas.

Table 4.2: Fauna habitat descriptions

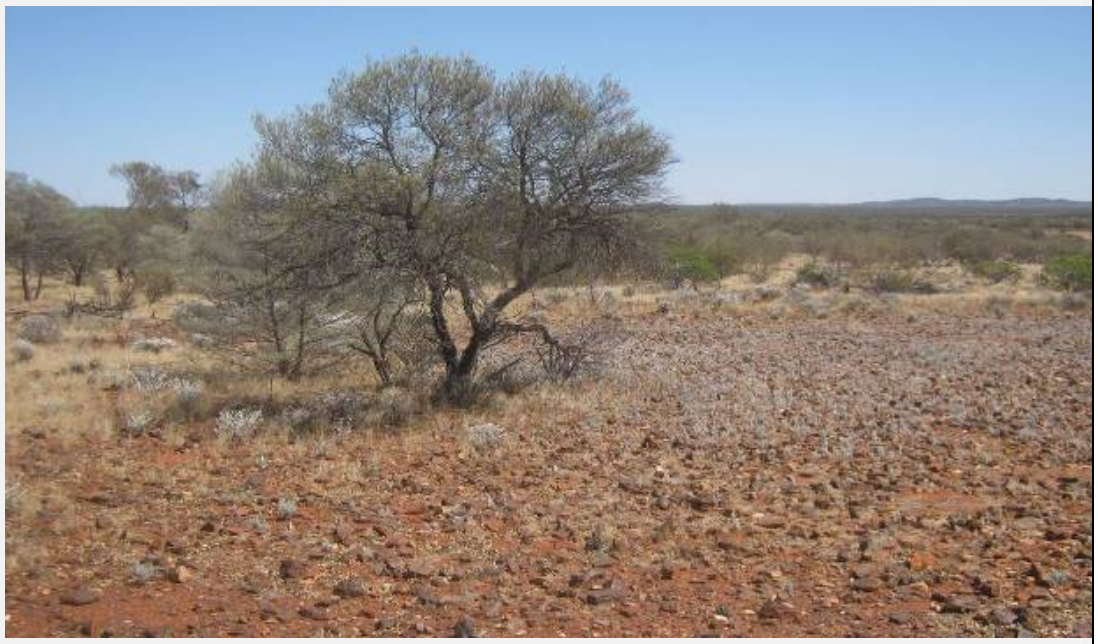
Habitat type	Distinguishing characteristics	Photo
Spinifex Hummock Grasslands on Ironstone Ridge Crests and Upper Slopes	Restricted to the upper slopes and crests of Mount Gould. An isolated fauna habitat that is absent on the surrounding plains. Small areas of similar habitat occur on the slopes and crests of Jack Hills. Ironstone outcropping occurs in some areas. Vegetation is dominated by *Triodia melvillei* hummock grasslands with or without a shrubland containing mostly *Acacia aneura*. The substrate varies but is mostly comprised of rocks, boulders and cobbles with minor areas of loam.	

Habitat type	Distinguishing characteristics	Photo
Open Mulga shrublands over Tussock Grassland on Ironstone Hills and Ridges	Occurs on the slopes of Mount Gould generally below FCT 5 (*Triodia melvillei* hummock grasslands). The substrate varies but is mostly comprised of rocks, boulders and cobbles with minor areas of loam. Vegetation is dominated by *Acacia aneura* occurring as a sparse shrubland or sparse woodland over tussock grasslands. Habitat is widespread but restricted to the BIF ridges in the region.	

Habitat type	Distinguishing characteristics	Photo
Stony lower slopes and plains below hill systems	Occurs on the lower slopes of Mount Gould and the adjacent stony plains. Vegetation is dominated by *Acacia aneura* shrublands occurring over tussock grasslands. The substrate is mostly comprised of cobbles with minor areas of sandy loam becoming more predominant on the plains. Habitat is widespread but restricted to the BIF ridges in the region.	

Habitat type	Distinguishing characteristics	Photo
Mixed *Acacia* shrublands on sandplain	Occurs in small areas adjacent to the slopes of Mount Gould. Characterised by deep sands supporting mixed *Acacia* shrublands (*Acacia ramulosa var. linophylla* and *A. kempeana*) over tussock grasslands. A widespread habitat.	

Habitat type	Distinguishing characteristics	Photo
Sparse Mulga shrublands on hardpan	Occurs on the plains surrounding Mount Gould and is widespread through the region. Vegetation is dominated by *Acacia aneura* shrublands sometimes forming dense groves with high leaf, twig and wood litter, and occasional *A. pruinocarpa* containing numerous hollows. Substrate has minor rocky areas and is predominately a sandy clay. A widespread habitat.	

Habitat type	Distinguishing characteristics	Photo
Sparse *Acacia* shrublands on stony undulating plains	Occurs on the plains surrounding Mount Gould and is widespread through the region. In the Study Area a small area occurs to the north of Mount Gould. Vegetation is generally sparse; however dense groves of mixed *Acacia* (*Acacia aneura*, *A. grasbyi*) occur in minor drainage lines. Substrate is mostly a gravely stony plain. A widespread habitat.	

Habitat type	Distinguishing characteristics	Photo
Breakaway systems containing deep crevices, caves and rock ledges	Minor breakaway areas containing small caves occur on the slopes of Mount Gould. A large cave containing seasonal moisture (dripping roof) occurs near the summit. Areas of similar habitat occur on Jack Hills however habitat is very isolated and restricted in the region.	

4.4 CONSERVATION SIGNIFICANT FAUNA

4.4.1 Conservation Significant Fauna Recorded in the Study Area and surrounds

Eight conservation significant species were been recorded within the Study Area (Figure 4.1):

- Peregrine Falcon (*Falco peregrinus*) – listed under Schedule 4 of the *Wildlife Conservation Act 1950;*
- Bush Stone-curlew (*Burhinus grallarius*) – listed as Priority 4 by the DEC;
- Australian Bustard (*Ardeotis australis*) – listed as Priority 4 by the DEC;
- Rainbow Bee-eater (*Merops ornatus*) – listed as Migratory under the EPBC Act;
- Woolley's Pseudantechinus (*Pseudantechinus woolleyae*) – listed as BIF Dependent by DEC;
- Little Woodswallow (*Artamus minor*) – listed as BIF Dependent by DEC;
- Painted Finch (*Emblema pictum*) – locally significant; and
- Little Broad-nosed Bat (*Scotorepens greyii*) – locally significant.

An additional two conservation significant species have been recorded nearby at Jack Hills and surrounds during previous fauna surveys:

- Long-tailed Dunnart (*Sminthopsis longicaudata*) – listed as Priority 4 by the DEC;
- Major Mitchell's Cockatoo (*Lophochroa leadbeateri*) - listed under Schedule 4 of the *Wildlife Conservation Act 1950;*

Information on each of these species is provided in the following sections. Conservation codes are explained in Appendix A, while locations of conservation significant fauna from the Study Area are presented in Appendix F.

In all, nineteen species of conservation significance were identified during the database and literature searches that may occur in the Study Area (Table 4.3). Each of these species, and the factors affecting their likelihood of occurrence, are considered in Table 4.3. Additionally, evidence of historical occupation (within the Study Area) of four locally extinct fauna species were recorded.

Peregrine Falcon (*Falco peregrinus*)

The Peregrine Falcon is listed under Schedule 4 of the WC *Act 1950*. In Western Australia, the species is considered to be moderately common in the Stirling Range, uncommon in the Kimberley, Hamersley and Darling Ranges, and rare or scarce elsewhere (Johnstone and Storr, 1998). Inland it is most often encountered along cliffs above rivers, ranges and wooded watercourses and lakes, where it seeks out its main prey, aerial birds (Johnstone and Storr, 1998). The Peregrine Falcon nests in recesses of cliff faces, tree hollows or in large abandoned nests of other birds (Birds Australia, 2011) Peregrine Falcons pair and mate for life, with pairs maintaining a home range of about 20 - 30 km^2 throughout the year. Blakers *et al.,* (1984) consider Australia as one of the strongholds of the species, since it has declined in many other parts of the world.

The Peregrine Falcon was recorded from Mount Gould during the second survey phase. Three individuals (two adults and one fledgling) were observed from the Mount Gould summit, and two nest sites were located. This confirmed observations made during a previous visit to Mount Gould, where an adult falcon displayed aggressive territorial behaviour to an observer on the summit, indicating that this species may be breeding in the area (see Appendix F). The Mount Gould summit comprises a series of cliff faces with numerous ledges and recesses. Several well-used roost sites and two nest sites belonging to Peregrine Falcons were located among these faces, evident from the extensive faecal smears ("whitewash") down on the rocks below the roost/nest (see Plates 1, 2, 3). The whitewash below one of the nest sites was over 5m high and visible several kilometres away, which indicates extensive use by falcons over many years. A breeding pair is therefore likely to permanently reside on the summit of Mount Gould.

Disturbances to Peregrine Falcon nesting and roosting habitat should be avoided.



Plate 1: View of Mount Gould summit showing faecal smears of two well used roosts.



Plate 2: Front view of Peregrine Falcon nesting ledge showing extensive faecal stains (whitewash).



Plate 3: Top view of Peregrine Falcon nesting ledge, showing prey remains, indicating recent use.

Australian Bustard (*Ardeotis australis*)

The Australian Bustard is listed as Priority 4 by the DEC. This species occurs in a variety of grassland, grassy woodland and shrubland habitats. It is nomadic, and may range over very large areas (Johnstone and Storr, 1998). The species has declined from its range further to the south, with the main threats to its survival being a combination of habitat loss/degradation and predation by feral cats and foxes (Johnstone and Storr, 1998).

The Australian Bustard was recorded on the plains adjacent to Mount Gould during the 2011 survey. This species is occasionally seen on Mount Gould Station (T. Pens, pers. com.) and is likely to be an occasional visitor to the plains surrounding Mount Gould.

Bush Stone-curlew (*Burhinus grallarius*)

The Bush Stone-curlew is classified as Priority 4 by DEC and Near Threatened by Garnett and Crowley (2000). This species is often associated with woodlands and dense shrublands such as Mulga (J. Turpin, pers. obs.).

This species has a widespread distribution, however, has significantly declined in southern parts of its range. Historically this species was widely distributed throughout much of Western Australia but it is now considered rare, with an estimated Australian population of 15,000 individuals (Garnett and Crowley 2000). Since Bush Stone-curlews are a ground dwelling and non-migratory species, they may be susceptible to local disturbances by humans and to predation by cats and foxes (Johnstone and Storr, 1998). Home range studies have not been conducted in the Murchison, however, in arid Eastern Australia Bush Stone-curlews occupy a large, permanent, home range (of about 250–600 ha) which contracts to a much smaller area (10–25 ha) during breeding (DEWHA, 2010a).

This species was recorded at Mount Gould from Fauna Site 4 and also from Mount Gould homestead. The Bush Stone-curlew has been recorded from the nearby Jack Hills and also at Weld Range and is likely to be a resident within the Study Area.

Rainbow Bee-eater (*Merops ornatus*)

The Rainbow Bee-eater is listed as Migratory under the EPBC Act. The species occurs all year round in the tropics of northern Australia, with a southward migration to both south-eastern and south-western Australia in early spring. Southern birds return north in autumn (Johnstone and Storr, 1998). It has a wide range and occurs in the better watered parts of Western Australia, between the Kimberley and south-west of Western Australia, preferring lightly wooded, preferably sandy country near water (Johnstone and Storr, 1998). It nests in burrows dug usually at a slight angle in flat ground, gently elevated slopes, sandy banks or cuttings, and often at the margins of roads or tracks.

When present, the Rainbow Bee-eater is common and prominent in both natural and altered environments. Although a species of high conservation significance, it is abundant and versatile in its selection of nest sites. This species was recorded in a number of locations at Mount Gould and may be a seasonal visitor to the Study Area.

Long-tailed Dunnart (*Sminthopsis longicaudata*)

The Long-tailed Dunnart is listed as Priority 4 by the DEC. This species has only been recorded from widely separated populations in the Pilbara, Murchison, Gibson Desert, southern Carnarvon Basin and in the Western MacDonnell Ranges (Northern Territory) (Burbidge *et al*. 2008). The Long-tailed Dunnart appears to be a specialist of rocky habitats (rocky ridges, hills and breakaways). It has been previously recorded at Weld Range and Jack Hills (ecologia, 2009a and 2009b); however, apart from records from BIF ridges, there are no records from the surrounding plains (DEC, 2011). DEC considers the Long-tailed Dunnart to be significantly dependent on banded ironstone formation ranges in the region (DEC, 2007).

The Long-tailed Dunnart has been previously recorded from several sites at Jack Hills. These include from banded ironstone ridge crests, slopes and minor drainage lines approximately 19km south of Mount Gould (ecologia, 2010). Due to the presence of suitable habitat, and nearby records, the Long-tailed Dunnart is likely to occur within the Study Area.

Major Mitchell's Cockatoo (*Lophochroa leadbeateri*)

Major Mitchell's Cockatoo is listed under Schedule 4 of the Wildlife Conservation Act. It is sporadically distributed through arid and semi-arid Australia and may occur in sparsely timbered grasslands and shrublands and rocky outcrops (DEC, 2011). In the region this species is mostly restricted to the margins of the Murchison River (Birds Australia, 2011) where it has been recorded within *Eucalyptus camaldulensis* woodland particularly near water (J Turpin, pers. obs.). The Major Mitchell's Cockatoo has been recorded from Mount Gould Station, from permanent waterholes in the Murchison River near Mount Taylor and also from Mount Taylor Well, approximately 8km south of the Study Area (T Penns, pers. com.). As this species nests within Eucalypt Woodland it is unlikely to be dependent on habitat within the Study Area.

Locally Significant Fauna Recorded at Mount Gould

In addition to the above species, DEC has listed several vertebrate fauna species it considers to be significantly dependent on banded ironstone formation ranges in the region (DEC, 2007). These include (in addition to Peregrine Falcon and Long-tailed Dunnart):

- Little Woodswallow – this species utilises vertical rock faces for refuges, breeding and roosting sites and is generally restricted to the BIF within the region (DEC, 2007). The Little Woodswallow was recorded from the Study Area (several roosting sites recorded).
- Woolley's Pseudantechinus – this species has a disjunct distribution between the Pilbara and Murchison regions with a strong habitat preference for rocky hills. As a result, it occurs in several fragmented populations. It inhabits deep rock crevices and caves in rocky outcrops. Woolley's Pseudantechinus was recorded from several locations within the Study Area, often containing extensive outcropping with deep rock crevices (see Figure 4.1).

The Painted Finch (*Emblema pictum*) occurs in the Pilbara, Kimberley and central deserts in Western Australia (Birds Australia, 2011). It typically inhabits spinifex grasslands in rocky country, in the vicinity of gorges where there are pools of water and occasionally in sandplain spinifex if water is available (Morcombe, 2000). The Painted Finch occurs in the Mount Gould area at the southern extent of its range. Storr (1985) mentions Mount Hale (in the nearby Jack Hills) as a southerly location for this species. Due to its distribution and dependence on the limited *Triodia* grasslands of the BIF ridges in the region, this species is considered locally significant.

The Painted Finch was recorded during both survey phases, with the species recorded nesting in large spinifex clumps on top of Mount Gould and drinking from small water pools collected in a large cave. The Painted Finch is expected to be dependent of the *Triodia melvillei* hummock grasslands occurring in the Jack Hills Range and at Mount Gould and was not recorded on the surrounding plains away from the ridge during either survey.

The Little Broad-nosed Bat (*Scotorepens greyii*) is locally common throughout northern Australia, roosting in tree hollows in open woodlands and plains. Within Western Australia it is known from the Gascoyne, Pilbara and Kimberley regions occurring in the Mount Gould area at the southern extreme of its range (ecologia, 2009). As a result the Little Broad-nosed Bat is considered locally significant.

4.4.2 Conservation Significant Fauna Potentially occurring in the Study Area

There are several additional conservation significant fauna species with the potential to occur in the Mount Gould Study Area. These species are discussed below:

Slender-billed Thornbill (*Acanthiza iredalei*)

The Western Slender-billed Thornbill is listed as Vulnerable under the EPBC Act. It occurs in shrubland, typically in areas of saltmarsh dominated by samphire, bluebush (*Maireana*) or saltbush (*Atriplex*) around salt lakes or low heath on sandplain (Pavey, 2006). The species occurs in a number of disjunct populations in Western Australia, from Shark Bay to the Nullarbor (Johnstone and Storr, 2004). The Western Slender-billed Thornbill is considered uncommon, rare and in some areas locally extinct in inland Western Australia. The species is declining in much of its range owing to the degradation of chenopod vegetation by livestock and rabbits (Johnstone and Storr, 2004). In the Northern Territory, the western subspecies of the Slender-billed Thornbill is classified as Regionally Extinct (Pavey, 2006). This species has been recorded at scattered locations throughout the Murchison, including at Weld Range (ecologia, 2009) and Nallan Station (Birds Australia, 2011). As the species inhabits samphire amongst the margins of salt lakes it is unlikely to occur in the Study Area.

Malleefowl (*Leipoa ocellata*)

The Malleefowl is listed as Vulnerable under the EPBC and WC Acts. In Western Australia Malleefowl occur mainly in scrubs and thickets of Mallee (*Eucalyptus* spp.), Boree (*Melaleuca lanceolata*) and Bowgada (*Acacia linophylla*), and also other dense litter-forming shrublands including Mulga Shrublands (Johnstone and Storr, 2004). The species distribution was once larger and less fragmented, but the widespread clearing of suitable habitat, coupled with the degradation of habitat by fire and livestock, and fox predation, have reduced Malleefowl numbers considerably. Malleefowl previously inhabited most of the Murchison; however, the species has undergone a dramatic range reduction in the region.

Malleefowl have developed a highly sophisticated method of temperature control for egg incubation. The species constructs distinctive nests that comprise a large mound covering a central core of leaf litter, typically in areas of dense vegetation. Old abandoned Malleefowl mounds have been recorded on the slopes of Weld Range (ecologia, 2009) and the species has been sighted between Weld Range and Jack Hills (M Seivwright, pers. com.). No Malleefowl mounds were recorded within the Study Area, which lies at the northern limit of this species distribution. Due to the paucity of the *Acacia* shrublands at Mount Gould, Malleefowl are unlikely to breed in the area.

Western Spiny-tailed Skink (Black Form, *Egernia stokesii badia*)

Western Spiny-tailed Skink (*Egernia stokesii badia*) is listed as Endangered under the EPBC Act and under Schedule 1 of the WC Act. This species has been recently recorded at several locations in the Murchison region, including near Weld Range (DEC, 2011). In the Murchison, the Western Spiny-tail Skink inhabits deep rock crevices on granite outcrops and hills (J. Turpin, pers. obs.). There are no areas of granite outcropping within the Mount Gould tenement and, as a result, this species is considered unlikely to occur within the Study Area.

Grey Falcon (*Falco hypoleucos*)

The Grey Falcon is listed as Priority 4 by DEC. This species appears to have a distribution centred around ephemeral or permanent drainage lines, utilising old nests of other bird species situated in the tallest trees along the river systems (Garnett and Crowley, 2000). Although the main threats to this species are not known, regional threats may include habitat degradation through grazing, which may have reduced prey abundance (Garnett and Crowley, 2000). The Grey Falcon is potentially a rare visitor to the Study Area, and is unlikely to breed within the Study Area due to a lack of suitable habitat.

Fork-tailed Swift (*Apus pacificus*)

The Fork-tailed Swift is listed as Migratory under the EPBC Act. It is an aerial species largely independent of terrestrial habitats, and is likely to be an irregular visitor to the Study Area.

Oriental Plover (*Charadrius veredus*)

The Oriental Plover is listed as Migratory under the EPBC Act. It is a non-breeding visitor to Australia, where it occurs in both coastal and inland areas. Along the coast the Oriental Plover inhabits estuarine mudflats, beaches and near coastal grasslands. Inland it occurs in flat, open, semi arid or arid grasslands (DEWHA, 2010a). On migration to Northern Australia (September – November), Oriental Plovers gather in flocks on open, thinly vegetated, grassland plains (Morecombe, 2000). There are no records of this species near Mount Gould; however, it was returned during database searches as potentially occurring within the Study Area.

Spinifex Slender Blue-tongue (*Cyclodomorphus melanops*)

The Spinifex Slender Blue-tongue is listed by DEC as significantly dependent on the BIF ranges in the region. It is considered to be restricted to the Spinifex dominated habitats on

the upper slopes of BIF ridges in the region, and absent from the surrounding plains (DEC, 2007).

The Spinifex Slender Blue-tongue inhabits spinifex hummock grasslands and has several disjunct populations across Western Australia including in the Pilbara and Gascoyne. It has been recorded at Jack Hills, from spinifex hummock grasslands on the upper slopes of the range (ecologia, 2009; Western Wildlife, 2006) and is also likely to occur at Mount Gould. Due to the highly restricted and isolated occurrence of Spinifex grasslands in the region, the Spinifex Slender Blue-tongue is also expected to have a highly restricted range in the region, limited to populations at Jack Hills, Robinson Range and Mount Gould.

Unbanded Delma (*Delma butleri*)

The Unbanded Delma is listed by DEC as significantly dependent on the BIF ranges in the region. It is considered to be restricted to the Spinifex dominated habitats on the upper slopes of BIF ridges in the region, and absent from the surrounding plains (DEC, 2007). It has been recorded at Jack Hills and is likely to occur at Mount Gould.

Locally Significant Fauna

The Banded Whiteface (*Aphelocephala nigricincta*) occurs across central Australia with the Murchison lying at the edge of this species range. Habitat for this species includes sandhills, chenopod shrubland and gibber plains (Simpson and Day, 2004). It appears to be uncommon in the Murchison though has been recorded near Cue. The Banded Whiteface is likely to be a rare visitor to the Study Area.

An additional bird species, the Grey Honeyeater, is also considered to be locally significant. It was formally listed as a priority species by DEC and is uncommon throughout the Murchison, recorded from a few scattered localities. This species inhabits low *Acacia* woodlands and shrublands across arid central Australia, particularly those dominated by Mulga. The Grey Honeyeater has been previously recorded at Weld Range (ecologia, 2009) and is likely to occur within the Study Area.

4.4.3 Locally Extinct Fauna

The Western Pebble-mound Mouse is listed as Priority 4 by the DEC, due to a significant decline in range from the Gascoyne and Murchison (van Dyck and Strahan, 2008). Preferred habitat includes the gentler slopes of rocky ranges where the ground is covered with a stony mantle and vegetated by hard spinifex, often with a sparse overstorey of eucalypts and scattered shrubs (van Dyck and Strahan, 2008).

Numerous old pebble-mounds constructed by the Western Pebble-mound Mouse (*Pseudomys chapmani*) were recorded on the lower slopes and stony plains surrounding

Mount Gould (see Appendix G, Plate 4). The Western Pebble-mound Mouse appears to be relatively common in the adjacent Pilbara region; however, there have been no recent records of this species from the Murchison. No active Pebble mounds were recorded and this species is unlikely to persist at Mount Gould.



Plate 4: Old, inactive Pebble Mound on the lower slopes of Mount Gould.

The Black-flanked Rock-Wallaby (*Petrogale lateralis*) is listed as Vulnerable under the EPBC Act and has significantly declined in Western Australia, with several populations declining to extinction in recent years. Old scats attributable to *Petrogale lateralis* were recorded from a ledge within a cave on the slopes of Mount Gould (see Appendix G) and are likely to be many decades old. This species formerly occurred in the region with records from Mount Farmer and Weld Range; however, there have been no records for many years (DEC, 2011). The Black-footed Rock-Wallaby is now considered to be extinct across the Murchison (DEC, 2011; WWF, 2011) and no fresh evidence of the species was recorded from the Study Area. This species is highly unlikely to persist in the local area.

The Boodie (*Bettongia lesueur*) and Stick-nest Rat (*Leporillus* sp.) are considered extinct on mainland Australia, although there have been some recent re-introductions to managed reserves. Old abandoned shelters constructed by the Stick-nest Rat were recorded from a cave on Mount Gould (see Appendix G). Abandoned burrow systems of the Boodie were recorded from the plains surrounding Mount Gould. Abandoned and

decayed shelters of both species (nests or mounds) are commonly seen across the Murchison; however, neither species has been recorded from the region in over 50 years.

Figure 4.1: Conservation significant fauna recorded in the Study Area

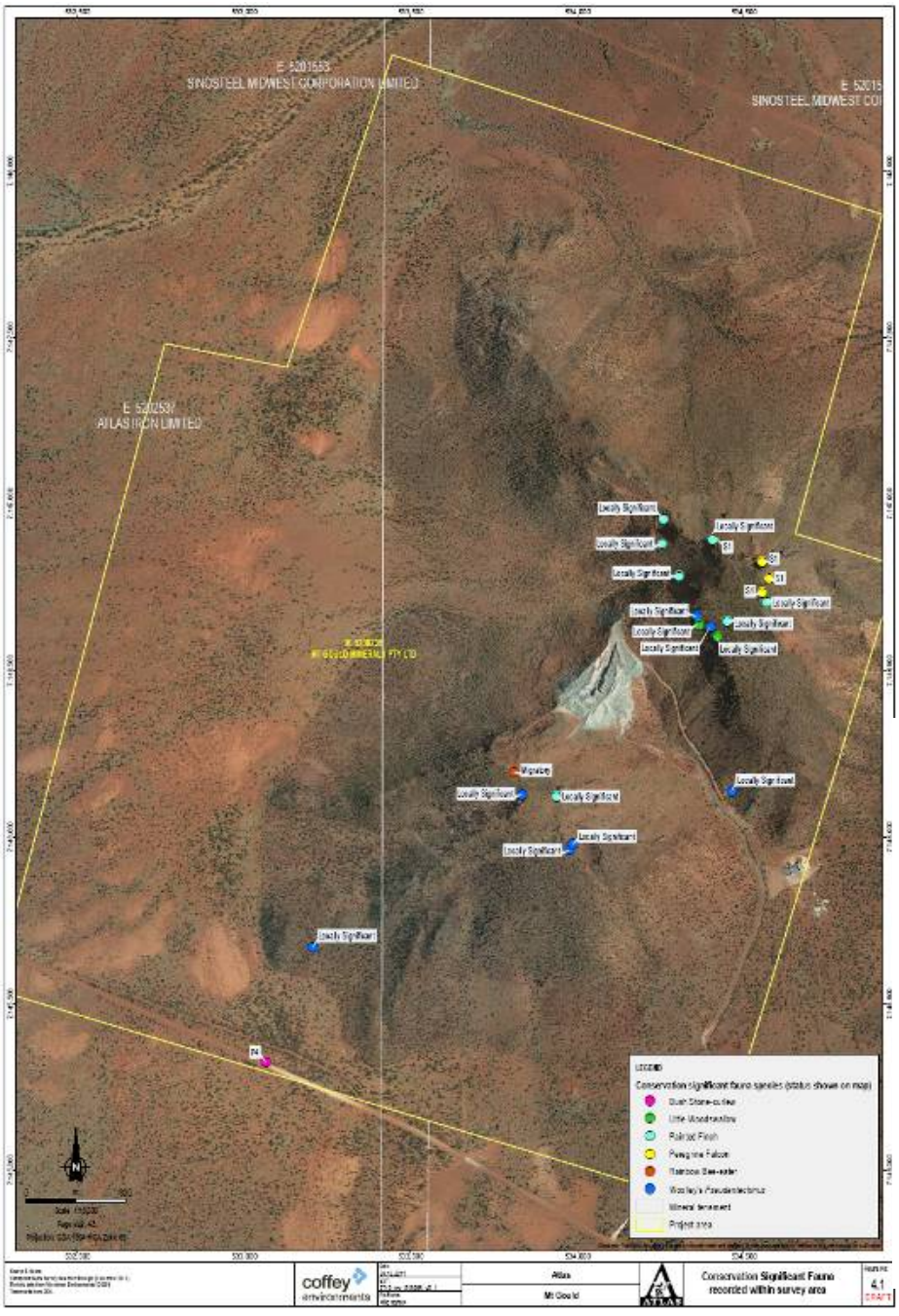


Table 4.3: Conservation significant fauna recorded or potentially occurring in the Study Area

CONSERVATION SIGNIFICANT FAUNA		Conservation Status				Records		Habitat		Status
COMMON NAME	**SPECIES NAME**	**EPBC**	**WA Act**	**DEC**	**Local**	**Study Area**	**Local Area**	**Type**	**Present In Study Area**	**Study Area**
REPTILES										
Western Spiny-tailed Skink	*Egernia stokesii badia*	END	S1				Meka	Granite Outcrops	No	Unlikely to occur
Spinifex Slender Blue-tongue	*Cyclodomorphus melanops*				BIF		Jack Hills	Spinifex Hummock Grasslands	Yes	**Likely Resident**
Unbanded Delma	*Delma butleri*				BIF		Jack Hills	Spinifex Hummock Grasslands	Yes	**Likely Resident**
BIRDS										
Peregrine Falcon	*Falco peregrinus*		S4		BIF	**Recorded**	**Mount Gould**	Rocky ridges, major drainage lines	Yes	**Breeding Resident**
Grey Falcon	*Falco hypoleucos*			P4			Lake Annean	Drainage lines, plains	No	Potential rare visitor
Australian Bustard	*Ardeotis australis*			P4		**Recorded**	**Mount Gould**	Plains	Yes	**Seasonal Visitor**
Bush Stone-curlew	*Burhinus grallarius*			P4		**Recorded**	**Mount Gould**	Mulga shrublands	Yes	**Resident**
Rainbow Bee-eater	*Merops ornatus*	MIG	S3			**Recorded**	**Mount Gould**	Watercourses, woodland	Yes	**Seasonal Visitor**
Fork-tailed Swift	*Apus pacificus*	MIG	S3				Lake Austin	Aerial	Yes	**Seasonal Visitor**
Oriental Plover	*Charadrius veredus*	MIG					None	Inland Plains	Yes	Potential Visitor

CONSERVATION SIGNIFICANT FAUNA		Conservation Status				Records		Habitat		Status
COMMON NAME	**SPECIES NAME**	**EPBC**	**WA Act**	**DEC**	**Local**	**Study Area**	**Local Area**	**Type**	**Present In Study Area**	**Study Area**
Slender-billed Thornbill	*Acanthiza iredalei*	VUL					Weld Range	Samphire, Chenopods	No	Unlikely to occur
Malleefowl	*Leipoa ocellata*	VUL	S1				Weld Range	Acacia shrublands, no recent records	Yes	Unlikely to occur
Major Mitchell's Cockatoo	*Lophochroa leadbeateri*		S4				Jack Hills	Major drainage line, woodland	No	Unlikely to occur
Little Woodswallow	*Artamus minor*				BIF	**Recorded**	**Mount Gould**	Rocky ridges	Yes	**Resident**
Painted Finch	*Emblema pictum*				L	**Recorded**	**Mount Gould**	Spinifex Ridges	Yes	**Resident**
Banded Whiteface	*Aphelocephala nigricincta*				L		Lake Austin	Open stony plains	Yes	Potential visitor
Grey Honeyeater	*Conopophila whitei*				L		Weld Range	Mulga Shrublands	Yes	**Likely Resident**
MAMMALS										
Long-tailed Dunnart	*Sminthopsis longicaudata*			P4	BIF		Jack Hills	Rocky Ridges, BIF	Yes	**Possible Resident**
Woolley's Pseudantechinus	*Pseudantechinus woolleyae*				BIF	**Recorded**	**Mount Gould**	Rocky Ridges, BIF	Yes	**Resident**
Little Broad-nosed Bat	*Scotorepens greyii*				L	**Recorded**	**Mount Gould**	Tree hollows in woodlands, shrublands	Yes	**Resident**

Conservation Status Codes:

1. *EPBC Act 1999: Endangered (END), Vulnerable (VUL), Migratory (M).*
2. *Wildlife Conservation Act 1950 (WCA): Schedule 1 (S1), Schedule 4 (S4).*
3. *DEC Priority Fauna (DEC): Priority 4 (P4).*
4. *Local Significance (Local): Taxa considered significant at the local level (L) or species considered by DEC to be mostly restricted to BIF in the region (BIF).*

4.5 Important Fauna Habitats

Each of the fauna habitats identified in Section 4.3 was given a significance score of High, Medium or Low based on criteria outlined in Table 3.5. Details of the assessment are provided in Table 4.1.

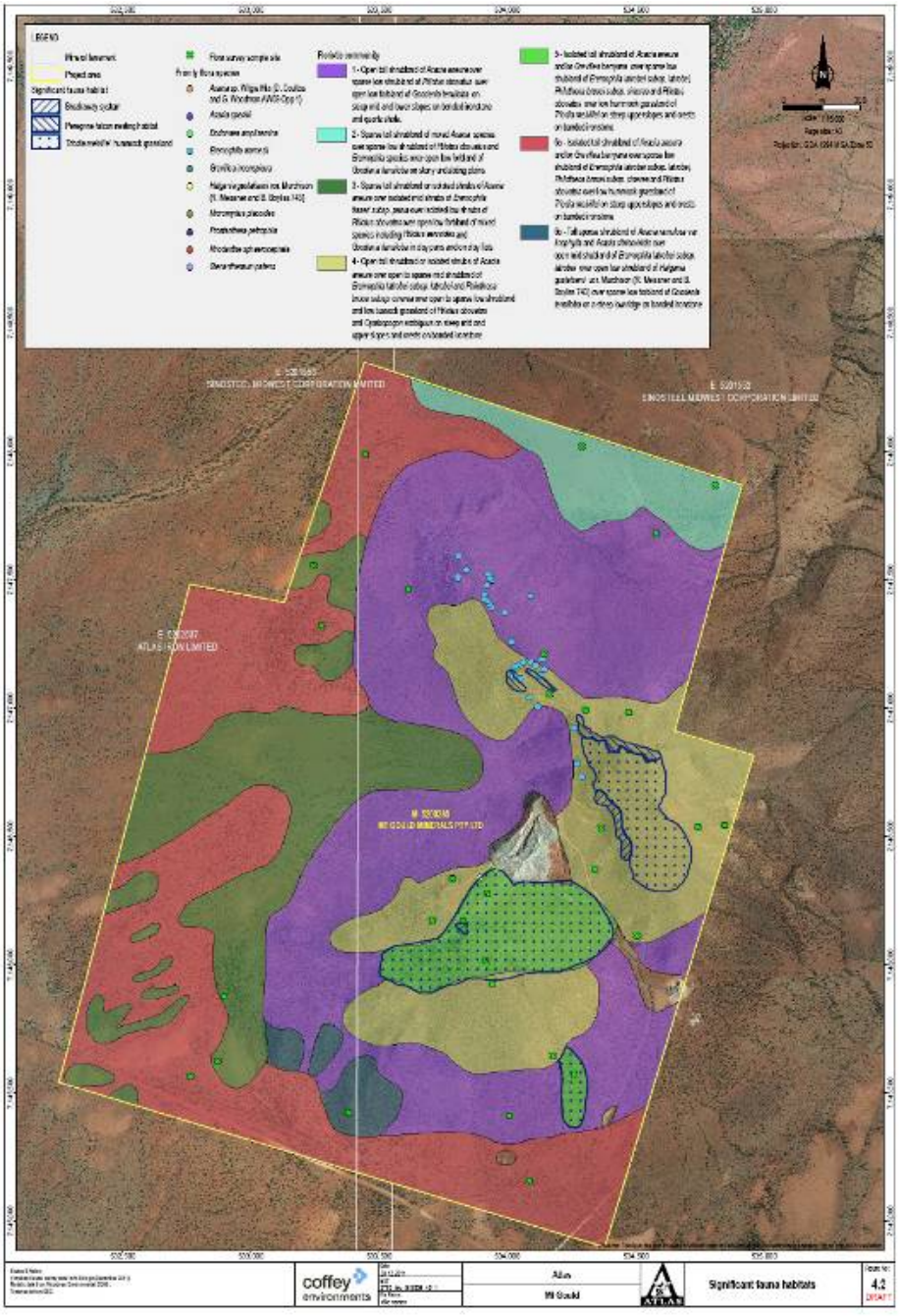
Two habitats, Spinifex Hummock Grasslands on Ironstone Hill Crests and Upper Slopes and Breakaway systems, were considered to be of High significance because they support or provide core habitat for a number of conservation significant species and are rare or restricted habitats in the region. A third habitat, Open Mulga shrublands over Tussock Grassland on Ironstone Hills and Ridges, is also considered significant due to its restricted occurrence in the region and the potential for conservation significant fauna. Disturbances to habitats types considered to be of "high significance" should be avoided or minimised where possible.

Table 4.1: Fauna habitat significance scores

Fauna habitat	Score	Rationale
Spinifex Hummock Grasslands on Ironstone Hill Crests and Upper Slopes	High	Highly restricted habitat, locally and in the region. Includes the Mount Gould Vegetation Complexes (BIF), a listed Priority Ecology Community (PEC) by the DEC. Restricted to the slopes of Mount Gould. Spinifex hummock grasslands on BIF occur only on the upper slopes of Jack Hills, Mount Gould and Robinson Range in the region. Likely to support reptiles with restricted ranges such as spinifex specialist species including *Cyclodomorphus melanops*. Also supports a breeding population of Painted Finch. The summit of Mount Gould contains a series of cliff faces containing breeding sites of the conservation significant Peregrine Falcon. At least two nesting sites occur and many roosting sites. Also contains nesting sites for the Australian Kestrel. The rock outcrops also support the BIF restricted Woolley's Pseudantechinus and are also likely to support the Priority 4 listed Long-tailed Dunnart.
Open Mulga shrublands over Tussock Grassland on Ironstone Hills and Ridges	Moderate - High	Occurs on the slopes of Mount Gould generally below *Triodia melvillei* hummock grasslands. A restricted and isolated habitat in the region. The rock outcrops also support the BIF restricted Woolley's Pseudantechinus and are also likely to support the Priority 4 listed Long-tailed Dunnart.
Stony lower slopes and plains below hill systems	Moderate	Occurs on the lower slopes of Mount Gould and the adjacent stony plains.
Mixed Acacia shrublands on sandplain	Moderate	Occurs in small areas adjacent to the slopes of Mount Gould.
Sparse Mulga shrublands on hardpan	Low	Occurs on the plains surrounding Mount Gould and is widespread through the region.

Sparse Acacia shrublands on stony undulating plains	Low	Occurs on the plains surrounding Mount Gould and is widespread through the region.
Breakaway systems containing deep crevices, caves and rock ledges	High	Occurs in small areas on the slopes of Mount Gould. A highly restricted habitat, also occurs on the nearby BIF ranges (Jack Hills, Robinson Range). Likely to support DEC Priority listed species, such as the Long-tailed Dunnart and supports the locally significant *Pseudantechinus woolleyae* and Little Woodswallow. Likely to supports some fauna species with restricted ranges and specific habitat requirements (eg. Bats). A deep cave on the slopes of Mount Gould contains a water seep after rainfall, providing a significant resource to the local Painted Finch population. Contains the historic evidence of Stick-nest Rats and Black-flanked Rock-wallabies. Deep caves are extremely uncommon in the region.

Figure 4.1: Important fauna habitats within the Study Area



5 CONCLUSIONS

Without a disturbance footprint it is difficult to determine impacts on specific fauna or fauna habitats, however, some conclusions can be drawn.

The development of mining activities at Mount Gould may impact on fauna in a number of ways. These include:

- Death/ injury/ displacement/ disturbance of fauna during clearing;
- Increased mortality of fauna from vehicle strikes;
- Loss of habitat through:
    - clearance, removal or degradation of native vegetation;
    - weed invasion displacing native vegetation;
    - hydrological changes altering or removing fauna habitat;
    - disturbance or loss of breeding sites (eg. cliffs, caves, tree hollows);
- Fragmentation of habitat;
- Alteration of the local fire regime;
- Changes in the abundance of feral species;
- Direct and indirect impacts of dust; and
- Disturbance of fauna in nearby areas from light, vibration and noise.

Important Fauna Habitats

Clearing for a development can lead to habitat loss, which may lead to a consequent decline in population size for local fauna species. Loss of habitat can occur directly by vegetation clearing or can also occur through the degradation of vegetation (such as weed invasion). The loss or degradation of vegetation can be minimised through controls during clearing and management during operation.

Seven fauna habitats were recorded from the Study Area with three of particular significance. The Spinifex hummock grasslands on the crests and upper slopes of Mount Gould are highly restricted, support species of conservation significance (including breeding populations of the locally significant Painted Finch) and are likely to support a highly restricted and specialised fauna assemblage . This vegetation type is also a Priority Ecological Community. This vegetation type is highly restricted in the region and may be confined to Jack Hills, Mount Gould and the Robinson Ranges. Disturbances to Spinifex hummock grasslands should be avoided.

Some small areas of breakaways containing caves and rock crevices also occur on the slopes of Mount Gould. These are likely to form core habitat for the DEC Priority 4 listed Long-tailed Dunnart and provide habitat for the locally restricted Woolley's Pseudantechinus and Little Woodswallow. Disturbances to this habitat should be avoided.

The Mulga shrublands over Tussock Grasslands on the slopes of Mount Gould are also of importance due to its restricted occurrence in the region and the potential for conservation significant fauna . Disturbances to this habitat types should be avoided where possible or minimised.

Conservation Significant Fauna

Loss of habitat can reduce population size that for some species may be critical. This may include the loss of breeding or nesting sites.

The hill crests, particularly the summit of Mount Gould, contain some cliff faces that have been extensively used by Peregrine Falcons for roosting and breeding over a number of years. Such habitat is very uncommon in the region and is therefore considered critical habitat for this species. The Peregrine Falcon is listed under Schedule 4 of the WC Act and, as such, disturbances to nesting and roosting habitat should be avoided.

The Spinifex Hummock Grasslands are also likely to support some highly restricted species. Locally significant and breeding populations of Painted Finch occur and two locally significant reptiles are expected; Spinifex Slender Blue-tongue and Unbanded Delma.

