Fortescue

Report

Native Vegetation Clearing Permit – Supporting Document

Nullagine Pilot Wind Project

5 May 2025

NU-AE-EN-0001

Rev: 0

This document is protected by copyright, no part of this document may be reproduced or adapted without the consent of the originator/company owner, all rights are reserved.

EXECUTIVE SUMMARY

Pilbara Energy Generation Pty Ltd (PEG), a wholly-owned subsidiary of Fortescue Ltd (Fortescue), is seeking approval for a Native Vegetation Clearing Permit (NVCP) for the Nullagine Pilot Wind Project (the Project) in the Pilbara region of Western Australia. The Project involves the construction and operation of 17 wind turbines with supporting infrastructure. The Project's footprint is 446.58 ha and PEG is proposing to clear up to 297.21 ha of native vegetation (approximately 149.36 ha existing clearing) within a Clearing Permit Application Area (CPAA) of 3,823.70 ha between August 2025 and August 2030. A summary of the baseline environmental assessments include:

- Several vegetation types are considered of conservation significance:
  - VfAl, associated with Priority Ecological Community (PEC) "Four plant assemblages of the Wona Land System," specifically the Priority 1 community "Cracking Clays of the Chichester and Mungaroona Range" – occupies 11.53 ha (0.30%) of the CPAA, none of which will be impacted by direct clearing.
  - EvAcCc (supporting groundwater dependent vegetation (GDV) and potential groundwater dependent vegetation (PGDV)) - occupies 236.37 ha (6.18%) of the CPAA. Of this, 224.87 ha (95.1%) will not be impacted by direct clearing.
- No Threatened Ecological Communities (TECs) or Threatened flora species listed under the *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth) (EPBC Act) or *Biodiversity Conservation Act 2016* (WA) (BC Act) were recorded within the CPAA.
- Two DBCA Priority flora species were identified (*Ipomoea racemigera* (P2) and *Ptilotus mollis* (P4)) within the CPAA. These species will not be impacted by direct clearing.
- Four conservation significant fauna species were recorded within the CPAA, however, the Project is not likely to significantly impact these species for the following key reasons:
  - Northern Quoll (Endangered - EPBC Act and BC Act) –Over 90% of this species' critical habitat will be retained within the CPAA, including approximately 99.7% of the Drainage Line/River/Creek (major), 92% of the Drainage Line/River/Creek (minor) and 99.9% of the Rocky Escarpment habitats.
  - Short-tailed Mouse (Priority 4 - DBCA) – 100% of the Plain (cracking clays) habitat and 92 % of Drainage Line/River/Creek habitat (minor) will remain undisturbed within the CPAA.
  - Western Pebble-mound Mouse (Priority 4 - DBCA) – 99.9% of the Rocky Escarpments and 91% of the Plain (stony/gibber) habitats will remain undisturbed within the CPAA.
  - Brush-tailed Mulgara (Priority 4 - DBCA) – 91% of the Plain (stony/gibber) habitat will remain undisturbed within the CPAA.
- Three conservation significant fauna species, though not recorded within the CPAA, have the potential to occur because suitable habitats exist within the CPAA. These species are: the Pilbara Leaf-nosed Bat (Vulnerable - EPBC Act and BC Act), Ghost Bat (Vulnerable - EPBC Act and BC Act) and Grey Falcon (Vulnerable - EPBC Act and BC Act). The Project is unlikely to have a significant impact on these species because at least 92% of each species' habitat will remain undisturbed within the CPAA.

An assessment against the ten clearing principles (detailed in Section 3) concludes that the proposed clearing is not likely to be at variance with any of the clearing principles.

TABLE OF CONTENTS

1 INTRODUCTION 1

1.1 Summary of the Proposal 1

1.2 Proposed Clearing Activities 3

1.3 Mitigation hierarchy 3

2 BASELINE ENVIRONMENTAL DATA 4

2.1 Climate 4

2.2 Landscape 6

2.2.1 Biogeography 6

2.2.2 Land Systems 7

2.3 Flora and Vegetation 7

2.3.1 Vegetation Types 7

2.3.2 Vegetation Condition 8

2.3.3 Threatened and Priority Ecological Communities 8

2.3.4 Conservation Significant Vegetation Types 9

2.3.5 Conservation Areas 12

2.3.6 Conservation Significant Flora 12

2.3.7 Groundwater Dependent Ecosystems 12

2.3.8 Introduced Species 12

2.4 Fauna and Habitat 13

2.4.1 Fauna Habitat 13

2.4.2 Terrestrial Fauna 14

2.4.3 Conservation Significant Fauna 14

2.4.4 Introduced Species 16

2.4.5 Short Range Endemics (SRE) 16

2.4.6 Subterranean Fauna 16

2.5 Hydrology 16

2.5.1 Regional Hydrology 17

2.5.2 Local Hydrology 17

2.6 Hydrogeology 18

2.6.1 Regional and Local Groundwater Setting 18

2.7 Heritage and Social Setting 19

2.7.1 Aboriginal Cultural Heritage 19

2.7.2 Non-Indigenous Heritage 19

3 ASSESSMENT OF CLEARING PRINCIPLES 20

4 ENVIRONMENTAL MANAGEMENT MEASURES 24

5 REHABILITATION 26

6 REFERENCES 27

LIST OF TABLES

Table 1-1: Project Details 1
Table 1-2: Disturbance Activities 3
Table 2-1: Land Systems Intersecting the CPAA (DPIRD, 2020) 7
Table 2-2: Vegetation Condition 8
Table 2-3: Summary of Vegetation Types 10
Table 2-4: Habitat type descriptions across the CPAA 13
Table 2-5: Conservation significant fauna recorded across the CPAA (ecologia, 2025b) 14
Table 3-1: Assessment against the ten clearing principles 20
Table 4-1: Environmental Management Measures and Commitments 24

LIST OF GRAPHS

Graph 2-1: Marble Bar (Site No. 004106) Climate Data 5
Graph 2-2: Bonney Downs Station (4006) Rainfall Data 5
Graph 2-3: Annual average wind roses Nullagine Weather Station 9am and 9pm 6

LIST OF POST TEXT FIGURES

Post Text Figure 1: Disturbance Layout 30
Post Text Figure 2: Biogeographic Location 31
Post Text Figure 3: Land Systems 32
Post Text Figure 4: Vegetation Types 33
Post Text Figure 5: Vegetation condition 34
Post Text Figure 6: Significant and Potentially Significant Vegetation 35
Post Text Figure 7: Conservation areas 36
Post Text Figure 8: DBCA-listed Priority Flora species 37
Post Text Figure 9: Introduced Species 38
Post Text Figure 10: Fauna Habitats 39
Post Text Figure 11: Conservation Significant Fauna Recordings 40
Post Text Figure 12: Regional Hydrological Setting 41
Post Text Figure 13: Key Surface Water Receptors 42
Post Text Figure 14: Pastoral Setting 43
Post Text Figure 15: Native Title Agreement Area 44
Post Text Figure 16: Registered Aboriginal Heritage Locations 45

LIST OF APPENDICES

Appendix 1: Bonney Downs Consolidated Flora and Vegetation Assessment (ecologia, 2025a)
Appendix 2: Annual Fauna Monitoring Program 2023 (Spectrum, 2024a)
Appendix 3: Bonney Downs: Terrestrial Vertebrate Fauna Survey Consolidation (ecologia, 2025b)
Appendix 4: Collision Risk Monitoring Feasibility Assessment (ecologia, 2024c)
Appendix 5: Land Use Certification Acquisitions and Tenements Procedure (100-PR-TA-0001)
Appendix 6: Weed Management Plan (NU-PL-EN-0003)
Appendix 7: Conservation Significant Fauna Management Plan (45-PL-EN-0034)

Appendix 8: Ground Disturbance and Topsoil Management (IO-PR-EN-0010)

1 INTRODUCTION

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

This report has been prepared to support an application for the Native Vegetation Clearing Permit (NVCP) for the proposed clearing activities described in Section 1.2. The report describes baseline environmental data to provide a context within which to assess the impacts of the proposed clearing activities. It then assesses in Section 3 the impacts from the proposed clearing activities based on the ten 'Land Clearing Principles' described within Schedule 5 of the EP Act. The report and accompanying NVCP application form as well as the supporting Index of Biodiversity Surveys for Assessments (IBSA) data and Geographic Information System (GIS) shapefile showing the proposed clearing area will be submitted to DEMIRS for assessment.

1.1 Summary of the Proposal

The Nullagine Pilot Wind Project (the Project) is 100% owned by Pilbara Energy Generation Pty Ltd (PEG) (ACN 631 303 305), a wholly-owned subsidiary of Fortescue.

The key details of the Project are presented in Table 1-1.

Table 1-1: Project Details

Site Details	
Project Name	Nullagine Pilot Wind Project (formerly known as Bonney Downs Stage 1 Wind Farm Project)
Description of Operation	The Project, located adjacent to Fortescue's Nullagine Iron Ore Mine in the Pilbara region of Western Australia, is approximately 45 km north of the Christmas Creek mine. This Project aims to support Fortescue's commitment to achieving zero net emissions by 2030. The Project comprises the following key activities: • 17 wind turbines and pads, each with a capacity of 7.6 MW; • 220 kV and 33 kV power transmission lines to connect the wind farm to the substations and power transmission pole pads; • Access tracks and service infrastructure corridors; • A camp and associated infrastructure such as: wastewater treatment plant, fuel storage, power generators, sprayfield and carparks; • Topsoil stockpiles; • Borrow pits; • Laydown and hardstand areas; • Communication infrastructure; • Operations facilities and a mobile concrete batch plant; • Pipelines; • A landfill site. The Project will be developed mostly within the Nullagine Mine's tenements, leveraging existing infrastructure and tenure to facilitate the construction of renewable energy

	generation facilities and supporting infrastructure. A small part of the Wind Farm is located on a tenement owned by Pilbara Energy Company Pty Ltd, which is a Fortescue subsidiary. However, there is no clearing proposed on this tenement (L46/213) under this NVCP. The Project will be developed in accordance with the associated Nullagine Pilot Wind Project Mining Proposal, to be submitted to DEMIRS for assessment.		
Total Clearing Proposed	297.21 ha of native vegetation (within a Clearing Permit Application Area of 3,823.70 ha).		
Estimated Project Commencement Date	Construction: 1 August 2025 (subject to approvals) Operation: 2027		
Tenement Details	**Tenement**	**Tenement Holder**	**Status**
	M46/515	FMG Nullagine Pty Ltd	Live
	M46/522	FMG Nullagine Pty Ltd	Live
	M46/535	FMG Nullagine Pty Ltd	Live
	L46/74	FMG Nullagine Pty Ltd	Live
	L46/80	FMG Nullagine Pty Ltd	Live
	L46/82	FMG Nullagine Pty Ltd	Live
	L46/83	FMG Nullagine Pty Ltd	Live
	L46/84	FMG Nullagine Pty Ltd	Live
	L46/93	FMG Nullagine Pty Ltd	Live
	L46/114	FMG Nullagine Pty Ltd	Live
	G46/9	FMG Nullagine Pty Ltd	Live
Clearing Method	Surface vegetation clearing will be undertaken in the form of blade-down clearing.		
Timeframe for clearing	August 2025 – August 2030 Native vegetation will be progressively cleared as required to develop the Project in accordance with the associated Nullagine Pilot Wind Project Mining Proposal.		
Purpose of Clearing	The clearing is to prepare for the construction, installation and operation of the Nullagine Pilot Wind Project.		
Proponent Details			
Company Name	Pilbara Energy Generation Pty Ltd (PEG)		
ACN/ABN	ACN: 631 303 305 ABN: 31 631 303 305		
Address	Ground Floor, 256 St Georges Terrace, Perth, WA 6000		
Postal Address	PO Box 6915 East Perth, Western Australia		
Key Contact	**Name**	Zena Harman	
	Position	Senior Manager, Sustaining Environmental Approvals	
	Phone	08 6218 8888	
	Email	miningapprovals@fortescue.com	

1.2 Proposed Clearing Activities

PEG is applying to clear 297.21 ha of native vegetation within the Indicative Disturbance Footprint (IDF) of 446.58 ha (Post Text Figure 1). Approximately 149.37 ha of the 446.58 ha has already been cleared by the operation of the Nullagine Mine. The proposed disturbance is located within 3,823.70 ha of the Clearing Permit Application Area (CPAA). The disturbance estimates of native vegetation for the Project have been detailed within Table 1-2.

Table 1-2: Disturbance Activities

Disturbance Activity	Total Area (ha)	Disturbance to Native Vegetation (ha)
Borrow Pit and Shallow Surface Excavation	136.59	13.30
Building or Camp Site	49.03	42.80
Landfill Site	7.85	0.00
Laydown or Hardstand Area	47.77	47.10
Topsoil Stockpile	23.34	22.89
Transport or Service Infrastructure Corridor	182.00	171.11
Total	**446.58***	**297.21**

*149.36 ha of the total footprint is over existing cleared areas

1.3 Mitigation hierarchy

Considerable design efforts have been expended to ensure the Project will have minimal impact on the environment. The Project has implemented the following avoidance and mitigation measures to eliminate, reduce or otherwise mitigate the need for and scale of the proposed clearing of native vegetation:

- The Project has been carefully designed to avoid sensitive environmental receptors such as rocky escarpment fauna habitat, PECs, TECs, significant flora and heritage sites.
- Numerous designs for the Project have been considered including moving wind turbine locations to ensure minimal impacts on the habitat of birds and bats.
- Areas already cleared for the Nullagine Mine will be utilised for the Project to the greatest extent practicable to minimise the need for additional clearing. Examples of these areas are: borrow pits, landfill, water supply infrastructure (production bores, tanks, pipelines, water storages) and transport or service infrastructure corridors.
- Areas cleared will be progressively rehabilitated as required to develop the Project in accordance with the associated Nullagine Pilot Wind Project Mining Proposal.

2 BASELINE ENVIRONMENTAL DATA

Baseline environmental data for the Project is presented in this section. The baseline data used for this report is based on available historical survey information and the most recent surveys and assessments that have been undertaken.

The flora and fauna surveys used to support this application were undertaken over a broad area within and surrounding the CPAA providing a robust data set to evaluate potential impacts.

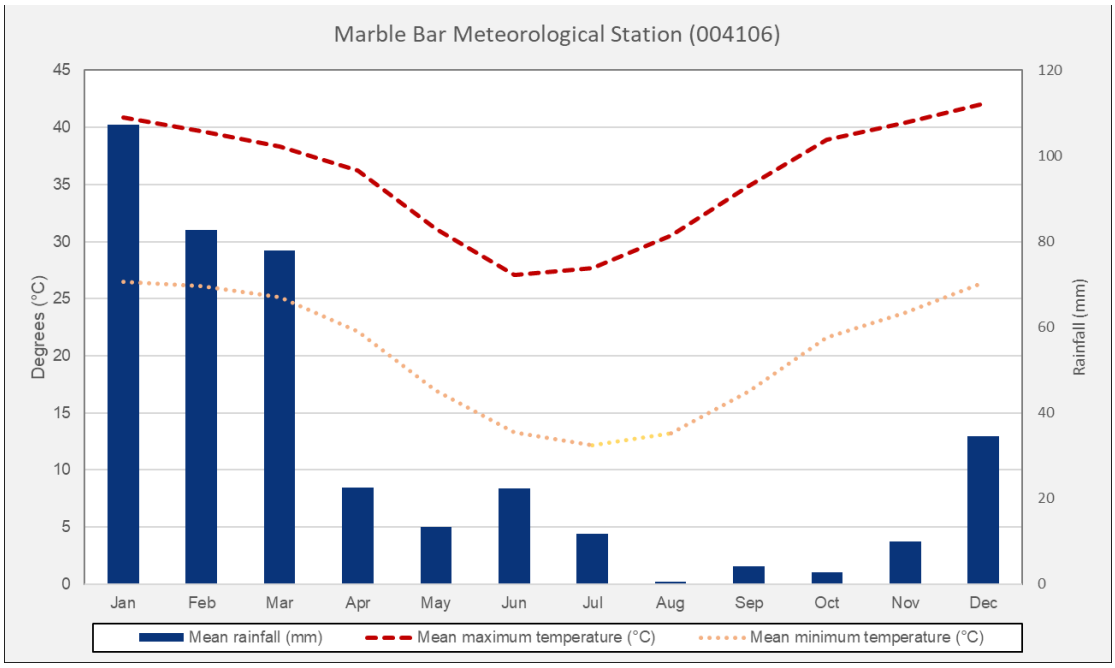
2.1 Climate

The Pilbara Region of Western Australia experiences an arid-tropical climate with two distinct seasons: the wet season from November to April and a dry season from May to October. The wet season is characterised by high temperatures and the majority of the region's rainfall, while the dry season is cooler with minimal precipitation. Rainfall during the wet season primarily results from tropical cyclones and monsoonal thunderstorms (Sudmeyer, 2016).

The most representative Bureau of Meteorology (BoM) weather stations are Marble Bar station (site number 004106), which is located approximately 100 km north of the Project, and the Bonney Downs Pastoral Station (site number 4006), which is located approximately 6.5 km south of the Project. Climate data from 2000 onwards is available from the Marble Bar station and comprehensive rainfall data from 1907 to present is available from the Bonney Downs Pastoral Station.

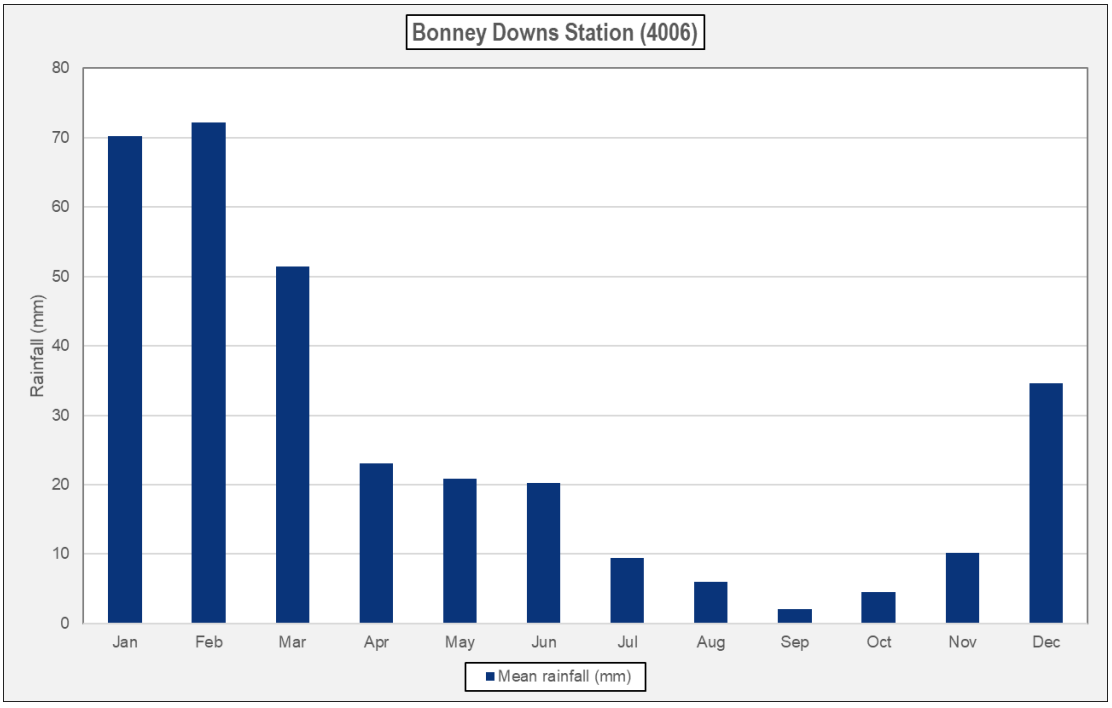
Based on the climate data recorded at Marble Bar station, the mean maximum temperature for the area ranged from 42.1°C in December to 27.1°C in June, and the mean minimum temperature ranged from 26.5°C in January to 12.2°C in July (Graph 2-1).

The mean annual rainfall recorded at Marble Bar station is 382.2 mm, with an average of 27.5 days of rain per year. The highest mean monthly rainfall occurs in January with 107.3 mm and the lowest mean monthly rainfall occurs in August with 0.6 mm (Graph 2-1).



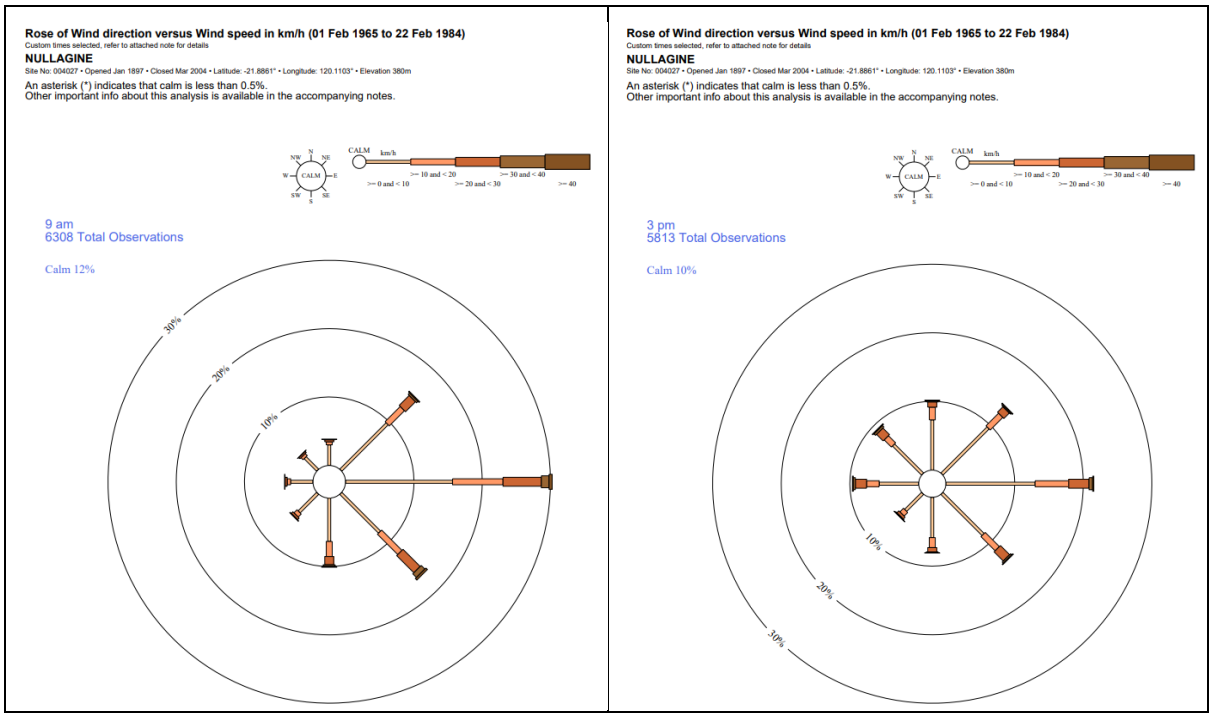
Graph 2-1: Marble Bar (Site No. 004106) Climate Data

The mean annual rainfall for all records from the Bonney Downs station (site number (4006) is 323.7 mm, with the lowest annual rainfall occurring in 1944 at 46.8 mm, and the highest in 2000 at 823.9 mm. The highest mean monthly rainfall occurs in February with 72.2 mm, and the lowest in September with 2.0 mm (Graph 2-2).



Graph 2-2: Bonney Downs Station (4006) Rainfall Data

Wind direction in the Project area is predominantly from the east, and its speed generally ranges from 10 km/hr to 30 km/hr. Annual average wind roses (9 AM and 9 PM) from the Nullagine Weather Station (1965-1984) are provided in Graph 2-3.



Graph 2-3: Annual average wind roses Nullagine Weather Station 9am and 9pm

2.2 Landscape

2.2.1 Biogeography

The Project is located in the Pilbara biogeographic region of the Interim Biogeographic Regionalisation for Australia (IBRA) (Thackway & Cresswell, 1995). The IBRA bioregions are defined on the basis of geology, landform, vegetation, fauna and climate. These bioregions are subdivided into 403 sub-regions. The Pilbara bioregion includes four major subregions; Chichester, Fortescue Plain, Hamersley and Roebourne.

The Project is in the Chichester and Fortescue IBRA subregions (Post Text Figure 2). The Chichester subregion is within the northern section of the Pilbara Craton and consists of undulating Archean granite and basalt plains with areas of significant basalt ranges. The plains support a shrub steppe with *Acacia inaequilatera* over *Triodia* species hummock grasslands, with *Eucalyptus leucophloia* tree steppe occurring on ranges (Kendrick & McKenzie, 2001).

The Fortescue subregion is characterised by vast coastal plains and inland mountain ranges with cliffs and deep gorges. The subregion supports predominantly mulga low woodlands or snappy gum over bunch and hummock grasses (Kendrick & McKenzie, 2001).

2.2.2 Land Systems

There are a total of six land systems that intersect the CPAA, as described in Table 2-1 and illustrated in Post Text Figure 3.

Table 2-1: Land Systems Intersecting the CPAA (DPIRD, 2020)

Land System	Description	Area in CPAA (ha)
Bonney	Gently undulating stony plains, rises and low hills of basalt, tributary drainage patterns and alkaline soils, relief up to 30 m. Low rounded hills and undulating stony plains supporting soft spinifex grasslands.	484.23
Wona	Level to gently undulating upland basaltic plains with gilgai microrelief and clay soils, relief up to 30 m. Basalt upland gilgai plains supporting tussock grasslands and minor hard spinifex grasslands.	20.21
Robe	Conspicuous chains of limonite mesas and buttes with steep breakaway faces, source of iron ore as pisolitic limonite, relief up to 50 m. Low limonite mesas and buttes supporting soft spinifex (and occasionally hard spinifex) grasslands.	261.72
Rocklea	Rough hill and mountain tracts predominantly of basalt, the largest land system in the survey area and widespread throughout, relief up to 110 m. Basalt hills, plateaux, lower slopes and minor stony plains supporting hard spinifex (and occasionally soft spinifex) grasslands.	2,349.45
McKay	Hills, ridges, plateaux remnants and minor breakaways of sedimentary and meta sedimentary rocks, relief up to 100 m. Hills, ridges, plateaux remnants and breakaways of meta sedimentary and sedimentary rocks supporting hard spinifex grasslands.	637.58
Newman	Rugged jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands.	70.52
Total:		3,823.70

2.3 Flora and Vegetation

Multiple flora and vegetation surveys have been conducted across the CPAA, the most recent of which was:

Bonney Downs Consolidated Flora and Vegetation Assessment (ecologia, 2025a) – which comprised a desktop assessment followed by a two-phase detailed flora and vegetation survey, and consolidated two other recent surveys (ecologia, 2024a; SLR, 2024) covering a total survey area of approximately 108,841 ha (Appendix 1).

The survey programs were conducted in accordance with:

- Environmental Factor Guideline – Flora and Vegetation (EPA, 2016a) and
- Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessments (EPA, 2016c).

2.3.1 Vegetation Types

A total of seventeen vegetation types were identified in the Consolidated Detailed Flora and Vegetation Assessment, nine of which occur within the CPAA. None of these vegetation types are restricted to the CPAA, as they occur more broadly within the survey area.

A summary of vegetation types is described in Table 2-3 and displayed in Post Text Figure 4.

2.3.2 Vegetation Condition

The vegetation condition within the survey area was categorised using the scale adopted by EPA Guideline (EPA, 2016a), with assessments conducted at each sampling site and periodically along traverses. The majority of the survey area (98,760.22 hectares, or 90.74%) was classified as being in Excellent condition, indicating no obvious disturbance or only negligible disturbance, such as the presence of a few non-aggressive weed species. The area has maintained its ecological integrity following the introduction of pastoral activities and supports a diverse range of native species. The vegetation condition within the CPAA and IDF is presented in Table 2-2.

Table 2-2: Vegetation Condition

Vegetation Condition	Area within CPAA (ha)	Area within IDF (ha)
Excellent	3,239.79	285.61
Very Good	13.25	0.03
Good	84.30	0.00
Poor	130.82	9.21
Degraded	30.10	2.36
N/A (cleared)	325.45	149.36
Total	3,823.70	446.58

Certain portions of the survey area, however, were recorded in Poor or Degraded condition due to more intensive disturbance factors. Notably, significant infestations of **Cenchrus ciliaris* (Buffel grass) and **Cenchrus setiger* (Birdwood grass) were observed within creek lines and floodplains, particularly impacting riparian zones. These areas exhibited reduced native vegetation cover and ecological function, contributing to a Degraded classification in major drainage channels.

In the Wona land system, sections of vegetation were classified as being in Poor condition due to the combined impacts of grazing pressure and the presence of invasive species, including *Vachellia farnesiana* (mimosa bush). These factors have resulted in diminished structural integrity and altered species composition within affected zones.

The vegetation condition has been mapped in Post Text Figure 5.

2.3.3 Threatened and Priority Ecological Communities

No Threatened Ecological Communities (TECs) listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) or the *Biodiversity Conservation Act 2016* (BC Act) were identified within the CPAA (ecologia, 2025a).

The survey identified one Department of Biodiversity, Conservation and Attractions (DBCA) – listed Priority Ecological Community (PEC) within the CPAA: the "Four plant assemblages of the Wona Land System". This PEC includes four different vegetation communities, with the recorded community in the CPAA being the Priority 1 “Cracking clays of the Chichester and Mungaroona Range”.

2.3.4 Conservation Significant Vegetation Types

The following vegetation types within the CPAA are considered of conservation significance (Post Text Figure 6).

- Vegetation type VfAl is a species-rich community occurring on clay soils associated with stony gibber plains and low hills. It aligns with the “Four Plant Assemblages of the Wona Land System”, specifically the Priority 1 community "Cracking Clays of the Chichester and Mungaroona Range." This shrubless plain of stony gibber has very little vegetative cover during the dry season; however, during the wet season, a suite of ephemerals, annuals, and short-lived perennials emerge, many of which are poorly known and range-end taxa. The VfAl community occupies 11.53 ha (0.30%) of the CPAA and is potentially regionally significant. It supports populations of Priority 1 species (*Stemodia sp*. Battle Hill (A. L. Payne 1006)), Priority 2 species (*Paspalidium retiglume*), and two Priority 3 species (*Euphorbia inappendiculata* var. *queenslandica* and *Neptunia longipila*), although none of these species were recorded within the CPAA. This vegetation type will not be impacted by direct clearing.
- Vegetation type EvAcCc represents 6.18% of the CPAA (236.37 ha). Of this area, 80.78 ha supports potentially groundwater-dependent vegetation where the only phreatophyte present is *Eucalyptus victrix* and the remaining 155.60 ha supports groundwater-dependent vegetation where there is an additional presence of *Eucalyptus camaldulensis*. Nevertheless, 224.87 ha (95.1%) of this vegetation type will not be impacted by direct clearing.

The vegetation type EvACc is also considered locally restricted, along with AaEp and AaTe. The AaEp vegetation type occurs in the CPAA but not the IDF and therefore, will not be directly impacted by clearing. Approximately 35.49 ha of vegetation type AaTe occurs in the CPAA, of which 0.22 ha is within the IDF.

Table 2-3: Summary of Vegetation Types

Vegetation Type code	Vegetation Type	Conservation Significance	Landform and Soils	Extent within CPAA (ha)	Extent within IDF (ha)
AaEp	*Acacia aptaneura*, *Acacia pruinocarpa* tall open shrubland; *Enneapogon polyphyllus*, ±*Triodia brizoides*, ±*Triodia longiceps* low open tussock/hummock grassland.	Locally restricted.	Gravelly plains and undulating plains with reddish-brown clay-loam soils.	4.20	-
AaTe	*Acacia aptaneura*, *Acacia pruinocarpa*, *Acacia bivenosa* tall open shrubland; *Triodia epactia* low open hummock grassland.	Locally restricted.	Primarily stony plains with red-brown clay-loam soils.	35.49	0.22
AiCpTe1	*Acacia inaequilatera* tall sparse shrubland; ±*Corchorus parviflorus* low sparse shrubland; *Triodia epactia*, ±*Triodia brizoides* low hummock grassland.	None.	Low stony hills and undulating plains. Mostly ironstone and basalt with some quartz and calcrete. Reddish brown clay-loam soils.	2,090.88 (mosaic)	213.20 (mosaic)
AiCpTe2	*Acacia inaequilatera* tall sparse shrubland; *Corchorus parviflorus* low sparse shrubland; *Triodia epactia* low hummock grassland.	None.	Primarily associated with minor drainage lines intersecting low stony hills and undulating plains. Reddish brown clay-loam soils.		
AiSgTb	*Acacia inaequilatera, Hakea lorea* subsp. *lorea* tall open shrubland; *Senna glutinosa* mid open shrubland; *Triodia brizoides, Triodia epactia*, *Cymbopogon ambiguus* low hummock/tussock grassland.	None.	Primarily associated with rocky ridges and outcrops. Reddish brown clay-loam soils.		
ElAbTl	*Eucalyptus leucophloia* subsp. *leucophloia*, ±*Corymbia hamersleyana* low open woodland; *Acacia bivenosa* mid sparse shrubland; *Triodia longiceps*, *Triodia wiseana, ±Triodia brizoides* low hummock grassland.	None.	Low stony hills, plains, and undulating plains sometimes with dissecting drainage lines. Often with quartz and calcrete. Reddish brown clay-loam.	883.22	43.42
ElGwTe	*Eucalyptus leucophloia* subsp. *leucophloia*, ±*Corymbia hamersleyana* low open woodland; *Grevillea wickhamii* mid sparse shrubland; *Triodia*	None. This vegetation unit supports the EPBC Act-listed	Low rocky hills and ridges with red-brown clay-loam soil.	236.53	28.88

Vegetation Type code	Vegetation Type	Conservation Significance	Landform and Soils	Extent within CPAA (ha)	Extent within IDF (ha)
	epactia, *Eriachne lanata*, *Eriachne mucronata* low hummock/tussock grassland.	species *Quoya zonalis* in the north-west corner of the survey area; however, this area is outside and far from the CPAA.			
EvAcCc (PGDV)	*Eucalyptus victrix*, ±*Eucalyptus camaldulensis* subsp. *refulgens* mid open woodland; *Acacia coriacea* subsp. *pendens*, *Acacia pyrifolia* var. *pyrifolia*, *Atalaya hemiglauca* tall open shrubland; **Cenchrus ciliaris, Triodia longiceps*, *Triodia epactia* low tussock/hummock grassland.	PGDV & GDV; locally restricted.	Minor and major creeks and minor gullies.	80.78	2.89
EvAcCc (GDV)				155.60	8.61
VfAl	**Vachellia farnesiana* mid sparse shrubland; *Aristida latifolia*, *Cynodon convergens*, *Eriachne mucronata* low tussock grassland.	Priority 1 PEC (Four plant assemblages of the Wona Land System).	Low hills and plains with clay soils, often stony.	11.53	-
Cleared				325.45	149.37
Total				**3,823.67**	**446.58**

2.3.5 Conservation Areas

There are no conservation areas adjacent to or within 4 km of the CPAA. The closest conservation area is the Fortescue Marsh, which is over 5 km from the most southern part of the Project within the CPAA (Post Text Figure 7).

2.3.6 Conservation Significant Flora

No threatened species under the EPBC Act and BC Act were recorded within the CPAA. Two DBCA-listed Priority species were identified within the CPAA Post Text Figure 8:

- *Ipomoea racemigera* (P3): One individual was recorded within a creek in vegetation type EvAcCc.
- *Ptilotus mollis* (P4): Widespread in the Pilbara region, typically occurring on steep rocky slopes. A total of 558 individuals were recorded within the CPAA.

2.3.7 Groundwater Dependent Ecosystems

As described in Section 2.3.4, vegetation type EvAcCc, supports both PGDV and DGV within the CPAA. However, the Project is not expected to directly impact groundwater or associated dependent ecosystems, as there will be no groundwater dewatering, disposal, or re-injection.

2.3.8 Introduced Species

Within the CPAA, eleven introduced species were recorded, including *Calotropis procera*, listed as a Declared Pest-s22 (2) on the Western Australian Organism List. This species was found mainly in the northern part of the CPAA, near the disturbed areas associated with the Nullagine Mine (Post Text Figure 9). Most introduced species are widely naturalised in the Pilbara, although *Chenopodium murale* was recorded at its range extension. Significant weed infestations were observed in major drainage channels (vegetation type EvAcCc), where *Cenchrus ciliaris* and *Cenchrus setiger* were often dominant in the ground layer.

The list of species recorded are:

- *Aerva javanica*;
- *Argemone ochroleuca subsp. ochroleuca*;
- *Calotropis procera*;
- *Cenchrus ciliaris*;
- *Cenchrus setiger*;
- *Chenopodium murale*;
- *Echinochloa colona*;
- *Malvastrum americanum*;
- *Solanum nigrum*;
- *Tribulus terrestris*; and
- *Vachellia farnesiana*.

2.4 Fauna and Habitat

Multiple fauna surveys have been conducted across the Nullagine Mine tenements, which intersect the CPAA, the most recent of which are:

- Fortescue Annual Fauna Monitoring Program 2023 (Spectrum, 2024a) (Appendix 2), which included a monitoring program for the Northern Quoll and other significant species in the Nullagine Mine area. This survey presents the results obtained in the previous year of monitoring using motion cameras and searches for secondary evidence of Northern Quoll in key habitats. It also compares these monitoring results to previous fauna monitoring.
- Bonney Downs: Terrestrial Vertebrate Fauna Survey Consolidation (ecologia, 2025b): consolidated all existing research on the area (e.g., ecologia, 2024b and Spectrum, 2024b) and included a detailed terrestrial vertebrate fauna study, the results of a Bird and Bat Site Utilisation Survey (BBSUS) (ecologia, 2024c) along with a targeted fauna survey to address knowledge gaps and verify existing data. The survey covered 102,802.56 ha, encompassing the entire CPAA and its surrounding areas (Appendix 3).

All surveys were conducted in accordance with the Technical Guidance – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment.

Additionally, a Collision Risk Modelling Feasibility Assessment (Appendix 4) was conducted to assess the potential collision risk of birds and bats with turbine rotors.

2.4.1 Fauna Habitat

There are a variety of fauna habitats within the CPAA, which are typical for the bioregion. Fauna habitats represented in the CPAA are generally well represented at a local and regional scale (ecologia, 2025b).

Nine broad fauna habitats were identified during the surveys, five of which were mapped within the CPAA. Details of these habitats, including their extent within the CPAA, are provided in Table 2-4 and presented in Post Text Figure 10.

Table 2-4: Habitat type descriptions across the CPAA

Habitat Type	Description	Area within CPAA (ha)	Area within IDF (ha)
Drainage Line/River/Creek (major)	Large creeklines and rivers supporting open woodland of *Eucalyptus camaldulensis* and *Eucalyptus victrix* over and *Acacia coriacea subsp. pendens* over mixed *Cenchrus* and *Triodia* low tussock and hummock grassland.	114.37	0.34
Drainage Line/River/Creek (minor)	Shallow incised drainage channels and a higher density of vegetation than surrounding areas. Substrates of gravelly, sand or rocks on clay/loam soils supports scattered trees and shrubs.	130.36	10.47
Plain (cracking clays)	Mid-sparse *Acacia synchronicia* and *Vachellia farnesiana* shrubland over low *Aristida latifolia, Cynodon convergens, Rhynchosia minima* tussock grassland/ herbland on cracking gilgai clays.	7.79	-
Plain (stony/gibber)	Stony or stony sand on undulating plains and low rises with scattered eucalypts over mixed *Acacias* over spinifex hummock grasslands on loam-clay with a stony mantle.	3,154.58	282.55

Habitat Type	Description	Area within CPAA (ha)	Area within IDF (ha)
Rocky Escarpments (Ridges / Mesa / Cliffs / Outcrops / Breakaways)	Rocky features from small-scale rock face to large protruding rocks/boulders and mesas, usually associated with the tops or bases of ridgelines, stony hills and rises.	76.47	0.01
Cleared	Anthropogenic clearing with little to no vegetation.	340.22	153.20*
Total		3,823.79	446.58

*There is a slight discrepancy of 3.83 ha of cleared areas within the IDF recorded between the flora and fauna baseline studies.

A significant portion of the identified fauna habitats within the CPAA will be retained. Of the 3,823.70 ha within the CPAA, 3,483.48 ha are mapped within one of the five broad fauna habitats, and only 297.21 ha are proposed for clearing. This means that approximately 91% of the existing fauna habitats within the CPAA will remain undisturbed. Notably, even within individual habitat types, a substantial majority will be retained. For instance, approximately 99.7% of the Drainage Line/River/Creek (major), 92% of Drainage Line/River/Creek (minor), 100% of the Plain (cracking clays), 91% of the Plain (stony/gibber) and 99.9% of the Rocky Escarpments habitat, will be retained within the CPAA.

2.4.2 Terrestrial Fauna

The detailed terrestrial fauna and habitat assessment undertaken confirmed the presence of 237 native species and three introduced species within the survey area (ecologia, 2025b). The surveys cover an area of approximately 102,802.56 ha, which is approximately 26 times greater than the 3,823.70 ha of the CPAA. The fauna assemblage within the CPAA includes 92 species.

2.4.3 Conservation Significant Fauna

The targeted fauna surveys confirmed the presence of four conservation significant species and a further three as potentially occurring within the CPAA (ecologia, 2025b). These species are listed in Table 2-5. Records of conservation significant fauna within the CPAA are displayed in Post Text Figure 11.

Table 2-5: Conservation significant fauna recorded across the CPAA (ecologia, 2025b)

Species	Common Name	Status	Comment on the potential presence
Dasyurus hallucatus	Northern Quoll	Endangered (EPBC Act and BC Act)	Rocky escarpments provide denning and shelter habitats, also known to inhabit riverine habitats and utilise drainage lines for distribution.
Rhinonicteris aurantia [Pilbara form])	Pilbara leaf-nosed bat	Vulnerable (EPBC Act and BC Act)	Found within large creeklines and rivers supporting open woodland of *Eucalyptus camaldulensis* and *Eucalyptus victrix* over and *Acacia coriacea subsp. pendens* over mixed *Cenchrus* and *Triodia* low tussock and hummock grassland. This species may use the habitat for transit and foraging, however, it is not likely that the habitat is used for roosting because no low-time calls indicative of roosting were detected and no suitable roosting caves were identified within the survey area for the BBSUS. Not recorded within

Species	Common Name	Status	Comment on the potential presence
			the CPAA but has the potential to forage in the CPAA.
Falco hypoleucos	*Grey falcon*	Vulnerable (EPBC Act and BC Act)	Species may utilise large creeklines and rivers within the survey area while foraging or breeding and may overfly all habitat types. Not recorded within the CPAA but has the potential to forage or roost in the CPAA.
Macroderma gigas	*Ghost bat*	Vulnerable (EPBC Act and BC Act)	Potential roosting habitat and nocturnal refugia present within the Rocky Escarpments habitat type. No caves with attributes required to support roosting were identified within the survey area. Not recorded within the CPAA but has the potential to forage within the CPAA.
Leggadina lakedownensis	Short-tailed mouse	Priority 4 (DBCA - WA)	Semi-arid habitats including spinifex and tussock grasslands, samphire and sedge lands. Acacia shrublands and stony ranges. Known to occur in seasonally inundated areas with red or white sandy clay soils.
Pseudomys chapmani	Western Pebble-mound Mouse	Priority 4 (DBCA - WA)	Found within the Rocky Escarpments and Plain (stony/gibber) habitat types. This species is considered locally widespread and suitable habitat for this species extends well beyond the survey area.
Dasycercus blythi	Brush-tailed Mulgara	Priority 4 (DBCA – WA)	Suitable burrowing habitat is found within sandier parts of the Plain (stony/gibber) habitat type. The species has been recorded on multiple occasions within 50 km of the survey area.

The conservation-significant fauna species recorded in the latest fauna survey are consistent with those identified in previous surveys conducted by BC Iron prior to 2016. The comprehensive assessment of conservation-significant fauna within the Nullagine Mine area highlights the presence of the Northern Quoll, a listed threatened species under the EPBC Act. Consequently, the Project has been determined to be a controlled action with the controlling provision being listed threatened species. Ongoing monitoring and management strategies are in place to mitigate potential impacts and protect these species.

While the Nullagine Pilot Wind Project intersects the area covered by the controlled action, it does not directly affect the key Northern Quoll habitat associated with Bonnie Creek and adjacent Rocky Escarpments habitat.

Bird and bat site utilisation surveys were conducted within the survey area to evaluate the potential interactions between local avian and chiropteran fauna and the proposed wind turbines. Three BBSUS have been completed: October 2023 (spring), February 2024 (summer), and March 2024 (autumn) (ecologia, 2024c). This data complements broader fauna assessments and targeted surveys previously conducted.

The Grey Falcon (*Falco hypoleucos* [Vulnerable] EPBC Act, BC Act), was recorded twice during BBSUS and nine times incidentally, at locations outside the CPAA. The Grey Falcon has the potential to forage or roost in the CPAA. Echolocation analysis identified two EPBC-listed species: the Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*, Pilbara form [Vulnerable] EPBC Act, BC Act) and Ghost Bat (*Macroderma gigas* [Vulnerable] EPBC Act, BC Act).

Calls from the Pilbara Leaf-nosed Bat were recorded at multiple sites, one of them located within the CPAA along the Nullagine-Christmas Creek haulage road, where no turbines are

planned. The usage of habitat types within the Project area appears to be restricted to foraging and dispersal activities only (ecologia, 2024c).

Ghost bats have shown limited presence in the project vicinity. Although Rocky Escarpment habitat may provide foraging and nocturnal refuge, no suitable roosting caves were located. The species was recorded once within Drainage Line/River/Creek (major) habitat outside the CPAA (ecologia, 2024c).

2.4.4 Introduced Species

Three introduced species were identified as having the potential to occur in the CPAA:

- *Felis catus* (Cat);
- *Bos primigenius taurus* (European cattle);
- *Mus musculus* (House mouse).

2.4.5 Short Range Endemics (SRE)

Short-range endemic (SRE) fauna are defined as animals that display restricted geographic distributions, nominally less than 10,000 km^2, that may also be disjunct and highly localised (EPA, 2016b).

The Project lies in a habitat that extends well outside of the CPAA. Such broadly represented environments across the landscape are not conducive to the evolution of SRE invertebrates, which are generally favoured by the presence of fragmented, isolated, and often mesic refugia (Bamford, 2016).

The likelihood of SRE invertebrates being present in the CPAA is considered to be low due to the lack of isolation and mesic refugia. The largest mesas, such as those in the Warrigal North area (outside the Project), have the greatest potential for SRE invertebrates but are part of a linear system and not isolated. Caves visited during the assessment were dry rather than moist, and the geology of the hills indicated moisture and water only in the streambed, with no moist seepages on the slopes (Bamford, 2016).

No SRE species were identified during the surveys (Bamford, 2016). Therefore, both the likelihood of SREs being present and the risk of impact are considered to be low.

2.4.6 Subterranean Fauna

Subterranean fauna are animals that inhabit underground habitats and include troglofauna and stygofauna. Troglofauna are terrestrial fauna that inhabit air chambers in underground caves or small, humid air-filled voids. Stygofauna are groundwater-dwelling aquatic fauna that inhabit a range of groundwater systems.

The Project is not expected to intercept groundwater, and therefore, there is no anticipated threat to subterranean fauna from these activities.

2.5 Hydrology

A series of hydrological studies have been undertaken to assess water resources, flow patterns, and potential hydrological impacts associated with the Project. These studies have been conducted over several years, focusing on understanding the seasonal variability, flood risks, surface water values and water quality parameters.

The most recent studies undertaken are:

- Pilbara Decarbonisation Project – Bonney Downs Baseline Hydrology Study (Advisian, 2023);
- Bonnie Creek Catchment – Baseline Surface Water Modelling Update (Fortescue, 2024a).
- Mining Development and Closure Proposal Surface Water Assessment (Fortescue, 2024b);
- Bonney Downs Stage 1 – Baseline Hydrology and Impact Assessment (Fortescue, 2025).

2.5.1 Regional Hydrology

The Project is located within the Nullagine River catchment, a sub-catchment of the De Grey River system. The Nullagine River catchment has an approximate total area of 7,220 km², which includes the headwaters that rise south of Bonney Downs Station. The river flows northward, crossing the Marble Bar Road at Nullagine before merging with the Oakover River to form the De Grey River. The De Grey River flows into the Indian Ocean. The regional hydrological setting is shown in Post Text Figure 12.

The Nullagine River catchment spans roughly 7,100 km² and lies to the south within the broader De Grey River catchment. It is bounded to the south by the Hamersley Ranges, which delineate the Nullagine River catchment from the Upper Fortescue River catchment. Major tributaries include Bonnie Creek, Cajuput Creek, and Five Mile Creek, with the main watercourse being the Nullagine River. This catchment contains ephemeral watercourses, which flow predominantly in response to seasonal rainfall (Fortescue, 2025).

The De Grey River catchment, encompassing approximately 57,000 km², is bordered by the Sandy Desert Basin to the east, the Fortescue River Basin to the south, and the Port Hedland Coast Basin to the west. This extensive catchment includes major tributaries such as the Strelley, Shaw, Coongan, and Oakover rivers, and it is defined by diverse hydrogeological provinces, including the ‘Coastal Plain,’ ‘Granite Greenstone Terrane,’ ‘Oakover,’ and areas of the ‘Chichester Range’ (Fortescue, 2024a).

2.5.2 Local Hydrology

Bonnie Creek is the primary watercourse flowing through the Project development area and contributes flow to the Nullagine River. Bonnie Creek is part of a 260 km² catchment area, with its flow occurring intermittently in response to seasonal rainfall events. Notable surface water receptors in the vicinity of the Project include:

- Bonnie Creek: The primary watercourse flowing through the mine site, carrying intermittent seasonal flows that contribute to the regional hydrology. Bonnie Creek is a culturally significant water source to Palyku and has been recorded as an ethnographic site. Bonnie Creek is also managed by Fortescue as a Heritage Restriction Zone (HRZ).
- Bonnie Pool: A persistent alluvial pool located in the lower reaches of Bonnie Creek, noted for its ecological and heritage values. Bonnie Pool also has cultural significance to Palyku.
- Nullagine River: The main regional watercourse, which serves as the receiving environment for Bonnie Creek’s flow and supports regional hydrological connectivity.

- Nullagine Water Reserve: A gazetted Public Drinking Water Source Area, located approximately 10 km downstream from the Nullagine Mine, providing a critical water resource for the surrounding communities.

The key surface water receptors are shown in Post Text Figure 13.

2.6 Hydrogeology

Several studies have been conducted to assess the hydrogeological conditions in the Nullagine region, providing an understanding of groundwater resources and changes over time. The following key studies have been identified:

- Annual Aquifer Review 2010 Nullagine Iron Ore Joint Venture Project (Parsons Brinckerhoff, 2010)
- Nullagine Annual Groundwater Monitoring Summary - January 2023 to 31 December 2023 (Fortescue, 2024c)
- Nullagine Baseline and Groundwater Change Assessment (Fortescue, 2024d).

These studies form the basis for the Project's hydrogeological assessment.

2.6.1 Regional and Local Groundwater Setting

The Project area is located on the northeastern edge of the Hamersley Basin, and features Tertiary aged channel iron deposits which lay non-conformably over Archean basalts and metasediments of the Fortescue Group, known as the Maddina basalts. Underlying the basalts and metasediments are faulted and folded Archean granitoids which form part of the Pilbara Craton.

Two main aquifers have been identified in the project area:

- Superficial formations including alluvium, colluvium, detritals and local calcretes
- Fractured and weathered bedrock

The superficial formations host very localised, seasonal aquifers with low yield potential. Most of the upper creeks are unsaturated. The Tertiary detritals are poorly sorted with calcrete precipitates which are highly weathered. No evidence of karstic features has been observed within the calcretes, or any other indication of enhanced secondary permeability (CH-16018-RP-HY-001).

The superficial formations overly the Fortescue Group basalts, which act as a fractured rock with typical low yielding potential. Increased permeability, secondary porosity and groundwater yields are associated with fracture formation and weathered bedrock profiles. Groundwater occurs predominantly in deep fractures, estimated to be 44 to 65m deep, but to a lesser extent also in shallow weathered and fractured zones from 6 to 18m depth (Emerge, 2013).

The two aquifers appear to be connected, with no clay or confining layers logged. Groundwater flow is typically from south to north across the site, consistent with topographic flow from recharge to discharge areas. Groundwater levels range from approximately 2m to 19m below ground level (m bgl).

The construction and operation of the Project is not expected to impact the groundwater setting or associated receptors over the mid to long term. Unlike mining activities, the Project will not require significant excavation or disturbance of the subsurface. Water for construction purposes, including dust suppression, will be sourced from existing, licenced borefields used for the Nullagine Mine, ensuring compliance with regulatory water allocation limits.

2.7 Heritage and Social Setting

The Project is located approximately 20 km southwest of the town of Nullagine, within the Shire of East Pilbara. Nullagine is a small town with a population of 147 people, according to the 2021 Census (Australian Bureau of Statistics, 2021). The town's economy is largely supported by surrounding mining operations, with industries related to other mine sites in the region.

The Project is situated within a region that is already established as a hub for mining activities. It is located primarily on the Bonney Downs Pastoral Lease, with sections of the haul road situated on the Hillside Pastoral Lease (Post Text Figure 14). While the Project is expected to generate some employment and procurement opportunities, the overall impact on the town of Nullagine is likely to remain modest.

2.7.1 Aboriginal Cultural Heritage

The Project's proposed wind turbines are situated on the traditional lands of the Palyku people, and the proposed haul road is on the traditional lands of the Nyiyaparli people. Both Palyku and Nyiyaparli have established Native Title determinations over portions of the Project area. BC Iron and Palyku signed a mining agreement in April 2010 (Post Text Figure 15). This agreement allows mining and associated activities to proceed within the area covered by the Palyku Native Title Determination, ensuring that cultural heritage is respected and appropriately managed.

Heritage surveys conducted across the Project area have identified numerous sites of ethnographic and archaeological significance (Aboriginal heritage sites) (Post Text Figure 16). Heritage surveys are continuing within the Project area to ensure information is up to date to inform current and future mine plans. These surveys have been undertaken in collaboration with Palyku and Nyiyaparli (where required). The Project's design avoided all presently known heritage sites and values.

2.7.2 Non-Indigenous Heritage

A search in the InHerit portal (Heritage Council, 2024) indicates no records of other heritage sites occurring within CPAA. The nearest recorded heritage site is the Bonney Downs Homestead and Log Cabin (Place number 820), situated about 6 km east of the haulage road connecting Nullagine to the Christmas Creek Mine.

3 ASSESSMENT OF CLEARING PRINCIPLES

The proposed clearing activities have been assessed against the ten clearing principles as outlined in Schedule 5 of the EP Act and presented in Table 3-1. These principles aim to ensure that all potential impacts resulting from the removal of native vegetation can be assessed in an integrated way and applied to all lands in Western Australia. The principles address the four main environmental areas of biodiversity significance, land degradation, conservation estate as well as ground and surface water quality.

Table 3-1: Assessment against the ten clearing principles

Proponent Assessment of the Clearing Principles
(a) Native vegetation should not be cleared if it comprises a high level of biological diversity.
The proposed clearing is not at variance with this principle. The proposed clearing area has been assessed for its biological diversity, particularly regarding TECs, PECs, and conservation significant flora. The key findings are: • No TECs listed under the EPBC Act or BC Act were identified within the CPAA (ecologia, 2025a). • A DBCA listed PEC, "Four plant assemblages of the Wona Land System," specifically the Priority 1 sub-community, “Cracking Clays of the Chichester and Mungaroona Range” was recorded within the CPAA (corresponding to vegetation type VfAl). Vegetation type VfAl will not be impacted by the proposed clearing as it has been avoided in the Project design (it covers 11.53 ha of the CPAA and 0 ha within the IDF). • The vegetation type EvAcCc is locally restricted and supports PGDV and GDV. However, of the total EvAcCc vegetation type within the CPAA, only 3.57% of PGDV and 5.54% of GDV is within the IDF. Therefore, this vegetation type will not be significantly impacted. • Two additional vegetation types in the CPAA are also considered potentially locally restricted; AaEp and AaTe. The AaEp vegetation type will not be directly impacted by the Project as it is outside the IDF. Only 0.62% of the AaTe vegetation type is within the IDF and therefore, it will not be significantly impacted. • There are no Priority species within the IDF, thereby minimising the potential biodiversity loss. Based on the information above, the proposed clearing is not likely to significantly affect areas with a high level of biodiversity at a local or regional scale. The impact to conservation significant vegetation and types will be nil to minimal, and therefore the proposed clearing is not at variance with this 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.

The proposed clearing is not at variance with this principle.
• Five broad fauna habitats were identified within the CPAA (ecologia, 2025b). These habitats are typical for the Pilbara bioregion and well represented at a local and regional scale.
• The targeted fauna surveys confirmed the presence of four conservation significant fauna species within the CPAA. These species are listed in Table 2-5 and presented in Post Text Figure 11. Below is a summary of the conservation significant fauna species and their likely impacts from the proposed clearing:
  ○ Northern Quoll – Endangered (EPBC Act, BC Act). Rocky escarpments and riverine habitats provide denning and shelter. Drainage lines are also used for distribution. The Project is unlikely to significantly impact key habitat areas for this species, as minimal clearing is planned within Rocky Escarpments, leaving approximately 99.9% of this habitat as well as 99.7% of Drainage Line/River/Creek (major) and 92% of Drainage Line/River/Creek (minor) habitats within the CPAA intact.
  ○ Grey Falcon - Vulnerable (EPBC Act and BC Act). Not recorded within the CPAA. Potential foraging habitat exists, particularly within Drainage Line/River/Creek (major) areas. This fauna habitat will be minimally impacted by direct clearing, retaining 99.7% of the area mapped within the CPAA.
  ○ Ghost Bat - Vulnerable (EPBC Act, BC Act): This species has the potential to forage in all habitat types. Rocky Escarpments offer potential nocturnal refugia and feeding perches. No suitable roosting caves were identified, and no low-time calls indicative of roosting were detected. 99.9% of the Rocky Escarpments habitat mapped within the CPAA will not be impacted by direct clearing.

- Pilbara Leaf-nosed Bat - Vulnerable (EPBC Act, BC Act): Potential foraging habitat within the Project area, mainly in Drainage Line/River/Creek (major) habitat. No suitable roosting caves were identified, and no low-time calls indicative of roosting were detected. 99.7% of the Drainage Line/River/Creek (major) will not be impacted by direct clearing.
- Short-tailed Mouse – Priority 4 (DBCA). Found in semi-arid habitats, including spinifex and tussock grasslands. Known to occur in areas with seasonally inundated soils. The habitat for this species is present within the CPAA but considered widespread in the local area, extending well beyond the Project area. No direct impact is expected for Plain (cracking clays) habitat, which is the most suitable habitat within the CPAA and 92% of Drainage Line/River/Creek (minor) mapped within the CPAA will not be impacted by direct clearing.
- Western Pebble-mound Mouse – Priority 4 (DBCA). Found within Rocky Escarpments and Plain (stony/gibber). While suitable habitat is present within the CPAA, it is unlikely that this species will be significantly impacted by the clearing given that the habitat for this species is locally widespread and extends well beyond the CPPA. The Rocky Escarpments and Plain (stony/gibber) habitats will be minimally impacted by direct clearing. Approximately 99.9% of the former and 91% of the latter habitat will remain undisturbed.
- Brush-tailed Mulgara - Priority 4 (DBCA). A suitable burrowing habitat is found within sandier parts of the Plain (stony/gibber) habitat type. Approximately 91% of this fauna habitat within the CPAA will not be impacted. The species has been recorded on multiple occasions within 50 km of the survey area.

- The likelihood of SRE fauna being present within the Project area is considered low due to the absence of isolated and mesic habitats, and no SRE species were confirmed during surveys.

Based on the surveys and assessment of fauna habitat and conservation significant species within the CPAA, the proposed clearing is unlikely to significantly impact the habitat of fauna indigenous to Western Australia at a local or regional level. No restricted fauna habitats have been identified, and the majority of conservation significant species are not expected to be significantly impacted by the clearing given their widespread and extensive habitat. Therefore, the proposed clearing is not likely to be at variance with this clearing principle.

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

The proposed clearing is not at variance with this principle.

No Threatened flora species protected under the EPBC Act or BC Act were recorded within the CPAA.

Two Priority flora species listed by DBCA were identified in the CPAA, including:

- *Ipomoea racemigera* (P3): One individual recorded in a creek, with potential for more presence in similar habitats. No clearing of this species will be undertaken.
- *Ptilotus mollis* (P4): Widespread in the Pilbara, occurring on steep rocky areas. No clearing of this species will be undertaken.

The proposed clearing will not affect any known Priority flora species, as all recorded individuals are outside the proposed clearing area.

Populations of Priority flora will be avoided where possible, and any new or previously unrecorded species identified during pre-clearance surveys will be assessed and managed appropriately in consultation with relevant authorities.

(d) Native vegetation should not be cleared if it comprises the whole or a part of or is necessary for the maintenance of a TEC.

The proposed clearing is not at variance with this principle.

- No TECs listed under the EPBC Act and the BC Act were recorded within the CPAA.
- The proposed clearing will not affect any known TECs or areas necessary for their maintenance.

The proposed clearing is unlikely to impact any TECs at a local or regional level. Therefore, the proposed clearing is not likely to be at variance with this 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 proposed clearing is not at variance with this principle.

- The survey area is located within the Chichester and Fortescue subregions of the Pilbara IBRA where the surrounding landscape is generally intact, and the vegetation types present within the CPAA are common and widespread.

- There is no indication that the vegetation within the CPAA is significant as remnant vegetation in an area that has been extensively cleared, as the habitats recorded are typical for the subregion and are found in adjacent areas.

Given the widespread extent of the vegetation within the CPAA and the survey area at large, the proposed clearing is not likely to significantly impact native vegetation as the vegetation is not considered to be significant as a remnant of native vegetation. Therefore, the proposed clearing is not likely to be at variance with this 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.

The proposed clearing is not at variance with this principle.

- There are no wetlands or permanent surface water features within the CPAA.
- All drainage lines within the CPAA are ephemeral and remain dry for most of the year.
- One vegetation type within the CPAA, EvAcCc, is associated with riparian vegetation. The proposed clearing is not expected to cause a significant impact on this vegetation type because out of 236.37 ha of this vegetation type mapped within the CPAA only 11.50 ha (<5%) will be cleared. This vegetation type is well-represented in the surrounding area.

Given the information above, the proposed clearing is unlikely to significantly impact watercourses or wetlands at a local or regional level. Therefore, the proposed clearing is not likely to be at variance with this clearing principle.

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

The proposed clearing is not at variance with this principle.

- The proposed clearing area is predominantly gently sloping, with no significant risk of erosion or land degradation identified.
- The depth to water in the project area is below 6 m, with most areas below 10 m. The project will not intercept the groundwater, and no deep excavations are predicted for construction. Therefore, the risk of disturbing acid-sulfate soils is low.
- Management measures, including the clearing technique (blade down), surface water control, erosion management and rehabilitation, will be implemented during and after clearing to minimise any risk of land degradation.
- Disturbed areas will be rehabilitated progressively during operations and at the completion of the Project.

Given the above, the proposed clearing is unlikely to cause appreciable land degradation at a local or regional level. Therefore, the proposed clearing is not likely to be at variance with this 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 is not at variance with this principle.

- There are no conservation areas adjacent to or within 4 km of the CPAA. The closest conservation area is the Fortescue Marsh, which is over 5 km from the most southern part of the Project within the CPAA.
- The proposed clearing will not impact any adjacent or nearby conservation areas.

The proposed clearing is not at variance with this 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.

The proposed clearing is not at variance with this principle.

Surface Water:

- There are ephemeral watercourses and drainage lines within the CPAA that remain dry most of the year.
- The flood study indicates that the Project will have minimal impacts on regional or local surface water flow regimes (Fortescue, 2025).
- No significant changes to water quality, such as increased sedimentation or contamination, are expected as a result of the proposed clearing.

Groundwater:

- The Project will not disturb groundwater, as there will be no significant excavation or disturbance of the subsurface.
- The Project is not expected to directly impact groundwater or associated dependent ecosystems, as there will be no groundwater dewatering, disposal, or reinjection.
- Groundwater for construction purposes will be sourced from existing licensed bores.

Based on the above, the proposed clearing is unlikely to significantly impact the quality of surface or groundwater at a local or regional level. Therefore, the proposed clearing is not likely to be at variance with this clearing principle.

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

The proposed clearing is not at variance with this principle.

- A detailed hydrological assessment has confirmed that the proposed clearing is unlikely to cause or exacerbate flooding (Fortescue, 2025).
- Flood modelling indicates that the changes in surface water flow resulting from the Project are localised and minimal, with negligible impact on regional or local flood peaks (Fortescue, 2025).

Based on the above, the proposed clearing is unlikely to cause or exacerbate flooding at a local or regional level. Therefore, it is not likely to conflict with this clearing principle.

In summary, the assessment of the proposed clearing of 297.21 ha of native vegetation within 3,823.70 ha of CPAA against the ten clearing principles demonstrates that the proposed clearing is not likely to be at variance with any of those principles.

4 ENVIRONMENTAL MANAGEMENT MEASURES

The environmental management measures and commitments listed within Table 4-1 have been created to ensure impacts to native flora, vegetation, fauna, and habitat are minimised as far as practicable. The management measures presented are consistent with those made within the Mining Proposal for the Nullagine Pilot Wind Project, which is currently under assessment by DEMIRS.

Table 4-1: Environmental Management Measures and Commitments

Environmental Aspect	Commitment Number	Commitment
Clearing and Topsoil Disturbance	Commitment 1	Activities are undertaken in a manner that minimises vegetation clearing and ground disturbance to the greatest extent practicable, to ensure conservation significant flora and vegetation types are protected. .
	Commitment 2	All clearing and ground disturbance will be undertaken in accordance with a Native Vegetation Clearing Permit and the Land Use Certification Acquisitions and Tenements Procedure (100-PR-TA-0001). The procedure will be incorporated into the site induction.
	Commitment 3	Vehicles and other equipment will remain on the designated access routes.
	Commitment 4	Disturbed areas will be rehabilitated progressively where possible and in accordance with the Mine Closure Plan.
	Commitment 5	Topsoil and vegetation will be removed and stored in windrows to a maximum height of 2 m for use in rehabilitation in accordance with the Ground Disturbance and Topsoil Management Procedure (Appendix 9). Stockpiles will be signposted.
Surface Water	Commitment 7	Access routes and mining infrastructure will avoid existing drainage lines where practicable.
	Commitment 8	Surface mobile equipment will be maintained throughout the life of the Project to minimise the risk of spillage and/or seepage of hydrocarbons to the environment.
	Commitment 9	Stormwater management controls, including v-drains, bunds and berms will be constructed as necessary to direct rainfall away from open excavations.
	Commitment 10	Nutrient management from spray fields will be undertaken in accordance with site-specific water quality management requirements to prevent excess nutrient loading and potential impacts on surface and groundwater quality.
Flora and Fauna	Commitment 11	Weed hygiene requirements described in the Weed Management Plan (NU-PL-EN-0003) will be adhered to, including the requirement that all vehicles and equipment arriving on site be in a clean condition, free of soil, weeds, seeds and vegetative matter.
	Commitment 12	Any weeds identified within the Project area will be controlled in accordance with the weed control and monitoring program prescribed in the Weed Management Plan (NU-PL-EN-0003).
	Commitment 13	Pre-clearance checks for conservation significant flora and fauna will be undertaken prior to clearing and in accordance with the Land Use Certification Acquisitions and Tenements Procedure

Environmental Aspect	Commitment Number	Commitment
		(100-PR-TA-0001). No ground disturbance will be undertaken without a valid land use certificate.
	Commitment 14	Conservation significant fauna and habitat identified during a targeted fauna survey will be recorded in the Corporate GIS and Product Information Management System (PIMS) in accordance with the Environmental Datasets – Data Governance Guidelines (100-GU-EN-0020).
	Commitment 15	Impacts to conservation significant fauna will be managed in accordance with the Conservation Significant Fauna Management Plan (45-PL-EN-0034) and the following requirements: • Targeted fauna surveys will be undertaken to determine the distribution of conservation significant fauna. • Light and noise emissions that could potentially impact fauna will be managed. • Speed limits to minimise collisions with fauna will be imposed.
Air Quality and Noise	Commitment 16	Dust impacts from Project activities will be managed in accordance with the Dust Management Plan (IO-PL-EN-0001), including the following requirements: • Unsealed surfaces will be watered as required to minimise the generation of dust in high-risk areas. • Dust monitoring programs will be implemented if required.
	Commitment 17	Vehicles will be maintained as per the manufacturer's specifications to ensure noise and air emissions are minimised.
Heritage	Commitment 18	All proposed operations will be carried out in accordance with the provisions of the *Aboriginal Heritage Act 1972.*
Chemical and Hydrocarbon Management	Commitment 19	Chemicals and hydrocarbons will be managed on site in accordance with the Chemical and Hydrocarbon Storage Procedure (100-PR-EN-1064) and Hazardous Chemicals Management Procedure (45-PR-SA-0061), including the following requirements: • Risk assessment of all hazardous chemicals. • Staff training (ChemAlert Administrator, Hazardous Chemicals, and Dangerous Goods). • Regular inspections of chemical storage areas. • Reporting of injuries, illnesses, and spills. • Adherence to chemical and hydrocarbon storage standards and design requirements. • Segregation of incompatible materials.
Workforce and Training	Commitment 20	Site induction will be completed by all personnel, which outlines strategies to protect the environment.

5 REHABILITATION

Rehabilitation is the return of disturbed land to a safe, stable, productive, non-polluting, and self-sustaining condition, enabling beneficial land uses. Disturbed areas will be rehabilitated progressively during operations and at the completion of the Project.

Rehabilitation, closure monitoring, and maintenance programs will be initiated to ensure the success of rehabilitation efforts, demonstrate compliance with completion criteria, and identify the need for maintenance activities as outlined in the Mine Closure Plan which will support the Mining Proposal for the Project.

6 REFERENCES

Advisian. (2023). *Pilbara Decarbonisation Project - Bonney Downs Baseline Hydrology Study.*

Australian Bureau of Statistics. (2021). *2021 Nullagine Census All persons QuickStats*.

Bamford. (2016). *BC Iron Nullagine Project Extension Areas – Warrigal North, Bonnie East, Coongan, Tindish and Woggie Assessment of Fauna Values*.

DPIRD. (2020). *Soil Landscape Mapping - Rangelands (DPIRD-064).*

ecologia. (2024a). *Bonney Downs North - Detailed Flora and Vegetation Assessment: Unpublished report prepared for Fortescue*.

ecologia. (2024b). *Bonney Downs North Wind Generation Project: Terrestrial Vertebrate Fauna Assessment*.

ecologia. (2024c). *Bonney Downs Stage 1 Wind Farm - Collision Risk Modelling Feasibility Assessment.*

ecologia. (2025a). *Bonney Downs Consolidated Flora and Vegetation Assessment*.

ecologia. (2025b). *Terrestrial Vertebrate Fauna Survey Consolidation*.

EPA. (2016a). *Environmental Factor Guideline: Flora and Vegetation*. Environmental Protection Authority, Perth.

EPA. (2016b). *Sampling of short range endemic invertebrate fauna*.

EPA. (2016c). *Technical Guidance Flora and Vegetation Surveys for Environmental Impact Assessment*. Environmental Protection Authority, Perth.

Fortescue. (2024a). *Bonnie Creek Catchment - Baseline Surface Water Modelling Update.*

Fortescue. (2024b). *Mining Development and Closure Proposal Surface Water Assessment.*

Fortescue. (2024c). *Nullagine Annual Groundwater Monitoring Summary - January 2023 to 31 December 2023*.

Fortescue. (2024d). *Nullagine Baseline and Groundwater Change Assessment*.

Fortescue. (2025). *Bonney Downs Stage 1 - Baseline Hydrology and Impact Assessment.*

Heritage Council. (2024). *inHerit.* https://inherit.dplh.wa.gov.au/Public/

Kendrick, P., & McKenzie, N. (2001). *Pilbara 1 (PIL1 - Chichester subregion) in A Biodiversity Audit of Western Australia's 53 Biogeographical Subregions in 2002*. Department of Conservation and Land Management, Perth.

Parsons Brinckerhoff. (2010). *Annual Aquifer Review 2010 Nullagine Iron Joint Venture Project.*

SLR. (2024). *Bonney Downs East Detailed Flora and Vegetation Survey: Unpublished report prepared for Fortescue.*

Spectrum. (2024a). *Annual Fauna Monitoring Program 2023-Operational Sites, Nullagine and North Star.*

Spectrum. (2024b). *Bonney Downs South Draft - Terrestrial Vertebrate Fauna Assessment.*

Strategen. (2014). *Warrigal Well Mining Proposal - M46/523*.

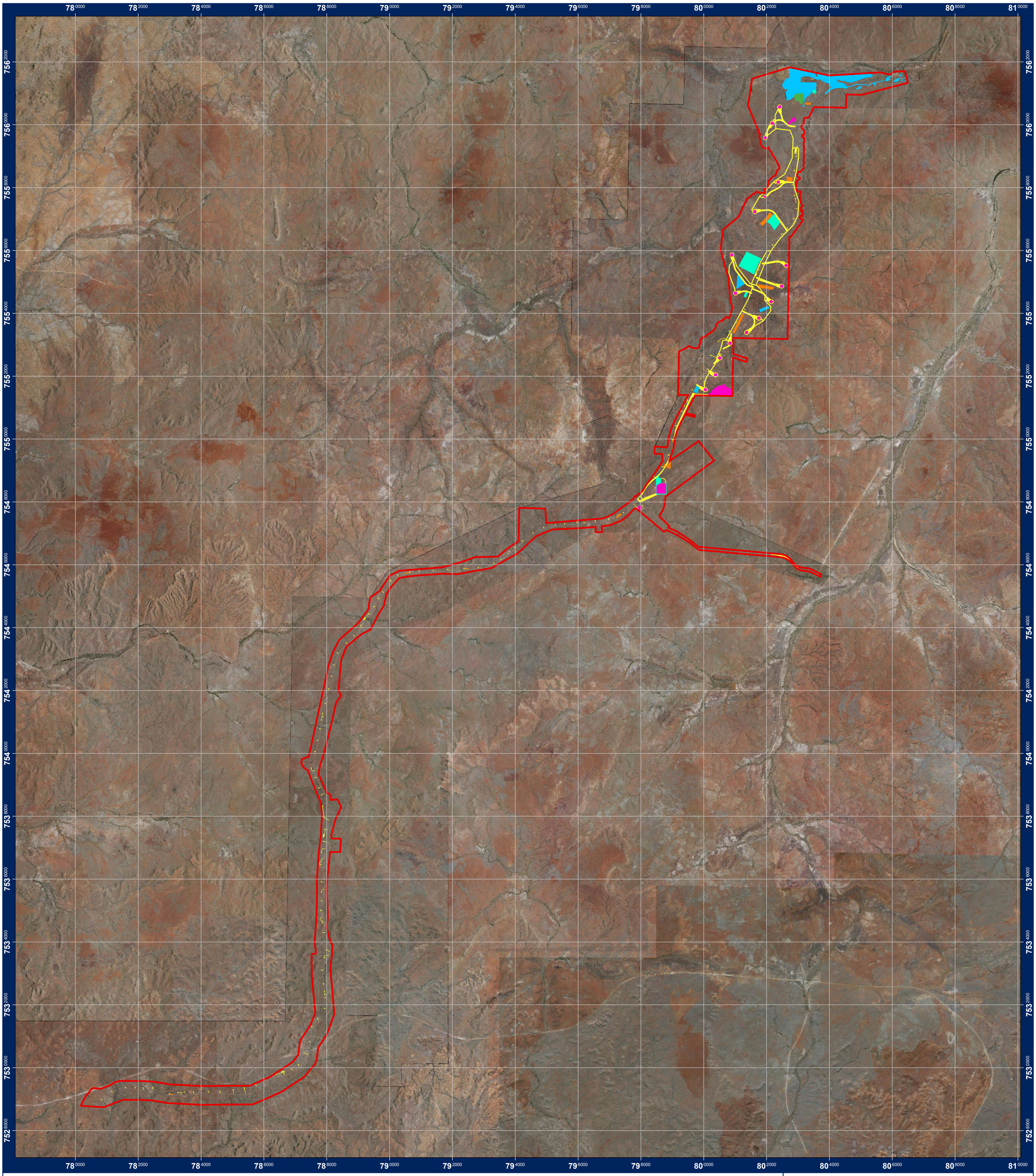
Sudmeyer, R. (2016). *Climate in the Pilbara Bulletin 4873*.

Thackway, R., & Cresswell, I. D. (1995). *An Interim Biogeographic Regionalisation for Australia: a framework for establishing the national system of reserves*.

DOCUMENT CONTROL

Native Vegetation Clearing Permit – Supporting Document		
Status	IFU - Issued for Use	5-May-25
Summary of Changes	N/A	
Author	Chris Heary	Signature
Checked or Squad Review# (if applicable)	Squad review	Signature
Approved	Zena Harman	Signature
Next Review Date (if applicable)	N/A	

Post Text Figure 1: Disturbance Layout



Legend

- Disturbance Envelope (CPAA)

Indicative Disturbance Footprint

- Borrow Pit and Shallow Surface Excavation
- Building or Camp Site
- Landfill Site
- Laydown or Hardstand Area
- Topsoil Stockpile
- Transport or Service Infrastructure Corridor

N

0 10

Kilometres

Data Source(s):
Indicative Disturbance Boundary, Fortescue, 15/04/2025
MRF Category, Fortescue, 15/04/2025

Basemap Credits: Esri, TomTom, Garmin, FAO, NOAA, USGS, Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Bonney Downs
Disturbance Layout

Requested By: Jacinta Saad
Drawn By: Nicholas Chai
Revised By: nchai
Approved By:
Scale: 1:80,000
Coordinate System: GDA 1994 MGA Zone 50
Plan Reference: Fig 1. Disturbance Layout
Document No.: 4519OP002_MP_EN_0072

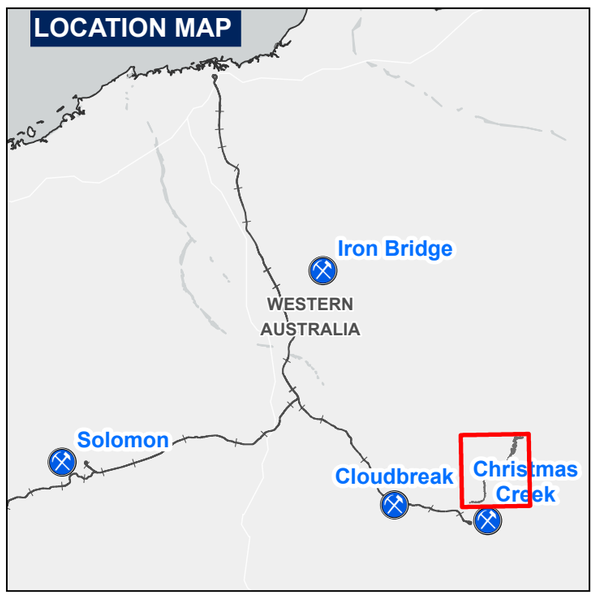
Date: 2/05/2025
Size: A3P
Revision: 0
Confidentiality: Public

Fortescue accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose. All information provided is to be used in accordance with any relevant Licence Agreements,Terms and Conditions and all applicable laws.

Fortescue™

Post Text Figure 2: Biogeographic Location





Legend

- Disturbance Envelope (CPAA)

IBRA Subregions

- Chichester
- Fortescue
- Indicative Disturbance Footprint

Data Source(s):
Indicative Disturbance Boundary, Fortescue, 15/04/2025
IBRA Subregions, WA Government, 15/04/2025

Basemap Credits: Esri, TomTom, Garmin, FAO, NOAA, USGS, Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

N

0 10

Kilometres

Bonney Downs
Biogeographic Location

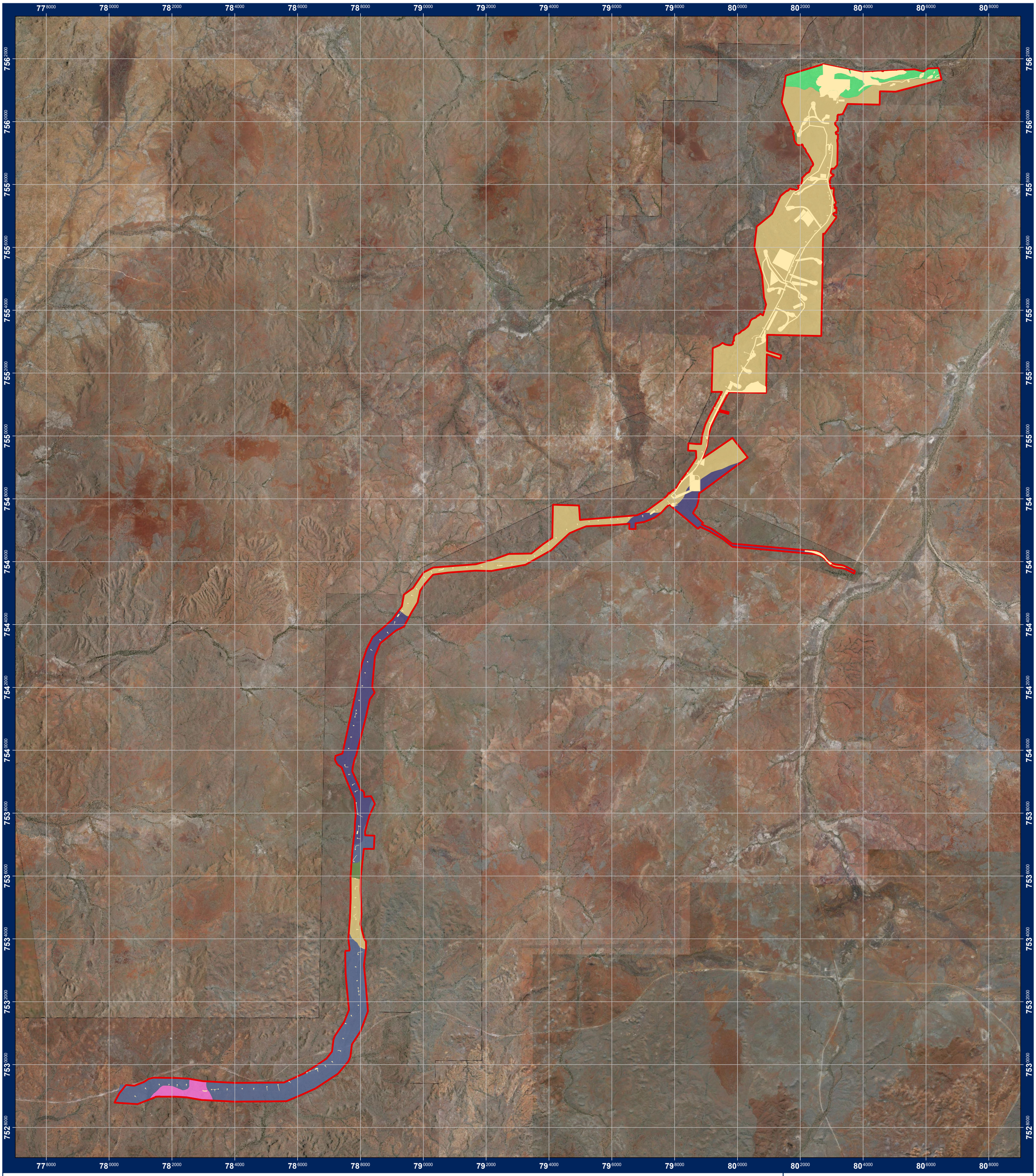
Requested By: Jacinta Saad
Drawn By: Nicholas Chai
Revised By: nchai
Approved By:
Scale: 1:80,000
Coordinate System: GDA 1994 MGA Zone 50
Plan Reference: Fig 2. Biogeographic Location
Document No.: 4519OP002_MP_EN_0072

Date: 2/05/2025
Size: A3P
Revision: 0
Confidentiality: Public

Fortescue accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose. All information provided is to be used in accordance with any relevant Licence Agreements,Terms and Conditions and all applicable laws.

Fortescue

Post Text Figure 3: Land Systems



Legend

- Disturbance Envelope (CPAA)
- Indicative Disturbance Footprint

WA Land Systems

- Bonney System
- McKay System
- Newman System
- Robe System
- Rocklea System
- Wona System

N

0 10

Kilometres

Data Source(s):
Indicative Disturbance Boundary, Fortescue, 15/04/2025
WA Land Systems, Fortescue, 15/04/2025

Basemap Credits: Esri, TomTom, Garmin, FAO, NOAA, USGS, Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Bonney Downs
Land Systems

Requested By: Jacinta Saad
Drawn By: Nicholas Chai
Revised By: nchai
Approved By:
Scale: 1:80,000
Coordinate System: GDA 1994 MGA Zone 50
Plan Reference: Fig 3. Land Systems
Document No.: 4519OP002_MP_EN_0072

Date: 2/05/2025
Size: A3P
Revision: 0
Confidentiality: Public

Fortescue accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose. All information provided is to be used in accordance with any relevant Licence Agreements,Terms and Conditions and all applicable laws.

Fortescue™

Post Text Figure 4: Vegetation Types



Legend

- Disturbance Envelope (CPAA)
- Indicative Disturbance Footprint

Vegetation Types

- AaEp
- AaTe
- ElAbTl
- ElGwTe
- Mosaic of AiCpTe1 AiCpTe2 AiSgTb
- VfAl
- Cleared
- EvAcCc (GDV)
- EvAcCc (PGDV)

N

0 10

Kilometres

Data Source(s):
Indicative Disturbance Boundary, Fortescue, 15/04/2025
WA Land Systems, Fortescue, 15/04/2025

Basemap Credits: Esri, TomTom, Garmin, FAO, NOAA, USGS, Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Bonney Downs
Vegetation Types

Requested By: Jacinta Saad
Drawn By: Nicholas Chai
Revised By: nchai
Approved By:
Scale: 1:80,000
Coordinate System: GDA 1994 MGA Zone 50
Plan Reference: Fig 4. Vegetation Types
Document No.: 4519OP002_MP_EN_0072

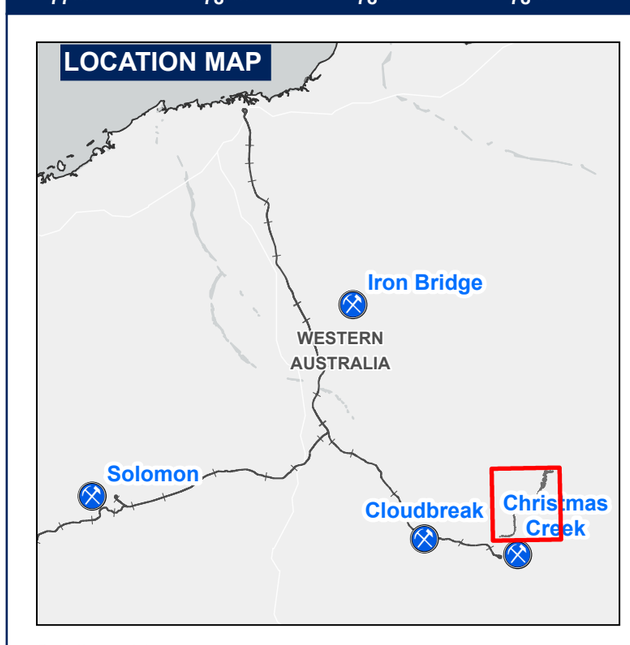
Date: 2/05/2025
Size: A3P
Revision: 0
Confidentiality: Public

Fortescue accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose. All information provided is to be used in accordance with any relevant Licence Agreements,Terms and Conditions and all applicable laws.

Fortescue™

Post Text Figure 5: Vegetation condition





Legend

- Disturbance Envelope (CPAA)
- Indicative Disturbance Footprint

Vegetation Condition

- Cleared
- Degraded
- Poor
- Good
- Very Good
- Excellent

N

0 10

Kilometres

Data Source(s):
Indicative Disturbance Boundary, Fortescue, 15/04/2025
WA Land Systems, Fortescue, 15/04/2025

Basemap Credits: Esri, TomTom, Garmin, FAO, NOAA, USGS, Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Bonney Downs
Vegetation Condition

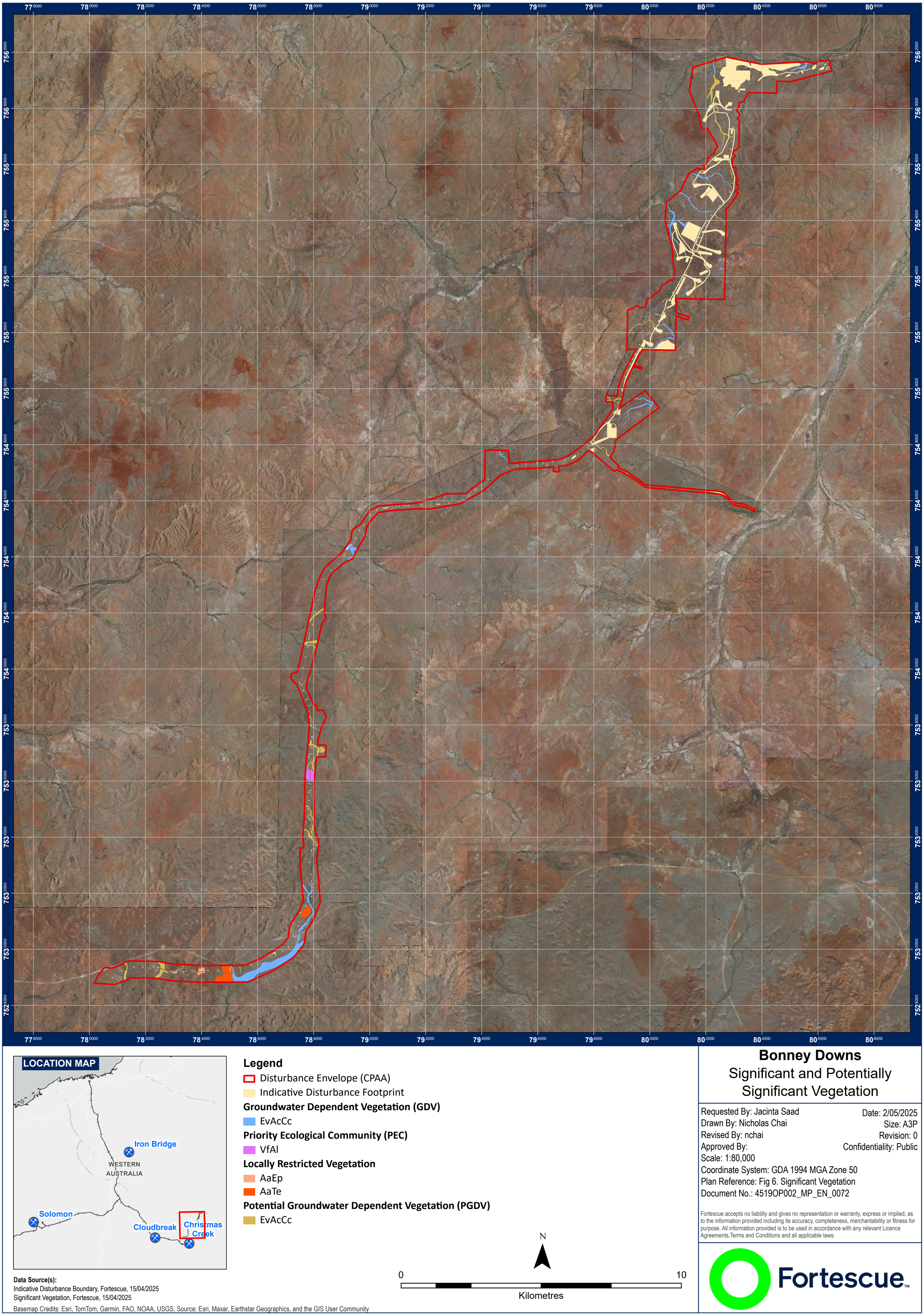
Requested By: Jacinta Saad
Drawn By: Nicholas Chai
Revised By: nchai
Approved By:
Scale: 1:80,000
Coordinate System: GDA 1994 MGA Zone 50
Plan Reference: Fig 5. Vegetation Condition
Document No.: 4519OP002_MP_EN_0072

Date: 2/05/2025
Size: A3P
Revision: 0
Confidentiality: Public

Fortescue accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose. All information provided is to be used in accordance with any relevant Licence Agreements,Terms and Conditions and all applicable laws.

Fortescue™

Post Text Figure 6: Significant and Potentially Significant Vegetation



Data Source(s):
Indicative Disturbance Boundary, Fortescue, 15/04/2025
Significant Vegetation, Fortescue, 15/04/2025

Basemap Credits: Esri, TomTom, Garmin, FAO, NOAA, USGS, Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Legend

- Disturbance Envelope (CPAA)
- Indicative Disturbance Footprint

Groundwater Dependent Vegetation (GDV)
- EvAcCc

Priority Ecological Community (PEC)
- VfAl

Locally Restricted Vegetation
- AaEp
- AaTe

Potential Groundwater Dependent Vegetation (PGDV)
- EvAcCc

N

0 10

Kilometres

Bonney Downs
Significant and Potentially Significant Vegetation

Requested By: Jacinta Saad
Drawn By: Nicholas Chai
Revised By: nchai
Approved By:
Scale: 1:80,000
Coordinate System: GDA 1994 MGA Zone 50
Plan Reference: Fig 6. Significant Vegetation
Document No.: 4519OP002_MP_EN_0072

Date: 2/05/2025
Size: A3P
Revision: 0
Confidentiality: Public

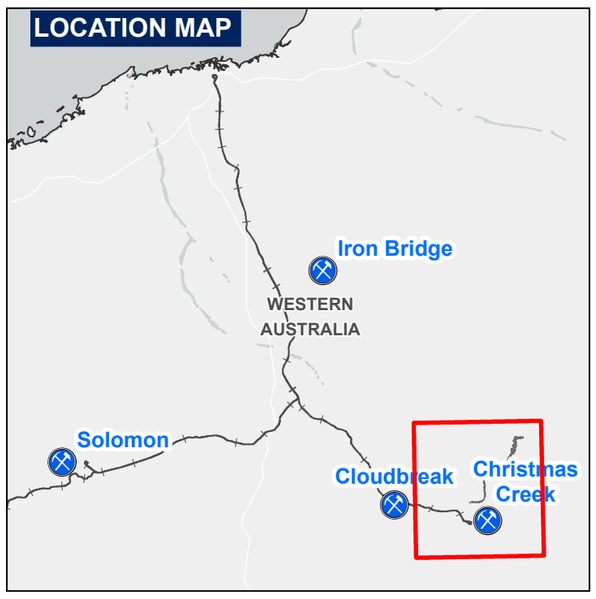
Fortescue accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose. All information provided is to be used in accordance with any relevant Licence Agreements,Terms and Conditions and all applicable laws.

Fortescue™

Post Text Figure 7: Conservation areas



LOCATION MAP



Legend

- Disturbance Envelope (CPAA)
- Indicative Disturbance Footprint

Conservation Area

- Fortescue Marsh

N

0 10

Kilometres

Data Source(s):
Indicative Disturbance Boundary, Fortescue, 15/04/2025
Fortescue Marsh, Fortescue, 15/04/2025

Basemap Credits: Esri, TomTom, Garmin, FAO, NOAA, USGS, Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Bonney Downs
Conservation Areas

Requested By: Jacinta Saad
Drawn By: Nicholas Chai
Revised By: nchai
Approved By:
Scale: 1:150,000
Coordinate System: GDA 1994 MGA Zone 50
Plan Reference: Fig 7. Conservation Areas
Document No.: 4519OP002_MP_EN_0072

Date: 2/05/2025
Size: A3P
Revision: 0
Confidentiality: Public

Fortescue accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose. All information provided is to be used in accordance with any relevant Licence Agreements,Terms and Conditions and all applicable laws.

Fortescue™

Post Text Figure 8: DBCA-listed Priority Flora species



Legend

- Disturbance Envelope (CPAA)
- Indicative Disturbance Footprint

Priority 3 (DBCA)

- Ipomoea racemigera

Priority 4 (DBCA)

- Ptilotus mollis

N

0 10

Kilometres

Data Source(s):
Indicative Disturbance Boundary, Fortescue, 15/04/2025
Significant Vegetation, Fortescue, 15/04/2025

Basemap Credits: Esri, TomTom, Garmin, FAO, NOAA, USGS, Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Bonney Downs
DBCA-Listed Priority Flora Species

Requested By: Jacinta Saad
Drawn By: Nicholas Chai
Revised By: nchai
Approved By:
Scale: 1:80,000
Coordinate System: GDA 1994 MGA Zone 50
Plan Reference: Fig 8. DBCA-Listed Priority Flora Species
Document No.: 4519OP002_MP_EN_0072

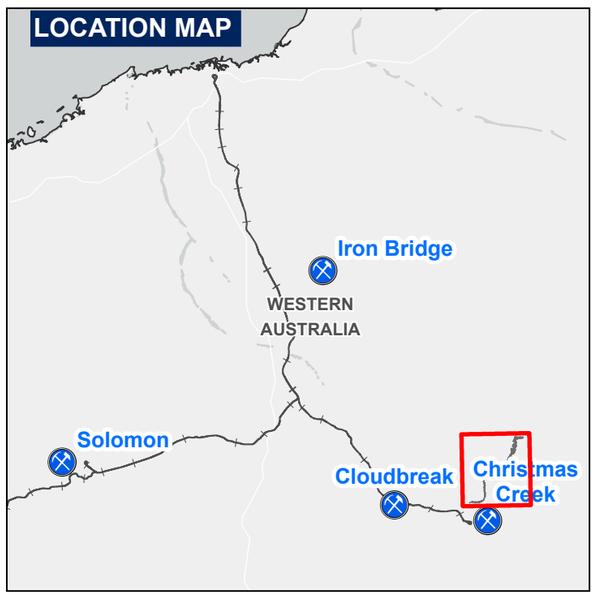
Date: 2/05/2025
Size: A3P
Revision: 0
Confidentiality: Public

Fortescue accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose. All information provided is to be used in accordance with any relevant Licence Agreements,Terms and Conditions and all applicable laws.

Fortescue™

Post Text Figure 9: Introduced Species





Legend

- Disturbance Envelope (CPAA)
- Indicative Disturbance Footprint

Introduced Flora Species

- Aerva javanica
- Argemone ochroleuca subsp. ochroleuca
- Calotropis procera
- Cenchrus ciliaris
- Cenchrus setiger
- Chenopodium murale
- Echinochloa colona
- Malvastrum americanum
- Solanum nigrum
- Tribulus terrestris
- Vachellia farnesiana

N

0 10

Kilometres

Data Source(s):
Indicative Disturbance Boundary, Fortescue, 15/04/2025
Significant Vegetation, Fortescue, 15/04/2025

Basemap Credits: Esri, TomTom, Garmin, FAO, NOAA, USGS, Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Bonney Downs
Introduced Flora Species

Requested By: Jacinta Saad
Drawn By: Nicholas Chai
Revised By: nchai
Approved By:
Scale: 1:80,000
Coordinate System: GDA 1994 MGA Zone 50
Plan Reference: Fig 9. Introduced Species
Document No.: 4519OP002_MP_EN_0072

Date: 2/05/2025
Size: A3P
Revision: 0
Confidentiality: Public

Fortescue accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose. All information provided is to be used in accordance with any relevant Licence Agreements,Terms and Conditions and all applicable laws.

Fortescue™

Post Text Figure 10: Fauna Habitats



Legend

- Disturbance Envelope (CPAA)
- Indicative Disturbance Footprint

Fauna Habitat

- Cleared
- Drainage Line/River/Creek (major)
- Drainage Line/River/Creek (minor)
- Plain (Cracking clays)
- Plain (stony/gibber)
- Rocky Escarpments (Ridges/Mesa/Cliffs/Outcrops/ Breakaways)

N

0 10

Kilometres

Data Source(s):
Indicative Disturbance Boundary, Fortescue, 15/04/2025
Significant Vegetation, Fortescue, 15/04/2025

Basemap Credits: Esri, TomTom, Garmin, FAO, NOAA, USGS, Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Bonney Downs
Fauna Habitats

Requested By: Jacinta Saad
Drawn By: Nicholas Chai
Revised By: nchai
Approved By:
Scale: 1:80,000
Coordinate System: GDA 1994 MGA Zone 50
Plan Reference: Fig 10. Fauna Habitats
Document No.: 4519OP002_MP_EN_0072

Date: 2/05/2025
Size: A3P
Revision: 0
Confidentiality: Public

Fortescue accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose. All information provided is to be used in accordance with any relevant Licence Agreements,Terms and Conditions and all applicable laws.

Fortescue™

Post Text Figure 11: Conservation Significant Fauna Recordings



Data Source(s):
Indicative Disturbance Boundary, Fortescue, 15/04/2025
Significant Vegetation, Fortescue, 15/04/2025

Basemap Credits: Esri, TomTom, Garmin, FAO, NOAA, USGS, Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Legend

- Disturbance Envelope (CPAA)
- Indicative Disturbance Footprint

Vulnerable

- Ghost Bat
- Grey Falcon
- Pilbara Leaf-nosed Bat

Endangered

- Northern quoll

Priority 4 (DBCA)

- Brush-tailed Mulgara, Ampurta
- Short-tailed mouse
- Western Pebble-mound Mouse

N

0 10

Kilometres

Bonney Downs
Conservation Significant Fauna Recordings

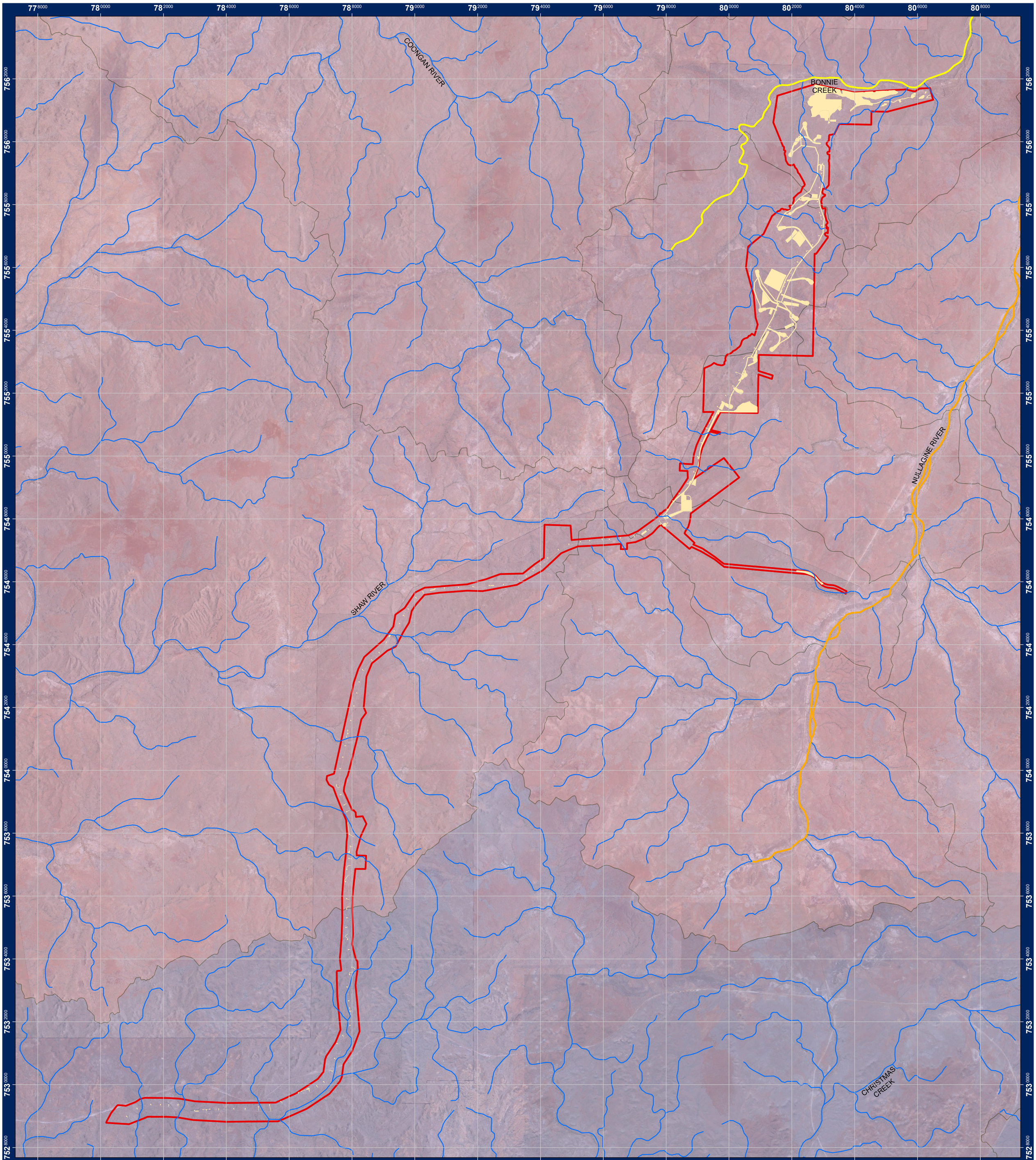
Requested By: Jacinta Saad
Drawn By: Nicholas Chai
Revised By: nchai
Approved By:
Scale: 1:80,000
Coordinate System: GDA 1994 MGA Zone 50
Plan Reference: Fig 11. Conservation Significant Fauna Recordings
Document No.: 4519OP002_MP_EN_0072

Date: 2/05/2025
Size: A3P
Revision: 0
Confidentiality: Public

Fortescue accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose. All information provided is to be used in accordance with any relevant Licence Agreements,Terms and Conditions and all applicable laws.

Fortescue™

Post Text Figure 12: Regional Hydrological Setting





Legend

- Disturbance Envelope (CPAA)
- Indicative Disturbance Footprint

River Basin

- De Grey River
- Fortescue River
- Watercourses
- Nullagine River
- Bonnie Creek

N

0 10

Kilometres

Data Source(s):
Indicative Disturbance Boundary, Fortescue, 15/04/2025
Significant Vegetation, Fortescue, 15/04/2025

Basemap Credits: Esri, TomTom, Garmin, FAO, NOAA, USGS, Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Bonney Downs
Regional Hydrological Setting

Requested By: Jacinta Saad
Drawn By: Nicholas Chai
Revised By: nchai
Approved By:
Scale: 1:80,000
Coordinate System: GDA 1994 MGA Zone 50
Plan Reference: Fig 12. Regional Hydrological Setting
Document No.: 4519OP002_MP_EN_0072

Date: 2/05/2025
Size: A3P
Revision: 0
Confidentiality: Public

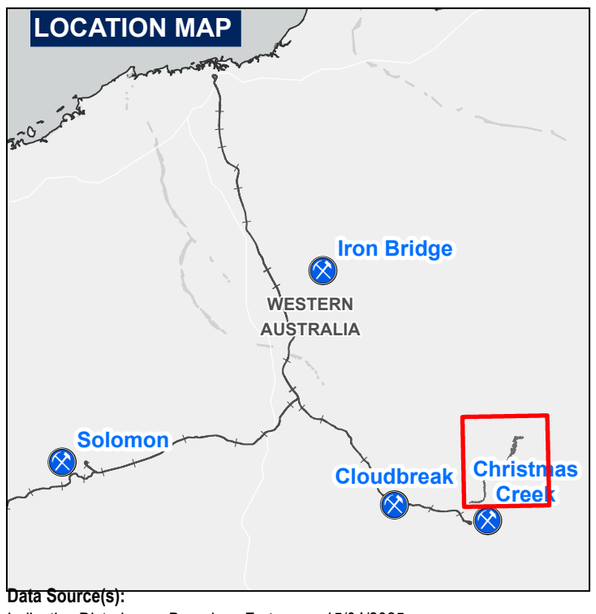
Fortescue accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose. All information provided is to be used in accordance with any relevant Licence Agreements,Terms and Conditions and all applicable laws.

Fortescue

Post Text Figure 13: Key Surface Water Receptors

Nullagine Water Reserve

Bonnie Pool



Legend

- Disturbance Envelope (CPAA)
- Indicative Disturbance Footprint

Watercourses

- Bonnie Pool
- Bonnie Creek
- Nullagine River

Sub Catchments

- Coongan River
- Fortescue River_Upper
- Nullagine River
- Shaw River

Public Drinking Water Source Areas

- Priority One

N

0 10

Kilometres

Bonney Downs
Key Surface Water Receptors

Requested By: Jacinta Saad
Drawn By: Nicholas Chai
Revised By: nchai
Approved By:
Scale: 1:100,000
Coordinate System: GDA 1994 MGA Zone 50
Plan Reference: Fig 13. Key Surface Water Receptors
Document No.: 4519OP002_MP_EN_0072

Date: 2/05/2025
Size: A3P
Revision: 0
Confidentiality: Public

Fortescue accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose. All information provided is to be used in accordance with any relevant Licence Agreements,Terms and Conditions and all applicable laws.

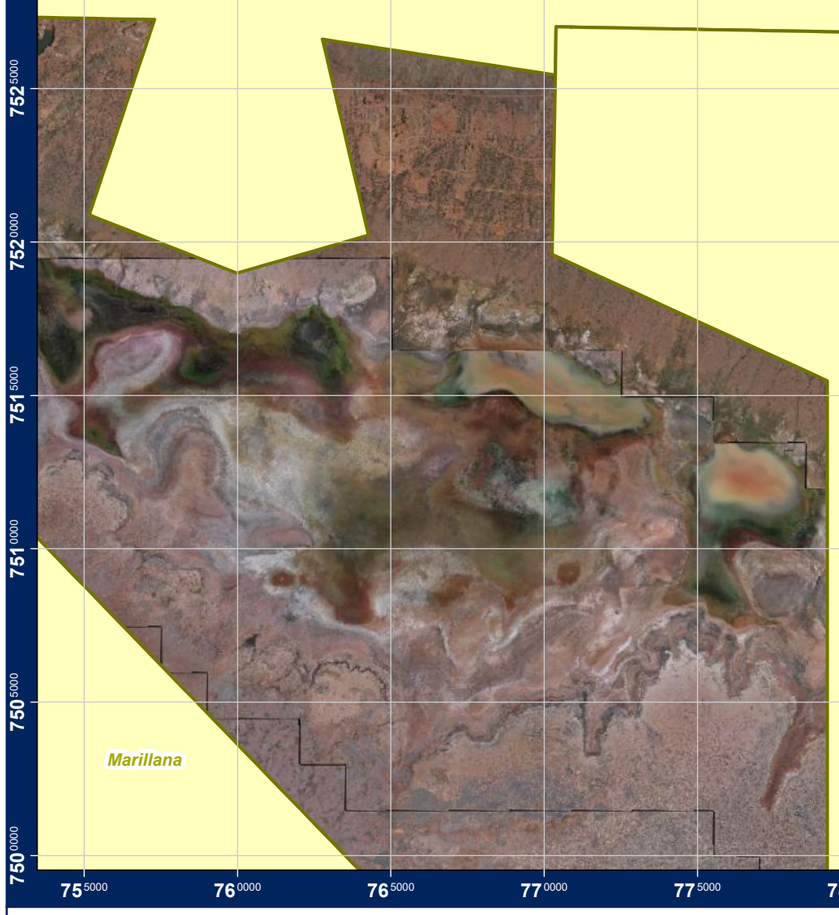
Data Source(s):
Indicative Disturbance Boundary, Fortescue, 15/04/2025
Subcatchments, Fortescue, 15/04/2025
Culverts,Watercourses, Sediment Traps, Fortescue, 15/04/2025

Basemap Credits: Esri, TomTom, Garmin, FAO, NOAA, USGS, Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Fortescue™

Post Text Figure 14: Pastoral Setting

Corunna Downs
Panorama
Bonney Downs
Hillside
Bonney Downs
Noreena Downs
Roy Hill
Marillana



Legend

- Disturbance Envelope (CPAA)
- FMG Pastoral Leases Generalised
- Indicative Disturbance Footprint

Data Source(s):
Indicative Disturbance Boundary, Fortescue, 15/04/2025
Pastoral Leases, Fortescue, 15/04/2025

Basemap Credits: Esri, TomTom, Garmin, FAO, NOAA, USGS, Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

N

0 10

Kilometres

Bonney Downs
Pastoral Setting

Requested By: Jacinta Saad
Drawn By: Nicholas Chai
Revised By: nchai
Approved By:
Scale: 1:200,000
Coordinate System: GDA 1994 MGA Zone 50
Plan Reference: Fig 14. Pastoral Setting
Document No.: 4519OP002_MP_EN_0072

Date: 2/05/2025
Size: A3P
Revision: 0
Confidentiality: Public

Fortescue accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose. All information provided is to be used in accordance with any relevant Licence Agreements,Terms and Conditions and all applicable laws.

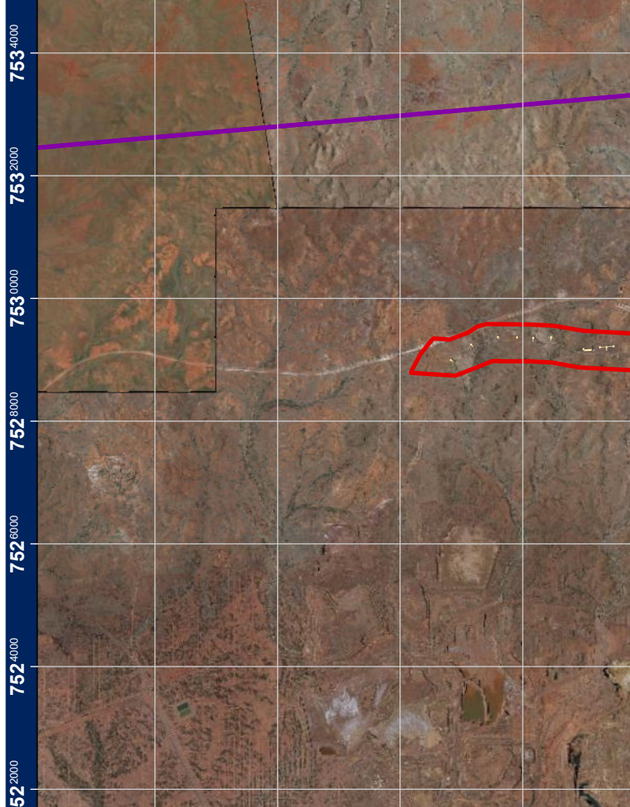
Fortescue™

Post Text Figure 15: Native Title Agreement Area

Palyku and Palyku #2
Native Title
Determination

Palyku Part A
Native Title
Determination

Nyiyaparli and
Nyiyaparli #3
Native Title
Determination



Legend

- Disturbance Envelope (CPAA)
- Indicative Disturbance Footprint
- Native Title Determination (Register)

Data Source(s):
Indicative Disturbance Boundary, Fortescue, 15/04/2025
Native Title Determiniation, Fortescue, 15/04/2025

Basemap Credits: Esri, TomTom, Garmin, FAO, NOAA, USGS, Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

N

0 10

Kilometres

Bonney Downs
Native Title Agreement Area

Requested By: Jacinta Saad
Drawn By: Nicholas Chai
Revised By: nchai
Approved By:
Scale: 1:100,000
Coordinate System: GDA 1994 MGA Zone 50
Plan Reference: Fig 15. Native Title Agreement Area
Document No.: 4519OP002_MP_EN_0072

Date: 2/05/2025
Size: A3P
Revision: 0
Confidentiality: Public

Fortescue accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose. All information provided is to be used in accordance with any relevant Licence Agreements,Terms and Conditions and all applicable laws.

Fortescue™

Post Text Figure 16: Registered Aboriginal Heritage Locations



Legend

- Disturbance Envelope (CPAA)
- Indicative Disturbance Footprint
- Archaeological Heritage Places
- Ethnographic Heritage Places

N

0 — 10

Kilometres

Data Source(s):
Indicative Disturbance Boundary, Fortescue, 15/04/2025
Heritage Places, Fortescue, 15/04/2025

Basemap Credits: Esri, TomTom, Garmin, FAO, NOAA, USGS, Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Bonney Downs
Registered Aboriginal Heritage Locations

Requested By: Jacinta Saad
Drawn By: Nicholas Chai
Revised By: nchai
Approved By:
Scale: 1:80,000
Coordinate System: GDA 1994 MGA Zone 50
Plan Reference: Fig 16. Registered Aboriginal Heritage Locations
Document No.: 4519OP002_MP_EN_0072

Date: 2/05/2025
Size: A3P
Revision: 0
Confidentiality: Public

Fortescue accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose. All information provided is to be used in accordance with any relevant Licence Agreements,Terms and Conditions and all applicable laws.

Fortescue™

APPENDICES

Appendix 1: Bonney Downs Consolidated Flora and Vegetation Assessment (ecologia, 2025a)

JANUARY 2025



Providing sustainable environmental strategies,
management and monitoring solutions
to industry and government.

ecologia
ENVIRONMENT

FORTESCUE LIMITED

BONNEY DOWNS CONSOLIDATED FLORA AND VEGETATION ASSESSMENT

Document status						
***ecologia* project number: 1991**						
Rev.	**Author(s)**	**Reviewer**	**Date**	**Approved for Issue**		
				Name	**Distributed To**	**Date**
0	A. Craigie, S. Ng, A. Shepherdson	S. Grein	17/01/2025	S. Grein	R. Sellers	17/01/2025

***ecologia* Environment (2025)**. Reproduction of this report in whole or in part by electronic, mechanical or chemical means, including photocopying, recording or by any information storage and retrieval system, in any language, is strictly prohibited without the express approval of *ecologia* Environmental Consultants and Fortescue Limited

ecologia Environment
463 Scarborough Beach Rd
OSBORNE PARK WA 6017
Phone: 08 6168 7200
Email: admin@ecologia.com.au

EXECUTIVE SUMMARY

Fortescue Limited (Fortescue) is assessing potential renewable energy generation sites as part of the commitment to decarbonise its mining operations in the Pilbara region of Western Australia. One of the options under consideration is the Bonney Downs project, a proposed wind generation hub and associated transmission line (PEC 8) with a connection to Cloudbreak and Christmas Creek (the project).

Ecologia Environmental Consultants (*ecologia*) was engaged by Fortescue to undertake a two-phase detailed flora and vegetation assessment of the Bonney Downs Consolidated survey area (the survey area) (approximately 108,991 ha) to inform environmental approvals applications for the potential development of the project. The survey area is located mostly west of Marble Bar Road, approximately 80 km south of Marble Bar in the Pilbara region of Western Australia (WA).

Most of the survey area has been surveyed recently by *ecologia* (Bonney Downs North) and SLR (Bonney Downs East). The objective of this survey was to undertake a detailed flora and vegetation survey and targeted flora survey within the remaining parts of the survey area and to combine the data from all three projects into a consolidated analysis and report detailing the flora and vegetation values of the entire area.

A total of 552 vascular plant taxa from 61 families and 204 genera were recorded within the survey area. These included one *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and *Biodiversity Conservation Act 2016* (BC Act) listed Threatened species (*Quoya zonalis*) and 18 Department of Biodiversity, Conservation and Attractions (DBCA) listed Priority (P) species. Twenty-five introduced species were recorded, of which one is a Declared Pest (**Calotropis procera*).

Hierarchical agglomerative clustering and ordination analyses were conducted on floristic data from 375 sampling sites, resulting in the classification of 17 vegetation types. Vegetation consisted mostly of low stony hills and undulating plains associated with the Rocklea land system supporting *Acacia inaequilatera* sparse shrubland over *Triodia epactia* low hummock grasslands. Vegetation was mostly in Excellent condition according to the Environmental Protection Authority (EPA) *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016) scale, except for drainage channels and parts of the Wona land system, which were comparatively more degraded in parts.

One of the described vegetation types (VfAl) is consistent with one of the four communities that comprise the 'Four plant assemblages of the Wona Land System', specifically the Priority 1 community 'Cracking clays of the Chichester and Mungaroona Range'. This vegetation type accounts for 7,375.9 ha (6.8%) of the survey area. There were no other plant communities observed that corresponded to any state (BC Act) or Commonwealth (EPBC Act) listed Threatened Ecological Community (TEC), or any DBCA listed PEC.

Thirteen vegetation types were significant according to one or more additional assessed criteria, including: supporting populations of threatened species (one vegetation type), playing a role as a refuge (one vegetation type), potentially locally restricted (nine vegetation types); groundwater dependent or potentially groundwater dependent vegetation (two vegetation types); and sheet-flow dependent mulga (one vegetation type).

TABLE OF CONTENTS

EXECUTIVE SUMMARY ..... **II**

1 INTRODUCTION **1**

1.1 PROJECT BACKGROUND 1

1.2 SCOPE OF WORK 1

1.3 LEGISLATIVE AND REGULATORY FRAMEWORK 1

1.4 DEFINITIONS 2
1.4.1 Significant Flora 2
1.4.2 Significant Vegetation 2
1.4.3 Introduced Plants 2

2 DESKTOP ASSESSMENT **5**

2.1 DESKTOP METHODOLOGY 5

2.2 RAINFALL AND TEMPERATURE 6

2.3 FIRE HISTORY 6

2.4 INTERIM BIOGEOGRAPHIC REGIONALISATION FOR AUSTRALIA 7

2.5 LAND SYSTEMS 7

2.6 DBCA MANAGED LANDS AND NATIONALLY IMPORTANT WETLANDS 7

2.7 FLORA 12
2.7.1 Floristic Diversity 12
2.7.2 Significant Species 12
2.7.3 Introduced Species 12

2.8 VEGETATION 16
2.8.1 Pre-European Vegetation 16
2.8.2 Threatened and Priority Ecological Communities 16
2.8.3 Groundwater Dependent Vegetation 17
2.8.4 Sheet-flow Dependent Mulga 17

3 METHODOLOGY **21**

3.1 FLORA AND VEGETATION ASSESSMENT 21
3.1.1 Field Survey 21
3.1.2 Quadrat Sampling 21
3.1.3 Significant Species 22
3.1.4 Specimen Identification 22
3.1.5 Asymptotic Species Richness and Rarefaction 22
3.1.6 Data Consolidation and Vegetation Classification 23
3.1.7 Vegetation Characterisation 24
3.1.8 Vegetation Mapping 24
3.1.9 Assessment of Vegetation Significance 25

3.2 STUDY TEAM AND LICENCES 26

3.3 LIMITATIONS AND CONSTRAINTS 28

4 RESULTS **29**

4.1 FLORA 29

4.1.1 Floristic Diversity and Estimated Species Richness 29
4.1.2 Significant Species 30
4.1.3 Introduced Species 31
4.2 VEGETATION 38
4.2.1 Vegetation Type Classification and Characterisation 38
4.2.2 Vegetation Condition 45
4.2.3 Significant Vegetation 45
5 DISCUSSION 60
5.1 FLORA 60
5.1.1 Floristic Diversity 60
5.1.2 Significant Species 60
5.1.3 Introduced Species 62
5.2 VEGETATION 62
5.2.1 Vegetation Types and Condition 62
5.2.2 Significant Vegetation 63
6 CONCLUSIONS 65
7 REFERENCES 66
8 APPENDICES 69

TABLES

Table 1: Databases queried for the desktop assessment. 5
Table 2: Criteria used to assess the likelihood of occurrence of significant species and communities. 5
Table 3: Land systems associated with the survey area (DPIRD-027). 8
Table 4: Significant plant species recorded within 50 km of the survey area. 13
Table 5: Introduced plant species recorded within 50 km of the survey area including BAM Act status and Weed Prioritisation Process rating. 14
Table 6: Pre-European vegetation associations mapped with the survey area (D. P. Shepherd et al., 2002). 16
Table 7: Threatened and Priority Ecological Communities within 50 km of the survey area. 18
Table 8: Vegetation condition scale. 22
Table 9: Criteria for assessment of potential vegetation significance. 25
Table 10: Project staff and licences. 26
Table 11: Flora and vegetation survey limitations. 28
Table 12: Species richness summary and estimates for the survey area. 29
Table 13: Summary of significant plant species recorded within the survey area. 32
Table 14: Summary of introduced species recorded within the survey area. 33
Table 15: Summary of vegetation types within the survey area – group characterisation. 41
Table 16: Summary of vegetation types within the survey area – landforms, condition, significance, species richness, and extent. 43
Table 17: Vegetation condition of the survey area. 45

FIGURES

Figure 1: Monthly median rainfall and temperature for Bonney Downs (rainfall) and Marble Bar (temperature). 6
Figure 2: Asymptotic species richness estimated by the Chao2 non-parametric richness estimator and rarefaction curve (species observed) for the survey area after 400 sampling sites. 30
Figure 3: Photographs of significant species recorded by Ecologia within the survey area. 37
Figure 4: UPGMA hierarchical agglomerative clustering dendrogram showing floristic relationships among 375 sites. 39
Figure 5: Non-metric multidimensional scaling (NMDS) plots showing relationships among sites and vegetation types. 40
Figure 6: Representative photographs of vegetation types - 1. 54
Figure 7: Representative photographs of vegetation types - 2. 55
Figure 8: Representative photographs of vegetation types - 3. 56
Figure 9: Representative photographs of vegetation types - 4. 57
Figure 10: Representative photographs of vegetation types - 5. 58
Figure 11: Representative photographs of vegetation types - 6. 59

MAP FIGURES

Map 1: Location of the Bonney Downs survey area. 4
Map 2: Recent fire history of the survey area (DBCA-060) (2019-2024) 9
Map 3: Land systems (DPIRD 2016). 10
Map 4: DBCA Legislated Lands and Nationally Important Wetlands near the survey area. 11
Map 5: Significant plant species records within 50 km of the survey area. 15
Map 6: Pre-European vegetation associations (Shepherd et al. 2002). 19
Map 7: Significant ecological communities within 50 km of the survey area. 20
Map 8: Locations of sampling sites within the survey area. 27
Map 9: Significant plant species recorded within the survey area (Threatened, Priority 1, Priority 2). 34
Map 10: Significant plant species recorded within the survey area (Priority 3, Priority 4). 35
Map 11: Locations of *Calotropis procera* (Declared Pest) recorded within the survey area. 36
Map 12: Vegetation types recorded within the survey area (north-west). 47
Map 13: Vegetation types recorded within the survey area (north-east). 48
Map 14: Vegetation types recorded within the survey area (south-west). 49
Map 15: Vegetation types recorded within the survey area (south-east) 50
Map 16: Vegetation types recorded within the survey area (transmission corridor). 51
Map 17: Vegetation condition within the survey area. 52
Map 18: Significant and potentially significant vegetation within the survey area. 53

APPENDICES

Appendix A Desktop assessment database search results.
Appendix B Plant species recorded within the survey area (all Ecologia and SLR records 2023 – 2024) and names amalgamated for data analysis.
Appendix C UPGMA hierarchical agglomerative clustering dendrogram.
Appendix D Species constancy within vegetation types.
Appendix E Flora and vegetation sampling site data.
Appendix F DBCA Significant Species Report Forms.

1 INTRODUCTION

1.1 PROJECT BACKGROUND

Fortescue Limited (Fortescue) is investigating potential options for renewable energy generation sites as part of the commitment to decarbonise its mining operations in the Pilbara region of Western Australia. One of the options under consideration is the Bonney Downs project, a proposed wind generation hub and associated transmission line (PEC 8) connecting to Cloudbreak and Christmas Creek (the project).

Ecologia Environmental Consultants (*ecologia*) was engaged by Fortescue to undertake a two-phase detailed flora and vegetation assessment of the Bonney Downs Consolidated survey area (the survey area, Map 1) (approximately 108,991 ha) to inform environmental approvals applications for the potential development of the project. The survey area is located mostly west of Marble Bar Road, approximately 80 km south of Marble Bar in the Pilbara region of Western Australia (WA).

Most of the survey area has been surveyed recently by *ecologia* (Bonney Downs North (*ecologia*, 2024)) and SLR (Bonney Downs East (SLR, 2024)) (Map 1). The objective of this survey was to undertake a detailed flora and vegetation survey and targeted flora survey within the remaining parts of the survey area and to combine the data from all three projects into a consolidated analysis and report detailing the flora and vegetation values of the entire area.

1.2 SCOPE OF WORK

Fortescue required the services of a suitably qualified and experienced consultant to undertake a two-phase detailed flora and vegetation survey, targeted searches for conservation significant plant species and communities, and a consolidated assessment for the whole of the survey area. The following were therefore provided as part of this assessment:

- A desktop assessment to evaluate biological values of the survey area and surrounds, including a review of existing physical and biological values, significant species and communities, and other relevant available data.
- A two-phase detailed flora and vegetation survey and targeted flora assessment within unsurveyed parts of the area in accordance with Environmental Protection Authority (EPA) *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA, 2016b).
- Consolidated vegetation classification, characterisation, and mapping of vegetation types and condition.
- Consolidated assessment of significant flora, significant vegetation, and introduced species.

1.3 LEGISLATIVE AND REGULATORY FRAMEWORK

The EPA objective for the *Flora and Vegetation* factor (EPA, 2016a) is to protect flora and vegetation so that biological diversity and ecological integrity are maintained. In this context, ecological integrity is the composition, structure, function and processes of ecosystems, and the natural range of variation of these elements. The primary objective of this assessment was to provide sufficient information to assess the impact of any proposed development on the flora and vegetation of the survey area, thereby ensuring that the EPA's objective can be met.

The survey was designed and undertaken to comply with the following EPA guidance documents:

- *Environmental Factor Guideline: Flora and Vegetation* (EPA, 2016a).
- *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA, 2016b).

1.4 DEFINITIONS

1.4.1 Significant Flora

According to the *EPA Factor Guideline: Flora and Vegetation* (EPA, 2016a), plant taxa (or records) may be considered significant for several reasons including, but not restricted to, the following:

- A taxon listed as Threatened under Western Australia's *Biodiversity Conservation Act 2016* (BC Act) or the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).
- A taxon on the Department of Biodiversity, Conservation and Attractions (DBCA) Priority Flora List (DBCA, 2020)
- Locally endemic species or those associated with a restricted habitat type (e.g., surface water or groundwater dependent ecosystems).
- New species or those having anomalous features that indicate a potential new species.
- Being representative of the range of a species (particularly, at the extremes of range, recently discovered range extensions, or isolated outliers of the main range).
- Unusual species, including restricted subspecies, varieties or naturally occurring hybrids.
- Being representative of taxonomic groups that no longer occur widely in the broader landscape (relictual species/populations).

1.4.2 Significant Vegetation

According to *EPA Factor Guideline: Flora and Vegetation* (EPA, 2016a), vegetation may be considered significant for reasons including, but not restricted to, the following:

- Being listed as a Threatened Ecological Community (TEC) under the BC Act or the EPBC Act.
- Being listed as a Priority Ecological Community (PEC) by DBCA.
- Having a restricted distribution.
- The degree of historical impact from threatening processes.
- Playing a role as a refuge.
- Providing an important function required to maintain ecological integrity of a significant ecosystem.

1.4.3 Introduced Plants

Weeds of National Significance

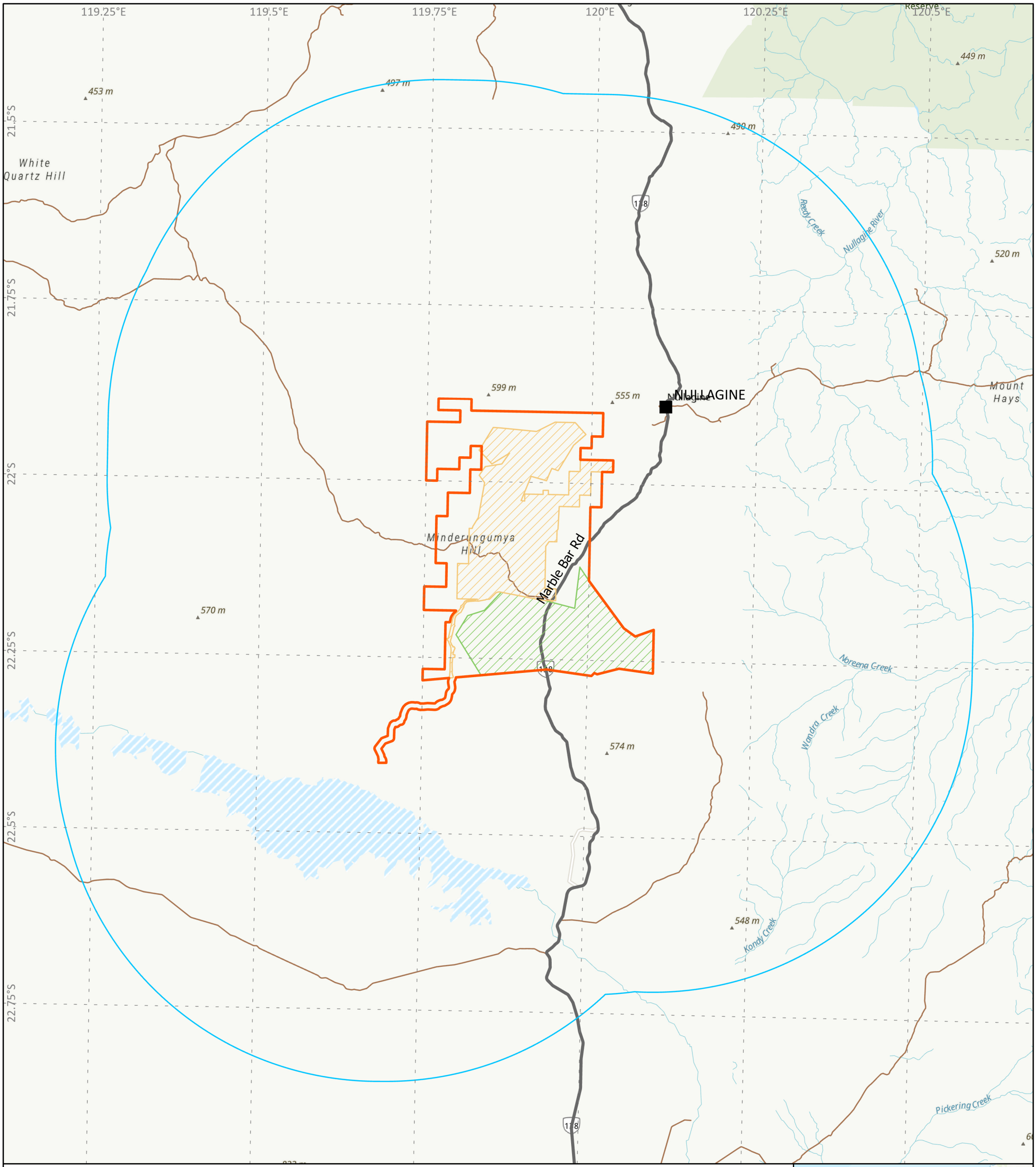
Under the Australian Weeds Strategy there are 32 introduced plant species listed as Weeds of National Significance (WONS) that are "causing major economic, environmental and/or social impacts in a number of states or territories with strong potential for further spread" (DAWR, 2017). These species require "coordinated and strategic management along with shared stakeholder investment to develop and implement best practice to prevent, eradicate, contain and/or minimise impacts in different parts of the nation" (DAWR, 2017).

Biosecurity and Agriculture Management Act 2007

The purpose of Western Australia's *Biosecurity and Agriculture Management Act 2007* (BAM Act) is to prevent serious animal and plant pests and diseases from entering Western Australia and becoming established, and to minimise the spread and impact of those that are already present. The Western Australian Organism List (WAOL) lists organisms that are categorised under the BAM Act into five legal categories: 'Declared Pest, Prohibited -s12', 'Declared Pest -s22(2)', 'Permitted -s11', 'Permitted, Requires Permit -r73', and 'Unlisted -s14'. A Declared Pest may be subject to control and keeping requirements once within Western Australia.

Regional Weed Prioritisation Process

At a regional level in Western Australia, introduced plant species are ranked using the Weed Prioritisation Process (DPaW, 2013). The process is intended to "highlight the species that have the highest ecological impact, most extensive potential distribution, highest invasiveness, lowest current distribution and highest feasibility of control within a regional context based on the information available at the time" (DPaW, 2013).



ecologia ENVIRONMENT

Project No.: 1991
Author: AS
Created Date: 11 December 2024
Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Scale: 1:562,683 @A3

Map 1: Location of the Bonney Downs survey area.

0 5 10 20
Kilometers

Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community, Esri, USGS

2 DESKTOP ASSESSMENT

2.1 DESKTOP METHODOLOGY

The methodology adopted for the desktop assessment was in accordance with the *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA, 2016b). A review of background environmental information for the survey area was undertaken, including, but not limited to, climate (Bureau of Meteorology, BOM), biogeography (IBRA 7) (DSEWPaC, 2012), soil-landscape systems (land systems) (DPIRD, 2016), the Surface Geology of Australia 1:1M spatial dataset (Geoscience Australia, 2012), the Atlas of Australian Soils (Northcote et al., 1960-1968), and pre-European native vegetation of Western Australia (D. P. Shepherd, Beeston, & Hopkins, 2002).

Searches of the databases listed in Table 1 were undertaken to determine the significant species and ecological communities previously recorded within 50 km of the survey area. The Atlas of Living Australia (ALA) database was used in place of NatureMap for this desktop assessment due to current data quality issues. The criteria listed in Table 2 were then applied to determine the likelihood of occurrence of these species and communities within the survey area. To assist in the assessment, habitat preferences were sourced, where available, from relevant taxonomic literature, FloraBase records (Western Australian Herbarium, 1998–), Threatened Species Profiles (SPRATs), or specimen data from the Australasian Virtual Herbarium (AVH) database (CHAH, 2017).

Table 1: Databases queried for the desktop assessment.