The rock crevices, outcrops and caves support the BIF restricted Woolley's Pseudantechinus and Little Woodswallow, and are likely to support the DEC Priority 4 listed Long-tailed Dunnart.

Feral Species

Introduced species may have adverse impacts upon native species. In particular, some mammal species expected in the area are sensitive to predation by Feral Cats and Foxes, of which both can increase in abundance with human activities. Additionally, a small group of Feral Goats reside on Mount Gould. Feral Goats have caused extensive damage to vegetation throughout the Murchison and have caused significant degradation of fauna habitats at Mount Gould (particularly near the summit). The management of feral fauna at Mount Gould should be considered. The small group occurring at Mount Gould may be easily eradicated.

Additionally, weed invasion poses a threat to the fauna and flora values of the Study Area. Invasive weed species can replace native species and degrade fauna habitats. Weeds can be spread by vehicles, earthworks and road construction. Weed outbreaks tend to

occur on recently disturbed ground such as road sides and drainage channels. A weed prevention and control strategy should be in implemented to prevent the spread of weeds in the area.

Fire

Increased human activity is often associated with an increased risk of fire or altered fire regimes. Increased incidence of fire may lead to the temporary destruction of vegetation or more lasting degradation of fauna habitats. Fire is a natural feature of the environment, but frequent, extensive fires may adversely impact some fauna. The restricted fauna assemblage within the *Triodia* hummock grasslands may be particularly susceptible to extensive wild fire and fire management practises may need to be considered in this area.

Increased Fauna Mortality

Direct mortality of fauna can occur during clearing of vegetation, and ongoing mortality may arise due to road collisions. Direct mortality of common species during clearing is unavoidable, but can be minimised; however, direct and ongoing mortality may have a significant impact on rare species, and the viability of species that occur at low population densities, within and adjacent to the Study Area.

Impacts of dust, light, vibration and noise

Dust pollution in the form of airborne particulate matter may damage vegetation, leading to reduced growth and altered species composition (Singh *et al.*, 2004). Vegetation structure and type is known to influence the structure of fauna communities (Jellenik *et al.*, 2004), and thus a decline in vegetation quality is likely to impact faunal assemblages.

Impacts of light, vibration and noise upon fauna are difficult to predict, as such, a precautionary approach is advised. Noise and light pollution may disrupt fauna species and may lead to the displacement of some fauna, particularly more mobile species. This may be significant for some bird species, such as the breeding populations of Peregrine Falcon and Painted Finch. Increased levels of noise, light, vibration and dust may inhibit the breeding success of these species and, as a result, may require management.

6 MANAGEMENT RECOMMENDATIONS

The following management strategies are recommended to mitigate impacts of the development on native fauna:

1. Limit loss of habitat by controlling the clearing footprint and, as such, retain as much habitat as possible, in the best condition possible. This will help retain the fauna values already present and facilitate rehabilitation;
2. Avoid disturbances to significant fauna habitats –
    a. Avoid disturbance to the Spinifex Hummock grasslands on the crests and upper slopes of Mount Gould;
    b. Avoid disturbance to Peregrine Falcon nesting habitat;
    c. Avoid disturbance to caves, breakaways and rocky outcrops;
    d. Minimise disturbance Mulga shrublands on the mid slopes of Mount Gould;
3. Following construction, appropriate revegetation of all disturbed areas should be carried out, using locally collected seed;
4. Develop a weed prevention and control management plan;
5. Develop a fire management plan;
6. Develop a feral fauna management plan and consider the removal of Feral Goats from Mount Gould;
7. Minimise the impacts of dust, light, noise and vibration on local fauna and monitor their impacts on breeding populations of conservation significant birds; and
8. Develop dust, light, noise and vibration pollution management procedures if necessary.

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Appendix A: Conservation Status Codes

Environment Protection and Biodiversity Conservation (EPBC) Act 1999

Category	Definition
Extinct	Taxa not definitely located in the wild during the past 50 years.
Extinct in the Wild	Taxa known to survive only in captivity.
Critically Endangered	Taxa facing an extremely high risk of extinction in the wild in the immediate future.
Endangered	Taxa facing a very high risk of extinction in the wild in the near future.
Vulnerable	Taxa facing a high risk of extinction in the wild in the medium-term future.
Migratory	Taxa listed under the following International Conventions: o Japan – Australia Migratory Bird Agreement (JAMBA) o China – Australia Migratory Bird Agreement (CAMBA) o Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention)

WA Wildlife Conservation Act 1950

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

Department of Environment and Conservation Priority codes

Category	Definition
Priority 1	Taxa with few, poorly known populations on threatened lands.
Priority 2	Taxa with few, poorly known populations on conservation lands; or taxa with several, poorly known populations not on conservation lands.
Priority 3	Taxa with several, poorly known populations, some on conservation lands.
Priority 4	Taxa in need of monitoring. Taxa which are considered to have been adequately surveyed, or for which sufficient knowledge is available, and which are considered not currently threatened or in need of special protection, but could be if present circumstances change.
Priority 5	Taxa in need of monitoring. Taxa which are not considered threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

IUCN Red List of Threatened Species

Category	Definition
Extinct	No individuals remaining.
Extinct in the Wild	Known only to survive in captivity, or as a naturalised population outside its historic range.
Critically Endangered	Extremely high risk of extinction in the wild.
Endangered	High risk of extinction in the wild.
Vulnerable	High risk of endangerment in the wild.
Near Threatened	Likely to become endangered in the near future.
Least Concern	Lowest risk. Does not qualify for a more risk category. Widespread and abundant taxa are included in this category.
Data Deficient	Not enough data to make an assessment of its risk of extinction.
Not Evaluated	Has not yet been evaluated against the IUCN criteria.

Appendix B: Survey site locations

Site	Number	Survey Type	Zone	Easting	Northing
1	1	Pitfall Trap	50J	534391.4	7146679
1	2	Pitfall Trap	50J	534411.9	7146665
1	3	Pitfall Trap	50J	534439.1	7146635
1	4	Pitfall Trap	50J	534462.3	7146622
1	5	Pitfall Trap	50J	534478.4	7146605
1	6	Pitfall Trap	50J	534524.3	7146561
1	7	Pitfall Trap	50J	534508.1	7146578
1	8	Pitfall Trap	50J	534540	7146532
1	9	Pitfall Trap	50J	534554.5	7146524
1	10	Pitfall Trap	50J	534571.5	7146504
2	1	Pitfall Trap	50J	534361.4	7146666
2	2	Pitfall Trap	50J	534358.7	7146662
2	3	Pitfall Trap	50J	534361.8	7146662
2	4	Pitfall Trap	50J	534357.1	7146636
2	5	Pitfall Trap	50J	534388.4	7146631
2	6	Pitfall Trap	50J	534401.2	7146630
2	7	Pitfall Trap	50J	534413.9	7146610
2	8	Pitfall Trap	50J	534419.6	7146594
2	9	Pitfall Trap	50J	534424.3	7146576
2	10	Pitfall Trap	50J	534430.9	7146556
3	1	Pitfall Trap	50J	533907.5	7146127
3	2	Pitfall Trap	50J	533921.5	7146120
3	3	Pitfall Trap	50J	533936.8	7146122
3	4	Pitfall Trap	50J	533961.8	7146092
3	5	Pitfall Trap	50J	533964.6	7146063
3	6	Pitfall Trap	50J	533984.7	7146020
3	7	Pitfall Trap	50J	533999.5	7146024
3	8	Pitfall Trap	50J	533985.8	7145979
3	9	Pitfall Trap	50J	533982.2	7145925
3	10	Pitfall Trap	50J	533976.2	7145960

Site	Number	Survey Type	Zone	Easting	Northing
4	1	Pitfall Trap	50J	533087.8	7145387
4	2	Pitfall Trap	50J	533107	7145406
4	3	Pitfall Trap	50J	533123.6	7145427
4	4	Pitfall Trap	50J	533146.3	7145439
4	5	Pitfall Trap	50J	533150.8	7145465
4	6	Pitfall Trap	50J	533168.7	7145483
4	7	Pitfall Trap	50J	533181.6	7145499
4	8	Pitfall Trap	50J	533182.9	7145531
4	9	Pitfall Trap	50J	533199.7	7145554
4	10	Pitfall Trap	50J	533202.1	7145567
5	1	Pitfall Trap	50J	533422	7145573
5	2	Pitfall Trap	50J	533400.4	7145582
5	3	Pitfall Trap	50J	533375.4	7145593
5	4	Pitfall Trap	50J	533352.6	7145612
5	5	Pitfall Trap	50J	533328.7	7145618
5	6	Pitfall Trap	50J	533305.3	7145630
5	7	Pitfall Trap	50J	533286	7145650
5	8	Pitfall Trap	50J	533257	7145659
5	9	Pitfall Trap	50J	533232	7145660
5	10	Pitfall Trap	50J	533206	7145669
6	1	Pitfall Trap	50J	534240	7147819
6	2	Pitfall Trap	50J	534238	7147798
6	3	Pitfall Trap	50J	534233	7147763
6	4	Pitfall Trap	50J	534230	7147726
6	5	Pitfall Trap	50J	534234	7147699
6	6	Pitfall Trap	50J	534246	7147682
6	7	Pitfall Trap	50J	534269	7147662
6	8	Pitfall Trap	50J	534291	7147641
6	9	Pitfall Trap	50J	534316	7147628
6	10	Pitfall Trap	50J	534344	7147614
7	1	Pitfall Trap	50J	533907.2	7145131
7	2	Pitfall Trap	50J	533883.9	7145111

Site	Number	Survey Type	Zone	Easting	Northing
7	3	Pitfall Trap	50J	533860.7	7145095
7	4	Pitfall Trap	50J	533842.4	7145089
7	5	Pitfall Trap	50J	533818.2	7145089
Motion Camera Sites		**Habitat**	**Zone**	**Easting**	**Northing**
1	3	Rock crevice	50J	533985	7145979
2	3	Rock crevice	50J	533833	7146127
3	Valley	Rock Outcrop	50J	534462	7146138
4	5	Rock Outcrop	50J	533206	7145669
5	2	Cave	50J	534401.2	7146630
6	6	Drainage Line	50J	534344	7147614
7	6	Rock Outcrop	50J	534350	7147746
8	6	Hill crest	50J	534417	7147768
9	6	Stony plain	50J	534337	7147992
10	7	Sandplain	50J	533860	7145095
11	opp	Incised drainage line	50J	535041	7147892
12	2	Cave	50J	534428	7146567
13	2	Rock crevice	50J	534357	7146636
14	2	Cave	50J	534357	7146656
15	3	Rock outcrop	50J	533772	7146189
16	3	Rock outcrop	50J	533985	7145979
17	4	Sandplain	50J	533194	7145568
18	5	Rocky slope	50J	533206	7145669
19	6	Dry creek gully	50J	534366	7147623
20	6	Dry creek gully	50J	535048	7147916
21	6	Dry creek gully	50J	534159.7113	7147730
22	6	Stony flats N Mt Gould -Extended camera trap	50J	535352.1189	7147807
23	Opp	Mount Gould Creek	50J	533430	7148379
24	Opp	Homestead	50J	539283	7146030
25	Opp	Dam	50J	535700	7146027

Appendix C: Fauna Survey Sites (Photos).

Trapping Sites:

Site 1: Mid Slope, Acacia over Spinifex



Site 2: Breakaway / Cave



Site 3: Ironstone Ridge Top, Spinifex hummock grassland



Site 4: Plain – mixed Acacia shrubland



Site 5: Lower Slope / Foothills



Site 6: Drainage Line / Stony Plain



Site 7: Mixed Acacia Sandplain



Site 2: Cave



Appendix D: Fauna Species Recorded and Expected in the Study Area

Information from nearby fauna assessments was used to generate species lists as well as DEC and Birds Australia Databases and Field Guides:

- Fauna Surveys– Jack Hills (Ecologia, 2009, Western Wildlife 2006, MBS, 2005a and MBS 2005b)
- Fauna Surveys– Weld Range (Ecologia, 2009, BCE, 2009)
- Fauna Survey – OPR Rail (Ecologia, 2010).

KEY

Database search codes:

I) EPBC Protected Matters Search Tool;

II) DEC NatureMap (Mount Gould with 40km buffer);

III) Biologic & Other Data.

Conservation Status Codes:

1. EPBC Act 1999: Endangered (EN), Vulnerable (VU), Migratory (M).
2. Wildlife Conservation Act 1950 (WCA): Schedule 1 (S1), Schedule 4 (S4).
3. DEC Priority Fauna (DEC): Priority 1 (P1), Priority 4 (P4).
4. Local Significance (L): Taxa considered significant at the local level.

Appendix D: Fauna recorded in the Study Area and region.

Table D1: Mammals

Family and Species	Common name	Conservation Status				Database Searches†			Surveys from the vicinity of the Study Area						This Survey
		EPBC	WCA	DEC	Other	I	II	III	Jack Hills ecologia 2009	Jack Hills MBS 2005	Jack Hills Western Wildlife 2006	Weld Range ecologia 2009	Weld Range BCE 2008	OPR Rail* ecologia 2010	Biologic 2011
TACHYGLOSSIDAE															
Tachyglossus aculeatus	Echidna								X	X		X	X		X
DASYURIDAE															
Antechinomys laniger	Kultarr											X			
Pseudantechinus woolleyae	Woolley's Pseudantechinus				L		X		X		X	X	X		X
Sminthopsis longicaudata	Long-tailed Dunnart			P4			X		X	X		X			
Sminthopsis macroura	Stripe-faced Dunnart						X		X		X	X			X
Sminthopsis dolichura	Little long-tailed Dunnart											X			
MACROPODIDAE															
Macropus robustus erubescens	Euro, Biggada						X		X	X	X	X	X		X
Macropus rufus	Red Kangaroo, Marlu						X			X	X	X	X		X
EMBALLONURIDAE															
Taphozous hilli	Hill's Sheathtail-bat								X		X	X	X	X	X
MOLOSSIDAE															
Mormopterus sp 3	Inland Freetail-bat														X
Tadarida australis	White-striped Freetail-bat									X	X	X	X		X
VESPERTILIONIDAE															
Chalinolobus gouldii	Gould's Wattled Bat								X		X	X		X	X
Nyctophilus geoffroyi	Lesser Long-eared Bat								X		X	X		X	X
Scotorepens balstoni	Inland Broad-nosed Bat						X		X		X	X			X
Scotorepens greyii	Little Broad-nosed Bat				L				X	X					X
Vespadelus finlaysoni	Finlayson's Cave Bat								X	X	X	X	X	X	X
MURIDAE															
Notomys alexis	Spinifex Hopping-mouse						X		X	X	X	X			X
Pseudomys hermannsburgensis	Sandy Inland Mouse						X		X	X		X			X
TOTAL							8		13	9	11	16	7	4	15
INTRODUCED MAMMALS															
Bos taurus	European Cattle						X					X			X
Canis lupus dingo	Dingo								X					X	X
Camelus dromedarius	Dromedary, Camel														X
Capra hircus	Goat						X		X	X	X	X	X		X
Equus asinus	Donkey														
Equus caballus	Horse														
Felis catus	Cat						X		X	X		X		X	X
Mus musculus	House Mouse						X		X	X		X			X
Oryctolagus cuniculus	Rabbit									X	X	X			X
Vulpes vulpes	Red Fox									X		X			
TOTAL							4		4	5	2	6	1	2	7

Table D2: Birds

Family and Species	Common name	Conservation Status			Database Searches†				Surveys from the vicinity of the Study Area						This Survey
		EPBC	WCA	DEC	I	II	III	IV	Jack Hills ecologia 2009	Jack Hills MBS 2005a	Jack Hills MBS 2005b	Jack Hills Western Wildlife 2006	Weld Range ecologia 2009	Weld Range BCE 2008	Biologic 2011
CASUARIIDAE															
Dromaius novaehollandiae	Emu					X		X	X	X	X	X	X	X	X
PHASIANIDAE															
Coturnix pectoralis	Stubble Quail														X
Coturnix ypsilophora	Brown Quail														
ANATIDAE															
Dendrocygna eytoni	Plumed Whistling-duck														X
Cygnus atratus	Black Swan					X									X
Tadorna tadornoides	Australian Shelduck					X		X							
Chenonetta jubata	Australian Wood Duck					X		X							X
Anas gracilis	Grey Teal					X									X
Anas superciliosa	Pacific Black Duck					X									X
Aythya australis	Hardhead					X									
Malacorhynchus membranaceus	Pink-eared Duck					X									
Biziura lobata	Musk Duck					X		X							
PODICIPEDIDAE															
Tachybaptus novaehollandiae	Australasian Grebe					X									
Podiocephalus poliocephalus	Hoary-headed Grebe					X									
Podiceps cristatus	Great Crested Grebe														
COLUMBIDAE															
Phaps chalcoptera	Common Bronzewing					X		X	X		X	X	X	X	X
Ocyphaps lophotes	Crested Pigeon					X		X	X	X	X	X	X	X	X
Geophaps plumifera	Spinifex Pigeon					X									
Geopelia cuneata	Diamond Dove					X		X	X	X	x	X	X		X
Geopelia striata	Peaceful Dove					X		X							X
PODARGIDAE															
Podargus strigoides	Tawny Frogmouth					X			X	X			X		
EUROSTOPODIDAE															
Eurostopodus argus	Spotted Nightjar					X			X		X	X	X	X	X
AEGOTHELIDAE															
Aegotheles cristatus	Australian Owlet-nightjar					X		X	X	X		X	X	X	X
APODIDAE															
Apus pacificus	Fork-tailed Swift	M													
ANHINGIDAE															
Anhinga novaehollandiae	Australasian Darter					X		X							X
PHALACROCORACIDAE															
Microcarbo melanoleucos	Little Pied Cormorant					X		X							
Phalacrocorax carbo	Great Cormorant					X									
Phalacrocorax varius	Pied Cormorant					X									

Family and Species	Common name	Conservation Status			Database Searches†				Surveys from the vicinity of the Study Area						This Survey
		EPBC	WCA	DEC	I	II	III	IV	Jack Hills ecologia 2009	Jack Hills MBS 2005a	Jack Hills MBS 2005b	Jack Hills Western Wildlife 2006	Weld Range ecologia 2009	Weld Range BCE 2008	Biologic 2011
Phalacrocorax sulcirostris	Little Black Cormorant					X		X							X
PELECANIDAE															
Pelecanus conspicillatus	Australian Pelican					X									X
ARDEIDAE															
Ardea pacifica	White-necked Heron					X		X							
Ardea modesta	Eastern Great Egret	M				X		X							
Egretta novaehollandiae	White-faced Heron					X		X							X
Ardea ibis	Cattle Egret	M													
Egretta garzetta	Little Egret														
Nycticorax caledonicus	Rufous Night Heron					X									
THRESKIORNITHIDAE															
Threskiornis spinicollis	Straw-necked Ibis					X		X							X
Threskiornis molucca	Australian White Ibis					X		X							
Plegadis falcinellus	Glossy Ibis	M													
Platalea regia	Royal Spoonbill														
Platalea flavipes	Yellow-billed Spoonbill					X							X		
ACCIPITRIDAE															
Elanus axillaris	Black-shouldered Kite					X		X	X						
Lophoictinia isura	Square-tailed Kite					X									
Hamirostra melanosternon	Black-breasted Buzzard							X	X		X		X	X	
Haliastur sphenurus	Whistling Kite					X		X	X			X	X	X	X
Milvus migrans	Black Kite					X									
Accipiter fasciatus	Brown Goshawk								X	X	X	X	X		X
Accipiter cirrocephalus	Collared Sparrowhawk					X		X	X				X		X
Circus assimilis	Spotted Harrier					X		X		X					X
Aquila audax	Wedge-tailed Eagle					X		X	X		X	X	X	X	X
Hieraaetus morphnoides	Little Eagle					X									
FALCONIDAE															
Falco cenchroides	Nankeen Kestrel					X		X	X	X	X	X	X	X	X
Falco berigora	Brown Falcon					X		X	X	X		X	X	X	X
Falco longipennis	Australian Hobby					X		X				X	X		X
Falco hypoleucos	Grey Falcon			P4		X									
Falco peregrinus	Peregrine Falcon		S4			X		X				X	X		X
RALLIDAE															
Gallirallus philippensis	Buff-banded Rail														
Porzana pusilla	Bailon's Crake														
Porzana tabuensis	Spotless Crake														
Tribonyx ventralis	Black-tailed Native-hen					X		X							
Fulica atra	Eurasian Coot					X		X							
OTIDIDAE															
Ardeotis australis	Australian Bustard			P4		X		X							X

Family and Species	Common name	Conservation Status			Database Searches†				Surveys from the vicinity of the Study Area						This Survey
		EPBC	WCA	DEC	I	II	III	IV	Jack Hills ecologia 2009	Jack Hills MBS 2005a	Jack Hills MBS 2005b	Jack Hills Western Wildlife 2006	Weld Range ecologia 2009	Weld Range BCE 2008	Biologic 2011
BURHINIDAE															
Burhinus grallarius	Bush Stone-curlew			P4		X					X	X	X		X
RECURVIROSTRIDAE															
Himantopus himantopus	Black-winged Stilt					X									
Recurvirostra novaehollandiae	Red-necked Avocet														
Cladorhynchus leucocephalus	Banded Stilt														
CHARADRIIDAE															
Charadrius ruficapillus	Red-capped Plover					X									
Elseyornis melanops	Black-fronted Dotterel					X		X							X
Erythrogonys cinctus	Red-kneed Dotterel					X									
Charadrius australis	Inland Dotterel														
Vanellus tricolor	Banded Lapwing					X		X							X
Charadrius veredus	Oriental Plover	M													
SCOLOPACIDAE															
Actitis hypoleucos	Common Sandpiper	M													
Tringa stagnatilis	Marsh Sandpiper	M													
Tringa glareola	Wood Sandpiper	M													
Tringa nebularia	Common Greenshank	M													
Calidris ruficollis	Red-necked Stint	M													
Calidris subminuta	Long-toed Stint	M													
Calidris acuminata	Sharp-tailed Sandpiper	M													
Calidris ferruginea	Curlew Sandpiper	M													
TURNICIDAE															
Turnix velox	Little Button-quail					X		X	X				X		X
LARIDAE															
Chlidonias hybridus	Whiskered Tern					X									
CACATUIDAE															
Eolophus roseicapillus	Galah					X		X	X	X	X	X	X	X	X
Cacatua sanguinea	Little Corella					X		X	X						X
Nymphicus hollandicus	Cockatiel					X		X		X			X		X
Lophochroa leadbeateri	Major Mitchell's Cockatoo		S4			X									
PSITTACIDAE															
Barnardius zonarius	Australian Ringneck					X		X	X			X	X		X
Psephotus varius	Mulga Parrot					X		X	X	X	X	X	X	X	X
Melopsittacus undulatus	Budgerigar					X		X	X	X		X	X		X
Neopsephotus bourkii	Bourke's Parrot					X				X	X	X	X		X
Neophema elegans	Elegant Parrot												X		
Pezoporus occidentalis	Night Parrot	EN, M	S1												
CUCULIDAE															
Chalcites basalis	Horsfield's Bronze-Cuckoo					X		X	X	X	X	X	X	X	X
Chalcites osculans	Black-eared Cuckoo					X		X					X	X	

Family and Species	Common name	Conservation Status			Database Searches†				Surveys from the vicinity of the Study Area						This Survey
		EPBC	WCA	DEC	I	II	III	IV	Jack Hills ecologia 2009	Jack Hills MBS 2005a	Jack Hills MBS 2005b	Jack Hills Western Wildlife 2006	Weld Range ecologia 2009	Weld Range BCE 2008	Biologic 2011
Cacomantis pallidus	Pallid Cuckoo					X		X			X		X	X	X
STRIGIDAE															
Ninox novaeseelandiae	Southern Boobook					X							X		X
TYTONIDAE															
Tyto javanica	Eastern Barn Owl								X						
HALCYONIDAE															
Todiramphus pyrrhopygius	Red-backed Kingfisher					X			X	X	X	X			X
Todiramphus sanctus	Sacred Kingfisher					X									X
MEROPIDAE															
Merops ornatus	Rainbow Bee-eater	M				X			X	X					X
CLIMACTERIDAE															
Climacteris affinis	White-browed Tree-creeper														
PTILINORHYNCHIDAE															
Ptilonorhynchus guttatus	Western Bowerbird					X		X	X		X	X	X	X	X
MALURIDAE															
Malurus splendens	Splendid Fairy-wren					X		X	X		X	X	X	X	X
Malurus leucopterus	White-winged Fairy-wren					X		X					X		X
Malurus lamberti	Variegated Fairy-wren					X		X	X				X	X	X
ACANTHIZIDAE															
Pyrrholaemus brunneus	Redthroat					X		X	X		X		X	X	X
Smicrornis brevirostris	Weebill					X		X		X			X		X
Gerygone fusca	Western Gerygone					X		X	X	X	X		X		X
Acanthiza robustirostris	Slaty-backed Thornbill					X		X	X	X			X		X
Acanthiza chrysorrhoa	Yellow-rumped Thornbill					X		X	X	X	X	X	X	X	X
Acanthiza uropygialis	Chestnut-rumped Thornbill					X		X	X		X	X	X	X	X
Acanthiza apicalis	Inland Thornbill					X			X			X	X	X	
Aphelocephala leucopsis	Southern Whiteface					X		X	X	X		X	X	X	X
Aphelocephala nigrcincta	Banded Whiteface					X									
PARDALOTIDAE															
Pardalotus rubricatus	Red-browed Pardalote					X									X
Pardalotus striatus	Striated Pardalote					X						X	X		X
MELIPHAGIDAE															
Certhionyx variegatus	Pied Honeyeater					X		X						X	
Lichenostomus virescens	Singing Honeyeater					X		X	X	X	X	X	X		X
Lichenostomus keartlandi	Grey-headed Honeyeater														
Lichenostomus penicillatus	White-plumed Honeyeater					X		X	X			X	X	X	X
Purnella albifrons	White-fronted Honeyeater					X			X					X	
Manorina flavigula	Yellow-throated Miner					X		X	X	X	X	X	X	X	X
Acanthagenys rufogularis	Spiny-cheeked Honeyeater					X		X	X	X	X	X	X	X	X
Conopophila whitei	Grey Honeyeater												X		
Epthianura tricolor	Crimson Chat					X		X	X			X	X		X

Family and Species	Common name	Conservation Status			Database Searches†				Surveys from the vicinity of the Study Area						This Survey
		EPBC	WCA	DEC	I	II	III	IV	Jack Hills ecologia 2009	Jack Hills MBS 2005a	Jack Hills MBS 2005b	Jack Hills Western Wildlife 2006	Weld Range ecologia 2009	Weld Range BCE 2008	Biologic 2011
Epthianura aurifrons	Orange Chat												X		
Epthianura albifrons	White-fronted Chat							X							
Sugomel niger	Black Honeyeater													X	
Lichmera indistincta	Brown Honeyeater					X		X		X	X			X	
POMATOSTOMIDAE															
Pomatostomus temporalis	Grey-crowned Babbler					X		X	X	X	X	X	X	X	X
Pomatostomus superciliosus	White-browed Babbler					X		X	X			X	X	X	X
PSOPHODIDAE															
Cinclosoma castaneothorax	Chestnut-breasted Quail-thrush					X			X	X	X	X	X	X	X
Psophodes occidentalis	Chiming Wedgebill								X		X			X	
NEOSITTIDAE															
Daphoenositta chrysoptera	Varied Sittella					X		X	X	X	X	X			
CAMPEPHAGIDAE															
Coracina maxima	Ground Cuckoo-shrike					X		X	X				X		
Coracina novaehollandiae	Black-faced Cuckoo-shrike					X		X	X	X	X	X	X	X	X
Lalage sueurii	White-winged Triller					X		X	X	X		X	X	X	X
PACHYCEPHALIDAE															
Pachycephala rufiventris	Rufous Whistler					X		X	X	X	X	X	X	X	X
Colluricincla harmonica	Grey Shrike-thrush					X		X	X	X	X	X	X	X	X
Oreoica gutturalis	Crested Bellbird					X		X	X	X	X	X	X	X	X
ARTAMIDAE															
Artamus personatus	Masked Woodswallow					X		X					X		X
Artamus cinereus	Black-faced Woodswallow					X		X	X	X	X	X	X	X	X
Artamus minor	Little Woodswallow					X			X	X	X	X	X	X	X
Cracticus torquatus	Grey Butcherbird					X		X	X	X	X	X	X	X	X
Cracticus nigrogularis	Pied Butcherbird					X		X	X	X	X	X	X	X	X
Cracticus tibicen	Australian Magpie					X		X	X		X		X	X	X
RHIPIDURIDAE															
Rhipidura albiscapa	Grey Fantail												X		
Rhipidura leucophrys	Willie Wagtail					X		X	X	X	X	X	X	X	X
CORVIDAE															
Corvus bennetti	Little Crow					X		X	X	X		X	X	X	X
Corvus orru	Torresian Crow					X		X	X		X	X	X		X
MONARCHIDAE															
Grallina cyanoleuca	Magpie-lark					X		X	X				X	X	X
PETROICIDAE															
Petroica goodenovii	Red-capped Robin					X		X	X	X	X	X	X	X	X
Melanodryas cucullata	Hooded Robin					X		X	X				X		
Microeca fascinans	Jacky Winter											X			
ACROCEPHALIDAE															

Family and Species	Common name	Conservation Status			Database Searches†				Surveys from the vicinity of the Study Area						This Survey
		EPBC	WCA	DEC	I	II	III	IV	Jack Hills ecologia 2009	Jack Hills MBS 2005a	Jack Hills MBS 2005b	Jack Hills Western Wildlife 2006	Weld Range ecologia 2009	Weld Range BCE 2008	Biologic 2011
Acrocephalus australis	Australian Reed-Warbler														
MEGALURIDAE															
Megalurus gramineus	Little Grassbird														
Cincloramphus mathewsi	Rufous Songlark					X		X	X	X			X	X	X
Cincloramphus cruralis	Brown Songlark					X		X				x			X
HIRUNDINIDAE															
Cheramoeca leucosterna	White-backed Swallow					X					X		X		
Hirundo neoxena	Welcome Swallow					X		X				X	X		X
Petrochelidon ariel	Fairy Martin							X					X		
Petrochelidon nigricans	Tree Martin					X		X			X	X			X
NECTARINIIDAE															
Dicaeum hirundinaceum	Mistletoebird							X		X			X	X	X
ESTRILDIDAE															
Taeniopygia guttata	Zebra Finch					X		X	X	X	X	X	X	X	X
Emblema pictum	Painted Finch								X						X
MOTACILLIDAE															
Anthus novaeseelandiae	Australasian Pipit					X		X	X	X	X	X	X	X	X
TOTAL		14	3	3		123		91	67	45	46	56	79	52	90

†*Database search codes: I) EPBC Protected Matters Search Tool; II) DEC NatureMap; Iii) Biologic & Other Data; iV) Birds Australia Birdata Database.*

Conservation Status Codes:

1. *EPBC Act 1999: Endangered (EN), Vulnerable (VU), Migratory (M).*
2. *Wildlife Conservation Act 1950 (WCA): Schedule 1 (S1), Schedule 4 (S4).*
3. *DEC Priority Fauna (DEC): Priority 1 (P1), Priority 4 (P4).*
4. *Local Significance (Local): Taxa considered significant at the local level.*

Table D3: Reptiles

Family and Species	Common name	Conservation Status			Database Searches†			Surveys from the vicinity of the Study Area							This Survey
		EPBC	WCA	DEC	I	II	III	Jack Hills ecologia 2009	Jack Hills MBS 2005a	Jack Hills MBS 2005b	Jack Hills Western Wildlife 2006	Weld Range ecologia 2009	Weld Range BCE 2008	OPR Rail* ecologia 2010	Biologic 2011
CHELUIDAE															
Chelodina steindachneri	Flat-shelled Turtle											X			
AGAMIDAE															
Amphibolurus longirostris	Long-nosed Dragon					X		X	X	X	X	X			X
Caimanops amphiboluroides	Mulga Dragon											X			
Ctenophorus caudicinctus	Ring-tailed Dragon					X		X	X	X	X	X	X	X	X
Ctenophorus nuchalis	Central Netted Dragon					X		X	X	X	X	X			X
Ctenophorus reticulatus	Western Netted Dragon					X			X	X	X	X	X		X
Ctenophorus scutulatus	Lozenge-marked Dragon					X					X	X	X		X
Moloch horridus	Thorny Devil											X			
Pogona minor	Bearded Dragon					X		X		X	X	X		X	X
Tympanocryptis cephalus	Pebble Dragon					X					X	X			
DIPLODACTYLIDAE															
Diplodactylus conspicillatus	Fat-tailed Gecko					X					X				
Diplodactylus granariensis	Wheatbelt Stone Gecko														
Diplodactylus pulcher	Fine-faced Gecko									X	X	X			
Lucasium squarrosum	Mottled Ground Gecko											X			
Lucasium stenodactylum	Pale-snouted Ground Gecko					X		X	X	X	X				X
Oedura marmorata	Marbled Velvet Gecko							X		X	X				
Rhynchoedura ornata	Beaked Gecko					X				X	X	X			X
Strophurus elderi	Jewelled Gecko														
Strophurus strophurus	Western Spiny-tailed Gecko					X				X	X				
Strophurus wilsoni	Mount Augustus Spiny-tailed Gecko														
Strophurus wellingtonae	Western-shield Spiny-tailed Gecko											X		X	
CARPHODACTYLIDAE															
Nephrurus vertebralis	Midline Knob-tail					X						X			X
Nephrurus wheeleri	Banded Knob-tail														
GEKKONIDAE															
Gehyra punctata	Spotted Dtella					X		X		X	X	X			X
Gehyra purpurascens	Purplish Dtella					X									
Gehyra variegata	Tree Dtella					X		X	X	X	X	X	X		X
Heteronotia binoei	Bynoe's Gecko							X		X	X	X	X		X
PYGOPODIDAE															
Delma australis	Marble-faced Delma											X			
Delma butleri	Unbanded Delma					X				X	X				
Delma tincta	Exciable Delma					X									X
Lialis burtonis	Burton's Leggless Lizard														
Pygopus nigriceps	Hooded Scaly-foot							X				X			
SCINCIDAE															
Cryptoblepharus buchananii	A skink								X			X	X		
Ctenotus leonhardii	A skink					X				X	X	X			X
Ctenotus schomburgkii	A skink					X				X	X	X		X	X
Ctenotus severus	A skink					X		X		X	X	X	X		X
Ctenotus uber	A skink											X			
Cyclodomorphus melanops	Slender Blue-tongue					X		X		X	X				

Family and Species	Common name	Conservation Status			Database Searches[†]			Surveys from the vicinity of the Study Area							This Survey
		EPBC	WCA	DEC	I	II	III	Jack Hills ecologia 2009	Jack Hills MBS 2005a	Jack Hills MBS 2005b	Jack Hills Western Wildlife 2006	Weld Range ecologia 2009	Weld Range BCE 2008	OPR Rail* ecologia 2010	Biologic 2011
Egernia depressa	Pygmy Spiny-tailed Skink					X		X				X		X	X
Eremiascincus richardsonii	Broad-banded Sand Swimmer					X					X	X			X
Lerista eupdoa	A skink			P1								X		X	
Lerista macropisthopus	A skink							X						X	
Lerista nichollsi	A skink					X						X		X	
Lerista timida	A skink							X		X	X	X	X	X	X
Menetia greyii	Dwarf Skink					X		X		X	X	X	X		X
Menetia surda	A skink														
Tiliqua occipitalis	Western Blue-tongue														
VARANIDAE															
Varanus caudolineatus	Pilbara Mulga Monitor									X		X			X
Varanus giganteus	Perentie							X			X	X			
Varanus gouldii	Bungarra or Sand Monitor							X			X				
Varanus panoptes	Yellow-spotted Monitor					X		X	X	X		X		X	X
Varanus tristis tristis	Racehorse Monitor							X		X	X	X			X
TYPHLOPIDAE															
Ramphotyphlops grypus	Long-beaked Blind Snake														X
Ramphotyphlops hamatus	Pale-headed Blind Snake							X			X	X			
BOIDAE															
Antaresia perthensis	Pygmy Python							X		X	X	X			X
Antaresia stimsoni	Stimson's Python														
Aspidites melanocephalus	Black-headed Python														
ELAPIDAE															
Acanthophis pyrrhus	Desert Death Adder														
Brachyurophis approximans	North-west Shovel-nosed Snake										X	X			
Demansia psammophis	Yellow-faced Whipsnake							X							X
Furina ornata	Moon Snake											X			
Parasuta monachus	Monk Snake											X			
Pseudechis australis	Mulga Snake														
Pseudechis butleri	Spotted Mulga Snake											X			
Pseudonaja modesta	Ringed Brown Snake											X			
Pseudonaja mengdeni	Western Brown Snake														
Simoselaps bertholdi	Jan's Banded Snake											X			X
Suta fasciata	Rosen's Snake											X			
TOTAL						**26**		**23**	**8**	**24**	**30**	**44**	**9**	**10**	**27**

[†]*Database search codes: I) EPBC Protected Matters Search Tool; II) DEC NatureMap; III) Local Biologic Records & Other Data.*

Conservation Status Codes:

5. *EPBC Act 1999: Endangered (EN), Vulnerable (VU), Migratory (M).*
6. *Wildlife Conservation Act 1950 (WCA): Schedule 1 (S1), Schedule 4 (S4).*
7. *DEC Priority Fauna (DEC): Priority 1 (P1), Priority 3 (P3), Priority 4 (P4).*
8. *Local Significance (Local): Taxa considered significant at the local level.*

Table D4: Amphibians

Family and Species	Common name	Database	Surveys from the vicinity of the Study Area						This Survey
		DEC NatureMap	Jack Hills ecologia 2009	Jack Hills MBS 2005	Jack Hills Western Wildlife 2006	Weld Range ecologia 2009	Weld Range BCE 2008	OPR Rail* ecologia 2010	Biologic 2011
HYLIDAE									
Cyclorana maini	Main's Frog			X					
Cyclorana platycephala	Water-Holding Frog			X					
Litoria rubella	Desert Tree Frog			X		X	X		X (Recorded adjacent)
MYOBATRACHIDAE									
Neobatrachus sutor	Shoemaker Frog								
Neobatrachus wilsmorei	Goldfields Bull Frog								
Opisthodon spenceri	Centralian Burrowing Frog			X					
TOTAL	6	0	0	4	0	1	1	0	1

Appendix E: Site by species records from the survey.

Table E1: Mammals

Family and Species	Common Name	Site 1		Site 2		Site 3		Site 4		Site 5		Site 6		Site 7		Anabat Records		Opportunistic Records		Motion Camera		TOTAL
		P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	
TACHYGLOSSIDAE																						
Tachyglossus aculeatus	Echidna	S		S		S					1							S	S			1
DASYURIDAE																						
Pseudantechinus woolleyae	Woolley's False Antechinus			2	S	2	3				1							S	S		1	9
Sminthopsis macroura	Striped Faced Dunnart							1					1									2
MACROPODIDAE																						
Macropus robustus	Euro		1		1		2											2	2		4	12
Macropus rufus	Red Kangaroo																	3	2			5
EMBALLONURIDAE																						
Taphozous hilli	Hill's Sheathtail-bat			B	B		B						B		B	B	B					
MOLOSSIDAE																						
Mormopterus sp 3	Inland Freetail-bat			B											B	B	B					
Tadarida australis	White-striped Freetail-bat			B												B						
VESPERTILIONIDAE																						
Chalinolobus gouldii	Gould's Wattled Bat			B	B		B		B				B			B	B					
Nyctophilus geoffroyi	Lesser Long-eared Bat															B						
Scotorepens balstoni	Western Broad-nosed Bat			B					B				B		B	B	B					
Scotorepens greyii	Little Broad-nosed Bat						B									B	B					
Vespadelus finlaysoni	Finlayson's Cave Bat			B	2		B									B	B					
MURIDAE																						
Notomys alexis	Spinifex Hopping mouse														1						1	2
Pseudomys hermannsbergensis	Sandy Inland Mouse							1	3				4									8
INTRODUCED MAMMALS																						
**Mus musculus*	House Mouse		1		1				4		1											7

Family and Species	Common Name	Site 1		Site 2		Site 3		Site 4		Site 5		Site 6		Site 7		Anabat Records		Opportunistic Records		Motion Camera		TOTAL
		P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	
**Canis lupus dingo*	Dingo																	1	S			1
**Capra hircus*	Goat						3											5	2			10
**Felis catus*	Feral Cat					1												S	1			2
**Oryctolagus cuniculus*	Rabbit																		1			1
**Bos taurus*	Cattle							S	S						S				5			5
EXTINCT MAMMALS																						
Petrogale lateralis	Black-footed Rock-wallaby						S															
Lepporillus sp.	Stick-nest Rat					S	S											S	S			
Pseudomys chapmani	Western Pebble-mound Mouse												S					S	S			

Note: species recorded using ANABAT and SM2 bat detectors are denoted by a B as individual numbers cannot be determined. Historic evidence of three extinct mammals was also recorded in the form of old scats in caves or old, disused and abandoned shelters.