Database	Search details	Access number/date
EPBC Act Protected Matters database	Records of matters of national significance under the EPBC Act within 50 km of the survey area.	29 May 2023
DBCA Threatened and Priority Ecological Communities	TECs and PECs within 50 km of the survey area.	36-0224EC, 22 February 2024
DBCA WAHERB and TPFL	Significant species records within 50 km of the survey area.	32-022FL, 15 February 2024
Atlas of Living Australia (ALA)	All vascular plant species records within 50 km of the survey area.	23 February 2024
Fortescue's significant flora database	Significant species records within 50 km of the survey area.	March 2023

Table 2: Criteria used to assess the likelihood of occurrence of significant species and communities.

Rating	Criterion
Recorded	The species/community has been recorded within the survey area.
Likely	Suitable habitat is almost certainly present and there are records immediately adjacent to survey area.
Possible	Suitable habitat is likely to be present and there are records within 50 km of the survey area, or there is insufficient information available to exclude the possibility of occurrence.
Unlikely	Suitable habitat is not likely to be present and/or there are no records within 50 km of the survey area.
Does not occur	The community is an existing regionally mapped vegetation association (e.g. Shepherd et al. 2002) or land system (e.g. DPIRD 2016) which does not occur within the survey area; or The species is recognised as being locally extinct or extinct in the wild and does not occur within the survey area.

2.2 RAINFALL AND TEMPERATURE

Rainfall data from the nearest long-term Bureau of Meteorology (BoM) weather station (since 1907) were obtained from Bonney Downs (Station No. 5006), located 2.0 km to the south of the survey area. Bonney Downs received a significant amount of rainfall in April 2023, two months prior to the primary survey in June 2023, but rainfall was slightly below the historical monthly median values in May 2023 (Figure 1). Bonney Downs also received well above average rainfall in January 2024, about a month prior to the primary survey in early March 2024, but below average rainfall in February 2024. Temperature data were obtained from Marble Bar (Station No. 7185) (BoM, 2024), which is located 83.9 km north of the survey area. Maximum daytime temperature at Marble Bar is frequently above 40°C between November and February and minimum temperatures can drop below 15°C between June and August (Figure 1).

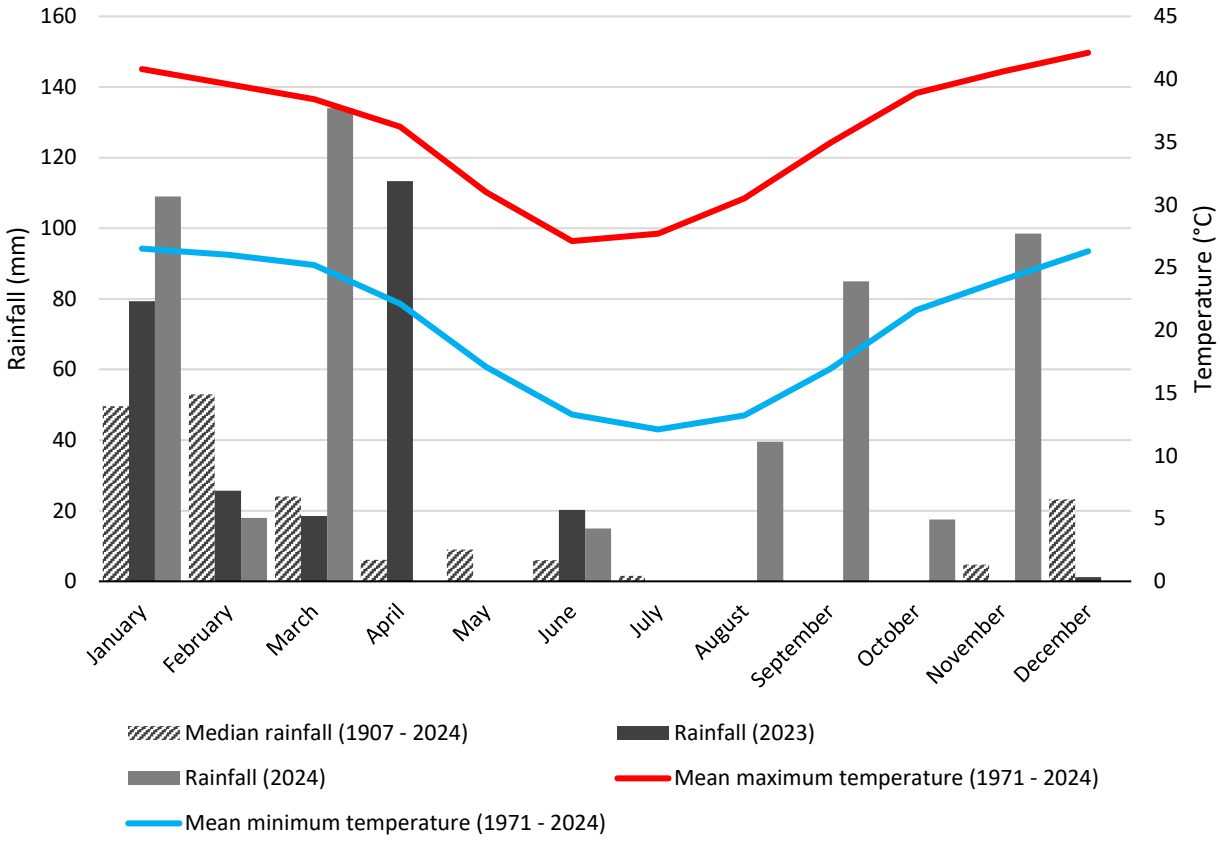


Figure 1: Monthly median rainfall and temperature for Bonney Downs (rainfall) and Marble Bar (temperature).

2.3 FIRE HISTORY

The fire history of the survey area was determined using the DBCA Fire History (DBCA-060) dataset (last updated 13 August 2024) (DBCA, 2024), which contains records of fire events (updated biannually), including information from completed projects including the Great Western Woodlands (GWW), Gnangara Sustainability Strategy (GSS), and remote sensing of Pilbara fire scars. The largest recorded recent fires occurred in 2019, with some scattered smaller fires occurring from 2020 to 2022 (Map 2). There were no fires recorded within the survey area from 2023 or 2024 according to this dataset.

2.4 INTERIM BIOGEOGRAPHIC REGIONALISATION FOR AUSTRALIA

The Interim Biogeographic Regionalisation for Australia (IBRA) classifies the Australian continent into bioregions based on similar geology, landform, vegetation, fauna and climate characteristics (DSEWPaC, 2012). The survey area is in the Pilbara bioregion according to IBRA 7. The Pilbara region is further divided into four subregions: Hamersley, Fortescue Plains, Chichester, and Roebourne. The survey area is in the Chichester subregion.

The Chichester subregion comprises the northern section of the Pilbara Craton (Kendrick & McKenzie, 2001). Undulating Archaean granite and basalt plains include significant areas of basaltic ranges. Plains support a shrub steppe characterised by *Acacia inaequilatera* over *Triodia wiseana* hummock grasslands, while *Euclayptus leucophloia* tree steppes occur on ranges. The climate is semi desert tropical and receives approximately 300 mm of rainfall annually. Drainage occurs to the north via numerous rivers (e.g., De Grey, Oakover, Nullagine, Shaw, Yule and Sherlock). The subregional area is 9,044,560 ha (Kendrick & McKenzie, 2001).

2.5 LAND SYSTEMS

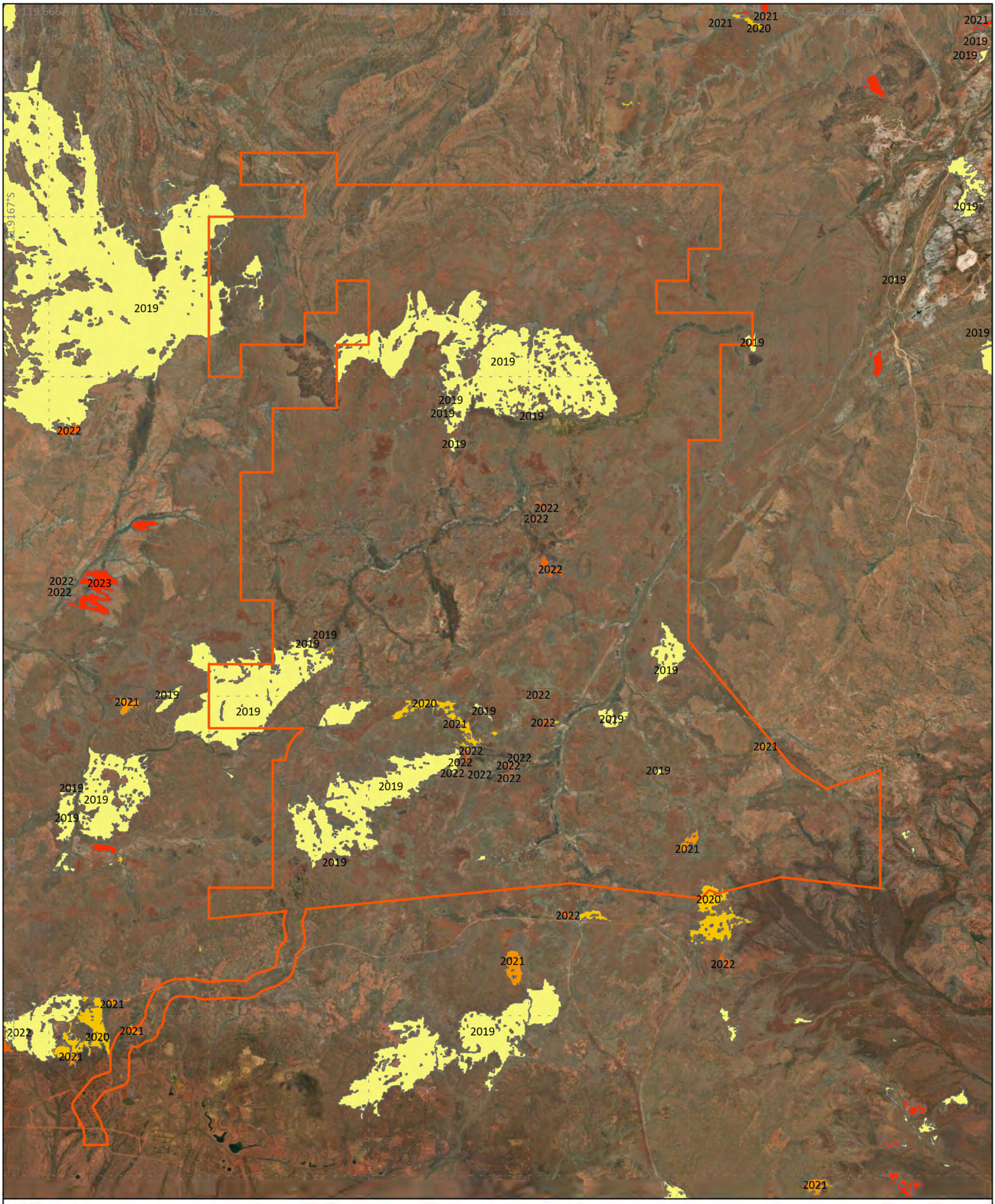
In 2016 the Department of Primary Industries and Regional Development (DPIRD) consolidated soil-landscape mapping of Western Australia from two technical reports created by the Department of Agriculture and Food (Department of Agriculture Resource Management Technical Reports RMTR No. 280 (Purdie, Tille, & Schoknecht, 2016) and RMTR No. 313 (Tille, 2006)). The resulting spatial dataset, Soil Landscape Mapping – Best Available (DPIRD-027) (DPIRD, 2022), is a compilation of various surveys at different scales varying between 1:20,000 and 1:3,000,000. Mapping conforms to a nested hierarchy established to deal with the varying levels of information resulting from the variety of scales in mapping to provide soil-landscape data for all of Western Australia. Seventeen soil-landscape systems (land systems) are associated with the survey area, with the Rocklea system being the most prominent (55.1%) (Table 3, Map 3).

2.6 DBCA MANAGED LANDS AND NATIONALLY IMPORTANT WETLANDS

Spatial datasets were queried for DWER Environmentally Sensitive Areas (ESAs) (DWER-046), Nationally Important Wetlands (DBCA-045), and DBCA managed lands and waters (DBCA-011), occurring in the vicinity of the survey area. One ESA occurs approximately 25 km south of the survey area: Fortescue Marsh (Nationally Important Wetland) (Map 4).

Table 3: Land systems associated with the survey area (DPIRD-027).

Land system	Description	Extent within survey area (ha)	Extent within survey area (%)
Bonney system	Low rounded hills and undulating stony plains supporting soft spinifex grasslands.	17,778	16.33
Capricorn system	Rugged sandstone hills, ridges, stony footslopes and interfluves supporting low acacia shrublands or hard spinifex grasslands with scattered shrubs.	6,296	5.78
Elimunna system	Stony plains on basalt supporting sparse acacia and cassia shrublands and patchy tussock grasslands.	430	0.40
Granitic system	Rugged granitic hills supporting shrubby hard and soft spinifex grasslands.	1,839	1.69
Jamindie system	Stony hardpan plains and rises supporting groved mulga shrublands, occasionally with spinifex understorey.	630	0.58
Laterite system	Low lateritic plateaux, mesas, buttes and gravelly rises and plains supporting sparse mulga shrublands.	1,762	1.62
Macroy system	Stony plains and occasional tor fields based on granite supporting hard and soft spinifex shrubby grasslands.	236	0.22
McKay system	Hills, ridges, plateaux remnants and breakaways of metasedimentary and sedimentary rocks supporting hard spinifex grasslands with acacias and occasional eucalypts.	5,728	5.26
Newman system	Rugged jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands.	305	0.28
Pindering system	Gravelly hardpan plains supporting groved mulga shrublands with hard and soft spinifex.	4	<0.01
River system	Narrow, seasonally active floodplains and major river channels supporting moderately close, tall shrublands or woodlands of acacias and fringing communities of eucalypts sometimes with tussock grasses or spinifex.	499	0.46
Robe system	Low plateaux, mesas and buttes of limonite supporting soft spinifex and occasionally hard spinifex grasslands.	4,314	3.96
Rocklea system	Basalt hills, plateaux, lower slopes and minor stony plains supporting hard spinifex and occasionally soft spinifex grasslands with scattered shrubs.	59,920	55.05
Spearhole system	Gently undulating gravelly hardpan plains and dissected slopes supporting groved mulga shrublands and hard spinifex	274	0.25
Talga system	Hills and ridges of greenstone and chert and stony plains supporting hard and soft spinifex grasslands	557	0.51
Turee system	Stony alluvial plains with gilgaied and non-gilgaied surfaces supporting tussock grasslands and grassy shrublands of mulga and snakewood	35	0.03
Wona system	Basalt upland gilgai plains supporting Roebourne Plains grass and Mitchell grass tussock grasslands, minor hard spinifex grasslands or annual grasslands/herbfields	8,235	7.57



Survey area

Fire year

- 2019
- 2020
- 2021
- 2022
- 2023

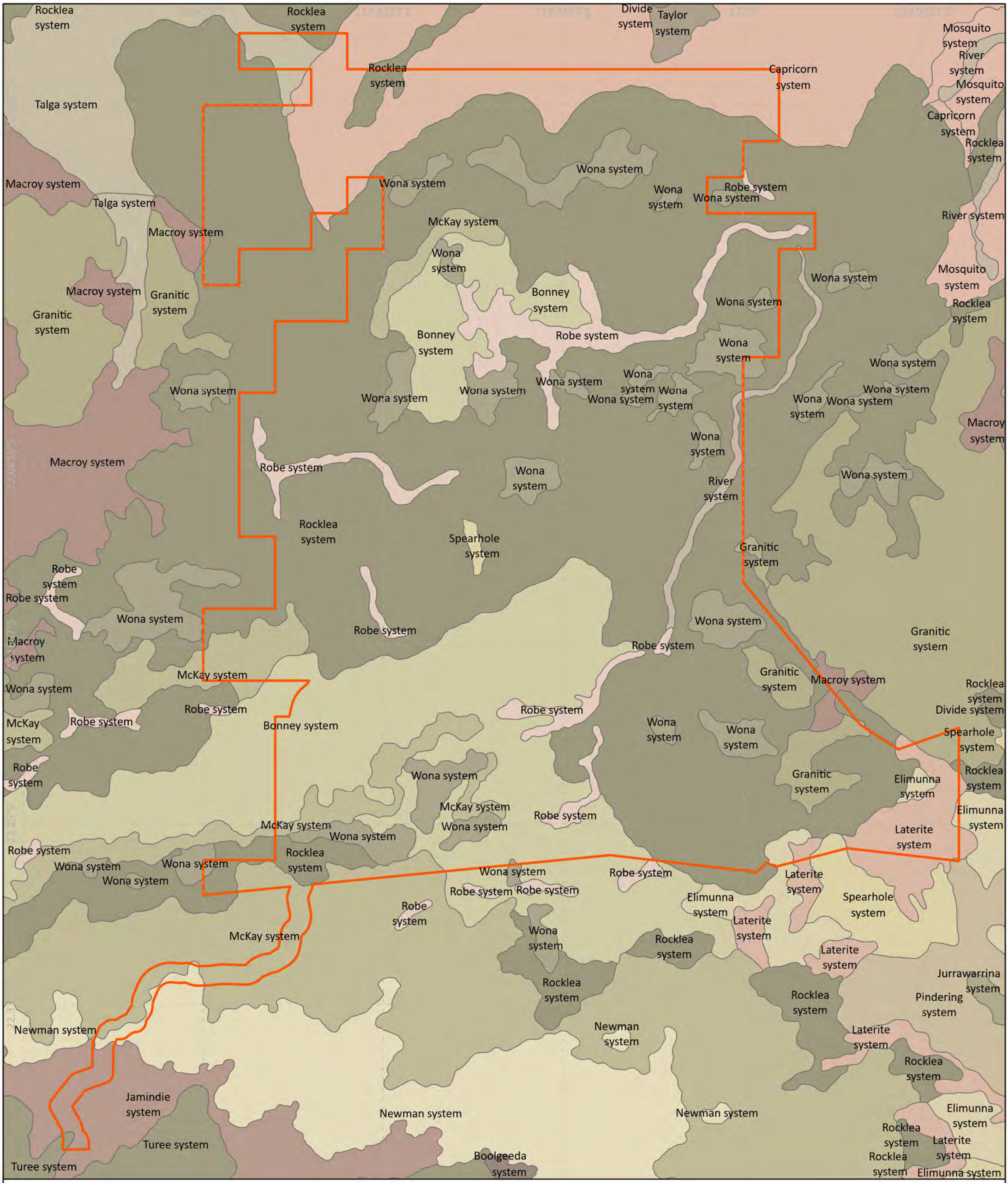
ecologia ENVIRONMENT

Project No.: 1991
Author: AC
Created Date: 11 December 2024
Coordinate System: GCS GDA 1994
Scale: 1:200,000 @A3

Map 2: Recent fire history of the survey area (DBCA-060) (2019-2024).

0 2.8 5.5 11.1
Kilometers

Earthstar Geographics, Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community, Esri, USGS



- Bonney Downs survey area

Land system

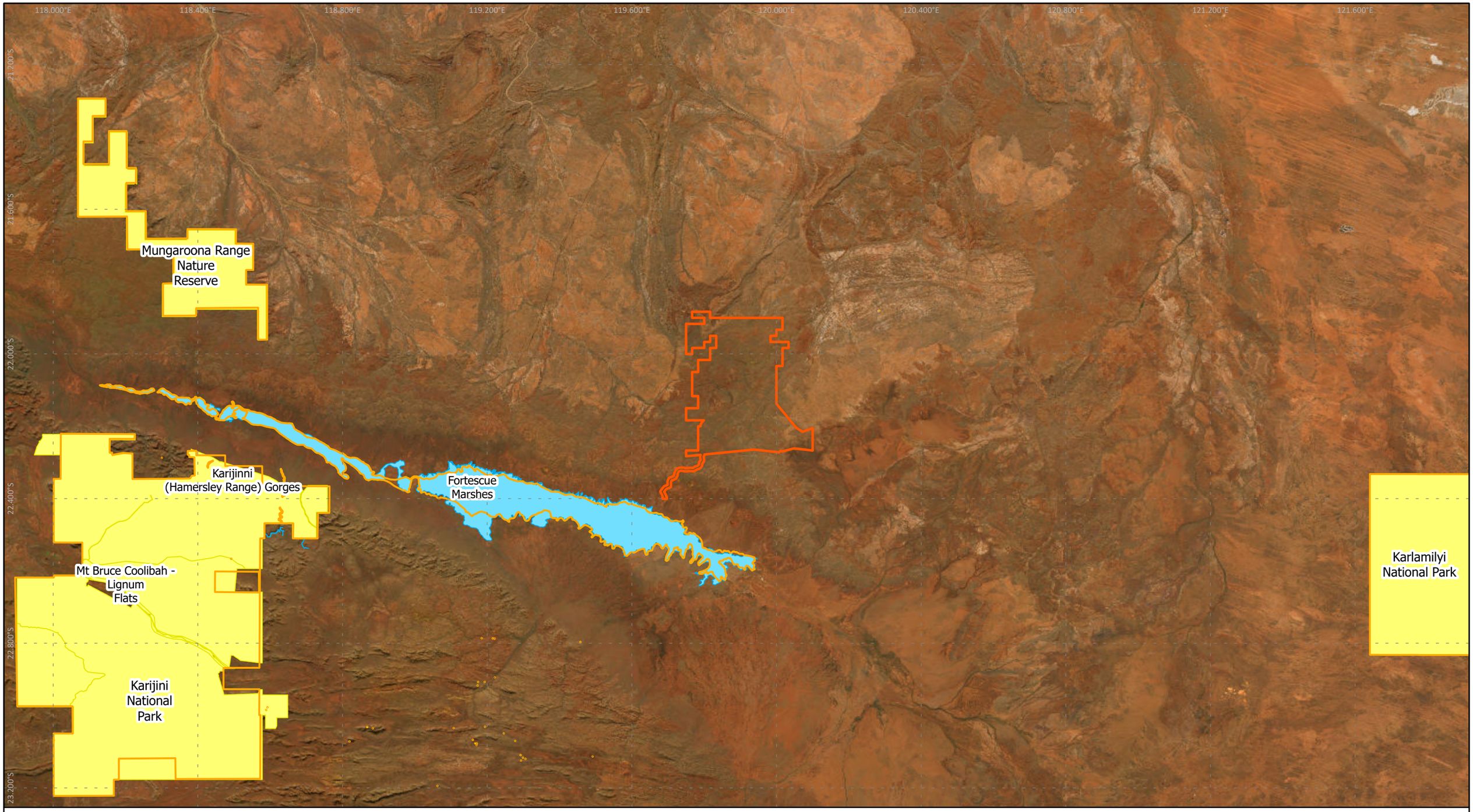
- Bonney system
- Boolgeeda system
- Capricorn system
- Divide system
- Elimunna system
- Granitic system
- Jamindie system
- Jurrawarrina system
- Laterite system
- Macroy system
- McKay system
- Mosquito system
- Newman system
- Pindering system
- River system
- Robe system
- Rocklea system
- Spearhole system
- Talga system
- Taylor system
- Turee system
- Wona system

ecologia ENVIRONMENT

Project No.: 1991
Author: AC
Created Date: 16 December 2024
Coordinate System: GCS GDA 1994
Scale: 1:180,000 @A3

Map 3: Land systems (DPIRD 2016).

0 1.7 3.3 5 10 Kilometers



Survey area

Environmentally Sensitive Area (DWER-046)

DBCA Managed Lands and Waters (DBCA-011)

Nationally Important Wetlands (DBCA-045)

ecologia ENVIRONMENT

Project No.: 1991
Author: AS
Created Date: 09 OCTOBER 2024
Coordinate System: GCS GDA 1994
Scale: 1:1,100,000 @A3

Map 4: DBCA Legislated Lands and Nationally Important Wetlands near the survey area.

0 13.7 27.3 41 82
Kilometers

Esri, TomTom, FAO, NOAA, USGS, Earthstar Geographics

2.7 FLORA

2.7.1 Floristic Diversity

A search of the Atlas of Living Australia (ALA) database (ALA, 2023) identified a total of 796 native vascular plant taxa, 15 naturalised vascular plant taxa, and one declared pest: *Parkinsonia aculeata* (including species, infraspecific taxa, and phrase name taxa), from 69 families and 258 genera, within 50 km of the survey area (Appendix A). The most diverse families were the Fabaceae (149 taxa), Poaceae (112), Malvaceae (64), Chenopodiaceae (61), Asteraceae (56), Amaranthaceae (38). The most diverse genera were *Acacia* (54 taxa), *Ptilotus* (23), *Goodenia* (16), *Sclerolaena* (15), *Eragrostis* (14), and *Eucalyptus* (13).

2.7.2 Significant Species

Database searches (WAHERB, TPFL, and Fortescue's Significant Flora database) identified 59 significant plant taxa occurring within 50 km of the survey area (Table 4), including one EPBC Act and BC Act listed Threatened species (*Quoya zonalis*) (Map 5, Table 4). Species identity has been anonymised on Map 5 in accordance with DBCA's Conditions of Supply, and the locations of *Quoya zonalis* (T) have been omitted. Several of these species are associated with the Fortescue Marsh to the south of the survey area. No EPBC Act listed plant species were identified by the PMST search (Appendix A). The likelihood for each taxon to occur within the survey area was assessed using the criteria outlined in section 2.1.

Seven significant taxa have previously been recorded from the survey area: *Atriplex flabelliformis* (P3), *Dolichocarpa* sp. Hamersley Station (A.A. Mitchell PRP 1479) (P3), *Indigofera ixocarpa* (P2), *Iotasperma sessilifolium* (P3), *Ptilotus mollis* (P4), *Stemodia* sp. Battle Hill (A.L. Payne 1006) (P1), and *Swainsona thompsoniana* (P3). Based on the proximity of previous records and the potential presence of suitable habitat, 38 significant taxa were identified as having potential to occur within the survey area (i.e., Likely and Possible likelihood of occurrence ratings) (Table 4). Fourteen taxa were assessed as Unlikely to occur due to the probable absence of suitable habitat within the survey area or because they are known to have very restricted distributions that are not in close vicinity of the survey area (Table 4). Several taxa identified by the database searches and assessed as Unlikely are associated with the Fortescue Marsh, which is ca. 25 km south of the survey area, and therefore suitable habitat is unlikely to be present.

2.7.3 Introduced Species

A search of the Atlas of Living Australia database (ALA, 2023) identified 16 introduced plant species within 50 km of the survey area (Table 5). One species is listed as a Weed of National Significance (WONS) (DAWR, 2017): **Parkinsonia aculeata*. Eight species have a high ecological impact rating and a rapid invasiveness rating according to the Weed Prioritisation Process for the region (**Aerva javanica, *Cenchrus ciliaris, *Cenchrus setiger, *Echinochloa colona, *Malvastrum americanum, *Parkinsonia aculeata, *Setaria verticillata*, and **Vachellia farnesiana*).

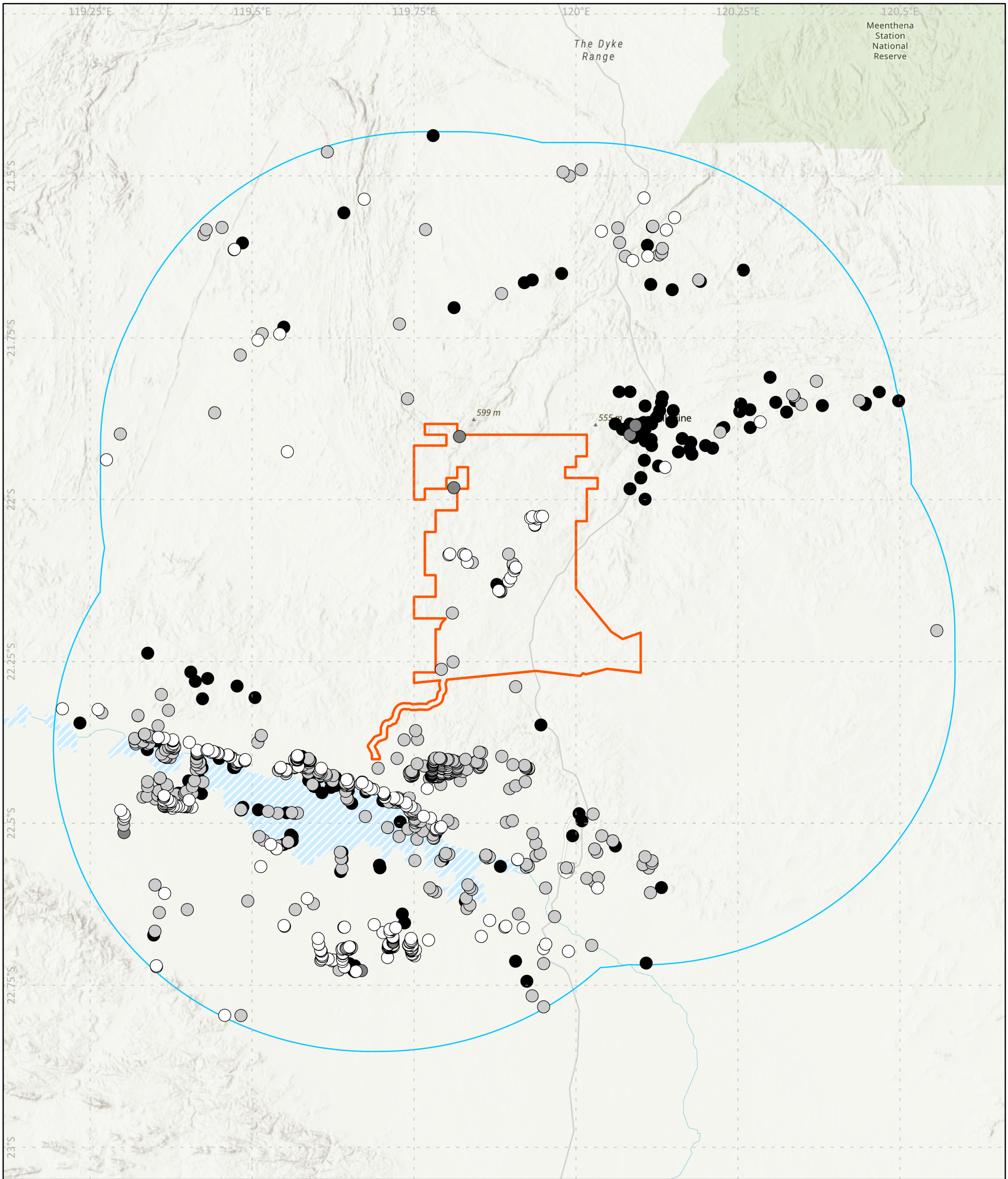
Table 4: Significant plant species recorded within 50 km of the survey area.

Taxon	Status (DBCA)	Habitat	Known flowering period	Approx. distance to nearest record	Likelihood of suitable habitat within the survey area	Post-survey likelihood of occurrence
Pre-survey likelihood: Recorded						
Atriplex flabelliformis	P3	Recorded from saline and swampy soils or seasonally inundated lateritic soils.	–	NA	NA	Recorded
Dolichocarpa sp. Hamersley Station (A.A. Mitchell PRP 1479)	P3	Cracking clays, clay plains, floodplains, flat and low in landscape. Red to brown loamy clays. Surface pebbles and cobbles.	May to July, September	NA	NA	Recorded
Indigofera ixocarpa	P2	Skeletal red soils over massive ironstone.	May	NA	NA	Recorded
Iotasperma sessilifolium	P3	Gilgai, cracking clays & crab hole country in periodically flooded areas.	–	NA	NA	Recorded
Ptilotus mollis	P4	Steep rocky slopes, massive ironstone formations.	May to September	NA	NA	Recorded
Stemodia sp. Battle Hill (A.L. Payne 1006)	P1	Cracking clay. Floodplain.	July to September	NA	NA	Recorded
Swainsona thompsoniana	P3	Open flood plains on heavy clay soils.	August to September	NA	NA	Recorded
Pre-survey likelihood: Likely						
Acacia cyperophylla var. *omearana*	P1	Stony & gritty alluvium. Along drainage lines.	March to April	5 km	Likely	Recorded
Acacia levata	P3	Sand or sandy loam over granite. Low rocky hills.	May	5 km	Likely	Unlikely
Ipomoea racemigera	P3	Sandy soils along watercourses.	March to August	0.6 km	Likely	Recorded
Quoya zonalis	T	Hills, hilltops, rocky slopes. Clay loam. Granite.	August	3 km	Likely	Recorded
Rostellularia adscendens var. *latifolia*	P3	Ironstone soils. Near creeks, rocky hills.	April to May	4 km	Likely	Recorded
Rhagodia sp. Hamersley (M. Trudgen 17794)	P3	Mulga woodlands on cracking clays.	–	1.5 km	Likely	Unlikely
Solanum sp. Mosquito Creek (A.A. Mitchell et al. AAM 10795)	P1	Plains, flats, depressions. Light brown & grey clay	June to October	5 km	Likely	Unlikely
Themeda sp. Hamersley Station (M.E. Trudgen 11431)	P3	Clay pan, grass plain.	August	3 km	Likely	Unlikely
Pre-survey likelihood: Possible						
Atriplex spinulosa	P1	Drainage floor with quartz.	–	10 km	Possible	Unlikely
Acacia aphanoclada	P1	Skeletal stony soils. Rocky hills, ridges & rises.	August to October	7 km	Likely	Unlikely
Bulbostylis burbidgeae	P4	Granitic soils. Granite outcrops, cliff bases.	March to August	21 km	Likely	Recorded
Euphorbia inappendiculata var. *inappendiculata*	P3	Clay soils. Among broken rocky screes.	August	41 km	Likely	Recorded
Goodenia pedicellata	P1	Rocky clayey soils. Rocky slopes and crests of small hills.	–	10 km	Likely	Unlikely
Nicotiana umbratica	P3	Shallow soils. Rocky outcrops.	April to June	47 km	Likely	Recorded
Ptilotus wilsonii	P1	Stony gravelly soils. Rocky hills.	October	9 km	Likely	Unlikely
Lepidium catapycnon	P4	Skeletal soils. Hillsides.	October	28 km	Likely	Unlikely
Rhynchosia bungarensis	P4	Rock piles, gorges, riverbeds and alluvial soils.	–	28 km	Likely	Unlikely
Rorippa sp. Fortescue Valley (M.N. Lyons & R.A. Coppen FV 0760)	P1	Riparian slope at water's edge.	–	36 km	Possible	Unlikely
Acacia fecunda	P1	Quartzite gibbers over grey-red skeletal soil. Along shallow creeks and drainage lines, hills.	May to August	22 km	Possible	Unlikely
Acacia sp. Nullagine (B.R. Maslin 4955)	P1	Low-lying area between rocky hills on rocky clay.	May to July	27 km	Possible	Unlikely
Acacia subtiliformis	P3	On rocky calcrete plateaus.	June to October	39 km	Possible	Unlikely
Amaranthus centralis	P3	Red sand in ephemeral watercourses, sandy to clayey loam on riverbanks and edges of permanent pools in eucalypt lined channels.	January to December	24 km	Possible	Unlikely
Calotis squamigera	P1	Pebbly red-brown loam.	–	11 km	Possible	Unlikely
Cochlospermum macnamarae	P1	Upper slopes of low hills. Shallow stony soil over granite.	–	26 km	Possible	Unlikely
Eleocharis papillosa	P3	Red clay over granite, open clay flats. Claypans.	November	7 km	Possible	Unlikely
Eragrostis sp. erect spikelets (P.K. Latz 2122)	P3	Gravelly creekline, sandy calcrete rises & platforms.	–	30 km	Possible	Unlikely
Eremophila pilosa	P1	Red-brown clay loam and sandy plains.	August to September	41 km	Possible	Unlikely
Eucalyptus rowleyi	P3	Creeks, drainage lines. Seasonal inundation. Red, grey loam, sand.	June	23 km	Possible	Unlikely
Euphorbia australis var. *glabra*	P3	Various habitats.	April to November	26 km	Possible	Unlikely
Fimbristylis sp. Shay Gap (K.R. Newbey 10293)	P1	Sandy soil along drainage lines.	June to July	38 km	Possible	Unlikely
Gompholobium sp. Roy Hill (G. Buller ATF08 AQ14)	P1	Clay loam, hills.	April	24 km	Possible	Unlikely
Gymnanthera cunninghamii	P3	Permanent or semi-permanent water courses on sandy soils.	January to December	48 km	Possible	Unlikely
Isotropis parviflora	P3	Valley slopes of ironstone plateaus.	March	36 km	Possible	Unlikely
Phyllanthus hebecarpus	P3	Sandy areas, granite domes.	April to August	42 km	Possible	Unlikely
Stackhousia clementii	P3	Skeletal soils. Sandstone hills.	–	35 km	Possible	Unlikely
Streptoglossa sp. Cracking clays (S. van Leeuwen et al. PBS 7353)	P3	Cracking clay plains, floodplains and fans, flat to gentle incline. Red-brown cracking clay, sandy clay, red clay loam. Ironstone, calcrete, sodic and saline alluvium, pebbles and cobbles.	June to September	33 km	Possible	Unlikely
Themeda sp. Panorama (J. Nelson et al. NS 102)	P1	Gullies, gorges, slopes or rocky creeks.	–	49 km	Possible	Unlikely
Triodia veniciae	P1	Low shale hill, crest, slopes.	–	9 km	Possible	Unlikely
Pre-survey likelihood: Unlikely						
Dysphania congestiflora	P3	Fortescue Marsh. Saline, deep, light-medium to heavy clay soils.	June to August	18 km	Unlikely	Unlikely
Eremophila spongiocarpa	P3	Sub-saline red clay loams in the Fortescue Marsh.	May or September	4 km	Unlikely	Unlikely
Eremophila youngii subsp. *lepidota*	P4	Stony red sandy loam. Flats plains, floodplains, sometimes semi-saline, clay flats.	January to September	4 km	Unlikely	Unlikely

Taxon	Status (DBCA)	Habitat	Known flowering period	Approx. distance to nearest record	Likelihood of suitable habitat within the survey area	Post-survey likelihood of occurrence
Goodenia sp. East Pilbara (A.A. Mitchell PRP 727)	P3	Known with certainly only in the vicinity of Mulga Downs Homestead, in a swamp on a major river system.	–	48 km	Unlikely	Unlikely
Helichrysum oligochaetum	P1	Depressions and floodplains in clay soils. Associated with the Fortescue and Ashburton River systems.	August to November	29 km	Unlikely	Unlikely
Heliotropium murinum	P3	Red sand plains, gibber plains, near granite and in *Triodia* hummock grasslands.	May to September	17 km	Unlikely	Unlikely
Lindernia sp. Pilbara (M.N. Lyons & L. Lewis FV 1069)	P1	Claypans, wetlands, riparian slopes.	–	36 km	Unlikely	Unlikely
Myriocephalus scalpellus	P1	Clay. Depression on flood plain.	July to September	27 km	Unlikely	Unlikely
Rothia indica subsp. *australis*	P3	Sandy soils. Sandhills and sandy flats.	April to August.	32 km	Unlikely	Unlikely
Samolus sp. Fortescue Marsh (A. Markey & R. Coppen FM 9702)	P1	Fortescue Marsh.	–	5 km	Unlikely	Unlikely
Tecticornia globulifera	P1	Moderately saline flats on red-brown gritty clay.	August to November	7 km	Unlikely	Unlikely
Tecticornia medusa	P3	Fortescue Marsh. Red-brown gritty clay on a saline alluvial plain and is found in dense populations some distance from the shoreline.	July to November	8 km	Unlikely	Unlikely
Tecticornia sp. Christmas Creek (K.A. Shepherd & T. Colmer et al. KS 1063)	P1	Saline flats of Fortescue marsh on red-brown clay.	August to November	5 km	Unlikely	Unlikely
Stylidium weeliwolli	P3	Permanent watercourses and springs.	Ausust to September	40 km	Unlikely	Unlikely

Table 5: Introduced plant species recorded within 50 km of the survey area including BAM Act status and Weed Prioritisation Process rating.

Species	Common name	BAM Act status and WONS	Ecological impact	Invasiveness
Aerva javanica	Kapok bush	Permitted - s11	High	Rapid
Asphodelus fistulosus	Onion weed	Permitted - s11	Unknown	Rapid
Bidens bipinnata	Bipinnate beggar's tick	Permitted - s11	Unknown	Rapid
Cenchrus ciliaris	Buffel grass	Permitted - s11	High	Rapid
Cenchrus setiger	Birdwood grass	Permitted - s11	High	Rapid
Citrullus colocynthis	Colocynth	Permitted - s11	Unknown	Moderate
Cucumis melo	Bush cucumber	Permitted - s11	Unknown	Moderate
Datura leichhardtii	Leichhardt's thornapple	Permitted - s11	Unknown	Unknown
Echinochloa colona	Awnless barnyard grass	Permitted - s11	High	Rapid
Malvastrum americanum	Spiked malvastrum	Permitted - s11	High	Rapid
Parkinsonia aculeata	Parkinsonia	Declared Pest - s22(2) (WONS)	High	Rapid
Portulaca oleracea	Purslane	Permitted - s11	Unknown	Unknown
Setaria verticillata	Whorled pigeon grass	Permitted - s11	High	Rapid
Sonchus oleraceus	Common sowthistle	Permitted - s11	Low	Rapid
Tribulus terrestris	Caltrop	Permitted - s11	Unknown	Moderate
Vachellia farnesiana	Mimosa bush	Permitted - s11	High	Rapid



Bonney Downs Survey area

Study area (50 km)

Priority 1 (DBCA)

Priority 2 (DBCA)

Priority 3 (DBCA)

Priority 4 (DBCA)

ecologia ENVIRONMENT

Project No.: 1991
Author: AC
Created Date: 16 December 2024
Coordinate System: GCS GDA 1994
Scale: 1:600,000 @A3

Map 5: Significant plant species records within 50 km of the survey area..

0 6.7 13.3 20 40 Kilometers

Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community, Esri, CGIAR

2.8 VEGETATION

2.8.1 Pre-European Vegetation

The Western Australian Land Use and Vegetation Data Project produced a 1:250,000 scale digital spatial dataset of the pre-European native vegetation of Western Australia, compiled from previous vegetation mapping exercises, primarily by J.S. Beard from 1964 to 1981, with updates reflecting the National Vegetation Information System (NVIS) standards (D. P. Shepherd et al., 2002). Six vegetation associations are mapped within the survey area, which consists almost entirely of association 173 (96.8%) (Table 6, Map 6).

The pre-European and current extent of each vegetation association is available from the Statewide Vegetation Statistics dataset (Government of Western Australia, 2018). The National Objectives and Targets for Biodiversity Conservation 2001-2005 (DEH, 2001) recognise that the retention of 30% or more of the pre-clearing extent of an ecological community is necessary if Australia's biological diversity is to be protected, as this is the threshold below which species loss appears to accelerate exponentially (EPA, 2000). Vegetation associations occurring outside of constrained areas (i.e., Perth Metropolitan, Peel and Greater Bunbury Region Schemes) at less than 30% of their pre-European extent are classified as either 'Vulnerable' (10-30%) or 'Endangered' (< 10 %) and should not be cleared according to Principle (e) of the native vegetation clearing guidelines (DER, 2014). The current extent of all six vegetation associations in the Pilbara bioregion is greater than 99%, well above the 30% threshold (Table 6), and are classified as 'least concern' (DER, 2014).

Table 6: Pre-European vegetation associations mapped with the survey area (D. P. Shepherd et al., 2002).

Vegetation association	Description	Pre-European extent within Pilbara IBRA (ha)	Percentage remaining within Pilbara IBRA	Current percentage protected for conservation within Pilbara IBRA	Extent within survey area (ha)
18	Low woodland; mulga (*Acacia aneura*).	676,556.72	99.30	16.76	708.42
29	Sparse low woodland; mulga, discontinuous in scattered groups.	1,133,219.76	99.87	1.91	736.86
82	Hummock grasslands, low tree steppe; snappy gum over *Triodia wiseana*.	2,563,583.23	99.50	10.26	884.52
93	Hummock grasslands, shrub steppe; kanji over soft spinifex.	3,042,114.27	99.88	0.44	181.51
173	Hummock grasslands, shrub steppe; kanji over soft spinifex & *Triodia wiseana* on basalt.	1,752,520.89	99.72	7.49	105347.51
562	Mosaic: Low woodland; mulga in valleys / Hummock grasslands, open low tree-steppe; snappy gum over *Triodia wiseana*.	103,606.82	100.00	nil	970.59

2.8.2 Threatened and Priority Ecological Communities

DBCA database searches (Appendix A) and the EPBC Act Protected Matters Report (Appendix B) indicate that no EPBC Act or BC Act listed TECs occur within 50 km of the survey area. DBCA database searches identified five PECs within 50 km of the survey area (Table 7, Map 7).

The 'Four plant assemblages of the Wona Land System' PEC includes four grassland communities occurring on cracking clay soils. The Wona land system, including an administrative buffer, is present within the survey area, occupying an extent of 19,435 ha (17% of the survey area). The remaining communities are either specific land systems that are not present within the survey area (Marsh land

system, Narbung land system), specific to a land system that is not present within the survey area (Stony saline plains of the Mosquito Land System) or are restricted to a specific habitat type that is not present within the survey area (Freshwater claypans of the Fortescue Valley).

2.8.3 Groundwater Dependent Vegetation

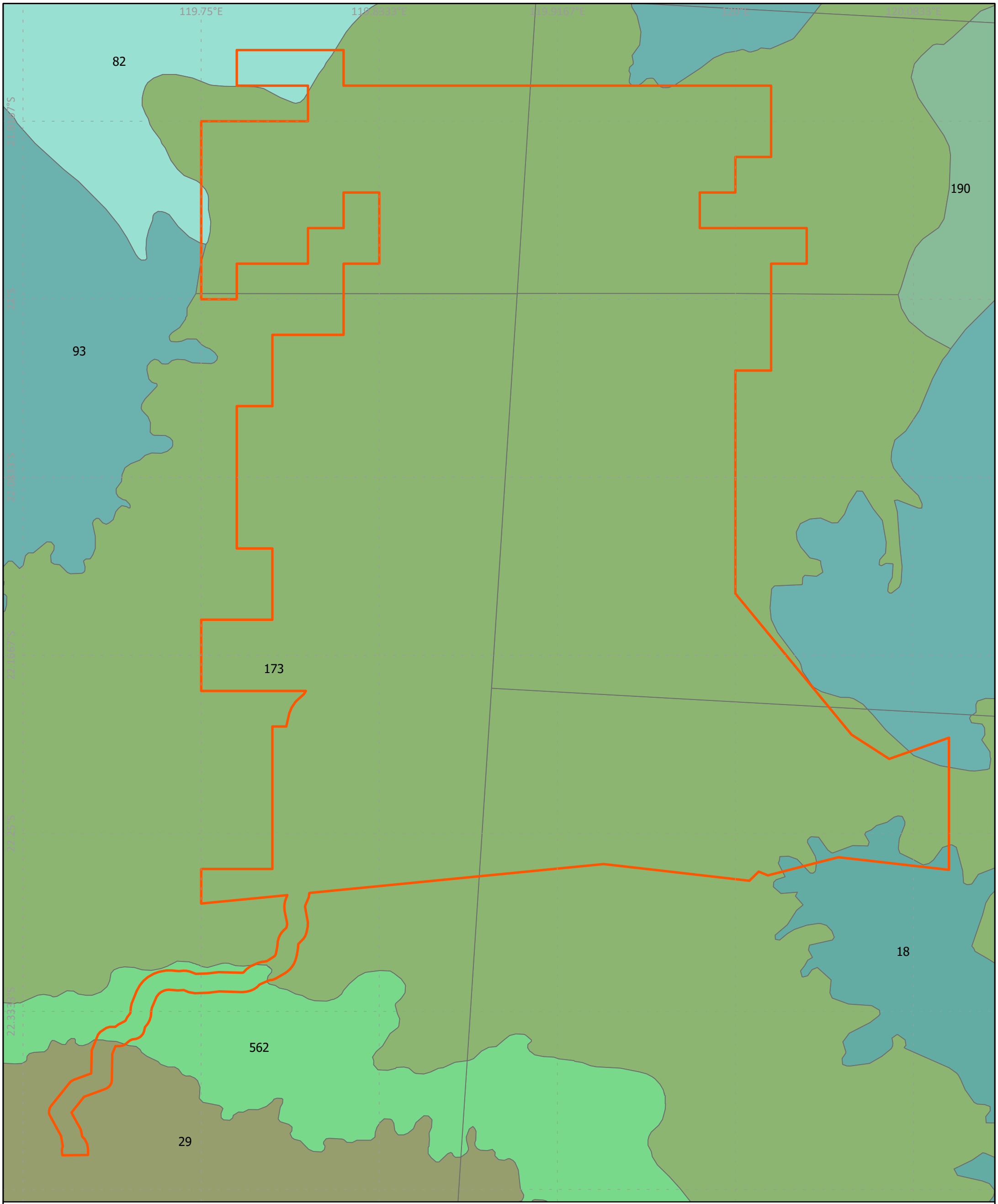
Three tree species commonly associated with riparian habitats in the Pilbara are considered potentially groundwater dependent: *Eucalyptus camaldulensis* (river red gum), *Eucalyptus victrix* (coolabah), and *Melaleuca argentea* (silver cadjeput). *Eucalyptus camaldulensis* and *E. victrix* are facultative phreatophytes, which are species that may be dependent on groundwater or water from the capillary fringe in environments that have otherwise low available surface derived water, particularly in the arid zone and during extended dry periods (Batini, 2009; Froend, 2009). This is particularly relevant during the Pilbara dry season (April to November) when recharge of the groundwater table is likely to be minimal and alternative water sources are limited (Eamus & Froend, 2006), although they appear to be resilient to fluctuating water table levels as well as to drought (Batini, 2009; Pfautsch, Dodson, Madden, & Adams, 2014). *Melaleuca argentea* is considered an obligate phreatophyte that is reliant on groundwater for its survival. Plant communities in which these species are dominant may be considered groundwater dependent vegetation (GDV) in some situations, and may potentially be impacted by groundwater abstraction, but they do not generally have any specific conservation significance. Previous surveys indicated that the drainage systems (creeks and major drainage channels) within the survey area commonly support *Eucalyptus camaldulensis* and/or *E. victrix*, and in some areas *Melaleuca argentea* (*ecologia*, 2024; SLR, 2024), and therefore GDV according to these criteria is present within the survey area.

2.8.4 Sheet-flow Dependent Mulga

Mulga communities cover over 20% of mainland Australian (Johnson & Burrows 1981) and are largely confined to areas south of the Tropic of Capricorn in semi-arid and arid areas not exceeding 250–300 mm annual rainfall (Maslin & Reid 2012). Mulgas are shallow-rooted (typically < 5 m) perennial trees or shrubs and are dependent on surface water recharge during rainfall events, although available data suggest they are resilient to prolonged periods of low water availability in the rooting zone (Page & Grierson, 2010). Mulga intercept rain falling on the canopy, redirecting water to surface soils at the base of the trunk. There is also some evidence that mulga groves intercept water runoff from higher elevations, especially in banded communities. Consequently, it has been suggested that mulga groves play an important role as water and nutrient sinks, creating fertile patches in generally water and nutrient poor landscapes (Dunkerley 2002; Johnson & Burrows 1981; Ludwig *et al*. 1997; Tongway & Ludwig 1990), and are characterised by significant biodiversity (Maslin & Reid 2012). Based on an evaluation of vegetation patterning on aerial imagery, sheet-flow dependent mulga communities (i.e., grove-intergrove mulga) are likely to be present at the southern end of the transmission corridor.

Table 7: Threatened and Priority Ecological Communities within 50 km of the survey area.

Community	Description	Likelihood of occurrence
Fortescue Marsh (Marsh Land System) (Priority 1)	Fortescue Marsh is an extensive, episodically inundated samphire marsh at the upper terminus of the Fortescue River and the western end of Goodiadarrie Hills. It is regarded as the largest ephemeral wetland in the Pilbara. It is a highly diverse ecosystem with fringing mulga woodlands (on the northern side), samphire shrublands and groundwater dependent riparian ecosystems. It is an arid wetland utilised by waterbirds and supports a rich diversity of restricted aquatic and terrestrial invertebrates. Recorded locality for night parrot and bilby and several other threatened vertebrate fauna. Endemic *Eremophila* species, populations of priority flora and several near-endemic and novel samphires.	Does not occur (only administrative buffer present)
Four plant assemblages of the Wona Land System (Priority 1, Priority 3)	Community: 1. Cracking clays of the Chichester and Mungaroona Range. This shrubless plain of stony gibber community occurs on the tablelands with very little vegetative cover during the dry season, however during the wet a suite of ephemerals/annuals and short-lived perennials emerge, many of which are poorly known and range-end taxa. (Priority 1) 2. Annual *Sorghum* grasslands on self-mulching clays with a moderate-dense overlay of rocks. This community appears very rare and restricted to the Pannawonica-Robe valley end of Chichester Range. Naturally species poor when dry. (Priority 1) 3. Mitchell grass plains (*Astrebla* spp.) on gilgai. (Priority 3) 4. Mitchell grass and Roebourne Plain grass (*Eragrostis xerophila*) plain on gilgai. *Astrebla pectinata, A. elymoides*, *E. xerophila, Aristida latifolia, Eriachne* and *Sida fibulifera* (Priority 3)	Present within the survey area (19,435 ha, including buffer)
Freshwater claypans of the Fortescue Valley (Priority 1)	Freshwater claypans downstream of the Fortescue Marsh - Goodiadarrie Hills on Mulga Downs Station. Larger claypans contain the highest number of invertebrate species and most of the restricted elements of the Pilbara riparian flora. Important for waterbirds, invertebrates and some poorly collected plants. *Eriachne* spp., *Eragrostis* spp. grasslands. Unique community, has few Coolibah.	Does not occur
Narbung Land System (Priority 3)	Alluvial washplains with prominent internal drainage foci supporting snakewood and mulga shrublands with halophytic low shrubs.	Does not occur
Stony saline plains of the Mosquito Land System (Priority 3)	*Triodia longiceps* grassland with scattered *Maireana melanocoma* and *Sclerolaena spp.* and includes Priority flora taxa *Atriplex spinulosa* (P1) and *Ptilotus wilsonii* (P1). Dissected by drainage lines. Dominated by (but not limited to) *Melaleuca eleuterostachya* and *Acacia bivenosa* occurring on saline red brown non-cracking clays with a mantle of quartz gravel and neutral subsurface soil material on level to undulating plains. Largely restricted to an area east of Nullagine.	Does not occur



Survey area

Pre-European vegetation association

- 18: Low woodland; mulga (Acacia aneura)
- 29: Sparse low woodland; mulga, discontinuous in scattered groups
- 82: Hummock grasslands, low tree steppe; snappy gum over Triodia wiseana
- 93: Hummock grasslands, shrub steppe; kanji over soft spinifex
- 111: Hummock grasslands, shrub steppe; Eucalyptus gamophylla over hard spinifex
- 173: Hummock grasslands, shrub steppe; kanji over soft spinifex & Triodia wiseana on basalt
- 190: Hummock grasslands, sparse shrub steppe; Acacia bivenosa & A. trachycarpa over hard spinifex, Triodia wiseana, Very poor rocky country on gneiss
- 562: Mosaic: Low woodland; mulga in valleys / Hummock grasslands, open low tree-steppe; snappy gum over Triodia wiseana

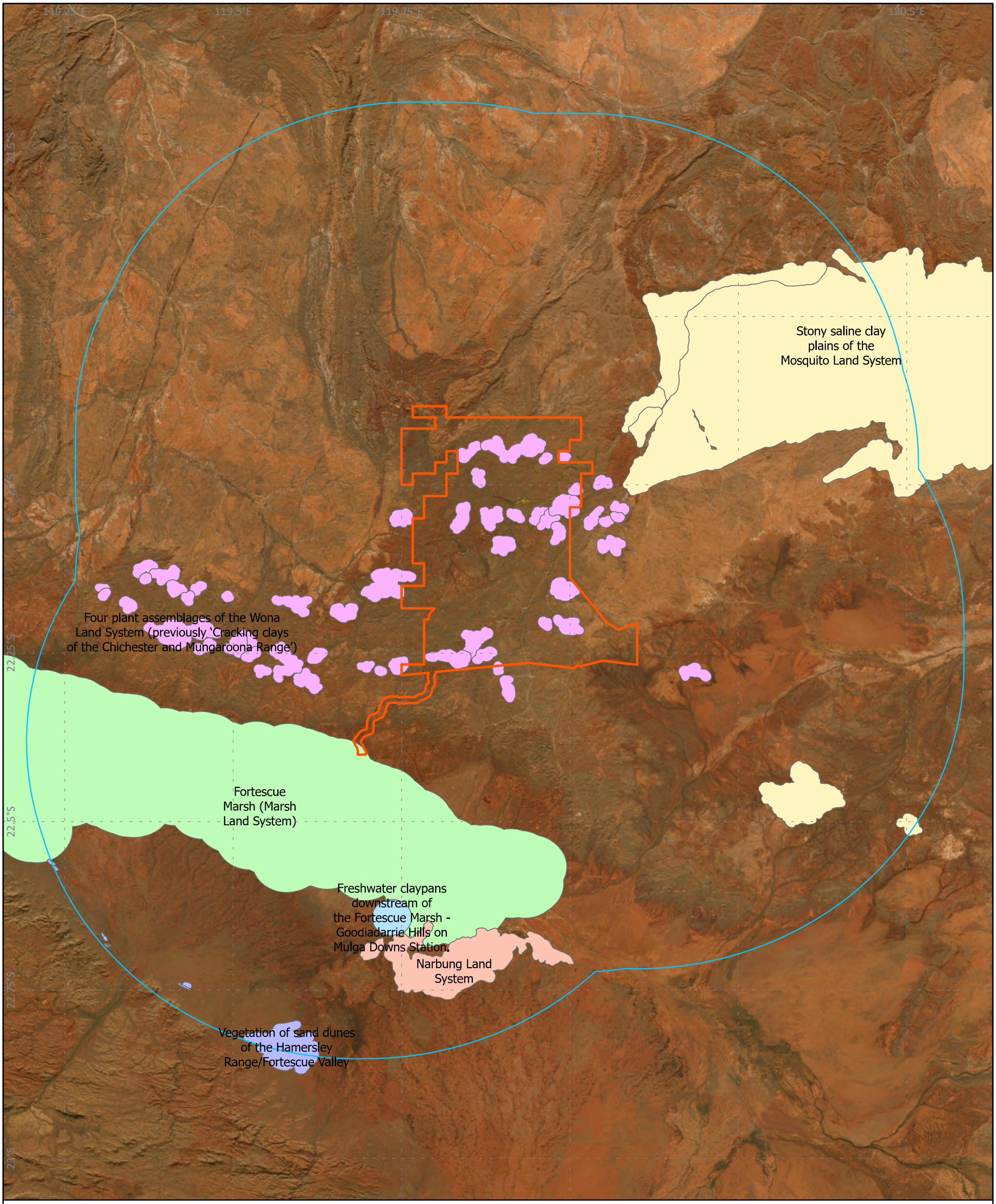
ecologia ENVIRONMENT

Project No.: 1991
Author: AS
Created Date: 09 OCTOBER 2024
Coordinate System: GCS GDA 1994
Scale: 1:180,000 @A3

Map 6: Pre-European vegetation associations (Shepherd et al. 2002).

0 2.5 5 10
Kilometers

Esri, TomTom, Garmin, FAO, NOAA, USGS, Earthstar Geographics, Esri, USGS



Survey area

Study area (50 km)

Community name

- Fortescue Marsh (Marsh Land System)
- Four plant assemblages of the Wona Land System (previously 'Cracking clays of the Chichester and Mungaroona Range')
- Freshwater claypans downstream of the Fortescue Marsh - Goodiadarrie Hills on Mulga Downs Station.
- Narbung Land System
- Stony saline clay plains of the Mosquito Land System
- Vegetation of sand dunes of the Hamersley Range/Fortescue Valley

ecologia ENVIRONMENT

Project No.: 1991
Author: AS
Created Date: 10 OCTOBER 2024
Coordinate System: GCS GDA 1994
Scale: 1:570,000 @A3

Map 7: Significant ecological communities within 50 km of the survey area.

0 8 16 32
Kilometers

Esri, TomTom, Garmin, FAO, NOAA, USGS, Earthstar Geographics, Esri, USGS

3 METHODOLOGY

3.1 FLORA AND VEGETATION ASSESSMENT

3.1.1 Field Survey

The Bonney Downs North area (Map 1) was surveyed by four botanists over two phases during 2023 (19 – 26 June and 13 – 20 September). The remainder of the survey area (excluding Bonney Downs East, Map 1) was surveyed by four botanists over two phases in 2024 (5 – 13 March and 15 – 21 July). The surveys were conducted in accordance with the *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA, 2016b), primarily by sampling vascular plant species within quadrats. To provide a more comprehensive species inventory for the survey area, quadrat sampling was supplemented by additional opportunistic sampling along traverses.

3.1.2 Quadrat Sampling

Sampling site locations were selected using a combination of aerial photography, topographic features, land system mapping, pre-European vegetation mapping, and field observations, to represent the geomorphological and floristic variation found within the survey area. At least three sites were selected to represent each potentially distinct plant community in accordance with EPA (2016b). However, as vegetation types are classified according to total floristic composition and cannot be determined until data analysis has been completed, final vegetation types may in some cases be represented by fewer than three sites. Sites were positioned to avoid obvious transition zones between plant communities and were preferentially placed in areas of intact mature vegetation and minimal disturbance.

Two-hundred and ninety-one sampling sites (275 quadrats and 16 relevés) were assessed and sampled within the survey area (Map 8). All quadrats were 50 m x 50 m in dimension or of an equivalent area, and in most cases had a north-south orientation. The location of each corner was recorded with a handheld GPS. Relevés were sampled in cases where installation of suitably sized quadrats was not feasible (e.g., narrow creeks, edges of water bodies). In this report a relevé is defined as an irregularly shaped sampling plot in which comprehensive floristic data are recorded within an area approximating a 50 m x 50 m quadrat. Site access was restricted within western portion of the survey area in 2024, so no quadrats were installed here (Map 8).

The following attributes were recorded from each quadrat and relevé:

- Site code.
- GPS coordinate of all corners (central location for relevé).
- Photograph from the north-west corner (central location for relevé).
- A comprehensive species list (including introduced species).
- The dominant heigh class (ESCAVI, 2017) and estimated percentage foliage cover (using a variant of the Domin scale) of each species (< 1%, 1-4%, 5-9%, 10-24%, 25-32%, 33-49%, 50-74%, 95-100%). Where isolated tall shrub and tree species are present in the surrounding landscape and do not occur within a quadrat, then the species may be recorded as an 'associated species' (Assoc.) if it is considered important to the overall description of the community.
- Vegetation condition according to EPA (2016b) (adapted from Trudgen 1988) (Table 8) and description of disturbance.
- Additional information to assist vegetation characterisation, including landform, slope, soil type, surface geology, and fire history.

Table 8: Vegetation condition scale.

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

3.1.3 Significant Species

Targeted searches for significant plant species identified from desktop assessment were made along traverses in areas of potential suitable habitat, and within representative areas of each of the major landforms and plant communities present within the survey area. Where significant species were observed, the following parameters were recorded:

- Location (for individual or localised plants) or population boundary (for more extensive populations, time permitting).
- Number of plants (count, for individual or localised plants) or estimated number of plants for more extensive populations.
- Reproductive state.
- Vegetation type.
- Landform.

The initial likelihood of occurrence assessment for each species was reviewed following the field survey based on the level of survey effort, seasonal conditions, vegetation condition, and the presence of suitable habitat.

3.1.4 Specimen Identification

Specimen identification was undertaken with reference to current taxonomic literature and herbarium reference specimens. Scientific names used in this report follow the species concepts currently adopted by the Western Australian Herbarium. Specimens that could not be adequately identified to genus or species level due to the absence of reproductive material required for positive identification were indicated with a query but were not considered to be otherwise anomalous.

3.1.5 Asymptotic Species Richness and Rarefaction

Estimators of asymptotic species richness use abundance or incidence data as a means of estimating the number of undetected species in an assemblage (Gotelli & Colwell, 2012). Asymptotic species richness was estimated for the survey area using the Chao 2 non-parametric sample-based estimator in EstimateS v9.1 with the default settings (Colwell, 2013) and 9,999 randomisations. To provide some indication of survey completeness, a sample-based rarefaction curve, which displays the rate at which new species are found within a sample in relation to increasing sampling effort, was also calculated in EstimateS and plotted against the Chao 2 species richness estimator and its 95% confidence intervals.

Rarefaction curves and estimates of species richness may provide some measure of survey completeness relating specifically to the proportion of species recorded, at least for the season in which the survey was conducted. Should the curve reach an asymptote, few additional species would be expected to have been recorded should additional samples have been taken in similar areas during the same season.

3.1.6 Data Consolidation and Vegetation Classification

The consolidated vegetation dataset consisted of 400 quadrats and relevé sampled by Ecologia (291 sites sampled in 2023 and 2024) and SLR (109 sites sampled in 2023 within the Bonney Downs East area) (Map 8). Twenty-five sites were excluded as they were too degraded or fire history was too recent. Some taxa were amalgamated prior to analysis if was reasonable to do so rather than excluding records (Appendix B). All indeterminate records were presumed to be the nominated taxon (e.g., all records of *Abutilon* ?*fraseri* were assumed to be *Abutilon fraseri*). Singletons (taxa recorded from only one site) were excluded. Species names were checked against the current Western Australian Plant Census to ensure taxonomic consistency across datasets. The final dataset used for classification included 375 sites and 398 taxa.

Hierarchical agglomerative clustering was used together with similarity profile analysis (SIMPROF) as a hypothesis testing-based approach for assessing multivariate group structure and to inform the classification of groups of floristically similar sites into vegetation types. All analyses were conducted in R 4.1.2 (R Core Team, 2021). Percentage cover scores recorded using the Domin scale were converted to percentage cover using the 'Domin 2.6' transformation (Currall, 1987). Pair-wise site dissimilarity was calculated from square root transformed percentage cover data using Bray-Curtis dissimilarity, and subsequent hierarchical agglomerative clustering used the unweighted pair-groups method using arithmetic averages (UPGMA). The site dissimilarity matrix and dendrogram were generated using the 'simprof' function of *clustsig* (Whitaker & Christman, 2014) and statistically different clusters of sites were determined with 999 permuted similarity profiles and $\alpha = 0.001$ as suggested by Clarke, Somerfield, and Gorley (2008).

Within a dendrogram, SIMPROF detects groups of homogenous objects (sampling sites) with respect to a set of descriptors (species) and provides a means of stopping unwarranted over-interpretation of group substructure. When no significant group structure is detected by the test there is no justification for further interpretation of substructure, and sites at this point may be considered essentially homogenous (i.e., vegetation types). Some groups identified by SIMPROF can be too fine to meaningfully interpret in an ecological context and, in such cases, it is appropriate to define coarser groupings as vegetation types provided they are supersets of the SIMPROF groups (Clarke et al., 2008).

Non-metric multidimensional scaling (NMDS) ordination was used as an independent clustering method to assess relationships among clusters and to visually validate the SIMPROF classification by assessing cluster compactness and dissimilarity from neighbouring clusters. The aim was not to define only highly discrete and compact groups as vegetation types as doing so would likely obscure much of the community diversity present within the survey area. Rather, groups classified here as vegetation types should at least form reasonably distinct clusters with minimal overlap with neighbouring clusters. NMDS using Bray-Curtis dissimilarity was conducted using the 'MetaMDS' function of *vegan* (Oksanen et al., 2017). A stress value for the ordination was calculated to determine if the 2-dimentional configuration of points is a good representation of the actual similarity between sites, where stress < 0.2 is considered acceptable.

Indicator species for each vegetation type were determined with the IndVal statistic (M De Cáceres & Legendre, 2009) using the 'multipatt' function of indicspecies (M. De Cáceres, Jansen, & Dell, 2017). Species with high indicator values (closer to 1.00) are those that occur in all (or most) sites within a group but also occur in no (or few) sites outside of that group and provide an additional means of cluster validation.

3.1.7 Vegetation Characterisation

The groups identified as vegetation types using the procedures described above were characterised by the constancy of shared species, shared dominant species, diagnostic (indicator) species, and other abiotic attributes (e.g., soil, landform).

Vegetation types were given descriptive names consistent with NVIS Level V – Association (ESCAVI, 2017), which include structural features and dominant or diagnostic species. Plant communities are naturally variable across wide geographic areas and vegetation types here are delineated based on the overall floristic similarity of sites. Species included in descriptive names are therefore those that are most characteristic of the vegetation type but were not necessarily present at all sites. Species that are dominant in some examples of a community but present in ≤50% of sites representing that community are indicated with '±' in the description.

3.1.8 Vegetation Mapping

Preliminary vegetation mapping of survey area was undertaken prior to the surveys and in the field using aerial imagery and data from ground-truthed sites. Vegetation types were then determined post-survey using the floristic classification methods described above and applied to these ground-truthed areas. Vegetation type boundaries were refined using aerial imagery in ESRI ArcGIS Pro. Extrapolative mapping was undertaken in areas that could not be ground-truthed and was based on observed similarities in spectral and structural features between ground-truthed sites and unvisited areas.

Existing mapping for Bonney Downs East (SLR, 2024) was consolidated with *ecologia's* mapping of the remainder of the survey area. SLR's mapping boundaries were maintained wherever possible, but some slight changes were made when they did not align with the results of the consolidated vegetation classification.

Vegetation condition mapping was undertaken in a similar manner, with reference to the condition recorded at sampled sites using the EPA scale (EPA, 2016b), opportunistic observations, and aerial imagery. In some cases, small changes in vegetation condition over large areas could not be perceived from aerial imagery or feasibly mapped in the field; in these cases, the most common vegetation condition for the area was applied since a range of conditions is not permitted by Fortescue's spatial data standards.

3.1.9 Assessment of Vegetation Significance

The significance of each vegetation type was assessed against 11 criteria (Table 9) to assist the environmental impact assessment (EIA) process.

Table 9: Criteria for assessment of potential vegetation significance.

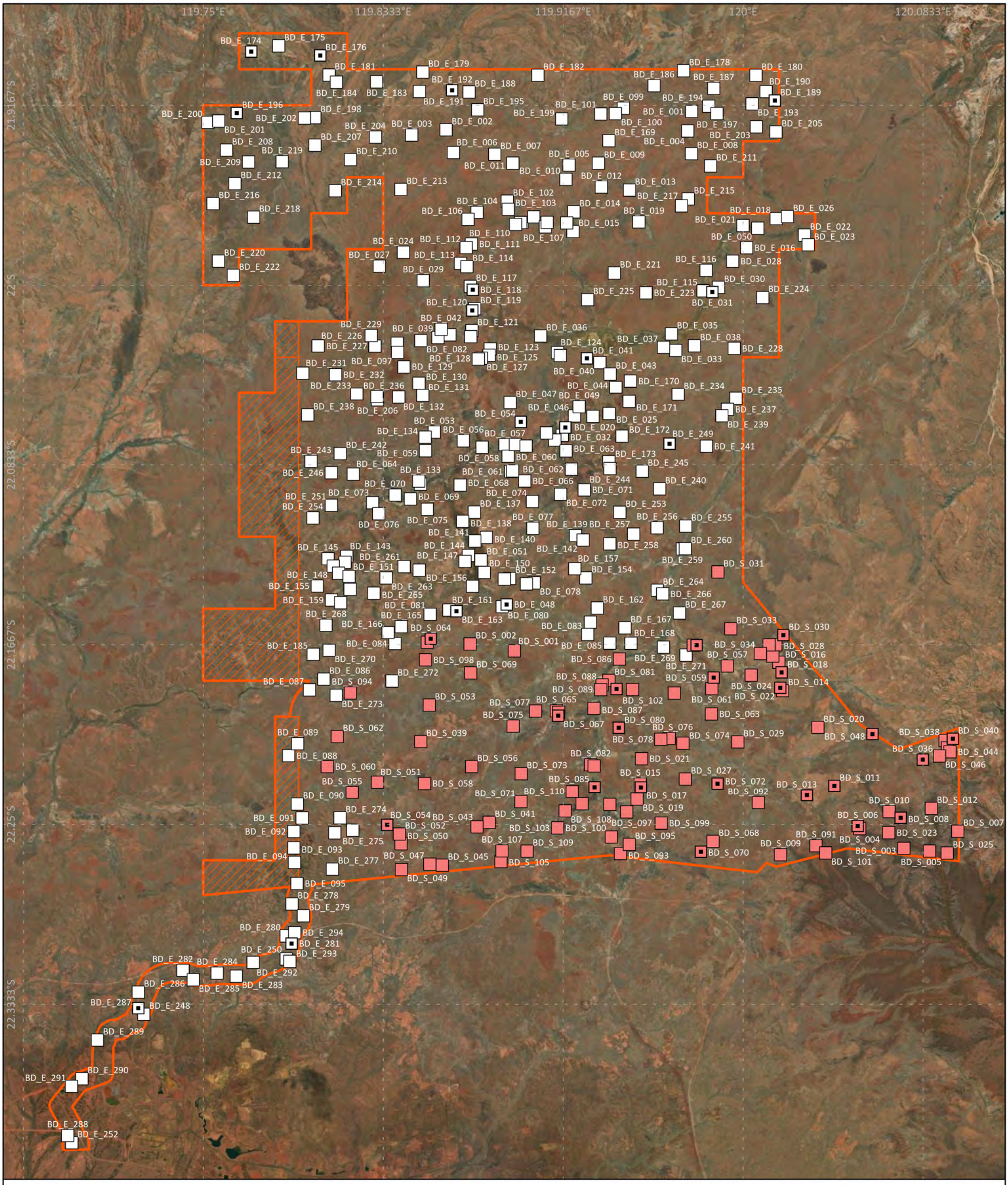
Level	Criterion
National	1. Vegetation supporting populations of Threatened (EPBC Act listed) plant species. 2. Vegetation corresponding to a nationally (EPBC Act) listed Threatened Ecological Community. 3. Vegetation which includes Ramsar wetlands and Nationally Important (DIWA) wetlands.
State	4. Vegetation supporting populations of Threatened (BC Act) plant species. 5. Vegetation which corresponds to a BC Act listed Threatened Ecological Community. 6. Vegetation corresponding to a state (DBCA) listed Priority Ecological Community. 7. Vegetation occurring within a state-managed conservation estate (areas protected under the *Conservation and Land Management Act 1984*) or areas that have been formally recommended by DBCA for inclusion in the state conservation estate.
Regional	8. Vegetation that is represented by less than 30% of its pre-European extent within the relevant bioregion. This criterion was assessed using the vegetation association mapping of D. P. Shepherd et al. (2002). 9. Habitats that play a role as a refuge: habitats that have a restricted regional distribution (e.g., isolated hills which are remnants of an ancient eroding surface, islands, mound springs, sheltered gorges, or permanent wetlands in arid areas) that support vegetation or plant species that are restricted to these specific biotic or abiotic conditions.
Other	10. Vegetation that has locally restricted distribution: vegetation types with a mapped extent < 5% of total survey area. 11. Vegetation representing groundwater dependent vegetation or sheet-flow dependent mulga (banded mulga).

3.2 STUDY TEAM AND LICENCES

The project was undertaken by those summarised in Table 10.

Table 10: Project staff and licences.

Project staff				
Name	**Qualification**	**Role**	Project role	Experience
Shaun Grein	B.App. Sc (Biol.); Grad. Dip. Nat. Resources; MBA	Managing Director/Senior Principal Scientist	Project management, QA	30+
Andrew Craigie	B.Sc. (Hons.) (Botany); PhD (Botany)	Principal Botanist and Taxonomist	Field survey (2023, 2024), specimen identification, data analysis	15+
Sandra Ng	B.Sc. (Marine Biol. and Cons. & Wildlife Biol.)	Botanist	Field survey (2024), desktop assessment	1+
Amelia Shepherdson	B.Sc. (Botany)	Botanist	Field survey (2024), desktop assessment	1+
Rob Sellers	B.Sc. (Cons. Biol. and Mngment)	Senior Botanist	Field survey (2023)	5+
Sam Hall	B.Sc. (Hons.) (Botany and Cons. Biol.)	Botanist	Field survey (2023)	5+
Lydia Ellwood	B.Sc. (Env. Mgmt. & Sust. & Cons. & WildlifeBiol.)	Botanist	Field survey (2023)	2+
Brett Neasham	B.Sc. (Hons.) (Biol. Sci.)	Senior Botanist	Field survey (2024)	5+
Licences				
Andrew Craigie	Flora Taking (Biological Assessment) Licence: FB62000135-2 (exp. 30/04/2025) Authorisation to Take Threatened Flora: TFL 54-1920 (exp. 30/4/2026)			
Rob Sellers	Flora Taking (Biological Assessment) Licence: FB2000198-2 (exp. 30/03/2026)			
Lydia Ellwood	Flora Taking (Biological Assessment) Licence: FB62000392 (exp. 06/02/2025)			
Sam Hall	Flora Taking (Biological Assessment) Licence: FB62000450 (exp. 3/07/2025)			
Sandra Ng	Flora Taking (Biological Assessment) Licence: FB62000543 (exp. 23/03/2026)			
Amelia Shepherdson	Flora Taking (Biological Assessment) Licence: FB62000723 (exp. 28/08/2025)			
Brett Neasham	Flora Taking (Biological Assessment) Licence: FB62000483 (exp. 07/11/2025)			


119.75°E
119.8333°E
119.9167°E
120°E
120.0833°E
21.9167°S
22°S
22.0833°S
22.1667°S
22.25°S
22.3333°S
BD_E_174
BD_E_175
BD_E_176
BD_E_181
BD_E_179
BD_E_182
BD_E_178
BD_E_180
BD_E_186
BD_E_187
BD_E_190
BD_E_189
BD_E_192
BD_E_188
BD_E_184
BD_E_183
BD_E_191
BD_E_195
BD_E_099
BD_E_194
BD_E_196
BD_E_200
BD_E_198
BD_E_202
BD_E_199
BD_E_101
BD_E_001
BD_E_193
BD_E_201
BD_E_204
BD_E_003
BD_E_002
BD_E_100
BD_E_197
BD_E_205
BD_E_208
BD_E_207
BD_E_169
BD_E_203
BD_E_004
BD_E_008
BD_E_219
BD_E_210
BD_E_006
BD_E_007
BD_E_209
BD_E_005
BD_E_009
BD_E_211
BD_E_011
BD_E_010
BD_E_212
BD_E_012
BD_E_013
BD_E_214
BD_E_213
BD_E_215
BD_E_216
BD_E_102
BD_E_217
BD_E_104
BD_E_103
BD_E_014
BD_E_218
BD_E_106
BD_E_019
BD_E_018
BD_E_026
BD_E_015
BD_E_021
BD_E_022
BD_E_110
BD_E_107
BD_E_050
BD_E_023
BD_E_024
BD_E_112
BD_E_111
BD_E_016
BD_E_220
BD_E_027
BD_E_113
BD_E_114
BD_E_116
BD_E_028
BD_E_222
BD_E_029
BD_E_221
BD_E_117
BD_E_115
BD_E_030
BD_E_118
BD_E_225
BD_E_223
BD_E_224
BD_E_120
BD_E_119
BD_E_031
BD_E_042
BD_E_229
BD_E_039
BD_E_121
BD_E_036
BD_E_035
BD_E_226
BD_E_037
BD_E_038
BD_E_227
BD_E_082
BD_E_123
BD_E_124
BD_E_228
BD_E_128
BD_E_125
BD_E_041
BD_E_033
BD_E_231
BD_E_097
BD_E_129
BD_E_127
BD_E_043
BD_E_232
BD_E_130
BD_E_040
BD_E_233
BD_E_236
BD_E_131
BD_E_170
BD_E_234
BD_E_044
BD_E_235
BD_E_047
BD_E_049
BD_E_238
BD_E_206
BD_E_132
BD_E_046
BD_E_171
BD_E_237
BD_E_054
BD_E_025
BD_E_053
BD_E_239
BD_E_134
BD_E_056
BD_E_057
BD_E_020
BD_E_172
BD_E_249
BD_E_243
BD_E_242
BD_E_032
BD_E_241
BD_E_059
BD_E_063
BD_E_058
BD_E_060
BD_E_173
BD_E_064
BD_E_245
BD_E_246
BD_E_133
BD_E_061
BD_E_062
BD_E_070
BD_E_068
BD_E_066
BD_E_244
BD_E_240
BD_E_251
BD_E_073
BD_E_069
BD_E_074
BD_E_071
BD_E_254
BD_E_137
BD_E_072
BD_E_253
BD_E_076
BD_E_075
BD_E_077
BD_E_256
BD_E_255
BD_E_138
BD_E_139
BD_E_257
BD_E_141
BD_E_140
BD_E_145
BD_E_143
BD_E_144
BD_E_258
BD_E_260
BD_E_261
BD_E_147
BD_E_051
BD_E_142
BD_E_157
BD_E_259
BD_S_031
BD_E_151
BD_E_150
BD_E_152
BD_E_154
BD_E_148
BD_E_156
BD_E_264
BD_E_155
BD_E_263
BD_E_266
BD_E_265
BD_E_078
BD_E_159
BD_E_161
BD_E_162
BD_E_081
BD_E_048
BD_E_267
BD_E_268
BD_E_165
BD_E_163
BD_E_080
BD_E_167
BD_S_033
BD_E_166
BD_S_064
BD_E_083
BD_S_030
BD_E_168
BD_S_002
BD_S_001
BD_E_185
BD_E_084
BD_E_085
BD_S_034
BD_S_028
BD_S_057
BD_S_016
BD_E_270
BD_S_098
BD_S_069
BD_S_086
BD_E_269
BD_S_018
BD_E_271
BD_E_086
BD_E_272
BD_S_081
BD_S_059
BD_S_088
BD_E_087
BD_S_094
BD_S_024
BD_S_014
BD_S_089
BD_S_022
BD_E_273
BD_S_053
BD_S_102
BD_S_061
BD_S_077
BD_S_065
BD_S_087
BD_S_063
BD_S_075
BD_S_067
BD_S_080
BD_S_020
BD_E_089
BD_S_062
BD_S_076
BD_S_038
BD_S_040
BD_S_039
BD_S_078
BD_S_074
BD_S_029
BD_S_048
BD_S_036
BD_S_044
BD_E_088
BD_S_082
BD_S_056
BD_S_021
BD_S_046
BD_S_060
BD_S_073
BD_S_051
BD_S_015
BD_S_027
BD_S_055
BD_S_085
BD_S_072
BD_S_011
BD_S_058
BD_S_013
BD_E_090
BD_S_071
BD_S_110
BD_S_092
BD_S_017
BD_S_010
BD_S_012
BD_E_274
BD_S_019
BD_S_006
BD_S_008
BD_E_091
BD_S_054
BD_S_043
BD_S_041
BD_S_108
BD_S_097
BD_S_099
BD_S_007
BD_E_092
BD_S_052
BD_S_103
BD_S_100
BD_E_275
BD_S_050
BD_S_095
BD_S_068
BD_S_091
BD_S_023
BD_S_004
BD_E_093
BD_S_107
BD_S_109
BD_S_009
BD_S_025
BD_E_094
BD_S_047
BD_S_045
BD_S_070
BD_S_003
BD_E_277
BD_S_105
BD_S_093
BD_S_101
BD_S_005
BD_S_049
BD_E_095
BD_E_278
BD_E_279
BD_E_280
BD_E_294
BD_E_281
BD_E_250
BD_E_293
BD_E_282
BD_E_284
BD_E_292
BD_E_286
BD_E_285
BD_E_283
BD_E_287
BD_E_248
BD_E_289
BD_E_290
BD_E_291
BD_E_288
BD_E_252
Bonney Downs survey area
Access prohibited in 2024
Quadrat (ecologia)
Releve (ecologia)
Quadrat (SLR)
Releve (SLR)
ecologia
ENVIRONMENT
Project No.: 1991
Author: AC
Created Date: 16 December 2024
Coordinate System: GCS GDA 1994
Scale: 1:180,000 @A3
Map 8: Locations of sampling sites within the survey area.
Earthstar Geographics
0
1.7
3.3
5
10 Kilometers

3.3 LIMITATIONS AND CONSTRAINTS

An assessment of survey-specific issues and limitations is detailed in Table 11. Except for recent fires preventing surveying some parts of the area in 2024, there were no significant limitations identified for either survey.

Table 11: Flora and vegetation survey limitations.

Aspect	Assessment	Constraint
Availability of contextual information at a regional and local scale	Broad vegetation, land system, soil, and geology mapping data were available for the survey area, in addition to DBCA Threatened and Priority Ecological Community spatial data. This information was adequate to provide appropriate contextual information for the survey.	Nil
Competency/experience of the team carrying out the survey, including experience in the bioregion surveyed	The personnel undertaking field work and specimen identification were suitably qualified and have conducted numerous botanical surveys within the Eremaean botanical province. Key personnel leading the field survey and undertaking specimen identification, data analysis, vegetation mapping, and reporting have over 10 years' experience with flora and vegetation surveys in the Pilbara region.	Nil
Proportion of flora recorded and/or collected, any identification issues	All species encountered during the survey were recorded within sampling sites or opportunistically. Representative specimens of all taxa recorded in the field were collected for confirmation. Some specimens could not be identified to species level due to a lack of required reproductive material, but a small number of unidentified samples is unlikely to have any impact on the classification of plant communities at this scale.	Nil
Was the appropriate area fully surveyed (effort and extent)	Two-hundred and ninety-one sampling sites (275 quadrats and 16 relevés) were assessed within the survey area as well as additional targeted searches and opportunistic collections. The appropriate area was sufficiently surveyed.	Nil
Access restrictions within the survey area	There were no access restrictions. A helicopter was used to access more remote parts of the survey area.	Nil
Survey timing, rainfall, season of survey	The surveys were conducted within the recommended timing for primary and supplementary flora and vegetation surveys in the Eremaean Botanical Province (EPA 2016). Seasonal conditions were adequate to describe the floristic values of the survey area.	Nil
Disturbance that may have affected the results of survey such as fire, flood or clearing	Parts of the survey area, particularly in the northwest, were affected by recent fires just prior to the 2024 surveys. In most cases, however, patches of adjacent unburned vegetation, which presumably also represented the same vegetation as the surrounding burned areas, were able to be surveyed.	Minor

4 RESULTS

4.1 FLORA

4.1.1 Floristic Diversity and Estimated Species Richness

A total of 552 vascular plant taxa (species, infraspecific taxa, and phrase names) from 61 families and 204 genera were recorded within 400 sampling sites (quadrats and relevés) and opportunistically (Appendix B). Of these species, 235 (ca. 42%) were annuals or short-lived perennials, and 25 (ca. 4.5%) were introduced. The most dominant families in terms of species richness were the Fabaceae (106 taxa), Poaceae (79), Malvaceae (59), Amaranthaceae (31), Asteraceae (27), and Cyperaceae (20). The most dominant genera were *Acacia* (35 taxa), *Ptilotus* (18), *Sida* (18), *Senna* (17), *Euphorbia* (12), and *Solanum* (11) (Appendix B). Most genera (115) were represented by only one taxon. Eighty-eight taxa were recorded from only a single sampling site (singletons), and 74 taxa were recorded from only two sample sites (doubletons) (Table 12).

The estimated species richness for the survey area using the Chao2 estimator was approximately 569 species (Table 12). Observed species richness (S) after sampling 400 sites and including opportunistic records was 552, suggesting that only 3.1% of the total estimated species were undetected. The rarefaction curve showed accumulation of new species tending towards zero (asymptote) by 400 sites (Figure 2) suggesting that additional site-based survey effort would probably not result in any notable increase in the number of taxa recorded at sites.

Table 12: Species richness summary and estimates for the survey area.

N (number of reference samples)	400
S (observed number of taxa within quadrats)	519
No. of singletons	88
No. of doubletons	74
No. taxa not observed in quadrats	33
Total taxa observed (including opportunistic records)	552
Estimated species richness (Chao2)	569.91 ± 14.29
Percent of species undetected	3.1%

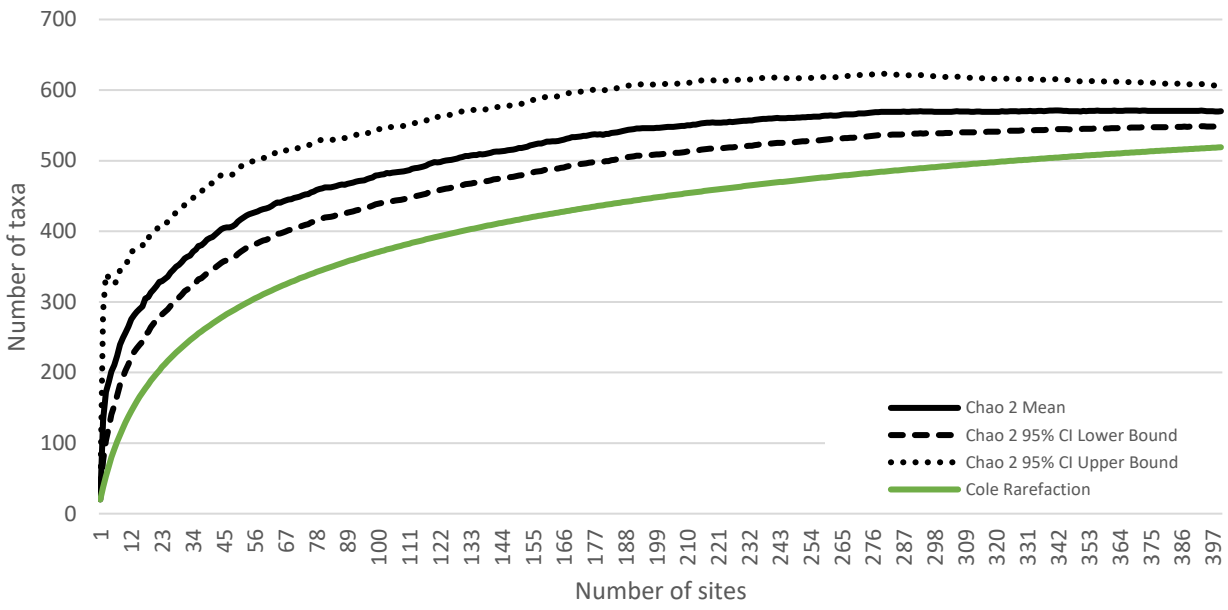


Figure 2: Asymptotic species richness estimated by the Chao2 non-parametric richness estimator and rarefaction curve (species observed) for the survey area after 400 sampling sites.

4.1.2 Significant Species

Threatened and Priority listed species

Representative areas of each of the major landforms and plant communities were included in the quadrat survey and also traversed on foot to record significant plant species. The EPBC Act and BC Act listed Threatened species *Quoya zonalis* was recorded from a single ridge in the northwest of the survey area (Table 13, Map 9). A further 18 DBCA listed Priority species were recorded (Table 13, Map 9, Map 10):

- *Acacia cyperophylla* var. *omearana* (P1)
- *Corchorus* sp. Yarrie (J. Bull & D. Roberts CAL 01.05) (P1)
- *Stemodia* sp. Battle Hill (A.L. Payne 1006) (P1)
- *Euphorbia inappendiculata* var. *inappendiculata* (P3)
- *Euphorbia inappendiculata* var. *queenslandica* (P3)
- *Indigofera ixocarpa* (P2)
- *Ipomoea racemigera* (P3)
- *Neptunia longipila* (P2)
- *Paspalidium retiglume* (P2)
- *Dolichocarpa* sp. Hamersley Station (A.A. Mitchell PRP 1479) (P3)
- *Euphorbia stevenii* (P3)
- *Iotasperma sessilifolium* (P3)
- *Nicotiana umbratica* (P3)
- *Rhagodia* sp. Hamersley (M. Trudgen 17794) (P3)
- *Rostellularia adscendens* var. *latifolia* (P3)
- *Swainsona thompsoniana* (P3)
- *Bulbostylis burbidgeae* (P4)
- *Ptilotus mollis* (P4)

The number of individuals of each taxon recorded and associated landforms and vegetation types (section 4.2.1) are summarised in Table 13.

Four collections identified as ?*Glycine falcata* were recorded within clay habitats but were never observed with flowers or fruit. These have been tentatively identified as the Priority 3 species *Glycine falcata* but could potentially belong to another *Glycine* species or to a similar genus.

Atypical specimens

Several specimens collected were unable to be identified to species level due to a lack of reproductive material required for positive identification but were not considered to be otherwise anomalous. Three taxa recorded by SLR within the Bonney Downs East survey area were believed to be atypical (*Olearia* aff. *fluvialis*, *Solanum* aff. *esuriale*, and *Solanum* aff. *horridum*) (SLR, 2024).

Range extensions

Based on current Atlas of Living Australia records (accessed on 2/12/2024), 10 taxa recorded within the survey area occurred more than 100 km from the nearest known locations. Five of the records extend the known range of the species (at edge of range), and five records occurred within the known range of the species (gap filler):

- *Brachyscome rudallensis* – edge of range
- *Calandrinia balonensis* – edge of range
- **Chenopodium murale* – edge of range
- *Crotalaria cunninghamii* subsp. *cunninghamii* – edge of range
- **Cynodon dactylon* – gap filler
- *Eragrostis exigua* – gap filler
- **Euphorbia hirta* – gap filler
- **Phoenix dactylifera* – gap filler
- *Stenopetalum velutinum* – edge of range
- *Tephrosia* sp. clay soils (S. van Leeuwen et al. PBS 0273) – gap filler

4.1.3 Introduced Species

Twenty-five introduced plant species were recorded within the survey area (Table 14). One is listed as a 'Declared Pest – s22 (2)' on the WAOL (DPIRD, 2007–) (**Calotropis procera*), 21 are listed as 'Permitted - s11', and three are not listed. There were no WONS recorded. Ecological impact and invasiveness ratings have been determined for introduced species in the Pilbara region using the Weed Prioritisation Process (DPaW, 2013), which are listed for these species in Table 14. **Calotropis procera* was recorded from twenty-three locations (approx. 113 individuals), mostly within and near to disturbed areas associated with the BC Iron Nullagine mine (Map 11).

Table 13: Summary of significant plant species recorded within the survey area.

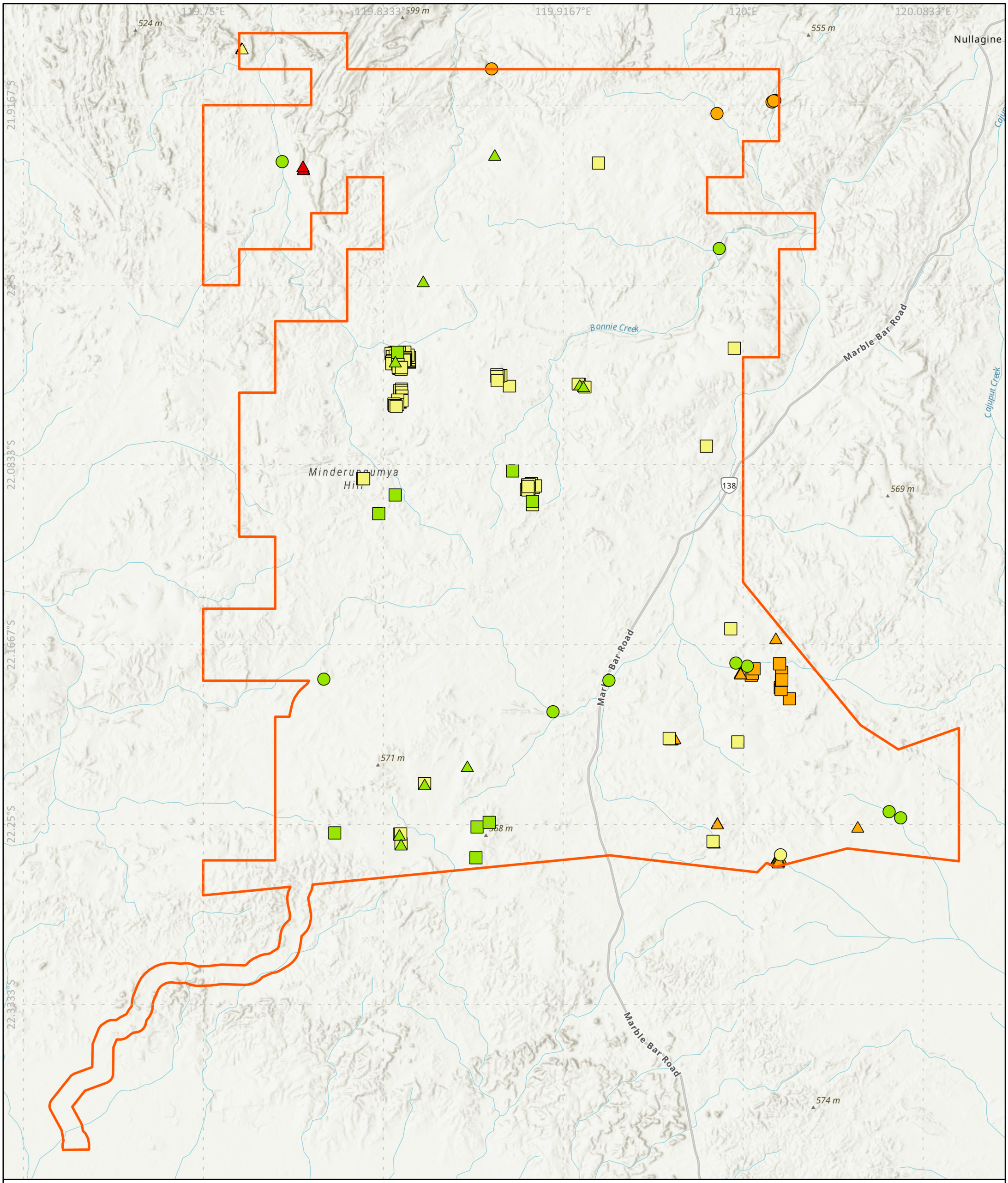
Name	Land system	Landform	Vegetation type/s (number of individuals)	Total estimated individuals recorded in the vicinity survey area[1]	Total individuals recorded within survey area (% of total)
Threatened					
Quoya zonalis	Capricorn	Rocky ridgetops	ElGwTe (21)	23	21 (91.3%)
Priority 1					
Acacia cyperophylla var. *omearana*	Capricorn, Rocklea	Stony creeks	AcTe (1,143)	2,179	1,143 (52.5%)
Corchorus sp. Yarrie (J. Bull & D. Roberts CAL 01.05)	Granitic, Rocklea	Granite outcrops	AhCspYTe (145), EcAcCs (2)	147	147 (100%)
Stemodia sp. Battle Hill (A.L. Payne 1006)	Elimunna, Rocklea, Wona	Low stony hills and plains with clay soils.	VfAl (370)	375	370 (98.7%)
Priority 2					
Indigofera ixocarpa	Rocklea	Rocky hills	ElAbTl (40)	45	40 (88.9%)
Neptunia longipila	Bonney, Robe, Rocklea, Wona	Low stony hills and plains with clay soils.	VfAl (189)	189	189 (100%)
Paspalidium retiglume	Bonney, Wona	Low stony hills and plains with clay soils.	VfAl (260)	260	260 (100%)
Priority 3					
Dolichocarpa sp. Hamersley Station (A.A. Mitchell PRP 1479)	Bonney, Elimunna, Rocklea, Wona	Plains with clay soils.	ElAbTl (110), VfAl (640)	751	750 (99.9%)
Euphorbia inappendiculata var. *inappendiculata*	Elimunna	Low stony hills and plains with clay soils.	VfAl (1)	53	1 (1.9%)
Euphorbia inappendiculata var. *queenslandica*	Rocklea, Wona	Low stony hills and plains with clay soils.	VfAl (1,977)	1,977	1,977 (100%)
Euphorbia stevenii	Rocklea	Low stony hills and plains with clay soils.	VfAl (80)	80	80 (100%)
Iotasperma sessilifolium	Bonney	Low stony hills and undulating plains.	Mosaic: AiCpTe1 + AiCpTe2 + AiSgTb (1)	6	1 (16.7%)
Ipomoea racemigera	Bonney, Laterite, Robe, Rocklea	Creeks	AeEp (2), EcAcCs (2), EvAcCc (7)	14	11 (78.6%)
Rhagodia sp. Hamersley (M. Trudgen 17794)	Laterite	Plains	AaEp (15), AaTs (20)	241	35 (15%)
Nicotiana umbratica	Granitic, Robe, Rocklea	Various	AeTe (25), AhCspYTe (373), ElAbTl (20), Mosaic: AiCpTe1 + AiCpTe2 + AiSgTb (130)	554	548 (98.9%)
Rostellularia adscendens var. *latifolia*	Granitic, Rocklea	Various	AeTe (30), AhCspYTe (77), Mosaic: AiCpTe1 + AiCpTe2 + AiSgTb (20)	165	127 (77%)
Swainsona thompsoniana	Bonney, Elimunna, Rocklea, Wona	Low stony hills and plains with clay soils.	VfAl (997)	1,006	997 (99.1%)
Priority 4					
Bulbostylis burbidgeae	Granitic	Granite outcrops	AeTe (120), AhCspYTe (1,505)	2,032	1,625 (80%)
Ptilotus mollis	Robe, Rocklea	Rocky slopes	ElAbTl (166), ElGwTe (1,008)	2,277	1,174 (51.6%)

[1]Includes records from spatial data provided by Fortescue, DBCA (WAHERB and TPFL), and records from the current Ecologia and SLR surveys. In cases where abundance data were not provided (e.g., WAHERB data), abundance was assumed to be 1.

Table 14: Summary of introduced species recorded within the survey area.

Family	Name	Common name	BAM Act status	Ecological impact[1]	Invasiveness[1]
Aizoaceae	*Trianthema portulacastrum*	Giant pigweed	Permitted - s11	Not listed	Not listed
Amaranthaceae	*Aerva javanica*	Kapok bush	Permitted - s11	High	Rapid
Amaranthaceae	*Alternanthera pungens*	Khaki weed	Permitted - s11	Low	Slow
Apocynaceae	*Calotropis procera*	Calotrope	Declared Pest - s22(2)	Not listed	Not listed
Arecaceae	*Phoenix dactylifera*	Date palm	Permitted - s11	High	Rapid
Asteraceae	*Bidens bipinnata*	Bipinnate begger's tick	Permitted - s11	Unknown	Rapid
Asteraceae	*Flaveria trinervia*	Speedy weed	Not listed	Not listed	Not listed
Asteraceae	*Sonchus oleraceus*	Common sowthistle	Permitted - s11	Low	Rapid
Chenopodiaceae	*Chenopodium murale*	Nettle-leaf goosefoot	Permitted - s11	Low	Unknown
Cucurbitaceae	*Citrullus amarus*	Bitter melon	Not listed	Not listed	Not listed
Cucurbitaceae	*Citrullus colocynthis*	Colocynth	Permitted - s11	Unknown	Moderate
Cucurbitaceae	*Cucumis myriocarpus* subsp. *myriocarpus*	Prickly paddy melon	Permitted - s11	Low	Rapid
Euphorbiaceae	*Euphorbia hirta*	Asthma plant	Not listed	Low	Slow
Fabaceae	*Senna occidentalis*	Coffee senna	Permitted - s11	Not listed	Not listed
Fabaceae	*Vachellia farnesiana*	Mimosa bush	Permitted - s11	High	Rapid
Malvaceae	*Malvastrum americanum*	Spiked malvastrum	Permitted - s11	High	Rapid
Papaveraceae	*Argemone ochroleuca* subsp. *ochroleuca*	Mexican poppy	Permitted - s11	Unknown	Rapid
Poaceae	*Cenchrus ciliaris*	Buffel grass	Permitted - s11	High	Rapid
Poaceae	*Cenchrus setiger*	Birdwood grass	Permitted - s11	High	Rapid
Poaceae	*Cynodon dactylon*	Couch	Permitted - s11	High	Rapid
Poaceae	*Echinochloa colona*	Awnless barnyard grass	Permitted - s11	High	Rapid
Poaceae	*Setaria verticillata*	Whorled pigeon grass	Permitted - s11	High	Rapid
Solanaceae	*Physalis angulata*	Wild gooseberry	Permitted - s11	Unknown	Unknown
Solanaceae	*Solanum nigrum*	Black berry nightshade	Permitted - s11	Low	Rapid
Zygophyllaceae	*Tribulus terrestris*	Caltrop	Permitted - s11	Unknown	Moderate

[1]Rating based on the Western Australian Weed Prioritisation Process.



Bonney Downs survey area

- Endangered (EN),Quoya zonalis
- Priority 1 (DBCA),Acacia cyperophylla var. omearana
- Priority 1 (DBCA),Corchorus sp. Yarrie (J. Bull & D. Roberts CAL 01.05)
- Priority 1 (DBCA),Stemodia sp. Battle Hill (A.L. Payne 1006)
- Priority 2 (DBCA),Euphorbia inappendiculata var. inappendiculata
- Priority 2 (DBCA),Euphorbia inappendiculata var. queenslandica
- Priority 2 (DBCA),Indigofera ixocarpa
- Priority 2 (DBCA),Ipomoea racemigera
- Priority 2 (DBCA),Neptunia longipila
- Priority 2 (DBCA),Paspalidium retiglume

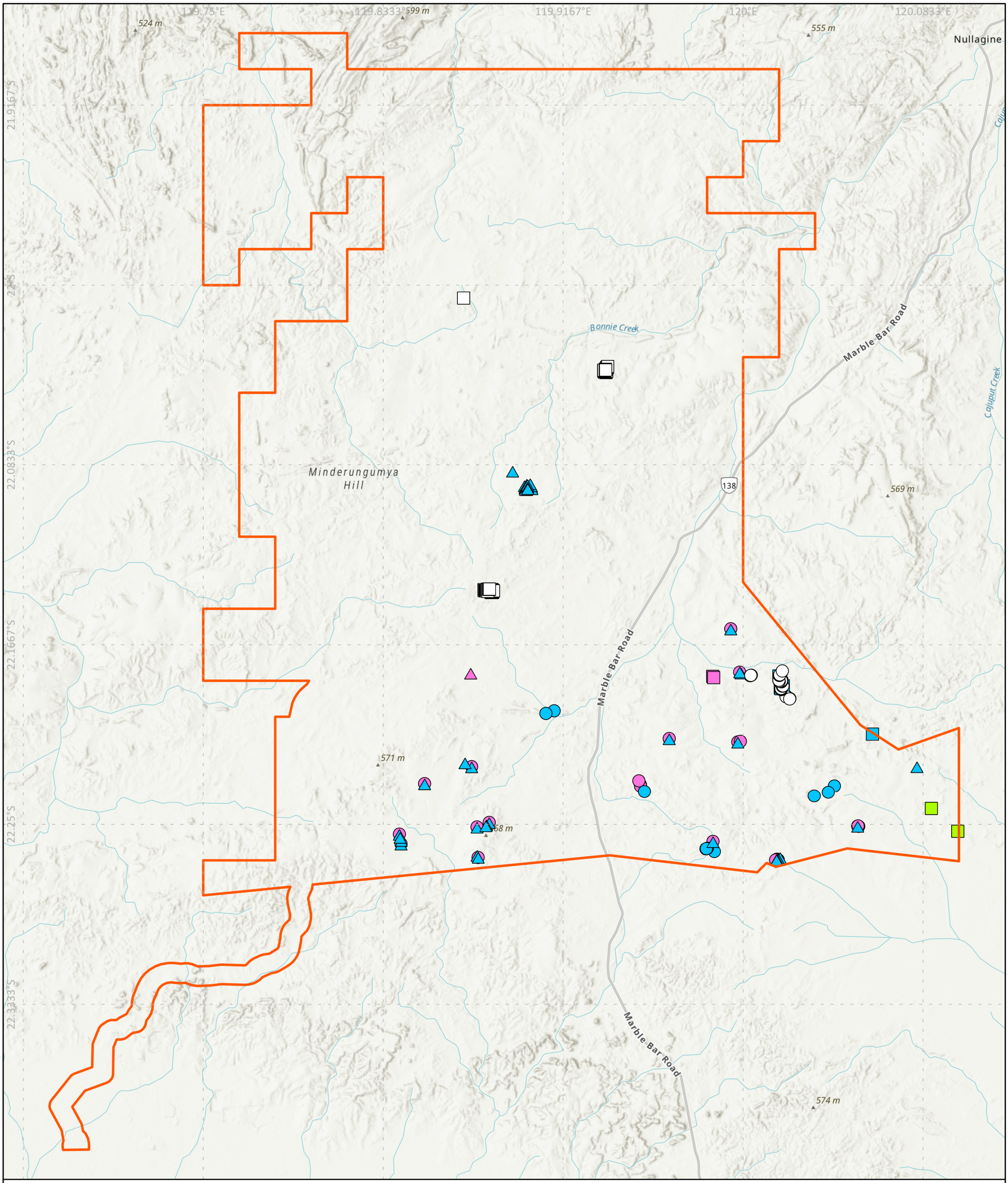
ecologia ENVIRONMENT

Project No.: 1991
Author: AC
Created Date: 16 December 2024
Coordinate System: GCS GDA 1994
Scale: 1:180,000 @A3

Map 9: Significant plant species recorded within the survey area (Threatened, Priority 1, Priority 2).

0 1.7 3.3 5 10 Kilometers

Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community, Esri, Geoscience Australia, NASA, NGA, USGS



Bonney Downs survey area

- Priority 3 (DBCA),Dolichocarpa sp. Hamersley Station (A.A. Mitchell PRP 1479)
- Priority 3 (DBCA),Euphorbia stevenii
- Priority 3 (DBCA),Iotasperma sessilifolium
- Priority 3 (DBCA),Nicotiana umbratica
- Priority 3 (DBCA),Rostellularia adscendens var. latifolia
- Priority 3 (DBCA),Rhagodia sp. Hamersley (M.Trudgen 17794)
- Priority 3 (DBCA),Swainsona thompsoniana
- Priority 4 (DBCA),Bulbostylis burbidgeae
- Priority 4 (DBCA),Ptilotus mollis

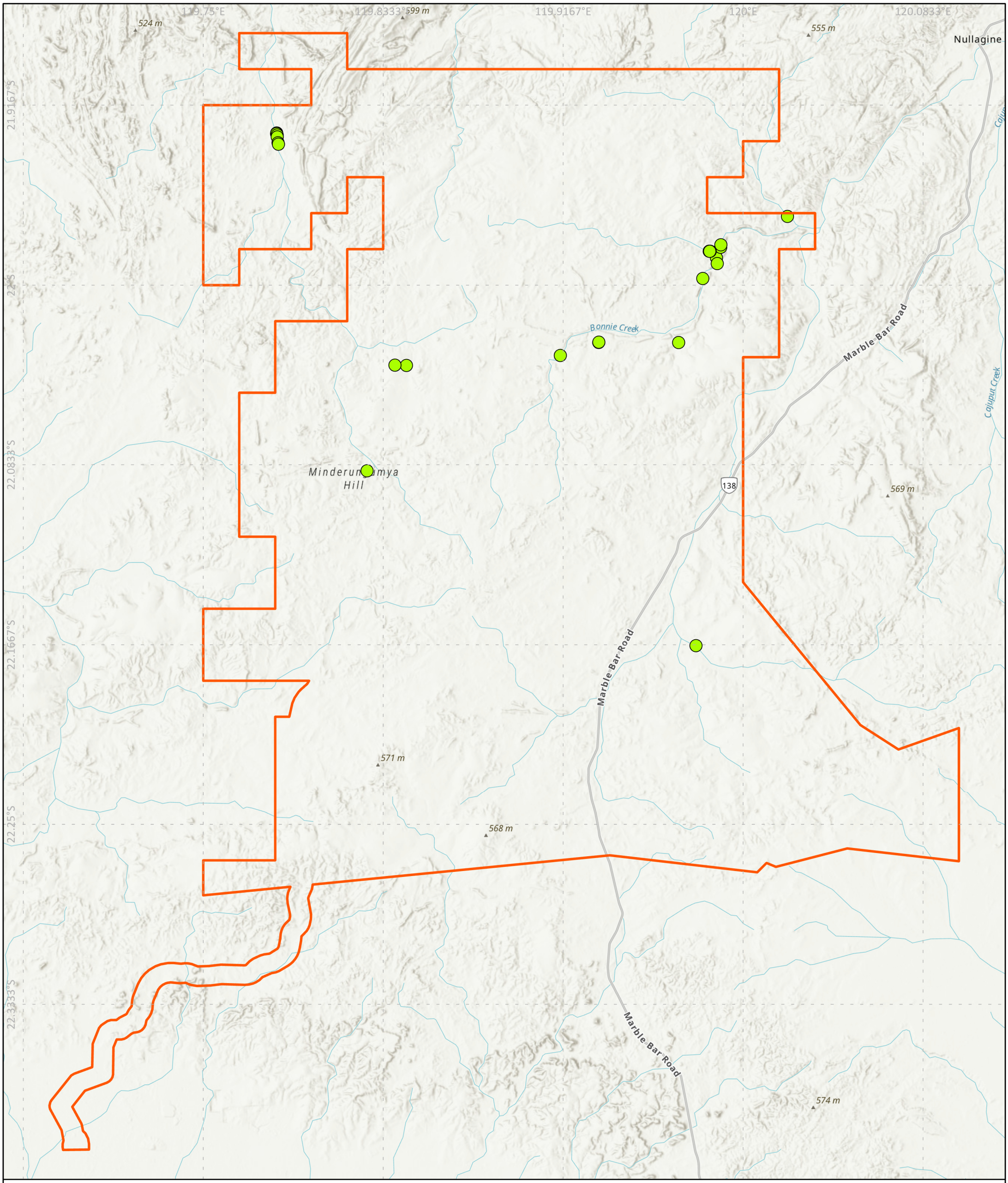
ecologia ENVIRONMENT

Project No.: 1991
Author: AC
Created Date: 16 December 2024
Coordinate System: GCS GDA 1994
Scale: 1:180,000 @A3

Map 10: Significant plant species recorded within the survey area (Priority 3, Priority 4).

0 1.7 3.3 5 10 Kilometers

Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community, Esri, CGIAR



Bonney Downs survey area

Calotropis procera (Declared Pest)

ecologia ENVIRONMENT

Project No.: 1991
Author: AC
Created Date: 16 December 2024
Coordinate System: GCS GDA 1994
Scale: 1:180,000 @A3

Map 11: Locations of *Calotropis procera* (Declared Pest) recorded within the survey area.

0 1.7 3.3 5 10 Kilometers

Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community, Esri, Geoscience Australia, NASA, NGA, USGS



Figure 3: Photographs of significant species recorded by e*cologia* within the survey area.

Top left to right: *Quoya zonalis* (T), *Acacia cyperophylla* var. *omearana* (P1), *Euphorbia inappendiculata* subsp. *queenslandica* (P2).
Middle left to right: *Indigofera ixocarpa* (P2), *Ipomoea racemigera* (P2), *Neptunia longipila* (P2).
Bottom left to right: *Paspalidium retiglume* (P2), *Ptilotus mollis* (P4), *Swainsona thompsoniana* (P3)

4.2 VEGETATION

4.2.1 Vegetation Type Classification and Characterisation

Hierarchical agglomerative clustering was conducted using floristic data from 375 sampling sites within the survey area (Figure 4). Similarity profile analysis (SIMPROF) identified 33 clusters (excluding solitary and paired sites) within which there was no meaningful sub-structure (Appendix C). Several of these groups were too fine to meaningfully interpret as distinct vegetation types at a scale appropriate for this assessment, so some neighbouring groups were amalgamated. These supersets were selected as vegetation types primarily on the basis of the consistency of shared dominant species. Seventeen vegetation types were described based on this classification (Table 15, Table 16).

There were no significant disagreements between the NMDS ordination (Figure 5) and the hierarchical clustering, lending support to the validity of the groups identified as vegetation types. Eight of the 17 vegetation types were further supported by one or more indicator species (IndVal > 0.70) (Table 15). Eleven of the vegetation types described from the hierarchical clustering were resolved as moderately distinct clusters of sites in the two-dimensional ordinations of four data subsets (Figure 5). Six vegetation types (AaTe, AiCpTe1, AiSgTb, AmTe, AoTe, and ElGwTe), which included sites from broadly similar landforms (mostly stony plains and hills), could not be resolved as distinct clusters. Although there was evidence for internal group structure within this group (Appendix C), the clustering was weak in some cases and the floristic differences not always clearly defined.

The floristic features used to characterise each vegetation type (i.e., dominant species, indicator species, and frequently occurring species) are summarised in Table 15, and other relevant attributes (i.e., landform, soils, vegetation condition, and species richness) are summarised in Table 16. The full species assemblage associated with each vegetation type is shown in a constancy-importance table in Appendix D. Representative site photographs are shown in Figure 6 – Figure 11(excluding vegetation types which were only represented by SLR sites for which suitable photographs were not available at the time of writing). Vegetation type boundaries were mapped within the survey area by extrapolation from aerial imagery and ground-truthed sites (Map 12 - Map 16). Three similar *Acacia inaequilatera* dominated vegetation types (AiCpTe1, AiCpTe2, and AiSgTb) were mapped as a mosaic unit as they could not be consistently distinguished using aerial imagery. Individual sampling site data are shown in Appendix E.

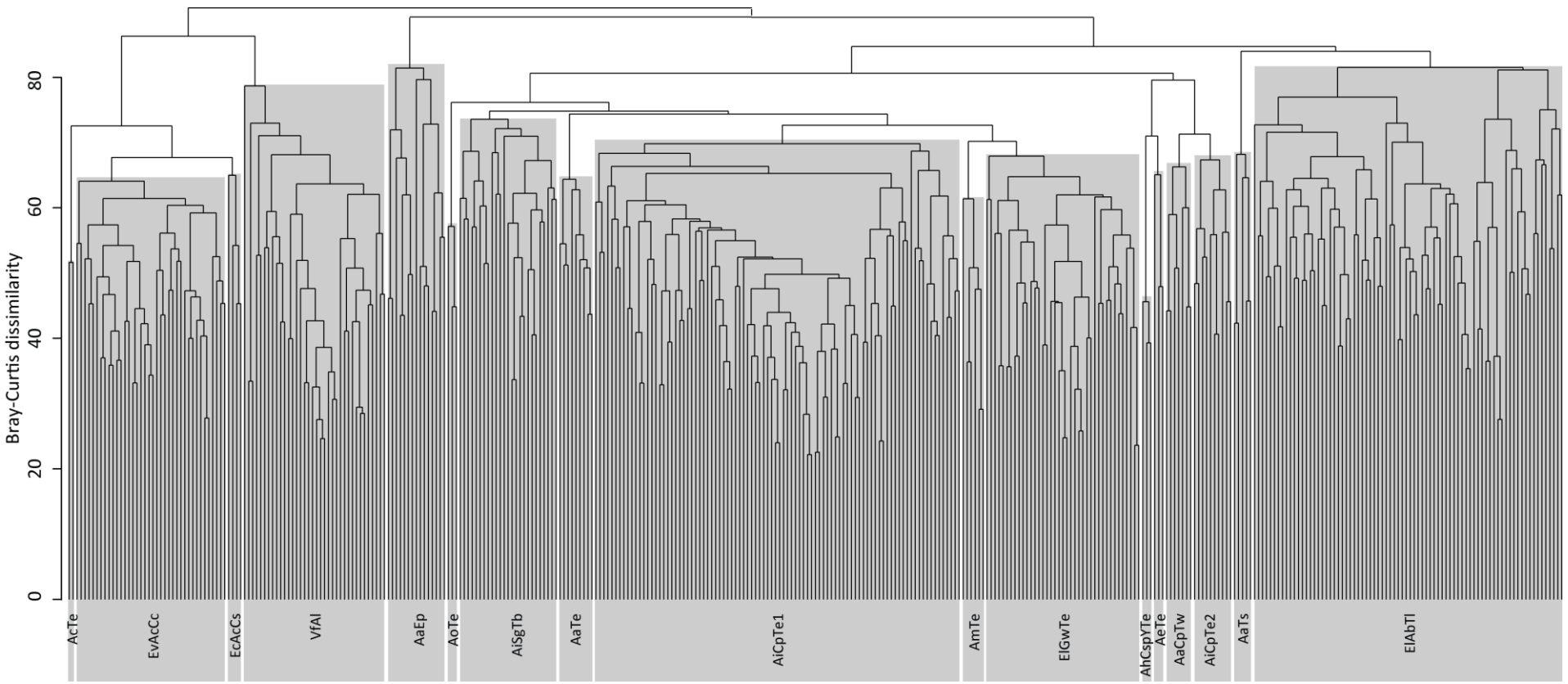


Figure 4: UPGMA hierarchical agglomerative clustering dendrogram showing floristic relationships among 375 sites.

Shaded areas indicate the groups of sites recognised as vegetation types. The significant group structure identified by similarity profile analysis and site names are shown in Appendix C.

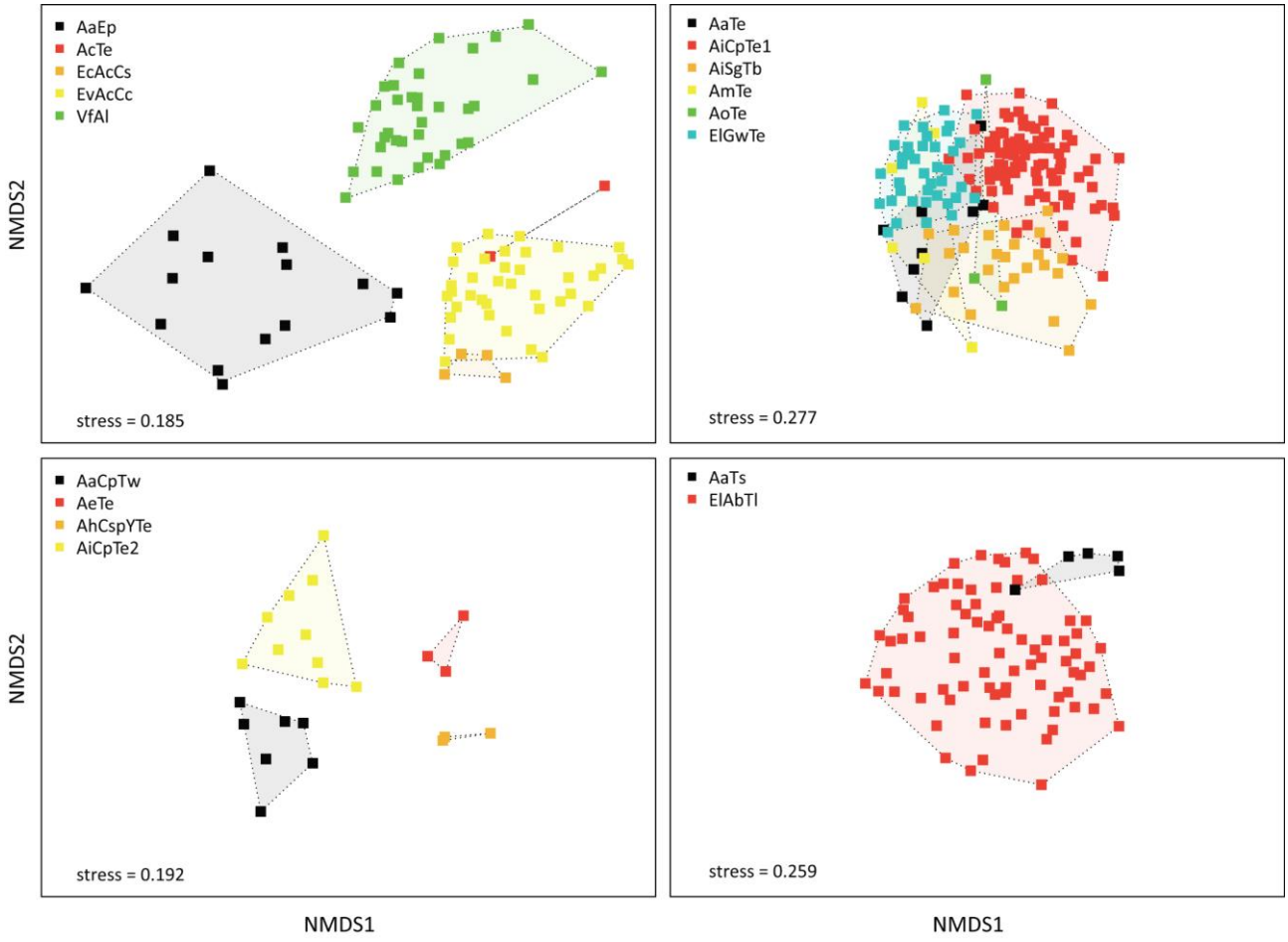


Figure 5: Non-metric multidimensional scaling (NMDS) plots showing relationships among sites and vegetation types.

Table 15: Summary of vegetation types within the survey area – group characterisation.

Map code	Broad floristic formation (NVIS III)	Vegetation type name (NVIS V compatible)	Frequently occurring species (occurrence in > 50% of quadrats within vegetation type)[1]	Indicator species (IndVal > 0.70, p < 0.05)	Significant species
AaCpTw	*Acacia* tall open shrubland	*Acacia aptaneura*, *Acacia tetragonophylla* tall open shrubland; *Corchorus parviflorus* low open shrubland; *Triodia wiseana*, *Enneapogon polyphyllus*, *Aristida contorta* low open tussock grassland.	*Abutilon macrum*, *Acacia aptaneura*, *Acacia tetragonophylla*, *Aristida contorta*, *Bonamia pilbarensis*, *Cheilanthes sieberi* subsp. *sieberi*, *Corchorus parviflorus*, *Enneapogon polyphyllus*, *Eriachne mucronata*, *Evolvulus alsinoides* var. *villosicalyx*, *Gomphrena cunninghamii*, *Goodenia muelleriana*, *Hibiscus sturtii* var. *campylochlamys*, *Rhagodia eremaea*, *Sclerolaena cornishiana*, *Solanum horridum*, *Solanum lasiophyllum*, *Triodia wiseana*	–	–
AaEp	*Acacia* tall open shrubland	*Acacia aptaneura*, *Acacia pruinocarpa* tall open shrubland; *Enneapogon polyphyllus*, ±*Triodia brizoides*, ±*Triodia longiceps* low open tussock/hummock grassland.	*Acacia aptaneura*, *Acacia pruinocarpa*, *Enneapogon polyphyllus*, *Evolvulus alsinoides* var. *villosicalyx*	–	*Ipomoea racemigera* (P3)
AaTe	*Acacia* tall open shrubland	*Acacia aptaneura*, *Acacia pruinocarpa*, *Acacia bivenosa* tall open shrubland; *Triodia epactia* low open hummock grassland.	*Acacia aptaneura*, *Acacia bivenosa*, *Acacia pruinocarpa*, *Duperreya commixta*, *Indigofera monophylla*, *Senna glutinosa* subsp. ×*luerssenii*, *Triodia epactia*	–	–
AaTs	*Acacia* tall open shrubland	*Acacia ancistrocarpa*, *Acacia aptaneura* tall open shrubland; *Triodia scintillans* low hummock grassland.	*Acacia ancistrocarpa*, *Acacia aptaneura*, *Acacia bivenosa*, *Acacia tetragonophylla*, *Dampiera candicans*, *Goodenia stobbsiana*, *Goodenia triodiophila*, *Hakea lorea* subsp. *lorea*, *Hibiscus sturtii* var. *campylochlamys*, *Indigofera monophylla*, *Paraneurachne muelleri*, *Senna artemisioides* subsp. *helmsii*, *Triodia epactia*, *Triodia longiceps*, *Triodia scintillans*, *Waltheria virgata*	*Triodia scintillans* (0.84)	–
AcTe	*Acacia* tall sparse shrubland	*Acacia cyperophylla* var. *omearana* (P1), *Acacia tumida* var. *pilbarensis* tall sparse shrubland; *Triodia epactia*, *Triodia longiceps* mid sparse hummock grassland.	*Acacia cyperophylla* var. *omearana*, *Acacia tumida* var. *pilbarensis*, *Afrohybanthus aurantiacus*, *Arivela viscosa*, *Cathetus exilis*, *Eriachne tenuiculmis*, *Eucalyptus victrix*, *Euphorbia trigonosperma*, *Grevillea wickhamii* subsp. *aprica*, *Sesbania cannabina*, *Triodia epactia*, *Triodia longiceps*	*Acacia cyperophylla* var. *omearana* (0.90), *Cathetus exilis* (0.71)	*Acacia cyperophylla* var. *omearana* (P1)
AeTe	*Triodia* low hummock grassland	*Acacia eriopoda* tall sparse shrubland; *Triodia epactia*, *Triodia longiceps* low hummock grassland.	*Acacia bivenosa*, *Acacia eriopoda*, *Afrohybanthus aurantiacus*, *Aristida holathera* var. *holathera*, *Bulbostylis barbata*, *Corchorus parviflorus*, *Dampiera candicans*, *Enneapogon polyphyllus*, *Evolvulus alsinoides* var. *villosicalyx*, *Fimbristylis dichotoma*, *Hibiscus sturtii* var. *campylochlamys*, *Indigofera monophylla*, *Pluchea dentex*, *Ptilotus fusiformis*, *Schizachyrium fragile*, *Trigastrotheca molluginea*, *Triodia epactia*, *Triodia longiceps*, *Tripogonella loliiformis*, *Triumfetta chaetocarpa*	–	*Bulbostylis burbidgeae* (P4), *Rostellularia adscendens* var. *latifolia* (P3), *Nicotiana umbratica* (P3)
AhCspYTe	*Atalaya* tall sparse shrubland	*Atalaya hemiglauca* tall sparse shrubland; *Corchorus* sp. Yarrie (J. Bull & D. Roberts CAL 01.05) (P1) mid open shrubland; *Triodia epactia* low sparse hummock grassland.	*Abutilon* sp. Dioicum (A.A. Mitchell PRP 1618), *Acacia eriopoda*, *Arivela viscosa*, *Atalaya hemiglauca*, *Bulbostylis burbidgeae*, *Cheilanthes brownii*, *Corchorus* sp. Yarrie (J. Bull & D. Roberts CAL 01.05), *Cucumis variabilis*, *Cymbopogon ambiguus*, *Enneapogon lindleyanus*, *Eriachne mucronata*, *Euphorbia australis* var. *subtomentosa*, *Evolvulus alsinoides* var. *villosicalyx*, *Gomphrena cunninghamii*, *Gossypium robinsonii*, *Grevillea wickhamii* subsp. *hispidula*, *Indigofera monophylla*, *Leiocarpa semicalva* subsp. *semicalva*, *Nicotiana umbratica*, *Pterocaulon sphacelatum*, *Senna venusta*, *Sida rohlenae* subsp. *rohlenae*, *Solanum chippendalei*, *Solanum cleistogamum*, *Solanum gabrielae*, *Trigastrotheca molluginea*, *Triodia epactia*, *Tripogonella loliiformis*, *Triumfetta chaetocarpa*, *Triumfetta maconochieana*	*Bulbostylis burbidgeae* (1.00), *Corchorus* sp. Yarrie (J. Bull & D. Roberts CAL 1.5) (1.00), *Nicotiana umbratica* (0.78), *Senna venusta* (0.84), *Solanum gabrielae* (1.00)	*Bulbostylis burbidgeae* (P4), *Rostellularia adscendens* var. *latifolia* (P3), *Corchorus* sp. Yarrie (J. Bull & D. Roberts CAL 01.05) (P1), *Nicotiana umbratica* (P3)
AiCpTe1	*Triodia* low hummock grassland	*Acacia inaequilatera* tall sparse shrubland; ±*Corchorus parviflorus* low sparse shrubland; *Triodia epactia*, ±*Triodia brizoides* low hummock grassland.	*Acacia inaequilatera*, *Bonamia pilbarensis*, *Triodia epactia*	–	*Iotasperma sessilifolium* (P3), *Nicotiana umbratica* (P3), *Rostellularia adscendens* var. *latifolia* (P3)
AiCpTe2	*Triodia* low hummock grassland	*Acacia inaequilatera* tall sparse shrubland; *Corchorus parviflorus* low sparse shrubland; *Triodia epactia* low hummock grassland.	*Acacia inaequilatera*, *Aristida contorta*, *Bonamia pilbarensis*, *Corchorus parviflorus*, *Enneapogon caerulescens*, *Enneapogon polyphyllus*, *Evolvulus alsinoides* var. *villosicalyx*, *Gomphrena cunninghamii*, *Rhynchosia minima*, *Senna notabilis*, *Solanum horridum*, *Triodia epactia*	–	
AiSgTb	*Triodia* low hummock grassland	*Acacia inaequilatera*, *Hakea lorea* subsp. *lorea* tall open shrubland; *Senna glutinosa* mid open shrubland; *Triodia brizoides*, *Triodia epactia*, *Cymbopogon ambiguus* low hummock/tussock grassland.	*Acacia inaequilatera*, *Bonamia pilbarensis*, *Cymbopogon ambiguus*, *Senna glutinosa* subsp. *glutinosa*, *Triodia brizoides*, *Triodia epactia*	–	
AmTe	*Acacia* tall closed shrubland	*Acacia monticola* tall closed shrubland; *Triodia epactia* low open hummock grassland.	*Acacia monticola*, *Goodenia stobbsiana*, *Grevillea wickhamii* subsp. *hispidula*, *Indigofera monophylla*, *Senna glutinosa* subsp. *glutinosa*, *Triodia epactia*	*Acacia monticola* (0.91)	–
AoTe	*Acacia* tall open shrubland	*Acacia orthocarpa*, *Acacia maitlandii* tall open shrubland; *Triodia epactia* low open hummock grassland.	*Acacia adoxa* var. *adoxa*, *Acacia maitlandii*, *Acacia orthocarpa*, *Corymbia hamersleyana*, *Grevillea wickhamii* subsp. *aprica*, *Triodia brizoides*, *Triodia epactia*, *Triodia longiceps*	*Acacia adoxa* var. *adoxa* (0.73), *Acacia orthocarpa* (0.90)	–
EcAcCs	*Eucalyptus* mid open woodland	*Eucalyptus camaldulensis* subsp. *refulgens*, ±*Melaleuca argentea* mid open woodland; *Acacia coriacea* subsp. *pendens*, *Acacia trachycarpa* tall open shrubland; **Cenchrus setiger*, *Triodia longiceps* low tussock/hummock grassland.	*Acacia ampliceps*, *Acacia coriacea* subsp. *pendens*, *Acacia pyrifolia* var. *pyrifolia*, *Acacia trachycarpa*, *Arivela viscosa*, *Atalaya hemiglauca*, *Bulbostylis barbata*, **Cenchrus setiger*, *Crotalaria cunninghamii* subsp. *cunninghamii*, *Cucumis variabilis*, *Cyperus vaginatus*, *Eucalyptus camaldulensis* subsp. *refulgens*, *Euphorbia australis* var. *subtomentosa*, *Evolvulus alsinoides* var. *decumbens*, *Ipomoea muelleri*, *Polymeria ambigua*, *Sida rohlenae* subsp. *rohlenae*, *Solanum diversiflorum*, *Triodia longiceps*, *Vigna lanceolata* var. *lanceolata*, *Wahlenbergia tumidifructa*	*Crotalaria cunninghamii* subsp. *cunninghamii* (0.87), *Vigna lanceolata* var. *lanceolata* (0.82), *Wahlenbergia tumidifructa* (0.75)	*Corchorus* sp. Yarrie (J. Bull & D. Roberts CAL 01.05) (P1) (2 records), *Ipomoea racemigera* (P3)

Map code	Broad floristic formation (NVIS III)	Vegetation type name (NVIS V compatible)	Frequently occurring species (occurrence in > 50% of quadrats within vegetation type)[1]	Indicator species (IndVal > 0.70, p < 0.05)	Significant species
ElAbTl	*Eucalyptus* low open woodland	*Eucalyptus leucophloia* subsp. *leucophloia*, ±*Corymbia hamersleyana* low open woodland; *Acacia bivenosa* mid sparse shrubland; *Triodia longiceps*, *Triodia wiseana*, ±*Triodia brizoides* low hummock grassland.	*Acacia bivenosa*, *Eucalyptus leucophloia* subsp. *leucophloia*, *Senna symonii*, *Triodia longiceps*, *Triodia wiseana*	–	*Dolichocarpa* sp. Hamersley Station (A.A. Mitchell PRP 1479) (P3), *Euphorbia inappendiculata* var. *inappendiculata* (P3), *Indigofera ixocarpa* (P2), *Nicotiana umbratica* (P3), *Ptilotus mollis* (P4)
ElGwTe	*Triodia* low hummock grassland	*Eucalyptus leucophloia* subsp. *leucophloia*, ±*Corymbia hamersleyana* low open woodland; *Grevillea wickhamii* mid sparse shrubland; *Triodia epactia*, *Eriachne lanata*, *Eriachne mucronata* low hummock/tussock grassland.	*Eriachne lanata*, *Eucalyptus leucophloia* subsp. *leucophloia*, *Grevillea wickhamii*, *Ptilotus calostachyus*, *Triodia epactia*	–	*Ptilotus mollis* (P4), *Quoya zonalis* (T)
EvAcCc	*Eucalyptus* mid open woodland	*Eucalyptus victrix*, ±*Eucalyptus camaldulensis* subsp. *refulgens* mid open woodland; *Acacia coriacea* subsp. *pendens*, *Acacia pyrifolia* var. *pyrifolia*, *Atalaya hemiglauca* tall open shrubland; **Cenchrus ciliaris*, *Triodia longiceps*, *Triodia epactia* low tussock/hummock grassland.	*Acacia coriacea* subsp. *pendens*, *Acacia pyrifolia* var. *pyrifolia*, *Alternanthera nana*, *Atalaya hemiglauca*, **Cenchrus ciliaris*, **Cenchrus setiger*, *Cyperus vaginatus*, *Eucalyptus camaldulensis* subsp. *refulgens*, *Eucalyptus victrix*, *Euphorbia australis* var. *subtomentosa*, *Ipomoea muelleri*, *Melaleuca glomerata*, *Nellica maderaspatensis*, *Rhynchosia minima*, *Triodia epactia*, *Triodia longiceps*, **Vachellia farnesiana*	*Cenchrus ciliaris* (0.89)	*Ipomoea racemigera* (P3)
VfAl	*Aristida* low tussock grassland	**Vachellia farnesiana* mid sparse shrubland; *Aristida latifolia*, *Cynodon convergens*, *Eriachne mucronata* low tussock grassland.	*Aristida latifolia*, *Arivela viscosa*, *Crotalaria medicaginea* var. *neglecta*, *Cynodon convergens*, *Dolichocarpa crouchiana*, *Eriachne mucronata*, *Grona muelleri*, *Heliotropium crispatum*, *Hibiscus brachysiphonius*, *Nellica maderaspatensis*, *Operculina aequisepala*, *Portulaca oleracea*, *Ptilotus gomphrenoides*, *Rhynchosia minima*, *Senna notabilis*, *Solanum lasiophyllum*, *Tephrosia* sp. clay soils (S. van Leeuwen et al. PBS 0273), **Vachellia farnesiana*	*Aristida latifolia* (0.84), *Cynodon convergens* (0.79), *Grona muelleri* (0.75), *Heliotropium crispatum* (0.80), *Hibiscus brachysiphonius* (0.75), *Operculina aequisepala* (0.76), *Ptilotus gomphrenoides* (0.73), *Tephrosia* sp. clay soils (S. van Leeuwen et al. PBS 273) (0.77)	*Dolichocarpa* sp. Hamersley Station (A.A. Mitchell PRP 1479) (P3), *Euphorbia inappendiculata* var. *queenslandica* (P3), *Euphorbia stevenii* (P3), *Neptunia longipila* (P2), *Paspalidium retiglume* (P2), *Stemodia* sp. Battle Hill (A.L. Payne 1006) (P1), *Swainsona thompsoniana* (P3)

[1] See Appendix D (constancy-importance table) for a full list of species associated with each vegetation type.