Table E2: Birds

Family and Species	Common Name	Site 1		Site 2		Site 3		Site 4		Site 5		Site 6		Site 7		Opportunistic Records		Motion Camera		TOTAL
		P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	
CASUARIIDAE																				
Dromaius novaehollandiae	Emu															1				1
PHASIANIDAE																				
Coturnix pectoralis	Stubble Quail																2			2
COLUMBIDAE																				
Phaps chalcoptera	Common Bronzewing															1				1
Ocyphaps lophotes	Crested Pigeon								1		2	4			1	2	1			11
Geopelia cuneata	Diamond Dove	51		32		10		3	4	118		475			12	17	13			735
EUROSTOPODIDAE																				
Eurostopodus argus	Spotted Nightjar					1										1	1			3
AEGOTHELIDAE																				
Aegotheles cristatus	Australian Owlet-nightjar				1		1										1			3
ACCIPITRIDAE																				
Haliastur sphenurus	Whistling Kite								1						1	1	2			5
Accipiter fasciatus	Brown Goshawk			1								1				2				4
Accipiter cirrocephalus	Collared Sparrowhawk																1			1
Circus assimilis	Spotted Harrier	2														6	2			10
Aquila audax	Wedge-tailed Eagle	2														3	1			6
FALCONIDAE																				
Falco cenchroides	Nankeen Kestrel	7	6	8	4	8		3		2							9			45
Falco berigora	Brown Falcon			1						2										3
Falco longipennis	Australian Hobby	1								1							1			3
Falco peregrinus	Peregrine Falcon	1	2				2									1	3			9

Family and Species	Common Name	Site 1		Site 2		Site 3		Site 4		Site 5		Site 6		Site 7		Opportunistic Records		Motion Camera		TOTAL
		P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	
OTIDIDAE																				
Ardeotis australis	Australian Bustard																1			1
BURHINIDAE																				
Burhinus grallarius	Bush Stone-curlew							1									1			2
CHARADRIIDAE																				
Vanellus tricolor	Banded Lapwing															5				5
TURNICIDAE																				
Turnix velox	Little Button-quail	8				10	1	16	7			11				15	3			71
CACATUIDAE																				
Eolophus roseicapillus	Galah							4								10	2			16
Cacatua sanguinea	Little Corella															2				2
Nymphicus hollandicus	Cockatiel												2			21	4			27
PSITTACIDAE																				
Barnardius zonarius	Australian Ringneck								6							2	6			14
Psephotus varius	Mulga Parrot									2						2				4
Melopsittacus undulatus	Budgerigar								8							69	34			111
Neopsephotus bourkii	Bourke's Parrot														2					2
CUCULIDAE																				
Chalcites basalis	Horsfield's Bronze-Cuckoo														4					4
Cacomantis pallidus	Pallid Cuckoo																3			3
STRIGIDAE																				
Ninox novaeseelandiae	Southern Boobook															1				1
HALCYONIDAE																				
Todiramphus pyrrhopygius	Red-backed Kingfisher															2	3			5
MEROPIDAE																				
Merops ornatus	Rainbow Bee-eater						2									6	3			11

Family and Species	Common Name	Site 1		Site 2		Site 3		Site 4		Site 5		Site 6		Site 7		Opportunistic Records		Motion Camera		TOTAL
		P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	
PTILINORHYNCHIDAE																				
Ptilonorhynchus guttatus	Western Bowerbird							1	3	6	3					1	3			17
MALURIDAE																				
Malurus splendens	Splendid Fairy-wren														15	5	2			22
ACANTHIZIDAE																				
Pyrrholaemus brunneus	Redthroat														6	1	2			8
Smicrornis brevirostris	Weebill																6			6
Gerygone fusca	Western Gerygone															4				4
Acanthiza robustirostris	Slaty-backed Thornbill														7	11				18
Acanthiza chrysorrhoa	Yellow-rumped Thornbill														5	4				9
Acanthiza uropygialis	Chestnut-rumped Thornbill						5						5		4		4			18
Aphelocephala leucopsis	Southern Whiteface												3			3	4			10
PARDALOTIDAE																				
Pardalotus rubricatus	Red-browed Pardalote																1			1
Pardalotus striatus	Striated Pardalote						1													1
MELIPHAGIDAE																				
Lichenostomus virescens	Singing Honeyeater									1		3			2	1	2			9
Lichenostomus penicillatus	White-plumed Honeyeater															9	5			14
Manorina flavigula	Yellow-throated Miner	2		4		21		11	9	7	13	13	8			4	12			104
Acanthagenys rufogularis	Spiny-cheeked Honeyeater		1						4						4	2	1			12
Epthianura tricolor	Crimson Chat									4		2			2	12	8			28
POMATOSTOMIDAE																				
Pomatostomus temporalis	Grey-crowned Babbler							16	14	19	12	8	15			14	3			101
Pomatostomus superciliosus	White-browed Babbler							3	6								5			14
CINCLOSOMATIDAE																				
Cinclosoma castaneothorax	Chestnut-breasted Quail-thrush												2			5	11	3		18

Family and Species	Common Name	Site 1		Site 2		Site 3		Site 4		Site 5		Site 6		Site 7		Opportunistic Records		Motion Camera		TOTAL
		P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	
CAMPEPHAGIDAE																				
Coracina novaehollandiae	Black-faced Cuckoo-shrike														1	6	3			10
Lalage sueurii	White-winged Triller								1				1		7	5	6			20
PACHYCEPHALIDAE																				
Pachycephala rufiventris	Rufous Whistler									3	2					7	2			14
Colluricincla harmonica	Grey Shrike-thrush	1			1	1	2				1		1		1	1	6			15
Oreoica gutturalis	Crested Bellbird							2	1	1			2		4	2	7			19
ARTAMIDAE																				
Artamus personatus	Masked Woodswallow	5				5		4	4				8		140	60	28			254
Artamus cinereus	Black-faced Woodswallow							2					2		6	6	3			19
Artamus minor	Little Woodswallow	6	7	15	8		7									11	11			65
Cracticus torquatus	Grey Butcherbird							6	2	6	5	2	2		2	1	1			27
Cracticus nigrogularis	Pied Butcherbird	2		1		2		2		1			1			1				10
Cracticus tibicen	Australian Magpie																2			2
RHIPIDURIDAE																				
Rhipidura leucophrys	Willie Wagtail	1		1			1	2		5			1		2	5			4	22
CORVIDAE																				
Corvus bennetti	Little Crow		1												7	8	3			19
Corvus orru	Torresian Crow											1	2		1		2			6
MONARCHIDAE																				
Grallina cyanoleuca	Magpie-lark										2				4	6	4			16
PETROICIDAE																				
Petroica goodenovii	Red-capped Robin														4	4	2			10
MEGALURIDAE																				
Cincloramphus mathewsi	Rufous Songlark								1						1		3			5
Cincloramphus cruralis	Brown Songlark															1				1

Family and Species	Common Name	Site 1		Site 2		Site 3		Site 4		Site 5		Site 6		Site 7		Opportunistic Records		Motion Camera		TOTAL
		P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	
HIRUNDINIDAE																				
Hirundo neoxena	Welcome Swallow															5	2			7
Petrochelidon nigricans	Tree Martin															21	5			26
NECTARINIIDAE																				
Dicaeum hirundinaceum	Mistletoebird								1											1
ESTRILDIDAE																				
Taeniopygia guttata	Zebra Finch	4	6	20	12		14	2		3		2	8		10	34	43			158
Emblema pictum	Painted Finch	18	18	11	5	14	3									20	5			94
MOTACILLIDAE																				
Anthus novaeseelandiae	Australasian Pipit											2	5			3	6			16
SPECIES RECORDED IN ADJACENT AREAS																				
COLUMBIDAE																				
Geopelia striata	Peaceful Dove															4				4
ANATIDAE																				
Cygnus atratus	Black Swan																6			6
Anas superciliosa	Pacific Black Duck															1	2			3
Anas gracilis	Grey Teal															10				10
Chenonetta jubata	Wood Duck															14				14
Dendrocygna eytoni	Plumed Whistling Duck																80			80
PELECANIDAE																				
Pelecanus conspicillatus	Australian Pelican															1				1
ARDEIDAE																				
Egretta novaehollandiae	White-faced Heron															4	2			6
THRESKIORNITHIDAE																				
Threskiornis spinicollis	Straw-necked Ibis															20	10			30
ANHINGIDAE																				
Anhinga novaehollandiae	Australasian Darter															7	2			9

Family and Species	Common Name	Site 1		Site 2		Site 3		Site 4		Site 5		Site 6		Site 7		Opportunistic Records		Motion Camera		TOTAL
		P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	
PHALACROCORACIDAE																				
Phalacrocorax sulcirostris	Little Black Cormorant																6			6
CHARADRIIDAE																				
Elseyornis melanops	Black-fronted Dotterel																2			2
HALCYONIDAE																				
Todiramphus sanctus	Sacred Kingfisher															2				2
MALURIDAE																				
Malurus leucopterus	White-winged Fairy-wren															3				3
Malurus lamberti	Variegated Fairy-wren															5				5

Table E3: Reptiles

Family and Species	Common Name	Site 1		Site 2		Site 3		Site 4		Site 5		Site 6		Site 7		Opportunistic Records		Motion Camera		TOTAL
		P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	
GEKKONIDAE																				
Gehyra punctata	Spotted Rock Dtella	1	2		1	2	6				4		1			1	6			24
Gehyra variegata	Tree Dtella	1	2					2	7	1	3	2	5		4	4	15			46
Heteronotia binoei	Bynoe's Gecko				1			1	2				1			8	7			20
Lucasium stenodactylum	Pale-snouted Ground Gecko												1		1		5			7
Nephrurus vertebralis	Midline Knob-tailed Gecko														1		1			2
Rhynchoedura ornata	Beaked Gecko								1						1		5			7
PYGOPODIDAE																				
Delma tincta			1				2													3
AGAMIDAE																				
Ctenophorus caudicinctus	Ring-tailed Dragon		1		2		6	1		5	26	1	29			8	21		1	101
Ctenophorus nuchalis	Central Netted Dragon												1		1		3			5
Ctenophours reticulatus	Western Netted Dragon				1												1			2
Ctenophorus scutulatus	Lozenge-marked Dragon							1	9						8		2			20
Lophognathus longirostris	Long-nosed Dragon												1				1			2
Pogona minor	Bearded Dragon		1		1	1	1	1	4		2					1	1		1	14
SCINCIDAE																				
Ctenotus leonhardii	Leonhardi's Ctenotus							2	17		1				2					22
Ctenotus schomburgkii	Barred Wedge-snout Ctenotus							4	1											5
Ctenotus severus	Rock Skink	16	18	2	1	20	28	1	10			5	7		2	2	9		1	122
Egernia depressa	Pygmy Spiny-tailed Skink														1	2	1			4
Eremiascincus richardsoni	Broad-banded Sandswimmer																1			1
Lerista timida	A Skink	4	5			3	4	1	10	1	6	2	3		1		4			44
Menetia greyii	Dwarf Skink	4	1	3	1	3	9		2	2	1	1	1				4			32
VARANIDAE																				
Varanus caudolineatus	Line-tailed Pygmy Monitor																1			1
Varanus panoptes panoptes	Yellow-spotted Monitor										1	1			1	1	2		2	8

Family and Species	Common Name	Site 1		Site 2		Site 3		Site 4		Site 5		Site 6		Site 7		Opportunistic Records		Motion Camera		TOTAL
		P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	
Varanus tristis	Black-headed Monitor	1															1			2
TYPHLOPIDAE																				
Ramphotyphlops grypus	Blind Snake								1				1							2
BOIDAE																				
Antaresia perthensis	Pygmy Python					1			1											2
ELAPIDAE																				
Demansia psammophis	Yellow-faced Whipsnake																1			1
Simoselaps bertholdi	Jan's banded Snake		2				1													3
TOTAL		27	33	5	8	30	57	14	65	9	44	12	51	0	23	27	92	0	5	502
SPECIES RICHNESS		6	9	2	7	6	8	9	12	4	8	6	11	0	11	7	21	0	4	27

Table E4: Amphibians

Family and Species	Common Name	Notes
HYLIDAE		
Litoria rubella	Desert Tree Frog	Several recorded outside the Study Area at Mount Gould homestead during both survey phases

Appendix F: Conservation significant fauna recorded within the Study Area

Species	Conservation Status	Location Easting	Location Northing	Comments
Peregrine Falcon	S1	534409	7146893	Old nest site
Peregrine Falcon	S1	534554	7146826	Old nest site
Peregrine Falcon	S1	534554	7146734	3 Individuals (2 adults, 1 fledgling)
Peregrine Falcon	S1	534575	7146777	1 individual
Bush Stone-curlew	P4	533065	7145324	tracks
Bush Stone-curlew	P4	539292	7146042	Heard calling
Australian Bustard	P4	-	-	Recorded adjacent to Study Area
Rainbow Bee-eater	Migratory	533809	7146196	2 individuals
Rainbow Bee-tear	Migratory	537047	7134591	2 observed outside Study Area
Painted Finch	Locally Significant	534304	7146782	Nest
Painted Finch	Locally Significant	534568	7146705	Nest
Painted Finch	Locally Significant	534258	7146953	10 individuals
Painted Finch	Locally Significant	534253	7146879	5 individuals
Painted Finch	Locally Significant	534409	7146893	5 individuals, cave entrance where moisture seeping onto floor
Painted Finch	Locally Significant	534450	7146648	Site 1
Painted Finch	Locally Significant	533936	7146122	Site 3
Woolley's Pseudantechinus	Locally Significant	534358	7146662	1 individual trapped
Woolley's Pseudantechinus	Locally Significant	533976	7145960	1 individual trapped
Woolley's Pseudantechinus	Locally Significant	534401	7146630	Recorded on Motion Camera
Woolley's Pseudantechinus	Locally Significant	534462	7146138	Recorded on Motion Camera
Woolley's Pseudantechinus	Locally Significant	533833	7146127	Recorded on Motion Camera
Woolley's Pseudantechinus	Locally Significant	533985	7145979	Recorded on Motion Camera
Woolley's Pseudantechinus	Locally Significant	533206	7145669	Recorded on Motion Camera
Little Woodswallow	Locally Significant	534420	7146601	Roosting site
Little Woodswallow	Locally Significant	534365	7146635	10 individuals

Appendix G: Evidence of extinct Mammals recorded within the Study Area

Species	Conservation Status	Location Easting	Location Northing	Comments
Petrogale lateralis	S1	534357.1	7146636	Old scats
Lepporillus sp.	EX	534357.1	7146636	Decayed nest
Lepporillus sp.	EX	534357.1	7146636	Decayed nest
Pseudomys chapmani	P4	534970	7147466	extinct mound
Pseudomys chapmani	P4	535159	7147414	extinct mound
Pseudomys chapmani	P4	535192	7147369	extinct mound
Pseudomys chapmani	P4	535161	7147413	extinct mound
Pseudomys chapmani	P4	534188	7147911	extinct mound
Pseudomys chapmani	P4	534219	7147921	extinct mound
Pseudomys chapmani	P4	534207	7147830	extinct mound
Pseudomys chapmani	P4	534145	7147706	extinct mound
Pseudomys chapmani	P4	534529	7147471	extinct mound
Pseudomys chapmani	P4	534443	7147658	extinct mound
Pseudomys chapmani	P4	535303	7148110	extinct mound
Pseudomys chapmani	P4	535295	7148108	extinct mound
Pseudomys chapmani	P4	535143	7147439	extinct mound
Pseudomys chapmani	P4	534994	7147579	extinct mound
Pseudomys chapmani	P4	534979	7147591	extinct mound
Pseudomys chapmani	P4	535143	7147489	extinct mound

APPENDIX 11: MOUNT GOULD VERTEBRATE FAUNA DESKTOP ASSESSMENT (BIOLOGIC 2022A)







Mt Gould Project Vertebrate Fauna Desktop Assessment

Biologic Environmental Survey

Report to MBS Environmental on behalf of Newcam Minerals

August 2022

Document Status				
Revision No.	Author	Review / Approved for Issue	Approved for Issue to	
			Name	Date
1	C. Knuckey, V. Steptoe	R. Ellis	T. Attwood	09/08/2022

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EXECUTIVE SUMMARY

MBS Environmental (MBS), on behalf of Newcam Minerals, commissioned Biologic Environmental Survey (Biologic) to undertake a vertebrate fauna desktop assessment for the Mt Gould Project (mining lease M52/236; hereafter referred to as the Study Area). The Study Area is located approximately 150 kilometres (km) north-west of Meekatharra and covers an area of approximately 613 hectares (ha). The objective of the desktop assessment was to complete a review of relevant databases and previous reports to identify vertebrate fauna and habitats potentially occurring within the Study Area, with a focus significant species. For the purposes of this report, significant species includes species listed as Threatened and/or Migratory under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), *Biodiversity Conservation Act 2016*, and/or as Priority by the Department of Biodiversity, Conservation and Attractions (DBCA).

The desktop assessment comprised four vertebrate fauna databases and three survey reports for surveys previously undertaken in the vicinity of the Study Area. A total of 222 vertebrate fauna species were identified in the desktop assessment as potentially occurring within the Study Area, including 28 mammals (19 native and nine introduced), 144 birds, 46 reptiles and four amphibians. Of these, 19 significant species with the potential to occur within the Study Area were identified, including four mammals, 14 birds, and one reptile.

One significant species has previously been confirmed from within the Study Area, the peregrine falcon (*Falco peregrinus* – Specially Protected BC Act). Three individuals (two adults and one fledgling) were observed from the summit of Mt Gould, and two active nest sites were recorded. Due to confirmation of breeding and well-used roosting locations, it was concluded that the species is likely to occur within the Study Area as a resident. Additionally, of the 19 significant species potentially occurring within the Study Area, one species was assessed as being Highly Likely to occur in the Study Area, long-tailed dunnart (*Sminthopsis longicaudata* – Priority 4 DBCA), and a further two species were assessed as having the possibility to occur in the Study Area, brush-tailed mulgara (*Dasycercus blythi* – Priority 4 DBCA) and grey falcon (*Falco hypoleucos* – Vulnerable EPBC Act/ BC Act). The long-tailed dunnart is high likely to occur as a resident in the Study Area based on the proximity contemporary records and the distribution of suitable habitat. Brush-tailed mulgara may occur where suitable sandy or loamy soils are present. Grey falcon has previously been recorded in the vicinity of the Study Area and may occasionally occur during foraging or dispersal movements, though no breeding or key foraging habitat is likely to be present.

Based on the results of the desktop assessment and preliminary likelihood of occurrence assessment, it is recommended, at a minimum, that a basic survey be undertaken within the Study Area to define and delineate broad fauna habitats. Obtaining detailed site-specific information of habitats occurring within the Study Area would facilitate improved accuracy of determining significant species' likelihood of occurrence, as well as identify the need for any further sampling within the Study Area, such as detailed and/or targeted surveys. Furthering knowledge of significant species occurrence within the Study Area will allow for appropriate consideration and improved support for any future environmental approvals for proposed works within the Study Area.

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1 INTRODUCTION

1.1 Background

MBS Environmental (MBS), on behalf of Newcam Minerals, commissioned Biologic Environmental Survey Pty Ltd (Biologic) to undertake a vertebrate fauna desktop assessment covering the Mt Gould Project (mining lease tenement M52/236; hereafter referred to as the Study Area) (Figure 1.1). The Study Area is located approximately 150 kilometres (km) north-west of Meekatharra in the Murchison region of Western Australia and covers approximately 613 hectares (ha) (Figure 1.1).

1.2 Objectives

The overall scope of work comprises a desktop assessment to increase the knowledge of the Study Area. Specifically this includes:

- A desktop assessment to identify the potential presence of vertebrate fauna species, fauna habitats and significant species within and near the Study Area.

1.3 Background to Protection of Fauna

Terrestrial fauna may be significant for a range of reasons, including:

- being identified as a threatened or priority species;
- being a species with restricted distribution;
- enduring a degree of historical impact from threatening processes; or
- providing an important function required to maintain the ecological integrity of a significant ecosystem (EPA, 2016).

Within Western Australia, native fauna is protected under the BC Act and at a national level under the EPBC Act. Any action that has the potential to impact on native fauna needs to be approved by relevant state and/ or federal departments as dictated by the state *Environmental Protection Act 1986* (EP Act). Some species of fauna that are determined to be at risk of extinction or decline are afforded extra protection under these Acts (Table 1.1; Appendix A).

For some species, there is insufficient information to determine their status. These species are generally considered by the Environmental Protection Authority (EPA) and the DBCA as being of significance for all environmental assessments and are listed on a 'Priority List' that is regularly reviewed and maintained by the DBCA (Table 1.1). For the purposes of this report, significant species refer to those listed as threatened and/or migratory under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and/or *Biodiversity Conservation Act 2016* (BC Act) or listed as Priority by the Department of Biodiversity, Conservation and Attractions (DBCA).

Table 1.1: Definitions and terms for significant species

Agreement, Act or List	Status Codes
Federal	
EPBC Act Department of Agriculture, Water and the Environment (DAWE) lists Threatened fauna, which are determined by the Threatened Species Scientific Committee (TSSC) per criteria set out in the Act. The Act lists fauna that are considered to be of significance under one of the listed categories (listed under 'Status Codes').	• Extinct (EX) • Extinct in the Wild (EW) • Critically Endangered (CR) • Endangered (EN) • Vulnerable (VU) • Conservation Dependent (CD) • Migratory (MI)
State	
BC Act The BC Act provides for the listing of threatened native fauna and that need protection as critically endangered, endangered or vulnerable species because they are under identifiable threat of extinction.	Species • Extinct (EX) • Extinct in the Wild (EW) • Critically Endangered (CR) • Endangered (EN) • Vulnerable (VU) • Migratory (MI) • Conservation Dependent Fauna (CD) • Other specially protected species (OS)
DBCA Priority list DBCA produces a list of Priority species and ecological communities that have not been assigned statutory protection under the BC Act. This system gives a ranking from Priority 1 to Priority 4.	• Priority 1 (Poorly known species) (P1) • Priority 2 (Poorly known species) (P2) • Priority 3 (Poorly known species) (P3) • Priority 4 (Rare, Near Threatened, and other species in need of monitoring) (P4)

532000
534000
536000
7150000
7148000
7146000
7144000
Mt Magnet
Geraldton
Kalgoorlie-Boulder
Gould Creek
Landor - Meekatharra Rd
Carnarvon

Legend

Study Area
Local Road

Surface Hydrology

Minor

IBRA Region

Murchison

IBRA Subregion

Eastern Murchison
Western Murchison

0 0.5 1 Km

Coordinate System: GDA2020 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA2020 Created 08/08/2022

N

biologic Environmental Survey

Scale: 1:25,000

MBS ENVIRONMENTAL

Mt Gould Vertebrate Fauna Assessment

Figure 1.1: Study Area

2 EXISTING ENVIRONMENT

2.1 Biogeography

The Interim Biogeographic Regionalisation for Australia (IBRA) is a bioregional framework that divides Australia into 85 bioregions and 419 subregions on the basis of climate, geology, landforms, vegetation and fauna (Thackway & Cresswell, 1995). The Study Area is located within the Murchison bioregion (Figure 1.1), which is characterised by low hills and mesas separated by flat colluvium and alluvial plains which support low mulga woodlands (Thackway & Cresswell, 1995).

The Study Area is located within the Western Murchison subregion (MUR02) of the Murchison bioregion. The Western Murchison subregion covers an area of approximately 7,847,996 ha and is characterised by mulga low woodlands, often rich in ephemerals (usually with bunch grasses), on outcrop and fine textured Quaternary alluvial and eluvial surfaces (Desmond *et al.*, 2001).

2.2 Climate

The Murchison bioregion has an arid climate with bimodal rainfall that usually falls in winter (Desmond *et al.*, 2001). The nearest active Bureau of Meteorology (BoM) weather station with long term climate data is Meekatharra Airport (station number 007045). The mean annual rainfall recorded at Meekatharra Airport is 233.7 millimetres (mm) with the majority of rainfall received between January and June each year (BoM, 2022) (Figure 2.1). The highest maximum temperatures occur between November and March, with the highest mean maximum recorded in January (38.4°C). The lowest minimum temperatures occur between May and August, with the lowest mean minimum temperature recorded in July (7.5°C) (BoM, 2022) (Figure 2.1).

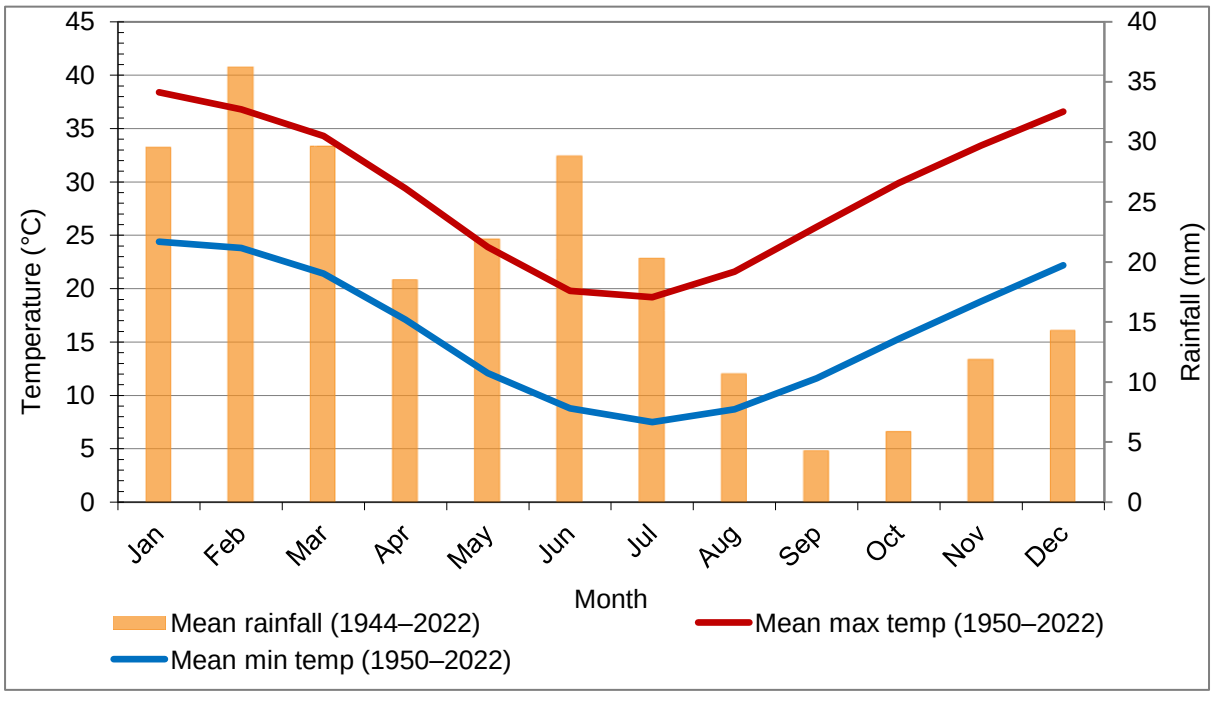


Figure 2.1: Climate data for Meekatharra Airport (station 007045)

2.3 Land Systems

Curry *et al.* (1994) classified and mapped the land systems of the Murchison bioregion, according to similarities in landform, soil, vegetation, geology and geomorphology. An assessment of land systems provides an indication of the diversity and distribution of fauna habitats present within the Study Area. Two land systems intersect the Study Area, the Peak Hill system and Cole system (Table 2.1; Figure 2.2).

Table 2.1: Land Systems mapped within the Study Area

Land System	Description	Area (ha)	%
Peak Hill	Rugged, sinuous ranges and rounded hills of banded ironstone and haematitic shale, supporting stunted mulga and cottonbush shrublands.	461.03	75.21
Cole	Hardpan wash plains with reticulate patterns of wanderrie banks and mulga groves and more concentrated drainage tracts, supporting mixed mulga and wanderrie shrublands.	151.94	24.79
Total		**612.97**	**100.00**

2.4 Pre-European Vegetation

Beard (1975) broadly (1:1,000,000) mapped the major structural vegetation types of Western Australia. Shepherd *et al.* (2002) reinterpreted and updated the vegetation association mapping to reflect the National Vegetation Information System (NVIS) standards (ESCAVI, 2003). This update also accounts for extensive clearing since Beard (1975) mapping.

Two vegetation associations occur within the Study Area, UPPER MURCHISON_202 and UPPER MURCHISON_29, the former of which is the more prevalent association throughout the Study Area (Table 2.2; Figure 2.3).

Table 2.2: Vegetation associations within the Study Area

Vegetation Association	Description	Area (ha)	%
UPPER MURCHISON_202	Wattle, tea tree & other species (*Acacia* spp. *Melaleuca* spp.). Scrub, open scrub or sparse scrub.	645.48	96.59
UPPER MURCHISON_29	Mulga (*Acacia aneura*) and associated species. Low woodland, open low woodland or sparse woodland.	22.80	3.41
Total		**612.97**	**100.00**

532000
534000
536000
7150000
7148000
7146000
7144000
Gould Creek
Landor - Meekatharra Rd

Legend

Study Area
Local Road

Surface Hydrology

Minor

Land System

Beringarra System
Cole System
Peak Hill System
Yandil System

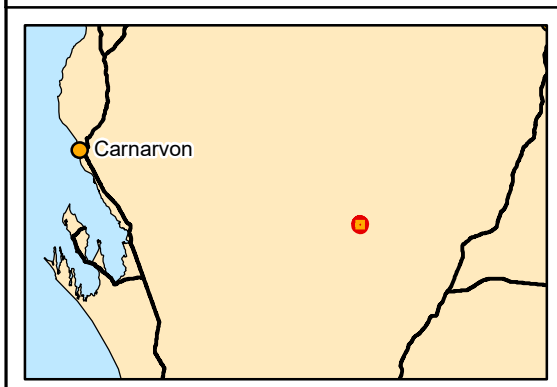
0 0.5 1 Km

Coordinate System: GDA2020 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA2020 Created 08/08/2022

N

biologic Environmental Survey

Scale: 1:25,000



MBS ENVIRONMENTAL

Mt Gould Vertebrate Fauna Assessment

Figure 2.2: Land Systems of the Study Area

532000
534000
536000
7150000
7148000
7146000
7144000
Gould Creek
Landor - Meekatharra Rd

Legend

Study Area

Local Road

Surface Hydrology

Minor

Pre-European Vegetation

UPPER MURCHISON 18

UPPER MURCHISON 202

UPPER MURCHISON 29

0 0.5 1 Km

Coordinate System: GDA2020 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA2020 Created 08/08/2022

N

Scale: 1:25,000



MBS ENVIRONMENTAL

Mt Gould Vertebrate Fauna Assessment

Figure 2.3: Vegetation associations of the Study Area

3 METHODS

3.1 Compliance

This assessment was carried out in a manner consistent with the following documents developed by the Western Australian EPA and DAWE (formerly the Department of Environment [DoE]:

- DoE (2013) Significant impact guidelines 1.1: Matters of national environmental significance;
- EPA (2016) Environmental factor guidelines – terrestrial fauna;
- EPA (2021) Statement of environmental principles, factors, objectives; and
- EPA (2020) Technical guidance: Terrestrial vertebrate fauna surveys for environmental impact assessment.

3.2 Desktop Assessment

The desktop assessment comprised both database searches and a literature review of relevant survey reports undertaken in the vicinity of the Study Area. The primary purpose of the assessment was to identify vertebrate fauna potentially occurring within the Study Area, with a focus of significant species.

3.2.1 Database Searches

Four databases were searched, two to obtain information on all species previously recorded (NatureMap (DBCA, 2022a) and Birdata (Birdlife Australia, 2022)), one to identify significant species previously recorded (DBCA Threatened and Priority Fauna Database (DBCA, 2022b)) and one to identify significant species known or likely to occur within the region (Protected Matters Database (Department of Climate Change, Energy, the Environment and Water [DCCEEW] 2022)). NatureMap, Birdata and Protected Matters Database were searched to include a 40 km buffer around a central coordinate -25.7987° S, 117.3362° E) within the Study Area and the DBCA Threatened, and Priority Fauna Database was extended 100 km from the central coordinate, due to the lack of records in the vicinity of the Study Area.

3.2.2 Literature Review

A review of publicly available literature relevant to the Study Area was undertaken to compile a list of fauna species with the potential to occur within the Study Area. Five reports were reviewed, comprising one detailed survey from within the Study Area, one detailed survey outside the Study Area and three basic surveys outside the Study Area (Table 3.1).

Table 3.1: Literature sources used for the review

Report	Survey Type	Distance from Study Area
Biologic (2012) Mount Gould vertebrate fauna study	Detailed	Overlaps
ecologia (2007) Jack Hills mine expansion vertebrate fauna assessment	Detailed	20 km S
Western Wildlife (2006) Jack Hills Project Area 2006 fauna survey	Basic	20 km S
MBS Environmental (2005) Jack Hills Iron Ore Project vegetation and fauna assessment	Basic	20 km S
MBS Environmental (2005) A vertebrate fauna survey of the Jack Hills Project Area	Basic	20 km S

3.3 Likelihood of Occurrence

Significant species identified by the desktop assessment were assessed for their likelihood of occurring within the Study Area based on a decision matrix (Table 3.2). Consideration for likelihood of occurrence is generally based on proximity of previous records, potential presence of suitable habitats or micro habitats (based on preliminary review of aerial imagery and existing environment data (i.e. land systems, pre-European vegetation associations) and/ or the Study Area occurring outside the known distribution for the species. Based on the decision matrix, each species was assigned to one of six categories of likelihood: Confirmed, Highly Likely, Likely, Possible, Unlikely, or Highly Unlikely.

The decision matrix is intended to be an indicative guide only, and the way in which it is interpreted may vary between species, depending on a given species' habitat preferences and ability to disperse, as well as the reliability and availability of contextual information. For example, considering species which have been previously recorded close to the Study Area, a species with a limited dispersal capability will have a reduced likelihood of occurring in the Study Area compared with a species with greater dispersal capability. It is also recognised that a lack of records in the vicinity of the Study Area may indicate limited sampling effort rather than species' absence, and that previous records may include historic or presumed erroneous information which may misrepresent a species' current distribution. Where the determination of a species' likelihood of occurrence within the Study Area deviates from the decision matrix, detailed justification for any variation will be presented.

Habitat mapping has not been undertaken previously within the Study Area. However, broad vegetation units have been mapped across the Study Area (Biologic, 2012), and were used as a surrogate for fauna habitats.

Table 3.2: Species likelihood of occurrence decision matrix

		Habitat suitability of Study Area			
		Critical/ breeding habitat present	**Foraging and dispersal habitat present**	**Marginally suitable habitat[2] present**	**No suitable habitat present**
Species Records[1]	**Recorded in Study Area**	Confirmed	Confirmed	Confirmed	Confirmed
	Recorded within 10 km of Study Area	Highly Likely	Likely	Possible	Possible
	Recorded within 10–50 km of Study Area	Likely	Possible	Possible	Unlikely
	Recorded within 50–100 km of Study Area	Possible	Possible	Unlikely	Unlikely
	Recorded >100 km of Study Area	Possible	Unlikely	Unlikely	Highly Unlikely
	Species considered locally/regionally extinct	Unlikely	Unlikely	Highly Unlikely	Highly Unlikely

[1]Only records within the previous 50 years are considered.

[2]Marginally suitable habitat is habitat which is possibly used by a species for roosting or nesting, or during foraging and dispersal activities, but is unlikely to be depended upon; for example, it may be of low quality or only sporadically present.

4 RESULTS AND DISCUSSION

4.1 Desktop Assessment

The desktop assessment identified a total of 222 vertebrate fauna species which have previously been recorded and/or have the potential to occur within the Study Area. This comprised 28 mammals (including nine introduced), 144 birds, 46 reptiles and 4 amphibians (Table 4.1; Appendix B). Due to the scarcity of previous studies conducted in the vicinity of the Study Area, it is possible that the species identified in the desktop assessment may be an underrepresentation of true diversity occurring. Due to the size of the desktop assessment search area, and likelihood of encompassing habitats which may not occur within the Study Area, results of the desktop review are likely to include species unlikely to occur within the Study Area. Additionally, many species tend to be patchily distributed even where appropriate habitats are present, and many species of birds can occur as regular migrants, occasional visitors or vagrants.

Of the 222 species identified in the desktop assessment, 19 species are listed as significant species, comprising four mammals, 14 birds and one reptile (Table 4.2; Appendix B). One of these species, the Peregrine Falcon (*Falco peregrinus* - Specially Protected BC Act), has previously been recorded within the Study Area (Biologic, 2012).

Table 4.1: Species richness recorded from the desktop assessment

Source	Mammals	Mammals (introduced)	Birds	Reptiles	Amphibians	Total
Literature review						
Biologic (2012) Mount Gould vertebrate fauna study	15	7	90	27	1	140
ecologia (2007) Jack Hills mine expansion vertebrate fauna assessment	13	4	67	23	0	107
Western Wildlife (2006) Jack Hills Project Area 2006 fauna survey	11	2	56	30	0	99
MBS Environmental (2005) Jack Hills Iron Ore Project vegetation and fauna assessment	9	5	46	24	4	88
MBS Environmental (2005) A vertebrate fauna survey of the Jack Hills Project Area	0	0	45	8	0	53
Database searches						
DBCA (2022a)	10	4	123	35	0	172
DBCA (2022b)	4	0	4	1	0	9
DCCEEW (2022)	0	7	12	0	0	19
Birdlife Australia (2022)	0	0	119	0	0	119
Total number of species	**19**	**9**	**144**	**46**	**4**	**222**
Total number of significant species	**4**	**0**	**14**	**1**	**0**	**19**

Of the 222 species identified in the desktop assessment, 125 fauna species have previously been recorded within the Study Area (Biologic, 2012); comprising 22 mammals (15 native and seven introduced), 75 birds, 27 reptiles and one amphibian species (Appendix B). At the time of the Biologic (2012) assessment, an additional seven species recorded were considered to be significant species. However, all of these species have since been delisted and are no longer consider representing significant species, this includes:

- bush stone-curlew (*Burhinus grallarius*) – previously listed as Priority 4 by the DEC (Department of Environment and Conservation, now DBCA);
- Australian bustard (*Ardeotis australis*) – previously listed as Priority 4 by the DEC;
- rainbow bee-eater (*Merops ornatus*) – previously listed as Migratory under the EPBC Act;
- Woolley's Pseudantechinus (*Pseudantechinus woolleyae*) – previously listed as BIF Dependent by DEC;
- Little Woodswallow (*Artamus minor*) – previously listed as BIF Dependent by DEC;
- Painted Finch (*Emblema pictum*) – previously considered locally significant; and
- Little Broad-nosed Bat (*Scotorepens greyii*) – previously considered locally significant.

Table 4.2: Significant species identified from the desktop assessment

Species		Conservation Status		
Scientific Name	**Common Name**	**EPBC Act**	**BC Act**	**DBCA**
MAMMALS				
DASYURIDAE				
Dasycercus blythi	Brush-tailed mulgara			P4
Sminthopsis longicaudata	Long-tailed dunnart			P4
MURIDAE				
Pseudomys chapmani	Western pebble-mound mouse			P4
THYLACOMYIDAE				
Macrotis lagotis	Bilby	VU	VU	
BIRDS				
CHARADRIIDAE				
Charadrius veredus	Oriental plover	MI	MI	
FALCONIDAE				
Falco hypoleucos	Grey falcon	VU	VU	
Falco peregrinus	Peregrine falcon		OS	
LARIDAE				
Gelochelidon nilotica	Gull-billed tern	MI	MI	
MOTACILLIDAE				
Motacilla cinerea	Grey wagtail	MI	MI	
Motacilla flava	Yellow wagtail	MI	MI	
PSITTACIDAE				
Pezoporus occidentalis	Night parrot	EN	CR	
ROSTRATULIDAE				
Rostratula australis	Australian painted snipe	EN	EN	

Species		Conservation Status		
Scientific Name	**Common Name**	**EPBC Act**	**BC Act**	**DBCA**
SCOLOPACIDAE				
Calidris acuminata	Sharp-tailed sandpiper	MI	MI	
Calidris ferruginea	Curlew sandpiper	CR/MI	CR/MI	
Calidris melanotos	Pectoral sandpiper	MI	MI	
Tringa glareola	Wood sandpiper	MI	MI	
Actitis hypoleucos	Common sandpiper	MI	MI	
REPTILES				
SCINCIDAE				
Egernia stokesii badia	Western spiny-tailed skink	EN	VU	

450000
500000
550000
7200000
7150000
7100000
Landor - Meekatharra Rd
Carnarvon

Legend

Study Area
Local Road

DBCA (2020b)

Bird

Grey falcon - VU
Gull-billed tern - MI
Wood sandpiper - MI
Peregrine falcon - OS

Mammal

Bilby - VU
Brush-tailed mulgara - P4
Long-tailed dunnart - P4
Western pebble-mound mouse - P4

Reptile

Western spiny-tailed skink - VU

0 10 20 Km

Coordinate System: GDA2020 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA2020 Created 08/08/2022

N

biologic Environmental Survey

Scale: 1:500,000

MBS ENVIRONMENTAL

Mt Gould Vertebrate Fauna Assessment

Figure 4.1: Significant species identified in the desktop assessment

4.2 Likelihood of Occurrence

Of the 19 significant species identified from the desktop assessment, one significant species has been Confirmed as occurring in the Study Area, the peregrine falcon. One species is considered Highly Likely to occur (long-tailed dunnart) and two species are considered to Possibly occur (brush-tailed mulgara and grey falcon) (Table 4.3), The remaining 15 species are considered Unlikely (n = 7) or Highly Unlikely (n = 8) to occur, primarily due to the lack of suitable habitat likely to occur within the Study Area (Table 4.3).

The occurrence of significant species which have either been considered Highly Likely or Possible to occur within the Study Area, are discussed in more detail below. Consideration for likelihood of occurrence is generally based on previous records, potential presence of suitable habitats or micro habitats within the Study Area and/ or the Study Area occurring outside the known distribution for the species. Fauna habitat mapping has not been undertaken within the Study Area previously, so habitats considered likely to occur within the Study Area is based on vegetation mapping presented in Biologic (2012) as well as broader regional land system and vegetation association mapping.