Table 16: Summary of vegetation types within the survey area – landforms, condition, significance, species richness, and extent.

Map code	Landform and soils	Vegetation condition	Median site species richness (range)	Environmental Significance (WA)	Environmental Significance (Other)	Extent within survey area (ha) (% of total area)	Sites
AaCpTw	Gravelly plains and undulating plains with reddish-brown clay-loam soils.	Excellent	38 (29 – 44)	None	Locally restricted	355.9 (0.3%)	BD_E_066, BD_E_105, BD_E_109, BD_S_021, BD_S_027, BD_S_074, BD_S_078
AaEp	Gravelly plains and undulating plains with reddish-brown clay-loam soils.	Very Good to Excellent	19 (11 – 58)	None	Sheet-flow dependent mulga (partly); locally restricted	1,214.0 (1.1%)	BD_E_252, BD_E_284, BD_E_288, BD_E_290, BD_E_291, BD_S_005, BD_S_008, BD_S_010, BD_S_012, BD_S_023, BD_S_025, BD_S_030, BD_S_036, BD_S_093, BD_S_101
AaTe	Primarily stony plains with red-brown clay-loam soils.	Excellent	21 (11 – 33)	None	Locally restricted	588.5 (0.5%)	BD_E_034, BD_E_036, BD_E_051, BD_E_138, BD_E_141, BD_E_146, BD_E_277, BD_E_283, BD_E_294
AaTs	Plains and undulating plains	Excellent	30 (25 – 46)	None	Locally restricted	701.1 (0.6%)	BD_S_003, BD_S_007, BD_S_038, BD_S_042, BD_S_044
AcTe	Rocky creeks and minor gullies	Very Good to Excellent	27.5 (24 – 31)	None	Locally restricted	164.5 (0.2%)	BD_E_189, BD_E_197
AeTe	Plains and undulating plains	Excellent	29 (25 – 41)	None	Locally restricted	1,266.4 (1.2%)	BD_S_011, BD_S_014, BD_S_034
AhCspYTe	Plains and undulating plains	Excellent	38 (24 – 42)	None	Locally restricted	48.0 (<0.1%)	BD_S_018, BD_S_022, BD_S_024
AiCpTe1	Low stony hills and undulating plains. Mostly ironstone and basalt with some quartz and calcrete. Reddish brown clay-loam soils.	Very Good to Excellent	12 (5 – 38)	None	None	64,165.5 (59%) (Mosaic)	BD_E_014, BD_E_015, BD_E_016, BD_E_018, BD_E_020, BD_E_023, BD_E_024, BD_E_027, BD_E_028, BD_E_030, BD_E_037, BD_E_038, BD_E_040, BD_E_047, BD_E_053, BD_E_057, BD_E_059, BD_E_061, BD_E_064, BD_E_078, BD_E_079, BD_E_080, BD_E_083, BD_E_088, BD_E_090, BD_E_092, BD_E_093, BD_E_094, BD_E_095, BD_E_096, BD_E_098, BD_E_099, BD_E_101, BD_E_106, BD_E_108, BD_E_110, BD_E_111, BD_E_113, BD_E_114, BD_E_117, BD_E_119, BD_E_121, BD_E_123, BD_E_125, BD_E_130, BD_E_142, BD_E_148, BD_E_152, BD_E_154, BD_E_155, BD_E_157, BD_E_162, BD_E_164, BD_E_167, BD_E_169, BD_E_176, BD_E_183, BD_E_195, BD_E_205, BD_E_208, BD_E_209, BD_E_215, BD_E_216, BD_E_217, BD_E_221, BD_E_222, BD_E_226, BD_E_229, BD_E_231, BD_E_233, BD_E_236, BD_E_238, BD_E_240, BD_E_254, BD_E_258, BD_E_266, BD_E_267, BD_E_270, BD_E_272, BD_E_274, BD_E_278, BD_S_001, BD_S_028, BD_S_031, BD_S_053, BD_S_055, BD_S_062, BD_S_065, BD_S_066, BD_S_069, BD_S_071, BD_S_073, BD_S_075, BD_S_097, BD_S_098, BD_S_099, BD_S_105, BD_S_107, BD_S_109, BD_S_110
AiCpTe2	Primarily associated with minor drainage lines intersecting low stony hills and undulating plains. Reddish brown clay-loam soils.	Poor to Excellent	33.5 (23 – 42)	None	None		BD_E_001, BD_E_002, BD_E_008, BD_E_046, BD_E_085, BD_E_087, BD_E_112, BD_E_131, BD_S_061, BD_S_063
AiSgTb	Primarily associated with rocky ridges and outcrops. Reddish brown clay-loam soils.	Excellent	22 (6 – 41)	None	None		BD_E_012, BD_E_013, BD_E_039, BD_E_075, BD_E_102, BD_E_103, BD_E_104, BD_E_122, BD_E_134, BD_E_153, BD_E_173, BD_E_201, BD_E_211, BD_E_251, BD_E_273, BD_E_275, BD_E_280, BD_S_004, BD_S_013, BD_S_020, BD_S_039, BD_S_048, BD_S_051, BD_S_064, BD_S_096
AmTe	Drainage lines and floodplains	Excellent	18.5 (6 – 24)	None	Locally restricted	100.1 (0.1%)	BD_S_070, BD_S_077, BD_S_079, BD_S_080, BD_S_084, BD_S_102
AoTe	Rocky hills and outcrops with sandy clay loam soils.	Excellent	11 (7 – 16)	None	Locally restricted	136.2 (0.1%)	BD_E_003, BD_E_182, BD_E_198
EcAcCs	Sandy creek	Degraded to Excellent	39 (33 – 69)	None	Groundwater dependent vegetation; locally restricted	137.4 (0.1%)	BD_S_016, BD_S_035, BD_S_037, BD_S_057
ElAbTl	Low stony hills, plains, and undulating plains sometimes with dissecting drainage lines. Often with quartz and calcrete. Reddish brown clay-loam.	Very Good to Excellent	17 (5 – 40)	None	None	18,244.8 (16.8%)	BD_E_004, BD_E_019, BD_E_032, BD_E_045, BD_E_055, BD_E_056, BD_E_058, BD_E_060, BD_E_063, BD_E_068, BD_E_069, BD_E_081, BD_E_082, BD_E_124, BD_E_127, BD_E_135, BD_E_136, BD_E_137, BD_E_139, BD_E_140, BD_E_144, BD_E_145, BD_E_147, BD_E_149, BD_E_150, BD_E_158, BD_E_159, BD_E_163, BD_E_165, BD_E_168, BD_E_175, BD_E_178, BD_E_180, BD_E_184, BD_E_186, BD_E_187, BD_E_190, BD_E_193, BD_E_194, BD_E_196, BD_E_199, BD_E_200, BD_E_218, BD_E_220, BD_E_223, BD_E_237, BD_E_239, BD_E_244, BD_E_245, BD_E_247, BD_E_248, BD_E_256, BD_E_257, BD_E_259, BD_E_262, BD_E_263, BD_E_264, BD_E_268, BD_E_269, BD_E_271, BD_E_282, BD_E_289, BD_E_292, BD_E_293, BD_S_009, BD_S_015, BD_S_026, BD_S_040, BD_S_046, BD_S_082,

Map code	Landform and soils	Vegetation condition	Median site species richness (range)	Environmental Significance (WA)	Environmental Significance (Other)	Extent within survey area (ha) (% of total area)	Sites
							BD_S_086, BD_S_087, BD_S_088, BD_S_089, BD_S_091, BD_S_092, BD_S_095, BD_S_104, BD_S_108
ElGwTe	Low rocky hills and ridges with red-brown clay-loam soil	Excellent	14 (6 – 21)	None	The EPBC Act listed species *Quoya zonalis* is present within this vegetation type in the north-west corner of the survey area.	8,122.4 (7.5%)	BD_E_021, BD_E_025, BD_E_043, BD_E_044, BD_E_049, BD_E_050, BD_E_062, BD_E_065, BD_E_071, BD_E_072, BD_E_073, BD_E_077, BD_E_084, BD_E_115, BD_E_118, BD_E_120, BD_E_128, BD_E_143, BD_E_151, BD_E_156, BD_E_161, BD_E_166, BD_E_172, BD_E_174, BD_E_179, BD_E_181, BD_E_188, BD_E_191, BD_E_202, BD_E_203, BD_E_204, BD_E_207, BD_E_210, BD_E_214, BD_E_225, BD_E_243, BD_E_255, BD_E_261, BD_E_265, BD_E_279, BD_E_285, BD_E_286, BD_E_287, BD_S_045, BD_S_047, BD_S_049, BD_S_085, BD_S_100, BD_S_103, BD_S_106
EvAcCc	Minor and major creeks and minor gullies.	Degraded to Very Good	36 (15 – 66)	None	Potential groundwater dependent vegetation; locally restricted	5,128.5 (4.7%)	BD_E_006, BD_E_017, BD_E_022, BD_E_026, BD_E_031, BD_E_033, BD_E_035, BD_E_041, BD_E_042, BD_E_048, BD_E_052, BD_E_054, BD_E_086, BD_E_089, BD_E_091, BD_E_107, BD_E_116, BD_E_126, BD_E_133, BD_E_160, BD_E_185, BD_E_192, BD_E_212, BD_E_219, BD_E_227, BD_E_232, BD_E_235, BD_E_242, BD_E_249, BD_E_250, BD_E_253, BD_E_260, BD_E_281, BD_S_002, BD_S_017, BD_S_019, BD_S_032, BD_S_054, BD_S_060, BD_S_067, BD_S_072, BD_S_081, BD_S_083, BD_S_094
VfAl	Low hills and plains with clay soils, often stony.	Poor to Excellent	37 (10 – 78)	Priority 1 PEC (Four plant assemblages of the Wona Land System)	Potential role as a refuge (a relatively uncommon habitat type in the Pilbara which supports numerous species restricted to clay soils)	7,375.9 (6.8%)	BD_E_005, BD_E_007, BD_E_009, BD_E_010, BD_E_011, BD_E_029, BD_E_067, BD_E_070, BD_E_074, BD_E_076, BD_E_097, BD_E_100, BD_E_129, BD_E_132, BD_E_170, BD_E_171, BD_E_206, BD_E_213, BD_E_224, BD_E_228, BD_E_234, BD_E_241, BD_E_246, BD_E_276, BD_S_006, BD_S_029, BD_S_033, BD_S_041, BD_S_043, BD_S_050, BD_S_052, BD_S_056, BD_S_058, BD_S_059, BD_S_068, BD_S_076
Cleared	NA	NA	NA	NA	NA	1,091.9 (1.0%)	NA

4.2.2 Vegetation Condition

Vegetation condition according to the EPA (2016) scale was recorded at each sampling site and was assessed periodically along traverses and ranged from Degraded to Excellent (Table 17, Map 17). Vegetation across most of the survey area was in Excellent condition (98,760.22 ha, 90.74%Table 17), having no obvious disturbance or only negligible disturbance (e.g., the presence of few non-aggressive weeds). The most significant infestations of introduced species were within creeks and associated floodplains, in which dense **Cenchrus ciliaris* (buffel grass) and **Cenchrus setiger* (Birdwood grass) infestations were sometimes present, and parts of the Wona land system which were sometimes heavily grazed and with infestations of introduced species including **Vachellia farnesiana* (mimosa bush). These areas were assessed as Very Good, Good, Poor, or Degraded. Cleared areas including the BC Iron mine area and vehicle tracks accounted for approximately 530 ha.

Table 17: Vegetation condition of the survey area.

Condition category	Area (ha)	Percentage of survey area
Excellent	98,760.22	90.74
Very Good	3,366.34	3.09
Good	949.65	0.87
Poor	2,924.18	2.69
Degraded	1,748.71	1.61
NA (cleared)	1,091.91	1.00

4.2.3 Significant Vegetation

Vegetation types were assessed against the criteria in Table 9 (section 3.1.9) to determine vegetation significance. Thirteen vegetation types were significant according to one or more of these criteria (Table 16, Map 18).

Threatened and Priority Ecological Communities

Vegetation type VfAl, which was a species rich community occurring on clay soils associated with stony gibber plains and low hills, was consistent with the DBCA listed community 'Four plant assemblages of the Wona Land System' and more specifically to the Priority 1 community 'Cracking clays of the Chichester and Mungaroona Range' (Table 7). This vegetation type accounted for 6.8% (7,375.9 ha) of the survey area.

Vegetation supporting populations of Threatened species

Vegetation type ElGwTe supported a population of the Threatened species *Quoya zonalis* in the northwest of the survey area (Map 18). The area in which additional populations of *Quoya zonalis* potentially occur would likely be restricted to areas in the northwest surrounding the known population, even though this vegetation type occurs somewhat more extensively across the survey area. This area accounted for approximately 4,016 ha.

Vegetation that plays a potential role as a refuge

The Wona land system has a relatively restricted and patchy regional distribution and supports many plant species restricted to clay soils. This habitat is potentially a refuge for species restricted to clay soils in the Pilbara. The Wona land system was represented by vegetation type vegetation type VfAl and therefore had a total extent of 7,375.9 ha (6.8%) within the survey area.

Locally restricted vegetation types

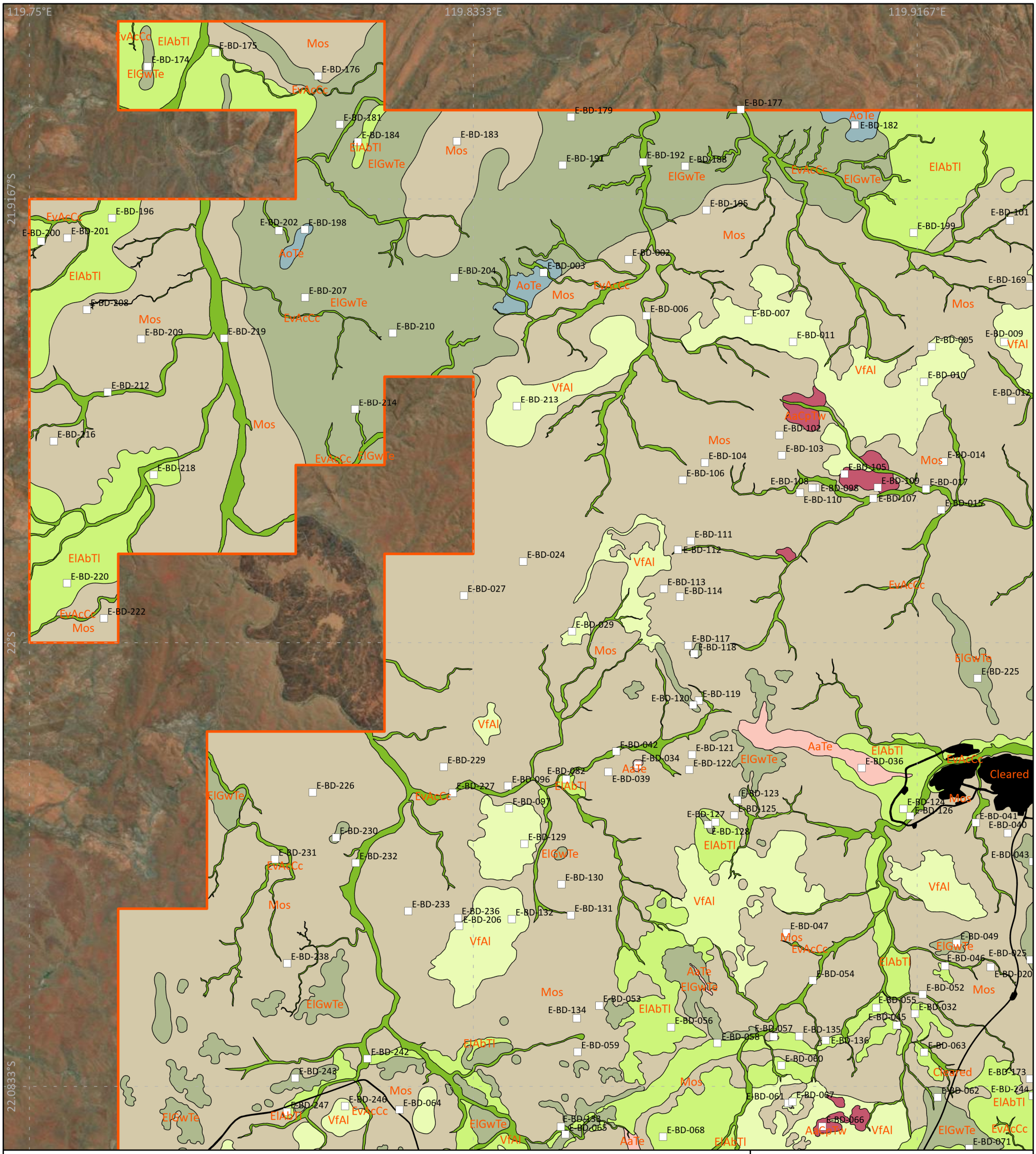
Nine vegetation types (AaCpTw, AaEp, AaTe, AaTs, AcTe, AeTe, AhCspYTe, AmTe, AoTe) each accounted for less than 5% of the total survey area (Table 16) and are potentially restricted in a local context. These collectively accounted for 3.7% (4,160 ha) of the survey area.

Groundwater dependent vegetation

Groundwater dependent vegetation was determined by the presence of the obligate phreatophyte *Melaleuca argentea* (GDV) or the facultative phreatophytes *Eucalyptus camaldulensis* and *Eucalyptus victrix* (potential GDV). Vegetation type EcAcCs supported *Melaleuca argentea* and *Eucalyptus camaldulensis* and was therefore considered to be GDV accounting for 137.4 ha (0.1%) of the survey area. Vegetation type EvAcCc which supported *Eucalyptus victrix* and occasionally *Eucalyptus camaldulensis*, but not *M. argentea*, is potential GDV and accounted for 5,128.5 (4.7%) of the survey area.

Sheet-flow dependent mulga

Sheet-flow dependent mulga communities (i.e., communities with characteristic grove-intergrove patterning) were present at the southern end of the transmission corridor (AaEp) and accounted for 413.7 ha (0.3%) of the survey area.



Bonney Downs survey area

Sampling site

AaCpTw,*Acacia aptaneura, Acacia tetragonophylla* tall open shrubland; *Corchorus parviflorus* low open shrubland; *Triodia wiseana, Enneapogon polyphyllus, Aristida contorta* low open tussock grassland.

AaEp,*Acacia aptaneura, Acacia pruinocarpa* tall open shrubland; *Enneapogon polyphyllus, ±Triodia brizoides, ±Triodia longiceps* low open tussock/hummock grassland.

AaTe,*Acacia aptaneura, Acacia pruinocarpa, Acacia bivenosa* tall open shrubland; *Triodia epactia* low open hummock grassland.

AaTs,*Acacia ancistrocarpa, Acacia aptaneura* tall open shrubland; *Triodia scintillans* low hummock grassland.

AcTe,*Acacia cyperophylla* var. *omearana* (P1), *Acacia tumida* var. *pilbarensis* tall sparse shrubland; *Triodia epactia, Triodia longiceps* mid sparse hummock grassland.

AeTe,*Acacia eriopoda* tall sparse shrubland; *Triodia epactia, Triodia longiceps* low hummock grassland.

AhCspYTe,*Atalaya hemiglauca* tall sparse shrubland; *Corchorus* sp. Yarrie (P1) mid open shrubland; *Triodia epactia* low sparse hummock grassland.

AmTe,*Acacia monticola* tall closed shrubland; *Triodia epactia* low open hummock grassland.

AoTe,*Acacia orthocarpa, Acacia maitlandii* tall open shrubland; *Triodia epactia* low open hummock grassland.

EcAcCs,*Eucalyptus camaldulensis, ±Melaleuca argentea* mid open woodland; *Acacia coriacea, Acacia trachycarpa* tall open shrubland; **Cenchrus setiger, Triodia longiceps* low tussock/hummock grassland.

ElAbTl,*Eucalyptus leucophloia, ±Corymbia hamersleyana* low open woodland; *Acacia bivenosa* mid sparse shrubland; *Triodia longiceps, Triodia wiseana, ±Triodia brizoides* low hummock grassland.

ElGwTe,*Eucalyptus leucophloia, ±Corymbia hamersleyana* low open woodland; *Grevillea wickhamii* mid sparse shrubland; *Triodia epactia, Eriachne lanata, Eriachne mucronata* low hummock/tussock grassland.

EvAcCc,*Eucalyptus victrix, ±Eucalyptus camaldulensis* mid open woodland; *Acacia coriacea, Acacia pyrifolia, Atalaya hemiglauca* tall open shrubland; **Cenchrus ciliaris, Triodia longiceps, Triodia epactia* low grassland.

VfAl,**Vachellia farnesiana* mid sparse shrubland; *Aristida latifolia, Cynodon convergens, Eriachne mucronata* low tussock grassland.

Mos,Mosaic of AiCpTe1 + AiCpTe2 + AiSgTb

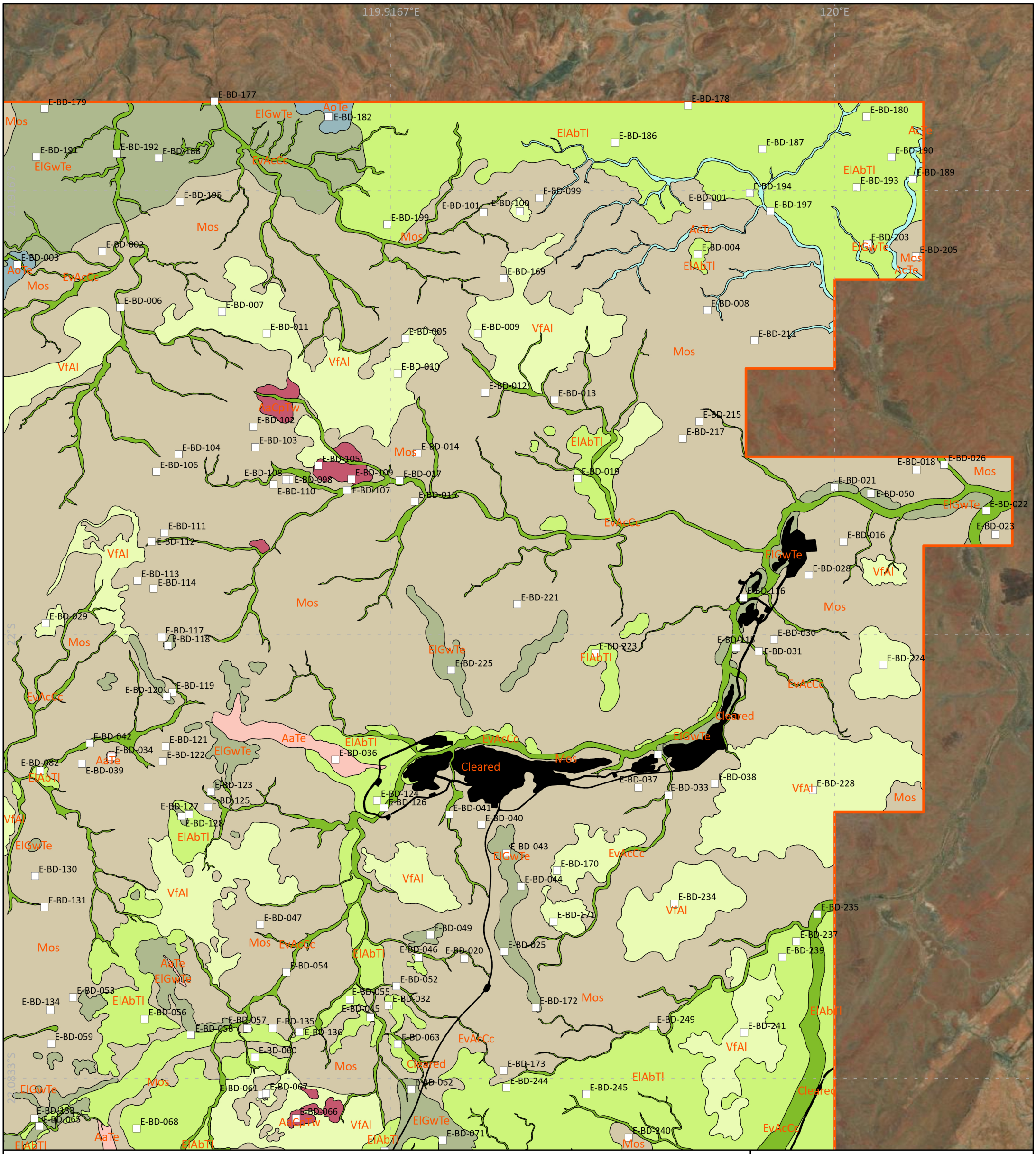
Cleared

ecologia ENVIRONMENT

Project No.: 1991
Author: AC
Created Date: 17 December 2024
Coordinate System: GCS GDA 1994
Scale: 1:75,000 @A3

Map 12: Vegetation types recorded within the survey area (north-west).

Earthstar Geographics



- Bonney Downs survey area
- Sampling site
- AaCpTw,*Acacia aptaneura, Acacia tetragonophylla* tall open shrubland; *Corchorus parviflorus* low open shrubland; *Triodia wiseana, Enneapogon polyphyllus, Aristida contorta* low open tussock grassland.
- AaEp,*Acacia aptaneura, Acacia pruinocarpa* tall open shrubland; *Enneapogon polyphyllus, ±Triodia brizoides, ±Triodia longiceps* low open tussock/hummock grassland.
- AaTe,*Acacia aptaneura, Acacia pruinocarpa, Acacia bivenosa* tall open shrubland; *Triodia epactia* low open hummock grassland.
- AaTs,*Acacia ancistrocarpa, Acacia aptaneura* tall open shrubland; *Triodia scintillans* low hummock grassland.
- AcTe,*Acacia cyperophylla* var. *omearana* (P1), *Acacia tumida* var. *pilbarensis* tall sparse shrubland; *Triodia epactia, Triodia longiceps* mid sparse hummock grassland.
- AeTe,*Acacia eriopoda* tall sparse shrubland; *Triodia epactia, Triodia longiceps* low hummock grassland.
- AhCspYTe,*Atalaya hemiglauca* tall sparse shrubland; *Corchorus* sp. Yarrie (P1) mid open shrubland; *Triodia epactia* low sparse hummock grassland.
- AmTe,*Acacia monticola* tall closed shrubland; *Triodia epactia* low open hummock grassland.
- AoTe,*Acacia orthocarpa, Acacia maitlandii* tall open shrubland; *Triodia epactia* low open hummock grassland.
- EcAcCs,*Eucalyptus camaldulensis, ±Melaleuca argentea* mid open woodland; *Acacia coriacea, Acacia trachycarpa* tall open shrubland; **Cenchrus setiger, Triodia longiceps* low tussock/hummock grassland.
- ElAbTl,*Eucalyptus leucophloia, ±Corymbia hamersleyana* low open woodland; *Acacia bivenosa* mid sparse shrubland; *Triodia longiceps, Triodia wiseana, ±Triodia brizoides* low hummock grassland.
- ElGwTe,*Eucalyptus leucophloia, ±Corymbia hamersleyana* low open woodland; *Grevillea wickhamii* mid sparse shrubland; *Triodia epactia, Eriachne lanata, Eriachne mucronata* low hummock/tussock grassland.
- EvAcCc,*Eucalyptus victrix, ±Eucalyptus camaldulensis* mid open woodland; *Acacia coriacea, Acacia pyrifolia, Atalaya hemiglauca* tall open shrubland; **Cenchrus ciliaris, Triodia longiceps, Triodia epactia* low grassland.
- VfAl,**Vachellia farnesiana* mid sparse shrubland; *Aristida latifolia, Cynodon convergens, Eriachne mucronata* low tussock grassland.
- Mos,Mosaic of AiCpTe1 + AiCpTe2 + AiSgTb
- Cleared



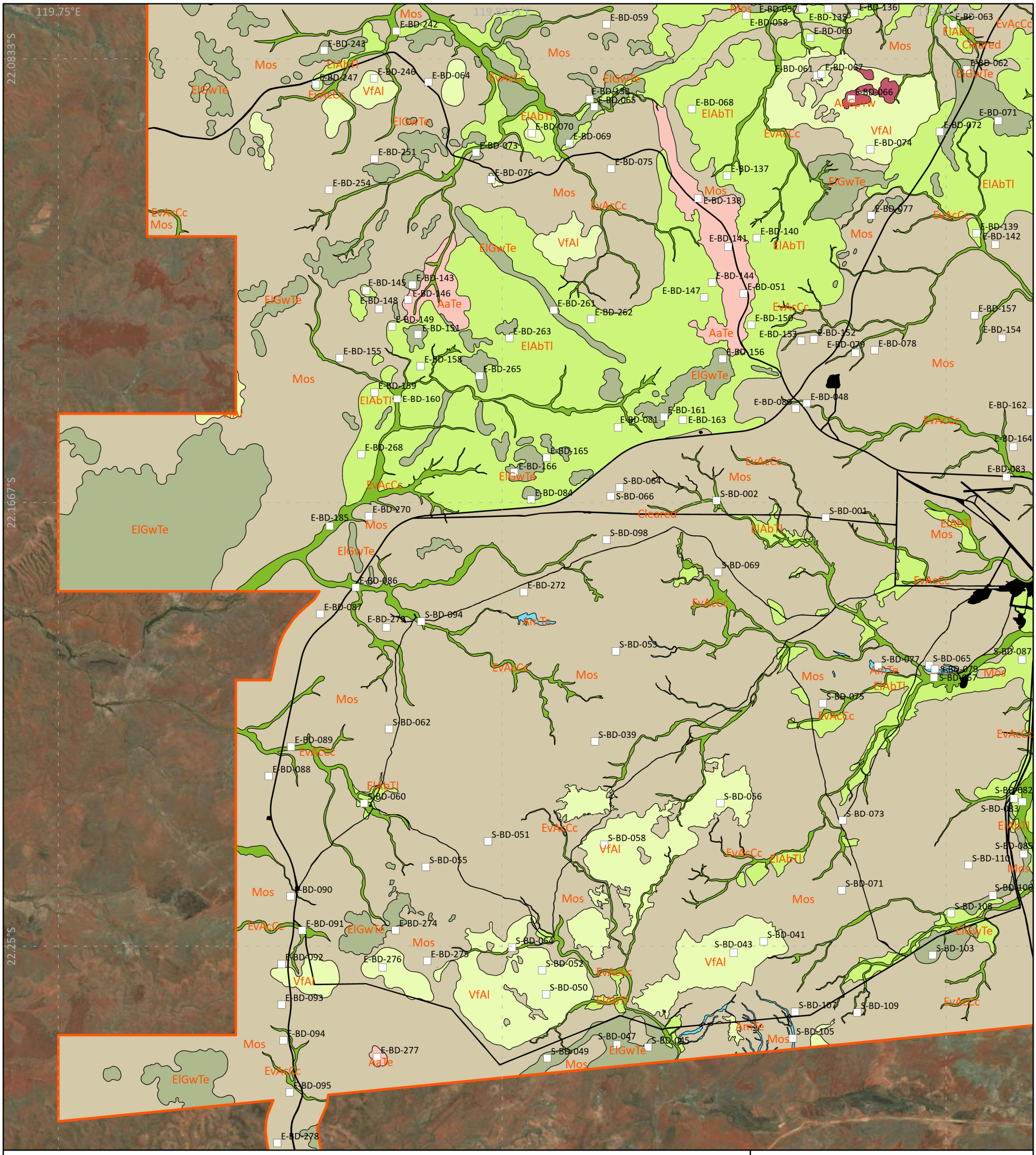
ecologia ENVIRONMENT

Project No.: 1991
Author: AC
Created Date: 17 December 2024
Coordinate System: GCS GDA 1994
Scale: 1:75,000 @A3

Map 13: Vegetation types recorded within the survey area (north-east).

Earthstar Geographics

0 0.5 1 1.5 3 Kilometers



Bonney Downs survey area

Sampling site

AaCpTw,*Acacia aptaneura, Acacia tetragonophylla* tall open shrubland; *Corchorus parviflorus* low open shrubland; *Triodia wiseana, Enneapogon polyphyllus, Aristida contorta* low open tussock grassland.

AaEp,*Acacia aptaneura, Acacia pruinocarpa* tall open shrubland; *Enneapogon polyphyllus, ±Triodia brizoides, ±Triodia longiceps* low open tussock/hummock grassland.

AaTe,*Acacia aptaneura, Acacia pruinocarpa, Acacia bivenosa* tall open shrubland; *Triodia epactia* low open hummock grassland.

AaTs,*Acacia ancistrocarpa, Acacia aptaneura* tall open shrubland; *Triodia scintillans* low hummock grassland.

AcTe,*Acacia cyperophylla* var. *omearana* (P1), *Acacia tumida* var. *pilbarensis* tall sparse shrubland; *Triodia epactia, Triodia longiceps* mid sparse hummock grassland.

AeTe,*Acacia eriopoda* tall sparse shrubland; *Triodia epactia, Triodia longiceps* low hummock grassland.

AhCspYTe,*Atalaya hemiglauca* tall sparse shrubland; *Corchorus* sp. Yarrie (P1) mid open shrubland; *Triodia epactia* low sparse hummock grassland.

AmTe,*Acacia monticola* tall closed shrubland; *Triodia epactia* low open hummock grassland.

AoTe,*Acacia orthocarpa, Acacia maitlandii* tall open shrubland; *Triodia epactia* low open hummock grassland.

EcAcCs,*Eucalyptus camaldulensis, ±Melaleuca argentea* mid open woodland; *Acacia coriacea, Acacia trachycarpa* tall open shrubland; **Cenchrus setiger, Triodia longiceps* low tussock/hummock grassland.

ElAbTl,*Eucalyptus leucophloia, ±Corymbia hamersleyana* low open woodland; *Acacia bivenosa* mid sparse shrubland; *Triodia longiceps, Triodia wiseana, ±Triodia brizoides* low hummock grassland.

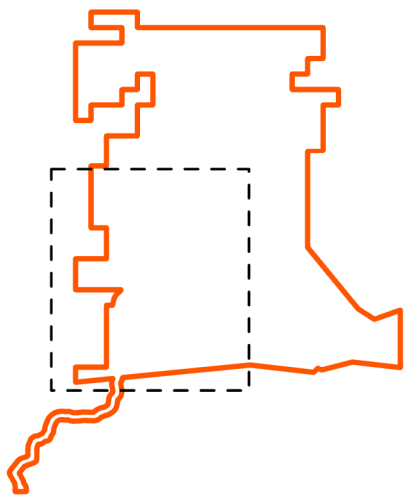
ElGwTe,*Eucalyptus leucophloia, ±Corymbia hamersleyana* low open woodland; *Grevillea wickhamii* mid sparse shrubland; *Triodia epactia, Eriachne lanata, Eriachne mucronata* low hummock/tussock grassland.

EvAcCc,*Eucalyptus victrix, ±Eucalyptus camaldulensis* mid open woodland; *Acacia coriacea, Acacia pyrifolia, Atalaya hemiglauca* tall open shrubland; **Cenchrus ciliaris, Triodia longiceps, Triodia epactia* low grassland.

VfAl,**Vachellia farnesiana* mid sparse shrubland; *Aristida latifolia, Cynodon convergens, Eriachne mucronata* low tussock grassland.

Mos,Mosaic of AiCpTe1 + AiCpTe2 + AiSgTb

Cleared



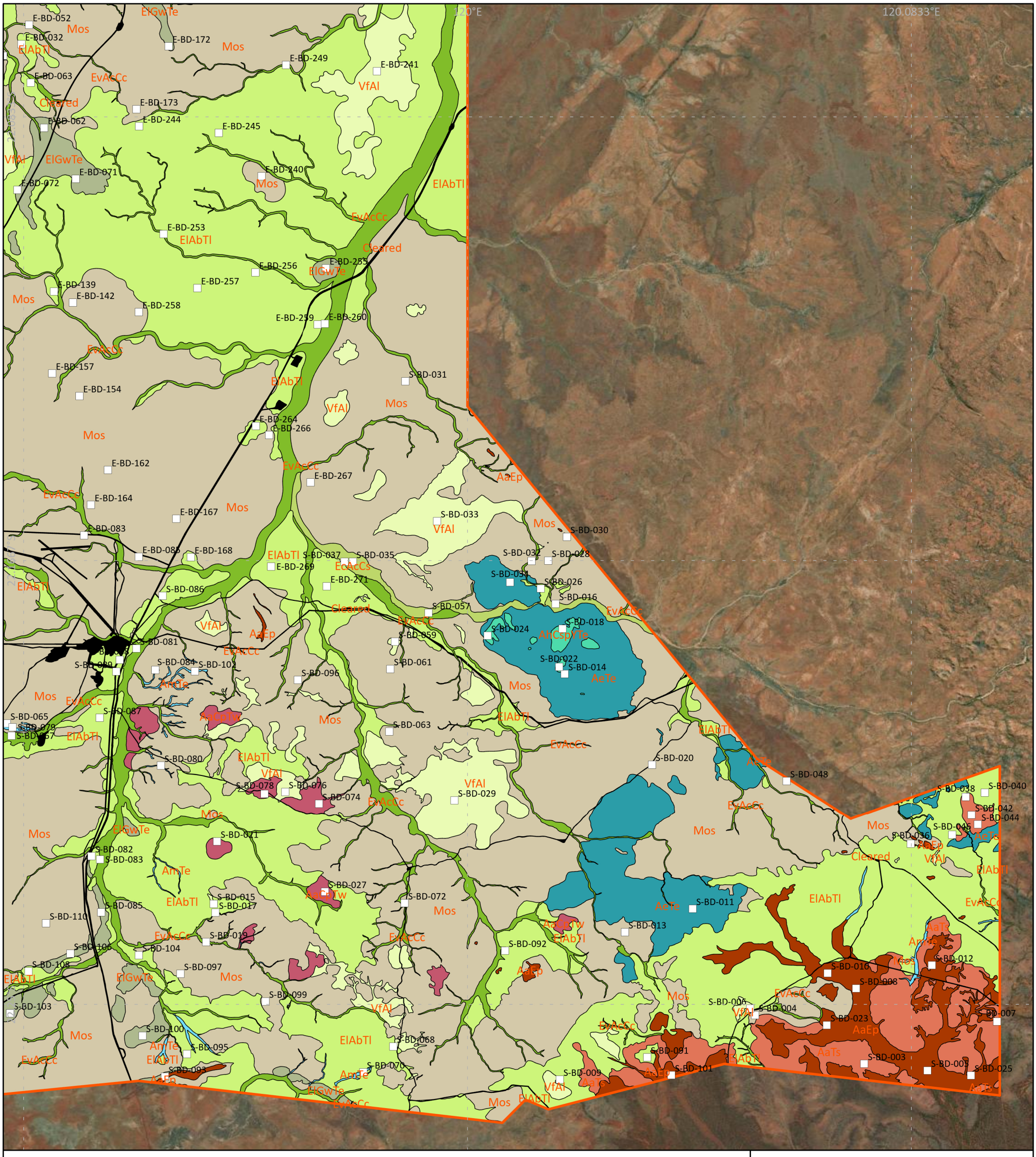
ecologia ENVIRONMENT

Project No.: 1991
Author: AC
Created Date: 17 December 2024
Coordinate System: GCS GDA 1994
Scale: 1:75,000 @A3

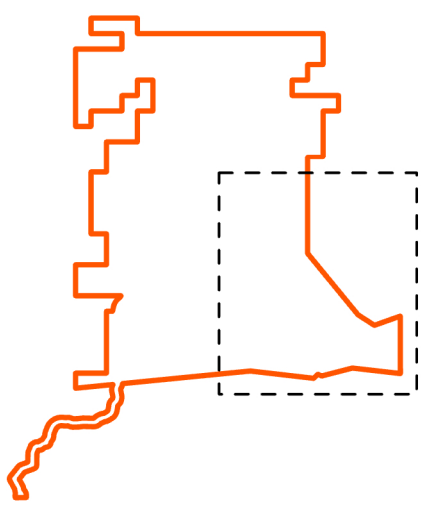
Map 14: Vegetation types recorded within the survey area (south-west).

Earthstar Geographics

0 0.5 1 1.5 3 Kilometers



- Bonney Downs survey area
- Sampling site
- AaCpTw,*Acacia aptaneura, Acacia tetragonophylla* tall open shrubland; *Corchorus parviflorus* low open shrubland; *Triodia wiseana, Enneapogon polyphyllus, Aristida contorta* low open tussock grassland.
- AaEp,*Acacia aptaneura, Acacia pruinocarpa* tall open shrubland; *Enneapogon polyphyllus, ±Triodia brizoides, ±Triodia longiceps* low open tussock/hummock grassland.
- AaTe,*Acacia aptaneura, Acacia pruinocarpa, Acacia bivenosa* tall open shrubland; *Triodia epactia* low open hummock grassland.
- AaTs,*Acacia ancistrocarpa, Acacia aptaneura* tall open shrubland; *Triodia scintillans* low hummock grassland.
- AcTe,*Acacia cyperophylla* var. *omearana* (P1), *Acacia tumida* var. *pilbarensis* tall sparse shrubland; *Triodia epactia, Triodia longiceps* mid sparse hummock grassland.
- AeTe,*Acacia eriopoda* tall sparse shrubland; *Triodia epactia, Triodia longiceps* low hummock grassland.
- AhCspYTe,*Atalaya hemiglauca* tall sparse shrubland; *Corchorus* sp. Yarrie (P1) mid open shrubland; *Triodia epactia* low sparse hummock grassland.
- AmTe,*Acacia monticola* tall closed shrubland; *Triodia epactia* low open hummock grassland.
- AoTe,*Acacia orthocarpa, Acacia maitlandii* tall open shrubland; *Triodia epactia* low open hummock grassland.
- EcAcCs,*Eucalyptus camaldulensis, ±Melaleuca argentea* mid open woodland; *Acacia coriacea, Acacia trachycarpa* tall open shrubland; **Cenchrus setiger, Triodia longiceps* low tussock/hummock grassland.
- ElAbTl,*Eucalyptus leucophloia, ±Corymbia hamersleyana* low open woodland; *Acacia bivenosa* mid sparse shrubland; *Triodia longiceps, Triodia wiseana, ±Triodia brizoides* low hummock grassland.
- ElGwTe,*Eucalyptus leucophloia, ±Corymbia hamersleyana* low open woodland; *Grevillea wickhamii* mid sparse shrubland; *Triodia epactia, Eriachne lanata, Eriachne mucronata* low hummock/tussock grassland.
- EvAcCc,*Eucalyptus victrix, ±Eucalyptus camaldulensis* mid open woodland; *Acacia coriacea, Acacia pyrifolia, Atalaya hemiglauca* tall open shrubland; **Cenchrus ciliaris, Triodia longiceps, Triodia epactia* low grassland.
- VfAl,**Vachellia farnesiana* mid sparse shrubland; *Aristida latifolia, Cynodon convergens, Eriachne mucronata* low tussock grassland.
- Mos,Mosaic of AiCpTe1 + AiCpTe2 + AiSgTb
- Cleared



ecologia ENVIRONMENT

Project No.: 1991
Author: AC
Created Date: 17 December 2024
Coordinate System: GCS GDA 1994
Scale: 1:75,000 @A3

Map 15: Vegetation types recorded within the survey area (south-east).

Earthstar Geographics

0 0.5 1 1.5 3 Kilometers

119.75°E
119.8333°E
22.25°S
22.3333°S
E-BD-273
AmTe
S-BD-053
EvAcCc
Mos
S-BD-062
S-BD-039
E-BD-089
EvAcCc
Mos
E-BD-088
ElAbTl
S-BD-060
EvAcCc
S-BD-051
S-BD-058
VfAl
S-BD-055
Mos
E-BD-090
Mos
EvAcCc
E-BD-091
ElGwTe
E-BD-274
S-BD-054
Mos
E-BD-092
E-BD-276
E-BD-275
S-BD-052
VfAl
VfAl
S-BD-050
E-BD-093
ElAbTl
E-BD-094
S-BD-047
Mos
E-BD-277
S-BD-049
EvAcCc
AaTe
ElGwTe
Mos
ElGwTe
E-BD-095
E-BD-278
E-BD-279
EvAcCc
ElAbTl
E-BD-294
E-BD-280
AaTe
Mos
E-BD-281
E-BD-250
E-BD-293
E-BD-292
Cleared
EvAcCc
E-BD-282
E-BD-284
AaEp
E-BD-283
E-BD-285
AaTe
ElAbTl
EvAcCc
ElGwTe
E-BD-286
E-BD-287
E-BD-248
ElAbTl
EvAcCc
E-BD-2
Cleared
E-BD-290
E-BD-291
AaEp
Cleared
E-BD-252
AaEp

- Bonney Downs survey area
- Sampling site
- AaCpTw,*Acacia aptaneura, Acacia tetragonophylla* tall open shrubland; *Corchorus parviflorus* low open shrubland; *Triodia wiseana, Enneapogon polyphyllus, Aristida contorta* low open tussock grassland.
- AaEp,*Acacia aptaneura, Acacia pruinocarpa* tall open shrubland; *Enneapogon polyphyllus, ±Triodia brizoides, ±Triodia longiceps* low open tussock/hummock grassland.
- AaTe,*Acacia aptaneura, Acacia pruinocarpa, Acacia bivenosa* tall open shrubland; *Triodia epactia* low open hummock grassland.
- AaTs,*Acacia ancistrocarpa, Acacia aptaneura* tall open shrubland; *Triodia scintillans* low hummock grassland.
- AcTe,*Acacia cyperophylla* var. *omearana* (P1), *Acacia tumida* var. *pilbarensis* tall sparse shrubland; *Triodia epactia, Triodia longiceps* mid sparse hummock grassland.
- AeTe,*Acacia eriopoda* tall sparse shrubland; *Triodia epactia, Triodia longiceps* low hummock grassland.
- AhCspYTe,*Atalaya hemiglauca* tall sparse shrubland; *Corchorus* sp. Yarrie (P1) mid open shrubland; *Triodia epactia* low sparse hummock grassland.
- AmTe,*Acacia monticola* tall closed shrubland; *Triodia epactia* low open hummock grassland.
- AoTe,*Acacia orthocarpa, Acacia maitlandii* tall open shrubland; *Triodia epactia* low open hummock grassland.
- EcAcCs,*Eucalyptus camaldulensis, ±Melaleuca argentea* mid open woodland; *Acacia coriacea, Acacia trachycarpa* tall open shrubland; **Cenchrus setiger, Triodia longiceps* low tussock/hummock grassland.
- ElAbTl,*Eucalyptus leucophloia, ±Corymbia hamersleyana* low open woodland; *Acacia bivenosa* mid sparse shrubland; *Triodia longiceps, Triodia wiseana, ±Triodia brizoides* low hummock grassland.
- ElGwTe,*Eucalyptus leucophloia, ±Corymbia hamersleyana* low open woodland; *Grevillea wickhamii* mid sparse shrubland; *Triodia epactia, Eriachne lanata, Eriachne mucronata* low hummock/tussock grassland.
- EvAcCc,*Eucalyptus victrix, ±Eucalyptus camaldulensis* mid open woodland; *Acacia coriacea, Acacia pyrifolia, Atalaya hemiglauca* tall open shrubland; **Cenchrus ciliaris, Triodia longiceps, Triodia epactia* low grassland.
- VfAl,**Vachellia farnesiana* mid sparse shrubland; *Aristida latifolia, Cynodon convergens, Eriachne mucronata* low tussock grassland.
- Mos,Mosaic of AiCpTe1 + AiCpTe2 + AiSgTb
- Cleared

ecologia ENVIRONMENT

Project No.: 1991
Author: AC
Created Date: 17 December 2024
Coordinate System: GCS GDA 1994
Scale: 1:75,000 @A3

Map 16: Vegetation types recorded within the survey area (transmission corridor).

Earthstar Geographics

0 0.5 1 1.5 3 Kilometers

119.75°E
119.8333°E
119.9167°E
120°E
120.0833°E
21.9167°S
22°S
22.0833°S
22.1667°S
22.25°S
22.3333°S

Bonney Downs survey area

Vegetation condition

- Excellent
- Very Good
- Good
- Poor
- Degraded
- NA (cleared)

ecologia ENVIRONMENT

Project No.: 1991
Author: AC
Created Date: 16 December 2024
Coordinate System: GCS GDA 1994
Scale: 1:180,000 @A3

Map 17: Vegetation condition within the survey area.

0 1.7 3.3 5 10 Kilometers

Esri, Geoscience Australia, NASA, NGA, USGS

119.75°E
119.8333°E
119.9167°E
120°E
120.0833°E
21.9167°S
22°S
22.0833°S
22.1667°S
22.25°S
22.3333°S

Bonney Downs survey area

Priority 1 PEC: Four plant assemblages of the Wona Land System

Other: Potentially supports EPBC Act listed Threatened species (*Quoya zonalis*)

Other: Groundwater dependent vegetation

Other: Potential groundwater dependent vegetation

Other: Sheetflow dependent mulga

Other: Locally restricted vegetation (if not otherwise significant)

ecologia ENVIRONMENT

Project No.: 1991
Author: AC
Created Date: 16 December 2024
Coordinate System: GCS GDA 1994
Scale: 1:180,000 @A3

Map 18: Significant and potentially significant vegetation within the survey area.

Esri, CGIAR

0 1.7 3.3 5 10 Kilometers

N



AaCpTw: *Acacia aptaneura*, *Acacia tetragonophylla* tall open shrubland; *Corchorus parviflorus* low open shrubland; *Triodia wiseana*, *Enneapogon polyphyllus*, *Aristida contorta* low open tussock grassland.



AaEp: *Acacia aptaneura*, *Acacia pruinocarpa* tall open shrubland; *Enneapogon polyphyllus*, ±*Triodia brizoides*, ±*Triodia longiceps* low open tussock/hummock grassland.

Figure 6: Representative photographs of vegetation types - 1.



AaTe: *Acacia aptaneura*, *Acacia pruinocarpa*, *Acacia bivenosa* tall open shrubland; *Triodia epactia* low open hummock grassland.



AcTe: *Acacia cyperophylla* var. *omearana* (P1), *Acacia tumida* var. *pilbarensis* tall sparse shrubland; *Triodia epactia*, *Triodia longiceps* mid sparse hummock grassland.

Figure 7: Representative photographs of vegetation types - 2.

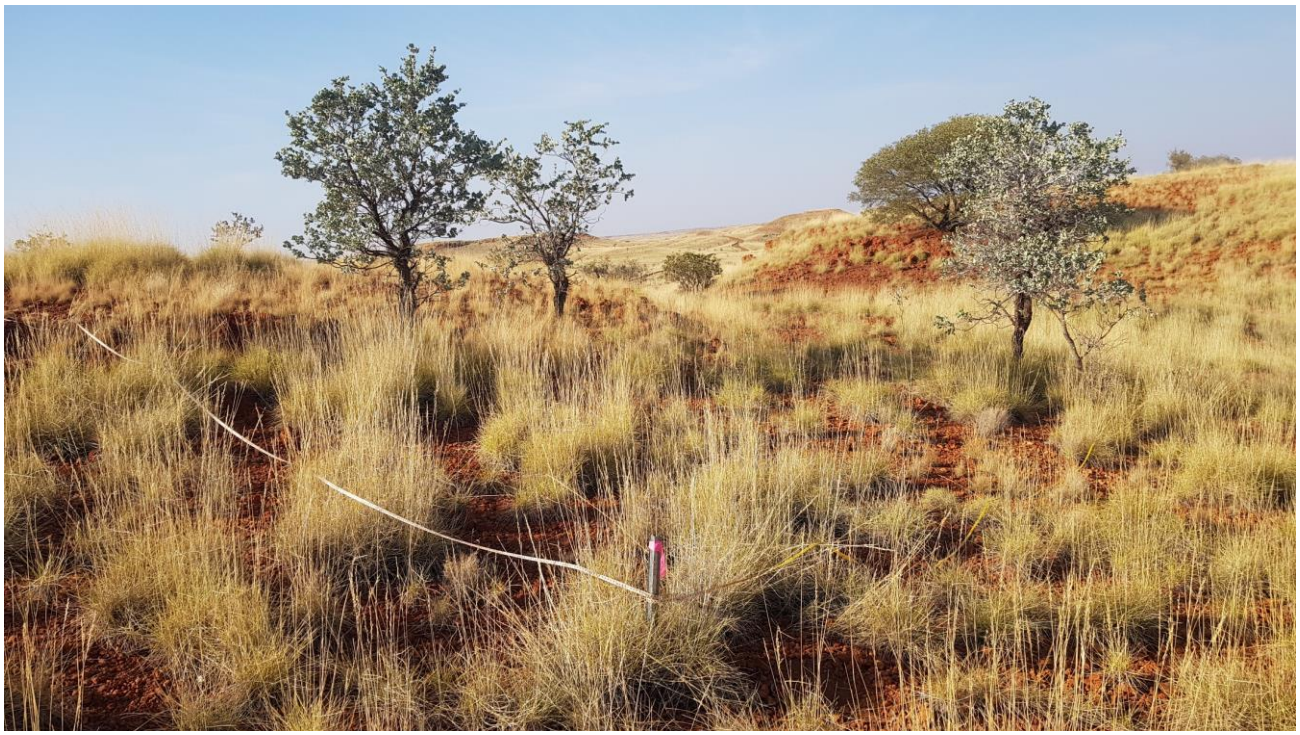


AiCpTe1: *Acacia inaequilatera* tall sparse shrubland; ±*Corchorus parviflorus* low sparse shrubland; *Triodia epactia*, ±*Triodia brizoides* low hummock grassland.



AiCpTe2: *Acacia inaequilatera* tall sparse shrubland; *Corchorus parviflorus* low sparse shrubland; *Triodia epactia* low hummock grassland.

Figure 8: Representative photographs of vegetation types - 3.



AiSgTb: *Acacia inaequilatera*, *Hakea lorea* subsp. *lorea* tall open shrubland; *Senna glutinosa* mid open shrubland; *Triodia brizoides*, *Triodia epactia*, *Cymbopogon ambiguus* low hummock/tussock grassland.



AoTe: *Acacia orthocarpa*, *Acacia maitlandii* tall open shrubland; *Triodia epactia* low open hummock grassland.

Figure 9: Representative photographs of vegetation types - 4.



ElAbTl: *Eucalyptus leucophloia* subsp. *leucophloia*, ±*Corymbia hamersleyana* low open woodland; *Acacia bivenosa* mid sparse shrubland; *Triodia longiceps*, *Triodia wiseana*, ±*Triodia brizoides* low hummock grassland.



ElGwTe: *Eucalyptus leucophloia* subsp. *leucophloia*, ±*Corymbia hamersleyana* low open woodland; *Grevillea wickhamii* mid sparse shrubland; *Triodia epactia*, *Eriachne lanata*, *Eriachne mucronata* low hummock/tussock grassland.

Figure 10: Representative photographs of vegetation types - 5.



EvAcCc: *Eucalyptus victrix*, ±*Eucalyptus camaldulensis* subsp. *refulgens* mid open woodland; *Acacia coriacea* subsp. *pendens*, *Acacia pyrifolia* var. *pyrifolia*, *Atalaya hemiglauca* tall open shrubland; **Cenchrus ciliaris*, *Triodia longiceps*, *Triodia epactia* low tussock/hummock grassland.



VfAl: **Vachellia farnesiana* mid sparse shrubland; *Aristida latifolia*, *Cynodon convergens*, *Eriachne mucronata* low tussock grassland.

Figure 11: Representative photographs of vegetation types - 6.

5 DISCUSSION

5.1 FLORA

5.1.1 Floristic Diversity

A total of 552 vascular plant taxa were recorded within the survey area, representing approximately 97% of the estimated species richness (Chao2) for the area at the time of the survey, and approximately 69% of the 796 taxa that have been recorded within 50 km of the survey area (ALA, 2023). The most dominant families were the Fabaceae, Poaceae, Malvaceae, Amaranthaceae, Asteraceae, and Cyperaceae; the most dominant genera were *Acacia*, *Ptilotus*, *Sida*, *Senna*, *Euphorbia*, and *Solanum*. These dominant groups are consistent with those identified for the area during the desktop assessment, and the overall species diversity and floristic composition of the survey area is typical of the landforms present and for the Chichester IBRA subregion more generally.

5.1.2 Significant Species

Threatened species

The EPBC Act listed Threatened species *Quoya zonalis* was recording from a single small population in the northeast of the survey area on the crest of a granite ridge associated with the Capricorn land system. Twenty-three plants were recorded, most of which were juvenile (i.e., < ca. 20 cm tall), and were not flowering or fruiting at the time of the survey. The dominant vegetation at the site was *Acacia monticola* and *Grevillea wickhamii* subsp. *aprica* mid open shrubland over *Triodia epactia* hummock grassland. It is expected to occur more extensively within the survey area in surrounding hills in similar vegetation.

Quoya zonalis is only known to occur within the Chichester IBRA subregion of the Pilbara IBRA region, where it is primarily restricted to a small area approximately 50 km west of Marble Bar. However, according to Western Australian Herbarium records, there is a recently discovered (2022) outlying population occurring approximately 8 km north of the records from this survey, so these new records do not represent a range extension.

Quoya zonalis is typically found on 'steep, rocky, sandstone conglomerate and granite slopes in skeletal, brown, sandy loam soils' (K. A. Shepherd & Hislop, 2020), and less frequently on flatter hilltops. Early species distribution modelling (which included environmental variables for land system, geology, elevation, slope, and aspect) identified land system and geology as likely the best predictors of species presence (*ecologia*, 2014), and to date *Quoya zonalis* has been found to be almost exclusively restricted to the Capricorn land system, which is broadly characterised by 'hills and ridges of sandstone and dolomite supporting shrubby hard and soft spinifex grasslands' (Van Vreeswyk, Payne, Leighton, & Hennig, 2004). The presence of these most recent records on a rocky ridge within the Capricorn land system is consistent with these findings.

The most frequently cited associated species for *Quoya zonalis* based on available records are *Eucalyptus leucophloia*, *Acacia tumida* var. *pilbarensis*, *Grevillea wickhamii*, *Triodia epactia*, and *Triodia wiseana,* which are consistent with the species associated with the population in the survey area.

Priority species

Eighteen DBCA listed Priority species were recorded within the survey area, many of which are restricted to clay soils associated with the Wona land system (vegetation type VfAl). A summary of the local and regional distribution of the Priority species recorded is as follows:

- ***Acacia cyperophylla* var. *omearana* (P1)** has a restricted distribution in the Pilbara from just north of Marble Bar southeast to Newman where it is restricted primarily to stony alluvium along drainage lines. It was only present in the north of the survey area where 1,143 individuals were

recorded from stony creeks and associated with a distinctive vegetation type in which it was dominant (AcTe).

- ***Bulbostylis burbidgeae* (P4)** is relatively widespread in the northeast Pilbara, occurring from Port Hedland to just north of Fortescue Marsh, where it is typically associated with granite outcrops and cliff bases. Within the survey area, 1,625 individuals were recorded from granite outcrops and overhangs, almost exclusively within vegetation type AhCspYTe.
- ***Corchorus* sp. Yarrie (J. Bull & D. Roberts CAL 01.05) (P1)** has a relatively restricted distribution in the northeast Pilbara and occurs primarily north of Marble Bar. Within the survey area, 147 individuals were recorded from granite outcrops, almost exclusively within vegetation type AhCspYTe in which it was dominant.
- ***Dolichocarpa* sp. Hamersley Station (A.A. Mitchell PRP 1479) (P3)** is widespread in the central Pilbara occurring from Karratha southeast to Newman where it grows mostly on inundated clays on gibber plains. Within the survey area, 750 individuals were recorded primarily from clay soils in vegetation type VfAl.
- ***Euphorbia inappendiculata* var. *inappendiculata* (P3)** is widespread across the Pilbara and it is typically associated with cracking clays. A single individual was recorded within the survey area from clay soils within vegetation type VfAl.
- ***Euphorbia inappendiculata* var. *queenslandica* (P3)** extends from near Tom Price in the west to the eastern edge of Karijini National Park, and it is typically associated with cracking clays. Over 1,900 individuals were recorded within the survey area on clay soils within vegetation type VfAl, where it is often locally abundant.
- ***Euphorbia stevenii* (P3)** extends from near Karratha southeast to near Newman in the Pilbara, with outlying records in the northern Kimberley. Eighty individuals were recorded within the survey area from clay soils within vegetation type VfAl.
- ***Indigofera ixocarpa* (P2)** has a relatively restricted distribution in the Pilbara with most records occurring near Tom Price and some outlying records near Nullagine. Forty individuals were recorded in the northwest of the survey area from rocky hillslopes in vegetation type ElAbTl.
- ***Iotasperma sessilifolium* (P3)** extends from just west of Tom Price to near Nullagine and grows mostly on the edges of waterholes and on cracking clays. One individual was recorded within the survey area from a minor drainage line.
- ***Ipomoea racemigera* (P3)** extends from near Karratha in the northwest of its distribution to near Newman in the southeast. It is widespread in northern Australia, occurring in southern and central Northern Territory, northern Queensland, and north-eastern South Australia. Fourteen individuals were recorded within the survey area primarily from creeks.
- ***Neptunia longipila* (P2)** is a recently described species that was split from *Neptunia dimorphantha*. It is a Pilbara endemic occurring from near Karratha in the northwest of its distribution to near Newman in the southeast. Within the survey area, 198 individuals were recorded on clay soils within vegetation type VfAl.
- ***Nicotiana umbratica* (P3)** is restricted primarily to the northeast of the Pilbara from just south of Port Hedland to near Nullagine where it mostly grows in shaded areas among rocky outcrops. Within the survey area, 554 individuals were recorded mostly from granite outcrops within vegetation type AhCspYTe.
- ***Paspalidium retiglume* (P2)** extends from near Karratha to near Wittenoom, where it is typically associated with clay soils. Within the survey area, 260 individuals were recorded on clay soils, mostly within vegetation type VfAl.
- ***Rhagodia* sp. Hamersley (M. Trudgen 17794) (P3)** is relatively common in the southeast of the Pilbara where it extends from near Tom Price to east of Newman, usually in mulga woodlands on clay soils. Thirty-five individuals were recorded from mulga plains in the southeast of the survey area.
- ***Rostellularia adscendens* var. *latifolia* (P3)** is widespread in central and eastern Pilbara where it extends from near Tom Price to Meenthena Station, growing in a variety of habitats. Within the

survey area, 127 individuals were recorded mostly from granite outcrops within vegetation type AhCspYTe.

- ***Stemodia* sp. Battle Hill (A.L. Payne 1006) (P1)** is only known from two locations, southwest of Nullagine and east of Fortescue Marsh, where it has been found growing on cracking clay soils and floodplains. Within the survey area, 370 individuals were recorded on clay soils within vegetation type VfAl.
- ***Swainsona thompsoniana* (P3)** occurs from near Karratha in the north-west to near Newman in the southeast and is typically associated with heavy clay soils. Within the survey area, 997 individuals were recorded on clay soils within vegetation type VfAl.
- ***Ptilotus mollis* (P4)** is widespread in the Pilbara region, occurring from Cane River Conservation Park in the west to Meenthena Station in the east, and typically grows on steep rocky slopes. Within the survey area, 1,174 individuals were recorded from several existing known locations. It was not recorded from any new locations. It potentially occurs on additional rocky hills within the survey area, but it is not particularly common.

The likelihood of occurrence of the species identified during the desktop assessment was reassessed following the field survey based on survey effort, the presence of suitable habitat, and vegetation condition. Seasonal conditions were suitable for detecting the presence of most annual species, and vegetation within the survey area was mostly in 'Excellent' condition. A total of 291 sampling sites (quadrats and releves) were distributed across representative areas of all habitat types within the survey area, and additional targeted searches were undertaken along walked traverses. Given the size of the survey area, this level of survey effort is reasonable for determining the likely presence of significant species. Therefore, the remaining significant species that were not recorded during these surveys are unlikely to occur.

Range Extensions

Based on the Atlas of Living Australia, which includes records from all Australian herbaria, 10 species recorded within the survey area occur more than 100 km from their nearest known record. The records of *Brachyscome rudallensis, Calandrinia balonensis, *Chenopodium murale*, *Crotalaria cunninghamii* subsp. *cunninghamii*, and *Stenopetalum velutinum* were at the edge of their known range in WA. The remaining records fall within the main range of the species and do not represent significant extensions from the edge of the range. These distributional gaps may be due to paucity of data rather than representing true gaps in the range.

5.1.3 Introduced Species

Twenty-five introduced species were recorded, one of which (**Calotropis procera*) is listed as Declared Pest. **Calotropis procera* was recorded primarily in the northeast of the survey area within or near disturbed areas associated with the BC Iron Nullagine mine. Most of these species are widely naturalised across the Pilbara region and their presence within the survey area is not considered unusual, although the records of **Chenopodium murale*, **Cynodon dactylon*, **Euphorbia hirta*, and **Phoenix dactylifera* were range extensions. The most significant weed infestations occurred in major drainage channels where **Cenchrus ciliaris* and **C. setiger* were often a dominant component of the ground layer. There were also notable infestations of **Vachellia farnesiana* usually associated with the Wona land system.

5.2 VEGETATION

5.2.1 Vegetation Types and Condition

Vegetation within the survey area consists mostly of low stony hills and undulating plains supporting *Acacia inaequilatera* sparse shrubland over *Triodia epactia* or *Triodia brizoides* low hummock grasslands (AiCpTe1, AiCpTe2, AiSgTb). These vegetation types account for approximately 59% of the survey area and were mostly in 'Excellent' condition. This is consistent with the pre-European

vegetation mapping of Shepherd et al. (2002) in which vegetation association 173 (Hummock grasslands, shrub steppe; kanji [*Acacia inaequilatera*] over soft spinifex [including *Triodia epactia*] & *Triodia wiseana* on basalt) is mapped over most of the survey area. *Eucalyptus leucophloia* subsp. *leucophloia* low open woodlands (ElAbTl and ElGwTe), also occurring on low rocky hills, account for approximately 24% of the survey area and were also mostly in 'Excellent' condition. Major drainage channels supporting riparian vegetation dominated by *Eucalypts victrix* and *E. camaldulensis* account for approximately 5% of the survey area. These riparian habitats were generally in Degraded or Poor condition owing to weed infestation (primarily **Cenchrus ciliaris* and **C. setiger*) in some areas. Low hills and upland plains with clay soils supporting *Aristida latifolia* tussock grasslands (VfAl) account for approximately 7% of the survey area. Vegetation condition in these areas was variable, with some areas more heavily grazed and with **Vachellia farnesiana* infestations, resulting in most of it being assessed in Poor to Good condition. Mulga (*Acacia aptaneura*) woodlands (AaCpTw, AaEp, AaTe) occur only occasionally within the survey area (approx. 2%).

The most significant areas of impact are associated with the former BC Iron mine site where extensive areas have been cleared and infestations of **Calotropis procera*, **Aerva javanica*, and **Cenchrus ciliaris* are sometimes present. These areas of weed infestation tend to be restricted to historically disturbed sites and the surrounding undisturbed vegetation is usually in Very Good to Excellent condition.

5.2.2 Significant Vegetation

Spatial data from the DBCA Threatened and Priority Ecological Communities Database and community descriptions were compared to the vegetation types described here to assess the potential presence of TECs and PECs within the survey area. TECs listed under the EPBC Act are regarded as nationally significant. No EPBC Act listed TECs were recorded within the survey area. State listed TECs and PECs are regarded as being of state significance. No state listed TECs were recorded within the survey area, and one state listed Priority 1 PEC was recorded.

Vegetation type VfAl is broadly consistent with the description of one of the four communities that make up the 'Four plant assemblages of the Wona Land System', specifically the Priority 1 community 'Cracking clays of the Chichester and Mungaroona Range'. Vegetation type VfAl accounts for 7,375.9 ha (6.8%) of the survey area, compared to 19,435 ha (18%) when using DBCA's significant communities data for the 'Four plant assemblages of the Wona Land System' (which includes a 500 m administrative buffer), but only 8,235 ha (7.5%) when using the land system mapping (DPIRD, 2022). The estimated extent of vegetation type VfAl within the survey area is therefore comparable the land system mapping, although the vegetation here has been mapped at a finer scale. The Wona land system occurs extensively outside of the survey area, occupying an extent of approximately 20,000 ha within the desktop study area (50 km buffer). Vegetation associated with the Wona land system in the vicinity of the survey area likely represents the same or similar vegetation to VfAl; consequently, VfAl is likely to occur extensively outside of the survey area.

An assessment of vegetation significance within the survey area identified thirteen vegetation types that have some level of regional or local significance:

- Vegetation type ElGwTe supported a population of the Threatened species *Quoya zonalis* in the northwest of the survey area. The area in which additional populations of *Quoya zonalis* potentially occur would likely be restricted to areas in the northwest surrounding the known population. The area expected to potentially support additional populations of *Quoya zonalis* within the survey area is approximately 4,016 ha of the survey area.
- The Wona land system has a relatively restricted and patchy regional distribution and supports many plant species restricted to clay soils, and this this habitat is therefore potentially a refuge for species restricted to clay soils in the Pilbara. The Wona land system was represented by

vegetation type vegetation type VfAl and therefore had a total extent of 7,375.9 ha (6.8%) within the survey area.

- Nine vegetation types (AaCpTw, AaEp, AaTe, AaTs, AcTe, AeTe, AhCspYTe, AmTe, AoTe) each accounted for less than 5% of the total survey area and are potentially restricted in a local context. These collectively accounted for 3.7% (4,160 ha) of the survey area.
- Vegetation type EcAcCs (supporting *Melaleuca argentea* and *Eucalyptus camaldulensis*) is considered to be GDV and accounted for 137.4 ha (0.1%) of the survey area. Vegetation type EvAcCc (supporting *Eucalyptus victrix* and occasionally *Eucalyptus camaldulensis*, but not *M. argentea*) is potential GDV and accounted for 5,128.5 (4.7%) of the survey area.
- Sheet-flow dependent mulga communities were present at the southern end of the transmission corridor (AaEp) and accounted for 413.7 ha (0.3%) of the survey area.

6 CONCLUSIONS

The key findings of this consolidated assessment were:

- A total of 552 vascular plant taxa were recorded from the survey area, representing approximately 97% of the estimated species richness for the survey area.
- Twenty-five introduced species were recorded, one of which (**Calotropis procera*) is a Declared Pest.
- One EPBC Act and BC Act listed Threatened species (*Quoya zonalis*) and 18 DBCA listed Priority species were recorded within the survey area.
- Hierarchical agglomerative clustering and ordination analyses were conducted using floristic data from 375 sampling sites, resulting in the classification of 17 vegetation types.
- Vegetation type VfAl is consistent with the DBCA listed PEC 'Four plant assemblages of the Wona Land System', specifically the Priority 1 community 'Cracking clays of the Chichester and Mungaroona Range'
- Thirteen vegetation types within the survey area have some level of regional or local significance including:
    - one vegetation types supporting a Threatened species (ElGwTe)
    - one vegetation type potentially playing a role as a refuge (VfAl)
    - nine vegetation types that are potentially locally restricted (AaCpTw, AaEp, AaTe, AaTs, AcTe, AeTe, AhCspYTe, AmTe, AoTe)
    - two vegetation types that are groundwater dependent (EcAcCs) or potentially groundwater dependent (EvAcCc)
    - one vegetation type that represents potentially sheet-flow dependent mulga in some parts (AaEp).

7 REFERENCES

ALA. (2023). Atlas of Living Australia website at http://www.ala.org.au. In.

Batini, F. (2009). *Eucalyptus victrix*, Karijini National Park Report to the EPA. In. Willetton, Western Australia.

BoM. (2024). Bureau of Meteorology. Available at: http://www.bom.gov.au. In. Canberra: Commonwealth of Australia.

CHAH. (2017). Australia's Virtual Herbarium. Available at http://avh.chah.org.au. In.

Clarke, K. R., Somerfield, P. J., & Gorley, R. N. (2008). Testing the null hypothesis in exploratory community analysis: similarity profiles and biota-environment linkage. *Journal of Experimental Marine Biology and Ecology, 366*, 56-69.

Colwell, R. K. (2013). EstimateS: EstimateS: Statistical estimation of species richness and shared species from samples. Version 9. Connecticut: University of Connecticut, USA. Retrieved from www.purl.oclc.org/estimates

Currall, J. E. P. (1987). A transformation of the Domin scale. *Vegetatio, 72*, 81-87.

DAWR. (2017). Australian Weeds Strategy 2017–2027. Invasive Plants and Animals Committee. Department of Agriculture and Water Resources. In.

DBCA. (2020). Conservation Codes For Western Australian Fauna and Flora. Available from https://www.dpaw.wa.gov.au/. In.

DBCA. (2024). DBCA Fire History (DBCA-060). Available at: https://catalogue.data.wa.gov.au/dataset/dbca-fire-history. (Data last updated 13/08/2024). In. Western Australia, Perth: Department of Primary Industries and Regional Development.

De Cáceres, M., Jansen, F., & Dell, N. (2017). indicspecies: Relationship Between Species and Groups of Sites. R package version 1.7.12. https://CRAN.R-project.org/package=indicspecies.

De Cáceres, M., & Legendre, P. (2009). Associations between species and groups of sites: indices and statistical inference. Ecology, URL http://sites.google.com/site/miqueldecaceres/.

DEH. (2001). National Objectives and Targets for Biodiversity Conservation 2001–2005. In. Canberra.

DER. (2014). A guide to the assessment of applications to clear native vegetation Under Part V Division 2 of the Environmental Protection Act 1986 December 2014. Retrieved from http://maps.dec.wa.gov.au/idelve/nv/index.jsp

DPaW. (2013). Invasive Plant Prioritisation Process for DPaW. Available at: http://dec.wa.gov.au/management-and-protection/plants/invasive-plants/invasive-plant-prioritisation-process.html. In: Department of Parks and Wildlife. Government of Western Australia.

DPIRD. (2007–). Western Australian Organism List (WAOL) - Declared pest list. Available at http://www.biosecurity.wa.gov.au/organisms/export/PER-DP. In. South Perth: Department of Agriculture and Food Western Australia. Government of Western Australia.

DPIRD. (2016). Soil Landscape Mapping - Best Available (DPIRD-027). Available at: https://catalogue.data.wa.gov.au/dataset/soil-landscape-mapping-best-available. In. Western Australia, Perth: Department of Primary Industries and Regional Development.

DPIRD. (2022). Soil Landscape Mapping - Best Available (DPIRD-027). Available at: https://catalogue.data.wa.gov.au/dataset/soil-landscape-mapping-best-available. (Data last updated 13/07/2022). In. Western Australia, Perth: Department of Primary Industries and Regional Development.

DSEWPaC. (2012). Interim Biogeographic Regionalisation for Australia (IBRA), Version 7. In. Canberra: Australian Government.

Eamus, D., & Froend, R. (2006). Groundwater-dependent ecosystems: the where, what and why of GDEs. *Australian Journal of Botany, 54*, 91-96.

ecologia. (2014). Pityrodia sp. Marble Bar Regional Survey Plan. Unpublished report prepared for Fortescue Metals Group Pty Ltd. In.

ecologia. (2024). Bonney Downs North Detailed Flora and Vegetation Assessment. Unpublished report prepared for Fortescue. In.

EPA. (2000). Position Statement No. 2: Environmental protection of native vegetation in Western Australia: clearing of native vegetation, with particular reference to the agricultural area. . In. Western Australia: Environment Protection Authority.

EPA. (2016a). *Environmental Factor Guideline: Flora and Vegetation, Environmental Protection Authority*. Western Australia: EPA.

EPA. (2016b). *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment*. Western Australia: EPA.

ESCAVI. (2017). *Australian Vegetation Attribute Manual: National Vegetation Information System (NVIS), Version 7.0. November 2017*. Canberra: Department of the Environment and Heritage.

Froend, R. (2009). Peer review of the Mt Bruce flats coolibah woodland 'state of knowledge' report.

Geoscience Australia. (2012). Surface Geology of Australia, 1:1 000 000 scale. In *2012 edition*: Bioregional Assessment Source Dataset.

Gotelli, N. J., & Colwell, R. K. (2012). *Estimating Species Richness. In: Biological Diversity: Frontiers in Measurement and Assessment*. United Kingdom: Oxford University Press.

Government of Western Australia. (2018). *2017 Statewide Vegetation Statistics incorporating the CAR Reserve Analysis (Full Report). Current as of December 2017. WA Department of Biodiversity Conservation and Attractions, Perth, https://catalogue.data.wa.gov.au/dataset/dbca-statewide-vegetation-statistics*

Kendrick, P., & McKenzie, N. (2001). Pilbara 1 (PIL1 - Chichester subregion). In *A Biodiversity Audit of Western Australia's 53 Biogeographic Subregions*. Perth, Western Australia: Department of Conservation and Land Management.

Northcote, K. H., Beckmann, G. G., Bettenay, E., Churchward, H. M., Van Dijk, D. C., Dimmock, G. M., . . . Wright, M. J. (1960-1968). Atlas of Australian Soils, Sheets 1 to 10. With explanatory data. In. Melbourne: CSIRO Australia and Melbourne University Press.

Oksanen, J., Blanchet, F. G., Friendly, M., Kindt, R., Legendre, P., McGlinn, D., . . . Wagner, H. (2017). vegan: Community Ecology Package. R package version 2.4-5. https://CRAN.R-project.org/package=vegan.

Page, G., & Grierson, P. (2010). Ecological Requirements of Mulga in the Pilbara. The University of Western Australia, Perth, Western Australia. In.

Pfautsch, S., Dodson, W., Madden, S., & Adams, M. A. (2014). Assessing the impact of large-scale water table modifications on riparian trees: a case study from Australia. *Ecohydrology, 8*(4), 642-651.

Purdie, B. R., Tille, P. J., & Schoknecht, N. R. (2016). Resource Management Technical Report 280 - Soil-landscape mapping in south-Western Australia: an overview of methodology and outputs. In. Western Australia, Perth: Department of Primary Industries and Regional Development.

R Core Team. (2021). R: A language and environment for statistical computing. . In: R Foundation for Statistical Computing, Vienna, Austria. ISBN 3-900051-07-0, URL http://www.R-project.org.

Shepherd, D. P., Beeston, G. R., & Hopkins, A. J. M. (2002). Native vegetation in Western Australia: Extent, type and status. In *Technical Report 249*. South Perth, Western Australia: Department of Agriculture.

Shepherd, K. A., & Hislop, M. (2020). Between a rock and a hard place: *Quoya zonalis* (Lamiaceae: Chloantheae), a new threatened Foxglove from Western Australia's Pilbara bioregion. *Nuytsia, 31*, 217–221.

SLR. (2024). Bonney Downs East Detailed Flora and Vegetation Survey. Unpublished report prepared for Fortescue. In.

Tille, P. J. (2006). Soil-landscapes of Western Australia's rangelands and arid interior. In *Report 313*. Western Australia, Perth: Department of Agriculture and Food.

Van Vreeswyk, A. M. E., Payne, A. L., Leighton, K. A., & Hennig, P. (2004). An inventory and condition survey of the Pilbara region, Western Australia. In *Technical Bulletin No. 92*. Western Australia: Department of Agriculture.

Western Australian Herbarium. (1998–). FloraBase – The Western Australian Flora. In: Department of Biodiversity, Conservation and Attractions. http://florabase.dpaw.wa.gov.au.

Whitaker, D., & Christman, M. (2014). clustsig: Significant Cluster Analysis. R package version 1.1. https://CRAN.R-project.org/package=clustsig.

8 APPENDICES

Appendix A Desktop assessment database search results.

Family	Taxon	Status	Introduced
Acanthaceae	*Rostellularia adscendens*		
	Dicladanthera forrestii		
Aizoaceae	*Trianthema cusackianum*		
	Trianthema triquetrum		
	Trianthema glossostigmum		
	Trianthema turgidifolium		
	Zaleya galericulata		
	Trianthema oxycalyptrum		
Amaranthaceae	*Aerva javanica*		*
	Ptilotus gomphrenoides	P3	
	Gomphrena cunninghamii		
	Ptilotus exaltatus	P3	
	Ptilotus obovatus	P3	
	Ptilotus mollis	P4	
	Ptilotus auriculifolius	P3	
	Ptilotus aervoides	P3	
	Ptilotus astrolasius	P3	
	Ptilotus calostachyus	P3	
	Ptilotus incanus	P3	
	Amaranthus undulatus		
	Amaranthus cuspidifolius		
	Ptilotus polystachyus	P3	
	Gomphrena affinis		
	Ptilotus carinatus	P3	
	Ptilotus fusiformis	P3	
	Ptilotus helipteroides	P3	
	Ptilotus schwartzii	P3	
	Gomphrena leptoclada		
	Ptilotus clementii	P3	
	Ptilotus gaudichaudii	P3	
	Ptilotus xerophilus	P3	
	Ptilotus rotundifolius	P3	
	Ptilotus axillaris	P3	
	Alternanthera nana		
	Ptilotus drummondii	P3	
	Alternanthera nodiflora		
	Gomphrena canescens		
	Gomphrena kanisii		
	Alternanthera angustifolia		
	Ptilotus wilsonii	P3	
	Amaranthus mitchellii		
	Achyranthes aspera		
	Alternanthera denticulata		
	Ptilotus latifolius	P3	
	Ptilotus indivisus	P3	
	Ptilotus macrocephalus	P3	

Apocynaceae	*Cynanchum floribundum*		
	Gymnema erectum		
	Gymnanthera cunninghamii	P3	
	Leichhardtia australis		
Araliaceae	*Trachymene oleracea*		
Asphodelaceae	*Asphodelus fistulosus*		*
Asteraceae	*Sonchus oleraceus*		*
	Bidens bipinnata		*
	Streptoglossa bubakii		
	Pterocaulon sphacelatum		
	Pluchea rubelliflora		
	Flaveria trinervia		
	Streptoglossa odora		
	Myriocephalus oldfieldii		
	Pluchea dentex		
	Pluchea ferdinandi-muelleri		
	Ixiochlamys cuneifolia		
	Minuria integerrima		
	Calotis plumulifera		
	Podolepis capillaris		
	Streptoglossa decurrens		
	Pentalepis trichodesmoides		
	Rhodanthe sterilescens		
	Pterocaulon serrulatum		
	Streptoglossa liatroides		
	Calocephalus pilbarensis		
	Centipeda minima		
	Pluchea dunlopii		
	Pterocaulon sphaeranthoides		
	Streptoglossa adscendens		
	Calocephalus beardii		
	Gnephosis brevifolia		
	Myriocephalus rudallii		
	Centipeda thespidioides		
	Calotis squamigera	P1	
	Streptoglossa cylindriceps		
	Vittadinia virgata		
	Rhodanthe margarethae		
	Myriocephalus scalpellus	P1	
	Centipeda crateriformis		
	Pluchea tetranthera		
	Angianthus cyathifer		
	Helichrysum oligochaetum	P1	
	Rhodanthe floribunda		
	Calotis porphyroglossa		
	Rhodanthe stricta		
	Senecio magnificus		

	Rhodanthe charsleyae		
	Calotis multicaulis		
	Roebuckiella similis		
	Iotasperma sessilifolium	P3	
	Streptoglossa sp. Cracking clays (S.van Leeuwen et al. PBS 7353)	P3	
	Isoetopsis graminifolia		
	Myriocephalus squamatus		
	Rhodanthe propinqua		
	Olearia xerophila	P1	
	Calotis latiuscula		
	Calocephalus francisii		
	Pseudognaphalium luteoalbum		
	Blumea tenella		
	Calocephalus knappii		
	Chrysocephalum apiculatum		
Bixaceae	*Cochlospermum macnamarae*	P1	
Boraginaceae	*Trichodesma zeylanicum*		
	Heliotropium heteranthum		
	Heliotropium murinum	P3	
	Heliotropium chrysocarpum		
	Heliotropium tenuifolium		
	Heliotropium curassavicum		
	Heliotropium inexplicitum		
	Ehretia saligna		
	Halgania solanacea		
	Heliotropium pachyphyllum		
	Heliotropium crispatum		
	Heliotropium ovalifolium		
	Heliotropium ammophilum		
	Heliotropium glanduliferum		
	Heliotropium cunninghamii		
Brassicaceae	*Lepidium pholidogynum*		
	Lepidium phlebopetalum		
	Lepidium pedicellosum		
	Lepidium echinatum		
	Lepidium platypetalum		
	Rorippa sp. Fortescue Valley (M.N.Lyons & R.A.Coppen FV 0760)	P1	
	Lepidium catapycnon	P4	
	Cardamine paucijuga	P2	
	Stenopetalum pedicellare		
	Lepidium oxytrichum		
	Stenopetalum nutans		
	Stenopetalum anfractum		
Byblidaceae	*Byblis pilbarana*		
Campanulaceae	*Lobelia arnhemiaca*		
	Wahlenbergia tumidifructa		
	Wahlenbergia queenslandica		

	Lobelia heterophylla		
Capparaceae	*Capparis lasiantha*		
	Capparis spinosa		
	Capparis umbonata		
Caryophyllaceae	*Polycarpaea longiflora*		
	Polycarpaea holtzei		
	Polycarpaea corymbosa		
Celastraceae	*Macgregoria racemigera*		
	Stackhousia muricata		
	Stackhousia clementii	P3	
Chenopodiaceae	*Tecticornia indica*		
	Atriplex spinulosa	P1	
	Tecticornia auriculata		
	Tecticornia medusa	P3	
	Tecticornia sp. Christmas Creek (K.A.Shepherd & T.Colmer et al. KS 1063)	P1	
	Maireana georgei		
	Sclerolaena hostilis		
	Sclerolaena cornishiana		
	Tecticornia sp. Dennys Crossing (K.A.Shepherd & J.English KS 552)		
	Rhagodia sp. Hamersley (M.Trudgen 17794)	P3	
	Atriplex amnicola		
	Sclerolaena cuneata		
	Sclerolaena densiflora		
	Maireana triptera		
	Atriplex codonocarpa		
	Tecticornia globulifera	P1	
	Sclerolaena costata		
	Atriplex flabelliformis	P3	
	Rhagodia eremaea		
	Sclerolaena lanicuspis		
	Maireana melanocoma		
	Maireana planifolia		
	Dysphania rhadinostachya		
	Maireana pyramidata		
	Enchylaena tomentosa		
	Sclerolaena bicornis		
	Tecticornia halocnemoides		
	Maireana carnosa		
	Dysphania plantaginella		
	Dysphania sphaerosperma		
	Sclerolaena glabra		
	Dysphania melanocarpa		
	Maireana eriosphaera		
	Tecticornia undulata		
	Einadia nutans		
	Sclerolaena diacantha		
	Maireana luehmannii		

	Salsola australis		
	Maireana tomentosa		
	Sclerolaena burbidgeae		
	Sclerolaena divaricata		
	Sclerolaena eriacantha		
	Dissocarpus paradoxus		
	Salsola tragus		
	Dysphania kalpari		
	Sclerolaena minuta		
	Sclerolaena deserticola		
	Eremophea spinosa		
	Atriplex semilunaris		
	Atriplex limbata		
	Maireana amoena		
	Sclerolaena recurvicuspis		
	Atriplex cinerea		
	Maireana villosa		
	Chenopodium gaudichaudianum		
	Maireana integra		
	Tecticornia pergranulata		
	Maireana platycarpa		
	Atriplex bunburyana		
	Dysphania congestiflora	P3	
	Atriplex lindleyi		
Cleomaceae	*Arivela viscosa*		
	Areocleome oxalidea		
Commelinaceae	*Commelina ensifolia*		
Convolvulaceae	*Bonamia erecta*		
	Convolvulus clementii		
	Evolvulus alsinoides		
	Cressa australis		
	Duperreya commixta		
	Operculina aequisepala		
	Bonamia media		
	Bonamia pannosa		
	Cuscuta victoriana		
	Ipomoea muelleri	P2	
	Ipomoea racemigera	P2	
	Ipomoea diamantinensis	P2	
	Ipomoea calobra	P2	
Cucurbitaceae	*Cucumis melo*		*
	Citrullus colocynthis		*
	Cucumis variabilis		
	Cucumis althaeoides		
Cyperaceae	*Eleocharis papillosa*	P3	
	Bulbostylis barbata		
	Bulbostylis turbinata		

	Bulbostylis burbidgeae	P4	
	Cyperus squarrosus		
	Cyperus rigidellus		
	Fimbristylis simulans	P1	
	Cyperus vaginatus		
	Cyperus bulbosus		
	Schoenoplectus subulatus		
	Fimbristylis microcarya	P1	
	Cyperus iria		
	Cyperus concinnus		
	Cyperus difformis		
	Cyperus bifax		
	Fimbristylis dichotoma	P1	
	Cyperus leptocarpus		
	Cyperus sp. (Coleman River)		
	Eleocharis geniculata		
	Schoenoplectiella dissachantha		
	Cyperus betchei		
	Isolepis congrua		
	Cyperus blakeanus		
	Fimbristylis leucocolea	P1	
	Cyperus ixiocarpus		
	Cyperus pygmaeus		
Droseraceae	*Drosera finlaysoniana*	P1	
Elatinaceae	*Bergia perennis*		
	Bergia trimera		
Euphorbiaceae	*Euphorbia australis*		
	Euphorbia careyi		
	Euphorbia tannensis		
	Euphorbia vaccaria		
	Adriana tomentosa		
	Euphorbia boophthona		
	Euphorbia biconvexa		
	Mallotus nesophilus		
	Euphorbia trigonosperma		
	Euphorbia wheeleri		
	Euphorbia coghlanii		
	Euphorbia inappendiculata		
Fabaceae	*Vachellia farnesiana*		*
	Parkinsonia aculeata		*
	Acacia aphanoclada	P1	
	Acacia orthocarpa	P1	
	Senna glutinosa		
	Senna artemisioides		
	Acacia cyperophylla	P1	
	Acacia trachycarpa	P1	
	Acacia bivenosa	P1	

	Swainsona stenodonta		
	Acacia sclerosperma	P1	
	Acacia pyrifolia	P1	
	Acacia aptaneura	P1	
	Tephrosia rosea		
	Cullen leucanthum		
	Acacia fecunda	P1	
	Acacia ampliceps	P1	
	Swainsona kingii		
	Indigofera monophylla		
	Acacia inaequilatera	P1	
	Acacia synchronicia	P1	
	Acacia arrecta	P1	
	Swainsona maccullochiana		
	Lotus australis		
	Tephrosia densa		
	Swainsona decurrens		
	Acacia acradenia	P1	
	Senna symonii		
	Acacia tenuissima	P1	
	Acacia spondylophylla	P1	
	Acacia eriopoda	P1	
	Acacia tumida	P1	
	Acacia tetragonophylla	P1	
	Acacia ancistrocarpa	P1	
	Acacia victoriae	P1	
	Acacia pruinocarpa	P1	
	Acacia coriacea	P1	
	Petalostylis labicheoides		
	Swainsona formosa		
	Cullen cinereum		
	Acacia dictyophleba	P1	
	Indigofera georgei		
	Acacia hilliana	P1	
	Cullen martinii		
	Tephrosia sp. Newman (A.A.Mitchell PRP 29)		
	Acacia colei	P1	
	Swainsona tanamiensis		
	Acacia sibirica	P1	
	Acacia xiphophylla	P1	
	Cullen stipulaceum		
	Indigofera ixocarpa	P2	
	Senna notabilis		
	Swainsona unifoliolata		
	Tephrosia sp. Bungaroo Creek (M.E.Trudgen 11601)		
	Rhynchosia minima		
	Acacia pachyacra	P1	

	Indigofera colutea		
	Senna sp. Meekatharra (E.Bailey 1-26)		
	Acacia citrinoviridis	P1	
	Senna sericea		
	Acacia retivenea	P1	
	Isotropis atropurpurea		
	Acacia marramamba	P1	
	Acacia rhodophloia	P1	
	Crotalaria medicaginea		
	Acacia aneura	P1	
	Sesbania cannabina		
	Cullen lachnostachys		
	Gompholobium sp. Roy Hill (G. Buller ATF08 AQ14)	P1	
	Indigofera trita		
	Lotus cruentus		
	Cajanus cinereus		
	Acacia ptychophylla	P1	
	Crotalaria cunninghamii		
	Acacia holosericea	P1	
	Aeschynomene indica		
	Petalostylis cassioides		
	Erythrina vespertilio		
	Acacia stellaticeps	P1	
	Swainsona thompsoniana	P3	
	Acacia kempeana	P1	
	Acacia sp. (Townsville)	P1	
	Indigofera linnaei		
	Glycine canescens	P1	
	Acacia melleodora	P1	
	Indigofera rugosa		
	Cullen leucochaites		
	Acacia arida	P1	
	Acacia wanyu	P1	
	Cullen pustulatum		
	Acacia balsamea	P1	
	Sesbania formosa		
	Alysicarpus muelleri		
	Acacia maitlandii	P1	
	Dichrostachys spicata		
	Trigonella suavissima		
	Rhynchosia australis		
	Acacia adoxa	P1	
	Acacia ayersiana	P1	
	Rothia indica		
	Acacia adsurgens	P1	
	Acacia ligulata	P1	
	Acacia distans	P1	

	Acacia monticola	P1	
	Tephrosia virens		
	Acacia microneura	P1	
	Tephrosia stipuligera		
	Senna hamersleyensis		
	Cullen pogonocarpum		
	Indigofera deserticola		
	Neptunia xanthonema		
	Isotropis parviflora	P3	
	Acacia catenulata	P1	
	Crotalaria novae-hollandiae		
	Senna ferraria		
	Acacia levata	P3	
	Senna stricta		
	Cajanus marmoratus		
	Acacia sericophylla	P1	
	Gompholobium polyzygum		
	Swainsona complanata		
	Acacia sibilans	P1	
	Rhynchosia bungarensis	P4	
	Swainsona pterostylis		
	Swainsona leeana		
	Jacksonia aculeata		
	Acacia subtiliformis	P3	
	Templetonia hookeri		
	Acacia sp. Ripon Hills (B.R.Maslin 8460)	P1	
	Gastrolobium grandiflorum		
	Crotalaria dissitiflora		
	Templetonia egena		
	Sesbania simpliciuscula		
	Senna occidentalis		
	Senna venusta		
	Acacia grasbyi	P1	
	Tephrosia sp. B Kimberley Flora (C.A.Gardner 7300)		
	Acacia drepanocarpa	P1	
	Acacia validinervia	P1	
	Acacia sp. Nullagine (B.R.Maslin 4955)	P1	
	Senna cardiosperma		
	Vigna lanceolata		
	Tephrosia sp. Northern (K.F.Kenneally 11950)		
	Tephrosia sp. NW Eremaean (S.van Leeuwen et al. PBS 0356)		
	Tephrosia supina		
	Indigofera chamaeclada		
	Vigna sp. Hamersley Clay (A.A.Mitchell PRP 113)		
	Desmodiopsis campylocaulon		
	Acacia cowleana	P1	
Frankeniaceae	*Frankenia setosa*		

	Frankenia ambita		
Gentianaceae	*Schenkia australis*		
Goodeniaceae	*Goodenia nuda*		
	Goodenia prostrata		
	Goodenia microptera		
	Goodenia lamprosperma		
	Scaevola spinescens		
	Goodenia cusackiana		
	Goodenia stobbsiana		
	Dampiera candicans		
	Scaevola collaris		
	Goodenia forrestii		
	Goodenia scaevolina		
	Scaevola parvifolia		
	Goodenia muelleriana		
	Goodenia sp. East Pilbara (A.R.Mitchell PRP 727)	P3	
	Goodenia aluta		
	Scaevola amblyanthera		
	Goodenia pascua		
	Goodenia vilmoriniae		
	Scaevola cunninghamii		
	Scaevola browniana		
	Goodenia tenuiloba		
	Goodenia wilunensis		
	Goodenia ramelii		
	Goodenia concinna		
	Goodenia pedicellata	P1	
	Goodenia iyouta		
Gyrostemonaceae	*Codonocarpus cotinifolius*		
Haloragaceae	*Haloragis gossei*		
	Haloragis maierae		
	Myriophyllum verrucosum		
Hydrocharitaceae	*Vallisneria nana*		
	Najas marina		
	Najas tenuifolia		
	Najas graminea		
Juncaginaceae	*Triglochin hexagona*		
Lamiaceae	*Dicrastylis cordifolia*		
	Basilicum polystachyon		
	Newcastelia sp. Hamersley Range (S.van Leeuwen 4264)		
	Clerodendrum floribundum		
	Newcastelia hexarrhena		
	Newcastelia cephalantha		
	Pityrodia sp. Marble Bar (G.Woodman & D.Coultas GWDS Opp 4)	EN	
	Teucrium racemosum		
	Newcastelia spodiotricha		
	Mesosphaerum suaveolens		

Linderniaceae	*Lindernia sp. Pilbara (M.N.Lyons & L.Lewis FV 1069)*	P1	
Loganiaceae	*Mitrasacme connata*		
Loranthaceae	*Amyema fitzgeraldii*		
	Amyema preissii		
	Amyema sanguinea		
	Lysiana casuarinae		
	Amyema hilliana		
	Lysiana subfalcata		
Lythraceae	*Ammannia baccifera*		
	Rotala diandra		
	Ammannia multiflora		
Malvaceae	*Malvastrum americanum*		*
	Hibiscus sturtii	P3	
	Gossypium robinsonii		
	Corchorus parviflorus		
	Abutilon sp. Dioicum (A.A.Mitchell PRP 1618)		
	Sida arsiniata		
	Abutilon lepidum		
	Gossypium australe		
	Abutilon oxycarpum		
	Corchorus lasiocarpus		
	Sida echinocarpa		
	Sida trichopoda		
	Corchorus walcottii		
	Abutilon sp. Pilbara (W.R.Barker 2025)		
	Triumfetta chaetocarpa		
	Hibiscus goldsworthii	P3	
	Triumfetta clementii		
	Hibiscus brachychlaenus	P3	
	Sida clementii		
	Abutilon leucopetalum		
	Lawrencia glomerata		
	Sida sp. L (A.M.Ashby 4202)		
	Sida arenicola		
	Sida rohlenae		
	Sida cardiophylla		
	Abutilon macrum		
	Corchorus laniflorus		
	Sida fibulifera		
	Abutilon sp. (Mataranka)		
	Abutilon malvifolium		
	Hibiscus burtonii	P3	
	Hibiscus coatesii	P3	
	Melhania oblongifolia		
	Sida sp. spiciform panicles (E.Leyland s.n. 14/8/1990)		
	Abutilon cryptopetalum		
	Sida sp. Rabbit Flat (B.J.Carter 626)		

	Lawrencia helmsii		
	Sida sp. (Small Flower)		
	Corchorus sidoides		
	Corchorus tridens		
	Hibiscus sp. Mt Robinson (G.Byrne 3537)	P3	
	Triumfetta appendiculata		
	Sida sp. Excedentifolia (J.L.Egan 1925)		
	Brachychiton acuminatus		
	Hibiscus austrinus	P3	
	Seringia exastia		
	Abutilon fraseri		
	Abutilon otocarpum		
	Sida aff. fibulifera		
	Lawrencia densiflora		
	Hibiscus brachysiphonius	P3	
	Sida platycalyx		
	Corchorus tectus		
	Sida brownii		
	Waltheria indica		
	Androcalva luteiflora		
	Hibiscus leptocladus	P3	
	Triumfetta leptacantha		
	Sida cunninghamii		
	Abutilon sp. Cape Range (A.S.George 1312)		
	Triumfetta maconochieana		
	Sida sp. Pindan (B.G.Thomson 3398)		
	Sida sp. Pilbara (A.A.Mitchell PRP1543)		
	Seringia nephrosperma		
Molluginaceae	*Trigastrotheca molluginea*		
	Glinus lotoides		
Moraceae	*Ficus aculeata*		
Myrtaceae	*Eucalyptus camaldulensis*	P4	
	Eucalyptus trivalva	P4	
	Eucalyptus leucophloia	P4	
	Eucalyptus rowleyi	P4	
	Melaleuca eleuterostachya	P4	
	Melaleuca xerophila	P4	
	Melaleuca glomerata	P4	
	Eucalyptus socialis	P4	
	Eucalyptus pilbarensis	P4	
	Eucalyptus lucasii	P4	
	Eucalyptus victrix	P4	
	Corymbia candida	P4	
	Melaleuca linophylla	P4	
	Eucalyptus gamophylla	P4	
	Eucalyptus xerothermica	P4	
	Calytrix carinata	P4	

	Corymbia flavescens	P4	
	Corymbia hamersleyana	P4	
	Eucalyptus rameliana	P4	
	Corymbia sp. Yampi Peninsula (R.L.Barrett & A.N.Start RLB 2280)	P4	
	Corymbia ferriticola	P4	
	Corymbia deserticola	P4	
	Eucalyptus aridimontana	P4	
	Eucalyptus carnei	P4	
	Corymbia opaca	P4	
	Melaleuca bracteata	P4	
Nyctaginaceae	*Boerhavia gardneri*		
	Boerhavia coccinea		
	Boerhavia repleta		
	Boerhavia burbidgeana		
	Commicarpus australis		
	Boerhavia schomburgkiana		
Oleaceae	*Jasminum didymum*		
Orobanchaceae	*Buchnera linearis*		
	Striga squamigera		
Papaveraceae	*Argemone ochroleuca*		
Pedaliaceae	*Josephinia eugeniae*		
	Josephinia sp. Mt Edgar Station (N.T.Burbidge 1194)		
Phrymaceae	*Peplidium sp. E Evol. Fl. Fauna Arid Aust. (A.S.Weston 12768)*		
	Peplidium muelleri		
	Mimulus gracilis		
	Peplidium aithocheilum		
	Elacholoma hornii		
	Uvedalia linearis		
Phyllanthaceae	*Flueggea virosa*		
	Phyllanthus erwinii		
	Notoleptopus decaisnei		
	Phyllanthus carpentariae	P3	
	Phyllanthus exilis		
	Phyllanthus maderaspatensis		
	Phyllanthus lacunarius		
	Phyllanthus virgatus		
	Phyllanthus sulcatus		
	Synostemon rhytidospermus		
Pittosporaceae	*Pittosporum angustifolium*	P4	
Plantaginaceae	*Stemodia grossa*		
	Stemodia viscosa		
	Stemodia sp. Battle Hill (A.L.Payne 1006)	P1	
Plumbaginaceae	*Muellerolimon salicorniaceum*		
	Plumbago zeylanica		
Poaceae	*Cenchrus ciliaris*		*
	Setaria verticillata		*
	Echinochloa colona		*

	Cenchrus setiger		*
	Triodia wiseana	P1	
	Triodia veniciae	P1	
	Enneapogon caerulescens		
	Eragrostis setifolia		
	Triodia scintillans	P1	
	Dactyloctenium radulans		
	Triodia longiceps	P1	
	Triodia epactia	P1	
	Triodia schinzii	P1	
	Triodia brizoides	P1	
	Sporobolus australasicus		
	Enteropogon ramosus		
	Eriachne aristidea		
	Eragrostis crateriformis	P3	
	Dichanthium sericeum		
	Aristida contorta		
	Eragrostis xerophila		
	Eragrostis pergracilis		
	Triodia pungens	P1	
	Triodia vanleeuwenii	P1	
	Eragrostis dielsii		
	Eriochloa pseudoacrotricha		
	Perotis rara		
	Cymbopogon obtectus		
	Paspalidium clementii		
	Themeda triandra		
	Panicum decompositum		
	Cymbopogon ambiguus		
	Enneapogon polyphyllus		
	Tragus australianus		
	Triodia basedowii	P1	
	Aristida latifolia		
	Eragrostis cumingii		
	Chloris pectinata		
	Eriachne flaccida		
	Eriachne benthamii		
	Eragrostis tenellula		
	Sporobolus mitchellii		
	Eulalia aurea		
	Eragrostis desertorum		
	Eriachne mucronata		
	Triraphis mollis		
	Cynodon prostratus		
	Eriachne lanata		
	Iseilema dolichotrichum		
	Themeda sp. Hamersley Station (M.E.Trudgen 11431)	P3	

	Sporobolus caroli		
	Iseilema membranaceum		
	Eragrostis eriopoda		
	Aristida inaequiglumis		
	Chrysopogon fallax		
	Aristida holathera		
	Xerochloa laniflora		
	Enneapogon avenaceus		
	Lachnagrostis filiformis		
	Eragrostis leptocarpa		
	Urochloa occidentalis		
	Heteropogon contortus		
	Astrebla pectinata		
	Oxychloris scariosa		
	Chloris pumilio		
	Acrachne racemosa		
	Paractaenum refractum		
	Enneapogon robustissimus		
	Triodia angusta	P1	
	Eragrostis speciosa		
	Aristida anthoxanthoides		
	Eragrostis sp. Erect spikelets (P.K.Latz 2122)	P3	
	Sporobolus actinocladus		
	Aristida burbidgeae		
	Eriachne gardneri		
	Iseilema eremaeum		
	Paspalidium tabulatum		
	Tripogonella loliiformis		
	Eragrostis falcata		
	Diplachne fusca		
	Enneapogon lindleyanus		
	Setaria surgens		
	Paspalidium jubiflorum		
	Elytrophorus spicatus		
	Digitaria longiflora		
	Xerochloa barbata		
	Setaria dielsii		
	Triodia bitextura	P1	
	Enneapogon cylindricus		
	Eriachne obtusa		
	Aristida hygrometrica		
	Digitaria ctenantha		
	Paspalidium constrictum		
	Eriachne pulchella		
	Enteropogon acicularis		
	Iseilema vaginiflorum		
	Triodia melvillei	P1	

	Triodia secunda	P1	
	Triodia lanigera	P1	
	Aristida pruinosa		
	Eragrostis olida		
	Iseilema macratherum		
	Bothriochloa ewartiana		
	Eriachne tenuiculmis		
	Paspalidium rarum		
	Panicum laevinode		
	Eriachne melicacea		
	Themeda avenacea		
	Yakirra australiensis		
	Cenchrus pennisetiformis		
	Eragrostis cilianensis		
	Urochloa piligera		
Polygalaceae	*Polygala glaucifolia*		
	Polygala isingii		
Polygonaceae	*Duma florulenta*		
	Polygonum plebeium		
Portulacaceae	*Portulaca oleracea*		*
	Calandrinia quadrivalvis		
	Calandrinia stagnensis		
	Calandrinia ptychosperma		
	Portulaca cyclophylla		
	Calandrinia pumila		
	Portulaca filifolia		
	Calandrinia schistorhiza		
	Portulaca conspicua		
	Calandrinia pentavalvis		
Potamogetonaceae	*Potamogeton tepperi*		
	Althenia hearnii		
Primulaceae	*Samolus sp. Fortescue Marsh (A.Markey & R.Coppen FM 9702)*	P1	
	Samolus repens		
Proteaceae	*Grevillea pyramidalis*		
	Grevillea wickhamii	P3	
	Hakea lorea		
	Grevillea striata		
	Grevillea stenobotrya		
	Grevillea juncifolia		
Rubiaceae	*Oldenlandia crouchiana*		
	Psydrax latifolia		
	Synaptantha tillaeacea		
	Psydrax suaveolens		
	Oldenlandia galioides		
	Spermacoce brachystema		
	Oldenlandia sp. Hamersley Station (A.A.Mitchell PRP 1479)	P3	
Ruppiaceae	*Ruppia polycarpa*		

	Ruppia maritima		
Santalaceae	*Santalum spicatum*		
	Anthobolus leptomerioides		
	Santalum lanceolatum		
Sapindaceae	*Atalaya hemiglauca*		
	Dodonaea petiolaris		
	Dodonaea lanceolata		
	Dodonaea coriacea		
	Diplopeltis stuartii		
Scrophulariaceae	*Eremophila youngii*	P1	
	Eremophila cuneifolia	P1	
	Eremophila spongiocarpa	P3	
	Eremophila latrobei	P1	
	Eremophila longifolia	P1	
	Eremophila lanceolata	P1	
	Eremophila maculata	P1	
	Eremophila forrestii	P1	
	Eremophila pilosa	P1	
	Eremophila exilifolia	P1	
	Eremophila caespitosa	P1	
	Eremophila pterocarpa	P1	
Solanaceae	*Datura leichhardtii*		*
	Solanum lasiophyllum		
	Solanum phlomoides		
	Nicotiana heterantha		
	Solanum sturtianum		
	Solanum horridum		
	Solanum elatius		
	Solanum diversiflorum		
	Solanum sp. Mosquito Creek (A.A.Mitchell et al. AAM 10795)	P1	
	Solanum morrisonii		
	Nicotiana occidentalis		
	Nicotiana umbratica	P3	
	Solanum dioicum		
	Nicotiana benthamiana		
	Nicotiana simulans		
	Nicotiana rosulata		
	Solanum cleistogamum		
	Solanum gabrielae		
	Solanum austropiceum		
	Nicotiana karijini		
Stylidiaceae	*Stylidium fluminense*		
	Stylidium weeliwolli	P3	
	Levenhookia pulcherrima	P3	
	Stylidium bulbiferum		
Surianaceae	*Stylobasium spathulatum*		
Typhaceae	*Typha domingensis*		

Violaceae	*Afrohybanthus aurantiacus*		
Zygophyllaceae	*Tribulus terrestris*		*
	Tribulus suberosus		
	Tribulus platypterus		
	Tribulus hirsutus		
	Tribulus astrocarpus		
	Tribulus macrocarpus		
	Roepera compressa		
	Roepera eichleri		
	Roepera similis		
	Tribulus cistoides		
	Tribulus occidentalis		
	Tribulus sp. long-styled eichlerianus (A.S.George 10666)		
	Roepera iodocarpa		

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 01-Jul-2024

Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat
Acknowledgements

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance (Ramsar	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	13
Listed Migratory Species:	9

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at https://www.dcceew.gov.au/parks-heritage/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	2
Commonwealth Heritage Places:	None
Listed Marine Species:	14
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	None
Regional Forest Agreements:	None
Nationally Important Wetlands:	1
EPBC Act Referrals:	34
Key Ecological Features (Marine):	None
Biologically Important Areas:	None
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

Listed Threatened Species		[Resource Information]
Status of Conservation Dependent and Extinct are not MNES under the EPBC Act. Number is the current name ID.		
Scientific Name	Threatened Category	Presence Text
BIRD		
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Endangered	Species or species habitat may occur within area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat known to occur within area
Pezoporus occidentalis Night Parrot [59350]	Endangered	Species or species habitat likely to occur within area
Polytelis alexandrae Princess Parrot, Alexandra's Parrot [758]	Vulnerable	Species or species habitat likely to occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
MAMMAL		
Dasyurus hallucatus Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Macroderma gigas		
Ghost Bat [174]	Vulnerable	Species or species habitat known to occur within area
Macrotis lagotis		
Greater Bilby [282]	Vulnerable	Species or species habitat known to occur within area
Rhinonicteris aurantia (Pilbara form)		
Pilbara Leaf-nosed Bat [82790]	Vulnerable	Roosting known to occur within area
REPTILE		
Liasis olivaceus barroni		
Pilbara Olive Python [66699]	Vulnerable	Species or species habitat likely to occur within area
Liopholis kintorei		
Great Desert Skink, Tjakura, Warrarna, Mulyamiji, Tjalapa, Nampu [83160]	Vulnerable	Species or species habitat may occur within area

Listed Migratory Species [Resource Information]

Scientific Name	Threatened Category	Presence Text
Migratory Marine Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Hirundo rustica		
Barn Swallow [662]		Species or species habitat may occur within area
Motacilla cinerea		
Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava		
Yellow Wagtail [644]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Calidris acuminata		
Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat known to occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat may occur within area
Charadrius veredus		
Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Commonwealth Lands [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Commonwealth Land Name	State
Unknown	
Commonwealth Land - [51746]	WA
Commonwealth Land - [51745]	WA

Listed Marine Species [Resource Information]

Scientific Name	Threatened Category	Presence Text
Bird		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area
Bubulcus ibis as Ardea ibis		
Cattle Egret [66521]		Species or species habitat may occur within area overfly marine area

Scientific Name	Threatened Category	Presence Text
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area overfly marine area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area overfly marine area
Chalcites osculans as Chrysococcyx osculans Black-eared Cuckoo [83425]		Species or species habitat known to occur within area overfly marine area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area overfly marine area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area overfly marine area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area overfly marine area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area overfly marine area

Scientific Name	Threatened Category	Presence Text
Rostratula australis as Rostratula benghalensis (sensu lato)		
Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area overfly marine area

Extra Information

Nationally Important Wetlands	[Resource Information]
Wetland Name	State
Fortescue Marshes	WA

EPBC Act Referrals			[Resource Information]
Title of referral	Reference	Referral Outcome	Assessment Status
East Hamersley Railway	2023/09542		Assessment
Nyidinghu Iron Ore Mine	2023/09543		Assessment
Roy Hill Iron Ore Mine expansion, Pilbara Region, WA	2018/8330		Post-Approval
Sanjiv Ridge Project - Stage 2	2021/8885		Post-Approval
Controlled action			
Additional Rail Infrastructure between Herb Elliott Port Facility and Cloudbreak Mine Site	2010/5513	Controlled Action	Post-Approval
Baralaba Train Load Out and Rail Loop	2012/6548	Controlled Action	Post-Approval
Bonney Downs Rail Alignment	2011/5867	Controlled Action	Post-Approval
Brockman Railway	2011/5833	Controlled Action	Post-Approval
Christmas Creek Iron Ore Mine Expansion Project, East Pilbara, WA	2013/7055	Controlled Action	Post-Approval
Christmas Creek Water Management Scheme	2010/5706	Controlled Action	Post-Approval
Cloud Break Open Pit Iron Ore Mine	2005/2205	Controlled Action	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Controlled action			
construction of iron ore mine & associated infrastructure	2013/6945	Controlled Action	Completed
Corunna Downs Iron Ore Mining Project, Pilbara Region, 33km south Marble Bar, WA	2017/7861	Controlled Action	Post-Approval
Expansion of Cloudbreak iron ore mine	2010/5696	Controlled Action	Post-Approval
FerrAus Pilbara Project - mine & Rail Pilbara Region WA	2011/6036	Controlled Action	Post-Approval
Golden Eagle Satellite Deposits Development	2011/5855	Controlled Action	Post-Approval
Koodaideri Iron Ore Mine & Infrastructure Project, WA	2012/6422	Controlled Action	Post-Approval
Marillana Iron Ore Project	2011/5892	Controlled Action	Post-Approval
McPhee Iron Ore Project	2021/8897	Controlled Action	Assessment Approach
Nullagine Iron Ore Extension Project, Pilbara region, WA	2013/6887	Controlled Action	Post-Approval
Nullagine Iron Ore Project	2009/4930	Controlled Action	Post-Approval
Roy Hill to Port Hedland Rail Line and Associated Infrastructure	2010/5424	Controlled Action	Post-Approval
Yandicoogina Junction South West and Oxbow Iron Ore Project	2011/5815	Controlled Action	Post-Approval
Not controlled action			
Development of iron ore resources in eastern Pilbara region, including port at P	2004/1562	Not Controlled Action	Completed
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed
Iron Valley Iron Ore Project	2012/6458	Not Controlled Action	Completed
Pilbara Bulk Ore Transport System Project, WA	2016/7637	Not Controlled Action	Completed
Pilbara Transmission Project, Pilbara, WA	2018/8349	Not Controlled Action	Completed
Roy Hill Iron Ore Project	2008/4624	Not Controlled Action	Completed

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action			
Stage B of Pilbara Iron Ore and Infrastructure Project	2004/1897	Not Controlled Action	Completed
Yandicoogina Pocket and Billiard South, Iron ore mine, WA	2014/7343	Not Controlled Action	Completed
Not controlled action (particular manner)			
Additional Rail Infrastructure	2012/6314	Not Controlled Action (Particular Manner)	Post-Approval
Northwest Resources Blue Spec Shear Gold-Antimony Project	2012/6672	Not Controlled Action (Particular Manner)	Post-Approval
Referral decision			
Mining at the Blue Spec and Gold Spec deposits	2012/6234	Referral Decision	Completed

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact us page.

© Commonwealth of Australia
Department of Climate Change, Energy, the Environment and Water
GPO Box 3090
Canberra ACT 2601 Australia
+61 2 6274 1111

Appendix B Plant species recorded within the survey area (all Ecologia and SLR records 2023 – 2024) and names amalgamated for data analysis.

Family	Name	Conservation status	Naturalised status	WAOL Status
Acanthaceae	*Dicladanthera forrestii*	None	Native	NA
Acanthaceae	*Rostellularia adscendens* var. *clementii*	None	Native	NA
Acanthaceae	*Rostellularia adscendens* var. *latifolia*	Priority 3 (DBCA)	Native	NA
Aizoaceae	*Trianthema cusackianum*	None	Native	NA
Aizoaceae	*Trianthema glossostigmum*	None	Native	NA
Aizoaceae	*Trianthema portulacastrum*	None	Introduced	Permitted - s11
Aizoaceae	*Trianthema triquetrum*	None	Native	NA
Aizoaceae	*Zaleya galericulata* subsp. *galericulata*	None	Native	NA
Amaranthaceae	*Achyranthes aspera*	None	Native	NA
Amaranthaceae	*Aerva javanica*	None	Introduced	Permitted - s11
Amaranthaceae	*Alternanthera denticulata* var. *denticulata*	None	Native	NA
Amaranthaceae	*Alternanthera nana*	None	Native	NA
Amaranthaceae	*Alternanthera nodiflora*	None	Native	NA
Amaranthaceae	*Alternanthera pungens*	None	Introduced	Permitted - s11
Amaranthaceae	*Amaranthus cuspidifolius*	None	Native	NA
Amaranthaceae	*Amaranthus undulatus*	None	Native	NA
Amaranthaceae	*Gomphrena affinis* subsp. *pilbarensis*	None	Native	NA
Amaranthaceae	*Gomphrena canescens* subsp. *canescens*	None	Native	NA
Amaranthaceae	*Gomphrena cunninghamii*	None	Native	NA
Amaranthaceae	*Gomphrena kanisii*	None	Native	NA
Amaranthaceae	*Gomphrena leptoclada* subsp. *leptoclada*	None	Native	NA
Amaranthaceae	*Ptilotus aervoides*	None	Native	NA
Amaranthaceae	*Ptilotus astrolasius*	None	Native	NA
Amaranthaceae	*Ptilotus auriculifolius*	None	Native	NA
Amaranthaceae	*Ptilotus axillaris*	None	Native	NA
Amaranthaceae	*Ptilotus calostachyus*	None	Native	NA
Amaranthaceae	*Ptilotus carinatus*	None	Native	NA
Amaranthaceae	*Ptilotus clementii*	None	Native	NA
Amaranthaceae	*Ptilotus exaltatus*	None	Native	NA
Amaranthaceae	*Ptilotus fusiformis*	None	Native	NA
Amaranthaceae	*Ptilotus gaudichaudii*	None	Native	NA
Amaranthaceae	*Ptilotus gomphrenoides*	None	Native	NA
Amaranthaceae	*Ptilotus helipteroides*	None	Native	NA
Amaranthaceae	*Ptilotus incanus*	None	Native	NA
Amaranthaceae	*Ptilotus mollis*	Priority 4 (DBCA)	Native	NA
Amaranthaceae	*Ptilotus obovatus* var. *obovatus*	None	Native	NA
Amaranthaceae	*Ptilotus polystachyus*	None	Native	NA
Amaranthaceae	*Ptilotus rotundifolius*	None	Native	NA

Family	Name	Conservation status	Naturalised status	WAOL Status
Amaranthaceae	*Ptilotus schwartzii*	None	Native	NA
Apocynaceae	*Calotropis procera*	None	Introduced	Declared Pest - s22(2)
Apocynaceae	*Carissa lanceolata*	None	Native	NA
Apocynaceae	*Cynanchum floribundum*	None	Native	NA
Apocynaceae	*Cynanchum viminale*	None	Native	NA
Apocynaceae	*Vincetoxicum lineare*	None	Native	NA
Araliaceae	*Trachymene oleracea*	None	Native	NA
Araliaceae	*Trachymene oleracea* subsp. *oleracea*	None	Native	NA
Arecaceae	*Phoenix dactylifera*	Other (Range Extension)	Introduced	Permitted - s11
Asteraceae	*Bidens bipinnata*	None	Introduced	Permitted - s11
Asteraceae	*Blumea tenella*	None	Native	NA
Asteraceae	*Brachyscome rudallensis*	Other (Range Extension)	Native	NA
Asteraceae	*Calocephalus knappii*	None	Native	NA
Asteraceae	*Centipeda minima* subsp. *macrocephala*	None	Native	NA
Asteraceae	*Flaveria trinervia*	None	Introduced	Not listed
Asteraceae	*Iotasperma sessilifolium*	Priority 3 (DBCA)	Native	NA
Asteraceae	*Leiocarpa semicalva* subsp. *semicalva*	None	Native	NA
Asteraceae	*Minuria integerrima*	None	Native	NA
Asteraceae	*Olearia aff. fluvialis*	Other (Anomalous features)	Native	NA
Asteraceae	*Pentalepis trichodesmoides* subsp. *trichodesmoides*	None	Native	NA
Asteraceae	*Peripleura virgata*	None	Native	NA
Asteraceae	*Pluchea dentex*	None	Native	NA
Asteraceae	*Pluchea ferdinandi-muelleri*	None	Native	NA
Asteraceae	*Pluchea rubelliflora*	None	Native	NA
Asteraceae	*Pluchea tetranthera*	None	Native	NA
Asteraceae	*Pseudognaphalium luteoalbum*	None	Native	NA
Asteraceae	*Pterocaulon serrulatum* var. *velutinum*	None	Native	NA
Asteraceae	*Pterocaulon sphacelatum*	None	Native	NA
Asteraceae	*Rhodanthe margarethae*	None	Native	NA
Asteraceae	*Rutidosis helichrysoides* subsp. *helichrysoides*	None	Native	NA
Asteraceae	*Sonchus oleraceus*	None	Introduced	Permitted - s11
Asteraceae	*Streptoglossa adscendens*	None	Native	NA
Asteraceae	*Streptoglossa bubakii*	None	Native	NA
Asteraceae	*Streptoglossa decurrens*	None	Native	NA
Asteraceae	*Streptoglossa liatroides*	None	Native	NA
Asteraceae	*Streptoglossa odora*	None	Native	NA
Boraginaceae	*Ehretia saligna* var. *saligna*	None	Native	NA
Boraginaceae	*Euploca chrysocarpa*	None	Native	NA

Family	Name	Conservation status	Naturalised status	WAOL Status
Boraginaceae	*Euploca conocarpa*	None	Native	NA
Boraginaceae	*Euploca cunninghamii*	None	Native	NA
Boraginaceae	*Euploca heterantha*	None	Native	NA
Boraginaceae	*Euploca pachyphylla*	None	Native	NA
Boraginaceae	*Euploca tanythrix*	None	Native	NA
Boraginaceae	*Heliotropium crispatum*	None	Native	NA
Boraginaceae	*Trichodesma zeylanicum* var. *zeylanicum*	None	Native	NA
Brassicaceae	*Lepidium muelleri-ferdinandi*	None	Native	NA
Brassicaceae	*Lepidium pedicellosum*	None	Native	NA
Brassicaceae	*Lepidium pholidogynum*	None	Native	NA
Brassicaceae	*Stenopetalum velutinum*	Other (Range Extension)	Native	NA
Campanulaceae	*Lobelia arnhemiaca*	None	Native	NA
Campanulaceae	*Wahlenbergia tumidifructa*	None	Native	NA
Capparaceae	*Capparis lasiantha*	None	Native	NA
Capparaceae	*Capparis spinosa* subsp. *nummularia*	None	Native	NA
Capparaceae	*Capparis umbonata*	None	Native	NA
Caryophyllaceae	*Polycarpaea corymbosa* var. *corymbosa*	None	Native	NA
Caryophyllaceae	*Polycarpaea holtzei*	None	Native	NA
Caryophyllaceae	*Polycarpaea involucrata*	None	Native	NA
Caryophyllaceae	*Polycarpaea longiflora*	None	Native	NA
Celastraceae	*Stackhousia muricata* subsp. annual (W.R. Barker 2172)	None	Native	NA
Chenopodiaceae	*Chenopodium murale*	Other (Range Extension)	Introduced	Permitted - s11
Chenopodiaceae	*Dysphania kalpari*	None	Native	NA
Chenopodiaceae	*Dysphania melanocarpa* forma *melanocarpa*	None	Native	NA
Chenopodiaceae	*Dysphania rhadinostachya* subsp. *rhadinostachya*	None	Native	NA
Chenopodiaceae	*Dysphania sphaerosperma*	None	Native	NA
Chenopodiaceae	*Enchylaena tomentosa* var. *tomentosa*	None	Native	NA
Chenopodiaceae	*Maireana georgei*	None	Native	NA
Chenopodiaceae	*Maireana melanocoma*	None	Native	NA
Chenopodiaceae	*Maireana planifolia*	None	Native	NA
Chenopodiaceae	*Maireana villosa*	None	Native	NA
Chenopodiaceae	*Rhagodia eremaea*	None	Native	NA
Chenopodiaceae	*Rhagodia* sp. Hamersley (M.Trudgen 17794)	None	Native	NA
Chenopodiaceae	*Salsola australis*	None	Native	NA
Chenopodiaceae	*Sclerolaena cornishiana*	None	Native	NA
Chenopodiaceae	*Sclerolaena costata*	None	Native	NA
Chenopodiaceae	*Sclerolaena densiflora*	None	Native	NA
Chenopodiaceae	*Sclerolaena eriacantha*	None	Native	NA

Family	Name	Conservation status	Naturalised status	WAOL Status
Chenopodiaceae	*Sclerolaena hostilis*	None	Native	NA
Cleomaceae	*Areocleome oxalidea*	None	Native	NA
Cleomaceae	*Arivela uncifera*	None	Native	NA
Cleomaceae	*Arivela viscosa*	None	Native	NA
Commelinaceae	*Commelina ensifolia*	None	Native	NA
Convolvulaceae	*Bonamia erecta*	None	Native	NA
Convolvulaceae	*Bonamia media*	None	Native	NA
Convolvulaceae	*Bonamia pannosa*	None	Native	NA
Convolvulaceae	*Bonamia pilbarensis*	None	Native	NA
Convolvulaceae	*Duperreya commixta*	None	Native	NA
Convolvulaceae	*Evolvulus alsinoides* var. *decumbens*	None	Native	NA
Convolvulaceae	*Evolvulus alsinoides* var. *villosicalyx*	None	Native	NA
Convolvulaceae	*Ipomoea lonchophylla*	None	Native	NA
Convolvulaceae	*Ipomoea muelleri*	None	Native	NA
Convolvulaceae	*Ipomoea plebeia*	None	Native	NA
Convolvulaceae	*Ipomoea polymorpha*	None	Native	NA
Convolvulaceae	*Ipomoea racemigera*	Priority 2 (DBCA)	Native	NA
Convolvulaceae	*Operculina aequisepala*	None	Native	NA
Convolvulaceae	*Polymeria ?mollis*	None	Native	NA
Convolvulaceae	*Polymeria ambigua*	None	Native	NA
Convolvulaceae	*Polymeria calycina*	None	Native	NA
Cucurbitaceae	*Austrobryonia pilbarensis*	None	Native	NA
Cucurbitaceae	*Citrullus amarus*	None	Introduced	Not listed
Cucurbitaceae	*Citrullus colocynthis*	None	Introduced	Permitted - s11
Cucurbitaceae	*Cucumis melo*	None	Native	NA
Cucurbitaceae	*Cucumis myriocarpus* subsp. *myriocarpus*	None	Introduced	Permitted - s11
Cucurbitaceae	*Cucumis variabilis*	None	Native	NA
Cyperaceae	*Bulbostylis barbata*	None	Native	NA
Cyperaceae	*Bulbostylis burbidgeae*	Priority 4 (DBCA)	Native	NA
Cyperaceae	*Bulbostylis turbinata*	None	Native	NA
Cyperaceae	*Cyperus bifax*	None	Native	NA
Cyperaceae	*Cyperus cunninghamii* subsp. *cunninghamii*	None	Native	NA
Cyperaceae	*Cyperus difformis*	None	Native	NA
Cyperaceae	*Cyperus hesperius*	None	Native	NA
Cyperaceae	*Cyperus iria*	None	Native	NA
Cyperaceae	*Cyperus ixiocarpus*	None	Native	NA
Cyperaceae	*Cyperus leptocarpus*	None	Native	NA
Cyperaceae	*Cyperus pulchellus*	None	Native	NA

Family	Name	Conservation status	Naturalised status	WAOL Status
Cyperaceae	*Cyperus squarrosus*	None	Native	NA
Cyperaceae	*Cyperus vaginatus*	None	Native	NA
Cyperaceae	*Fimbristylis depauperata*	None	Native	NA
Cyperaceae	*Fimbristylis dichotoma*	None	Native	NA
Cyperaceae	*Fimbristylis elegans*	None	Native	NA
Cyperaceae	*Fimbristylis microcarya*	None	Native	NA
Cyperaceae	*Fimbristylis simulans*	None	Native	NA
Cyperaceae	*Schoenoplectiella dissachantha*	None	Native	NA
Cyperaceae	*Schoenoplectus subulatus*	None	Native	NA
Elatinaceae	*Bergia pedicellaris*	None	Native	NA
Elatinaceae	*Bergia trimera*	None	Native	NA
Euphorbiaceae	*Adriana tomentosa* var. *tomentosa*	None	Native	NA
Euphorbiaceae	*Euphorbia australis* var. *hispidula*	None	Native	NA
Euphorbiaceae	*Euphorbia australis* var. *subtomentosa*	None	Native	NA
Euphorbiaceae	*Euphorbia biconvexa*	None	Native	NA
Euphorbiaceae	*Euphorbia boophthona*	None	Native	NA
Euphorbiaceae	*Euphorbia careyi*	None	Native	NA
Euphorbiaceae	*Euphorbia hirta*	Other (Range Extension)	Introduced	Not listed
Euphorbiaceae	*Euphorbia inappendiculata* var. *inappendiculata*	Priority 2 (DBCA)	Native	NA
Euphorbiaceae	*Euphorbia inappendiculata* var. *queenslandica*	Priority 2 (DBCA)	Native	NA
Euphorbiaceae	*Euphorbia stevenii*	Priority 3 (DBCA)	Native	NA
Euphorbiaceae	*Euphorbia tannensis* subsp. *eremophila*	None	Native	NA
Euphorbiaceae	*Euphorbia trigonosperma*	None	Native	NA
Euphorbiaceae	*Euphorbia vaccaria* var. *vaccaria*	None	Native	NA
Fabaceae	?*Glycine falcata*	Possible Priority 3	Native	NA
Fabaceae	*Acacia acradenia*	None	Native	NA
Fabaceae	*Acacia adoxa var. adoxa*	None	Native	NA
Fabaceae	*Acacia adsurgens*	None	Native	NA
Fabaceae	*Acacia ampliceps*	None	Native	NA
Fabaceae	*Acacia ancistrocarpa*	None	Native	NA
Fabaceae	*Acacia ancistrocarpa* x *monticola*	None	Native	NA
Fabaceae	*Acacia aptaneura*	None	Native	NA
Fabaceae	*Acacia arida*	None	Native	NA
Fabaceae	*Acacia arrecta*	None	Native	NA
Fabaceae	*Acacia ayersiana*	None	Native	NA
Fabaceae	*Acacia bivenosa*	None	Native	NA
Fabaceae	*Acacia catenulata* subsp. *occidentalis*	None	Native	NA
Fabaceae	*Acacia colei* var. *colei*	None	Native	NA

Family	Name	Conservation status	Naturalised status	WAOL Status
Fabaceae	*Acacia coriacea* subsp. *pendens*	None	Native	NA
Fabaceae	*Acacia cyperophylla* var. *omearana*	Priority 1 (DBCA)	Native	NA
Fabaceae	*Acacia elachantha*	None	Native	NA
Fabaceae	*Acacia eriopoda*	None	Native	NA
Fabaceae	*Acacia inaequilatera*	None	Native	NA
Fabaceae	*Acacia maitlandii*	None	Native	NA
Fabaceae	*Acacia monticola*	None	Native	NA
Fabaceae	*Acacia orthocarpa*	None	Native	NA
Fabaceae	*Acacia pruinocarpa*	None	Native	NA
Fabaceae	*Acacia ptychophylla*	None	Native	NA
Fabaceae	*Acacia pyrifolia* var. *morrisonii*	None	Native	NA
Fabaceae	*Acacia pyrifolia* var. *pyrifolia*	None	Native	NA
Fabaceae	*Acacia retivenea* subsp. *clandestina*	None	Native	NA
Fabaceae	*Acacia rhodophloia*	None	Native	NA
Fabaceae	*Acacia sclerosperma* subsp. *sclerosperma*	None	Native	NA
Fabaceae	*Acacia sibirica*	None	Native	NA
Fabaceae	*Acacia spondylophylla*	None	Native	NA
Fabaceae	*Acacia synchronicia*	None	Native	NA
Fabaceae	*Acacia tenuissima*	None	Native	NA
Fabaceae	*Acacia tetragonophylla*	None	Native	NA
Fabaceae	*Acacia trachycarpa*	None	Native	NA
Fabaceae	*Acacia tumida* var. *pilbarensis*	None	Native	NA
Fabaceae	*Alysicarpus muelleri*	None	Native	NA
Fabaceae	*Crotalaria cunninghamii* subsp. *cunninghamii*	Other (Range Extension)	Native	NA
Fabaceae	*Crotalaria cunninghamii* subsp. *sturtii*	None	Native	NA
Fabaceae	*Crotalaria dissitiflora* subsp. *benthamiana*	None	Native	NA
Fabaceae	*Crotalaria medicaginea* var. *neglecta*	None	Native	NA
Fabaceae	*Crotalaria novae-hollandiae* subsp. *novae-hollandiae*	None	Native	NA
Fabaceae	*Cullen ?lachnostachys*	None	Native	NA
Fabaceae	*Cullen graveolens*	None	Native	NA
Fabaceae	*Cullen leucanthum*	None	Native	NA
Fabaceae	*Cullen leucochaites*	None	Native	NA
Fabaceae	*Cullen martinii*	None	Native	NA
Fabaceae	*Cullen pogonocarpum*	None	Native	NA
Fabaceae	*Cullen pustulatum*	None	Native	NA
Fabaceae	*Cullen stipulaceum*	None	Native	NA
Fabaceae	*Desmodiopsis campylocaulon*	None	Native	NA
Fabaceae	*Erythrina vespertilio*	None	Native	NA

Family	Name	Conservation status	Naturalised status	WAOL Status
Fabaceae	*Glycine canescens*	None	Native	NA
Fabaceae	*Grona ?filiformis*	None	Native	NA
Fabaceae	*Grona muelleri*	None	Native	NA
Fabaceae	*Indigastrum parviflorum*	None	Native	NA
Fabaceae	*Indigofera colutea*	None	Native	NA
Fabaceae	*Indigofera deserticola*	None	Native	NA
Fabaceae	*Indigofera ixocarpa*	Priority 2 (DBCA)	Native	NA
Fabaceae	*Indigofera linifolia*	None	Native	NA
Fabaceae	*Indigofera linnaei*	None	Native	NA
Fabaceae	*Indigofera monophylla*	None	Native	NA
Fabaceae	*Indigofera rugosa*	None	Native	NA
Fabaceae	*Indigofera trita* subsp. *trita*	None	Native	NA
Fabaceae	*Isotropis atropurpurea*	None	Native	NA
Fabaceae	*Lotus cruentus*	None	Native	NA
Fabaceae	*Neptunia dimorphantha*	None	Native	NA
Fabaceae	*Neptunia longipila*	Priority 2 (DBCA)	Native	NA
Fabaceae	*Neptunia xanthonema*	None	Native	NA
Fabaceae	*Petalostylis labicheoides*	None	Native	NA
Fabaceae	*Rhynchosia minima*	None	Native	NA
Fabaceae	*Senna ?hamersleyensis*	None	Native	NA
Fabaceae	*Senna ?stricta*	None	Native	NA
Fabaceae	*Senna artemisioides* subsp. ×*artemisioides*	None	Native	NA
Fabaceae	*Senna artemisioides* subsp. *helmsii*	None	Native	NA
Fabaceae	*Senna artemisioides* subsp. *helmsii* × *oligophylla*	None	Native	NA
Fabaceae	*Senna artemisioides* subsp. *oligophylla*	None	Native	NA
Fabaceae	*Senna glaucifolia*	None	Native	NA
Fabaceae	*Senna glutinosa* subsp. ×*luerssenii*	None	Native	NA
Fabaceae	*Senna glutinosa subsp. glutinosa*	None	Native	NA
Fabaceae	*Senna glutinosa subsp. pruinosa*	None	Native	NA
Fabaceae	*Senna notabilis*	None	Native	NA
Fabaceae	*Senna occidentalis*	None	Introduced	Permitted - s11
Fabaceae	*Senna sericea*	None	Native	NA
Fabaceae	*Senna* sp. Karijini (M.E.Trudgen 10392)	None	Native	NA
Fabaceae	*Senna* sp. Meekatharra (E. Bailey 1-26)	None	Native	NA
Fabaceae	*Senna symonii*	None	Native	NA
Fabaceae	*Senna venusta*	None	Native	NA
Fabaceae	*Sesbania cannabina*	None	Native	NA
Fabaceae	*Swainsona decurrens*	None	Native	NA