4.2.1 Species Confirmed to Occur

Peregrine Falcon (*Falco peregrinus*) – Specially Protected (BC Act)

In arid areas of its distribution, the peregrine falcon is often recorded along cliffs above rivers, ranges and wooded watercourses where it hunts birds (Johnstone & Storr, 1998). It typically nests on rocky ledges occurring on tall, vertical cliff faces between 25–50 m high (Olsen & Olsen, 1989). It also appears to prefer nesting on ledges a reasonable distance from the top of the cliff (Olsen & Olsen, 1989), possibly to avoid predators. Nesting also occasionally occurs in tall trees along drainage lines, including use of abandoned nests of other large bird species (Olsen & Olsen, 1989).

The peregrine falcon was previously recorded within the Study Area by Biologic (2012) and has also been recorded at the nearby Jack Hills (DBCA, 2022a, 2022b) which represents similar habitat to that within the Study Area (ecologia, 2007). Three individuals (two adults and one fledgling) were observed from the summit of Mt Gould, and two nest sites were recorded by Biologic (2012). Biologic (2012) identified a series of cliff faces with numerous ledges and recesses suitable for the species around the Mt Gould summit. Additionally, several well-used roost sites and two nest sites belonging to peregrine falcon were located among this habitat, evident from the extensive faecal smears (“whitewash”) down on the rocks below the roost/ nest site. As confirmation of breeding and well-used roosting locations was recorded during the survey, it was concluded that the species is likely to occur as a resident.

4.2.2 Species Highly Likely to Occur

Long-tailed dunnart (*Sminthopsis longicaudata*) – Priority 4 (DBCA)

The long-tailed dunnart is a nocturnal and agile species that is distributed through the Pilbara, through the Murchison and north-eastern goldfields and Gibson desert, south to the Nullarbor Plain, to central Northern Territory and western South Australia (van Dyck & Strahan, 2008). Its core habitat includes rocky scree slopes with hummock grass and shrubs, and tall open *Acacia* shrubland and woodlands (McKenzie *et al.*, 2008).

The species has previously been recorded on two occasions at Jack Hills, approximately 20 km and 27 km south of the Study Area (Figure 4.1) (DBCA, 2022b). Based on aerial imagery and habitat descriptions provided by ecologia (2007) and Biologic (2012), this habitat is synonymous with that which occurs across the Study Area and the species is considered Highly Likely to occur.

4.2.3 Species Possibly Occurring

Brush-tailed Mulgara (*Dasycercus blythi*) – Priority 4 (DBCA)

The species occurs in a range of habitats across the Australian arid zone, often dominated by spinifex *Triodia* spp. grasslands on sandy or stony plains where suitable burrowing substrate is present (Pavey *et al.*, 2012; Woolley, 2006). The species has previously been recorded on seven occasions, all from 2013, six approximately 85 km west-north-west of the Study Area and one approximately 63 km west (Figure 4.1) (DBCA, 2022b). It is possible the brush-tailed mulgara occurs within the Study Area, particularly where suitable sandy and/or loamy soils permitting burrow excavation and vegetation cover occur (Table 4.3).

Grey Falcon (*Falco hypoleucos*) – Vulnerable (EPBC/BC Act)

The grey falcon is a widely distributed but infrequently recorded species which appears to have a distribution centred on ephemeral or permanent creek lines (Garnett & Crowley, 2000). The species tends to prefer sparsely-treed, open plains and creek lines for foraging (Olsen & Olsen, 1986), while nesting often occurs in the abandoned nest of a raptor or corvid in trees or tall infrastructure such as tall power line or communications towers (Olsen & Olsen, 1986; Schoenjahn *et al.*, 2019). The nearest contemporary record if the species (2007) is located approximately 6.5 km south-east of the Study Area (Figure 4.1) (DBCA, 2022a). Based on aerial imagery, the record is located within a broad drainage area, which is consistent with the species general habitat preferences. Such habitat does not appear to be present in the Study Area, thus any species' presence is likely to be temporary while foraging or dispersing.

Table 4.3. Likelihood of significant species occurrence within the Study Area

Common Name (Scientific Name)	Conservation Status[1]			Preferred Broad Habitats	Nearest Record to the Study Area	Likelihood of Occurrence
	EPBC Act	BC Act	DBCA			
MAMMALS						
DASYURIDAE						
Brush-tailed mulgara (*Dasycercus blythi*)			P4	Can occur in a range of habitats across the Australian arid zone, often dominated by spinifex *Triodia* spp. grasslands on sandy or stony plains where suitable burrowing substrate is present (Pavey *et al.*, 2012; Woolley, 2006). Mature spinifex hummocks appear to be important for protection from introduced predators (Körtner *et al.*, 2007).	~63 km W (2013) DBCA (2022b)	Possible
Long-tailed dunnart (*Sminthopsis longicaudata*)			P4	Typically occurs on plateaus near breakaways and scree slopes, and on rugged boulder-strewn scree slopes (Burbidge *et al.*, 2008). Once considered rare but now shown to be relatively common and widespread in rocky habitats (Burbidge *et al.*, 2008).	~20 km S (2009) DBCA (2022b)	Highly Likely
MURIDAE						
Western pebble-mound mouse (*Pseudomys chapmani*)			P4	This species occurs on the gentler slopes of rocky ranges where the ground is covered with a stony mantle and vegetated by hard spinifex, often with a sparse overstorey of eucalypts and scattered shrubs (Anstee, 1996; Start *et al.*, 2000). Species is considered to be extinct from the Murchison region (Start *et al.*, 2000).	~60 km WNW (1970), ~70 km W DBCA (2022b)	Highly Unlikely
THYLACOMYIDAE						
Bilby (*Macrotis lagotis*)	VU	VU		Variety of habitats including spinifex hummock grassland and *Acacia* shrubland, on soft soils (Burrows *et al.*, 2012). In the Pilbara often associated with major drainage line sandy terraces (How *et al.*, 1991). Includes residual landforms (e.g. laterite rises), loamy or sandy soils associated with palaeodrainage lines and perched drainage lines, sandplains and dune fields, habitat types where shrubs containing root dwelling larvae are common, and recently burnt habitat (within the last 1-3 years) (DBCA, 2017).	~60 km S (1961) DBCA (2022b)	Unlikely

Common Name (Scientific Name)	Conservation Status[1]			Preferred Broad Habitats	Nearest Record to the Study Area	Likelihood of Occurrence
	EPBC Act	BC Act	DBCA			
BIRDS						
FALCONIDAE						
Grey falcon (*Falco hypoleucos*)	VU	VU		Timbered lowlands, particularly *Acacia* shrubland and along inland drainage systems. Also frequents spinifex and tussock grassland habitats to forage (Burbidge *et al.*, 2010; Olsen & Olsen, 1986). The species commonly nests in timbered areas, particularly tall trees along watercourses, or tall infrastructure (e.g. powerline towers) and forages in open or more sparsely vegetated habitats (Garnett *et al.*, 2011).	~6.5 km E (2007) DBCA (2022b)	Possible
Peregrine falcon (*Falco peregrinus*)		OS		Arid areas and is most often encountered along cliffs above rivers, ranges and wooded watercourses where it hunts birds (Johnstone & Storr, 1998). It typically nests on rocky ledges occurring on tall, vertical cliff faces between 25 m and 50 m high (Olsen *et al.*, 2004; Olsen & Olsen, 1989). In general it nests on cliffs, granite outcrops, quarries and in the wheatbelt, old Raven and Whistling Kite nests (Johnstone & Storr, 1998).	Breeding pair confirmed within the Study Area (Biologic, 2012)	Confirmed
MOTACILLIDAE						
Grey wagtail (*Motacilla cinerea*)	MI	MI		A rare vagrant to Western Australia where it has been recorded within various habitats with open waterbodies (Johnstone & Storr, 2004).	>100 km DBCA (2022b)	Highly Unlikely
Yellow wagtail (*Motacilla flava*)	MI	MI		An uncommon but regular visitor to the Pilbara region (Johnstone *et al.*, 2013). Occupies a range of damp or wet habitats with low vegetation although favors edges of fresh water, especially sewage ponds (Johnstone & Storr, 2004).	>100 km DBCA (2022b)	Highly Unlikely
LARIDAE						
Gull-billed tern (*Gelochelidon nilotica*)	MI	MI		Found in freshwater swamps, brackish and salt lakes, beaches and estuarine mudflats, floodwaters, sewage farms, irrigated croplands and grasslands (Johnstone & Storr, 1998). In the interior, they are often associated with inundated saltlakes and claypans and watercourses (Johnstone & Storr, 1998). Colonially breeds and nests on islets in partially filled saltlakes or saltmarshes in mid-western interior (Johnstone & Storr, 1998).	~60 km S DBCA (2022b)	Highly Unlikely

Common Name (Scientific Name)	Conservation Status[1]			Preferred Broad Habitats	Nearest Record to the Study Area	Likelihood of Occurrence
	EPBC Act	BC Act	DBCA			
PSITTACIDAE						
Night parrot (*Pezoporus occidentalis*)	EN	CR		The night parrot prefers sandy/stony plain habitat with old-growth spinifex for roosting and nesting in conjunction with native grasses and herbs for foraging (DPaW, 2017).	Closest known record is at least 200 km E of Wiluna (Jackett *et al.*, 2017)	Unlikely
SCOLOPACIDAE						
Sharp-tailed sandpiper (*Calidris acuminata*)	MI	MI		Coastal and inland areas saline and freshwater but prefers non-tidal fresh or brackish wetlands (Geering *et al.*, 2007). Favors flooded samphire flats and grasslands, mangrove creeks mudflats, beaches, river pools, saltwork ponds, sewage ponds and freshwater soaks (Johnstone *et al.*, 2013).	>100 km DBCA (2022b)	Highly Unlikely
Curlew sandpiper (*Calidris ferruginea*)	CR/ MI	CR/ MI		Inhabits intertidal mudflats in sheltered coastal areas (i.e. estuaries, bays, inlets and lagoons) (Geering *et al.*, 2007). This rare species generally roosts on bare dry shingle, shell or sand beaches, sandspits and islets in or around coastal or near-coastal lagoons and other wetlands (Geering *et al.*, 2007).	>100 km DBCA (2022b)	Highly Unlikely
Pectoral sandpiper (*Calidris melanotos*)	MI	MI		Coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands (Johnstone & Storr, 2004; Johnstone *et al.*, 2013). It prefers wetlands with open fringing mudflats and low, emergent or fringing vegetation (Geering *et al.*, 2007).	>100 km DBCA (2022b)	Highly Unlikely
Oriental plover (*Charadrius veredus*)	MI	MI		Variety of habitats, including coastal habitats, such as estuarine mudflats and sandbanks, on sandy or rocky ocean beaches as well as open inland environments such as, semi-arid or arid grasslands, where the grass is short and sparse (Johnstone & Storr, 2004).	>100 km DBCA (2022b)	Highly Unlikely
Common sandpiper (*Actitis hypoleucos*)	MI	MI		Estuaries and deltas of streams, as well as banks farther upstream; around lakes, pools, billabongs, reservoirs, dams and claypans (Johnstone & Storr, 1998).	>100 km DBCA (2022b)	Highly Unlikely

Common Name (Scientific Name)	Conservation Status[1]			Preferred Broad Habitats	Nearest Record to the Study Area	Likelihood of Occurrence
	EPBC Act	BC Act	DBCA			
REPTILES						
SCINCIDAE						
Western spiny-tailed skink (*Egernia stokesii badia*)	VU	VU		This species has been recently recorded at several locations in the Murchison region, including near Weld Range (DEC, 2011). In the Murchison, the Western Spiny-tail Skink inhabits deep rock crevices on granite outcrops and hills (Cogger, 2014). There are no areas of granite outcropping within the Mt Gould tenement and the Study Area sits outside of the species recognised distribution (DoE, 2022).	>53 km SW DBCA (2022b)	Unlikely

[1] CR – Critically Endangered, EN – Endangered, VU – Vulnerable, OS – Specially protected, MI – Migratory, P1–P4 – Priority 1–4.

5 CONCLUSION AND RECOMMENDATIONS

A total of 222 vertebrate fauna species were identified in the desktop assessment as potentially occurring within the Study Area, comprising 28 mammals (including 19 native and nine non-native), 144 birds, 46 reptiles and four amphibians. This total number of species identified as potentially occurring within the Study Area may be an underrepresentation of true diversity occurring due to the scarcity of previous studies (n = 3) conducted in the vicinity. Of these 222 species, a total of 19 significant species with the potential to occur within the Study Area were identified, including four mammals, 14 birds and one reptile.

Of the 222 species previously recorded, 125 fauna species have been recorded from within the Study Area previously; comprising 15 native and seven introduced mammal, 75 bird, 27 reptile and one amphibian species. At the time of the assessment, eight species recorded were considered to be significant species. However, seven of these species have since been delisted and are no longer consider representing significant species. The remaining significant species which has been recorded within the Study Area is the peregrine falcon. Three individuals (two adults and one fledgling) were observed from the summit of Mt Gould, and two nest sites were located. Due to confirmation of breeding and well-used roosting locations, it was concluded that the species is likely to occur as a resident.

Of the 19 significant species identified, one species was assessed as being highly likely to occur in the Study Area, the long-tailed dunnart, and a further two species were assessed as having the possibility to occur in the Study Area, the brush-tailed mulgara and grey falcon. The long-tailed dunnart is high likely to occur as a resident in the Study Area based on the proximity of nearby contemporary records and the distribution of suitable habitat. The brush-tailed mulgara may occur on any sandy or loamy soils, if present. The grey falcon has previously been recorded in the vicinity of the Study Area and may occasionally fly over the Study Area for foraging or dispersal, though no breeding or key foraging habitat is likely to be present. The remaining 15 species were considered Unlikely (n = 7) or Highly Unlikely (n = 8) to occur, primarily due to the lack of suitable habitat within the Study Area and/or the Study Area occurring outside the species current known distribution.

The likelihood of occurrence of significant species within the Study Area is limited by the lack of accurate habitat mapping and species records within, or in the vicinity of the Study Area. Hence, the likelihood of occurrence is preliminary and based largely on the Study Area occurring within current known species distributions, nearby records and consideration of habitats that species are known to use. Consideration of the occurrence of suitable habitat within the Study Area is based on existing contextual environmental information including land systems, aerial imagery and previous vegetation mapping. The preliminary likelihood of occurrence species assessment may differ following on-ground assessment and delineation of habitats within the Study Area.

Based on the results of the desktop assessment and preliminary likelihood of occurrence assessment, it is recommended, at a minimum, that a basic survey be undertaken within the Study Area to define and delineate broad fauna habitats. Obtaining detailed site specific information of habitats occurring within the Study Area would facilitate improved accuracy of determining significant species' likelihood

of occurrence, as well as identify the need for any further sampling within the Study Area, such as detailed and/or targeted surveys. Furthering knowledge of significant species occurrence within the Study Area will allow for appropriate consideration and improved support for any future environmental approvals for proposed works within the Study Area.

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7 APPENDICES

Appendix A – Conservation listings

Environment Protection and Biodiversity Conservation Act 1999

Category	Definition
Threatened	
Extinct (EX)	Presumed extinct i.e. there is no reasonable doubt that the last member of the species has died.
Extinct in the Wild (EW)	Presumed extinct in the wild, only surviving in cultivation, captivity or as a naturalised population well outside its past range.
Critically Endangered (CR)	Taxa facing an extremely high risk of extinction in the wild in the immediate future (i.e. 50% chance of extinction in the immediate future).
Endangered (EN)	Taxa facing a very high risk of extinction in the wild in the near future i.e. 20% chance of extinction in the near future.
Vulnerable (VU)	Taxa facing a high risk of extinction in the wild in the medium-term future i.e. 10% chance of extinction in the medium-term future.
Conservation Dependent (CD)	Taxa which will become Vulnerable, Endangered or Critically Endangered if specific conservation efforts cease.
Other	
Migratory (MI)	Birds listed under international agreements relating to the protection of migratory birds i.e. Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), China-Australia Migratory Bird Agreement (CAMBA), Japan-Australia Migratory Bird Agreement (JAMBA) or Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA).

Biodiversity Conservation Act 2016

Category	Definition
Extinct	
Extinct (EX)	Presumed extinct i.e. there is no reasonable doubt that the last member of the species has died.
Extinct in the Wild (EW)	Presumed extinct in the wild i.e. species which have been adequately searched for and there is no reasonable doubt that the last wild individual has died.
Threatened	
Critically Endangered (CR)	Taxa facing an extremely high risk of extinction in the wild.
Endangered (EN)	Taxa facing a very high risk of extinction in the wild.
Vulnerable (VU)	Taxa facing a high risk of extinction in the wild.
Specially Protected	
Migratory (MI)	Birds listed under international agreements relating to the protection of migratory birds i.e. Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), China-Australia Migratory Bird Agreement (CAMBA), Japan-Australia Migratory Bird Agreement (JAMBA) or Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA).
Conservation Dependent (CD)	Species dependent on ongoing conservation intervention to prevent them becoming eligible for listing as threatened.
Other specially protected fauna (OS)	Species otherwise in need of special protection to ensure their conservation.

Department of Biodiversity, Conservation and Attractions Priority codes

Category	Definition
Poorly known	
Priority 1 (P1)	Species that are known from one or a few locations which are potentially at risk. Species whose occurrences are either small, on lands not managed for conservation or otherwise threatened with habitat destruction or degradation. Species that are well known from one or more locations but are under immediate threat from threatening processes. In urgent need of further survey.
Priority 2 (P2)	Species that are known from one or a few locations, some of which are on lands managed for conservation. Species that are well known from one or more locations but are under threat from threatening processes. In urgent need of further survey. In need of further survey.
Priority 3 (P3)	Species that are well known from several locations and are not under imminent threat. Species known from few but widespread locations with either a large population size or with large areas of suitable habitat remaining, much of which is not under imminent threat. Species that are well known from one or more locations and threatening processes exist that could affect them.
Rare, Near Threatened and other species in need of monitoring	
Priority 4 (P4)	*Rare* – Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and which are considered not currently threatened or in need of special protection but could be if present circumstances change. *Near Threatened* – Species that are considered to have been adequately surveyed and that are close to qualifying for Vulnerable but are not listed as Conservation Dependent. *In need of monitoring* - Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy

Appendix B – Vertebrate fauna identified by the desktop assessment

Species		Conservation Status				Database review				Literature review				
Scientific Name	Common Name	EPBC Act	BC Act	DBCA	IUCN	DBCA (2022a)	DCCEEW (2022)	DBCA (2022b)	Birdlife Australia (2022)	ecologia (2007)Assessment ecologia 2009	MBS Environmental (2005)	MBS Environmental (2005)	Western Wildlife (2006)	Biologic (2012)
MAMMALS														
BOVIDAE														
Bos taurus	*European cattle					X								X
Capra hircus	*Goat					X	X			X		X	X	X
CAMELIDAE														
Camelus dromedarius	*Camel													X
CANIDAE														
Canis familiaris	*Dog						X			X				X
Vulpes vulpes	*Red fox						X					X		
DASYURIDAE														
Dasycercus blythi	Brush-tailed mulgara			P4				X						
Pseudantechinus woolleyae	Woolley's pseudantechinus					X				X			X	X
Sminthopsis longicaudata	Long-tailed dunnart			P4		X		X		X		X		
Sminthopsis macroura	Stripe-faced dunnart					X				X			X	X
EMBALLONURIDAE														
Taphozous hilli	Hill's sheath-tailed bat									X			X	X
EQUIDAE														
Equus asinus	*Donkey						X							
FELIDAE														
Felis catus	*Cat					X	X			X		X		X
LEPORIDAE														
Oryctolagus cuniculus	*Rabbit						X					X	X	X

Species		Conservation Status				Database review				Literature review				
Scientific Name	Common Name	EPBC Act	BC Act	DBCA	IUCN	DBCA (2022a)	DCCEEW (2022)	DBCA (2022b)	Birdlife Australia (2022)	ecologia (2007)Assessment ecologia 2009	MBS Environmental (2005)	MBS Environmental (2005)	Western Wildlife (2006)	Biologic (2012)
MACROPODIDAE														
Osphranter robustus	Euro					X				X		X	X	X
Osphranter rufus	Red kangaroo					X						X	X	X
MOLOSSIDAE														
Austronomus australis	White-striped free-tailed bat					X						X	X	X
Ozimops petersi	Inland free-tailed bat													X
MURIDAE														
Mus musculus	*House mouse					X	X			X		X		X
Notomys alexis	Spinifex hopping-mouse					X				X		X	X	X
Pseudomys chapmani	Western pebble-mound mouse			P4				X						
Pseudomys hermannsburgensis	Sandy inland mouse					X				X		X		X
TACHYGLOSSIDAE														
Tachyglossus aculeatus	Short-beaked echidna					X				X		X		X
THYLACOMYIDAE														
Macrotis lagotis	Bilby	VU	VU		VU			X						
VESPERTILIONIDAE														
Chalinolobus gouldii	Gould's wattled bat									X			X	X
Nyctophilus geoffroyi	Lesser long-eared bat									X			X	X
Scotorepens balstoni	Inland broad-nosed bat					X				X			X	X
Scotorepens greyii	Little broad-nosed bat									X		X		X
Vespadelus finlaysoni	Finlayson's cave bat									X		X	X	X

Species		Conservation Status				Database review				Literature review				
Scientific Name	Common Name	EPBC Act	BC Act	DBCA	IUCN	DBCA (2022a)	DCCEEW (2022)	DBCA (2022b)	Birdlife Australia (2022)	ecologia (2007)Assessment ecologia 2009	MBS Environmental (2005)	MBS Environmental (2005)	Western Wildlife (2006)	Biologic (2012)
BIRDS														
ACANTHIZIDAE														
Acanthiza apicalis	Inland thornbill					X			X	X			X	
Acanthiza chrysorrhoa	Yellow-rumped thornbill					X			X	X	X	X	X	X
Acanthiza robustirostris	Slaty-backed thornbill					X			X	X	X			X
Acanthiza uropygialis	Chestnut-rumped thornbill					X			X	X		X	X	X
Aphelocephala leucopsis	Southern whiteface					X			X	X	X		X	X
Aphelocephala nigricincta	Banded whiteface					X								
Gerygone fusca	Western gerygone					X			X	X	X	X		X
Pyrrholaemus brunneus	Redthroat					X			X	X		X		X
Smicrornis brevirostris	Weebill					X			X		X			X
ACCIPITRIDAE														
Accipiter cirrocephalus	Collared sparrowhawk					X			X	X				X
Accipiter fasciatus	Brown goshawk					X			X	X	X	X	X	X
Aquila audax	Wedge-tailed eagle					X			X	X		X	X	X
Circus assimilis	Spotted harrier					X			X		X			X
Elanus axillaris	Black-shouldered kite					X			X	X				
Haliastur sphenurus	Whistling kite					X			X	X			X	X
Hamirostra melanosternon	Black-breasted buzzard					X			X	X		X		
Milvus migrans	Black kite					X								
AEGOTHELIDAE														
Aegotheles cristatus	Australian owlet-nightjar					X			X	X	X		X	X

Species		Conservation Status				Database review				Literature review				
Scientific Name	Common Name	EPBC Act	BC Act	DBCA	IUCN	DBCA (2022a)	DCCEEW (2022)	DBCA (2022b)	Birdlife Australia (2022)	ecologia (2007)Assessment ecologia 2009	MBS Environmental (2005)	MBS Environmental (2005)	Western Wildlife (2006)	Biologic (2012)
ALCEDINIDAE														
Todiramphus pyrrhopygius	Red-backed kingfisher					X			X	X	X	X	X	X
Todiramphus sanctus	Sacred kingfisher					X			X					X
ANATIDAE														
Anas gracilis	Grey teal					X			X					X
Anas superciliosa	Pacific black duck					X			X					X
Aythya australis	Hardhead					X								
Biziura lobata	Musk duck					X			X					
Chenonetta jubata	Australian wood duck					X			X					X
Cygnus atratus	Black swan					X			X					X
Dendrocygna eytoni	Plumed whistling-duck													X
Malacorhynchus membranaceus	Pink-eared duck					X								
Tadorna tadornoides	Australian shelduck					X			X					
ANHINGIDAE														
Anhinga novaehollandiae	Australiasian darter					X			X					X
ARDEIDAE														
Ardea alba	Great egret					X			X					
Egretta novaehollandiae	White-faced heron					X			X					X
Ardea pacifica	White-necked heron					X			X					
Artamus cinereus	Black-faced woodswallow					X			X	X	X	X	X	X
Artamus minor	Little woodswallow					X			X	X	X	X	X	X
Artamus personatus	Masked woodswallow					X			X					X

Species		Conservation Status				Database review				Literature review				
Scientific Name	Common Name	EPBC Act	BC Act	DBCA	IUCN	DBCA (2022a)	DCCEEW (2022)	DBCA (2022b)	Birdlife Australia (2022)	ecologia (2007)Assessment ecologia 2009	MBS Environmental (2005)	MBS Environmental (2005)	Western Wildlife (2006)	Biologic (2012)
Cracticus nigrogularis	Pied butcherbird					X			X	X	X	X	X	X
Gymnorhina tibicen	Australian magpie					X			X	X		X		X
Cracticus torquatus	Grey butcherbird					X			X	X	X	X	X	X
BURHINIDAE														
Burhinus grallarius	Bush stone-curlew					X			X			X	X	X
CACATUIDAE														
Eolophus roseicapilla	Galah					X			X	X	X	X	X	X
Cacatua sanguinea	Little corella					X			X	X				X
Calyptorhynchus banksii	Red-tailed black cockatoo					X			X					
Lophochroa leadbeateri	Major Mitchell's cockatoo					X			X					
Nymphicus hollandicus	Cockatiel					X			X		X			X
CAMPEPHAGIDAE														
Coracina maxima	Ground cuckoo-shrike					X			X	X				
Coracina novaehollandiae	Black-faced cuckoo-shrike					X			X	X	X	X	X	X
Lalage tricolor	White-winged triller					X			X	X	X		X	X
CAPRIMULGIDAE														
Eurostopodus argus	Spotted nightjar					X			X	X		X	X	X
CASUARIIDAE														
Dromaius novaehollandiae	Emu					X			X	X	X	X	X	X
CHARADRIIDAE														
Charadrius ruficapillus	Red-capped plover					X			X					
Charadrius veredus	Oriental plover	MI	MI				X							
Elseyornis melanops	Black-fronted dotterel					X			X					X

Species		Conservation Status				Database review				Literature review				
Scientific Name	Common Name	EPBC Act	BC Act	DBCA	IUCN	DBCA (2022a)	DCCEEW (2022)	DBCA (2022b)	Birdlife Australia (2022)	ecologia (2007)Assessment ecologia 2009	MBS Environmental (2005)	MBS Environmental (2005)	Western Wildlife (2006)	Biologic (2012)
Erythrogonys cinctus	Red-kneed dotterel					X			X					
Vanellus tricolor	Banded lapwing					X			X					X
CINCLOSOMATIDAE														
Cinclosoma castaneothorax	Chestnut-breasted quail-thrush					X			X	X	X	X	X	X
COLUMBIDAE														
Geopelia cuneata	Diamond dove					X			X	X	X	x	X	X
Geopelia placida	Peaceful dove					X			X					X
Ocyphaps lophotes	Crested pigeon					X			X	X	X	X	X	X
Phaps chalcoptera	Common bronzewing					X			X	X		X	X	X
CORVIDAE														
Corvus bennetti	Little crow					X			X	X	X		X	X
Corvus orru	Torresian crow					X			X	X		X	X	X
CUCULIDAE														
Heteroscenes pallidus	Pallid cuckoo					X			X			X		X
Chalcites basalis	Horsfield's bronze-cuckoo					X			X	X	X	X	X	X
Chalcites osculans	Black-eared cuckoo						X		X					
DICAEIDAE														
Dicaeum hirundinaceum	Mistletoebird					X			X		X			X
ESTRILDIDAE														
Emblema pictum	Painted finch					X				X				X
Taeniopygia guttata	Zebra finch					X			X	X	X	X	X	X

Species		Conservation Status				Database review				Literature review				
Scientific Name	Common Name	EPBC Act	BC Act	DBCA	IUCN	DBCA (2022a)	DCCEEW (2022)	DBCA (2022b)	Birdlife Australia (2022)	ecologia (2007)Assessment ecologia 2009	MBS Environmental (2005)	MBS Environmental (2005)	Western Wildlife (2006)	Biologic (2012)
FALCONIDAE														
Falco berigora	Brown falcon					X			X	X	X		X	X
Falco cenchroides	Nankeen kestrel					X			X	X	X	X	X	X
Falco hypoleucos	Grey falcon	VU	VU		VU	X	X	X						
Falco longipennis	Australian hobby					X			X				X	X
Falco peregrinus	Peregrine falcon		OS			X		X	X				X	X
HIRUNDINIDAE														
Cheramoeca leucosterna	White-backed swallow											X		
Hirundo neoxena	Welcome swallow					X			X				X	X
Petrochelidon ariel	Fairy martin					X								
Petrochelidon nigricans	Tree martin					X			X			X	X	X
LARIDAE														
Gelochelidon nilotica	Gull-billed tern	MI	MI					X						
Chlidonias hybrida	Whiskered tern								X					
LOCUSTELLIDAE														
Cincloramphus cruralis	Brown songlark					X			X				x	X
Cincloramphus mathewsi	Rufous songlark					X			X	X	X			X
MALURIDAE														
Malurus lamberti	Variegated fairy-wren					X			X	X				X
Malurus leucopterus	White-winged fairy-wren					X			X					X
Malurus splendens	Splendid fairy-wren					X			X	X		X	X	X
MELIPHAGIDAE														
Acanthagenys rufogularis	Spiny-cheeked honeyeater					X			X	X	X	X	X	X

Species		Conservation Status				Database review				Literature review				
Scientific Name	Common Name	EPBC Act	BC Act	DBCA	IUCN	DBCA (2022a)	DCCEEW (2022)	DBCA (2022b)	Birdlife Australia (2022)	ecologia (2007)Assessment ecologia 2009	MBS Environmental (2005)	MBS Environmental (2005)	Western Wildlife (2006)	Biologic (2012)
Certhionyx variegatus	Pied honeyeater					X			X					
Epthianura albifrons	White-fronted chat								X					
Epthianura tricolor	Crimson chat					X			X	X			X	X
Gavicalis virescens	Singing honeyeater					X			X	X	X	X	X	X
Lichmera indistincta	Brown honeyeater					X			X		X	X		
Manorina flavigula	Yellow-throated miner					X			X	X	X	X	X	X
Ptilotula penicillata	White-plumed honeyeater					X			X	X			X	X
Purnella albifrons	White-fronted honeyeater					X				X				
Sugomel nigrum	Black honeyeater					X								
MEROPIDAE														
Merops ornatus	Rainbow bee-eater					X	X		X	X	X			X
MONARCHIDAE														
Grallina cyanoleuca	Magpie-lark					X			X	X				X
MOTACILLIDAE														
Anthus novaeseelandiae	Australian pipit					X			X	X	X	X	X	X
Motacilla cinerea	Grey wagtail	MI	MI				X							
Motacilla flava	Yellow wagtail	MI	MI				X							
NEOSITTIDAE														
Daphoenositta chrysoptera	Varied sittella					X			X	X	X	X	X	
OREOICIDAE														
Oreoica gutturalis	Crested bellbird					X			X	X	X	X	X	X
OTIDIDAE														
Ardeotis australis	Australian bustard					X			X					X

Species		Conservation Status				Database review				Literature review				
Scientific Name	Common Name	EPBC Act	BC Act	DBCA	IUCN	DBCA (2022a)	DCCEEW (2022)	DBCA (2022b)	Birdlife Australia (2022)	ecologia (2007)Assessment ecologia 2009	MBS Environmental (2005)	MBS Environmental (2005)	Western Wildlife (2006)	Biologic (2012)
PACHYCEPHALIDAE														
Colluricincla harmonica	Grey shrike-thrush					X			X	X	X	X	X	X
Pachycephala rufiventris	Rufous whistler					X			X	X	X	X	X	X
PARDALOTIDAE														
Pardalotus rubricatus	Red-browed pardalote					X			X					X
Pardalotus striatus	Striated pardalote					X							X	X
PELECANIDAE														
Pelecanus conspicillatus	Australian pelican					X			X					X
PETROICIDAE														
Melanodryas cucullata	Hooded robin					X			X	X				
Microeca fascinans	Jacky winter												X	
Petroica goodenovii	Red-capped robin					X			X	X	X	X	X	X
PHALACROCORACIDAE														
Microcarbo melanoleucos	Little pied cormorant					X			X					
Phalacrocorax sulcirostris	Little black cormorant					X			X					X
PHASIANIDAE														
Coturnix pectoralis	Stubble quail								X					X
PODARGIDAE														
Podargus strigoides	Tawny frogmouth					X			X	X	X			
PODICIPEDIDAE														
Poliocephalus poliocephalus	Hoary-headed grebe					X			X					
Tachybaptus novaehollandiae	Australasian grebe					X			X					

Species		Conservation Status				Database review				Literature review				
Scientific Name	Common Name	EPBC Act	BC Act	DBCA	IUCN	DBCA (2022a)	DCCEEW (2022)	DBCA (2022b)	Birdlife Australia (2022)	ecologia (2007)Assessment ecologia 2009	MBS Environmental (2005)	MBS Environmental (2005)	Western Wildlife (2006)	Biologic (2012)
POMATOSTOMIDAE														
Pomatostomus superciliosus	White-browed babbler					X			X	X			X	X
Pomatostomus temporalis	Grey-crowned babbler					X			X	X	X	X	X	X
PSITTACIDAE														
Barnardius zonarius	Australian ringneck					X			X	X			X	X
Melopsittacus undulatus	Budgerigar					X			X	X	X		X	X
Neopsephotus bourkii	Bourke's parrot					X			X		X	X	X	X
Pezoporus occidentalis	Night parrot	EN	CR		EN		X							
Platycercus icterotis	Western rosella					X								
Psephotus varius	Mulga parrot								X	X	X	X	X	X
PSOPHODIDAE														
Psophodes occidentalis	Chiming wedgebill					X			X	X		X		
PTILINORHYNCHIDAE														
Chlamydera guttata	Western bowerbird					X			X	X		X	X	X
RALLIDAE														
Fulica atra	Eurasian coot					X			X					
Tribonyx ventralis	Black-tailed native-hen					X			X					
RECURVIROSTRIDAE														
Cladorhynchus leucocephalus	Banded stilt								X					
Himantopus himantopus	Black-winged stilt					X			X					
RHIPIDURIDAE														
Rhipidura albiscapa	Grey fantail					X			X					

Species		Conservation Status				Database review				Literature review				
Scientific Name	Common Name	EPBC Act	BC Act	DBCA	IUCN	DBCA (2022a)	DCCEEW (2022)	DBCA (2022b)	Birdlife Australia (2022)	ecologia (2007)Assessment ecologia 2009	MBS Environmental (2005)	MBS Environmental (2005)	Western Wildlife (2006)	Biologic (2012)
Rhipidura leucophrys	Willie wagtail					X			X	X	X	X	X	X
ROSTRATULIDAE														
Rostratula australis	Australian painted snipe	EN	EN		EN		X							
SCOLOPACIDAE														
Calidris acuminata	Sharp-tailed sandpiper	MI	MI				X							
Calidris ferruginea	Curlew sandpiper	CR/MI	CR/MI		NT		X							
Calidris melanotos	Pectoral sandpiper	MI	MI				X							
Tringa glareola	Wood sandpiper	MI	MI					X						
Actitis hypoleucos	Common sandpiper	MI	MI				X							
STRIGIDAE														
Ninox boobook	Boobook owl					X			X					X
THRESKIORNITHIDAE														
Platalea flavipes	Yellow-billed spoonbill					X			X					
Threskiornis moluccus	Australian white ibis					X			X					
Threskiornis spinicollis	Straw-necked ibis					X			X					X
TURNICIDAE														
Turnix velox	Little button-quail					X			X	X				X
TYTONIDAE														
Tyto javanica	Eastern barn owl								X	X				
REPTILES														
AGAMIDAE														
Ctenophorus caudicinctus	Western ring-tailed dragon					X				X	X	X	X	X

Species		Conservation Status				Database review				Literature review				
Scientific Name	Common Name	EPBC Act	BC Act	DBCA	IUCN	DBCA (2022a)	DCCEEW (2022)	DBCA (2022b)	Birdlife Australia (2022)	ecologia (2007)Assessment ecologia 2009	MBS Environmental (2005)	MBS Environmental (2005)	Western Wildlife (2006)	Biologic (2012)
Ctenophorus nuchalis	Central netted dragon					X				X	X	X	X	X
Ctenophorus reticulatus	Western netted dragon					X					X	X	X	X
Ctenophorus scutulatus						X							X	X
Gowidon longirostris	Long-nosed dragon					X				X	X	X	X	X
Pogona minor	Western bearded dragon					X				X		X	X	X
Tympanocryptis pseudocephos	Goldfield's pebble-mimic dragons				DD	X							X	
CARPHODACTYLIDAE														
Nephrurus vertebralis						X								X
CHELIDAE														
Chelodina steindachneri	Flat-shelled turtle					X								
DIPLODACTYLIDAE														
Diplodactylus conspicillatus	Variable fat-tailed gecko					X							X	
Diplodactylus pulcher												X	X	
Lucasium stenodactylus	Western sandplain gecko					X				X	X	X	X	X
Oedura fimbria	Western marbled velvet gecko									X		X	X	
Rhynchoedura ornata	Western beaked gecko					X						X	X	X
Strophurus strophurus						X						X	X	
ELAPIDAE														
Brachyurophis approximans													X	
Demansia psammophis	Yellow-faced whipsnake									X				X
Simoselaps bertholdi	Jan's banded snake					X								X

Species		Conservation Status				Database review				Literature review				
Scientific Name	Common Name	EPBC Act	BC Act	DBCA	IUCN	DBCA (2022a)	DCCEEW (2022)	DBCA (2022b)	Birdlife Australia (2022)	ecologia (2007)Assessment ecologia 2009	MBS Environmental (2005)	MBS Environmental (2005)	Western Wildlife (2006)	Biologic (2012)
GEKKONIDAE														
Gehyra punctata						X				X		X	X	X
Gehyra purpurascens						X								
Gehyra variegata	Variegated gehyra					X				X	X	X	X	X
Heteronotia binoei	Bynoe's gecko					X				X		X	X	X
PYGOPODIDAE														
Delma butleri						X						X	X	
Delma tincta						X								X
Pygopus nigriceps										X				
PYTHONIDAE														
Antaresia perthensis	Pygmy python					X				X		X	X	X
SCINCIDAE														
Cryptoblepharus buchananii											X			
Ctenotus leonhardii						X						X	X	X
Ctenotus schomburgkii						X						X	X	X
Ctenotus severus						X				X		X	X	X
Cyclodomorphus melanops						X				X		X	X	
Egernia depressa	Southern pygmy spiny-tailed skink					X				X				X
Egernia stokesii badia		EN	VU					X						
Eremiascincus richardsonii	Broad-banded sand swimmer					X							X	X
Lerista macropisthopus										X				
Lerista muelleri						X								

Species		Conservation Status				Database review				Literature review				
Scientific Name	Common Name	EPBC Act	BC Act	DBCA	IUCN	DBCA (2022a)	DCCEEW (2022)	DBCA (2022b)	Birdlife Australia (2022)	ecologia (2007)Assessment ecologia 2009	MBS Environmental (2005)	MBS Environmental (2005)	Western Wildlife (2006)	Biologic (2012)
Lerista nichollsi						X								
Lerista timida						X				X		X	X	X
Menetia greyii						X				X		X	X	X
TYPHLOPIDAE														
Anilios grypus						X								X
Anilios hamatus										X			X	
Varanus caudolineatus						X						X		X
Varanus giganteus	Perentie									X			X	
Varanus gouldii	Bungarra or sand goanna									X			X	
Varanus panoptes						X				X	X	X		X
Varanus tristis	Racehorse goanna					X				X		X	X	X
AMPHIBIANS														
LIMNODYNASTIDAE														
Platyplectrum spenceri	Centralian burrowing frog											X		
PELODRYADIDAE														
Cyclorana maini	Sheep frog											X		
Cyclorana occidentalis	Western water-holding frog											X		
Litoria rubella	Little red tree frog											X		X

APPENDIX 12: MOUNT GOULD BASIC VERTEBRATE FAUNA SURVEY (BIOLOGIC 2022B)







Mt Gould Project Basic Terrestrial Vertebrate Fauna Survey

Biologic Environmental Survey

Report to MBS Environmental on behalf of Newcam Minerals

2 December 2022



Document Status				
Revision No.	Author	Review / Approved for Issue	Approved for Issue to	
			Name	Date
1	V. Steptoe	R. Ellis	T. Attwood	14/11/2022
2	V. Steptoe	C. Knuckey	T. Attwood	02/12/2022

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EXECUTIVE SUMMARY

MBS Environmental Pty Ltd (MBS), on behalf of Newcam Minerals Pty Ltd (Newcam), commissioned Biologic Environmental Survey Pty Ltd (Biologic) to undertake a basic terrestrial vertebrate fauna survey for the Mt Gould Project (mining lease M52/236; hereafter referred to as the Study Area). The Study Area is located approximately 150 kilometres (km) north-west of Meekatharra and covers an area of approximately 613 hectares (ha). The objective of the basic fauna survey was to delineate the extent of fauna habitats and determine the likelihood of occurrence of significant vertebrate fauna species identified in a recent desktop assessment. The results of the survey will be used to inform requirements for further vertebrate fauna sampling within the Study Area and may be used in state and/or Commonwealth environmental approval processes. For the purposes of this report, significant species includes species listed as Threatened and/or Migratory under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), *Biodiversity Conservation Act 2016*, and/or as Priority by the Department of Biodiversity, Conservation and Attractions (DBCA).

A detailed desktop assessment was conducted prior to the field survey to identify vertebrate fauna species which have previously been recorded or have the potential to occur in the vicinity of the Study Area. This recent desktop assessment was submitted to Newcam Minerals as a separate report (Biologic, 2022b), and the current field survey aimed to build on these findings. The field survey was undertaken between 11th and 13th October 2022 and comprised of 60 habitat assessments, active searching, and opportunistic deployment of camera traps and ultrasonic recorders within habitat suitable for significant species within the Study Area.