Family	Name	Conservation status	Naturalised status	WAOL Status
Fabaceae	*Swainsona kingii*	None	Native	NA
Fabaceae	*Swainsona stenodonta*	None	Native	NA
Fabaceae	*Swainsona thompsoniana*	Priority 3 (DBCA)	Native	NA
Fabaceae	*Tephrosia densa*	None	Native	NA
Fabaceae	*Tephrosia rosea* var. *clementii*	None	Native	NA
Fabaceae	*Tephrosia rosea* var. Fortescue creeks (M.I.H. Brooker 2186)	None	Native	NA
Fabaceae	*Tephrosia* sp. Bungaroo Creek (M.E. Trudgen 11601)	None	Native	NA
Fabaceae	*Tephrosia* sp. clay soils (S. van Leeuwen et al. PBS 0273)	Other (Range Extension)	Native	NA
Fabaceae	*Tephrosia* sp. Newman (A.A.Mitchell PRP 29)	None	Native	NA
Fabaceae	*Tephrosia* sp. NW Eremaean (S. van Leeuwen et al. PBS 0356)	None	Native	NA
Fabaceae	*Tephrosia supina*	None	Native	NA
Fabaceae	*Tephrosia uniovulata*	None	Native	NA
Fabaceae	*Vachellia farnesiana*	None	Introduced	Permitted - s11
Fabaceae	*Vigna lanceolata* var. *lanceolata*	None	Native	NA
Fabaceae	*Vigna* sp. Hamersley Clay (A.A. Mitchell PRP 113)	None	Native	NA
Fabaceae	*Zornia albiflora*	None	Native	NA
Gentianaceae	*Schenkia clementii*	None	Native	NA
Goodeniaceae	*Dampiera candicans*	None	Native	NA
Goodeniaceae	*Goodenia ?tenuiloba*	None	Native	NA
Goodeniaceae	*Goodenia cusackiana*	None	Native	NA
Goodeniaceae	*Goodenia forrestii*	None	Native	NA
Goodeniaceae	*Goodenia lamprosperma*	None	Native	NA
Goodeniaceae	*Goodenia microptera*	None	Native	NA
Goodeniaceae	*Goodenia muelleriana*	None	Native	NA
Goodeniaceae	*Goodenia nuda*	None	Native	NA
Goodeniaceae	*Goodenia prostrata*	None	Native	NA
Goodeniaceae	*Goodenia stobbsiana*	None	Native	NA
Goodeniaceae	*Goodenia triodiophila*	None	Native	NA
Goodeniaceae	*Scaevola amblyanthera* var. *centralis*	None	Native	NA
Goodeniaceae	*Scaevola browniana* subsp. *browniana*	None	Native	NA
Goodeniaceae	*Scaevola spinescens*	None	Native	NA
Gyrostemonaceae	*Codonocarpus cotinifolius*	None	Native	NA
Haloragaceae	*Gonocarpus ephemerus*	None	Native	NA
Haloragaceae	*Haloragis maierae*	None	Native	NA
Haloragaceae	*Haloragis trigonocarpa*	None	Native	NA
Hydrocharitaceae	*Najas* sp.	None	Native	NA
Lamiaceae	*Basilicum polystachyon*	None	Native	NA
Lamiaceae	*Clerodendrum floribundum* var. *angustifolium*	None	Native	NA

Family	Name	Conservation status	Naturalised status	WAOL Status
Lamiaceae	*Clerodendrum tomentosum* var. *lanceolatum*	None	Native	NA
Lamiaceae	*Prostanthera albiflora*	None	Native	NA
Lamiaceae	*Quoya zonalis*	Endangered (EN)	Native	NA
Lamiaceae	*Teucrium teucriiflorum*	None	Native	NA
Lauraceae	*Cassytha capillaris*	None	Native	NA
Loranthaceae	*?Amyema benthamii*	None	Native	NA
Loranthaceae	*Amyema ?sanguinea*	None	Native	NA
Loranthaceae	*Amyema preissii*	None	Native	NA
Lythraceae	*Ammannia baccifera*	None	Native	NA
Lythraceae	*Ammannia multiflora*	None	Native	NA
Lythraceae	*Rotala diandra*	None	Native	NA
Malvaceae	*Abutilon ?amplum*	None	Native	NA
Malvaceae	*Abutilon cunninghamii*	None	Native	NA
Malvaceae	*Abutilon fraseri subsp. fraseri*	None	Native	NA
Malvaceae	*Abutilon lepidum*	None	Native	NA
Malvaceae	*Abutilon macrum*	None	Native	NA
Malvaceae	*Abutilon malvifolium*	None	Native	NA
Malvaceae	*Abutilon otocarpum*	None	Native	NA
Malvaceae	*Abutilon oxycarpum* subsp. Prostrate (A.A. Mitchell PRP 1266)	None	Native	NA
Malvaceae	*Abutilon* sp. Dioicum (A.A. Mitchell PRP 1618)	None	Native	NA
Malvaceae	*Androcalva luteiflora*	None	Native	NA
Malvaceae	*Corchorus incanus*	None	Native	NA
Malvaceae	*Corchorus lasiocarpus* subsp. *lasiocarpus*	None	Native	NA
Malvaceae	*Corchorus lasiocarpus* subsp. *parvus*	None	Native	NA
Malvaceae	*Corchorus parviflorus*	None	Native	NA
Malvaceae	*Corchorus sidoides* subsp. *vermicularis*	None	Native	NA
Malvaceae	*Corchorus* sp. Yarrie (J. Bull & D. Roberts CAL 01.05)	Priority 1 (DBCA)	Native	NA
Malvaceae	*Corchorus tridens*	None	Native	NA
Malvaceae	*Corchorus trilocularis*	None	Native	NA
Malvaceae	*Corchorus walcottii*	None	Native	NA
Malvaceae	*Gossypium australe*	None	Native	NA
Malvaceae	*Gossypium robinsonii*	None	Native	NA
Malvaceae	*Hibiscus austrinus* var. *austrinus*	None	Native	NA
Malvaceae	*Hibiscus brachysiphonius*	None	Native	NA
Malvaceae	*Hibiscus burtonii*	None	Native	NA
Malvaceae	*Hibiscus coatesii*	None	Native	NA
Malvaceae	*Hibiscus goldsworthii*	None	Native	NA
Malvaceae	*Hibiscus leptocladus*	None	Native	NA

Family	Name	Conservation status	Naturalised status	WAOL Status
Malvaceae	*Hibiscus sturtii* var. *campylochlamys*	None	Native	NA
Malvaceae	*Hibiscus sturtii* var. *grandiflorus*	None	Native	NA
Malvaceae	*Hibiscus sturtii* var. *platychlamys*	None	Native	NA
Malvaceae	*Hibiscus verdcourtii*	None	Native	NA
Malvaceae	*Lawrencia densiflora*	None	Native	NA
Malvaceae	*Malvastrum americanum*	None	Introduced	Permitted - s11
Malvaceae	*Melhania oblongifolia*	None	Native	NA
Malvaceae	*Seringia exastia*	None	Native	NA
Malvaceae	*Seringia nephrosperma*	None	Native	NA
Malvaceae	Sida ?sp. Golden calyces glabrous (H.N. Foote 32)	None	Native	NA
Malvaceae	*Sida* ?sp. L (A.M. Ashby 4202)	None	Native	NA
Malvaceae	*Sida arenicola*	None	Native	NA
Malvaceae	*Sida arsiniata*	None	Native	NA
Malvaceae	*Sida brownii*	None	Native	NA
Malvaceae	*Sida cardiophylla*	None	Native	NA
Malvaceae	*Sida clementii*	None	Native	NA
Malvaceae	*Sida echinocarpa*	None	Native	NA
Malvaceae	*Sida ectogama*	None	Native	NA
Malvaceae	*Sida fibulifera*	None	Native	NA
Malvaceae	*Sida platycalyx*	None	Native	NA
Malvaceae	*Sida rohlenae* subsp. *rohlenae*	None	Native	NA
Malvaceae	*Sida* sp. dark green fruits (S. van Leeuwen 2260)	None	Native	NA
Malvaceae	*Sida* sp. Excedentifolia (J.L. Egan 1925)	None	Native	NA
Malvaceae	*Sida* sp. Pilbara (A.A. Mitchell PRP 1543)	None	Native	NA
Malvaceae	*Sida* sp. spiciform panicles (E. Leyland s.n. 14/8/90)	None	Native	NA
Malvaceae	*Sida spinosa*	None	Native	NA
Malvaceae	*Sida trichopoda*	None	Native	NA
Malvaceae	*Triumfetta chaetocarpa*	None	Native	NA
Malvaceae	*Triumfetta clementii*	None	Native	NA
Malvaceae	*Triumfetta maconochieana*	None	Native	NA
Malvaceae	*Waltheria indica*	None	Native	NA
Malvaceae	*Waltheria virgata*	None	Native	NA
Marsileaceae	*Marsilea exarata*	None	Native	NA
Marsileaceae	*Marsilea hirsuta*	None	Native	NA
Menispermaceae	*Tinospora smilacina*	None	Native	NA
Molluginaceae	*Trigastrotheca molluginea*	None	Native	NA
Montiaceae	*Calandrinia ?stagnensis*	None	Native	NA
Montiaceae	*Calandrinia balonensis*	Other (Range Extension)	Native	NA

Family	Name	Conservation status	Naturalised status	WAOL Status
Montiaceae	*Calandrinia pentavalvis*	None	Native	NA
Moraceae	*Ficus brachypoda*	None	Native	NA
Myrtaceae	*Calytrix carinata*	None	Native	NA
Myrtaceae	*Corymbia ?ferriticola*	None	Native	NA
Myrtaceae	*Corymbia candida* subsp. *candida*	None	Native	NA
Myrtaceae	*Corymbia hamersleyana*	None	Native	NA
Myrtaceae	*Eucalyptus camaldulensis* subsp. *refulgens*	None	Native	NA
Myrtaceae	*Eucalyptus leucophloia* subsp. *leucophloia*	None	Native	NA
Myrtaceae	*Eucalyptus socialis* subsp. *eucentrica*	None	Native	NA
Myrtaceae	*Eucalyptus victrix*	None	Native	NA
Myrtaceae	*Eucalyptus xerothermica*	None	Native	NA
Myrtaceae	*Melaleuca argentea*	None	Native	NA
Myrtaceae	*Melaleuca bracteata*	None	Native	NA
Myrtaceae	*Melaleuca eleuterostachya*	None	Native	NA
Myrtaceae	*Melaleuca glomerata*	None	Native	NA
Myrtaceae	*Melaleuca linophylla*	None	Native	NA
Nyctaginaceae	*Boerhavia burbidgeana*	None	Native	NA
Nyctaginaceae	*Boerhavia coccinea*	None	Native	NA
Nyctaginaceae	*Boerhavia gardneri*	None	Native	NA
Nyctaginaceae	*Boerhavia paludosa*	None	Native	NA
Nyctaginaceae	*Boerhavia schomburgkiana*	None	Native	NA
Nyctaginaceae	*Commicarpus australis*	None	Native	NA
Oleaceae	*Jasminum didymum* subsp. *lineare*	None	Native	NA
Onagraceae	*Ludwigia perennis*	None	Native	NA
Orobanchaceae	*Striga ?squamigera*	None	Native	NA
Papaveraceae	*Argemone ochroleuca* subsp. *ochroleuca*	None	Introduced	Permitted - s11
Pedaliaceae	*Josephinia eugeniae*	None	Native	NA
Phrymaceae	*Mimulus gracilis*	None	Native	NA
Phrymaceae	*Peplidium* sp. E Evol. Fl. Fauna Arid Aust. (A.S. Weston 12768)	None	Native	NA
Phyllanthaceae	*Cathetus exilis*	None	Native	NA
Phyllanthaceae	*Dendrophyllanthus erwinii*	None	Native	NA
Phyllanthaceae	*Flueggea virosa* subsp. *melanthesoides*	None	Native	NA
Phyllanthaceae	*Nellica maderaspatensis*	None	Native	NA
Phyllanthaceae	*Notoleptopus decaisnei*	None	Native	NA
Plantaginaceae	*Stemodia grossa*	None	Native	NA
Plantaginaceae	*Stemodia* sp. Battle Hill (A.L. Payne 1006)	Priority 1 (DBCA)	Native	NA
Plantaginaceae	*Stemodia viscosa*	None	Native	NA
Plumbaginaceae	*Plumbago zeylanica*	None	Native	NA

Family	Name	Conservation status	Naturalised status	WAOL Status
Poaceae	*Amphipogon sericeus*	None	Native	NA
Poaceae	*Aristida burbidgeae*	None	Native	NA
Poaceae	*Aristida contorta*	None	Native	NA
Poaceae	*Aristida holathera* var. *holathera*	None	Native	NA
Poaceae	*Aristida inaequiglumis*	None	Native	NA
Poaceae	*Aristida latifolia*	None	Native	NA
Poaceae	*Astrebla elymoides*	None	Native	NA
Poaceae	*Astrebla pectinata*	None	Native	NA
Poaceae	*Bothriochloa ewartiana*	None	Native	NA
Poaceae	*Cenchrus ciliaris*	None	Introduced	Permitted - s11
Poaceae	*Cenchrus setiger*	None	Introduced	Permitted - s11
Poaceae	*Chloris pectinata*	None	Native	NA
Poaceae	*Chrysopogon fallax*	None	Native	NA
Poaceae	*Cymbopogon ambiguus*	None	Native	NA
Poaceae	*Cymbopogon obtectus*	None	Native	NA
Poaceae	*Cynodon convergens*	None	Native	NA
Poaceae	*Cynodon dactylon*	Other (Range Extension)	Introduced	Permitted - s11
Poaceae	*Cynodon prostratus*	None	Native	NA
Poaceae	*Dactyloctenium radulans*	None	Native	NA
Poaceae	*Dichanthium sericeum* subsp. *humilius*	None	Native	NA
Poaceae	*Digitaria brownii*	None	Native	NA
Poaceae	*Digitaria ctenantha*	None	Native	NA
Poaceae	*Diplachne fusca* subsp. *muelleri*	None	Native	NA
Poaceae	*Echinochloa colona*	None	Introduced	Permitted - s11
Poaceae	*Elytrophorus spicatus*	None	Native	NA
Poaceae	*Enneapogon caerulescens*	None	Native	NA
Poaceae	*Enneapogon lindleyanus*	None	Native	NA
Poaceae	*Enneapogon polyphyllus*	None	Native	NA
Poaceae	*Enteropogon ramosus*	None	Native	NA
Poaceae	*Eragrostis cumingii*	None	Native	NA
Poaceae	*Eragrostis desertorum*	None	Native	NA
Poaceae	*Eragrostis dielsii*	None	Native	NA
Poaceae	*Eragrostis eriopoda*	None	Native	NA
Poaceae	*Eragrostis exigua*	Other (Range Extension)	Native	NA
Poaceae	*Eragrostis leptocarpa*	None	Native	NA
Poaceae	*Eragrostis setifolia*	None	Native	NA
Poaceae	*Eragrostis tenellula*	None	Native	NA
Poaceae	*Eragrostis xerophila*	None	Native	NA

Family	Name	Conservation status	Naturalised status	WAOL Status
Poaceae	*Eriachne aristidea*	None	Native	NA
Poaceae	*Eriachne benthamii*	None	Native	NA
Poaceae	*Eriachne ciliata*	None	Native	NA
Poaceae	*Eriachne flaccida*	None	Native	NA
Poaceae	*Eriachne lanata*	None	Native	NA
Poaceae	*Eriachne mucronata*	None	Native	NA
Poaceae	*Eriachne obtusa*	None	Native	NA
Poaceae	*Eriachne pulchella* subsp. *dominii*	None	Native	NA
Poaceae	*Eriachne pulchella* subsp. *pulchella*	None	Native	NA
Poaceae	*Eriachne tenuiculmis*	None	Native	NA
Poaceae	*Eulalia aurea*	None	Native	NA
Poaceae	*Heteropogon contortus*	None	Native	NA
Poaceae	*Ischaemum albovillosum*	None	Native	NA
Poaceae	*Iseilema dolichotrichum*	None	Native	NA
Poaceae	*Iseilema eremaeum*	None	Native	NA
Poaceae	*Iseilema membranaceum*	None	Native	NA
Poaceae	*Iseilema vaginiflorum*	None	Native	NA
Poaceae	*Panicum australiense* var. *australiense*	None	Native	NA
Poaceae	*Panicum decompositum*	None	Native	NA
Poaceae	*Panicum effusum*	None	Native	NA
Poaceae	*Panicum laevinode*	None	Native	NA
Poaceae	*Paraneurachne muelleri*	None	Native	NA
Poaceae	*Paspalidium basicladum*	None	Native	NA
Poaceae	*Paspalidium clementii*	None	Native	NA
Poaceae	*Paspalidium rarum*	None	Native	NA
Poaceae	*Paspalidium retiglume*	Priority 2 (DBCA)	Native	NA
Poaceae	*Perotis rara*	None	Native	NA
Poaceae	*Schizachyrium fragile*	None	Native	NA
Poaceae	*Setaria verticillata*	None	Introduced	Permitted - s11
Poaceae	*Sporobolus actinocladus*	None	Native	NA
Poaceae	*Sporobolus australasicus*	None	Native	NA
Poaceae	*Themeda triandra*	None	Native	NA
Poaceae	*Triodia basedowii*	None	Native	NA
Poaceae	*Triodia brizoides*	None	Native	NA
Poaceae	*Triodia epactia*	None	Native	NA
Poaceae	*Triodia longiceps*	None	Native	NA
Poaceae	*Triodia scintillans*	None	Native	NA
Poaceae	*Triodia wiseana*	None	Native	NA

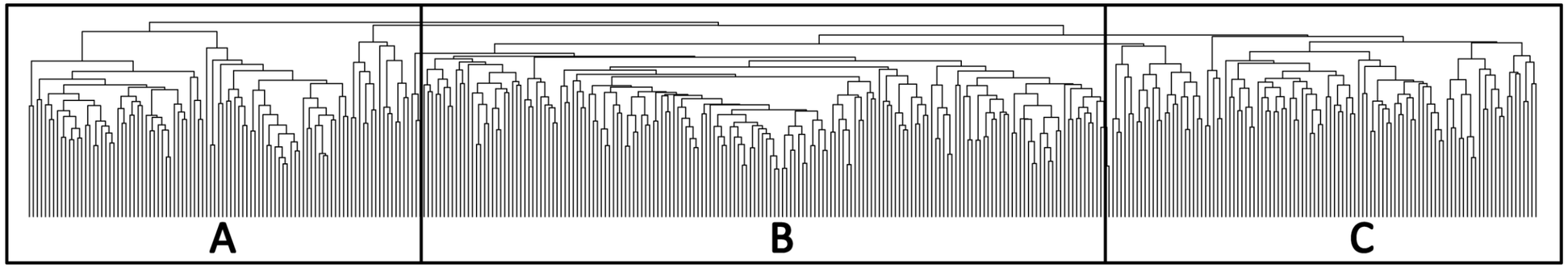
Family	Name	Conservation status	Naturalised status	WAOL Status
Poaceae	*Tripogonella loliiformis*	None	Native	NA
Poaceae	*Urochloa holosericea* subsp. *velutina*	None	Native	NA
Poaceae	*Urochloa occidentalis* var. *occidentalis*	None	Native	NA
Polygalaceae	*Polygala glaucifolia*	None	Native	NA
Portulacaceae	*Portulaca conspicua*	None	Native	NA
Portulacaceae	*Portulaca cyclophylla*	None	Native	NA
Portulacaceae	*Portulaca filifolia*	None	Native	NA
Portulacaceae	*Portulaca oleracea*	None	Native	NA
Potamogetonaceae	*Potamogeton tepperi*	None	Native	NA
Proteaceae	*Grevillea berryana*	None	Native	NA
Proteaceae	*Grevillea pyramidalis* subsp. *leucadendron*	None	Native	NA
Proteaceae	*Grevillea wickhamii* subsp. *aprica*	None	Native	NA
Proteaceae	*Grevillea wickhamii* subsp. *hispidula*	None	Native	NA
Proteaceae	*Hakea chordophylla*	None	Native	NA
Proteaceae	*Hakea lorea* subsp. *lorea*	None	Native	NA
Pteridaceae	*Cheilanthes brownii*	None	Native	NA
Pteridaceae	*Cheilanthes sieberi* subsp. *sieberi*	None	Native	NA
Rubiaceae	*Dolichocarpa crouchiana*	None	Native	NA
Rubiaceae	*Dolichocarpa* sp. Hamersley Station (A.A. Mitchell PRP 1479)	Priority 3 (DBCA)	Native	NA
Rubiaceae	*Psydrax latifolia*	None	Native	NA
Rubiaceae	*Psydrax suaveolens*	None	Native	NA
Rubiaceae	*Scleromitrion galioides*	None	Native	NA
Rubiaceae	*Synaptantha tillaeacea* var. *tillaeacea*	None	Native	NA
Santalaceae	*Anthobolus leptomerioides*	None	Native	NA
Santalaceae	*Santalum lanceolatum*	None	Native	NA
Sapindaceae	*Atalaya hemiglauca*	None	Native	NA
Sapindaceae	*Dodonaea coriacea*	None	Native	NA
Sapindaceae	*Dodonaea lanceolata* var. *lanceolata*	None	Native	NA
Sapindaceae	*Dodonaea petiolaris*	None	Native	NA
Scrophulariaceae	*Eremophila cuneifolia*	None	Native	NA
Scrophulariaceae	*Eremophila exilifolia*	None	Native	NA
Scrophulariaceae	*Eremophila forrestii* subsp. *forrestii*	None	Native	NA
Scrophulariaceae	*Eremophila latrobei* subsp. *filiformis*	None	Native	NA
Scrophulariaceae	*Eremophila latrobei* subsp. *glabra*	None	Native	NA
Scrophulariaceae	*Eremophila latrobei* subsp. *latrobei*	None	Native	NA
Scrophulariaceae	*Eremophila longifolia*	None	Native	NA
Solanaceae	*Nicotiana benthamiana*	None	Native	NA
Solanaceae	*Nicotiana obliqua/occidentalis*	None	Native	NA

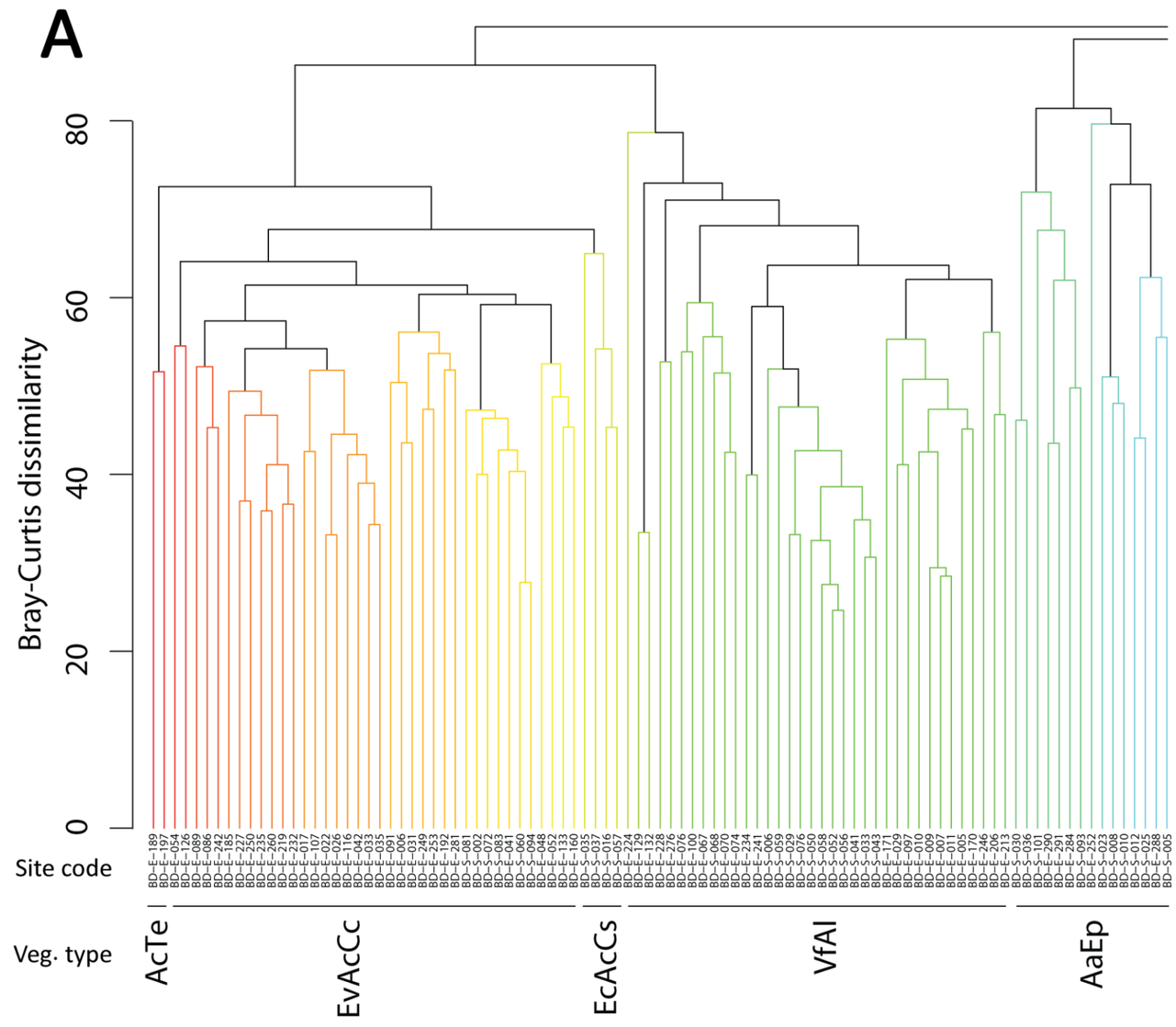
Family	Name	Conservation status	Naturalised status	WAOL Status
Solanaceae	*Nicotiana umbratica*	Priority 3 (DBCA)	Native	NA
Solanaceae	*Physalis angulata*	None	Introduced	Permitted - s11
Solanaceae	*Solanum* aff. *esuriale*	Other (Anomalous features)	Native	NA
Solanaceae	*Solanum* aff. *horridum*	Other (Anomalous features)	Native	NA
Solanaceae	*Solanum chippendalei*	None	Native	NA
Solanaceae	*Solanum cleistogamum*	None	Native	NA
Solanaceae	*Solanum diversiflorum*	None	Native	NA
Solanaceae	*Solanum elatius*	None	Native	NA
Solanaceae	*Solanum gabrielae*	None	Native	NA
Solanaceae	*Solanum horridum*	None	Native	NA
Solanaceae	*Solanum lasiophyllum*	None	Native	NA
Solanaceae	*Solanum nigrum*	None	Introduced	Permitted - s11
Solanaceae	*Solanum phlomoides*	None	Native	NA
Violaceae	*Afrohybanthus aurantiacus*	None	Native	NA
Zygophyllaceae	*Tribulopis angustifolia*	None	Native	NA
Zygophyllaceae	*Tribulus astrocarpus*	None	Native	NA
Zygophyllaceae	*Tribulus hirsutus*	None	Native	NA
Zygophyllaceae	*Tribulus platypterus*	None	Native	NA
Zygophyllaceae	*Tribulus suberosus*	None	Native	NA
Zygophyllaceae	*Tribulus terrestris*	None	Introduced	Permitted - s11

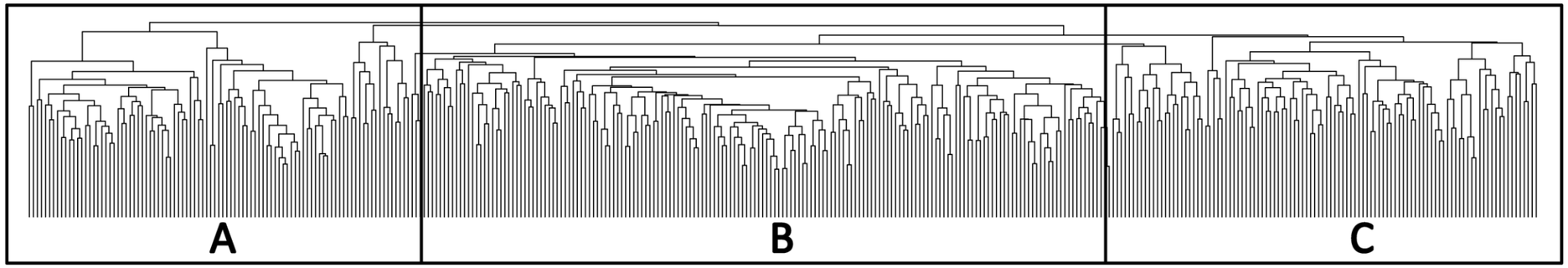
Names amalgamated for vegetation classification.

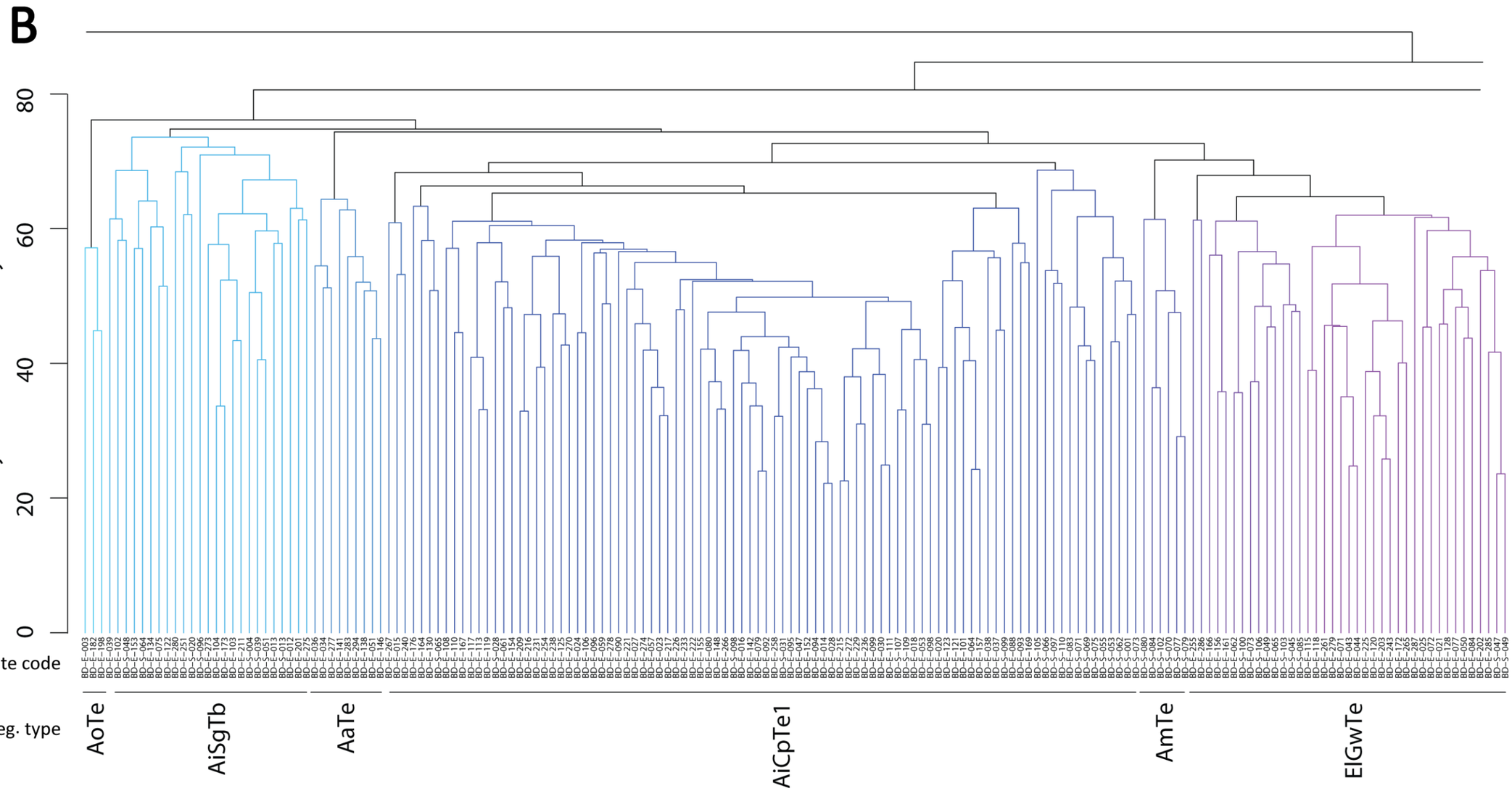
Analysis name	Included taxa	Justification for amalgamation
Alternanthera denticulata/nodiflora	See analysis name	Includes records that could not be adequately identified to either taxon.
Amaranthus undulatus/cuspidifolius	See analysis name	Includes records that could not be adequately identified to either taxon.
Bulbostylis barbata/turbinata	See analysis name	Includes records that could not be adequately identified to either taxon.
Cenchrus ciliaris/setiger	See analysis name	Includes records that could not be adequately identified to either taxon.
Corchorus tridens/trilocularis	See analysis name	Includes records that could not be adequately identified to either taxon.
Cullen leucochaites/lachnostachys	See analysis name	Includes records that could not be adequately identified to either taxon.
Dysphania kalpari/sphaerosperma	See analysis name	Includes records that could not be adequately identified to either taxon.
Eragrostis exigua/tenellula	See analysis name	Includes records that could not be adequately identified to either taxon.
Euphorbia australis/vaccaria	See analysis name	Includes records that could not be adequately identified to either taxon.
Euphorbia biconvexa/trigonosperma	See analysis name	Includes records that could not be adequately identified to either taxon.
Euphorbia boophthona/tannensis/stevenii	See analysis name	Includes records that could not be adequately identified to either taxon.
Euploca cunninghamii/tanythrix	See analysis name	Includes records that could not be adequately identified to either taxon.
Euploca pachyphylla/chrysocarpa	See analysis name	Includes records that could not be adequately identified to either taxon.
Grona filiformis/muelleri	See analysis name	Includes records that could not be adequately identified to either taxon.
Senna glaucifolia/symonii	See analysis name	Includes records that could not be adequately identified to either taxon.
Senna stricta/artemisioides subsp. x*luerssenii*	See analysis name	Includes records that could not be adequately identified to either taxon.
Seringia exastia/nephrosperma	See analysis name	Includes records that could not be adequately identified to either taxon.
Sida arsiniata/echinocarpa	See analysis name	Includes records that could not be adequately identified to either taxon.
Sida rohlenae/spinosa	See analysis name	Includes records that could not be adequately identified to either taxon.
Solanum cleistogamum/horridum	See analysis name	Includes records that could not be adequately identified to either taxon.
Solanum lasiophyllum/phlomoides	See analysis name	Includes records that could not be adequately identified to either taxon.
Tribulus hirsutus/terrestris	See analysis name	Includes records that could not be adequately identified to either taxon.
Acacia pyrifolia	Includes all infraspecific taxa	Infraspecific taxon could not always be adequately determined.
Clerodendrum floribundum	Includes all infraspecific taxa	Infraspecific taxon could not always be adequately determined.
Corchorus lasiocarpus	Includes all infraspecific taxa	Infraspecific taxon could not always be adequately determined.
Dichanthium sericeum	Includes all infraspecific taxa	Infraspecific taxon could not always be adequately determined.
Eremophila latrobei	Includes all infraspecific taxa	Infraspecific taxon could not always be adequately determined.
Eriachne pulchella	Includes all infraspecific taxa	Infraspecific taxon could not always be adequately determined.
Evolvulus alsinoides	Includes all infraspecific taxa	Infraspecific taxon could not always be adequately determined.
Grevillea wickhamii	Includes all infraspecific taxa	Infraspecific taxon could not always be adequately determined.
Hibiscus sturtii	Includes all infraspecific taxa	Infraspecific taxon could not always be adequately determined.
Rostellularia adscendens	Includes all infraspecific taxa	Infraspecific taxon could not always be adequately determined.
Crotalaria cunninghamii	Includes all infraspecific taxa	There are no confirmed records of subsp. *cunninghamii* in the Pilbara, and the SLR record could not be confirmed.
Senna artemisioides subsp. *oligophylla*	*S. artemisioides* subsp. *helmsii* x *oligophylla*	Possible hybrid. Assumed to be subsp. *oligophylla* for analysis.
Dolichocarpa crouchiana	Includes *Dolichocarpa* sp. Hamersley Station (A.A. Mitchell PRP 1479)	Taxon is questionably distinct from *D. crouchiana*. Treated as *D. crouchiana* for analysis.

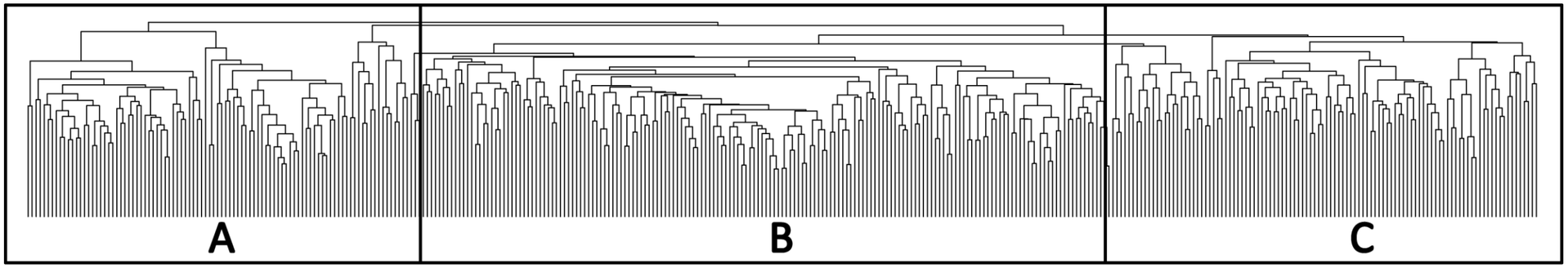
Appendix C UPGMA hierarchical agglomerative clustering dendrogram.

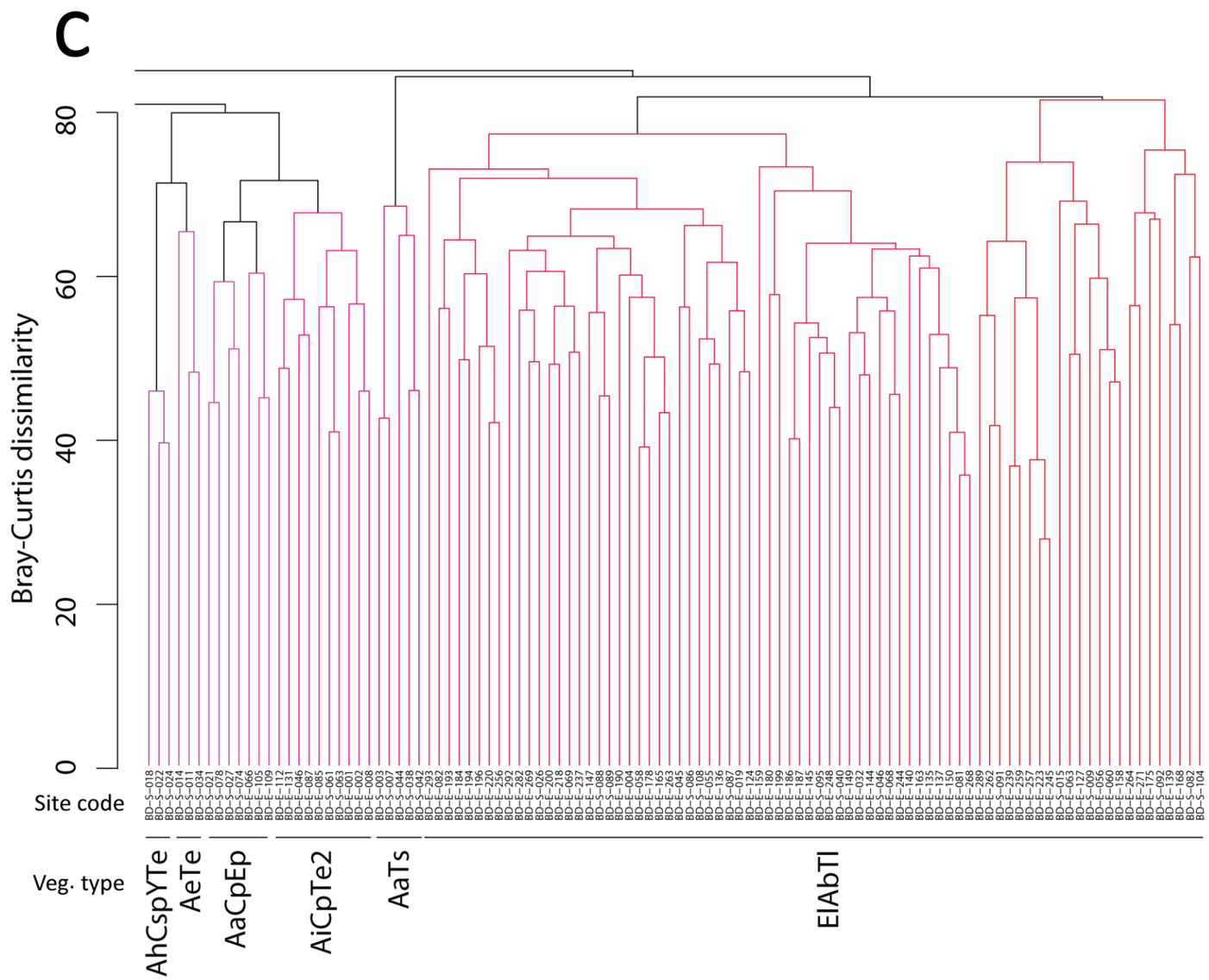

A
B
C


A
Bray-Curtis dissimilarity
0
20
40
60
80
Site code
Veg. type
AcTe
EvAcCc
EcAcCs
VfAl
AaEp


A
B
C


B
Bray-Curtis dissimilarity
0
20
40
60
80
Site code
Veg. type
AoTe
AiSgTb
AaTe
AiCpTe1
AmTe
ElGwTe


A
B
C


C
Bray-Curtis dissimilarity
0
20
40
60
80
Site code
Veg. type
AhCspYTe
AeTe
AaCpEp
AiCpTe2
AaTs
ElAbTl

Appendix D Species constancy within vegetation types.

Name	AaCpTw[1]	AaEp	AaTe	AaTs	AcTe	AeTe	AhCspYTe	AiCpTe1	AiCpTe2
?Amyema benthamii	–	–	–	–	–	–	–	–	–
?Glycine falcata	–	–	–	–	–	–	–	–	–
Abutilon ?amplum	–	–	–	–	–	–	–	–	–
Abutilon cunninghamii	–	13% (1.5)	–	–	–	–	–	–	–
Abutilon fraseri subsp. fraseri	–	7% (1.5)	–	–	–	–	–	–	–
Abutilon lepidum	14% (1.5)	20% (1.5)	11% (1.5)	–	–	–	–	2% (1.5)	10% (1.5)
Abutilon macrum	57% (1.5)	7% (1.5)	–	–	–	–	–	–	10% (1.5)
Abutilon malvifolium	–	–	–	–	–	–	–	–	–
Abutilon otocarpum	14% (1.5)	13% (1.5)	–	20% (1.5)	–	–	–	–	–
Abutilon oxycarpum subsp. Prostrate (A.A. Mitchell PRP 1266)	–	–	–	–	–	–	–	2% (1.5)	–
Abutilon sp. Dioicum (A.A. Mitchell PRP 1618)	29% (1.5)	13% (1.5)	–	–	–	–	100% (3.37)	1% (1.5)	30% (2.43)
Acacia acradenia	–	–	–	–	–	–	–	2% (2.9)	–
Acacia adoxa var. adoxa	–	–	–	–	–	–	–	–	–
Acacia adsurgens	–	–	11% (4.3)	–	–	–	–	1% (4.3)	–
Acacia ampliceps	–	–	–	–	–	–	–	–	–
Acacia ancistrocarpa	–	7% (1.5)	33% (9.97)	100% (5.7)	–	–	–	7% (3.25)	–
Acacia ancistrocarpa x monticola	–	–	–	–	–	–	–	–	–
Acacia aptaneura	100% (15.07)	100% (29.09)	67% (18.22)	60% (7.4)	–	–	33% (4.3)	4% (5.92)	10% (9.2)
Acacia arida	–	–	–	–	–	–	–	2% (2.9)	–
Acacia arrecta	–	–	–	–	–	–	–	–	–
Acacia ayersiana	–	7% (4.3)	11% (4.3)	–	–	–	–	–	–
Acacia bivenosa	14% (1.5)	27% (2.2)	89% (6.95)	80% (1.5)	–	67% (2.9)	–	20% (1.97)	30% (2.43)
Acacia catenulata subsp. occidentalis	–	13% (8.95)	–	–	–	–	–	–	–
Acacia colei var. colei	14% (1.5)	7% (1.5)	–	40% (1.5)	–	–	–	4% (1.5)	20% (1.5)
Acacia coriacea subsp. pendens	14% (1.5)	20% (1.5)	–	–	–	–	–	2% (1.5)	20% (10.35)
Acacia cyperophylla var. omearana	–	–	11% (4.3)	–	100% (9.2)	–	–	–	–
Acacia elachantha	–	–	–	–	–	–	–	–	–
Acacia eriopoda	–	–	–	40% (4.3)	–	100% (4.3)	67% (4.3)	1% (1.5)	–
Acacia inaequilatera	29% (4.3)	–	11% (1.5)	–	–	–	–	82% (4.54)	80% (6.14)
Acacia maitlandii	–	–	–	20% (1.5)	–	33% (1.5)	–	1% (4.3)	–
Acacia monticola	–	–	–	–	–	–	–	–	–
Acacia orthocarpa	–	–	–	–	–	–	–	4% (2.9)	–
Acacia pruinocarpa	14% (1.5)	67% (2.9)	89% (7.36)	40% (2.9)	–	–	–	8% (2.7)	–
Acacia ptychophylla	–	–	–	–	–	–	–	–	–
Acacia pyrifolia var. morrisonii	–	–	–	–	–	–	–	1% (1.5)	–
Acacia pyrifolia var. pyrifolia	–	–	11% (4.3)	–	–	–	–	4% (3.6)	–
Acacia sclerosperma subsp. sclerosperma	–	–	–	–	–	–	–	–	–
Acacia sibirica	–	–	–	–	–	–	–	–	–
Acacia spondylophylla	–	–	–	–	50% (1.5)	–	–	–	–
Acacia synchronicia	43% (2.43)	13% (5.35)	33% (5)	–	–	–	–	12% (4.36)	10% (4.3)
Acacia tenuissima	–	–	22% (6.75)	20% (1.5)	–	–	–	1% (1.5)	–
Acacia tetragonophylla	100% (3.4)	33% (2.62)	–	80% (1.5)	–	–	–	8% (2.3)	10% (1.5)
Acacia trachycarpa	–	–	–	–	–	–	–	4% (2.9)	–
Acacia tumida var. pilbarensis	–	–	11% (4.3)	–	100% (6.75)	–	–	–	–
Achyranthes aspera	–	–	–	–	–	–	–	1% (1.5)	–
Adriana tomentosa var. tomentosa	–	–	–	–	–	–	–	–	–
Aerva javanica	29% (1.5)	–	–	–	–	–	–	5% (1.5)	–
Afrohybanthus aurantiacus	14% (1.5)	20% (1.5)	11% (1.5)	–	100% (1.5)	67% (1.5)	33% (1.5)	4% (1.5)	10% (1.5)
Alternanthera denticulata var. denticulata	–	7% (1.5)	–	–	–	–	–	–	–
Alternanthera nana	–	27% (1.5)	11% (1.5)	–	50% (1.5)	–	–	–	–
Alternanthera nodiflora	–	–	–	–	–	–	–	–	–
Alysicarpus muelleri	29% (1.5)	–	–	–	–	–	–	8% (1.5)	30% (1.5)
Amaranthus cuspidifolius	14% (1.5)	–	–	–	–	–	33% (1.5)	–	–
Amaranthus undulatus	–	7% (1.5)	–	–	–	–	–	–	10% (1.5)
Ammannia baccifera	–	–	–	–	–	–	–	–	–

Name	AaCpTw[1]	AaEp	AaTe	AaTs	AcTe	AeTe	AhCspYTe	AiCpTe1	AiCpTe2
Ammannia multiflora	–	7% (1.5)	–	–	–	–	–	–	–
Amphipogon sericeus	–	–	11% (1.5)	–	–	–	–	1% (4.3)	–
Amyema ?sanguinea	–	–	–	–	–	–	–	–	–
Amyema preissii	–	–	–	–	–	–	–	1% (1.5)	–
Androcalva luteiflora	–	–	11% (1.5)	–	–	–	–	–	–
Anthobolus leptomerioides	–	13% (2.9)	22% (1.5)	–	–	–	–	–	–
Areocleome oxalidea	–	7% (1.5)	–	–	–	–	–	–	–
Argemone ochroleuca subsp. ochroleuca	–	–	–	–	–	–	–	–	–
Aristida burbidgeae	–	–	–	–	–	–	33% (1.5)	–	–
Aristida contorta	86% (5.27)	33% (3.04)	44% (1.5)	20% (1.5)	–	33% (1.5)	–	29% (2.69)	90% (2.43)
Aristida holathera var. holathera	–	–	11% (1.5)	–	–	67% (1.5)	–	1% (4.3)	20% (1.5)
Aristida inaequiglumis	–	13% (1.5)	11% (4.3)	–	–	–	–	–	–
Aristida latifolia	–	–	–	–	–	–	–	2% (1.5)	10% (4.3)
Arivela uncifera	–	–	–	–	–	–	–	1% (1.5)	–
Arivela viscosa	29% (1.5)	27% (4.12)	11% (1.5)	–	100% (2.9)	33% (1.5)	67% (1.5)	20% (1.5)	40% (1.5)
Astrebla elymoides	–	–	–	–	–	–	–	–	–
Astrebla pectinata	–	–	–	–	–	–	–	–	–
Atalaya hemiglauca	14% (1.5)	7% (1.5)	–	–	50% (4.3)	–	100% (1.5)	1% (9.2)	20% (4.3)
Austrobryonia pilbarensis	–	–	–	–	–	–	–	–	–
Basilicum polystachyon	–	–	–	–	–	–	–	–	–
Bergia pedicellaris	–	–	–	–	–	–	–	–	–
Bergia trimera	–	–	–	–	–	–	–	–	–
Bidens bipinnata	29% (1.5)	40% (4.07)	–	40% (1.5)	–	33% (4.3)	–	–	–
Blumea tenella	–	–	–	–	–	–	–	–	–
Boerhavia burbidgeana	–	–	–	–	50% (1.5)	–	–	1% (1.5)	–
Boerhavia coccinea	29% (1.5)	20% (1.5)	–	20% (1.5)	50% (1.5)	–	33% (1.5)	8% (1.5)	50% (2.06)
Boerhavia gardneri	14% (1.5)	–	–	–	–	–	–	14% (1.5)	20% (2.9)
Boerhavia paludosa	–	–	–	–	–	–	–	–	10% (1.5)
Boerhavia schomburgkiana	–	–	–	–	–	–	–	–	–
Bonamia erecta	–	–	–	40% (1.5)	–	–	–	–	–
Bonamia media	–	–	–	–	–	–	–	–	–
Bonamia pannosa	–	–	–	20% (1.5)	–	33% (1.5)	–	–	10% (1.5)
Bonamia pilbarensis	57% (1.5)	–	11% (1.5)	40% (1.5)	50% (1.5)	33% (1.5)	–	55% (1.55)	70% (1.9)
Bothriochloa ewartiana	–	–	–	–	–	–	–	–	–
Bulbostylis barbata	14% (1.5)	7% (1.5)	–	–	–	67% (1.5)	33% (1.5)	3% (1.5)	–
Bulbostylis burbidgeae	–	–	–	–	–	–	100% (1.5)	–	–
Bulbostylis turbinata	–	–	–	–	–	–	–	4% (4.12)	10% (1.5)
Calandrinia ?stagnensis	–	7% (1.5)	–	–	–	–	–	–	–
Calandrinia balonensis	–	–	–	–	–	–	–	–	–
Calocephalus knappii	14% (1.5)	–	–	–	–	–	–	1% (1.5)	–
Calotropis procera	–	–	–	–	–	–	–	–	–
Capparis lasiantha	–	–	11% (4.3)	–	–	–	–	–	–
Capparis spinosa subsp. nummularia	–	–	–	–	–	–	–	–	10% (1.5)
Capparis umbonata	–	–	–	40% (2.9)	–	–	–	1% (1.5)	–
Carissa lanceolata	29% (1.5)	–	–	–	–	–	–	–	–
Cassytha capillaris	–	–	–	20% (1.5)	–	33% (1.5)	–	–	–
Cathetus exilis	–	–	–	–	100% (1.5)	–	–	–	–
Cenchrus ciliaris	14% (1.5)	33% (12.58)	–	40% (1.5)	50% (4.3)	–	33% (1.5)	11% (2.06)	50% (8.12)
Cenchrus setiger	43% (2.43)	27% (13.95)	–	–	–	–	–	9% (1.85)	40% (6.05)
Centipeda minima subsp. macrocephala	–	7% (1.5)	–	–	–	–	–	–	–
Cheilanthes brownii	–	–	–	–	–	33% (1.5)	67% (1.5)	–	–
Cheilanthes sieberi subsp. sieberi	57% (1.5)	33% (1.5)	11% (1.5)	20% (1.5)	–	–	–	–	–
Chenopodium murale	–	–	–	–	–	–	–	–	–
Chloris pectinata	14% (1.5)	7% (1.5)	–	–	–	–	–	–	20% (1.5)
Chrysopogon fallax	43% (1.5)	13% (1.5)	–	20% (1.5)	–	–	–	1% (1.5)	10% (1.5)

Name	AaCpTw[1]	AaEp	AaTe	AaTs	AcTe	AeTe	AhCspYTe	AiCpTe1	AiCpTe2
Citrullus amarus	–	–	–	–	–	–	–	–	–
Citrullus colocynthis	–	–	–	–	–	–	–	–	–
Clerodendrum floribundum var. angustifolium	–	–	–	–	–	–	–	–	–
Clerodendrum tomentosum var. lanceolatum	–	–	–	–	–	–	–	1% (1.5)	–
Commelina ensifolia	–	7% (1.5)	–	–	–	–	–	–	–
Commicarpus australis	–	–	–	–	–	–	–	–	–
Corchorus incanus	–	–	11% (1.5)	–	–	–	–	3% (1.5)	10% (1.5)
Corchorus lasiocarpus subsp. lasiocarpus	14% (1.5)	–	–	–	–	33% (1.5)	–	5% (1.5)	–
Corchorus lasiocarpus subsp. parvus	–	–	–	–	–	–	–	8% (1.5)	–
Corchorus parviflorus	100% (1.5)	33% (2.06)	–	40% (1.5)	–	67% (1.5)	–	46% (2.32)	90% (5.51)
Corchorus sidoides subsp. vermicularis	–	–	–	20% (1.5)	–	–	–	–	–
Corchorus sp. Yarrie (J. Bull & D. Roberts CAL 01.05)	–	–	–	–	–	–	100% (4.3)	–	–
Corchorus tridens	29% (1.5)	13% (1.5)	–	–	50% (1.5)	33% (1.5)	–	–	–
Corchorus trilocularis	14% (1.5)	–	–	–	–	–	–	–	10% (1.5)
Corchorus walcottii	–	–	–	–	–	–	–	–	–
Corymbia ?ferriticola	–	–	–	–	–	–	–	–	–
Corymbia candida subsp. candida	–	20% (3.37)	–	–	50% (4.3)	–	–	–	–
Corymbia hamersleyana	–	–	–	20% (1.5)	–	–	–	25% (2.84)	20% (1.5)
Crotalaria cunninghamii subsp. cunninghamii	–	–	–	–	–	–	–	–	–
Crotalaria cunninghamii subsp. sturtii	–	–	–	–	–	–	–	–	–
Crotalaria dissitiflora subsp. benthamiana	–	–	–	–	–	–	–	–	–
Crotalaria medicaginea var. neglecta	–	20% (1.5)	–	–	50% (1.5)	–	–	7% (1.5)	40% (1.5)
Cucumis melo	–	20% (1.5)	–	–	–	–	–	–	10% (1.5)
Cucumis myriocarpus subsp. myriocarpus	–	–	–	–	–	–	–	–	–
Cucumis variabilis	43% (1.5)	27% (1.5)	22% (1.5)	–	–	33% (1.5)	67% (1.5)	14% (1.5)	40% (1.5)
Cullen ?lachnostachys	–	–	–	–	–	–	–	–	–
Cullen graveolens	–	–	–	–	–	–	–	–	–
Cullen leucanthum	–	–	–	–	–	–	–	–	20% (1.5)
Cullen leucochaites	–	–	–	–	–	–	–	–	–
Cullen pustulatum	–	–	–	–	–	–	–	1% (1.5)	–
Cymbopogon ambiguus	43% (2.43)	20% (1.5)	44% (2.2)	20% (1.5)	50% (4.3)	–	100% (2.43)	14% (1.93)	50% (1.5)
Cymbopogon obtectus	–	–	–	–	–	–	–	1% (4.3)	–
Cynanchum floribundum	–	–	–	–	–	–	33% (1.5)	–	–
Cynanchum viminale	–	–	11% (1.5)	–	–	–	–	1% (1.5)	–
Cynodon convergens	–	–	–	–	–	–	33% (1.5)	1% (1.5)	–
Cynodon dactylon	–	–	–	–	–	–	–	–	–
Cynodon prostratus	–	–	–	–	–	–	–	1% (1.5)	–
Cyperus bifax	–	–	–	–	–	–	–	–	–
Cyperus cunninghamii subsp. cunninghamii	–	–	–	–	–	–	33% (1.5)	–	–
Cyperus difformis	–	7% (1.5)	–	–	–	–	–	–	–
Cyperus hesperius	–	–	–	–	50% (1.5)	–	–	–	–
Cyperus iria	–	7% (1.5)	–	–	–	33% (1.5)	–	–	–
Cyperus ixiocarpus	–	–	–	–	–	33% (1.5)	–	–	–
Cyperus squarrosus	–	–	–	–	–	33% (1.5)	–	–	–
Cyperus vaginatus	–	13% (1.5)	–	–	50% (1.5)	–	–	–	20% (1.5)
Dactyloctenium radulans	–	20% (2.43)	–	–	50% (1.5)	33% (1.5)	–	2% (1.5)	20% (1.5)
Dampiera candicans	–	–	–	60% (1.5)	–	67% (1.5)	–	2% (1.5)	10% (1.5)
Dendrophyllanthus erwinii	–	–	–	–	–	33% (1.5)	–	–	–
Desmodiopsis campylocaulon	–	–	–	–	–	–	–	–	–
Dichanthium sericeum subsp. humilius	–	13% (1.5)	–	–	–	–	–	1% (1.5)	10% (1.5)
Dicladanthera forrestii	–	7% (1.5)	–	–	–	–	–	–	–
Digitaria brownii	–	–	–	20% (1.5)	–	–	33% (1.5)	–	–
Digitaria ctenantha	14% (1.5)	–	–	–	–	–	–	–	–
Diplachne fusca subsp. muelleri	–	–	–	–	–	–	–	–	–
Dodonaea coriacea	–	–	–	40% (1.5)	–	–	–	1% (1.5)	–

Name	AaCpTw[1]	AaEp	AaTe	AaTs	AcTe	AeTe	AhCspYTe	AiCpTe1	AiCpTe2
Dodonaea lanceolata var. lanceolata	–	–	–	–	–	–	–	–	–
Dodonaea petiolaris	–	27% (16.62)	22% (2.9)	–	–	–	–	–	–
Dolichocarpa crouchiana	–	–	–	–	–	–	–	1% (1.5)	10% (1.5)
Dolichocarpa sp. Hamersley Station (A.A. Mitchell PRP 1479)	–	–	–	–	–	–	–	–	–
Duperreya commixta	29% (1.5)	40% (1.5)	67% (1.5)	–	–	–	–	–	–
Dysphania kalpari	–	7% (1.5)	–	–	–	–	–	–	–
Dysphania melanocarpa forma melanocarpa	–	–	–	–	–	–	–	1% (1.5)	–
Dysphania rhadinostachya subsp. rhadinostachya	–	–	–	–	–	–	–	–	20% (1.5)
Dysphania sphaerosperma	–	–	11% (1.5)	–	–	–	–	–	–
Echinochloa colona	–	7% (1.5)	–	–	–	–	–	–	–
Ehretia saligna var. saligna	–	–	–	–	–	–	–	1% (4.3)	–
Enchylaena tomentosa var. tomentosa	29% (1.5)	13% (1.5)	11% (1.5)	–	–	–	–	–	–
Enneapogon caerulescens	43% (2.43)	13% (1.5)	–	–	–	–	–	23% (1.5)	70% (2.3)
Enneapogon lindleyanus	–	–	–	–	–	–	100% (1.5)	–	–
Enneapogon polyphyllus	100% (2.3)	53% (5.99)	11% (1.5)	40% (1.5)	–	67% (1.5)	33% (1.5)	15% (1.5)	90% (2.12)
Enteropogon ramosus	–	–	–	–	–	–	–	–	–
Eragrostis cumingii	14% (1.5)	13% (1.5)	–	–	–	–	–	–	–
Eragrostis desertorum	–	13% (2.9)	11% (1.5)	–	–	–	–	1% (1.5)	–
Eragrostis dielsii	–	–	–	–	–	–	–	–	–
Eragrostis eriopoda	14% (1.5)	–	–	–	–	–	–	5% (1.5)	–
Eragrostis exigua	–	–	–	–	–	–	–	–	–
Eragrostis leptocarpa	–	7% (1.5)	–	–	–	–	–	–	–
Eragrostis setifolia	–	–	–	–	–	–	–	–	–
Eragrostis tenellula	–	27% (2.2)	–	–	–	–	–	–	20% (1.5)
Eragrostis xerophila	14% (1.5)	–	–	–	–	–	–	–	–
Eremophila cuneifolia	14% (1.5)	13% (4.3)	11% (4.3)	–	–	–	–	–	–
Eremophila exilifolia	–	–	–	–	–	–	–	–	–
Eremophila forrestii subsp. forrestii	29% (2.9)	40% (1.97)	11% (1.5)	–	–	–	–	3% (2.43)	10% (4.3)
Eremophila latrobei subsp. filiformis	–	40% (1.5)	44% (3.6)	–	–	–	–	–	–
Eremophila latrobei subsp. glabra	14% (9.2)	–	22% (2.9)	–	–	–	–	2% (2.9)	–
Eremophila latrobei subsp. latrobei	14% (1.5)	–	22% (2.9)	40% (1.5)	–	–	–	–	–
Eremophila longifolia	–	–	–	–	–	–	–	7% (2.78)	10% (1.5)
Eriachne aristidea	–	–	–	–	–	33% (1.5)	–	–	–
Eriachne benthamii	–	–	–	–	–	–	–	–	–
Eriachne ciliata	14% (1.5)	7% (1.5)	–	–	–	33% (1.5)	–	–	–
Eriachne flaccida	–	–	–	–	–	–	–	–	–
Eriachne lanata	–	–	–	–	–	–	–	8% (3.4)	–
Eriachne mucronata	57% (1.5)	33% (2.62)	11% (1.5)	–	50% (16.4)	–	100% (1.5)	2% (1.5)	20% (1.5)
Eriachne obtusa	14% (1.5)	–	–	–	–	–	–	–	–
Eriachne pulchella subsp. dominii	–	7% (1.5)	11% (1.5)	–	–	–	–	5% (1.5)	–
Eriachne pulchella subsp. pulchella	–	13% (1.5)	–	20% (1.5)	–	33% (1.5)	–	2% (1.5)	–
Eriachne tenuiculmis	–	–	–	–	100% (4.3)	–	–	–	–
Erythrina vespertilio	–	–	–	–	–	–	–	–	–
Eucalyptus camaldulensis subsp. refulgens	–	–	–	–	–	–	–	–	–
Eucalyptus leucophloia subsp. leucophloia	–	7% (1.5)	22% (2.9)	40% (2.9)	–	–	–	1% (1.5)	–
Eucalyptus socialis subsp. eucentrica	–	–	–	–	–	–	–	–	–
Eucalyptus victrix	14% (1.5)	–	–	–	100% (5.35)	–	–	1% (4.3)	10% (1.5)
Eucalyptus xerothermica	–	13% (4.3)	–	–	–	–	–	–	–
Eulalia aurea	–	13% (1.5)	–	20% (1.5)	–	–	–	1% (1.5)	–
Euphorbia australis var. hispidula	–	–	–	–	–	–	–	1% (1.5)	–
Euphorbia australis var. subtomentosa	29% (1.5)	13% (1.5)	–	–	–	–	67% (1.5)	13% (1.5)	40% (1.5)
Euphorbia biconvexa	–	7% (1.5)	–	20% (1.5)	–	–	–	2% (2.9)	40% (1.5)
Euphorbia boophthona	14% (1.5)	7% (1.5)	–	–	–	–	–	2% (1.5)	10% (1.5)
Euphorbia careyi	–	–	–	–	–	–	–	12% (1.5)	10% (1.5)
Euphorbia hirta	–	–	–	–	–	–	–	–	–

Name	AaCpTw[1]	AaEp	AaTe	AaTs	AcTe	AeTe	AhCspYTe	AiCpTe1	AiCpTe2
Euphorbia inappendiculata var. inappendiculata	–	–	–	–	–	–	–	–	–
Euphorbia inappendiculata var. queenslandica	–	–	–	–	–	–	–	–	–
Euphorbia stevenii	–	–	–	–	–	–	–	–	–
Euphorbia tannensis subsp. eremophila	–	7% (1.5)	–	–	–	–	–	3% (1.5)	–
Euphorbia trigonosperma	–	20% (1.5)	–	–	100% (1.5)	–	–	–	10% (1.5)
Euphorbia vaccaria var. vaccaria	14% (1.5)	–	–	–	–	–	–	1% (1.5)	–
Euploca chrysocarpa	–	–	–	–	–	–	–	3% (1.5)	10% (1.5)
Euploca conocarpa	–	–	–	–	–	–	–	–	–
Euploca cunninghamii	–	–	–	–	–	–	–	–	–
Euploca heterantha	14% (1.5)	–	–	–	–	–	–	3% (1.5)	–
Euploca pachyphylla	–	–	–	20% (1.5)	–	–	–	2% (1.5)	–
Euploca tanythrix	14% (1.5)	–	–	–	–	–	–	–	–
Evolvulus alsinoides var. decumbens	–	7% (1.5)	–	–	–	–	–	3% (1.5)	–
Evolvulus alsinoides var. villosicalyx	100% (1.5)	53% (1.5)	22% (1.5)	40% (1.5)	50% (1.5)	100% (1.5)	100% (1.5)	16% (1.5)	80% (1.85)
Ficus brachypoda	–	–	–	–	–	–	–	–	–
Fimbristylis depauperata	–	–	–	–	–	–	–	–	–
Fimbristylis dichotoma	43% (1.5)	7% (1.5)	–	20% (1.5)	–	67% (1.5)	–	10% (3.29)	–
Fimbristylis microcarya	–	–	–	–	–	–	–	–	–
Fimbristylis simulans	–	–	–	–	–	33% (1.5)	–	–	–
Flaveria trinervia	–	7% (1.5)	–	–	–	–	–	–	–
Flueggea virosa subsp. melanthesoides	–	–	–	–	50% (1.5)	–	–	–	–
Glycine canescens	–	–	–	–	–	–	–	–	–
Gomphrena affinis subsp. pilbarensis	–	–	–	–	–	–	–	–	–
Gomphrena canescens subsp. canescens	–	13% (1.5)	–	–	–	33% (1.5)	–	1% (1.5)	–
Gomphrena cunninghamii	86% (1.5)	7% (1.5)	–	20% (1.5)	–	33% (1.5)	67% (1.5)	3% (2.43)	70% (1.5)
Gomphrena kanisii	–	7% (1.5)	–	–	–	–	–	–	–
Gomphrena leptoclada subsp. leptoclada	–	–	–	–	–	33% (1.5)	–	–	–
Gonocarpus ephemerus	–	–	–	–	–	33% (1.5)	–	–	–
Goodenia ?tenuiloba	–	–	–	–	–	–	–	1% (1.5)	–
Goodenia cusackiana	–	–	–	–	–	–	–	–	–
Goodenia forrestii	–	–	–	–	–	–	–	2% (1.5)	–
Goodenia lamprosperma	–	–	–	–	50% (1.5)	33% (1.5)	–	–	–
Goodenia microptera	14% (1.5)	–	–	20% (1.5)	–	33% (1.5)	–	7% (1.5)	10% (1.5)
Goodenia muelleriana	57% (1.5)	–	–	–	–	–	–	3% (1.5)	10% (1.5)
Goodenia prostrata	–	20% (1.5)	–	–	–	–	–	–	–
Goodenia stobbsiana	–	7% (1.5)	33% (2.43)	80% (1.5)	–	–	–	8% (1.5)	–
Goodenia triodiophila	–	–	–	60% (1.5)	–	–	–	–	–
Gossypium australe	14% (1.5)	–	–	20% (1.5)	–	–	–	8% (1.9)	20% (2.9)
Gossypium robinsonii	–	–	–	–	–	–	67% (2.9)	–	–
Grevillea berryana	–	20% (3.37)	–	–	–	–	–	–	–
Grevillea pyramidalis subsp. leucadendron	–	–	–	–	–	–	–	24% (2.65)	30% (3.37)
Grevillea wickhamii subsp. aprica	–	–	44% (1.5)	–	100% (1.5)	–	–	12% (3.41)	–
Grevillea wickhamii subsp. hispidula	–	7% (4.3)	–	40% (1.5)	–	33% (1.5)	100% (2.43)	5% (2.06)	–
Grona ?filiformis	–	–	–	–	–	–	–	–	–
Grona muelleri	–	–	–	–	–	–	–	–	–
Hakea chordophylla	–	–	–	–	–	–	–	1% (1.5)	–
Hakea lorea subsp. lorea	14% (1.5)	7% (1.5)	33% (1.5)	80% (1.5)	–	–	–	38% (2.14)	20% (2.9)
Haloragis trigonocarpa	–	–	–	–	–	–	–	–	–
Heliotropium crispatum	–	–	–	–	–	–	–	–	10% (1.5)
Hibiscus austrinus var. austrinus	–	–	–	–	–	–	–	–	–
Hibiscus brachysiphonius	–	–	–	–	–	–	–	–	–
Hibiscus burtonii	–	27% (1.5)	44% (1.5)	20% (1.5)	–	–	–	–	–
Hibiscus coatesii	–	7% (1.5)	11% (1.5)	–	–	–	–	2% (1.5)	30% (1.5)
Hibiscus sturtii var. campylochlamys	57% (1.5)	–	44% (1.5)	60% (1.5)	–	67% (1.5)	33% (1.5)	2% (1.5)	10% (1.5)
Hibiscus sturtii var. grandiflorus	–	7% (1.5)	–	–	–	–	–	1% (1.5)	–