Five broad fauna habitats were recorded and mapped within the Study Area, Rocky Hill (51.11%, 313.29 ha), Sandy Plain (30.88%, 189.29 ha), Stony Plain (9.68%, 59.36 ha), Rocky Outcrop/ Breakaway (2.69%, 16.51 ha), and Minor Drainage Line (2.06%, 12.63 ha) (Figure 5.2; Table 5.2). The remaining 3.57% (21.89 ha) comprised Cleared/ Disturbed areas, attributed to historic mining operations. Of the five fauna habitats mapped within the Study Area, Rocky outcrop/ Breakaway and Sandy Plain were deemed to be of Moderate significance, as they provide critical habitat for a number of significant species, including long-tailed dunnart and peregrine falcon within Rocky Outcrop/ Breakaway habitat and brush-tailed mulgara within Sand Plain habitat. The remaining three fauna habitats (Rocky Hill, Stony Plain and Minor Drainage Line) may provide supporting habitat (i.e. foraging and dispersal) for some significant species; however, are unlikely to be relied upon for the persistence of any species at a local or regional scale and are therefore deemed low significance. All habitats mapped within the Study Area occur more broadly across the Murchison bioregion.

A total of 222 vertebrate fauna species were identified in the desktop assessment as potentially occurring within the Study Area, including 28 mammals (19 native and nine introduced), 144 birds, 46 reptiles and four amphibians (Biologic, 2022b). Of these, 18 significant species with the potential to occur within the Study Area were identified, including four mammals, 13 birds, and one reptile. The peregrine falcon was the only significant species recorded within the Study Area during the current survey, comprising two adults observed near the summit of Mt Gould, similar to a previous record by Biologic (2012), confirming the species is an established resident within the Study Area.

Additionally, of the 17 remaining significant species potentially occurring within the Study Area, one species, long-tailed dunnart (*Sminthopsis longicaudata* – Priority 4 DBCA), was considered Highly Likely to occur in the Study Area and a further two species, brush-tailed mulgara (*Dasycercus blythi* – Priority 4 DBCA) and grey falcon (*Falco hypoleucos* – Vulnerable EPBC Act and BC Act), were considered as Possibly occurring, where suitable habitat was present.

Further sampling (i.e. detailed and/or targeted surveys) within the Study Area are likely to further ascertain the presence of significant species and their supporting habitats within the Study Area, particularly those deemed Highly Likely or Possible to occur, to support future potential environmental approval processes.

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1 INTRODUCTION

1.1 Background

MBS Environmental Pty Ltd (MBS), on behalf of Newcam Minerals Pty Ltd (Newcam), commissioned Biologic Environmental Survey Pty Ltd (Biologic) to undertake a basic terrestrial vertebrate fauna survey for the Mt Gould Project (the Project), occurring on mining lease tenement M52/236 (hereafter referred to as the Study Area; Figure 1.1). The Study Area is located approximately 150 kilometres (km) north-west of Meekatharra in the Murchison region of Western Australia and covers approximately 613 hectares (ha) (Figure 1.1).

1.2 Objectives

The overarching objective of the survey was to increase knowledge of vertebrate fauna values within the Study Area and identify any significant species that may require consideration during the Project's design and/or approvals processes. Specifically, the key objectives of the assessment were to:

- undertake a basic vertebrate fauna field survey to validate the recent desktop assessment (Biologic, 2012), define and delineate the extent of fauna habitats, and determine the likelihood of occurrence of significant vertebrate fauna species; and
- use results from basic fauna survey to identify and make recommendations for further detailed and/or targeted survey requirements to support the environmental approval process.

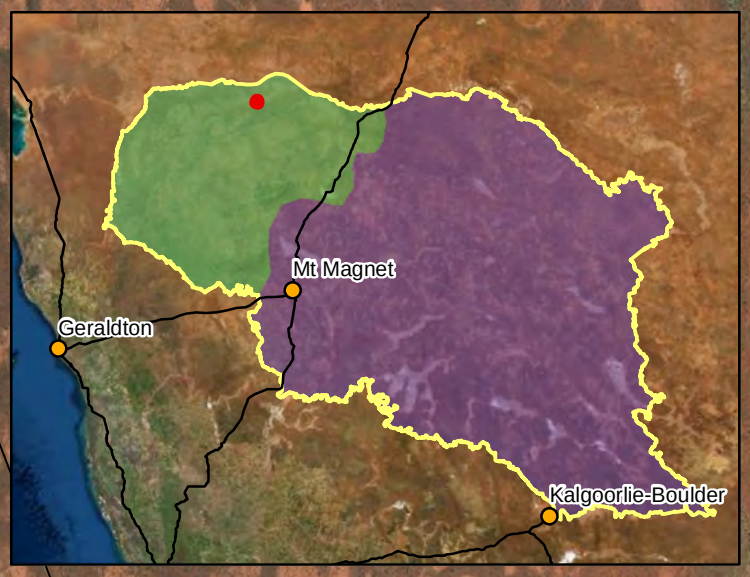
1.3 Compliance

The survey was carried out in a manner consistent with the following documents developed by the Western Australian Environmental Protection Authority (EPA), the Department of Biodiversity, Conservation and Attractions (DBCA), and the Department of Climate Change, Energy, the Environment and Water (DCCEEW; formerly the Department of Environment (DoE), Department of Sustainability, Water, Population, and Communities (DSEWPaC), and Department of Environment, Water, Heritage and Arts (DEWHA)):

- DEWHA (2010a) Survey guidelines for Australia's threatened bats;
- DEWHA (2010b) Survey guidelines for Australia's threatened birds;
- DoE (2013) Significant impact guidelines 1.1: Matters of National Environmental Significance;
- DSEWPaC (2011a) Survey guidelines for Australia's threatened reptiles;
- DSEWPaC (2011b) Survey guidelines for Australia's threatened mammals;
- EPA (2020) Technical guidance: Terrestrial vertebrate fauna surveys for environmental impact assessment;
- EPA (2018) Statement of environmental principles, factors and objectives;
- EPA (2016) Environmental factor guidelines – terrestrial fauna; and
- TSSC (2020) Conservation advice: *Falco hypoleucos,* grey falcon.

The survey was conducted under a DBCA Regulation 27 "Fauna Taking (Biological Assessment) License" issued to Chris Knuckey (license number BA27000700-2). All sampling undertaken for the survey was approved through Murdoch University's Animal Ethics Committee (permit RW3354/ 21).

532000
534000
536000
7150000
7148000
7146000
7144000



Landor - Meekatharra Rd

Legend

Study Area

Local Road

IBRA Region

Murchison

IBRA Subregion

Eastern Murchison

Western Murchison

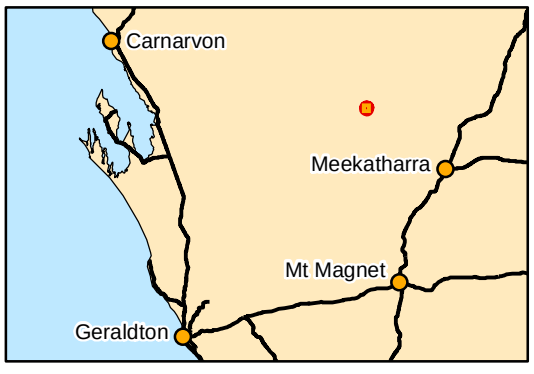
0 0.5 1 Km

Coordinate System: GDA2020 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA2020 Created 07/11/2022

N

biologic Environmental Survey

Scale: 1:25,000



MBS ENVIRONMENTAL

Mt Gould Basic Vertebrate Fauna Survey

Figure 1.1: Study Area and regional location

1.4 Background to Protection of Fauna

Terrestrial fauna may be significant for a range of reasons, including:

- being identified as a threatened or priority species;
- being a species with restricted distribution;
- enduring a degree of historical impact from threatening processes; or
- providing an important function required to maintain the ecological integrity of a significant ecosystem (EPA, 2016).

Within Western Australia, all native fauna is protected under the *Biodiversity Conservation Act 2016* (BC Act) and at a national level under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Any action that has the potential to impact on native fauna needs to be approved by relevant state and/or federal departments as dictated by the state *Environmental Protection Act 1986* (EP Act).

While all native fauna is protected under these Acts, some species are afforded extra protection. These include species that are considered Threatened under the EPBC Act and/or BC Act, or; migratory bird species that are protected under international agreements and subsequently listed as Migratory under the EPBC Act and/or BC Act (Table 1.1;Appendix A). Furthermore, any species that may be threatened but for which there is insufficient information available to allocate a threatened status under the EBPC Act and/or BC Act, can also be listed as Priority species by the WA DBCA (Table 1.1; Appendix A).

For the purposes of this assessment, species considered to be of conservation significance (herein significant species), are those that are afforded protection under the EPBC Act, BC Act and/or listed as Priority by DBCA (Table 1.1; Appendix A). A summary of applicable legislation and status codes is provided in Table 1.1.

Table 1.1: Definitions and terms for significant species

Act, Agreement or List	Status Codes[1]
Federal	
EPBC Act In Australia, native fauna are protected under the EPBC Act. This Act makes provisions for an independent committee (the Threatened Species Scientific Committee [TSSC]), which is charged with maintaining a list of threatened species. Threatened species are listed under one of six categories, depending on their specific conservation status. Migratory bird species are those listed under international agreements and protected under the EPBC Act as a MNES. Relevant international agreements include the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), China-Australia Migratory Bird Agreement (CAMBA), Japan-Australia Migratory Bird Agreement (JAMBA), and Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA).	*Extinct:* • EX – Extinct • EW – Extinct in the Wild *Threatened:* • CR – Critically Endangered • EN – Endangered • VU – Vulnerable • CD – Conservation Dependent *Other:* • MI – Migratory
State	
BC Act In WA, native fauna are protected under the BC Act. Species in special need of protection are listed as being Extinct, Threatened or Specially Protected. Within these groups, species are listed under one of eight categories, depending on their specific conservation status. Migratory bird species are those listed under the Bonn Convention and/or CAMBA, JAMBA and ROKAMBA agreements.	*Extinct:* • EX – Extinct *Threatened:* • CR – Critically Endangered • EN – Endangered • VU – Vulnerable *Specially Protected:* • MI – Migratory • CD – Conservation Dependent • OS – Other specially protected fauna
DBCA Priority List The DBCA maintains a list of Priority species that are considered to be possibly threatened but have not been assigned statutory protection under the BC Act, as not enough information is available for an accurate determination of conservation status. These species are generally in urgent need of survey to determine their distribution and abundance.	*Poorly Known:* • P1 – Priority 1 • P2 – Priority 2 • P3 – Priority 3 *Rare, Near Threatened and other* • P4 – Priority

[1]See Appendix A for definitions of status codes

2 EXISTING ENVIRONMENT

2.1 Interim Biogeographical Regionalisation for Australia

The Study Area is located within the Western Murchison subregion (MUR02) of the Murchison bioregion (Thackway & Cresswell, 1995) (Figure 1.1), which is characterised by mulga low woodlands, often rich in ephemerals (usually with bunch grasses), on outcrop and fine textured Quaternary alluvial and eluvial surfaces (Desmond *et al.*, 2001).

2.2 Climate

The Murchison bioregion has an arid climate with bimodal rainfall that usually falls in winter (Desmond *et al.*, 2001). The nearest active Bureau of Meteorology (BoM) weather station with long term climate data is Meekatharra Airport (station number 007045). The mean annual rainfall recorded at Meekatharra Airport is 233.7 millimetres (mm) with the majority of rainfall received between January and June each year (BoM, 2022). The highest maximum temperatures occur between November and March, with the highest mean maximum recorded in January (38.4°C). The lowest minimum temperatures occur between May and August, with the lowest mean minimum temperature recorded in July (7.5°C) (BoM, 2022).

2.3 Geology

The Murchison bioregion, is located within the Archaean Yilgarn Craton, characterised by shallow alluvial valleys connected by stony pediments to low rocky hills of bedrock, or to breakaways over duricrust-capped bedrock (Curry *et al.*, 1994). Granitoid outcropping produces large monoliths and extensive uplands of flat pavements, while basaltic outcropping forms rugged, rounded hills. The Study Area occurs across five geological units, the dominant of which is the Exposed unit (_X-YPP, covering 37.72% of the Study Area and comprised of exposed bedrock (Table 2.1; Figure 2.1).

Table 2.1: Geological units mapped within the Study Area

Code	Description	Extent in Study Area	
		Ha	%
Exposed unit, YPP (_X-YPP)	Exposed bedrock	231.23	37.72
Sheetwash unit, YPP (_W-YPP)	Clay, silt and sand in extensive fans; local ferruginous gravel	172.82	28.19
Colluvial unit, YPP (_Ct-t-YPP)	Lithic-rich talus deposits	141.75	23.04
Alluvial/fluvial unit, YPP (_A-YPP)	Clay, silt, sand, and gravel in channels and on floodplains	66.71	10.88
Alluvial/fluvial unit, YPP (_Aa-YPP)	Clay, silt, sand, and gravel on alluvial plains	0.46	0.08
Total		**612.96**	**100.00**

532000
534000
536000
7150000
7148000
7146000
7144000
W-YPP
W-YPP
X-YPP
Ct-t-YPP
C-q-YPP
A-YPP
X-YPP
Aa-YPP
W-YPP
Landor - Meekatharra Rd

Legend

Study Area

Local Road

Regolith Geology

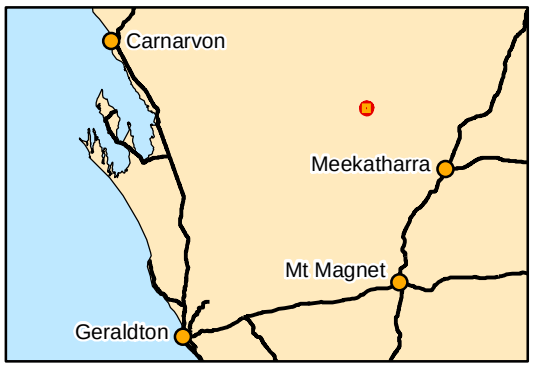
- A-YPP; Alluvial/fluvial unit, YPP
- Aa-YPP; Alluvial/fluvial unit, YPP
- C-q-YPP; Colluvial unit, YPP
- Ct-t-YPP; Colluvial unit, YPP
- W-YPP; Sheetwash unit, YPP
- X-YPP; Exposed unit, YPP

0 0.5 1 Km

Coordinate System: GDA2020 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA2020 Created 07/11/2022

N

Scale: 1:25,000



MBS ENVIRONMENTAL

Mt Gould Basic Vertebrate Fauna Survey

Figure 2.2: Broad geology of the Study Area

2.4 Soils

The Commonwealth Scientific and Industrial Research Organisation (2009) Atlas of Australian Soils described and mapped the soils of Australia following Northcote *et al.* (1968). The Study Area occurs across two soil-landscape units, My50 and Mz24 (Table 2.2; Figure 2.2). The dominant soil unit occurring within the Study Area is My50, which is defined as broad plains with a scatter of surface gravels and shallow soils and earthy loams.

Table 2.2: Soil Units within the Study Area

Soil Unit	Description[1]	Study Area	
		ha	%
My50	Broad plains with a scatter of surface gravels: chief soils are shallow neutral red earths (Gn2.12) and shallow earthy loams (Um5.3) in intimate micro-association. They are underlain by a red-brown hardpan at depths of 6-30in.	611.58	99.78
Mz24	Extensive plains similar to unit Mz23 of Sheet 6 but with small sand ridges: chief soils are acid red earths (Gn2.11)	1.39	0.22
Total		**612.96**	**100.00**

[1]Source: CSIRO (1992). Supporting soil code information is available in McKenzie and Hook (1992)

2.5 Land Systems

Curry *et al.* (1994) classified and mapped the land systems of the Murchison bioregion, according to similarities in landform, soil, vegetation, geology and geomorphology. An assessment of land systems provides an indication of the diversity and distribution of fauna habitats present within the Study Area. The Study Area intersects two land systems, the Peak Hill system and Cole system (Table 2.3; Figure 2.3). The dominant land system of the Study Area is the Peak Hill system, covering approximately 75.21% of the Study Area (Table 2.3; Figure 2.3). The Peak Hill system is defined as rugged ranges and rounded hills of banded ironstone and haematitic shale, mulga and cottonbush shrublands.

Table 2.3: Land Systems mapped within the Study Area

Land System	Description	Area (ha)	%
Peak Hill	Rugged, sinuous ranges and rounded hills of banded ironstone and haematitic shale, supporting stunted mulga and cottonbush shrublands.	461.03	75.21
Cole	Hardpan wash plains with reticulate patterns of wanderrie banks and mulga groves and more concentrated drainage tracts, supporting mixed mulga and wanderrie shrublands.	151.94	24.79
Total		**612.96**	**100.00**

532000
534000
536000
7150000
7148000
7146000
7144000
Landor - Meekatharra Rd

Legend

Study Area

Local Road

Soil Unit

My50

Mz24

Oc47

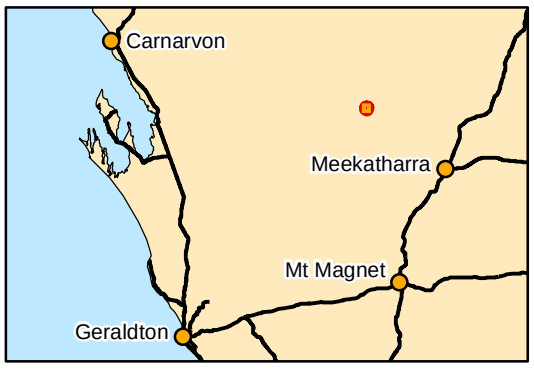
0 0.5 1 Km

Coordinate System: GDA2020 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA2020 Created 07/11/2022

N

biologic Environmental Survey

Scale: 1:25,000



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Figure 2.3: Soils of the Study Area

532000
534000
536000
7150000
7148000
7146000
7144000
Landor - Meekatharra Rd

Legend

Study Area

Local Road

Land System

Beringarra System

Cole System

Peak Hill System

Yandil System

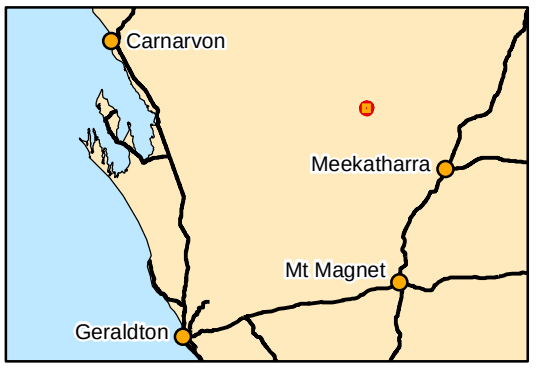
0 0.5 1 Km

Coordinate System: GDA2020 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA2020 Created 07/11/2022

N

biologic Environmental Survey

Scale: 1:25,000



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Figure 2.4: Land Systems of the Study Area

2.6 Pre-European Vegetation

Beard (1975) broadly (1:1,000,000) mapped the major structural vegetation types of Western Australia. Shepherd *et al.* (2002) reinterpreted and updated the vegetation association mapping to reflect the National Vegetation Information System (NVIS) standards (ESCAVI, 2003). This update also accounts for extensive clearing since Beard (1975) mapping.

Two vegetation associations occur within the Study Area, UPPER MURCHISON_202 and UPPER MURCHISON_29, the former of which is the more prevalent association throughout the Study Area (Table 2.4; Figure 2.4).

Table 2.4: Vegetation associations within the Study Area

Vegetation Association	Description	Area (ha)	%
UPPER MURCHISON_202	Wattle, tea tree & other species (*Acacia* spp. *Melaleuca* spp.). Scrub, open scrub or sparse scrub.	500.06	81.57
UPPER MURCHISON_29	Mulga (*Acacia aneura*) and associated species. Low woodland, open low woodland or sparse woodland.	112.90	18.43
Total		**612.96**	**100.00**

532000
534000
536000
7150000
7148000
7146000
7144000
Landor - Meekatharra Rd

Legend

Study Area

Local Road

Pre-European Vegetation

UPPER MURCHISON 18

UPPER MURCHISON 202

UPPER MURCHISON 29

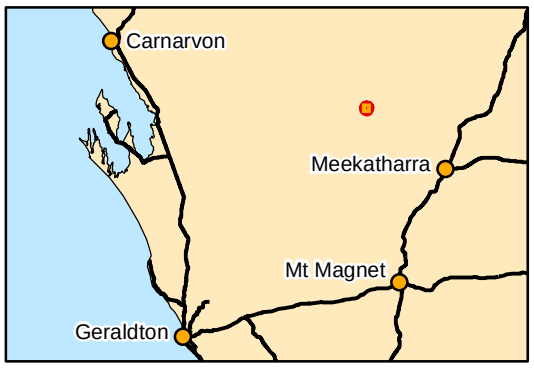
0 0.5 1 Km

Coordinate System: GDA2020 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA2020 Created 07/11/2022

N

biologic Environmental Survey

Scale: 1:25,000



MBS ENVIRONMENTAL

Mt Gould Basic Vertebrate Fauna Survey

Figure 2.5: Pre-European vegetation associations of the Study Area

2.7 Threatened and Priority Ecological Communities

One state listed PEC occurs within the Study Area, the Mount Gould vegetation complex (banded ironstone formation [BIF]) (Priority 1), characterised by *Triodia melvillei* hummock grasses (Table 2.5; Figure 2.5) (DBCA, 2022c; Woodman, 2009). Vegetation complexes included in the PEC will be further described in a flora and vegetation survey report for the Study Area (in progress) (Biologic, 2022a). The PEC is distributed across a large proportion of the Study Area (522.70 ha, 85.27%); and extends approximately 4 km north-east from the north-east corner of the Study Area (DBCA, 2022c). No TECs occur within the Study Area.

Six additional PECs occurs within 50 km of the Study Area, including four Priority 1 PECs and two Priority 3 PECs (Table 2.5; Figure 2.5) (DBCA, 2022b, 2022c). No TECs occur within 50 km of the Study Area.

Table 2.5: Priority Ecological Communities within the vicinity of the Study Area

Ecological Community	Category	Description	Distance to Study Area
Mount Gould vegetation complexes	Priority 1	Banded ironstone formation	Overlapping
Jack Hills vegetation complexes	Priority 1	Banded ironstone formation	10 km SSE
Mount Dugel/ Mount Nairn vegetation complexes	Priority 1	Banded ironstone formation	26 km E
Beringarra Calcrete	Priority 1	Beringarra calcrete groundwater assemblage type on Murchison palaeodrainage on Beringarra Station. Unique assemblages of invertebrates have been identified in the groundwater calcretes.	30 km SW
Frederick Land System	Priority 3	Hardpan wash plains characterised by broad, reticulate mulga groves and Wanderrie banks supporting tall Acacia shrublands with grassy understorey	33 - 41 km WNW
Trillbar Land System	Priority 3	Gently sloping stony plains with low rises of metamorphic rocks and gilgaied drainage foci; supports more or less saline shrublands of snakewood, mulga, bluebush and samphire with patches of tussock grassland	36 km NE
Jingle Land System	Priority 3	Flood plains with Eucalypt woodlands and variable shrublands marginal to rivers	44 km NNW

450000
500000
550000
7250000
7200000
7150000
7100000

Landor - Mt Augustus Rd
Landor - Mount Cl
Dalgety Downs - Landor Rd
Erong Rd
Yunda Rd
Beringarra - Mount Gould Rd
Beringarra - Byro Rd
Beringarra - Pindar Rd
Beringarra - Cue Rd
Trillbar Rd
Moorarie/Trillbar Rd
Judal Rd
Judal-Mileura Rd
Landor - Meekatharra Rd

Legend

- Study Area
- Local Road

Threatened and Priority Ecological Community

Community - Category

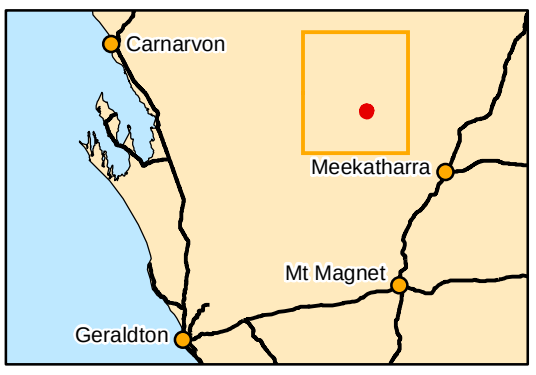
- Beringarra Calcrete - Priority 1
- Jack Hills BIF - Priority 1
- Mount Dugel and Nairn BIF - Priority 1
- Mount Gould BIF - Priority 1
- Frederick Land System - Priority 3
- Jingle Land System - Priority 3
- Trillbar Land System - Priority 3

0 10 20 Kilometers

Coordinate System: GDA2020 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA2020 Created 07/11/2022

N

Scale: 1:550,000



MBS ENVIRONMENTAL

Mt Gould Basic Vertebrate Fauna Survey

Figure 2.6: Threatened and Priority Ecological Communities identified from the desktop assessment

3 DESKTOP ASSESSMENT

A comprehensive desktop assessment was completed for the Study Area prior to the current field survey, and results documented in a separate report (Biologic, 2022b). Four vertebrate fauna databases and three survey reports were reviewed to identify vertebrate fauna species and fauna habitats potentially occurring in the Study Area, with a focus on significant species. Further information regarding the desktop assessment, including methodology and findings can be found in the report by (Biologic, 2022b).

4 FIELD SURVEY METHODS

4.1.1 Survey Timing and Personnel Timing

The field survey was conducted over three days from the 11th to 13th October 2022 by Senior Zoologists Verity Steptoe and Gina Barnett, who collectively have more than 30 years' experienced undertaking surveys in the region (Table 4.1).

Table 4.1: Survey personnel and experience

Personnel	Position and Role	Qualification	Experience
Verity Steptoe	Senior Zoologist • project management • field survey • reporting	BSc Zoology and Marine Biology	14 years' Environmental Impact Assessment (EIA) (consulting) 17 years' field survey 17 years' vertebrate zoology/ ecology
Gina Barnett	Senior Zoologist • field survey	BEnvSc (Hons)	15 years' EIA (consulting) 15 years' field survey 15 years' vertebrate zoology/ ecology

4.1.2 Climate and Weather

In the twelve months prior to the field survey (November 2021 to October 2022), the region experienced some fluctuation in average monthly temperatures (ranging from 3.0°C degrees warmer in January 2022 to 2.9°C cooler in October 2022) when compared to the long-term averages for corresponding months (BoM, 2022). The annual rainfall preceding the survey (254.8 mm) was similar to the long-term average annual rainfall of 231.9 mm (BoM, 2022). Of the 254.8 mm total received for the year, 56.4 mm fell in September 2022 (significantly greater than the long-term average of 4.3 mm), the month preceding the survey (Figure 4.1). No rainfall was recorded during or in the five days prior to the field survey and the average maximum daytime temperature during the survey was 22.8°C (Table 4.2) (BoM, 2022).



Figure 4.1: Long-term average and contemporary recorded at Meekatharra Airport (BoM, 2022), with approximate survey timing shown in shaded box.

Table 4.2: Climatic conditions recorded at Meekatharra weather station during the field survey

Date	Min. Temp (°C)	Max. Temp (°C)	Rainfall (mm)
11/10/2022	13.3	22.2	0
12/10/2022	12.8	22.3	0
13/10/2022	10.5	24.0	0
Average/ total	**12.2**	**22.8**	**0**

4.1.3 Sampling and Survey Methods

Habitat assessments and mapping

Habitat assessments were undertaken at 60 locations across the Study Area to characterise and define habitats and their significance to vertebrate fauna (Figure 4.2). Habitat assessments were conducted using methodology and terminology modified from the *Australian Soil and Land Survey Field Handbook* (National Committee on Soil and Terrain, 2009). Characteristics recorded during the habitat assessments were:

- site information: location and photo;
- habitat: broad habitat type, landform, aspect, slope, soil type and availability, rocky outcropping presence and type;
- ground cover: rock size, vegetation litter and woody debris;
- vegetation: broad vegetation type, structure and dominant species;
- microhabitat: rocky cracks/ crevices, burrowing suitability, water presence; and
- condition: time since fire, disturbance and overall habitat condition.

Fauna habitat mapping was completed for the Study Area using the habitat assessments completed during the field survey, as well as high-resolution aerial imagery, vegetation, topographical, geology and soil mapping. Habitats were delineated and mapped across the Study Area at a scale of approximately 1:12,000.

Active searching and opportunistic fauna records

Active searches for vertebrate fauna were undertaken opportunistically throughout the Study Area and records of all species observed were documented. Records included those from primary (i.e. direct observation and calls) or secondary evidence (i.e. tracks, feathers, nests, scats and diggings). Efforts were made to observe fauna from likely microhabitats by turning rocks, logs and anthropogenic debris where present. A total of 27.5 person hours of active searches were undertaken within the Study Area during the field survey (Table 4.3). Additionally, 2 person hours of nocturnal searches (i.e. spotlighting) were also undertaken to observe nocturnal species (Table 4.3).

Camera Traps

Camera traps (Swift Enduro) were opportunistically deployed at eight sites within the Study Area during the field survey. Camera traps were deployed within suitable habitat (i.e. sandy plains, exposed rock and stony soil with hummock grasses, and rocky outcrops) for two significant species identified in the desktop as potentially occurring within the Study Area, brush-tailed mulgara (*Dasycercus blythi* – Priority 4 DBCA) and long-tailed dunnart (*Sminthopsis longicaudata* – Priority 4 DBCA) (Figure 4.2; Table 4.3). Each camera was baited with non-reward universal bait (mixture of oats, peanut butter and sardines) and deployed for between one to two nights, equating to a total of 13 trap nights.

Ultrasonic recorders

Two ultrasonic recorders (SM4 units) were deployed opportunistically within suitable habitats (i.e. caves, water features, foraging/ dispersal corridors) to capture bat species that may occur within the Study Area (Figure 4.2; Table 4.3). One unit was deployed at a cave entrance near Mt Gould summit, with a second unit deployed in Minor Drainage Line habitat, over two nights, for a total of four sample nights. Ultrasonic calls were analysed by Robert Bullen (WA bat specialist).

Table 4.3: Survey effort by sampling site

Survey effort	Latitude	Longitude	Date		Sampling effort (person hrs/ nights)	Comments
			Deployment	Retrieval		
Active searches - daytime						
Total					**27.5**	
Active searches - nocturnal						
Total					**2.0**	
Camera traps						
	-25.8031	117.3442	12/10/2022	13/10/2022	1	
	-25.8008	117.3275	11/10/2022	13/10/2022	2	
	-25.7945	117.3403	11/10/2022	13/10/2022	2	
	-25.7937	117.3405	11/10/2022	13/10/2022	2	
	-25.7983	117.3433	11/10/2022	13/10/2022	2	
	-25.8036	117.3398	12/10/2022	13/10/2022	1	
	-25.8097	117.3358	12/10/2022	13/10/2022	1	At entrance of burrow
	-25.8057	117.3249	11/10/2022	13/10/2022	2	
Total					**13**	
Ultrasonic recorders						
	-25.7846	117.3363	11/10/2022	13/10/2022	2	
	-25.7982	117.3428	11/10/2022	13/10/2022	2	At entrance of cave
Total					**4**	

Taxonomy and Nomenclature

The latest checklist of mammal, reptile and amphibian names published by the WAM (2022) was used as a guide to the current taxonomy and nomenclature of these groups, with the exception of taxonomic changes published subsequent to the checklist. For birds, the current checklist of Australian birds maintained by the Australian Faunal Directory (ABRS, 2021) was used in conjunction with the WAM (2022) species list.

532000 533000 534000 535000

7148000 7147000 7146000 7145000

Landor - Meekatharra Rd

Legend

Study Area
Local Road

Sampling Type

Camera Trap
Habitat Assessment
Ultrasonic Recorder

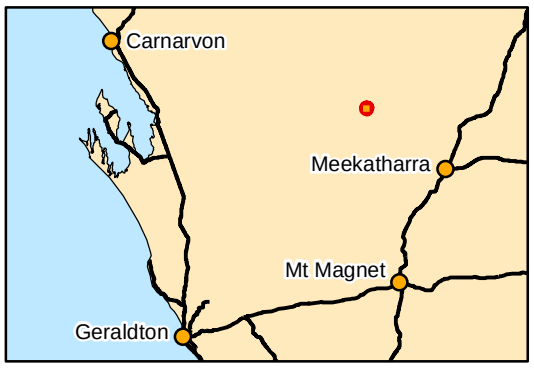
Traverse

0 0.2 0.4 0.6 Km

Coordinate System: GDA2020 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA2020 Created 07/11/2022

N

Scale: 1:12,000



MBS ENVIRONMENTAL

Mt Gould Basic Vertebrate Fauna Survey

Figure 3.2: Fauna sample sites and traverses

4.2 Likelihood of Significant Species Occurrence

Following the field survey, significant species identified during the desktop assessment (Biologic, 2012) were re-assessed for their likelihood of occurrence within the Study Area based on current habitat mapping and classification. Likelihood was determined using a decision matrix which considers the suitability of habitat present within the Study Area and the proximity of previous records (Table 4.4). Based on this decision matrix, each species was assigned to one of six categories of likelihood: Confirmed, Highly Likely, Likely, Possible, Unlikely, or Highly Unlikely.

The decision matrix is intended to be an indicative guide only, and the way in which it is interpreted may vary between species, depending on a given species' habitat preferences and ability to disperse, as well as the reliability and availability of contextual information. For example, considering species which have been previously recorded close to the Study Area, a species with a limited dispersal capability will have a reduced likelihood of occurring in the Study Area compared with a species with greater dispersal capability. It is also recognised that a lack of records in the vicinity of the Study Area may indicate limited sampling effort rather than species' absence, and that previous records may include historic or presumed erroneous information which may misrepresent a species' current distribution. Where the determination of a species' likelihood of occurrence within the Study Area deviates from the decision matrix, detailed justification for any variation will be presented.

Table 4.4: Species likelihood of occurrence decision matrix

		Habitat Suitability of Study Area			
		Breeding Habitat Present	**Foraging and Dispersal Habitat Present**	**Supporting Habitat[2] Present**	**No Suitable Habitat Present**
Species Records[1]	**Recorded in Study Area**	Confirmed	Confirmed	Confirmed	Confirmed
	Recorded within 10 km of Study Area	Highly Likely	Likely	Possible	Possible
	Recorded within 10–50km of Study Area	Likely	Possible	Possible	Unlikely
	Recorded within 50–100 km of Study Area	Possible	Possible	Unlikely	Unlikely
	Recorded >100 km of Study Area	Possible	Unlikely	Unlikely	Highly Unlikely
	Species considered locally/regionally extinct	Unlikely	Unlikely	Highly Unlikely	Highly Unlikely

[1] Only records within the previous 50 years are considered.

[2] Supporting habitat is habitat which is possibly used by a species but is unlikely to be depended upon; for example, it may be used only when in proximity to core breeding, foraging or dispersal habitat.

4.3 Assessment of Habitat Significance

Mapped habitats of the Study Area were assigned significance based on whether they provided habitat critical to the survival of significant species (Table 4.5). Habitat critical to the survival of a species is defined by DoE (2013) as *"areas that are necessary: for activities such as foraging, breeding, roosting, or dispersal, the long-term maintenance of the species, to maintain genetic diversity and long term evolutionary development, or for the reintroduction of populations or recovery of the species"*. Habitats considered marginally suitable were deemed to be of moderate significance.

Table 4.5: Fauna habitat significance assessment criteria

Score	Possible criteria (score results from any possible criterion being met)
High	Fauna listed as threatened under the EPBC Act or BC Act have been recorded from this habitat type within the Study Area.
	Habitat known to be suitable core habitat[1] for EPBC Act and/or BC Act listed threatened fauna, and there are records of this species within 40 km.
	Habitat is regionally uncommon or limited in extent and known to support species listed as Threatened fauna under the EPBC Act and/or BC Act, but it is not their core habitat (e.g. may be used periodically/ seasonally or for dispersal).
Moderate	Habitat is common and widespread but is known to support species listed Threatened fauna under the EPBC Act and/or BC Act, but it is not their core habitat (e.g. may be used periodically/ seasonally or for dispersal).
Low	Habitat is widespread/common and does not directly support any Threatened fauna under the EPBC Act and/or BC Act.

[1] Core habitat is defined as containing the critical habitat elements for survival and reproduction of a species (Bingham & Noon, 1997) or as otherwise defined within relevant species recovery plans and guidelines.

[2] Note in instances where survey work over this area has been limited, then a precautionary approach is generally applied, and the species may be considered likely to be present.

5 RESULTS AND DISCUSSION

5.1 Desktop Assessment

The previous desktop assessment completed for the Study Area by Biologic (2022b), identified a total of 222 vertebrate fauna species which have previously been recorded and/or have the potential to occur within the Study Area, comprising 28 mammals, 144 birds, 46 reptiles and four amphibians (Appendix B). Of these, 18 are listed as significant species, comprising four mammals, 13 birds and one reptile (Table 5.1). One significant species has previously been recorded within the Study Area, peregrine falcon (*Falco peregrinus* - Specially Protected BC Act) (Biologic, 2012).

Table 5.1: Significant species identified during the desktop assessment

Species		Conservation Status		
Scientific Name	**Common Name**	**EPBC Act**	**BC Act**	**DBCA**
Mammals				
Dasyuridae				
Dasycercus blythi	Brush-tailed mulgara			P4
Sminthopsis longicaudata	Long-tailed dunnart			P4
Muridae				
Pseudomys chapmani	Western pebble-mound mouse			P4
Thylacomyidae				
Macrotis lagotis	Bilby	VU	VU	
Birds				
Charadriidae				
Charadrius veredus	Oriental plover	MI	MI	
Falconidae				
Falco hypoleucos	Grey falcon	VU	VU	
Falco peregrinus	Peregrine falcon		OS	
Laridae				
Gelochelidon nilotica	Gull-billed tern	MI	MI	
Motacillidae				
Motacilla cinerea	Grey wagtail	MI	MI	
Motacilla flava	Yellow wagtail	MI	MI	
Psittacidae				
Pezoporus occidentalis	Night parrot	EN	CR	
Rostratulidae				
Rostratula australis	Australian painted snipe	EN	EN	
Scolopacidae				
Calidris acuminata	Sharp-tailed sandpiper	MI	MI	
Calidris ferruginea	Curlew sandpiper	CR/MI	CR/MI	
Calidris melanotos	Pectoral sandpiper	MI	MI	
Tringa glareola	Wood sandpiper	MI	MI	
Actitis hypoleucos	Common sandpiper	MI	MI	
Reptiles				
Scincidae				
Egernia stokesii badia	Western spiny-tailed skink	EN	VU	

450000
500000
550000
7200000
7150000
7100000
Dalgety Downs - Landor Rd
Landor - Meekatharra Rd
Erong Rd
Yunda Rd
Moorarie - Trillbar Rd
Beringarra - Mount Gould Rd
Landor - Meekatharra Rd
Beringarra - Byro Rd
Judal Rd
Judal-Mileura Rd
Beringarra - Cue Rd
Mileura - Nookawarra Rd
Beringarra - Pindar Rd
Manfred Rd

Legend

- Study Area
- Local Road

DBCA (2020b)

Bird

- Grey falcon - VU
- Gull-billed tern - MI
- Wood sandpiper - MI
- Peregrine falcon - OS

Mammal

- Bilby - VU
- Brush-tailed mulgara - P4
- Long-tailed dunnart - P4
- Western pebble-mound mouse - P4

Reptile

- Western spiny-tailed skink - VU

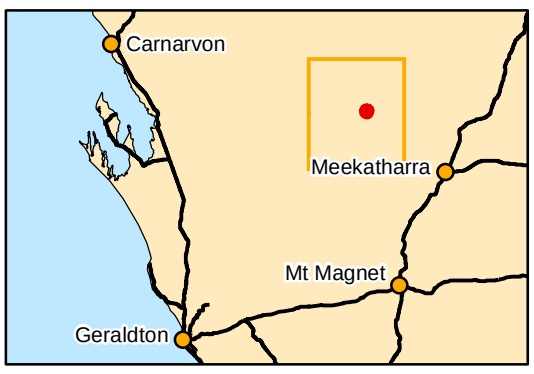
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Coordinate System: GDA2020 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA2020 Created 07/11/2022

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biologic Environmental Survey

Scale: 1:500,000



MBS ENVIRONMENTAL

Mt Gould Basic Vertebrate Fauna Survey

Figure 4.1: Significant species identified in the desktop assessment

5.2 Vertebrate Fauna Survey

5.2.1 Fauna Habitat

A total of five broad fauna habitats were recorded and mapped within the Study Area, comprising, in decreasing extent of occurrence, Rocky Hill (51.11%, 313.29 ha), Sandy Plain (30.88%, 189.29 ha), Stony Plain (9.68%, 59.36 ha), Rocky Outcrop/ Breakaway (2.69%, 16.51 ha), and Minor Drainage Line (2.06%, 12.63 ha) (Figure 5.2; Table 5.2). The remaining 3.57% (21.89 ha) of the Study Area comprised Cleared/ Disturbed areas, in the form of a mine pit, laydown areas and access tracks relating to previous mining operations (Figure 5.2; Table 5.2). Descriptions of the distinguishing characteristics and the occurrence within the Study Area for each of these habitat types are presented in Table 5.2, and the data from on-site habitat assessments are presented in Appendix C.

Of the five fauna habitats mapped within the Study Area, Rocky outcrop/ Breakaway and Sandy Plain were deemed to be of Moderate significance, as they provide critical habitat for a number of significant species. The remaining three (Rocky Hill, Stony Plain and Minor Drainage Line) were deemed to be of low significance, as they provide only supporting habitat for significant species, which are unlikely to be relied upon by any species for their long-term persistence within the Study Area or broader vicinity.

Rocky Outcrop/ Breakaway habitat provides critical habitat two significant species; peregrine falcon, though the provision of breeding habitat, particularly among areas of breakaway and cliff faces on the Mt Gould summit and breeding (denning and shelter) habitat for long-tailed dunnart, particularly in areas where suitable rocky crevices occur. Sandy Plain habitat provides critical habitat for brush-tailed mulgara, particularly in areas where substrates permitting burrow excavation are present. Sandy Plain habitat is also likely to provide supporting foraging and dispersal habitat for peregrine falcon and grey falcon. While both habitats deemed to be of moderate significance occur more broadly throughout the Murchison bioregion, their occurrence and extent are often sporadically distributed, they provide important connectivity between occurrences of the habitat within and beyond the Study Area.

While the remaining three fauna habitats mapped within the Study Area (Rocky Hill, Stony Plain and Minor Drainage Line) are likely to provide supporting habitat for some significant species (i.e. foraging and dispersal), they are unlikely to be relied upon for the persistence of any significant species. For example Rocky Hill habitat is likely to provide supporting foraging and dispersal habitat for long-tailed dunnart and peregrine falcon, particularly when occurring adjacent to Rocky Outcrop and Breakaway habitat. Additionally, Stony Plain and Minor Drainage Line may also provide supporting habitat for brush-tailed mulgara (particularly when occurring adjacent to Sandy Plain), peregrine falcon and grey falcon. All habitats mapped within the Study Area are well represented more broadly across the Murchison bioregion

Habitat condition within the Study Area ranged from very degraded to very good. Disturbances were concentrated on the slopes of Mt Gould and surrounding flats, and primarily caused by historic mining operations (including mine pit, access tracks, and lay down areas). Other disturbances included feral herbivores, weed invasion and scattered rubbish.

Table 5.2: Fauna habitat descriptions

Habitat	Distinguishing habitat characteristics	Extent of the habitat	Suitability for Significant Species	Photo
Rocky Hill **313.29 ha** **51.11%** **Significance: Low**	Rocky Hill habitat comprises hills and undulating stony plains of higher elevation, supporting spinifex or tussock grassland, *Ptilotis* spp and sparse mulga woodland on a mantle of gravel and larger rocks with occasional minor to moderate ironstone/ granite outcropping.	Rocky Hill habitat is common throughout the Study Area, particularly on Mt Gould. The occurrence of this habitat type throughout the region is relatively common and widespread, with isolated patches scattered across the Murchison region.	Supporting habitat for: • long-tailed dunnart (foraging and dispersal) • peregrine falcon (foraging and dispersal)	
Sandy Plain **189.29 ha** **30.88%** **Significance: Moderate**	Sandy Plain habitat comprises flat plains with vegetation dominated by scattered *Acacia* spp. and mulga trees and shrubs and patches of various small to medium shrub species on soft sandy clay loam substrates. Evidence of cattle and camel trampling and grazing.	Sandy Plain habitat occurs throughout a large portion of the Study Area, often occurring at the foothills of Rocky Hill habitat. Sandy Plain is a common and widespread habitat types within the Murchison bioregion. The vegetation and substrate which make up this habitat type are characteristic features of the region.	Critical habitat for: • brush-tailed mulgara (breeding, foraging and dispersal) Supporting habitat for: • peregrine falcon (foraging and dispersal) • grey falcon (foraging and dispersal)	
Stony Plain **59.36 ha** **9.68%** **Significance: Low**	Stony Plain habitat comprises flat to low undulating areas and low hills with vegetation dominated by mulga trees over tussock grasslands on stony clay loam substrates.	Stony Plain habitat is primarily restricted to the northern section of the Study Area on flat plains within the Mt Gould vegetation complex PEC. Stony Plain habitat is widespread throughout the Murchison bioregion.	Supporting habitat for: • brush-tailed mulgara (foraging and dispersal, where occurring near Sandy Plain habitat) • peregrine falcon (foraging and dispersal) • grey falcon (foraging and dispersal)	
Rocky Outcrop/ Breakaway **16.51 ha** **2.69%** **Significance: Moderate**	Rocky Outcrop/ Breakaway habitat provided some of the most elevated and steepest terrain within the Study Area. Composed of piles of large ironstone and haematite boulders, this habitat type was scattered patchily throughout the Study Area. This habitat also provides a multitude of deep cracks and crevices in rocky outcropping for shelter for a range of vertebrate fauna species. In some areas of this habitat scattered *Acacia* spp. shrubs provided additional shelter or foraging opportunities.	Rocky Outcrop/ Breakaway habitat was scattered throughout the Study Area. Patches of Rocky Outcrop/ Breakaway habitat were separated by hill slopes, and plains whereby connectivity of habitat was highly interrupted. Mt Gould had several breakaways and cliff faces that provide suitable roosting and breeding habitat for peregrine falcon. Vertebrate fauna (excluding bird species) utilising this habitat would potentially be restricted to individual pockets of the habitat due to high predation risk during dispersal to another surrounding similar habitat. This habitat type is widespread, yet scattered throughout the Murchison bioregion.	Critical habitat for: • peregrine falcon (breeding) • long-tailed dunnart (breeding, foraging and dispersal)	

Habitat	Distinguishing habitat characteristics	Extent of the habitat	Suitability for Significant Species	Photo
Minor Drainage Line **12.63 ha** **2.06%** **Significance: Low**	Drainage lines were located in the footslopes of Mt Gould and adjacent to Gorge/ Gully, Rocky Hill, and Stony Plain habitats. Vegetation within this habitat comprised of scattered to dense mixed *Acacia* species (*Acacia aneura, Acacia grasbyi*), with the exception of the drainage line in the centre of the Study Area, which was associated with previous mining operations and consequently, highly disturbed. Soils were often soft and deep, and conducive to burrowing.	Minor Drainage Line habitat is patchily distributed throughout the Study Area, where water accumulates and flows from Rocky Outcrops and Rocky Hill habitats of Mt Gould toward the lower lying Stony and Sandy Plains habitats. This fauna habitat is relatively common throughout the Murchison bioregion, with the Murchison River briefly intersecting the north-western edge of the Study Area and running less than 1 km from the western boundary. Across the region its structure and condition is variable as a result of rainfall events and disturbance (i.e., fire and cattle grazing).	Supporting habitat for: • peregrine falcon (foraging and dispersal) • grey falcon (foraging and dispersal)	
Cleared/ Disturbed **21.89 ha** **3.57%**	Access tracks and cleared areas associated with mining/ exploration activities (i.e. mine pit, lay down areas).	Access tracks throughout the Study Area were associated with mining and exploration as well as historical mine pit and laydown areas. These were centred mostly around and towards the summit of Mt Gould.	• N/A	

532000 533000 534000 535000

7148000 7147000 7146000 7145000

Landor - Meekatharra Rd

Legend

Study Area

Local Road

Fauna Habitat

- Disturbed
- Minor Drainage Line
- Rocky Hill
- Rocky Outcrop/Breakaway
- Sandy Plain
- Stony Plain

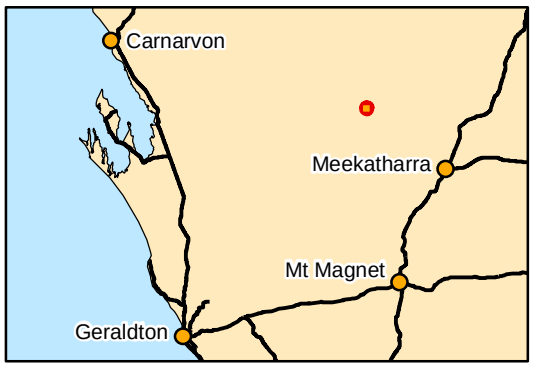
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Coordinate System: GDA2020 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA2020 Created 14/11/2022

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biologic Environmental Survey

Scale: 1:12,000



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Mt Gould Basic Vertebrate Fauna Survey

Figure 4.2: Fauna habitats in the Study Area

5.2.2 Fauna Recorded

A total of 62 vertebrate fauna species were recorded within the Study Area during the current survey (Table 5.3, Appendix B), from direct observation and/or secondary evidence (i.e. diggings, tracks, scats, burrows). This comprised of 18 mammal species (including six introduced species), 40 birds, and four reptiles. Several species recorded during the field survey were not identified in the recent desktop assessment as previously occurring within or in the vicinity of the Study Area, including one bird species: Australian raven (*Corvus coronoides*), and two reptile species: barred wedge-snout ctenotus (*Ctenotus schomburgkii*), and mottled ground gecko (*Lucasium squarrosum)*.

Table 5.3: Vertebrate fauna recorded during the current survey

Scientific name	Common name	Conservation status		
		EPBC Act	BC Act	WA
Mammals				
Austronomus australis	White-striped freetail bat			
Bos taurus	Cattle*			
Camelus dromedarius	Camel*			
Canis familiaris	Dog*			
Capra hircus	Goat*			
Chaerephon jobensis	Northern freetail bat			
Chalinolobus gouldii	Gould's wattled bat			
Felis catus	Domestic cat*			
Leporillus conditor	Greater stick-nest rat			
Osphranter robustus	Euro			
Osphranter rufus	Red kangaroo			
Ozimops petersi	Inland freetail bat			
Pseudantechinus woolleyae	Woolley's pseudantechinus			
Pseudomys hermannsburgensis	Sandy inland mouse			
Tachyglossus aculeatus	Short-beaked echidna			
Taphozous hilli	Hill's sheath-tail bat			
Vespadelus finlaysoni	Finlayson's cave bat			
Vulpes vulpes	Red fox*			
Birds				
Acanthagenys rufogularis	Spiny-cheeked honeyeater			
Acanthiza uropygialis	Chestnut-rumped thornbill			
Aegotheles cristatus	Australian owlet-nightjar			
Anthus novaeseelandiae	Australiasian pipit			
Aphelocephala leucopsis	Southern whiteface			
Aquila audax	Wedge-tailed eagle			
Artamus cinereus	Black-faced woodswallow			
Artamus minor	Little woodswallow			
Artamus personatus	Masked woodswallow			
Burhinus grallarius	Bush stone-curlew			
Certhionyx variegatus	Pied honeyeater			
Chalcites basalis	Horsefield's bronze-cuckoo			
Coracina novaehollandiae	Black-faced cuckoo-shrike			
Corvus coronoides	Australian raven			
Corvus orru	Torresian crow			
Cracticus nigrogularis	Pied butcherbird			
Cracticus torquatus	Grey butcherbird			
Emblema pictum	Painted finch			

Scientific name	Common name	Conservation status		
		EPBC Act	BC Act	WA
Epthianura tricolor	Crimson chat			
Eurostopodus argus	Spotted nightjar			
Falco berigora	Brown falcon			
Falco cenchroides	Nankeen kestrel			
Falco peregrinus	Peregrine falcon		OS	
Gavicalis virescens	Singing honeyeater			
Geopelia cuneata	Diamond dove			
Grallina cyanoleuca	Magpie-lark			
Lalage tricolor	White-winged triller			
Malurus lamberti	Variegated fairy-wren			
Malurus splendens	Splendid fairy-wren			
Manorina flavigula	Yellow-throated miner			
Melopsittacus undulatus	Budgerigar			
Ocyphaps lophotes	Crested pigeon			
Oreoica gutturalis	Crested bellbird			
Phaps chalcoptera	Common bronzewing			
Pomatostomus temporalis	Grey-crowned babbler			
Pyrrholaemus brunneus	Redthroat			
Rhipidura leucophrys	Willie wagtail			
Taeniopygia guttata	Zebra finch			
Todiramphus pyrrhopygius	Red-backed kingfisher			
Turnix velox	Little button-quail			
Reptiles				
Ctenophorus caudicinctus	Western ring-tailed dragon			
Ctenotus schomburgkii	Barred wedge-snout ctenotus			
Gehyra polka	Large spotted mid-west rock gehyra			
Lucasium squarrosum	Mottled ground gecko			

*denotes introduced species

5.2.3 Significant Species

One significant species was recorded within the Study Area during the current survey, peregrine falcon. The species was recorded from direct observation of two adults flying around the summit of Mt Gould (Table 5.4; Figure 5.3). Based on known species' distributions, previous records identified in the desktop assessment and assessment of fauna habitats during the field survey, one additional species was considered Highly Likely to occur (long-tailed dunnart) and two species were considered to Possibly occur (brush-tailed mulgara and grey falcon) within the Study Area (Table 5.4).

The remaining 14 species were considered Unlikely (*n = 3*) or Highly Unlikely (*n = 11*) to occur, primarily due to the lack of suitable habitat likely to support the species within the Study Area (Table 5.4). These results support the preliminary likelihood of occurrence for species considered during the recent desktop assessment (Biologic, 2022b). The occurrence of significant species which have been recorded or are deemed Highly Likely or Possible to occur within the Study Area, are outlined below.

Species Confirmed as occurring in the Study Area

Peregrine falcon (*Falco peregrinus*) – Specially Protected (BC Act)

The peregrine falcon is considered moderately common in the Stirling Range, uncommon in the Kimberley, Hamersley and Darling Ranges, and rare elsewhere (Johnstone & Storr, 1998). In arid areas of its distribution, the peregrine falcon is often recorded along cliffs above rivers, ranges and wooded watercourses where it hunts birds (Johnstone & Storr, 1998). It typically nests on rocky ledges occurring on tall, vertical cliff faces between 25–50 m high (Olsen & Olsen, 1989). It also appears to prefer nesting on ledges a reasonable distance from the top of the cliff (Olsen & Olsen, 1989), possibly to avoid predators. Nesting also occasionally occurs in tall trees along drainage lines, including use of abandoned nests of other large bird species (Olsen & Olsen, 1989). The species mate for life, with a home range of approximately 20 to 30 km^2.

Two adult peregrine falcons were recorded in Rocky Outcrop/ Breakaway habitat near the summit of Mt Gould, an area characterised by numerous ledges, recesses and cliff faces (Figure 5.3). The species has also previously been recorded (two adults and one fledgling) in the vicinity of the Mt Gould summit by Biologic (2012) and at the nearby Jack Hills (DBCA, 2022a, 2022d). Within the Study Area, there are a series of cliff faces with numerous ledges and recesses suitable for nesting by the species around the Mt Gould summit. This is supported by observations of roost sites during the current and 2012 surveys, with the 2012 survey also recording two nest sites located in the same area (Biologic, 2012). Current and historical records of peregrine falcon within the Study Area indicates the species (specifically a breeding pair and nests) are established residents of the area and it is likely to be utilising cliff faces within Rocky outcrop/ Breakaway habitat on Mt Gould for breeding. Additionally, Rocky Hill, Sandy Plain, Stony Plain and Minor Drainage Line habitats are also likely to utilised as foraging and dispersal habitat by the species. The species broad foraging ranges suggests the species is likely to forage broadly across most habitats of the Study Area and occasionally beyond the Study Area.

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Landor - Meekatharra Rd

Legend

- Study Area
- Local Road

Fauna Habitat

- Disturbed
- Minor Drainage Line
- Rocky Hill
- Rocky Outcrop/ Breakaway
- Sandy Plain
- Stony Plain

- Peregrine falcon - OS

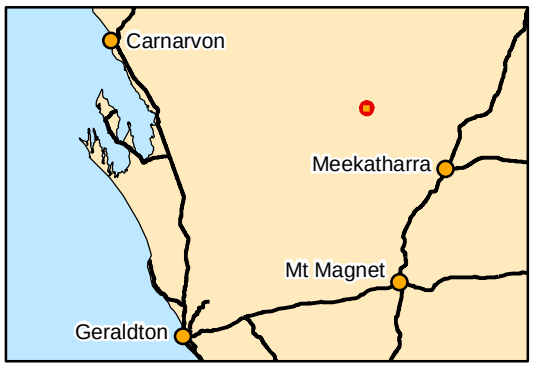
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Projection: Transverse Mercator
Datum: GDA2020 Created 14/11/2022

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biologic Environmental Survey

Scale: 1:12,000



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Mt Gould Basic Vertebrate Fauna Survey

Figure 4.3: Significant fauna recorded in the Study Area

Species Highly Likely to occur in the Study Area

Long-tailed dunnart (*Sminthopsis longicaudata*) – Priority 4 (DBCA)

The long-tailed dunnart is a nocturnal and agile species distributed through the Murchison, Pilbara, and north-eastern goldfields and Gibson desert, south to Nullarbor Plain, to central Northern Territory and western South Australia (van Dyck & Strahan, 2008). Its core habitat includes rocky scree slopes with hummock grass and shrubs, and tall open *Acacia* shrubland and woodlands (McKenzie *et al.*, 2008).

The species was not recorded during the current survey; however, it has previously been recorded on two occasions at Jack Hills, approximately 20 km and 27 km south of the Study Area (Figure 5.1) (DBCA, 2022d). The presence of suitable critical breeding habitat amongst occurrences of Rocky Outcrop/ Breakaway habitat and supporting foraging and dispersal habitat within Rocky Hill habitat, and proximity of previous records in the vicinity of the Study Area indicate the species is Highly Likely to occur (Figure 5.2). The species is likely to occur as a resident within suitable habitats of the Study Area, with foraging and dispersal movements also possibly occurring more broadly into habitats adjacent to critical breeding habitat (Figure 5.2).

Possible to occur in the Study Area

Brush-tailed mulgara (*Dasycercus blythi*) – Priority 4 (DBCA)

The species occurs in a range of habitats across the Australian arid zone, often dominated by spinifex *Triodia* spp. grasslands on sandy or stony plains where suitable burrowing substrate is present (Pavey *et al.*, 2012; Woolley, 2006).

The species has previously been recorded on seven occasions in the broader vicinity of the Study Area, six times approximately 85 km west-north-west of Study Area and once approximately 63 km west (Figure 5.1) (DBCA, 2022d). The species was not recorded during the current survey; however, the species is deemed possible to occur, particularly within Sandy Plain habitat where suitable vegetation cover and sandy and loamy substrates permitting burrow excavation occur, which provides critical breeding habitat for the species (Figure 5.2). The species may also utilise Stony Plain and Minor Drainage Line habitats as foraging and dispersal habitat, particularly where occurring adjacent to Sandy Plain habitat (Figure 5.2).

Grey falcon (*Falco hypoleucos*) – Vulnerable (EPBC and BC Act)

The grey falcon is a widely distributed but infrequently recorded species which appears to have a distribution centred on ephemeral or permanent creek lines (Garnett & Crowley, 2000). The species tends to prefer sparsely-treed, open plains and creek lines for foraging (Olsen & Olsen, 1986), while nesting often occurs in the abandoned nest of a raptor or corvid in trees or tall infrastructure such as tall power line or communications towers (Olsen & Olsen, 1986; Schoenjahn *et al.*, 2019).

Grey falcon was not recorded during the current survey; however, the nearest contemporary record of the species (2007) is located approximately 6.5 km south-east of the Study Area (Figure 5.1) (DBCA, 2022a) and the species is considered possible to occur. Based on aerial imagery, the record is located within Drainage Area/ Floodplain habitat, which is consistent with the species broad habitat preferences. While there is no Drainage Area/ Floodplain habitat mapped within the Study Area, the species may occasionally occur during foraging and dispersal activities, particularly within Sandy Plain, Stony Plain, and to a lesser extent, Minor Drainage Line habitats (Figure 5.2). No habitats within the Study Area are likely to provide critical habitat for the species, primarily due to the lack of suitable tall trees or other infrastructure which may be used for nesting. Due to the species broad foraging range and the widespread occurrence of these habitats in the broader vicinity of the Study Area, foraging is likely to occur over a much broader area and not confined to the Study Area. The species occurrence within the Study Area is likely to be occasional, though dependent on the proximity of nesting to the Study Area,

Table 5.4: Significant species likelihood of occurrence assessment

Common name (*Scientific name*)	Conservation status[1]			Preferred broad habitats	Nearest record to the Study Area	Potential critical habitat					Likelihood of occurrence	Occurrence	Comments
	EPBC Act	BC Act	DBCA			Sandy Plain	Stony Plain	Rocky Hill	Rocky Outcrop	Minor Drainage Line			
MAMMALS													
DASYURIDAE													
Brush-tailed mulgara (*Dasycercus blythi*)			P4	Can occur in a range of habitats across the Australian arid zone, often dominated by spinifex *Triodia* spp. grasslands on sandy or stony plains where suitable burrowing substrate is present (Pavey *et al.*, 2012; Woolley, 2006). Mature spinifex hummocks appear to be important for protection from introduced predators (Körtner *et al.*, 2007).	~63 km W (2013) DBCA (2022d)	•	•				Possible	Resident	Sandy Plain habitat at the foothills of Rocky Hill habitat has high burrowing suitability and therefore the species may occur within the Study Area. Foraging and dispersal may also occur within Stony Plain habitat.
Long-tailed dunnart (*Sminthopsis longicaudata*)			P4	Typically occurs on plateaus near breakaways and scree slopes, and on rugged boulder-strewn scree slopes (Burbidge *et al.*, 2008). Once considered rare but now shown to be relatively common and widespread in rocky habitats (Burbidge *et al.*, 2008).	~20 km S (2009) DBCA (2022d)			•	•		Highly Likely	Resident	Isolated patches of Rocky Outcrop/ Breakaway habitat may provide suitable denning and shelter habitat, with the adjacent Rocky Hill habitat providing supporting foraging and dispersal habitat.
MURIDAE													
Western pebble-mound mouse (*Pseudomys chapmani*)			P4	This species occurs on the gentler slopes of rocky ranges where the ground is covered with a stony mantle and vegetated by hard spinifex, often with a sparse overstorey of eucalypts and scattered shrubs (Anstee, 1996; Start *et al.*, 2000). Species is considered to be extinct from the Murchison region (Start *et al.*, 2000).	~60 km WNW (1970), ~70 km W DBCA (2022d)						Highly Unlikely	N/A	While limited suitable habitat occurs within the Study Area, the species is considered extinct within the broader Murchison region and therefore not likely to occur within the Study Area.
THYLACOMYIDAE													
Bilby (*Macrotis lagotis*)	VU	VU		Variety of habitats including spinifex hummock grassland and *Acacia* shrubland, on soft soils Includes residual landforms (e.g. laterite rises), loamy or sandy soils associated with palaeodrainage lines and perched drainage lines, sandplains and dune fields, habitat types where shrubs containing root dwelling larvae are common, and recently burnt habitat (within the last 1-3 years) (DBCA, 2017).	~60 km S (1961) DBCA (2022d)						Unlikely	N/A	No suitable habitat present.
BIRDS													
CHARADRIIDAE													
Oriental plover (*Charadrius veredus*)	MI	MI		Variety of habitats, including coastal habitats, such as estuarine mudflats and sandbanks, on sandy or rocky ocean beaches as well as open inland environments such as, semi-arid or arid grasslands, where the grass is short and sparse (Johnstone & Storr, 2004).	>100 km DBCA (2022d)						Highly Unlikely	N/A	No suitable habitat present.

Common name (*Scientific name*)	Conservation status[1]			Preferred broad habitats	Nearest record to the Study Area	Potential critical habitat					Likelihood of occurrence	Occurrence	Comments
	EPBC Act	BC Act	DBCA			Sandy Plain	Stony Plain	Rocky Hill	Rocky Outcrop	Minor Drainage Line			
FALCONIDAE													
Grey falcon (*Falco hypoleucos*)	VU	VU		Timbered lowlands, particularly *Acacia* shrubland and along inland drainage systems. Also frequents spinifex and tussock grassland habitats to forage (Burbidge *et al.*, 2010; Olsen & Olsen, 1986). The species commonly nests in timbered areas, particularly tall trees along watercourses, or tall infrastructure (e.g. powerline towers) and forages in open or more sparsely vegetated habitats (Garnett *et al.*, 2011).	~6.5 km E (2007) DBCA (2022d)	•	•			•	Possible	Occasional visitor	Occurrence within the Study Area likely to be restricted to occasional visitation during foraging and dispersal activities. Frequency of occurrence likely to be dependent on the proximity of nesting in the broader vicinity of the Study Area.
Peregrine falcon (*Falco peregrinus*)		OS		Arid areas and is most often encountered along cliffs above rivers, ranges and wooded watercourses where it hunts birds (Johnstone & Storr, 1998). It typically nests on rocky ledges occurring on tall, vertical cliff faces between 25 m and 50 m high (Olsen *et al.*, 2004; Olsen & Olsen, 1989). In general it nests on cliffs, granite outcrops, quarries and in the wheatbelt, old raven and whistling kite nests (Johnstone & Storr, 1998).	Breeding pair confirmed within the Study Area (Biologic, 2012)	•	•	•	•		Confirmed	Resident	An adult pair were recorded near the summit of Mt Gould, in Rocky Outcrop/ Breakaway habitat. A pair of adults and one fledgling have previously been recorded in the vicinity of the current record, indicating the species are likely to occur as residents within the Study Area. Foraging likely to occur more broadly within Sandy Plain and Stony Plain habitats.
LARIDAE													
Gull-billed tern (*Gelochelidon nilotica*)	MI	MI		Found in freshwater swamps, brackish and salt lakes, beaches and estuarine mudflats, floodwaters, sewage farms, irrigated croplands and grasslands (Johnstone & Storr, 1998). In the interior, they are often associated with inundated saltlakes and claypans and watercourses (Johnstone & Storr, 1998). Colonially breeds and nests on islets in partially filled saltlakes or saltmarshes in mid-western interior (Johnstone & Storr, 1998).	~60 km S DBCA (2022d)						Highly Unlikely	N/A	No suitable habitat present.
MOTACILLIDAE													
Grey wagtail (*Motacilla cinerea*)	MI	MI		A rare vagrant to Western Australia where it has been recorded within various habitats with open waterbodies (Johnstone & Storr, 2004).	>100 km DBCA (2022d)						Highly Unlikely	N/A	No suitable habitat present.
Yellow wagtail (*Motacilla flava*)	MI	MI		An uncommon visitor to the Murchison region (Johnstone *et al.*, 2013). Occupies a range of damp or wet habitats with low vegetation although favors edges of fresh water, especially sewage ponds (Johnstone & Storr, 2004).	>100 km DBCA (2022d)						Highly Unlikely	N/A	No suitable habitat present.
PSITTACIDAE													
Night parrot (*Pezoporus occidentalis*)	EN	CR		The night parrot prefers sandy/stony plain habitat with old-growth spinifex for roosting and nesting in conjunction with native grasses and herbs for foraging (DPaW, 2017).	> 200 km E of Wiluna (Jackett *et al.*, 2017)						Unlikely	N/A	No suitable habitat present.

Common name (*Scientific name*)	Conservation status[1]			Preferred broad habitats	Nearest record to the Study Area	Potential critical habitat					Likelihood of occurrence	Occurrence	Comments
	EPBC Act	BC Act	DBCA			Sandy Plain	Stony Plain	Rocky Hill	Rocky Outcrop	Minor Drainage Line			
ROSTRATULIDAE													
Australian painted snipe (*Rostratula australis*)	EN	EN		Generally, occupies shallow terrestrial freshwater wetlands (i.e. temporary and permanent lakes, swamps and claypans) with rank emergent tussocks of grass, sedges, rushes or reeds, or samphire (Johnstone & Storr, 1998)	>100 km DBCA (2022d)						Highly Unlikely	N/A	No suitable habitat present.
SCOLOPACIDAE													
Sharp-tailed sandpiper (*Calidris acuminata*)	MI	MI		Coastal and inland areas saline and freshwater but prefers non-tidal fresh or brackish wetlands (Geering *et al.*, 2007). Favors flooded samphire flats and grasslands, mangrove creeks mudflats, beaches, river pools, saltwork ponds, sewage ponds and freshwater soaks (Johnstone *et al.*, 2013).	>100 km DBCA (2022d)						Highly Unlikely	N/A	No suitable habitat present.
Curlew sandpiper (*Calidris ferruginea*)	CR/ MI	CR/ MI		Inhabits intertidal mudflats in sheltered coastal areas (i.e. estuaries, bays, inlets and lagoons) (Geering *et al.*, 2007). This rare species generally roosts on bare dry shingle, shell or sand beaches, sandspits and islets in or around coastal or near-coastal lagoons and other wetlands (Geering *et al.*, 2007).	>100 km DBCA (2022d)						Highly Unlikely	N/A	No suitable habitat present.
Pectoral sandpiper (*Calidris melanotos*)	MI	MI		Coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands (Johnstone & Storr, 2004; Johnstone *et al.*, 2013). It prefers wetlands with open fringing mudflats and low, emergent or fringing vegetation (Geering *et al.*, 2007).	>100 km DBCA (2022d)						Highly Unlikely	N/A	No suitable habitat present.
Wood sandpiper (*Tringa glareola*)	MI	MI		Species occurs as a non-breeding summer migrant which occurs throughout the region. Occurs mainly in river pools, sewage ponds, flooded claypans, freshwater lagoons and bore overflows (Johnstone *et al.*, 2013).	~48 km SSW DBCA (2022d)						Highly Unlikely	N/A	No suitable habitat present.
Common sandpiper (*Actitis hypoleucos*)	MI	MI		Estuaries and deltas of streams, as well as banks farther upstream; around lakes, pools, billabongs, reservoirs, dams and claypans (Johnstone & Storr, 1998).	>100 km DBCA (2022d)						Highly Unlikely	N/A	No suitable habitat present.
REPTILES													
SCINCIDAE													
Western spiny-tailed skink (*Egernia stokesii badia*)	VU	VU		This species has been recently recorded at several locations in the Murchison region, including near Weld Range (DBCA, 2022d). In the Murchison, the western spiny-tail skink inhabits deep rock crevices on granite outcrops and hills (Cogger, 2014). There are no areas of granite outcropping within the Mt Gould tenement and the Study Area sits outside of the species recognised distribution (DoE, 2022).	>53 km SW DBCA (2022d)						Unlikely	N/A	No suitable habitat present.

[1] CR – Critically Endangered, EN – Endangered, VU – Vulnerable, OS – Specially Protected, MI – Migratory, P1–P4 – Priority 1–4.

5.3 Constraints and Limitations

The EPA (2020) outlines several potential limitations and constraints which have the potential to affect the results of vertebrate fauna surveys. These aspects are assessed and discussed below in Table 5.5.

Table 5.5: Survey limitations and constraints

Potential limitation or constraint	Constraint	Applicability to this survey
Sources/availability of data and information (recent or historic) and availability of contextual information	No	While previous surveys in the vicinity of the Study Area are relatively limited, a sufficient number of survey and assessment reports (*n = 6*), in combination with four database searches, provided sufficient contextual data for the survey.
Competency/ experience of the survey team	No	Senior Zoologists Verity Steptoe and Gina Barnett undertook the basic fauna survey and habitat assessments. Both team members possess over 15 years survey experience, including within the Murchison region.
Scope (faunal groups sampled and whether any constraints affect this)	No	The scope was a basic level vertebrate fauna survey with targeted sampling components, which was conducted within the EPA (2020) framework.
Timing, weather, and season	No	Field surveys occurred over appropriate or optimal periods for sampling the vertebrate habitat. No weather or seasonality constraints or limitations were identified during the survey which are likely to have influenced the likelihood of occurrence assessment of any significant species.
Disturbances (e.g. fire or flood)	No	No disturbance occurred during or immediately prior to the surveys that was likely to impinge on the results of this assessment.
Proportion of fauna identified	No	All fauna observed during the field surveys were identified to species level. Species identification of fauna recorded via camera traps and ultrasonic recorders were able to be accurately identified with a total of 62 species identified for the Study Area during the survey.
Adequacy of the survey intensity and proportion of the survey achieved	No	A basic survey was undertaken across the Study Area to assist with decisions on future survey effort and environmental approvals.
Remoteness or access issues	No	The Study Area was accessible either by vehicle or on foot, thus the sampling techniques used in these areas during this survey were unconstrained by accessibility or remoteness.
Problems with data and analysis, including sampling bias	No	No limitations with data collection and/or analysis were encountered during the field survey or during subsequent analysis.

6 CONCLUSION

Six broad fauna habitats were identified and mapped within the Study Area, comprising, in order of extent, Rocky Hill (51.11%, 313.29 ha), Sandy Plain (30.88%, 189.29 ha), Stony Plain (9.68%, 59.36 ha), Rocky Outcrop/ Breakaway (2.69%, 16.51 ha), and Minor Drainage Line (2.06%, 12.63 ha). The remaining 3.57% (21.89 ha) of the Study Area comprised Cleared/ Disturbed areas, with disturbance largely attributed to previous mining operations.

Of the five fauna habitats mapped within the Study Area, Rocky outcrop/ Breakaway and Sandy Plain were deemed to be of Moderate significance, as they provide critical habitat for a number of significant species, including long-tailed dunnart and peregrine falcon within Rocky Outcrop/ Breakaway habitat and brush-tailed mulgara within Sand Plain habitat. While both habitats deemed to be of moderate significance occur more broadly throughout the Murchison bioregion, their occurrence and extent are often sporadically distributed, they provide important connectivity between occurrences of the habitat within and beyond the Study Area. c

A total of 222 vertebrate fauna species were identified in the desktop assessment as potentially occurring within the Study Area, including 28 mammals (19 native and nine introduced), 144 birds, 46 reptiles and four amphibians (Biologic, 2022b). Of these, 18 significant species with the potential to occur within the Study Area were identified, including four mammals, 13 birds, and one reptile. Of the 18 significant species identified in the desktop assessment, one has previously been recorded within the Study Area, peregrine falcon.

A total of 65 vertebrate species were recorded during the current survey, including one significant species, (peregrine falcon). The species has also been recorded during a previous survey undertaken within the Study Area, (Biologic, 2012). Based on previous observations of nesting occurring within the Study Area (Biologic, 2012), it is likely the species occurs as a resident within the Study Area. Of the remaining 17 significant species potentially occurring within the Study Area, one species was assessed as being Highly Likely to occur in the Study Area (long-tailed dunnart) and a further two species were assessed as possibility occurring (brush-tailed mulgara and grey falcon).

Additional detailed and/or targeted sampling, in line with EPA (2020), are likely to provide additional supporting information on the occurrence of vertebrate fauna species and assemblages within the Study Area, particularly significant species. Given the cryptic nature of many significant species deemed Highly Likely or Possible to occur within the Study Area, further species specific targeted sampling could be undertaken to further refine the known occurrence, distribution, abundance and habitat use in the Study Area.

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8 APPENDICIES

Appendix A – Conservation Codes

Environment Protection and Biodiversity Conservation Act 1999

Category	Definition
Threatened Ecological Communities (TEC)	
Critically Endangered	An ecological community is eligible to be included in the critically endangered category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
Endangered	An ecological community is eligible to be included in the endangered category at a particular time if, at that time: (a) it is not critically endangered; and (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
Vulnerable	An ecological community is eligible to be included in the vulnerable category at a particular time if, at that time: (a) it is not critically endangered nor endangered; and (b) it is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.
Threatened Fauna Species	
Extinct (EX)	Taxa not definitely located in the wild during the past 50 years.
Extinct in the Wild (EW)	Taxa known to survive only in captivity.
Critically Endangered (CE)	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 future.
Migratory (MIG)	Consists of species listed under the following International Conventions: Japan-Australia Migratory Bird Agreement (JAMBA) China-Australia Migratory Bird Agreement (CAMBA) Convention on the Conservation of Migratory Species of Wild animals (Bonn Convention)

Biodiversity Conservation Act 2016

Category	Definition
Threatened Ecological Communities (TEC)	
Critically Endangered (CR)	An ecological community is eligible for listing in the category of critically endangered ecological community at a particular time if, at that time — (a) it is facing an extremely high risk of becoming eligible for listing as a collapsed ecological community in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines; and (b) listing in that category is otherwise in accordance with the ministerial guidelines.
Endangered (EN)	An ecological community is eligible for listing in the category of endangered ecological community at a particular time if, at that time — (a) it is not a critically endangered ecological community; and (b) it is facing a very high risk of becoming eligible for listing as a collapsed ecological community in the near future, as determined in accordance with criteria set out in the ministerial guidelines; and (c) listing in that category is otherwise in accordance with the ministerial guidelines.
Vulnerable (VU)	An ecological community is eligible for listing in the category of vulnerable ecological community at a particular time if, at that time — (a) it is not a critically endangered ecological community or an endangered ecological community; and (b) it is facing a high risk of becoming eligible for listing as a collapsed ecological community in the medium-term future, as determined in accordance with criteria set out in the ministerial guidelines; and (c) listing in that category is otherwise in accordance with the ministerial guidelines.
Collapsed	An ecological community is eligible for listing as a collapsed ecological community at a particular time if, at that time — (a) there is no reasonable doubt that the last occurrence of the ecological community has collapsed; or (b) the ecological community has been so extensively modified throughout its range that no occurrence of it is likely to recover — (i) its species composition or structure; or (ii) its species composition and structure.
Threatened Fauna Species	
Critically Endangered (Cr)	Rare or likely to become extinct, as *critically endangered* fauna.
Endangered (En)	Rare or likely to become extinct, as *endangered* fauna.
Vulnerable (Vu)	Rare or likely to become extinct, as *vulnerable* fauna.

Category	Definition
Extinct (Ex)	Being fauna that is presumed to be extinct.
Migratory (Mi)	Birds that are subject to international agreements relating to the protection of migratory birds.
Conservation Dependent (CD)	Special conservation need being species dependent on ongoing conservation intervention. (Conservation Dependant)
Other Specially Protected Species (OS)	In need of special protection, otherwise than for the reasons pertaining to Schedule 1 through to Schedule 6 Fauna. (Other specially protected species

Department of Biodiversity, Conservation and Attractions Priority Definitions

Category	Definition
Priority Fauna Species	
Priority 1 (P1)	**Poorly known Species** Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.
Priority 2 (P2)	**Poorly known Species** Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.
Priority 3 (P3)	**Poorly known Species** Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.
Priority 4 (P4)	**Rare, Near Threatened and other species in need of monitoring** (a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands. (b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for vulnerable but are not listed as Conservation Dependent. (c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

Category	Definition
Priority Ecological Communities (PEC)	
Priority 1 (P1)	**Poorly known ecological communities** Ecological communities that are known from very few occurrences with a very restricted distribution (generally ≤5 occurrences or a total area of ≤ 100ha). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist. May include communities with occurrences on protected lands. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.
Priority 2 (P2)	**Poorly known Ecological Communities** Communities that are known from few occurrences with a restricted distribution (generally ≤10 occurrences or a total area of ≤200ha). At least some occurrences are not believed to be under immediate threat (within approximately 10 years) of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.
Priority 3 (P3)	**Poorly known Ecological Communities** (i) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or: (ii) communities known from a few widespread occurrences, which are either large or with significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat (within approximately 10 years), or; (iii) communities made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, inappropriate fire regimes, clearing, hydrological change etc. Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.

Category	Definition
Priority 4 (P4)	**Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring.** (i) Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands. (ii) Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for a higher threat category. (iii) Ecological communities that have been removed from the list of threatened communities during the past five years.
Priority 5 (P5)	**Conservation Dependent Ecological Communities** Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

Appendix B – Vertebrate Fauna Identified from the Desktop Assessment

Species		Conservation Status				Database review				Literature review					Current survey
Scientific Name	Common Name	EPBC Act	BC Act	DBCA	IUCN	DBCA (2022a)	DCCEEW (2022)	DBCA (2022d)	Birdlife Australia (2022)	ecologia (2007)Assessment ecologia 2009	MBS Environmental (2005)	MBS Environmental (2005)	Western Wildlife (2006)	Biologic (2012)	
MAMMALS															
BOVIDAE															
Bos taurus	*European cattle					X								X	X
Capra hircus	*Goat					X	X			X		X	X	X	X
CAMELIDAE															
Camelus dromedarius	*Camel													X	X
CANIDAE															
Canis familiaris	*Dog						X			X				X	X
Vulpes vulpes	*Red fox						X					X			X
DASYURIDAE															
Dasycercus blythi	Brush-tailed mulgara			P4				X							
Pseudantechinus woolleyae	Woolley's pseudantechinus					X				X			X	X	X
Sminthopsis longicaudata	Long-tailed dunnart			P4		X		X		X		X			
Sminthopsis macroura	Stripe-faced dunnart					X				X			X	X	
EMBALLONURIDAE															
Taphozous hilli	Hill's sheath-tailed bat									X			X	X	X
EQUIDAE															
Equus asinus	*Donkey						X								
FELIDAE															
Felis catus	*Cat					X	X			X		X		X	X
LEPORIDAE															
Oryctolagus cuniculus	*Rabbit						X					X	X	X	
MACROPODIDAE															
Osphranter robustus	Euro					X				X		X	X	X	X
Osphranter rufus	Red kangaroo					X						X	X	X	X
MOLOSSIDAE															
Austronomus australis	White-striped free-tailed bat					X						X	X	X	X
Ozimops petersi	Inland free-tailed bat													X	X
MURIDAE															
Mus musculus	*House mouse					X	X			X		X		X	
Notomys alexis	Spinifex hopping-mouse					X				X		X	X	X	
Pseudomys chapmani	Western pebble-mound mouse			P4				X							
Pseudomys hermannsburgensis	Sandy inland mouse					X				X		X		X	X
TACHYGLOSSIDAE															
Tachyglossus aculeatus	Short-beaked echidna					X				X		X		X	X
THYLACOMYIDAE															
Macrotis lagotis	Bilby	VU	VU		VU			X							
VESPERTILIONIDAE															

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Chalinolobus gouldii	Gould's wattled bat									X			X	X	X
Nyctophilus geoffroyi	Lesser long-eared bat									X			X	X	
Scotorepens balstoni	Inland broad-nosed bat					X				X			X	X	
Scotorepens greyii	Little broad-nosed bat									X		X		X	
Vespadelus finlaysoni	Finlayson's cave bat									X		X	X	X	X
BIRDS															
ACANTHIZIDAE															
Acanthiza apicalis	Inland thornbill					X			X	X			X		
Acanthiza chrysorrhoa	Yellow-rumped thornbill					X			X	X	X	X	X	X	
Acanthiza robustirostris	Slaty-backed thornbill					X			X	X	X			X	
Acanthiza uropygialis	Chestnut-rumped thornbill					X			X	X		X	X	X	
Aphelocephala leucopsis	Southern whiteface					X			X	X	X		X	X	X
Aphelocephala nigricincta	Banded whiteface					X									
Gerygone fusca	Western gerygone					X			X	X	X	X		X	
Pyrrholaemus brunneus	Redthroat					X			X	X		X		X	X
Smicrornis brevirostris	Weebill					X			X		X			X	
ACCIPITRIDAE															
Accipiter cirrocephalus	Collared sparrowhawk					X			X	X				X	
Accipiter fasciatus	Brown goshawk					X			X	X	X	X	X	X	
Aquila audax	Wedge-tailed eagle					X			X	X		X	X	X	X
Circus assimilis	Spotted harrier					X			X		X			X	
Elanus axillaris	Black-shouldered kite					X			X	X					
Haliastur sphenurus	Whistling kite					X			X	X			X	X	
Hamirostra melanosternon	Black-breasted buzzard					X			X	X		X			
Milvus migrans	Black kite					X									
AEGOTHELIDAE															
Aegotheles cristatus	Australian owlet-nightjar					X			X	X	X		X	X	X
ALCEDINIDAE															
Todiramphus pyrrhopygius	Red-backed kingfisher					X			X	X	X	X	X	X	X
Todiramphus sanctus	Sacred kingfisher					X			X					X	
ANATIDAE															
Anas gracilis	Grey teal					X			X					X	
Anas superciliosa	Pacific black duck					X			X					X	
Aythya australis	Hardhead					X									
Biziura lobata	Musk duck					X			X						
Chenonetta jubata	Australian wood duck					X			X					X	
Cygnus atratus	Black swan					X			X					X	
Dendrocygna eytoni	Plumed whistling-duck													X	

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Malacorhynchus membranaceus	Pink-eared duck					X									
Tadorna tadornoides	Australian shelduck					X			X						
ANHINGIDAE															
Anhinga novaehollandiae	Australiasian darter					X			X					X	
ARDEIDAE															
Ardea alba	Great egret					X			X						
Egretta novaehollandiae	White-faced heron					X			X					X	
Ardea pacifica	White-necked heron					X			X						
Artamus cinereus	Black-faced woodswallow					X			X	X	X	X	X	X	X
Artamus minor	Little woodswallow					X			X	X	X	X	X	X	X
Artamus personatus	Masked woodswallow					X			X					X	X
Cracticus nigrogularis	Pied butcherbird					X			X	X	X	X	X	X	X
Gymnorhina tibicen	Australian magpie					X			X	X		X		X	
Cracticus torquatus	Grey butcherbird					X			X	X	X	X	X	X	X
BURHINIDAE															
Burhinus grallarius	Bush stone-curlew					X			X			X	X	X	X
CACATUIDAE															
Eolophus roseicapilla	Galah					X			X	X	X	X	X	X	
Cacatua sanguinea	Little corella					X			X	X				X	
Calyptorhynchus banksii	Red-tailed black cockatoo					X			X						
Lophochroa leadbeateri	Major Mitchell's cockatoo					X			X						
Nymphicus hollandicus	Cockatiel					X			X		X			X	
CAMPEPHAGIDAE															
Coracina maxima	Ground cuckoo-shrike					X			X	X					
Coracina novaehollandiae	Black-faced cuckoo-shrike					X			X	X	X	X	X	X	X
Lalage tricolor	White-winged triller					X			X	X	X		X	X	X
CAPRIMULGIDAE															
Eurostopodus argus	Spotted nightjar					X			X	X		X	X	X	X
CASUARIIDAE															
Dromaius novaehollandiae	Emu					X			X	X	X	X	X	X	
CHARADRIIDAE															
Charadrius ruficapillus	Red-capped plover					X			X						
Charadrius veredus	Oriental plover	MI	MI				X								
Elseyornis melanops	Black-fronted dotterel					X			X					X	
Erythrogonys cinctus	Red-kneed dotterel					X			X						
Vanellus tricolor	Banded lapwing					X			X					X	
CINCLOSOMATIDAE															
Cinclosoma castaneothorax	Chestnut-breasted quail-thrush					X			X	X	X	X	X	X	

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COLUMBIDAE															
Geopelia cuneata	Diamond dove					X			X	X	X	x	X	X	X
Geopelia placida	Peaceful dove					X			X					X	
Ocyphaps lophotes	Crested pigeon					X			X	X	X	X	X	X	X
Phaps chalcoptera	Common bronzewing					X			X	X		X	X	X	X
CORVIDAE															
Corvus bennetti	Little crow					X			X	X	X		X	X	
Corvus orru	Torresian crow					X			X	X		X	X	X	X
CUCULIDAE															
Heteroscenes pallidus	Pallid cuckoo					X			X			X		X	
Chalcites basalis	Horsfield's bronze-cuckoo					X			X	X	X	X	X	X	X
Chalcites osculans	Black-eared cuckoo						X		X						
DICAEIDAE															
Dicaeum hirundinaceum	Mistletoebird					X			X		X			X	
ESTRILDIDAE															
Emblema pictum	Painted finch					X				X				X	X
Taeniopygia guttata	Dragon finch					X			X	X	X	X	X	X	
FALCONIDAE															
Falco berigora	Brown falcon					X			X	X	X		X	X	X
Falco cenchroides	Nankeen kestrel					X			X	X	X	X	X	X	X
Falco hypoleucos	Grey falcon	VU	VU		VU	X	X	X							
Falco longipennis	Australian hobby					X			X				X	X	
Falco peregrinus	Peregrine falcon		OS			X		X	X				X	X	X
HIRUNDINIDAE															
Cheramoeca leucosterna	White-backed swallow											X			
Hirundo neoxena	Welcome swallow					X			X				X	X	
Petrochelidon ariel	Fairy martin					X									
Petrochelidon nigricans	Tree martin					X			X			X	X	X	
LARIDAE															
Gelochelidon nilotica	Gull-billed tern	MI	MI					X							
Chlidonias hybrida	Whiskered tern								X						
LOCUSTELLIDAE															
Cincloramphus cruralis	Brown songlark					X			X				x	X	
Cincloramphus mathewsi	Rufous songlark					X			X	X	X			X	
MALURIDAE															
Malurus lamberti	Variegated fairy-wren					X			X	X				X	X
Malurus leucopterus	White-winged fairy-wren					X			X					X	
Malurus splendens	Splendid fairy-wren					X			X	X		X	X	X	X

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MELIPHAGIDAE															
Acanthagenys rufogularis	Spiny-cheeked honeyeater					X			X	X	X	X	X	X	X
Certhionyx variegatus	Pied honeyeater					X			X						X
Epthianura albifrons	White-fronted chat								X						
Epthianura tricolor	Crimson chat					X			X	X			X	X	X
Gavicalis virescens	Singing honeyeater					X			X	X	X	X	X	X	X
Lichmera indistincta	Brown honeyeater					X			X		X	X			
Manorina flavigula	Yellow-throated miner					X			X	X	X	X	X	X	X
Ptilotula penicillata	White-plumed honeyeater					X			X	X			X	X	
Purnella albifrons	White-fronted honeyeater					X				X					
Sugomel nigrum	Black honeyeater					X									
MEROPIDAE															
Merops ornatus	Rainbow bee-eater					X	X		X	X	X			X	
MONARCHIDAE															
Grallina cyanoleuca	Magpie-lark					X			X	X				X	X
MOTACILLIDAE															
Anthus novaeseelandiae	Australian pipit					X			X	X	X	X	X	X	X
Motacilla cinerea	Grey wagtail	MI	MI				X								
Motacilla flava	Yellow wagtail	MI	MI				X								
NEOSITTIDAE															
Daphoenositta chrysoptera	Varied sittella					X			X	X	X	X	X		
OREOICIDAE															
Oreoica gutturalis	Crested bellbird					X			X	X	X	X	X	X	X
OTIDIDAE															
Ardeotis australis	Australian bustard					X			X					X	
PACHYCEPHALIDAE															
Colluricincla harmonica	Grey shrike-thrush					X			X	X	X	X	X	X	
Pachycephala rufiventris	Rufous whistler					X			X	X	X	X	X	X	
PARDALOTIDAE															
Pardalotus rubricatus	Red-browed pardalote					X			X					X	
Pardalotus striatus	Striated pardalote					X							X	X	
PELECANIDAE															
Pelecanus conspicillatus	Australian pelican					X			X					X	
PETROICIDAE															
Melanodryas cucullata	Hooded robin					X			X	X					
Microeca fascinans	Jacky winter												X		
Petroica goodenovii	Red-capped robin					X			X	X	X	X	X	X	
PHALACROCORACIDAE															

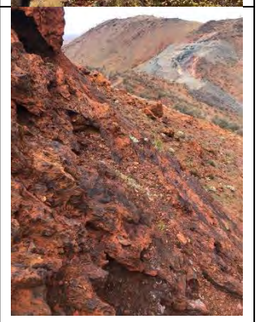
Species		Conservation Status				Database review				Literature review					Current survey
Scientific Name	Common Name	EPBC Act	BC Act	DBCA	IUCN	DBCA (2022a)	DCCEEW (2022)	DBCA (2022d)	Birdlife Australia (2022)	ecologia (2007)Assessment ecologia 2009	MBS Environmental (2005)	MBS Environmental (2005)	Western Wildlife (2006)	Biologic (2012)	
Microcarbo melanoleucos	Little pied cormorant					X			X						
Phalacrocorax sulcirostris	Little black cormorant					X			X					X	
PHASIANIDAE															
Coturnix pectoralis	Stubble quail								X					X	
PODARGIDAE															
Podargus strigoides	Tawny frogmouth					X			X	X	X				
PODICIPEDIDAE															
Poliocephalus poliocephalus	Hoary-headed grebe					X			X						
Tachybaptus novaehollandiae	Australasian grebe					X			X						
POMATOSTOMIDAE															
Pomatostomus superciliosus	White-browed babbler					X			X	X			X	X	
Pomatostomus temporalis	Grey-crowned babbler					X			X	X	X	X	X	X	X
PSITTACIDAE															
Barnardius zonarius	Australian ringneck					X			X	X			X	X	
Melopsittacus undulatus	Budgerigar					X			X	X	X		X	X	X
Neopsephotus bourkii	Bourke's parrot					X			X		X	X	X	X	
Pezoporus occidentalis	Night parrot	EN	CR		EN		X								
Platycercus icterotis	Western rosella					X									
Psephotus varius	Mulga parrot								X	X	X	X	X	X	
PSOPHODIDAE															
Psophodes occidentalis	Chiming wedgebill					X			X	X		X			
PTILINORHYNCHIDAE															
Chlamydera guttata	Western bowerbird					X			X	X		X	X	X	
RALLIDAE															
Fulica atra	Eurasian coot					X			X						
Tribonyx ventralis	Black-tailed native-hen					X			X						
RECURVIROSTRIDAE															
Cladorhynchus leucocephalus	Banded stilt								X						
Himantopus himantopus	Black-winged stilt					X			X						
RHIPIDURIDAE															
Rhipidura albiscapa	Grey fantail					X			X						
Rhipidura leucophrys	Willie wagtail					X			X	X	X	X	X	X	X
ROSTRATULIDAE															
Rostratula australis	Australian painted snipe	EN	EN		EN		X								
SCOLOPACIDAE															
Calidris acuminata	Sharp-tailed sandpiper	MI	MI				X								
Calidris ferruginea	Curlew sandpiper	CR/MI	CR/MI		NT		X								
Calidris melanotos	Pectoral sandpiper	MI	MI				X								

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Tringa glareola	Wood sandpiper	MI	MI					X							
Actitis hypoleucos	Common sandpiper	MI	MI				X								
STRIGIDAE															
Ninox boobook	Boobook owl					X			X					X	
THRESKIORNITHIDAE															
Platalea flavipes	Yellow-billed spoonbill					X			X						
Threskiornis moluccus	Australian white ibis					X			X						
Threskiornis spinicollis	Straw-necked ibis					X			X					X	
TURNICIDAE															
Turnix velox	Little button-quail					X			X	X				X	X
TYTONIDAE															
Tyto javanica	Eastern barn owl								X	X					
REPTILES															
AGAMIDAE															
Ctenophorus caudicinctus	Western ring-tailed dragon					X				X	X	X	X	X	
Ctenophorus nuchalis	Central netted dragon					X				X	X	X	X	X	
Ctenophorus reticulatus	Western netted dragon					X					X	X	X	X	
Ctenophorus scutulatus						X							X	X	
Gowidon longirostris	Long-nosed dragon					X				X	X	X	X	X	
Pogona minor	Western bearded dragon					X				X		X	X	X	
Tympanocryptis pseudocephos	Goldfield's pebble-mimic dragons				DD	X							X		
CARPHODACTYLIDAE															
Nephrurus vertebralis						X								X	
CHELIDAE															
Chelodina steindachneri	Flat-shelled turtle					X									
DIPLODACTYLIDAE															
Diplodactylus conspicillatus	Variable fat-tailed gecko					X							X		
Diplodactylus pulcher												X	X		
Lucasium stenodactylus	Western sandplain gecko					X				X	X	X	X	X	
Oedura fimbria	Western marbled velvet gecko									X		X	X		
Rhynchoedura ornata	Western beaked gecko					X						X	X	X	
Strophurus strophurus						X						X	X		
ELAPIDAE															
Brachyurophis approximans													X		
Demansia psammophis	Yellow-faced whipsnake									X				X	
Simoselaps bertholdi	Jan's banded snake					X								X	

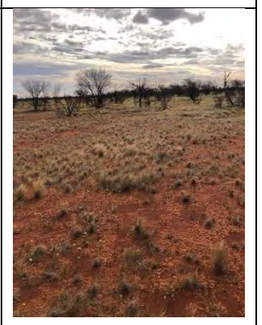
Species		Conservation Status				Database review				Literature review					Current survey
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GEKKONIDAE															
Gehyra polka						X				X		X	X	X	X
Gehyra purpurascens						X									
Gehyra variegata	Variegated gehyra					X				X	X	X	X	X	
Heteronotia binoei	Bynoe's gecko					X				X		X	X	X	
PYGOPODIDAE															
Delma butleri						X						X	X		
Delma tincta						X								X	
Pygopus nigriceps										X					
PYTHONIDAE															
Antaresia perthensis	Pygmy python					X				X		X	X	X	
SCINCIDAE															
Cryptoblepharus buchananii											X				
Ctenotus leonhardii						X						X	X	X	
Ctenotus schomburgkii						X						X	X	X	
Ctenotus severus						X				X		X	X	X	
Cyclodomorphus melanops						X				X		X	X		
Egernia depressa	Southern pygmy spiny-tailed skink					X				X				X	
Egernia stokesii badia		EN	VU					X							
Eremiascincus richardsonii	Broad-banded sand swimmer					X							X	X	
Lerista macropisthopus										X					
Lerista muelleri						X									
Lerista nicholsi						X									
Lerista timida						X				X		X	X	X	
Menetia greyii						X				X		X	X	X	
TYPHLOPIDAE															
Anilios grypus						X								X	
Anilios hamatus										X			X		
VARANIDAE															
Varanus caudolineatus						X						X		X	
Varanus giganteus	Perentie									X			X		
Varanus gouldii	Bungarra or sand goanna									X			X		
Varanus panoptes						X				X	X	X		X	
Varanus tristis	Racehorse goanna					X				X		X	X	X	
AMPHIBIANS															
LIMNODYNASTIDAE															
Platyplectrum spenceri	Centralian burrowing frog											X			
PELODRYADIDAE															

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Cyclorana maini	Sheep frog											X			
Cyclorana occidentalis	Western water-holding frog											X			
Litoria rubella	Little red tree frog											X		X	

Appendix C – Vertebrate Fauna Habitat Assessments

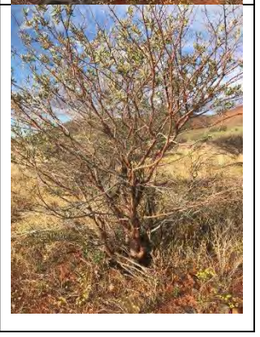
Site	Latitude	Longitude	Habitat type	Landform	Aspect	Slope	Soil type	Soil available	Outcrop	Rock size	Vegetation litter	Woody debris	Vegetation type	Rocky cracks crevices	Burrow suitable	Water present	Last fire	Disturbances	Hab. cond	Photo
VGOU-01	-25.8027	117.3436	Rocky Hill	Ironstone Outcrops	South/ West	Moderate	Silty Clay Loam	Scarce	Minor Outcropping	Large Rocks (21-60cm)	Few Small Patches	Few Small Patches	Mulga Woodland	Moderate	Low	None	Old (6+ yr)	Road/ Access Track Mining Exploration Weed Invasion	0.6	
VGOU-02	-25.7954	117.3421	Rocky Outcrop/ Breakaway	Hillcrest/ Upper Hillslope	South/ West	Steep	Silty Clay Loam	Scarce	Moderate Outcropping	Boulders (>61cm)	Scarce	None Discernible		Very High	Nil	None	Old (6+ yr)	Road/ Access Track Mining Exploration	0.6	
VGOU-03	-25.7965	117.3429	Rocky Hill	Ironstone Outcrops	South/ West	Steep	Silty Clay Loam	Scarce	Major Outcropping	Large Rocks (21-60cm)	Many Small Patches	Few Small Patches	Spinifex Hummock Grassland	Very High	Nil	None	Old (6+ yr)	Road/ Access Track Mining Exploration	0.6	
VGOU-04	-25.7945	117.3403	Rocky Outcrop/ Breakaway	Ironstone Outcrops	South/ East	Moderate	Clay Loam	Scarce	Extensive Outcropping	Large Rocks (21-60cm)	Many Small Patches	Few Small Patches	Scattered Shrubs	Very High	Nil	None	Old (6+ yr)	Mining Exploration Road/ Access Track	0.6	

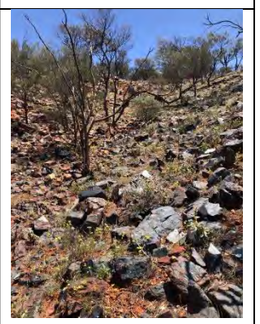
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VGOU-05	-25.7983	117.3433	Rocky Hill	Boulders/ Rockpiles	South/ West	Steep	Silty Clay Loam	Scarce	Major Outcropping	Large Rocks (21-60cm)	Many Small Patches	Few Large Patches	Mulga Woodland	Very High	Nil	None	Old (6+ yr)	Road/ Access Track Mining Exploration	0.6	
VGOU-06	-25.7939	117.3392	Rocky Hill	Boulders/ Rockpiles	South/ West	Moderate	Clay Loam	Scarce	Moderate Outcropping	Large Rocks (21-60cm)	Many Small Patches	Few Small Patches	Mulga Woodland	Moderate	Nil	None	Old (6+ yr)	Mining Exploration Road/ Access Track	0.6	
VGOU-07	-25.7902	117.3378	Rocky Outcrop/ Breakaway	Hillcrest/ Upper Hillslope	West	Low	Sandy Clay Loam	Few Small Patches	Moderate Outcropping	Small Rocks (11-20cm)	Few Small Patches	Scarce	Scattered Shrubs	Moderate	Nil	None	Old (6+ yr)	None Discernible	0.8	
VGOU-08	-25.7846	117.3354	Stony Plain	Stony Plain	Flat	Flat	Silty Clay Loam	Evenly Spread	Negligible	Pebbles (5-10cm)	Many Small Patches	Few Small Patches	Scattered Shrubs	Nil	High	None	Old (6+ yr)	Mining Exploration Road/ Access Track	0.6	
VGOU-09	-25.7846	117.3363	Minor Drainage Line	Stony Plain	Flat	Flat	Sandy Loam	Evenly Spread	Negligible	Small Rocks (11-20cm)	Many Small Patches	Few Small Patches	Mulga Woodland	Nil	High	Prone to Flooding	Old (6+ yr)	Road/ Access Track	0.6	

Site	Latitude	Longitude	Habitat type	Landform	Aspect	Slope	Soil type	Soil available	Outcrop	Rock size	Vegetation litter	Woody debris	Vegetation type	Rocky cracks crevices	Burrow suitable	Water present	Last fire	Disturbances	Hab. cond	Photo
VGOU-10	-25.7971	117.3262	Sandy Plain	Sandy/ Stony Plain	Flat	Flat	Clay Loam Sandy	Evenly Spread	Negligible	Negligible	Many Small Patches	Few Small Patches	Mulga Woodland	Nil	High	None	Old (6+ yr)	Road/ Access Track Mining Exploration	0.6	
VGOU-11	-25.8010	117.3252	Sandy Plain	Sandy/ Stony Plain	Flat	Flat	Sandy Clay Loam	Evenly Spread	Negligible	Negligible	Evenly Spread	Many Small Patches	Spinifex Hummock Grassland	Nil	High	None	Old (6+ yr)	Road/ Access Track Mining Exploration	0.6	
VGOU-12	-25.8085	117.3275	Sandy Plain	Sandy/ Stony Plain	Flat	Flat	Sandy Clay Loam	Evenly Spread	Negligible	Negligible	Evenly Spread	Many Small Patches	Mulga Woodland	Nil	Very High	None	Old (6+ yr)	Road/ Access Track	0.4	
VGOU-13	-25.8073	117.3282	Sandy Plain	Sandy/ Stony Plain	Flat	Flat	Clay Loam Sandy	Evenly Spread	Negligible	Negligible	Evenly Spread	Few Large Patches	Mulga Woodland, Spinifex Hummock Grassland	Nil	Moderate	None	Old (6+ yr)	Road/ Access Track	0.6	
VGOU-14	-25.8027	117.3291	Sandy Plain	Sandy/ Stony Plain	Flat	Flat	Sandy Clay Loam	Evenly Spread	Negligible	Gravel (1-4cm)	Many Small Patches	Many Small Patches	Spinifex Hummock Grassland, Scattered Shrubs	Nil	Moderate	None	Old (6+ yr)	Road/ Access Track	0.6	
VGOU-15	-25.8041	117.3413	Rocky Hill	Hillslope	East	Steep	Sandy Clay Loam	Few Small Patches	Moderate Outcropping	Large Rocks (21-60cm)	Scarce	Few Small Patches		High	Low	None	Old (6+ yr)	Feral herbivores	0.8	

Site	Latitude	Longitude	Habitat type	Landform	Aspect	Slope	Soil type	Soil available	Outcrop	Rock size	Vegetation litter	Woody debris	Vegetation type	Rocky cracks crevices	Burrow suitable	Water present	Last fire	Disturbances	Hab. cond	Photo
VGOU-16	-25.8049	117.3413	Rocky Hill	Hillslope	East	Steep	Sandy Clay Loam	Scarce	Moderate Outcropping	Large Rocks (21-60cm)	Few Small Patches	Many Small Patches		High	Nil	None	Old (6+ yr)	Feral herbivores	0.8	
VGOU-17	-25.8056	117.3385	Rocky Hill	Hillslope	South	Very Steep	Sandy Clay Loam	Scarce	Moderate Outcropping	Large Rocks (21-60cm)	Many Small Patches	Many Small Patches		High	Low	None	Old (6+ yr)	Feral herbivores	0.8	
VGOU-18	-25.8042	117.3363	Rocky Hill	Hillslope	West	Very Steep	Sandy Clay Loam	Many Small Patches	Moderate Outcropping	Large Rocks (21-60cm)	Scarce	Scarce		High	Nil	None	Moderate (3 to 5 yr)	Feral herbivores	0.6	
VGOU-19	-25.8038	117.3370	Rocky Hill	Hillslope	North/ West	Steep	Silty Loam	Scarce	Moderate Outcropping	Large Rocks (21-60cm)	Evenly Spread	Many Small Patches	Spinifex Hummock Grassland, Tussock Grassland	Very High	Nil	None	Old (6+ yr)	Rubbish/ Litter Mining Exploration	0.6	
VGOU-20	-25.8016	117.3365	Rocky Hill	Hillcrest/ Upper Hillslope	West	Very Steep	Sandy Clay Loam	Many Small Patches	Minor Outcropping	Large Rocks (21-60cm)	Few Small Patches	Few Small Patches		High	Low	None	Old (6+ yr)	Mining Exploration Feral herbivores	0.6	
VGOU-21	-25.8011	117.3362	Rocky Outcrop/ Breakaway	Hillslope	North/ West	Very Steep	Clay Loam	None Discernible	Moderate Outcropping	Large Rocks (21-60cm)	Evenly Spread	Many Small Patches	Tussock Grassland, Spinifex Hummock Grassland	Very High	Nil	None	Old (6+ yr)	Mining Exploration	0.6	

Site	Latitude	Longitude	Habitat type	Landform	Aspect	Slope	Soil type	Soil available	Outcrop	Rock size	Vegetation litter	Woody debris	Vegetation type	Rocky cracks crevices	Burrow suitable	Water present	Last fire	Disturbances	Hab. cond	Photo
VGOU-22	-25.8088	117.3378	Rocky Hill	Footslope	South	Low	Silty Loam	Many Small Patches	Negligible	Small Rocks (11-20cm)	Many Small Patches	Few Small Patches		Nil	Moderate	None	Old (6+ yr)	Rubbish/ Litter Weed Invasion Mining Exploration Feral herbivores	0.6	
VGOU-23	-25.8054	117.3448	Minor Drainage Line	Medium Drainage Line	South	Low	Sandy Loam	Few Large Patches	Limited Outcropping	Small Rocks (11-20cm)	Few Small Patches	Scarce		Nil	Moderate	Prone to Flooding	Old (6+ yr)	Weed Invasion Drain to old dam	0.1	
VGOU-24	-25.8016	117.3384	Rocky Hill	Hillslope	South/ East	Moderate	Silty Clay Loam	Scarce	Minor Outcropping	Small Rocks (11-20cm)	Evenly Spread	Few Small Patches	Spinifex Hummock Grassland	High	Nil	None	Old (6+ yr)	Mining Exploration Road/ Access Track	0.6	
VGOU-25	-25.8014	117.3404	Rocky Hill	Hillslope	North/ East	Moderate	Silty Clay Loam	Many Small Patches	Limited Outcropping	Large Rocks (21-60cm)	Evenly Spread	Many Small Patches	Spinifex Hummock Grassland	High	Low	None	Old (6+ yr)	Mining Exploration Road/ Access Track	0.4	
VGOU-26	-25.8016	117.3409	Rocky Hill	Hillslope	North/ East	Low	Silty Clay Loam	Scarce	Limited Outcropping	Small Rocks (11-20cm)	Evenly Spread	Many Small Patches		High	Nil	None	Old (6+ yr)	Mining Exploration Road/ Access Track	0.4	
VGOU-27	-25.8019	117.3413	Rocky Hill	Hillslope	North/ East	Low	Silty Clay Loam	Few Small Patches	Limited Outcropping	Small Rocks (11-20cm)	Evenly Spread	Many Small Patches	Spinifex Hummock Grassland	Moderate	Low	None	Old (6+ yr)	Mining Exploration Road/ Access Track	0.6	

Site	Latitude	Longitude	Habitat type	Landform	Aspect	Slope	Soil type	Soil available	Outcrop	Rock size	Vegetation litter	Woody debris	Vegetation type	Rocky cracks crevices	Burrow suitable	Water present	Last fire	Disturbances	Hab. cond	Photo
VGOU-28	-25.8081	117.3416	Minor Drainage Line	Footslope	South	Low	Clay Loam	Few Small Patches	Negligible	Small Rocks (11-20cm)	Evenly Spread	Evenly Spread	Mulga Woodland	Moderate	Nil	None	Old (6+ yr)	None Discernible	0.6	
VGOU-29	-25.8080	117.3419	Rocky Hill	Footslope	South	Low	Clay Loam	Few Small Patches	Negligible	Pebbles (5-10cm)	Evenly Spread	Evenly Spread	Mulga Woodland	Low	Nil	None	Old (6+ yr)	None Discernible	0.6	
VGOU-30	-25.8008	117.3276	Sandy Plain	Sand Plain	West	Flat	Sandy Loam	Evenly Spread	Negligible	Negligible	Few Small Patches	Many Small Patches		Nil	Very High	None	Old (6+ yr)	Cattle Grazing Mining Exploration	0.6	
VGOU-31	-25.8085	117.3291	Sandy Plain	Sand Plain	North/ West	Flat	Sandy Loam	Evenly Spread	Negligible	Negligible	Many Small Patches	Many Small Patches		Nil	High	None	Old (6+ yr)	Cattle Grazing Weed Invasion Feral animals	0.6	
VGOU-32	-25.8044	117.3299	Rocky Hill	Footslope	West	Low	Sandy Loam	Evenly Spread	Limited Outcropping	Small Rocks (11-20cm)	Few Small Patches	Few Small Patches		Nil	Moderate	None	Old (6+ yr)	Cattle Grazing Feral herbivores	0.6	
VGOU-33	-25.8009	117.3316	Rocky Hill	Footslope	West	Low	Sandy Loam	Many Small Patches	Negligible	Small Rocks (11-20cm)	Scarce	Few Small Patches		Nil	Low	None	Old (6+ yr)	Feral herbivores	0.6	

Site	Latitude	Longitude	Habitat type	Landform	Aspect	Slope	Soil type	Soil available	Outcrop	Rock size	Vegetation litter	Woody debris	Vegetation type	Rocky cracks crevices	Burrow suitable	Water present	Last fire	Disturbances	Hab. cond	Photo
VGOU-34	-25.7962	117.3293	Sandy Plain	Hardpan Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Negligible	None Discernible	Scarce		Nil	Low	Prone to Pooling	Old (6+ yr)	Feral herbivores	0.6	
VGOU-35	-25.8032	117.3391	Rocky Outcrop/ Breakaway	Hillcrest/ Upper Hillslope	North/ East	Moderate	Silty Clay Loam	Scarce	Major Outcropping	Small Rocks (11-20cm)	Many Small Patches	Scarce	Spinifex Hummock Grassland, Scattered Shrubs	High	Nil	None	Old (6+ yr)	Road/ Access Track Rubbish/ Litter Mining Exploration	0.4	
VGOU-36	-25.8047	117.3397	Minor Drainage Line	Hillcrest/ Upper Hillslope	South/ East	Moderate	Clay Loam	Scarce	Moderate Outcropping	Large Rocks (21-60cm)	Many Small Patches	Many Small Patches	Tussock Grassland, Scattered Shrubs, Mulga Woodland	High	Nil	None	Old (6+ yr)	Weed Invasion	0.8	
VGOU-37	-25.8051	117.3396	Rocky Outcrop/ Breakaway	Hillcrest/ Upper Hillslope	South/ East	Steep	Clay Loam	Scarce	Moderate Outcropping	Boulders (>61cm)	Many Large Patches	Many Small Patches	Scattered Shrubs, Tussock Grassland	Very High	Nil	None	Old (6+ yr)	None Discernible	0.8	
VGOU-38	-25.8042	117.3380	Rocky Hill	Boulders/ Rockpiles	West	Low	Silty Clay Loam	Scarce	Moderate Outcropping	Large Rocks (21-60cm)	Evenly Spread	Many Small Patches	Spinifex Hummock Grassland, Scattered Shrubs	High	Nil	None	Old (6+ yr)	None Discernible	0.6	
VGOU-39	-25.8032	117.3367	Rocky Hill	Hillslope	West	Very Steep	Sandy Loam	Many Small Patches	Moderate Outcropping	Boulders (>61cm)	Many Small Patches	Few Small Patches		High	Low	None	Old (6+ yr)	Weed Invasion Feral herbivores	0.8	

Site	Latitude	Longitude	Habitat type	Landform	Aspect	Slope	Soil type	Soil available	Outcrop	Rock size	Vegetation litter	Woody debris	Vegetation type	Rocky cracks crevices	Burrow suitable	Water present	Last fire	Disturbances	Hab. cond	Photo
VGOU-40	-25.8026	117.3371	Rocky Hill	Hillcrest/ Upper Hillslope	South/ West	Steep	Sandy Clay Loam	Scarce	Moderate Outcropping	Large Rocks (21-60cm)	Evenly Spread	Many Small Patches	Spinifex Hummock Grassland, Scattered Shrubs	High	Nil	None	Old (6+ yr)	Road/ Access Track Mining Exploration	0.6	
VGOU-41	-25.8031	117.3442	Rocky Outcrop/ Breakaway	Boulders/ Rockpiles	South/ East	Moderate	Sandy Clay Loam	Scarce	Moderate Outcropping	Large Rocks (21-60cm)	Few Small Patches	Few Small Patches		Very High	Nil	None	Old (6+ yr)	Road/ Access Track, Weed Invasion Feral herbivores	0.8	
VGOU-42	-25.8000	117.3386	Disturbed/ Cleared	Hillslope	North	Very Steep	Loam	None Discernible	Negligible	Small Rocks (11-20cm)	Few Small Patches	Scarce	Spinifex Hummock Grassland	Low	Nil	None	Old (6+ yr)	Mining Exploration, Road/ Access Track, Rubbish/ Litter	0.1	
VGOU-43	-25.8015	117.3391	Rocky Hill	Gully	East	Moderate	Clay Loam	Few Small Patches	Minor Outcropping	Small Rocks (11-20cm)	Evenly Spread	Many Small Patches	Spinifex Hummock Grassland	High	Nil	None	Old (6+ yr)	Road/ Access Track, Mining Exploration	0.4	
VGOU-44	-25.8106	117.3408	Sandy Plain	Sand Plain	Flat	Flat	Sandy Loam	Evenly Spread	Negligible	Negligible	Many Small Patches	Few Small Patches		Nil	Very High	None	Moderate (3 to 5 yr)	Cattle Grazing, Mining Exploration, Road/ Access Track, Rubbish/ Litter Weed Invasion	0.4	
VGOU-45	-25.8065	117.3258	Sandy Plain	Sandy/ Stony Plain	Flat	Flat	Clay Loam Sandy	Evenly Spread	Negligible	Negligible	Evenly Spread	Few Large Patches	Mulga Woodland, Spinifex Hummock Grassland	Nil	Moderate	None	Old (6+ yr)	Road/ Access Track	0.6	

Site	Latitude	Longitude	Habitat type	Landform	Aspect	Slope	Soil type	Soil available	Outcrop	Rock size	Vegetation litter	Woody debris	Vegetation type	Rocky cracks crevices	Burrow suitable	Water present	Last fire	Disturbances	Hab. cond	Photo
VGOU-46	-25.7983	117.3403	Disturbed/ Cleared	Hillcrest/ Upper Hillslope	South/ East	Moderate	Silty Loam	Many Small Patches	Moderate Outcropping	Large Rocks (21-60cm)	Many Small Patches	Many Small Patches		Moderate	Nil	None	Old (6+ yr)	Mining Exploration, Road/ Access Track, Rubbish/ Litter, Weed Invasion	0.1	
VGOU-47	-25.8038	117.3449	Rocky Hill	Footslope	South/ West	Low	Clay Loam	Scarce	Minor Outcropping	Small Rocks (11-20cm)	Evenly Spread	Many Small Patches		Moderate	Nil	None	Old (6+ yr)	Road/ Access Track, Mining Exploration	0.4	
VGOU-48	-25.8037	117.3458	Rocky Hill	Hillslope	South/ East	Steep	Clay Loam	Scarce	Minor Outcropping	Large Rocks (21-60cm)	Many Small Patches	Many Small Patches		High	Nil	None	Old (6+ yr)	Mining Exploration, Road/ Access Track	0.4	
VGOU-49	-25.8031	117.3458	Stony Plain	Hillslope	Flat	Flat	Clay Loam	Scarce	Limited Outcropping	Small Rocks (11-20cm)	Many Small Patches	Many Small Patches	Scattered Shrubs	Low	Nil	None	Old (6+ yr)	Road/ Access Track, Mining Exploration	0.6	
VGOU-50	-25.8056	117.3451	Stony Plain	Stony Plain	Flat	Flat	Silty Clay Loam	Many Small Patches	Negligible	Pebbles (5-10cm)	Evenly Spread	Many Small Patches	Mulga Woodland, Spinifex Hummock Grassland	Low	Low	None	Old (6+ yr)	Road/ Access Track, Mining Exploration	0.4	
VGOU-51	-25.8080	117.3377	Rocky Hill	Undulating Low Hills	South/ East	Low	Clay Loam	Scarce	Limited Outcropping	Small Rocks (11-20cm)	Evenly Spread	Many Small Patches	Mulga Woodland	Low	Nil	None	Old (6+ yr)	Road/ Access Track	0.4	
VGOU-52	-25.8094	117.3434	Sandy Plain	Sandy/ Stony Plain	Flat	Flat	Silty Clay Loam	Evenly Spread	Negligible	Gravel (1-4cm)	Evenly Spread	Many Small Patches	Spinifex Hummock Grassland, Mulga Woodland	Nil	High	None	Old (6+ yr)	Mining Exploration, Road/ Access Track	0.2	

Site	Latitude	Longitude	Habitat type	Landform	Aspect	Slope	Soil type	Soil available	Outcrop	Rock size	Vegetation litter	Woody debris	Vegetation type	Rocky cracks crevices	Burrow suitable	Water present	Last fire	Disturbances	Hab. cond	Photo
VGOU-53	-25.8054	117.3450	Disturbed/ Cleared	Stony Plain	Flat	Flat	Silty Clay Loam	Scarce	Negligible	Pebbles (5-10cm)	Evenly Spread	Few Small Patches	Tussock Grassland, Scattered Shrubs	Low	Nil	None	Old (6+ yr)	Mining Exploration, Road/ Access Track, Rubbish/ Litter	0.2	
VGOU-54	-25.7870	117.3478	Stony Plain	Stony Plain	Flat	Flat	Silty Clay Loam	Scarce	Minor Outcropping	Small Rocks (11-20cm)	Evenly Spread	Few Small Patches	Tussock Grassland, Scattered Shrubs	Low	Low	None	Old (6+ yr)	Road/ Access Track	0.6	
VGOU-55	-25.7903	117.3440	Minor Drainage Line	Minor Drainage Line	Flat	Flat	Silty Clay Loam	Many Large Patches	Limited Outcropping	Pebbles (5-10cm)	Many Small Patches	Many Large Patches	Mulga Woodland, Tussock Grassland	Low	Moderate	Prone to Flooding	Old (6+ yr)	None Discernible	0.6	
VGOU-56	-25.7860	117.3425	Stony Plain	Stony Plain	North/ West	Low	Sandy Loam	Many Small Patches	Negligible	Small Rocks (11-20cm)	Few Small Patches	Few Small Patches	Shrubland	Nil	Moderate	None	Old (6+ yr)	None Discernible	0.6	
VGOU-57	-25.7886	117.3467	Rocky Hill	Breakaway	East	Low	Silty Loam	Many Small Patches	Minor Outcropping	Small Rocks (11-20cm)	Many Small Patches	Many Small Patches	Mulga Woodland	Low	High	None	Old (6+ yr)	None Discernible	0.6	
VGOU-58	-25.7883	117.3436	Rocky Hill	Granite Outcrops/ Domes	North/ West	Moderate	Silty Loam	Few Small Patches	Moderate Outcropping	Boulders (>61cm)	Few Small Patches	Few Small Patches	Scattered Shrubs	High	Low	None	Old (6+ yr)	None Discernible	0.6	
VGOU-59	-25.7842	117.3386	Stony Plain	Stony Plain	Flat	Flat	Silty Clay Loam	Scarce	Minor Outcropping	Small Rocks (11-20cm)	Evenly Spread	Few Small Patches	Tussock Grassland, Scattered Shrubs	Low	Low	None	Old (6+ yr)	None Discernible	0.6	
VGOU-60	-25.7937	117.3404	Rocky Outcrop/ Breakaway	Ironstone Outcrops	South/ East	Moderate	Clay Loam	Scarce	Extensive Outcropping	Large Rocks (21-60cm)	Many Small Patches	Few Small Patches	Scattered Shrubs	Very High	Nil	None	Old (6+ yr)	Mining Exploration, Road/ Access Track	0.6	Not available

APPENDIX 13: DESKTOP ASSESSMENT OF SUBTERRANEAN FAUNA AT THE MOUNT GOULD IRON ORE PROJECT (BENNELONGIA 2022B)

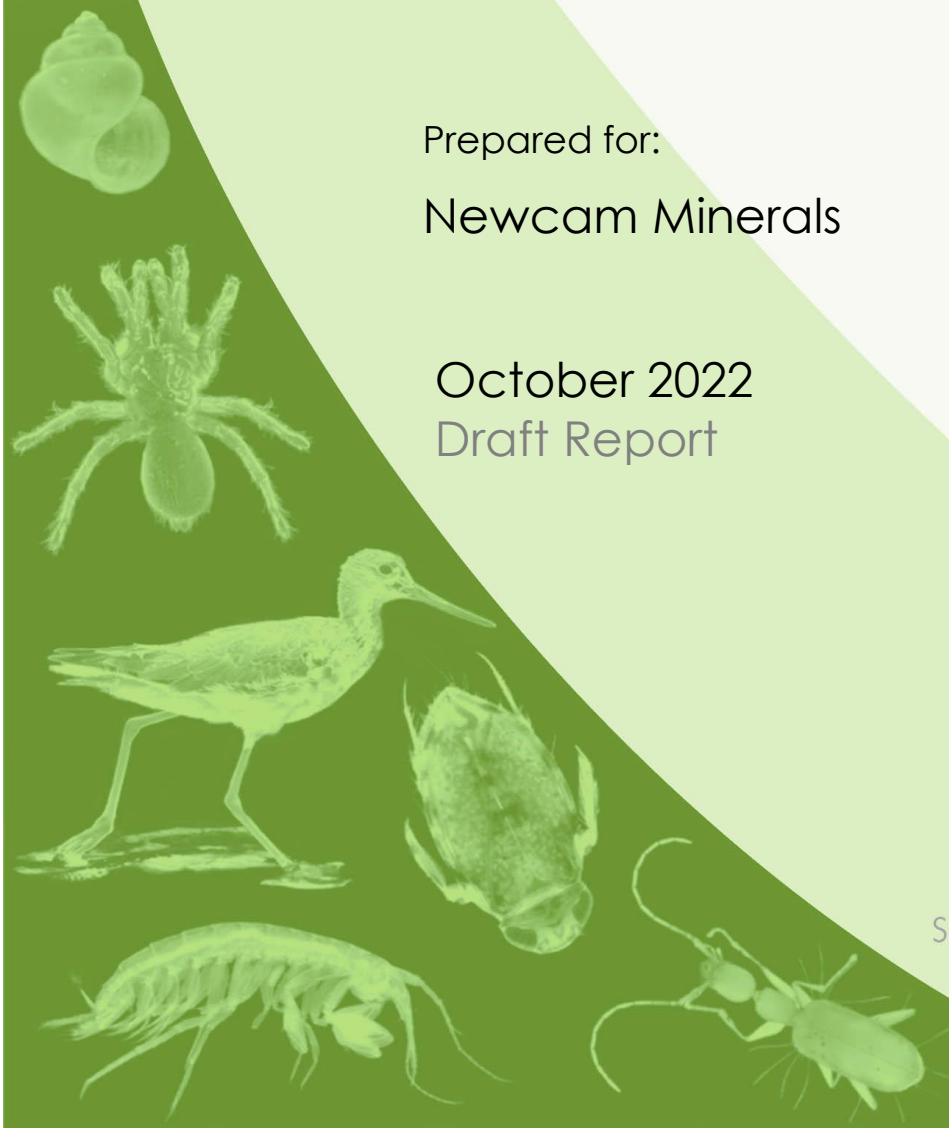
Bennelongia Environmental Consultants

Desktop Assessment of Short-Range Endemic Fauna at the Mt. Gould Iron Ore Project

Prepared for:

Newcam Minerals

October 2022
Draft Report



Short-Range Endemics I Subterranean Fauna

Waterbirds I Wetlands

Desktop Assessment of Short-Range Endemic Fauna at the Mt. Gould Iron Ore Project

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Report Version	Prepared by	Reviewed by	Submitted to Client	
			Method	Date
Draft	Monique Moroney	Stuart Halse	email	5 October 2022
Final				

BEC_MtGould_SRE_desktop_draft5x22.docx

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EXECUTIVE SUMMARY

Newcam Minerals is proposing to develop the Mt. Gould Iron Ore Project (the Project), located in the Gascoyne region of Western Australia. The project covers an area of 613.5 ha and is situated 140 km northwest of the town of Meekatharra.

The project is targeting one iron ore deposit and will involve open cut mining from a single pit, with the development of supporting infrastructure in addition to mining operations. The life of the Project is estimated to be approximately six years.

The desktop search revealed that at least 48 species belonging to SRE Groups (i.e. various taxonomic groups of ground-dwelling invertebrates containing high proportions of SRE species) have been collected in a search area of 100 x 100 km around the Project. One listed species has been recorded within the search area, the Priority 3 shield-backed spider *Idiosoma clypeatum* but this listing is an historical artefact. No Confirmed SRE species has been recorded but several of the species found fit into the Likely Potential SRE category. In addition to a moderately rich SRE Group fauna occurring, habitat that is prospective for SREs occurs at the Project. This includes rocky outcrops and slopes (particularly those south-facing), spinifex grasslands and acacia shrublands.

A survey undertaken at the Project itself 10 years ago (in 2012) collected six species belonging to SRE Groups: one species of mygalomorph spider, four species of pseudoscorpion and one species of isopod. Pseudoscorpions were the main group collected at the Project area, but the particular species collected were considered to be Unlikely Potential SRE species owing to occurrence in multiple habitat types. The mygalomorph spider *Idiommata* `MYG254` is currently the only Likely Potential SRE known from within the Project area.

The majority of records from the search area were from south of the Project along the Jack Hills Range (records ranging from 16 to 56 km from the Project area). With similar geologies and habitats, the Project potentially contains a similar SRE Group community although substantial elements of the community were not collected in the previous Project area survey (i.e., additional mygalomorph spiders, centipedes, scorpions, and millipedes).

In conclusion, despite previous sampling results it appears that the Project area is prospective for SRE species. In addition to being likely to support species in SRE Groups, Mount Gould is an isolated feature. This increases the likelihood of short range species. Assessment of the likelihood of significant loss of conservation values as a result of Project development required addition information about the SRE community.

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1. INTRODUCTION

Newcam Minerals is proposing to develop the Mt. Gould Iron Ore Project (the Project), located in the Gascoyne region of Western Australia. The project covers an area of 613.5 ha and is situated 140 km northwest of the town of Meekatharra (Figure 1).

The project is targeting one main iron ore deposit and will involve open cut mining from a single pit, with the development of supporting infrastructure in addition to mining operations. The life of the Project is currently estimated to be approximately six years (AQ2 2021).

Bennelongia Environmental Consultants were engaged to conduct a desktop assessment to appraise the likelihood of short-range endemic (SRE) species occurring within and in the vicinity of the Project.

The specific aims of this assessment are to:

1. Review available information to assess the prospectivity of habitats within and in the vicinity of the Project for SRE fauna.
2. Compile and evaluate records of species belonging to SRE groups in the vicinity of the Project (including listed species and communities) by reviewing ranges and other available information pertaining to recorded species to characterise the likelihood of SRE fauna in the Project area.
3. Consider the key threats of proposed developments to determine the significance of any potential impacts to SRE species and/or other conservation significant invertebrates.

2. SRE FRAMEWORK

SRE species are defined as having overall ranges of less than 10,000 km^2 (Harvey 2002). They tend to exhibit patchy distributions within their range, slow growth, low fecundity, and poor dispersal capabilities. Guidelines for the consideration and assessment of SRE invertebrates in Western Australia are provided in *Environmental Factor Guideline: terrestrial fauna* (EPA 2020) and *Technical Guidance: sampling of short range endemic invertebrate fauna* (EPA 2016). Assessment typically focuses on several taxonomic groups (SRE Groups) that are known to contain at least some, but more commonly moderate to high proportions of SRE species. The groups include land snails (Gastropoda); millipedes (Diplopoda); centipedes (Chilopoda); pseudoscorpions (Pseudoscorpiones); scorpions (Scorpiones); spiders [Araneae, mainly Mygalomorphae (trapdoor spiders)]; slaters (Isopoda); and harvestmen (Opiliones). Some other groups, such as velvet worms (Onychophora) and earthworms (Oligochaeta), are SRE Groups but are restricted to mesic landscapes.

Groups containing species that are mostly widespread due to high vagility, ecological plasticity or xeric adaptation, may also have species with restricted ranges (e.g., Framenau *et al.* 2008; Rix *et al.* 2015) but these are not included in SRE assessments. More importantly from the viewpoint of SRE surveys, some species belonging to SRE Groups are in fact widespread. Determining whether a species belonging to an SRE Group really has a significantly restricted range (<10,000 km^2) is often difficult. However, in many cases the distribution of an SRE Group species fully reflects the extent of its preferred or obligate habitat(s), and ranges can be estimated from habitat extent. In other cases, species ranges reflect life history or behaviour, rather than historical biogeography, and species may be SREs through occupying only part of a widespread habitat (Harvey 2002; Harvey *et al.* 2011; Rix *et al.* 2015).

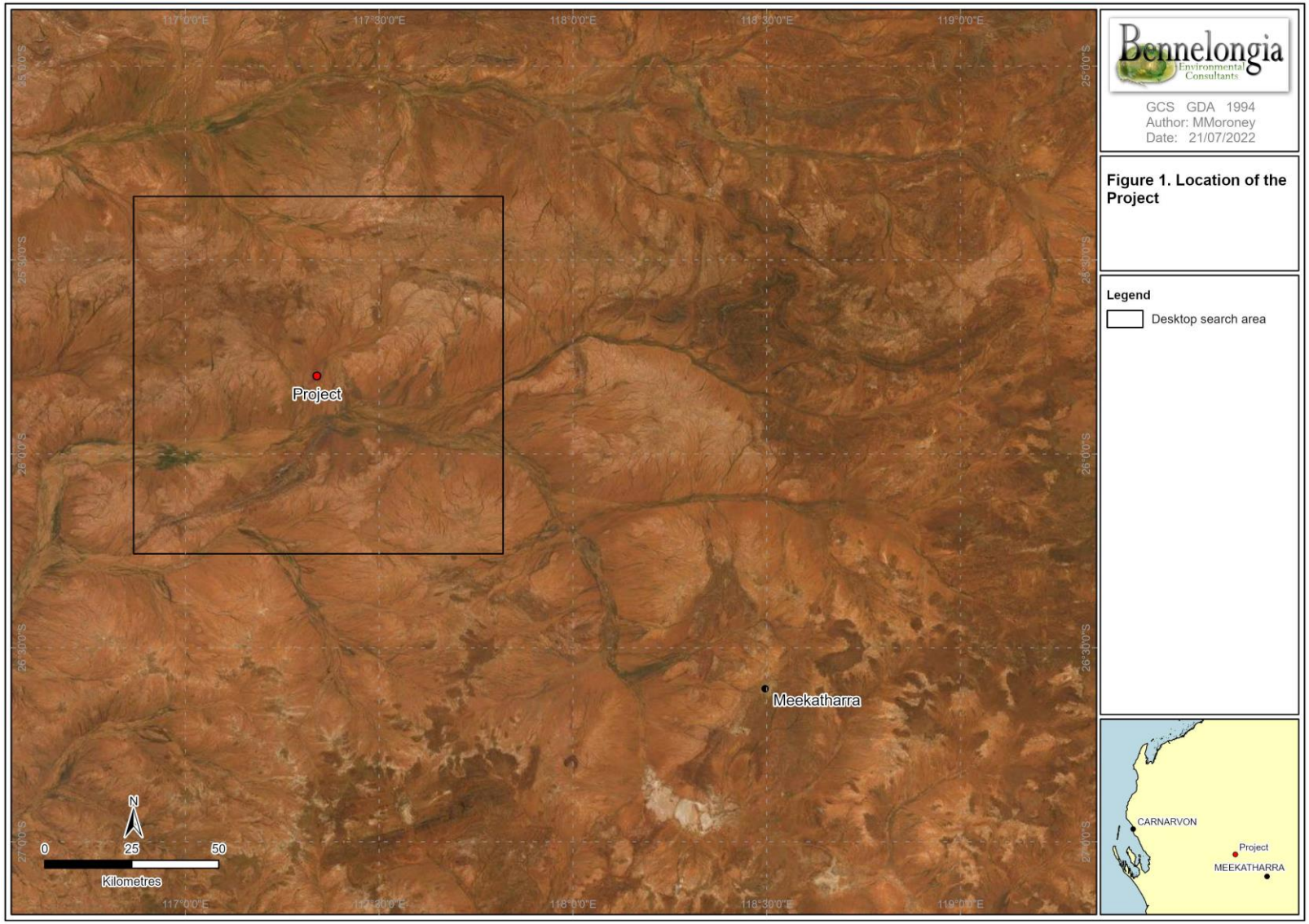


Figure 1. Location of the Project

The following classification, slightly modified from that used by the Western Australian Museum (WAM), was followed to determine whether or not a species is an SRE:

1. **Confirmed SREs** have a known distribution range < 10,000 km^2. The taxonomy is well known, and the group well represented in collections and/or via comprehensive sampling.
2. **Potential SREs** belong to a group with gaps in our knowledge, either because the group is not well represented in collections, taxonomic knowledge is incomplete, or the distribution is poorly understood due to insufficient sampling. Potential SREs can be divided into two groups.
    a. *Likely Potential*: current known distribution is out of date and requires further research, but habitat specificity and biology of the species suggests it is likely to have a restricted range.
        i. *Data Deficient* – this subcategory originally reflected taxonomic uncertainty but is now used to reflect uncertainty more generally, including when the species is represented by a single record and life history inferences are unclear.
    b. *Unlikely Potential*: current known distribution is out of date and requires further research, but the species shows multiple habitat preferences, including non-prospective habitats, and biology of the species suggests it is unlikely to have a restricted range.
3. **Widespread (not SRE)** species have a known distribution range >10,000 km^2. The taxonomy is well known, and the group well represented in collections via comprehensive sampling. Large linear ranges may be used to infer range is >10,000 km^2.

The factors considered when evaluating the SRE status of each species in this report were the known range of the species, habitat(s) at the collection location(s) and the spatial extent and connectivity of these habitats, and the distribution patterns of phylogenetically related surrogate species (ideally members of the same genus).

Even restricted species may have distributions that mostly lie outside a project area, so identifying SRE or potential SRE species is only the first part of a filtering process used to determine whether species may be threatened by a proposed development. The actual level of threat to an SRE species depends on its distribution relative to the development footprint, rather than SRE status alone. This distribution can usually be inferred with at least moderate reliability, based on extent of the species' preferred habitat outside the area of disturbance, as well as within it.

3. REGIONAL SETTING

The Project is situated within the Murchison bioregion, which mostly consists of low hills and mesas separated by flat alluvial and colluvium plains. The climate of the Murchison region is described as arid with predominantly winter rainfall. The average annual rainfall of Meekatharra is approximately 236 mm (AQ2 2021).

The Project is located approximately 200 m above the Murchison River plains. The Murchison River flows periodically following large rainfall events, often between January and June (AQ2 2021).

3.1. Habitat Assessment

A habitat assessment conducted by Biologic Environmental in 2011 showed that the Project has the following broad habitat types:

- Mixed acacia shrubland,
- Rocky outcropping,
- Spinifex grasslands,
- Exposed slopes/outcropping,
- Minor drainage lines and,
- Mugla plains

Of these, the most prospective habitats for SRE Groups are rocky outcrops and slopes (particularly those south-facing), the spinifex grasslands that are predominately isolated to the northern slopes of the southern peak of Mt Gould and acacia shrublands. The shrubland is discontinuous due to the surrounding widespread mulga plains (Biologic 2012).

4. SRE OCCURRENCE

The likelihood of SRE species occurring in the Project area, based on broad patterns of animal distribution, was assessed by compiling records of species belonging to SRE Groups in a search area of 100 km x 100 km area centred on the Project (decimal degree coordinates of search area: top left -25.4°S:116.9°E, bottom right -26.3°S:117.8°E) (Figure 2). Records were extracted from the WAM and Bennelongia databases, as well as information available in published research papers and environmental reports for this area. Results from the search area provide an indication of the level of species richness that can be expected in the vicinity of the Project, rather than a precise number of species that exists in the area.

Appendix 1 provides a tabulated list of species recorded in the search area. Due to incomplete or inconsistent taxonomy, some recorded species may contain multiple taxa and, conversely, some specimens assigned to different taxa may in reality represent the same species. Altogether, 482 individuals from at least 48 species belonging to seven SRE groups have been recorded in the search area (Figure 2). Records comprise 12 species of pseudoscorpion, five species of scorpion, 18 species of spider, eight species of centipede, two species of millipede, one species of slater and two species of land snail (Appendix 1).

Thirty-one records were identified to higher order only, likely due to being incorrect sex (female) or life stage (juveniles) for species identification, 12 of which are not viewed as unique species and may belong to other listed species (see Appendix 1).

Undescribed species and some species identified only to higher order were assigned to Likely Potential-Data Deficient (DD) SRE given their taxonomic uncertainty. However, it is important to note that further research on specific taxonomic groups could result in more information, formal species descriptions and recognized ranges that potentially could modify this SRE status.

The most common SRE Group around the Project area are pseudoscorpions. These species were assigned as Unlikely Potential SREs due to the collection of specimens from multiple habitat types (Biologic 2012).

No Confirmed SRE species was found during the desktop search, although several species assigned to the Likely Potential category occur. The only Likely Potential SRE known from within the Project area is the mygalomorph spider *Idiommata* `MYG254`.

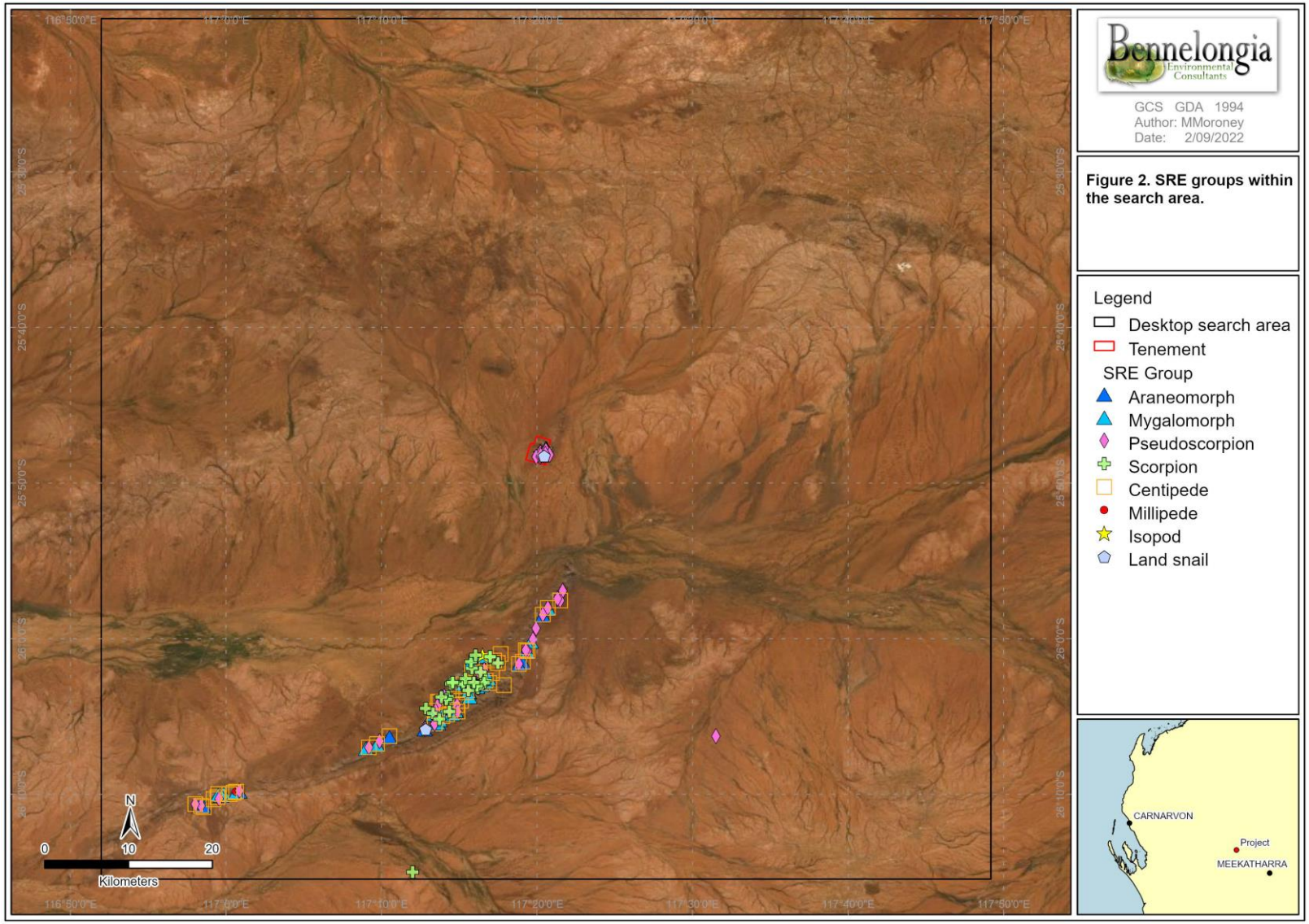


Figure 2. SRE groups within the search area

4.1. Listed Communities and Species

An ecological community comprising a naturally occurring biological assemblage in a particular habitat type may be listed by the Minister for the Environment as a Threatened Ecological Community (TEC) if it presumed to be totally destroyed, critically endangered, endangered or vulnerable. A community that is threatened but does not meet these criteria, is rare but not threatened, is near threatened, has recently been removed from the TEC list, or is conservation-dependent, may be listed by the Department of Biodiversity, Conservation and Attractions (DBCA) as a Priority Ecological Community (PEC).

No PECs or TECs are recognised in the search area on the basis of their terrestrial invertebrate communities (ground-dwelling or otherwise) but the vegetation complexes on Mt. Gould are listed as a PEC. This can be attributed to its unique vegetation, particularly near the summit.

A search of the DBCA database of threatened and priority fauna records indicates one invertebrate species listed under the BC Act occurs within the search area.

The Priority 3 shield-backed trapdoor spider *Idiosoma clypeatum* was recorded in the search area at Jack Hills by Ecologica (2009a, 2009b). *Idiosoma clypeatum* belongs to a group of species in the family Idiopidae; this group are characterised by enlarged and sclerotised third abdominal sigilla and, in some species, highly sclerotised abdominal shields used for burrow defence. The taxonomic review of the genus resulted in the description of several species within what was previously recognised (with little range information) as *I. nigrum*. There are now 17 described species in the *nigrum* complex (Rix *et al.* 2018a).

In 2017 a Priority 3 recommendation was made due to the widespread occurrence of *Idiosoma clypeatum* in areas prospective for mining and mineral resources (Rix *et al.* 2018a).

4.2. Likelihood of SRE species

The distributions and SRE status of species recorded in the search area, within the main target groups, are discussed below.

Araneomorph spiders

Databases contained records of five Potential SRE species of araneomorph spider in the search area (Appendix 1). Two of them were classified as widespread, two as data deficient Likely Potential SREs and one was a higher order identification where SRE assessment was unable to be completed. The spiders were one species of Hersilidae (long-tailed spiders/tree trunk spiders), one species of Lycosidae (wolf spiders), two Selenopidae (flat-bodied wall spiders) and one Segestriidae (tube spiders), respectively.

The identifications for the Selenopidae (*Karaops* sp. and *Karaops* `sp. indet.` `Erwandoo`) represent a genus level identification and an undescribed species, respectively, because of low numbers in museum collections and any species being represented only one sex and/or specimen, it has been suggested that data deficient selenopid species should perhaps be treated as SREs (Crews and Harvey 2011; Crews 2013).

Mygalomorph spiders

The search area around the Project provided records of at least 13 Potential SRE species of mygalomorph (trapdoor) spiders.

These were four species of Anamidae (open-holed trapdoor spiders), all of which are higher order identifications. Three species of Barychelidae (brush-footed trapdoor spiders), four species of Idiopidae (armoured trapdoor spiders), and two higher order identification species of Actinopodidae (mouse spiders) and Euagridae (curtain web spiders) (Appendix 1). Species of these families are typically confined

to sandy or loose soil types because they lack a rastellum for digging in more compact soils, and are therefore likely to face particularly strong habitat restrictions (Main *et al.* 2000).
Three of the species were found to be widespread and not SREs. Six species were considered Unlikely Potential SREs given their distribution patterns and records, and three were considered data deficient Likely Potential SRE species given they have been studied, have few records and limited distributions. There was one higher order identification, seen as a unique species due to being the only occurrence of the genus in the search area, for which SRE classification was unable to be completed.

One species has been recorded within the Project area. It is the brush-footed trapdoor spider *Idiommata* `MYG254`, which was collected as by-catch during a vertebrate survey by Biologic (2012). It is classified as a Likely Potential SRE (Appendix 1).

The Priority 3 shield-backed trapdoor spider *Idiosoma clypeatum* has been recorded at Jack Hills, during ecologica surveys (2009a, 2009b) when records of *I. clypeatum* burrows were found within drainage lines and beneath *Acacia* vegetation. The majority of burrows were located on southern slopes of drainage valleys or at the base of hills in the immediate proximity to creeks. Very few burrows were recorded on hill tops and none on plains. Similar environments are present at the Project.

Pseudoscorpions
Twelve species of pseudoscorpions were recorded within the search area from four families. While some pseudoscorpions have restricted distributions, as a group they are mostly widespread. Four of the recorded in the search area were widespread species. Two of the three undescribed species (*Austrohorus* `sp. A` and *Austrohorus* `sp. B`) were assigned to data deficient Potential SREs by default, due to being currently known only as single records from Jack hills approximately 16 km south of the Project. *Austrohorus* has a patchy distribution throughout WA.

Four species recorded in the search area have been collected within the Project area (Figure 3). *Synsphyronus* `PSE010` was collected at eight sites during the Level 2 SRE invertebrate survey by Biologic (2012). The specimens were ground-dwelling and were collected from a variety of microhabitats, including leaf litter, under rocks, and in the soil under spinifex as well as across multiple broad habitat types (spinifex, on outcropping and boulders and exposed slopes). Therefore, *Synsphyronus* `PSE010` was assigned to Unlikely Potential SRE.

Records of *Austrohorus* sp. were collected at two sites during the Biologic (2012) survey (Figure 3). They were reported as collected from two different habitats (spinifex and boulders) however, due to the higher order identification and, therefore some uncertainty about whether only one species was present, *Austrohorus* sp. is regarded as a data deficient Likely Potential SRE.

Indolpium sp. was recorded at five sites within the Project area from multiple habitat types (Biologic 2012). Due to the higher order identification and uncertainty about whether only one species was present, *Indolpium* sp. is regarded as a data deficient Likely Potential SRE but this is a precautionary assignment.

The widespread species, *Beierolpium* 'sp. 8/4' was also collected at the Project (Figure 3).

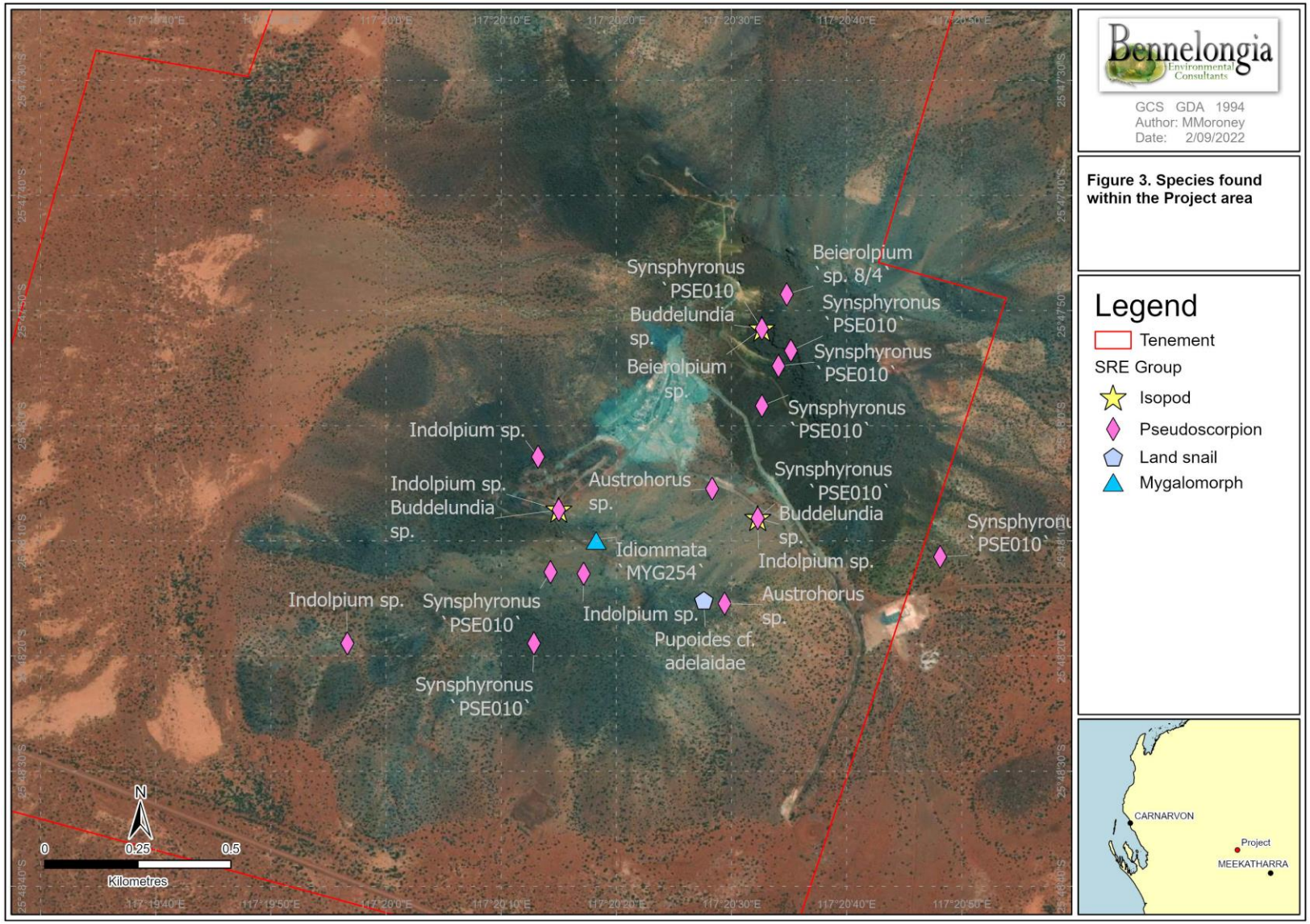


Figure 3. Species found within the Project area

Scorpion
Five species of Potential SRE scorpions were recorded within the search area, belonging to the families Buthidae and Urodacidae**.** Most urodacid scorpions have fossorial habits within sandy substrates where they construct their burrows (Volschenk *et al.* 2012), while the majority of buthid scorpions can inhabit sandy patches and areas of dense leaf litter, as well as occurring under bark and climbing into shrubs.

Three species of *Lychas* (Buthidae) were considered widespread. The species *Lychas* `MML1` and *Urodacus* `jack hills` were classified as Likely Potential SREs. The basis for the classification of *Urodacus* `jack hills` is that while some species of *Urodacus* are widespread, even these species tend to have populations that are restricted and occupy only small and patchy areas of the available habitat. Other *Urodacus* species are confirmed SREs.

Centipede
At least eight species of centipede from four families have been recorded in the search area. Species of geophilid have been assigned as data-deficient Likely Potential SREs by default because they are higher order identifications in a group with many SRE species. The five species from the family Scolopendridae are all widespread (Appendix 1).

Millipedes
Only one species of millipede, *Antichiropus* `DIP063, dead goat` was recorded in the search area. This diverse genus has been extensively studied recently (Car and Harvey 2014; Car *et al.* 2019; Car *et al.* 2013), and the genus contains both confirmed SREs and widespread species. This genus requires further documentation of species ranges, because species once thought to be Confirmed SREs have been reclassified as widespread. An example is *Antichiropus verutus,* which was initially classified as a Confirmed SRE by Car *et al.* (2019) but collection of the species by Bennelongia (2022) approximately 400 km away suggests it is widespread. However, reflection the occurrence of many restricted species in the genus, *Antichiropus* `DIP063, dead goat` was classified as a Likely Potential SRE.

Isopods
In Australia, the order Isopoda contains a largely undescribed and diverse group of terrestrial epigean crustaceans (suborder Oniscidae) that, due to poor dispersal capabilities and specific habitat preferences, are often SREs (Judd 2004; Judd and Horwitz 2003; Judd and Tati 2011).

At least one species of isopod has been recorded in the search area. *Buddelundia* sp. was collected within the Project area by Biologic (2012) but could not be identified further (Figure 3). The genus *Buddelundia* contains confirmed SRE species and therefore these records are assigned as data deficient Likely Potential SREs (Appendix 1).

Land snails (Gastropoda)
Two widespread species of gastropods were recorded in the search area from the family Pupillidae: *Gastrocopta bannertonensis* and *Pupoides* cf. *adelaidae* (Appendix 1).

5. DISCUSSION

The desktop search identified a moderate diversity of species (48) from SRE groups from within the search area around the Project. There is a great deal of taxonomic uncertainty in the identifications of the records in the desktop search (Appendix 1), but it is clear that at least a moderate community of potentially restricted species occurs within the sub-region around the Project. One listed species has been recorded within the search area, the Priority 3 shield-backed spider *Idiosoma clypeatum*. No Confirmed SRE species were found during the desktop search, but 15 species were assigned to the Likely Potential SRE category.

It is evident from the Biologic (2012) survey that there is prospective habitat present at the Project to harbour SRE groups. This survey identified prospective habitat for SRE fauna groups including, rocky outcrops and slopes (particularly those south-facing), spinifex grasslands and acacia shrublands. The survey resulted in the collection of specimens from multiple habitat types primarily, spinifex grasslands, outcropping and from exposed slopes.

The survey undertaken at the Project in 2012 resulted in the collection of six species belonging to the following groups: one species of mygalomorph spider, four species of pseudoscorpion and one species of isopod. The majority of records in the search area were collected south of the Project along the Jack Hills range (records ranging from 16 to 56 km from the Project area). With similar geologies and habitats, the Project potentially contains a similar community of SRE groups, which have not yet been collected at the Project (i.e., additional mygalomorph spiders, centipedes, scorpions, and millipedes).

The Project area is prospective for SRE groups, Mount Gould is an isolated feature in the area and threats to SRE species from the proposed development is predominantly habitat removal, either by total removal or part clearing resulting in reduced habitat connectivity.

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Appendix 1. Species of SRE groups recorded in the search area

N.B. Grey denotes higher order identifications that might belong to other listed species (not viewed as unique species), blue represents species found within the Project area and orange denotes listed species.

Higher Classification	Lowest Identification	SRE Status	Comment
Mollusca			
Gastropoda			
Pupillidae	*Gastrocopta bannertonensis*	Widespread	
	Pupoides cf. *adelaidae*	Widespread	Uncertain taxonomy- described species exhibits widespread distribution (ALA 2022).
Arthropoda			
Arachnida			
Scorpiones			
Buthidae	*Lychas* `*harveyi*`	Widespread	Manuscript name (not formally described but morphologically recognised). From records within the Bennelongia database this species has a wide distribution.
	Lychas jonesae	Widespread	
	Lychas splendens	Widespread	
	Lychas `MML1`	Likely Potential	Morphospecies of the genera *Lychas*, the framework for formal scorpion identification in Australia requires revision.
	Lychas `MML2`	Likely Potential	As above.
	Lychas sp.	Unlikely Potential	Uncertain taxonomy, further research on the area and taxonomy revisions of widespread species required. Genus has a broad distribution in WA.
Urodacidae	*Urodacus* `jack hills`	Likely Potential	Morphospecies of the genera *Urodacus*. There are currently 20 described species of *Urodacus*, however several undescribed species are known from the Western Australian Museum collection. Some of the described species are widespread, but even in these species the populations are restricted and only occupy small and patchy areas of the available habitat. At the same time, other Urodacus species are confirmed SREs.
	Urodacus sp.	Likely Potential: DD	Higher order identification
Pseudoscorpiones			

Higher Classification	Lowest Identification	SRE Status	Comment
Chthoniidae	*Tyrannochthonius aridus*	Widespread	This species is considered as widespread however, recent studies suggest records may actually represent a species complex.
Atemnidae	*Oratemnus* sp.	Unlikely Potential	Uncertain taxonomy, further research on the area and taxonomy revisions of widespread species required. Genus has a broad distribution in WA.
Garypidae	*Synsphyronus `8/3 long pedipalps`*	Unlikely Potential	
	Synsphyronus `PSE010`	Unlikely Potential	Currently only known from search area, collected in 2012 by Biologic at the Project.
	Synsphyronus sp.	Unlikely Potential	Higher order identification
Olpiidae	*Austrohorus* `sp. A`	Likely Potential: DD	Morphospecies currently only known from Jack Hills, but further research on the area and taxonomy revisions could determine as unlikely or widespread species. Genus currently shows a patchy distribution within WA.
	Austrohorus `sp. B`	Likely Potential: DD	As above
	Austrohorus sp.	Likely Potential: DD	Uncertain taxonomy, set to likely as default, but further research on the area and taxonomy revisions could determine as unlikely or widespread species. Genus currently shows a patchy distribution within WA.
	Beierolpium `sp. 8/2`	Widespread	
	Beierolpium `sp. 8/3`	Widespread	
	Beierolpium `sp. 8/4`	Widespread	
	Beierolpium `sp. nov. 8/4 small`	Unlikely Potential	Uncertain taxonomy, however, the species considered is found in the Pilbara suggesting it is likely a widespread species.
	Beierolpium sp.	Unlikely Potential	Uncertain taxonomy, further research on the area and taxonomy revisions of widespread species required. Genus has a broad distribution in WA.
	Euryolpium sp.	Unlikely Potential	Uncertain taxonomy, further research on the area and taxonomy revisions of widespread species required. Genus has a broad distribution in WA.
	Indolpium sp.	Unlikely Potential	Uncertain taxonomy, further research on the area and taxonomy revisions of widespread species required. Genus has a broad distribution in WA.
	Olpiidae sp.	N/A	Higher order identification
Araneae			
Araneomorphae			
Hersiliidae	*Tamopsis occidentalis*	Widespread	
Lycosidae	*Lycosa australicola*	Widespread	

Higher Classification	Lowest Identification	SRE Status	Comment
Segestriidae	Segestriidae sp.	N/A	Higher order identification.
Selenopidae	*Karaops* sp.	Likely Potential: DD	Uncertain taxonomy, but the entire genus has been flagged as potential SREs by Crews and Harvey 2011.
	Karaops `sp. indet.` `Erwandoo`	Likely Potential: DD	Species level identification but undescribed. Little known but the entire genus has been flagged as potential SRE by Crews and Harvey 2011.
Mygalomorphae			
Actinopodidae	*Missulena* sp. indet.	Unlikely Potential	Uncertain taxonomy due to specimen being juvenile, but further research on the area and taxonomy revisions could determine as unlikely or widespread species. There are no current confirmed SRE species within this genus making it unlikely this record represents a future SRE species.
Anamidae	*Aname* sp. indet.	Unlikely Potential	Uncertain taxonomy due to specimens being either juvenile or female, but further research on the area and taxonomy revisions could determine as unlikely or widespread species. Although this genus does contain some confirmed SRE species, the majority of the species are indeed widespread, and it is unlikely this record represents a future SRE species
	Anamidae sp. indet.	N/A	Higher order identification.
	Kwonkan sp.	Unlikely Potential	Uncertain taxonomy. There are currently confirmed SRE species within the genus, however the majority of the species are widespread, and it is unlikely this record represents a future SRE species. There are also few currently described species, however high molecular diversity is recognised in this genus (Harvey *et.al.* 2018).
	`*Teyl*?` sp.	Unlikely Potential	Uncertain taxonomy. There are current confirmed SRE species within the genus, however the majority of the species are widespread, and it is unlikely this record represents a future SRE species. Few currently described species, however there is high molecular diversity recognised in this genus (Harvey *et.al.* 2018).
	Swolnpes sp.	Unlikely Potential	Uncertain taxonomy, but further research on the area and taxonomy revisions could determine as unlikely or widespread species. There are current confirmed SRE species within the genus, however the majority of the species are widespread, and it is unlikely this record represents a future SRE species. Few currently described species, however there is high molecular diversity recognised in this genus (Harvey et.al. 2018)

Higher Classification	Lowest Identification	SRE Status	Comment
Barychelidae	*Aurecocrypta `chichester`*	Widespread	Manuscript name- not formally described but morphologically recognised. From records in the Bennelongia database it has a widespread distribution.
	Aurecocrypta sp.	Unlikely Potential	Higher order identification.
	Idiommata `MYG254`	Likely Potential	Currently only known from Project area, collected in 2012 by Biologic.
	Synothele sp.	Likely Potential: DD	Few currently described species, however there is high molecular diversity recognised in this genus.
Euagridae	*Cethegus* sp.	Unlikely Potential	Uncertain taxonomy due to specimens being either juvenile or female. This genus requires further revisions, presently there is one species complex known from WA: *Cethegus fugax*.
Idiopidae	*Bungulla bertmaini*	Widespread	This species has a widespread distribution in WA (Rix *et.al*. 2018b).
	Bungulla sp.	Unlikely Potential	Uncertain taxonomy. This genus has a wide distribution throughout WA, however, it is also molecularly diverse (Rix *et.al*. 2018b).
	`*Eucyrtops*?` sp. indet.	N/A	Higher order identification and uncertain taxonomy.
	Idiosoma clypeatum	Widespread	Has a widespread distribution in Western Australia's largely throughout the Yalgoo and Murchison bioregions (Rix *et.al*. 2018a).
	Idiosoma clypeatum	Widespread	Priority 3 shield-backed trapdoor spider has a widespread distribution throughout the Yalgoo and Murchison bioregion (Rix *et.al*. 2018a).
	Idiopidae sp.	N/A	Higher order identification.
Malacostraca			
Isopoda			
Armadillidae	*Buddelundia* sp.	Likely Potential: DD	Higher order identification, genus contains SRE species therefore set as data deficient likely potential as default.
	Armadillidae sp.	N/A	Higher order identification.
Chilopoda			
Geophilida			
Chilenophilidae	Chilenophilidae sp.	Likely Potential: DD	Higher order identification and poorly known Australian fauna, however, some species have been considered SREs.
Geophilidae	Geophilidae sp.	Likely Potential: DD	Higher order identification and poorly known Australian fauna, however, some species have been considered SREs.
	Geophilida sp.	N/A	Higher order identification.

Higher Classification	Lowest Identification	SRE Status	Comment
Lithobiida			
Lithobiidae	Lithobiidae sp.	N/A	Higher order identification.
	Lithobiida sp.	N/A	Higher order identification.
Scolopendrida			
Scolopendridae	*Arthrorhabdus paucispinus*	Widespread	
	Cormocephalus turneri	Widespread	
	Ethmostigmus rubripes	Widespread	
	Scolopendra laeta	Widespread	
	Scolopendra morsitans	Widespread	
Diplopoda			
Polydesmida			
Paradoxosomatidae	*Antichiropus* `DIP063, dead goat`	Likely Potential	Genus has been extensively studied and contains both confirmed SREs and widespread species.
Polyzoniida	*Polyzoniida* sp.	N/A	Higher order identification.