Name	AaCpTw[1]	AaEp	AaTe	AaTs	AcTe	AeTe	AhCspYTe	AiCpTe1	AiCpTe2
Hibiscus sturtii var. platychlamys	–	–	11% (1.5)	20% (1.5)	–	–	–	2% (1.5)	30% (1.5)
Hibiscus verdcourtii	–	–	–	–	–	–	–	–	–
Indigofera colutea	43% (1.5)	–	–	–	–	–	–	8% (1.5)	40% (1.5)
Indigofera deserticola	–	–	–	–	–	–	–	1% (1.5)	–
Indigofera linifolia	–	–	–	–	–	–	–	13% (1.5)	20% (1.5)
Indigofera linnaei	–	–	–	–	–	–	–	2% (1.5)	–
Indigofera monophylla	29% (2.9)	7% (1.5)	56% (5.6)	100% (1.5)	50% (1.5)	100% (1.5)	67% (1.5)	27% (3.21)	–
Indigofera rugosa	–	–	–	–	–	–	–	1% (1.5)	–
Indigofera trita subsp. trita	–	–	–	–	–	–	–	2% (1.5)	10% (1.5)
Iotasperma sessilifolium	–	–	–	–	–	–	–	1% (1.5)	–
Ipomoea lonchophylla	–	–	–	–	–	–	–	–	–
Ipomoea muelleri	–	7% (1.5)	–	–	50% (1.5)	33% (1.5)	–	1% (1.5)	–
Ipomoea plebeia	–	–	–	–	–	–	–	–	–
Ipomoea polymorpha	–	7% (1.5)	–	–	50% (1.5)	–	–	–	10% (1.5)
Ipomoea racemigera	–	13% (1.5)	–	–	–	–	–	–	–
Ischaemum albovillosum	–	–	–	–	–	–	–	–	–
Iseilema dolichotrichum	14% (1.5)	–	–	–	–	–	–	–	–
Iseilema eremaeum	–	7% (1.5)	–	–	–	–	–	–	–
Iseilema membranaceum	–	7% (1.5)	–	–	–	–	–	–	–
Iseilema vaginiflorum	43% (1.5)	7% (1.5)	–	–	–	–	–	5% (1.5)	30% (2.43)
Isotropis atropurpurea	–	–	–	20% (1.5)	–	33% (1.5)	–	–	–
Jasminum didymum subsp. lineare	–	–	22% (2.9)	–	–	–	33% (1.5)	–	–
Josephinia eugeniae	–	–	–	–	–	–	–	–	–
Leiocarpa semicalva subsp. semicalva	–	–	–	–	–	–	67% (1.5)	–	–
Lepidium muelleri-ferdinandi	–	–	–	–	–	–	–	–	–
Lepidium pedicellosum	–	–	–	–	–	–	–	–	–
Lobelia arnhemiaca	–	–	–	–	–	–	–	–	–
Lotus cruentus	–	–	–	–	–	–	–	–	–
Ludwigia perennis	–	–	–	–	–	–	–	–	–
Maireana georgei	–	13% (1.5)	–	–	–	–	–	–	–
Maireana melanocoma	–	–	–	–	–	–	–	–	–
Maireana planifolia	14% (1.5)	13% (1.5)	–	–	–	–	–	–	–
Maireana villosa	–	13% (1.5)	–	–	–	–	–	–	–
Malvastrum americanum	29% (1.5)	27% (7.15)	–	–	50% (1.5)	–	–	–	20% (1.5)
Marsilea exarata	–	–	–	–	–	–	–	–	–
Marsilea hirsuta	–	7% (1.5)	–	–	–	–	–	–	–
Melaleuca argentea	–	–	–	–	–	–	–	–	–
Melaleuca bracteata	–	–	–	–	–	–	–	–	–
Melaleuca eleuterostachya	–	–	–	–	–	–	–	–	–
Melaleuca glomerata	–	–	–	–	–	–	–	–	–
Melaleuca linophylla	–	–	–	–	–	–	–	–	10% (16.4)
Melhania oblongifolia	43% (1.5)	–	–	–	–	–	–	1% (1.5)	–
Minuria integerrima	–	–	–	–	–	–	–	–	10% (1.5)
Najas sp.	–	–	–	–	–	–	–	–	–
Nellica maderaspatensis	–	13% (1.5)	–	–	50% (1.5)	–	–	1% (1.5)	20% (1.5)
Neptunia dimorphantha	–	–	–	–	–	–	–	–	–
Neptunia longipila	–	–	–	–	–	–	–	–	–
Neptunia xanthonema	–	–	–	–	–	–	–	–	–
Nicotiana benthamiana	–	–	–	–	–	–	–	–	–
Nicotiana obliqua/occidentalis	–	–	–	–	–	–	–	–	–
Nicotiana umbratica	–	–	–	–	–	33% (1.5)	100% (1.5)	–	–
Notoleptopus decaisnei	–	7% (1.5)	–	–	–	–	–	–	10% (1.5)
Olearia aff. fluvialis	–	–	–	–	–	–	–	–	–
Operculina aequisepala	–	–	–	–	–	–	–	–	–
Panicum australiense var. australiense	–	–	–	20% (1.5)	–	–	–	1% (1.5)	–

Name	AaCpTw[1]	AaEp	AaTe	AaTs	AcTe	AeTe	AhCspYTe	AiCpTe1	AiCpTe2
Panicum decompositum	–	–	–	–	–	–	–	–	–
Panicum effusum	–	7% (1.5)	–	–	–	–	–	–	–
Panicum laevinode	–	–	–	–	–	–	–	–	–
Paraneurachne muelleri	14% (1.5)	–	22% (10.35)	60% (1.5)	–	33% (1.5)	–	4% (1.5)	40% (2.2)
Paspalidium basicladum	14% (1.5)	20% (2.43)	–	20% (1.5)	–	–	33% (1.5)	–	20% (1.5)
Paspalidium clementii	43% (1.5)	–	–	–	–	–	–	–	–
Paspalidium rarum	–	–	–	–	50% (1.5)	33% (1.5)	33% (1.5)	–	–
Paspalidium retiglume	–	–	–	–	–	–	–	–	–
Pentalepis trichodesmoides subsp. trichodesmoides	–	–	11% (1.5)	–	–	–	–	4% (2.2)	10% (1.5)
Peplidium sp. E Evol. Fl. Fauna Arid Aust. (A.S. Weston 12768)	–	–	–	–	–	–	–	–	–
Peripleura virgata	–	–	–	–	–	–	–	1% (1.5)	–
Perotis rara	–	–	–	–	–	33% (1.5)	33% (1.5)	2% (1.5)	–
Petalostylis labicheoides	–	7% (1.5)	–	–	–	–	–	–	–
Pluchea dentex	–	–	–	40% (1.5)	50% (1.5)	67% (1.5)	–	1% (1.5)	–
Pluchea ferdinandi-muelleri	–	–	–	–	–	–	–	1% (1.5)	–
Pluchea rubelliflora	–	7% (1.5)	–	–	–	–	–	–	–
Pluchea tetranthera	14% (1.5)	–	–	–	–	–	–	5% (2.62)	–
Plumbago zeylanica	–	–	–	–	–	–	–	–	–
Polycarpaea corymbosa var. corymbosa	–	–	–	–	–	33% (1.5)	–	–	–
Polycarpaea holtzei	–	–	–	–	–	–	–	–	10% (1.5)
Polycarpaea involucrata	–	–	–	–	–	–	–	–	–
Polycarpaea longiflora	–	–	–	–	–	–	33% (1.5)	–	–
Polygala glaucifolia	–	–	–	–	–	–	–	2% (1.5)	–
Polymeria ?mollis	–	7% (1.5)	–	–	–	–	–	–	–
Polymeria ambigua	–	–	–	–	50% (1.5)	–	33% (1.5)	1% (1.5)	–
Polymeria calycina	–	–	–	–	–	–	–	1% (1.5)	–
Portulaca conspicua	–	–	–	–	–	–	–	–	–
Portulaca cyclophylla	–	–	–	–	–	–	–	3% (1.5)	–
Portulaca filifolia	–	–	–	–	–	–	–	–	–
Portulaca oleracea	43% (1.5)	33% (1.5)	11% (1.5)	20% (1.5)	–	–	–	2% (1.5)	10% (1.5)
Potamogeton tepperi	–	–	–	–	–	–	–	–	–
Pseudognaphalium luteoalbum	–	–	–	–	–	–	–	–	–
Psydrax latifolia	–	47% (1.5)	–	–	–	–	–	–	–
Psydrax suaveolens	–	40% (1.5)	44% (2.2)	20% (1.5)	–	–	–	–	–
Pterocaulon serrulatum var. velutinum	–	–	–	–	–	–	–	–	–
Pterocaulon sphacelatum	–	7% (1.5)	–	–	–	–	67% (1.5)	–	30% (1.5)
Ptilotus aervoides	14% (1.5)	–	–	–	–	–	–	3% (1.5)	10% (1.5)
Ptilotus astrolasius	14% (1.5)	20% (2.43)	11% (1.5)	20% (1.5)	–	–	–	3% (1.5)	–
Ptilotus auriculifolius	–	–	–	–	–	–	–	2% (1.5)	10% (1.5)
Ptilotus axillaris	–	–	–	–	–	–	–	1% (1.5)	–
Ptilotus calostachyus	–	13% (1.5)	33% (1.5)	40% (1.5)	–	–	–	16% (1.5)	20% (1.5)
Ptilotus carinatus	–	–	–	–	–	–	–	–	–
Ptilotus clementii	–	–	–	–	–	–	–	1% (1.5)	10% (1.5)
Ptilotus exaltatus	14% (1.5)	27% (2.2)	–	–	–	–	–	1% (1.5)	10% (1.5)
Ptilotus fusiformis	–	–	–	20% (1.5)	–	67% (1.5)	–	–	–
Ptilotus gaudichaudii	–	7% (1.5)	–	–	–	–	–	–	–
Ptilotus gomphrenoides	14% (1.5)	7% (1.5)	–	–	–	–	–	–	10% (4.3)
Ptilotus helipteroides	–	7% (1.5)	–	–	–	–	–	–	–
Ptilotus incanus	–	–	–	–	–	–	–	2% (2.9)	10% (4.3)
Ptilotus obovatus var. obovatus	–	20% (1.5)	–	–	–	–	33% (1.5)	1% (1.5)	20% (1.5)
Ptilotus polystachyus	–	13% (1.5)	–	–	–	–	33% (1.5)	–	–
Ptilotus rotundifolius	–	–	–	–	–	–	–	1% (1.5)	–
Ptilotus schwartzii	–	20% (3.37)	11% (4.3)	–	–	–	–	–	–
Rhagodia eremaea	57% (1.5)	20% (2.43)	–	–	–	–	–	1% (1.5)	–
Rhagodia sp. Hamersley (M.Trudgen 17794)	–	7% (1.5)	–	20% (1.5)	–	–	–	–	–

Name	AaCpTw[1]	AaEp	AaTe	AaTs	AcTe	AeTe	AhCspYTe	AiCpTe1	AiCpTe2
Rhodanthe margarethae	–	–	–	–	–	–	–	–	–
Rhynchosia minima	29% (1.5)	13% (1.5)	11% (4.3)	–	–	33% (1.5)	33% (1.5)	26% (1.62)	90% (1.81)
Rostellularia adscendens var. clementii	14% (1.5)	40% (3.25)	–	–	50% (1.5)	–	–	–	–
Rostellularia adscendens var. latifolia	–	–	–	–	–	–	33% (1.5)	–	–
Rotala diandra	–	–	–	–	–	–	–	–	–
Rutidosis helichrysoides subsp. helichrysoides	–	–	–	–	–	–	–	–	–
Salsola australis	–	7% (1.5)	–	–	–	–	–	7% (1.5)	40% (1.5)
Santalum lanceolatum	–	–	–	–	50% (1.5)	–	–	–	–
Scaevola amblyanthera var. centralis	–	–	11% (1.5)	–	–	–	–	9% (1.5)	–
Scaevola spinescens	–	–	–	–	–	–	–	1% (1.5)	–
Schizachyrium fragile	–	–	–	40% (1.5)	–	67% (1.5)	–	–	–
Schoenoplectus subulatus	–	–	–	–	–	–	–	–	–
Sclerolaena cornishiana	71% (2.06)	13% (1.5)	–	20% (1.5)	–	–	–	12% (2.01)	10% (4.3)
Sclerolaena costata	29% (1.5)	7% (1.5)	–	–	–	–	–	9% (1.85)	40% (2.9)
Sclerolaena densiflora	–	–	–	–	–	–	–	–	–
Sclerolaena eriacantha	–	–	–	–	–	–	–	–	–
Sclerolaena hostilis	–	–	–	–	–	–	–	1% (1.5)	–
Scleromitrion galioides	–	–	–	–	–	–	–	–	–
Senna ?hamersleyensis	–	–	–	–	–	–	–	–	10% (4.3)
Senna ?stricta	14% (1.5)	13% (2.9)	33% (2.43)	–	–	–	–	15% (1.9)	–
Senna artemisioides subsp. ×artemisioides	–	–	–	–	–	–	–	–	–
Senna artemisioides subsp. helmsii	29% (1.5)	13% (1.5)	11% (1.5)	60% (2.43)	–	–	–	8% (2.3)	10% (1.5)
Senna artemisioides subsp. helmsii x oligophylla	–	–	–	–	–	–	–	–	–
Senna artemisioides subsp. oligophylla	–	7% (4.3)	44% (1.5)	–	–	–	–	10% (1.5)	30% (1.5)
Senna glaucifolia	–	7% (1.5)	–	–	–	–	–	–	–
Senna glutinosa subsp. ×luerssenii	14% (1.5)	33% (3.18)	56% (3.18)	40% (1.5)	–	–	–	10% (2.12)	–
Senna glutinosa subsp. glutinosa	14% (1.5)	20% (2)	44% (2.2)	40% (1.5)	–	–	–	22% (1.78)	20% (1.5)
Senna glutinosa subsp. pruinosa	14% (1.5)	7% (1.5)	–	20% (1.5)	–	–	–	16% (2.06)	20% (1.5)
Senna notabilis	14% (1.5)	13% (1.5)	22% (1.5)	–	50% (1.5)	33% (1.5)	–	11% (1.5)	80% (3.36)
Senna sericea	–	–	–	20% (1.5)	–	–	–	–	–
Senna sp. Karijini (M.E.Trudgen 10392)	–	–	–	–	–	–	–	1% (1.5)	–
Senna sp. Meekatharra (E. Bailey 1-26)	–	–	–	–	–	–	–	–	–
Senna symonii	–	–	–	40% (1.5)	–	–	–	11% (2.34)	10% (1.5)
Senna venusta	–	–	–	–	–	–	100% (2.43)	1% (1.5)	–
Seringia exastia	–	7% (4.3)	33% (6.47)	20% (1.5)	–	–	–	–	–
Seringia nephrosperma	–	–	–	20% (1.5)	–	–	–	–	–
Sesbania cannabina	–	–	–	–	100% (1.5)	–	–	–	–
Setaria verticillata	–	20% (1.5)	–	–	–	–	–	–	–
Sida ?sp. L (A.M. Ashby 4202)	–	–	–	–	–	–	–	1% (1.5)	–
Sida arenicola	–	–	11% (1.5)	20% (1.5)	–	–	–	–	–
Sida arsiniata	–	–	–	20% (1.5)	–	–	–	1% (1.5)	10% (1.5)
Sida brownii	14% (1.5)	–	–	–	–	–	–	–	–
Sida cardiophylla	–	–	–	–	–	–	–	–	–
Sida clementii	–	–	–	20% (1.5)	–	–	–	–	–
Sida echinocarpa	43% (1.5)	7% (1.5)	–	–	–	–	33% (1.5)	13% (1.73)	40% (2.2)
Sida ectogama	–	13% (16.4)	–	–	–	–	–	–	–
Sida fibulifera	14% (1.5)	40% (1.5)	–	20% (1.5)	–	–	–	4% (1.5)	–
Sida platycalyx	–	13% (1.5)	–	–	–	–	–	–	–
Sida rohlenae subsp. rohlenae	14% (1.5)	–	–	–	–	–	67% (1.5)	3% (1.5)	40% (2.2)
Sida sp. dark green fruits (S. van Leeuwen 2260)	–	20% (1.5)	–	20% (1.5)	–	–	–	2% (1.5)	–
Sida sp. Excedentifolia (J.L. Egan 1925)	–	–	–	–	–	–	–	–	–
Sida sp. Golden calyces glabrous (H.N. Foote 32)	–	–	–	–	–	–	–	–	–
Sida sp. Pilbara (A.A. Mitchell PRP 1543)	–	–	11% (1.5)	40% (1.5)	–	33% (1.5)	33% (1.5)	9% (1.85)	–
Sida sp. spiciform panicles (E. Leyland s.n. 14/8/90)	14% (1.5)	–	–	–	–	–	–	–	–
Sida spinosa	–	7% (1.5)	–	–	–	–	–	–	10% (1.5)

Name	AaCpTw[1]	AaEp	AaTe	AaTs	AcTe	AeTe	AhCspYTe	AiCpTe1	AiCpTe2
Sida trichopoda	43% (1.5)	–	22% (1.5)	–	–	–	–	2% (1.5)	30% (1.5)
Solanum aff. esuriale	–	–	–	20% (1.5)	–	–	–	–	–
Solanum aff. horridum	14% (1.5)	–	–	–	–	33% (1.5)	33% (1.5)	4% (1.5)	20% (1.5)
Solanum chippendalei	–	–	–	20% (1.5)	–	33% (1.5)	67% (1.5)	2% (1.5)	–
Solanum cleistogamum	14% (1.5)	7% (1.5)	–	–	–	33% (1.5)	67% (1.5)	2% (1.5)	20% (1.5)
Solanum diversiflorum	–	–	–	–	–	33% (1.5)	33% (1.5)	–	10% (1.5)
Solanum elatius	–	–	–	–	–	–	–	1% (1.5)	–
Solanum gabrielae	–	–	–	–	–	–	100% (1.5)	–	–
Solanum horridum	57% (1.5)	7% (1.5)	11% (1.5)	–	50% (1.5)	–	–	26% (1.5)	70% (1.9)
Solanum lasiophyllum	57% (1.5)	7% (1.5)	33% (1.5)	40% (1.5)	–	33% (1.5)	–	9% (1.5)	20% (1.5)
Solanum nigrum	–	–	–	–	–	–	–	–	–
Solanum phlomoides	29% (1.5)	7% (1.5)	–	–	–	–	–	–	10% (1.5)
Sonchus oleraceus	–	–	–	–	–	–	–	–	–
Sporobolus actinocladus	–	–	–	–	–	–	–	–	–
Sporobolus australasicus	43% (1.5)	13% (1.5)	11% (1.5)	–	–	–	–	23% (1.5)	50% (1.5)
Stackhousia muricata subsp. annual (W.R. Barker 2172)	–	–	–	–	–	–	–	1% (4.3)	–
Stemodia grossa	–	–	–	–	–	–	–	2% (1.5)	10% (1.5)
Stemodia sp. Battle Hill (A.L. Payne 1006)	–	–	–	–	–	–	–	–	–
Stemodia viscosa	–	7% (1.5)	–	–	–	–	–	–	–
Streptoglossa adscendens	–	–	–	–	–	–	–	–	–
Streptoglossa bubakii	–	–	–	–	–	–	–	–	–
Streptoglossa decurrens	–	–	–	–	–	–	–	1% (1.5)	–
Streptoglossa liatroides	–	–	–	–	–	–	–	2% (1.5)	–
Streptoglossa odora	–	–	–	–	–	–	–	–	–
Striga ?squamigera	–	–	–	–	–	–	–	–	–
Swainsona decurrens	–	–	–	–	–	–	–	3% (2.43)	20% (1.5)
Swainsona kingii	–	–	–	–	–	33% (1.5)	–	–	–
Swainsona stenodonta	–	–	–	–	–	–	–	11% (1.5)	10% (1.5)
Swainsona thompsoniana	–	–	–	–	–	–	–	–	–
Synaptantha tillaeacea var. tillaeacea	–	–	–	–	–	33% (1.5)	–	–	–
Tephrosia densa	–	–	–	–	–	–	33% (1.5)	–	10% (1.5)
Tephrosia rosea var. clementii	–	–	–	–	–	–	–	4% (2.2)	–
Tephrosia rosea var. Fortescue creeks (M.I.H. Brooker 2186)	–	–	11% (1.5)	–	–	–	–	1% (1.5)	–
Tephrosia sp. Bungaroo Creek (M.E. Trudgen 11601)	–	–	–	–	–	–	33% (1.5)	–	–
Tephrosia sp. clay soils (S. van Leeuwen et al. PBS 0273)	14% (1.5)	–	–	–	–	–	–	–	–
Tephrosia sp. Newman (A.A.Mitchell PRP 29)	–	–	–	–	–	–	–	1% (1.5)	–
Tephrosia sp. NW Eremaean (S. van Leeuwen et al. PBS 0356)	29% (1.5)	–	–	20% (1.5)	–	–	–	7% (1.5)	10% (1.5)
Tephrosia supina	–	–	–	–	–	–	–	1% (1.5)	–
Tephrosia uniovulata	–	–	–	–	–	33% (1.5)	–	–	–
Teucrium teucriiflorum	–	7% (1.5)	–	–	–	–	–	–	–
Themeda triandra	29% (1.5)	7% (1.5)	–	20% (1.5)	–	–	–	2% (2.9)	10% (1.5)
Tinospora smilacina	–	–	–	–	–	–	–	–	–
Trachymene oleracea subsp. oleracea	–	–	–	–	–	–	–	–	–
Trianthema cusackianum	–	–	–	–	–	–	–	–	–
Trianthema glossostigmum	–	–	–	–	–	–	–	2% (1.5)	–
Trianthema portulacastrum	–	–	–	–	–	–	–	–	–
Trianthema triquetrum	29% (1.5)	7% (1.5)	–	–	–	33% (1.5)	–	1% (1.5)	30% (1.5)
Tribulopis angustifolia	–	7% (1.5)	–	–	–	–	–	–	–
Tribulus astrocarpus	–	7% (1.5)	–	–	–	–	–	–	10% (1.5)
Tribulus hirsutus	–	–	11% (1.5)	–	–	–	–	7% (1.5)	–
Tribulus suberosus	14% (1.5)	13% (1.5)	–	40% (1.5)	–	–	–	8% (1.5)	10% (1.5)
Tribulus terrestris	14% (1.5)	–	–	–	–	–	–	1% (1.5)	10% (1.5)
Trichodesma zeylanicum var. zeylanicum	29% (1.5)	–	11% (1.5)	–	–	–	–	3% (1.5)	–
Trigastrotheca molluginea	–	–	11% (1.5)	40% (1.5)	–	100% (1.5)	100% (1.5)	5% (2.06)	–
Triodia basedowii	–	–	–	–	–	–	–	–	–

Name	AaCpTw[1]	AaEp	AaTe	AaTs	AcTe	AeTe	AhCspYTe	AiCpTe1	AiCpTe2
Triodia brizoides	43% (20.5)	40% (14)	11% (4.3)	20% (16.4)	–	–	–	12% (6.65)	20% (28.6)
Triodia epactia	43% (19.03)	13% (2.9)	100% (28.38)	60% (1.5)	100% (9.2)	100% (27.4)	100% (11.67)	100% (34.79)	100% (14.98)
Triodia longiceps	43% (2.43)	47% (4.9)	22% (6.75)	60% (1.5)	100% (9.2)	67% (21.4)	–	8% (2.7)	20% (2.9)
Triodia scintillans	–	13% (1.5)	–	100% (39)	–	–	–	–	–
Triodia wiseana	57% (17.9)	–	11% (4.3)	20% (1.5)	–	–	–	7% (12.75)	30% (5)
Tripogonella loliiformis	43% (1.5)	–	11% (4.3)	20% (1.5)	–	67% (1.5)	67% (1.5)	4% (2.2)	–
Triumfetta chaetocarpa	–	–	–	–	–	67% (1.5)	67% (1.5)	–	–
Triumfetta clementii	–	–	–	–	–	–	–	–	10% (1.5)
Triumfetta maconochieana	–	–	–	–	–	–	100% (1.5)	–	–
Urochloa holosericea subsp. velutina	–	–	–	–	–	33% (1.5)	–	–	–
Urochloa occidentalis var. occidentalis	29% (1.5)	27% (1.5)	–	–	–	–	–	–	–
Vachellia farnesiana	–	20% (1.5)	–	–	50% (1.5)	–	–	7% (1.5)	50% (6.02)
Vigna lanceolata var. lanceolata	–	–	–	–	–	–	–	–	–
Vigna sp. Hamersley Clay (A.A. Mitchell PRP 113)	–	–	–	–	–	–	–	–	10% (1.5)
Vincetoxicum lineare	–	7% (1.5)	11% (1.5)	40% (1.5)	–	–	–	–	–
Wahlenbergia tumidifructa	–	–	–	–	–	–	–	–	–
Waltheria indica	–	–	–	–	–	–	–	–	–
Waltheria virgata	–	–	–	60% (1.5)	–	33% (1.5)	–	–	–
Zaleya galericulata subsp. galericulata	–	–	–	–	–	–	–	–	10% (1.5)
Zornia albiflora	–	–	–	–	–	33% (1.5)	–	–	–

Name	AiSgTb	AmTe	AoTe	EcAcCs	ElAbTl	ElGwTe	EvAcCc	VfAl
?Amyema benthamii	–	–	–	–	–	–	3% (1.5)	–
?Glycine falcata	–	–	–	–	–	–	–	6% (1.5)
Abutilon ?amplum	–	–	–	–	–	–	3% (1.5)	–
Abutilon cunninghamii	–	–	–	–	4% (1.5)	–	–	–
Abutilon fraseri subsp. fraseri	–	–	–	–	1% (1.5)	–	3% (1.5)	–
Abutilon lepidum	–	–	–	–	4% (1.5)	–	–	–
Abutilon macrum	–	–	–	–	–	–	–	–
Abutilon malvifolium	–	–	–	–	–	–	–	39% (1.5)
Abutilon otocarpum	4% (1.5)	–	–	–	1% (1.5)	–	–	6% (1.5)
Abutilon oxycarpum subsp. Prostrate (A.A. Mitchell PRP 1266)	–	–	–	–	–	–	–	–
Abutilon sp. Dioicum (A.A. Mitchell PRP 1618)	4% (1.5)	–	–	–	5% (2.2)	–	5% (1.5)	–
Acacia acradenia	–	–	–	–	–	8% (7.4)	–	–
Acacia adoxa var. adoxa	–	–	67% (2.9)	–	1% (1.5)	–	–	–
Acacia adsurgens	4% (4.3)	–	33% (1.5)	–	4% (7.4)	3% (4.3)	3% (4.3)	–
Acacia ampliceps	–	–	–	75% (1.5)	–	–	29% (3.73)	–
Acacia ancistrocarpa	28% (3.4)	50% (1.5)	–	–	21% (4.09)	33% (3.38)	13% (3.74)	–
Acacia ancistrocarpa x monticola	–	17% (1.5)	–	–	–	–	–	–
Acacia aptaneura	8% (1.5)	–	–	–	6% (2.62)	15% (5.27)	5% (1.5)	–
Acacia arida	–	–	–	–	–	–	–	–
Acacia arrecta	–	–	–	–	6% (4.72)	–	–	–
Acacia ayersiana	–	–	–	–	–	–	–	–
Acacia bivenosa	48% (1.73)	17% (1.5)	33% (4.3)	25% (1.5)	67% (3.42)	33% (2.74)	24% (4.14)	6% (1.5)
Acacia catenulata subsp. occidentalis	–	–	–	–	–	–	–	–
Acacia colei var. colei	12% (1.5)	–	33% (1.5)	50% (1.5)	4% (2.43)	–	8% (3.37)	–
Acacia coriacea subsp. pendens	4% (1.5)	–	–	100% (3.6)	4% (1.5)	3% (1.5)	97% (6.97)	3% (1.5)
Acacia cyperophylla var. omearana	–	–	–	–	–	–	–	–
Acacia elachantha	4% (1.5)	–	–	–	–	–	–	–
Acacia eriopoda	12% (2.43)	–	33% (1.5)	–	1% (1.5)	–	5% (6.75)	–
Acacia inaequilatera	72% (3.48)	–	–	–	32% (3.8)	15% (4.65)	5% (5.35)	3% (1.5)
Acacia maitlandii	–	–	67% (10.35)	–	3% (2.9)	–	–	–
Acacia monticola	4% (1.5)	100% (62.98)	–	–	–	31% (6.01)	3% (1.5)	–
Acacia orthocarpa	4% (1.5)	–	100% (19.73)	–	1% (1.5)	–	–	–

Name	AiSgTb	AmTe	AoTe	EcAcCs	ElAbTl	ElGwTe	EvAcCc	VfAl
Acacia pruinocarpa	28% (3.4)	33% (1.5)	–	–	8% (2.43)	38% (4.39)	–	–
Acacia ptychophylla	8% (12.8)	–	–	–	5% (10.88)	10% (5.52)	–	–
Acacia pyrifolia var. morrisonii	–	–	–	–	–	–	–	–
Acacia pyrifolia var. pyrifolia	–	17% (1.5)	–	75% (1.5)	9% (2.7)	3% (1.5)	76% (3.55)	6% (1.5)
Acacia sclerosperma subsp. sclerosperma	–	–	–	–	3% (1.5)	–	3% (1.5)	–
Acacia sibirica	–	–	–	–	4% (2.43)	3% (4.3)	–	–
Acacia spondylophylla	–	–	–	–	1% (1.5)	–	–	–
Acacia synchronicia	24% (1.97)	–	–	–	32% (3.19)	–	8% (2.43)	42% (2.57)
Acacia tenuissima	–	–	–	–	9% (4.83)	3% (1.5)	3% (4.3)	–
Acacia tetragonophylla	4% (1.5)	17% (1.5)	–	–	9% (1.5)	–	11% (2.9)	6% (2.9)
Acacia trachycarpa	–	17% (1.5)	–	100% (2.2)	1% (1.5)	3% (1.5)	39% (4.72)	–
Acacia tumida var. pilbarensis	4% (1.5)	–	33% (1.5)	–	4% (3.37)	8% (9.03)	26% (8.19)	–
Achyranthes aspera	4% (1.5)	–	–	25% (1.5)	–	–	21% (2.81)	–
Adriana tomentosa var. tomentosa	–	–	–	–	–	–	3% (1.5)	–
Aerva javanica	–	–	–	25% (1.5)	3% (1.5)	3% (1.5)	26% (1.78)	6% (1.5)
Afrohybanthus aurantiacus	16% (1.5)	33% (1.5)	–	–	14% (1.5)	10% (1.5)	45% (1.5)	6% (1.5)
Alternanthera denticulata var. denticulata	–	–	–	50% (1.5)	–	–	21% (1.5)	–
Alternanthera nana	12% (1.5)	17% (1.5)	–	–	–	–	53% (1.78)	–
Alternanthera nodiflora	–	–	–	–	–	–	3% (9.2)	–
Alysicarpus muelleri	4% (1.5)	–	–	–	3% (1.5)	–	16% (1.5)	14% (1.5)
Amaranthus cuspidifolius	4% (1.5)	–	–	–	–	–	3% (1.5)	–
Amaranthus undulatus	4% (1.5)	–	–	50% (1.5)	–	–	37% (1.5)	–
Ammannia baccifera	–	–	–	25% (1.5)	–	–	16% (2.9)	–
Ammannia multiflora	–	–	–	–	–	–	–	–
Amphipogon sericeus	12% (1.5)	–	–	–	1% (1.5)	33% (3.67)	–	–
Amyema ?sanguinea	–	–	–	–	–	–	5% (1.5)	–
Amyema preissii	–	–	–	–	1% (4.3)	–	–	–
Androcalva luteiflora	–	–	–	–	3% (2.9)	–	11% (2.2)	–
Anthobolus leptomerioides	–	–	–	–	3% (1.5)	–	–	–
Areocleome oxalidea	–	–	–	–	–	–	–	–
Argemone ochroleuca subsp. ochroleuca	–	–	–	50% (1.5)	–	–	21% (2.2)	–
Aristida burbidgeae	–	–	–	–	1% (1.5)	–	–	–
Aristida contorta	28% (1.5)	17% (1.5)	33% (1.5)	–	9% (2.3)	3% (1.5)	3% (1.5)	25% (5.43)
Aristida holathera var. holathera	–	–	–	25% (1.5)	–	3% (1.5)	–	3% (1.5)
Aristida inaequiglumis	8% (1.5)	–	–	–	–	–	–	3% (4.3)
Aristida latifolia	–	–	–	–	4% (1.5)	3% (1.5)	–	75% (7.74)
Arivela uncifera	–	–	–	–	–	–	–	–
Arivela viscosa	36% (1.5)	–	–	100% (1.5)	13% (2.62)	–	50% (2.35)	92% (3.16)
Astrebla elymoides	–	–	–	–	–	–	–	6% (1.5)
Astrebla pectinata	–	–	–	–	–	–	–	6% (2.9)
Atalaya hemiglauca	4% (4.3)	–	–	75% (2.43)	3% (1.5)	3% (4.3)	71% (4.46)	6% (2.9)
Austrobryonia pilbarensis	–	–	–	–	–	–	–	44% (1.5)
Basilicum polystachyon	–	–	–	–	–	–	5% (1.5)	–
Bergia pedicellaris	–	–	–	–	–	–	5% (1.5)	–
Bergia trimera	–	–	–	–	–	–	5% (1.5)	–
Bidens bipinnata	8% (1.5)	–	–	–	–	–	–	–
Blumea tenella	–	–	–	–	–	–	3% (1.5)	–
Boerhavia burbidgeana	4% (1.5)	–	–	–	–	–	37% (1.7)	17% (1.97)
Boerhavia coccinea	12% (1.5)	–	–	50% (1.5)	5% (2.2)	–	45% (1.92)	31% (2.01)
Boerhavia gardneri	4% (1.5)	–	–	–	4% (2.43)	–	5% (2.9)	22% (2.2)
Boerhavia paludosa	–	–	–	–	1% (1.5)	–	–	42% (2.06)
Boerhavia schomburgkiana	–	–	–	–	–	–	–	11% (1.5)
Bonamia erecta	–	17% (1.5)	–	–	–	–	–	–
Bonamia media	–	–	–	25% (1.5)	–	–	–	–
Bonamia pannosa	–	–	–	–	–	–	3% (1.5)	–

Name	AiSgTb	AmTe	AoTe	EcAcCs	ElAbTl	ElGwTe	EvAcCc	VfAl
Bonamia pilbarensis	60% (1.5)	50% (1.5)	33% (1.5)	25% (1.5)	21% (1.5)	44% (1.5)	11% (1.5)	17% (1.5)
Bothriochloa ewartiana	–	–	–	–	1% (4.3)	–	5% (2.9)	3% (1.5)
Bulbostylis barbata	20% (1.5)	–	–	75% (1.5)	1% (1.5)	–	3% (1.5)	11% (1.5)
Bulbostylis burbidgeae	–	–	–	–	–	–	–	–
Bulbostylis turbinata	–	–	33% (4.3)	–	4% (3.37)	–	3% (1.5)	17% (1.97)
Calandrinia ?stagnensis	–	–	–	–	–	–	–	–
Calandrinia balonensis	–	–	–	25% (1.5)	–	–	–	–
Calocephalus knappii	–	–	–	–	–	–	–	–
Calotropis procera	–	–	–	–	–	–	3% (1.5)	–
Capparis lasiantha	4% (1.5)	17% (1.5)	–	–	4% (1.5)	3% (1.5)	5% (1.5)	–
Capparis spinosa subsp. nummularia	8% (1.5)	–	–	–	3% (1.5)	3% (1.5)	3% (1.5)	8% (1.5)
Capparis umbonata	12% (1.5)	33% (1.5)	–	–	23% (1.97)	10% (1.5)	11% (2.9)	–
Carissa lanceolata	4% (1.5)	–	–	–	–	–	3% (1.5)	3% (1.5)
Cassytha capillaris	–	–	33% (4.3)	25% (1.5)	5% (3.6)	–	–	–
Cathetus exilis	–	–	–	25% (1.5)	–	–	3% (1.5)	–
Cenchrus ciliaris	16% (1.5)	–	–	50% (4.3)	10% (1.85)	–	95% (22.93)	14% (2.06)
Cenchrus setiger	–	17% (1.5)	–	100% (22.15)	12% (1.5)	–	84% (16.97)	11% (1.5)
Centipeda minima subsp. macrocephala	–	–	–	50% (1.5)	–	–	13% (3.04)	3% (1.5)
Cheilanthes brownii	–	–	–	–	–	–	–	–
Cheilanthes sieberi subsp. sieberi	4% (1.5)	–	–	25% (1.5)	1% (1.5)	–	5% (1.5)	–
Chenopodium murale	–	–	–	–	–	–	3% (1.5)	–
Chloris pectinata	–	–	–	–	–	–	3% (4.3)	25% (4.14)
Chrysopogon fallax	–	–	–	25% (1.5)	1% (1.5)	–	5% (1.5)	3% (1.5)
Citrullus amarus	–	–	–	–	–	–	–	3% (1.5)
Citrullus colocynthis	–	–	–	–	–	–	5% (1.5)	3% (1.5)
Clerodendrum floribundum var. angustifolium	8% (2.9)	–	–	–	–	–	–	–
Clerodendrum tomentosum var. lanceolatum	–	17% (1.5)	–	–	–	–	–	–
Commelina ensifolia	–	–	–	–	–	–	–	3% (1.5)
Commicarpus australis	–	–	–	–	–	–	–	3% (1.5)
Corchorus incanus	4% (4.3)	–	–	–	4% (2.43)	–	11% (1.5)	–
Corchorus lasiocarpus subsp. lasiocarpus	4% (1.5)	–	–	–	3% (1.5)	3% (1.5)	8% (1.5)	3% (1.5)
Corchorus lasiocarpus subsp. parvus	8% (1.5)	–	–	–	–	15% (1.97)	5% (1.5)	–
Corchorus parviflorus	28% (2.3)	17% (1.5)	–	50% (1.5)	45% (2.42)	8% (2.43)	42% (1.85)	31% (1.5)
Corchorus sidoides subsp. vermicularis	–	–	–	–	–	–	–	–
Corchorus sp. Yarrie (J. Bull & D. Roberts CAL 01.05)	–	–	–	–	–	–	–	–
Corchorus tridens	–	–	–	25% (1.5)	4% (1.5)	–	13% (3.04)	31% (1.75)
Corchorus trilocularis	–	–	–	–	–	–	–	31% (1.5)
Corchorus walcottii	–	–	–	–	1% (1.5)	–	–	–
Corymbia ?ferriticola	–	–	–	–	–	–	3% (4.3)	–
Corymbia candida subsp. candida	–	–	–	–	–	–	–	–
Corymbia hamersleyana	36% (2.43)	33% (2.9)	67% (2.9)	–	36% (4.66)	33% (2.74)	21% (10.41)	–
Crotalaria cunninghamii subsp. cunninghamii	–	–	–	75% (1.5)	–	–	–	–
Crotalaria cunninghamii subsp. sturtii	–	–	–	–	–	–	3% (1.5)	–
Crotalaria dissitiflora subsp. benthamiana	–	–	–	–	–	–	–	25% (3.52)
Crotalaria medicaginea var. neglecta	–	–	–	25% (1.5)	1% (1.5)	–	42% (1.5)	75% (2.2)
Cucumis melo	–	–	–	–	–	–	3% (1.5)	25% (1.5)
Cucumis myriocarpus subsp. myriocarpus	–	–	–	–	–	–	–	8% (1.5)
Cucumis variabilis	20% (1.5)	–	–	100% (1.5)	5% (1.5)	3% (1.5)	45% (1.5)	14% (1.5)
Cullen ?lachnostachys	4% (1.5)	–	–	–	–	–	–	–
Cullen graveolens	–	–	–	–	–	–	–	28% (3.83)
Cullen leucanthum	–	–	–	25% (1.5)	–	–	37% (1.5)	–
Cullen leucochaites	–	–	–	–	–	–	3% (1.5)	–
Cullen pustulatum	–	–	–	–	–	–	–	–
Cymbopogon ambiguus	64% (1.85)	33% (1.5)	–	–	13% (1.5)	23% (1.5)	50% (2.53)	14% (5.04)
Cymbopogon obtectus	–	17% (1.5)	–	–	1% (1.5)	–	–	–

Name	AiSgTb	AmTe	AoTe	EcAcCs	ElAbTl	ElGwTe	EvAcCc	VfAl
Cynanchum floribundum	–	–	–	25% (1.5)	–	–	–	–
Cynanchum viminale	–	–	–	–	–	–	–	–
Cynodon convergens	–	–	–	–	1% (1.5)	–	–	64% (5.58)
Cynodon dactylon	–	–	–	–	–	–	13% (5.7)	–
Cynodon prostratus	–	–	–	–	–	–	–	3% (1.5)
Cyperus bifax	–	–	–	–	–	–	3% (1.5)	–
Cyperus cunninghamii subsp. cunninghamii	–	–	–	–	–	–	–	–
Cyperus difformis	–	–	–	25% (1.5)	–	–	8% (2.43)	–
Cyperus hesperius	–	–	–	–	–	–	–	–
Cyperus iria	–	–	–	–	–	–	3% (4.3)	6% (1.5)
Cyperus ixiocarpus	–	–	–	25% (1.5)	–	–	–	–
Cyperus squarrosus	–	–	–	–	–	–	–	–
Cyperus vaginatus	–	–	–	75% (1.5)	–	–	87% (5.61)	–
Dactyloctenium radulans	–	–	–	50% (1.5)	1% (1.5)	–	24% (1.81)	14% (1.5)
Dampiera candicans	8% (1.5)	–	–	25% (1.5)	3% (1.5)	44% (2.78)	–	–
Dendrophyllanthus erwinii	–	–	–	–	1% (1.5)	–	–	–
Desmodiopsis campylocaulon	–	–	–	–	1% (1.5)	–	–	31% (1.5)
Dichanthium sericeum subsp. humilius	–	–	–	–	3% (1.5)	–	16% (2.43)	33% (1.73)
Dicladanthera forrestii	–	–	–	–	–	–	–	–
Digitaria brownii	–	–	–	–	–	–	–	–
Digitaria ctenantha	4% (1.5)	–	–	–	–	–	3% (1.5)	–
Diplachne fusca subsp. muelleri	–	–	–	–	–	–	5% (1.5)	–
Dodonaea coriacea	12% (1.5)	17% (1.5)	–	–	8% (1.97)	28% (2.01)	–	–
Dodonaea lanceolata var. lanceolata	–	–	–	–	–	–	3% (1.5)	–
Dodonaea petiolaris	8% (1.5)	–	–	–	–	–	–	–
Dolichocarpa crouchiana	4% (1.5)	–	–	–	1% (1.5)	–	–	56% (1.64)
Dolichocarpa sp. Hamersley Station (A.A. Mitchell PRP 1479)	–	–	–	–	–	–	–	33% (1.5)
Duperreya commixta	8% (1.5)	17% (1.5)	–	–	3% (1.5)	3% (1.5)	11% (1.5)	–
Dysphania kalpari	–	–	–	25% (1.5)	–	–	–	–
Dysphania melanocarpa forma melanocarpa	–	–	–	–	–	–	–	–
Dysphania rhadinostachya subsp. rhadinostachya	4% (1.5)	–	–	25% (1.5)	–	–	5% (1.5)	3% (1.5)
Dysphania sphaerosperma	–	–	–	–	1% (1.5)	–	–	–
Echinochloa colona	–	–	–	25% (1.5)	–	–	18% (2.7)	–
Ehretia saligna var. saligna	–	–	–	–	1% (1.5)	–	5% (1.5)	–
Enchylaena tomentosa var. tomentosa	–	–	–	–	8% (1.5)	–	–	–
Enneapogon caerulescens	24% (1.5)	17% (1.5)	33% (1.5)	25% (1.5)	14% (1.75)	3% (1.5)	18% (1.5)	47% (2.32)
Enneapogon lindleyanus	–	–	–	–	–	–	5% (2.9)	–
Enneapogon polyphyllus	32% (2.46)	–	–	–	6% (1.5)	5% (1.5)	8% (1.5)	25% (3.06)
Enteropogon ramosus	–	–	–	–	–	–	3% (1.5)	–
Eragrostis cumingii	–	–	–	50% (1.5)	–	–	13% (2.62)	–
Eragrostis desertorum	–	–	–	–	8% (3.98)	–	–	8% (3.37)
Eragrostis dielsii	–	–	–	–	–	–	3% (1.5)	–
Eragrostis eriopoda	–	–	–	25% (1.5)	5% (1.5)	3% (1.5)	–	–
Eragrostis exigua	–	–	–	–	–	–	8% (2.43)	–
Eragrostis leptocarpa	–	–	–	–	–	–	16% (1.5)	6% (1.5)
Eragrostis setifolia	–	–	–	–	–	–	–	3% (1.5)
Eragrostis tenellula	–	–	–	25% (1.5)	3% (1.5)	–	24% (2.12)	25% (1.81)
Eragrostis xerophila	–	–	–	–	–	–	–	28% (3.11)
Eremophila cuneifolia	–	–	–	–	1% (1.5)	–	–	–
Eremophila exilifolia	–	–	–	–	1% (4.3)	–	–	–
Eremophila forrestii subsp. forrestii	4% (1.5)	–	–	–	1% (1.5)	–	–	3% (1.5)
Eremophila latrobei subsp. filiformis	–	–	–	–	–	–	–	–
Eremophila latrobei subsp. glabra	4% (9.2)	–	–	–	–	–	–	–
Eremophila latrobei subsp. latrobei	8% (2.9)	–	–	–	–	–	–	–
Eremophila longifolia	12% (2.43)	–	–	–	8% (1.97)	–	8% (2.43)	3% (1.5)

Name	AiSgTb	AmTe	AoTe	EcAcCs	ElAbTl	ElGwTe	EvAcCc	VfAl
Eriachne aristidea	–	–	–	25% (1.5)	–	–	–	–
Eriachne benthamii	–	–	–	–	–	–	3% (1.5)	6% (8.95)
Eriachne ciliata	–	17% (1.5)	–	–	3% (1.5)	5% (1.5)	3% (1.5)	–
Eriachne flaccida	–	–	–	–	1% (1.5)	–	–	3% (16.4)
Eriachne lanata	4% (4.3)	–	–	–	13% (2.9)	56% (6.07)	–	–
Eriachne mucronata	44% (3.03)	50% (1.5)	–	–	23% (2.59)	49% (2.53)	13% (2.06)	58% (10.04)
Eriachne obtusa	8% (5.35)	33% (1.5)	–	–	1% (1.5)	8% (2.43)	–	–
Eriachne pulchella subsp. dominii	–	–	–	–	4% (1.5)	–	–	3% (1.5)
Eriachne pulchella subsp. pulchella	4% (1.5)	–	–	–	1% (1.5)	–	–	3% (1.5)
Eriachne tenuiculmis	–	–	–	–	–	–	29% (3.47)	–
Erythrina vespertilio	–	–	–	–	–	–	5% (1.5)	–
Eucalyptus camaldulensis subsp. refulgens	–	–	–	75% (13.3)	–	–	53% (10.38)	–
Eucalyptus leucophloia subsp. leucophloia	4% (1.5)	17% (1.5)	–	–	50% (6.8)	59% (5.15)	3% (9.2)	–
Eucalyptus socialis subsp. eucentrica	–	–	–	–	3% (9.2)	–	–	–
Eucalyptus victrix	–	–	–	25% (9.2)	1% (9.2)	–	92% (14.77)	–
Eucalyptus xerothermica	–	–	–	–	1% (4.3)	–	–	–
Eulalia aurea	–	–	–	50% (2.9)	–	–	3% (1.5)	–
Euphorbia australis var. hispidula	–	–	–	–	–	–	3% (1.5)	–
Euphorbia australis var. subtomentosa	–	–	–	100% (1.5)	12% (1.5)	–	61% (1.62)	11% (1.5)
Euphorbia biconvexa	–	–	–	–	5% (2.2)	3% (1.5)	32% (1.73)	8% (2.43)
Euphorbia boophthona	–	–	–	–	–	–	–	11% (1.5)
Euphorbia careyi	16% (2.2)	–	–	–	6% (2.06)	3% (4.3)	8% (1.5)	–
Euphorbia hirta	–	–	–	–	–	–	8% (1.5)	–
Euphorbia inappendiculata var. inappendiculata	–	–	–	–	1% (1.5)	–	–	–
Euphorbia inappendiculata var. queenslandica	–	–	–	–	–	–	–	36% (1.5)
Euphorbia stevenii	–	–	–	–	–	–	–	3% (1.5)
Euphorbia tannensis subsp. eremophila	4% (1.5)	–	–	–	–	–	–	3% (1.5)
Euphorbia trigonosperma	4% (1.5)	–	–	50% (1.5)	1% (1.5)	–	29% (1.5)	8% (1.5)
Euphorbia vaccaria var. vaccaria	–	–	–	–	1% (1.5)	–	–	3% (1.5)
Euploca chrysocarpa	4% (1.5)	–	–	–	24% (1.79)	–	–	–
Euploca conocarpa	–	–	–	–	–	–	–	14% (1.5)
Euploca cunninghamii	8% (1.5)	–	–	–	1% (1.5)	–	–	14% (2.06)
Euploca heterantha	4% (1.5)	–	–	–	3% (1.5)	–	–	3% (1.5)
Euploca pachyphylla	–	–	–	25% (1.5)	1% (1.5)	–	–	–
Euploca tanythrix	–	–	–	–	–	–	–	22% (1.85)
Evolvulus alsinoides var. decumbens	–	17% (1.5)	–	75% (1.5)	3% (1.5)	–	21% (1.5)	–
Evolvulus alsinoides var. villosicalyx	32% (1.85)	17% (1.5)	–	–	13% (1.5)	5% (1.5)	34% (1.5)	31% (1.5)
Ficus brachypoda	4% (1.5)	–	–	–	–	–	3% (1.5)	–
Fimbristylis depauperata	–	–	–	50% (1.5)	–	–	–	–
Fimbristylis dichotoma	24% (1.97)	–	–	–	5% (1.5)	3% (1.5)	–	11% (5.22)
Fimbristylis microcarya	–	–	–	–	–	–	5% (1.5)	–
Fimbristylis simulans	–	–	–	–	3% (8.95)	3% (1.5)	–	–
Flaveria trinervia	–	–	–	–	–	–	–	–
Flueggea virosa subsp. melanthesoides	–	–	–	–	–	–	32% (2.2)	–
Glycine canescens	–	–	–	–	–	–	18% (1.5)	–
Gomphrena affinis subsp. pilbarensis	–	–	–	–	–	–	–	3% (1.5)
Gomphrena canescens subsp. canescens	–	–	–	–	–	–	–	–
Gomphrena cunninghamii	24% (1.5)	–	–	–	–	–	5% (1.5)	14% (1.5)
Gomphrena kanisii	8% (1.5)	–	–	–	–	3% (1.5)	–	–
Gomphrena leptoclada subsp. leptoclada	–	–	–	–	–	–	–	–
Gonocarpus ephemerus	–	–	–	–	–	–	–	–
Goodenia ?tenuiloba	–	–	–	–	–	–	3% (1.5)	–
Goodenia cusackiana	12% (1.5)	–	–	–	18% (2.45)	13% (2.06)	–	–
Goodenia forrestii	–	–	–	–	–	–	–	–
Goodenia lamprosperma	–	–	–	25% (1.5)	–	–	–	–

Name	AiSgTb	AmTe	AoTe	EcAcCs	ElAbTl	ElGwTe	EvAcCc	VfAl
Goodenia microptera	8% (1.5)	–	–	–	10% (1.5)	–	8% (1.5)	–
Goodenia muelleriana	–	–	–	–	5% (1.5)	–	–	47% (1.5)
Goodenia prostrata	–	–	–	–	–	–	–	–
Goodenia stobbsiana	20% (2.06)	67% (1.5)	–	25% (1.5)	23% (1.81)	46% (2.55)	–	–
Goodenia triodiophila	–	–	–	–	–	3% (1.5)	–	–
Gossypium australe	32% (1.85)	–	–	–	5% (1.5)	5% (2.9)	34% (2.15)	3% (1.5)
Gossypium robinsonii	–	–	–	50% (1.5)	1% (1.5)	–	11% (3.6)	–
Grevillea berryana	–	–	–	–	–	–	–	–
Grevillea pyramidalis subsp. leucadendron	12% (3.37)	–	–	–	3% (1.5)	3% (9.2)	8% (1.5)	–
Grevillea wickhamii subsp. aprica	20% (5.14)	–	100% (2.43)	–	3% (2.9)	28% (4.62)	18% (3.1)	–
Grevillea wickhamii subsp. hispidula	16% (1.5)	83% (22.02)	–	50% (1.5)	3% (1.5)	23% (4.77)	5% (1.5)	–
Grona ?filiformis	–	–	–	–	–	–	–	6% (1.5)
Grona muelleri	–	–	–	–	–	–	–	56% (3.08)
Hakea chordophylla	4% (1.5)	–	–	–	1% (1.5)	–	–	–
Hakea lorea subsp. lorea	48% (1.97)	17% (1.5)	–	–	24% (2.24)	15% (1.97)	5% (1.5)	6% (1.5)
Haloragis trigonocarpa	–	–	–	–	1% (1.5)	–	–	–
Heliotropium crispatum	–	–	–	25% (1.5)	–	–	–	67% (2.56)
Hibiscus austrinus var. austrinus	–	–	–	25% (1.5)	–	–	–	–
Hibiscus brachysiphonius	–	–	–	–	–	–	–	56% (2.44)
Hibiscus burtonii	4% (1.5)	–	–	–	3% (1.5)	–	–	6% (2.9)
Hibiscus coatesii	20% (1.5)	33% (1.5)	–	–	6% (1.5)	3% (1.5)	3% (1.5)	–
Hibiscus sturtii var. campylochlamys	12% (1.5)	33% (1.5)	–	–	18% (1.5)	3% (1.5)	3% (1.5)	3% (1.5)
Hibiscus sturtii var. grandiflorus	8% (1.5)	–	–	–	–	–	–	–
Hibiscus sturtii var. platychlamys	–	17% (1.5)	–	–	4% (1.5)	–	3% (1.5)	11% (1.5)
Hibiscus verdcourtii	–	–	–	–	–	–	–	6% (1.5)
Indigofera colutea	4% (1.5)	–	–	25% (1.5)	1% (1.5)	–	13% (1.5)	17% (1.5)
Indigofera deserticola	–	–	–	–	1% (4.3)	–	–	–
Indigofera linifolia	–	–	–	25% (1.5)	3% (1.5)	–	39% (1.5)	33% (2.38)
Indigofera linnaei	–	–	–	25% (1.5)	3% (1.5)	–	11% (1.5)	–
Indigofera monophylla	36% (2.36)	67% (2.9)	–	25% (4.3)	38% (2.53)	23% (2.12)	32% (1.97)	–
Indigofera rugosa	–	–	–	–	–	–	–	–
Indigofera trita subsp. trita	4% (1.5)	–	–	–	4% (1.5)	–	26% (1.5)	44% (2.38)
Iotasperma sessilifolium	–	–	–	–	–	–	–	–
Ipomoea lonchophylla	–	–	–	–	–	–	–	14% (2.06)
Ipomoea muelleri	–	–	–	100% (1.5)	–	–	55% (1.5)	28% (1.78)
Ipomoea plebeia	–	–	–	–	–	–	13% (1.5)	–
Ipomoea polymorpha	–	–	–	25% (1.5)	–	–	11% (1.5)	11% (1.5)
Ipomoea racemigera	–	–	–	–	–	–	8% (1.5)	–
Ischaemum albovillosum	–	–	–	–	–	–	–	3% (1.5)
Iseilema dolichotrichum	–	–	–	–	1% (1.5)	–	–	–
Iseilema eremaeum	–	–	–	–	–	–	–	–
Iseilema membranaceum	–	–	–	–	–	–	–	6% (1.5)
Iseilema vaginiflorum	4% (1.5)	–	–	–	–	–	–	47% (5.39)
Isotropis atropurpurea	–	–	–	–	–	–	–	–
Jasminum didymum subsp. lineare	4% (1.5)	–	–	–	1% (1.5)	3% (1.5)	8% (1.5)	–
Josephinia eugeniae	–	–	–	–	–	–	–	14% (2.06)
Leiocarpa semicalva subsp. semicalva	–	–	–	–	–	–	–	–
Lepidium muelleri-ferdinandi	–	–	–	–	–	–	3% (1.5)	–
Lepidium pedicellosum	–	–	–	–	1% (1.5)	–	–	–
Lobelia arnhemiaca	–	–	–	–	–	–	5% (1.5)	–
Lotus cruentus	–	–	–	–	–	–	–	3% (1.5)
Ludwigia perennis	–	–	–	–	–	–	3% (1.5)	–
Maireana georgei	4% (1.5)	–	–	–	4% (1.5)	–	–	–
Maireana melanocoma	–	–	–	–	1% (1.5)	–	–	–
Maireana planifolia	–	–	–	–	–	–	–	–

Name	AiSgTb	AmTe	AoTe	EcAcCs	ElAbTl	ElGwTe	EvAcCc	VfAl
Maireana villosa	8% (1.5)	–	–	–	–	–	–	–
Malvastrum americanum	4% (1.5)	–	–	25% (1.5)	4% (1.5)	–	50% (1.65)	39% (1.5)
Marsilea exarata	–	–	–	–	–	–	18% (2.6)	–
Marsilea hirsuta	–	–	–	–	–	–	–	6% (1.5)
Melaleuca argentea	–	–	–	50% (5.35)	–	–	–	–
Melaleuca bracteata	–	–	–	–	–	–	21% (7.3)	–
Melaleuca eleuterostachya	–	–	–	–	1% (16.4)	–	–	–
Melaleuca glomerata	–	–	–	50% (8.95)	–	–	58% (8.06)	–
Melaleuca linophylla	–	–	–	50% (4.3)	–	–	39% (8.49)	–
Melhania oblongifolia	–	–	–	–	1% (1.5)	–	3% (1.5)	3% (1.5)
Minuria integerrima	–	–	–	–	1% (1.5)	–	–	8% (1.5)
Najas sp.	–	–	–	–	–	–	3% (1.5)	–
Nellica maderaspatensis	–	–	–	–	5% (1.5)	–	53% (1.5)	75% (1.5)
Neptunia dimorphantha	–	–	–	–	1% (1.5)	–	–	22% (2.46)
Neptunia longipila	–	–	–	–	–	–	–	22% (2.81)
Neptunia xanthonema	–	–	–	–	–	–	3% (1.5)	11% (2.2)
Nicotiana benthamiana	8% (1.5)	–	–	–	–	–	–	–
Nicotiana obliqua/occidentalis	–	–	–	–	–	–	11% (1.5)	–
Nicotiana umbratica	4% (1.5)	–	–	–	–	–	–	–
Notoleptopus decaisnei	–	–	–	–	–	–	18% (1.5)	–
Olearia aff. fluvialis	–	–	–	25% (1.5)	–	–	–	–
Operculina aequisepala	–	–	–	–	–	–	3% (1.5)	58% (2.95)
Panicum australiense var. australiense	–	–	–	–	–	–	–	–
Panicum decompositum	–	–	–	–	–	–	5% (1.5)	28% (4.09)
Panicum effusum	–	–	–	–	–	–	–	6% (1.5)
Panicum laevinode	–	–	–	–	–	–	–	8% (2.43)
Paraneurachne muelleri	28% (1.5)	50% (1.5)	33% (1.5)	–	21% (1.5)	15% (1.5)	8% (1.5)	–
Paspalidium basicladum	–	–	–	–	1% (1.5)	–	–	–
Paspalidium clementii	16% (1.5)	–	–	–	3% (1.5)	–	–	–
Paspalidium rarum	4% (1.5)	–	–	25% (1.5)	–	–	–	–
Paspalidium retiglume	–	–	–	–	–	–	–	14% (1.5)
Pentalepis trichodesmoides subsp. trichodesmoides	–	–	–	–	4% (2.43)	–	3% (1.5)	–
Peplidium sp. E Evol. Fl. Fauna Arid Aust. (A.S. Weston 12768)	–	–	–	–	–	–	3% (1.5)	–
Peripleura virgata	–	–	–	–	–	–	–	–
Perotis rara	4% (1.5)	–	–	50% (1.5)	–	–	–	–
Petalostylis labicheoides	–	–	–	50% (1.5)	4% (4.3)	3% (1.5)	5% (1.5)	–
Pluchea dentex	–	–	–	25% (1.5)	–	–	3% (1.5)	–
Pluchea ferdinandi-muelleri	12% (1.5)	–	–	25% (1.5)	8% (1.97)	–	3% (1.5)	–
Pluchea rubelliflora	–	–	–	25% (1.5)	–	–	18% (3.1)	–
Pluchea tetranthera	16% (1.5)	–	–	–	12% (1.5)	–	3% (1.5)	3% (1.5)
Plumbago zeylanica	–	–	–	25% (1.5)	–	–	8% (1.5)	–
Polycarpaea corymbosa var. corymbosa	4% (1.5)	–	–	25% (1.5)	–	–	–	–
Polycarpaea holtzei	–	–	–	25% (1.5)	–	–	–	–
Polycarpaea involucrata	8% (1.5)	–	–	–	–	–	–	–
Polycarpaea longiflora	4% (1.5)	–	–	–	–	–	5% (1.5)	–
Polygala glaucifolia	–	–	–	–	–	–	–	6% (1.5)
Polymeria ?mollis	–	–	–	–	–	–	–	–
Polymeria ambigua	–	–	–	75% (1.5)	4% (1.5)	–	16% (1.5)	–
Polymeria calycina	–	–	–	–	–	–	13% (1.5)	–
Portulaca conspicua	4% (1.5)	–	–	–	–	–	–	–
Portulaca cyclophylla	–	–	33% (1.5)	–	4% (2.43)	3% (1.5)	3% (1.5)	–
Portulaca filifolia	–	–	–	–	–	–	–	3% (1.5)
Portulaca oleracea	4% (1.5)	–	–	–	–	–	29% (1.75)	53% (1.5)
Potamogeton tepperi	–	–	–	–	–	–	8% (2.43)	–
Pseudognaphalium luteoalbum	–	–	–	25% (1.5)	–	–	–	–

Name	AiSgTb	AmTe	AoTe	EcAcCs	ElAbTl	ElGwTe	EvAcCc	VfAl
Psydrax latifolia	–	–	–	–	–	–	–	–
Psydrax suaveolens	–	–	–	–	1% (1.5)	–	–	–
Pterocaulon serrulatum var. velutinum	–	–	–	–	1% (1.5)	–	–	3% (1.5)
Pterocaulon sphacelatum	4% (1.5)	–	–	–	1% (1.5)	–	3% (1.5)	6% (1.5)
Ptilotus aervoides	–	–	–	–	4% (1.5)	–	–	22% (2.81)
Ptilotus astrolasius	–	–	–	–	12% (2.12)	8% (2.43)	–	–
Ptilotus auriculifolius	–	–	–	–	3% (1.5)	–	–	–
Ptilotus axillaris	–	–	–	–	1% (1.5)	–	–	3% (1.5)
Ptilotus calostachyus	36% (1.5)	50% (1.5)	–	–	23% (1.5)	69% (1.6)	–	–
Ptilotus carinatus	–	–	–	–	–	–	–	6% (2.9)
Ptilotus clementii	4% (1.5)	–	–	–	12% (2.36)	8% (1.5)	–	–
Ptilotus exaltatus	8% (1.5)	–	–	–	24% (1.65)	15% (1.5)	3% (1.5)	6% (1.5)
Ptilotus fusiformis	–	–	–	–	–	–	–	–
Ptilotus gaudichaudii	–	–	–	–	–	–	–	–
Ptilotus gomphrenoides	–	–	–	–	–	–	8% (1.5)	64% (2.39)
Ptilotus helipteroides	–	–	–	–	–	–	–	–
Ptilotus incanus	4% (1.5)	–	–	–	3% (1.5)	3% (1.5)	–	–
Ptilotus obovatus var. obovatus	12% (1.5)	17% (1.5)	–	–	1% (1.5)	–	–	–
Ptilotus polystachyus	–	–	–	–	–	–	–	–
Ptilotus rotundifolius	–	–	–	–	–	–	–	–
Ptilotus schwartzii	–	–	–	–	–	3% (1.5)	–	–
Rhagodia eremaea	–	–	–	–	–	–	–	–
Rhagodia sp. Hamersley (M.Trudgen 17794)	–	–	–	–	–	–	–	–
Rhodanthe margarethae	8% (1.5)	–	–	–	–	–	–	–
Rhynchosia minima	8% (2.9)	17% (1.5)	–	25% (1.5)	9% (1.9)	–	66% (1.92)	78% (2.48)
Rostellularia adscendens var. clementii	–	–	–	–	1% (1.5)	–	21% (1.85)	11% (2.9)
Rostellularia adscendens var. latifolia	4% (1.5)	–	–	–	–	–	–	–
Rotala diandra	–	–	–	–	–	–	3% (1.5)	–
Rutidosis helichrysoides subsp. helichrysoides	–	–	–	–	–	–	3% (1.5)	–
Salsola australis	12% (1.5)	–	–	–	15% (1.5)	3% (1.5)	11% (1.5)	8% (1.5)
Santalum lanceolatum	–	33% (1.5)	–	–	5% (4.12)	5% (5.35)	–	–
Scaevola amblyanthera var. centralis	4% (1.5)	–	–	–	14% (1.5)	–	13% (2.06)	–
Scaevola spinescens	–	–	–	–	5% (1.5)	–	–	–
Schizachyrium fragile	–	–	–	–	–	–	–	–
Schoenoplectus subulatus	–	–	–	–	–	–	5% (1.5)	–
Sclerolaena cornishiana	4% (1.5)	–	–	–	3% (1.5)	–	–	17% (1.5)
Sclerolaena costata	4% (1.5)	–	–	–	3% (1.5)	–	8% (1.5)	17% (1.97)
Sclerolaena densiflora	8% (1.5)	–	–	–	1% (4.3)	3% (1.5)	–	–
Sclerolaena eriacantha	–	–	–	–	3% (1.5)	–	–	–
Sclerolaena hostilis	–	–	–	–	–	–	–	–
Scleromitrion galioides	–	–	–	25% (1.5)	–	–	3% (1.5)	–
Senna ?hamersleyensis	–	–	–	–	1% (1.5)	–	–	14% (2.06)
Senna ?stricta	12% (3.37)	–	–	–	19% (2.99)	13% (2.06)	3% (4.3)	–
Senna artemisioides subsp. ×artemisioides	–	–	–	–	1% (1.5)	–	–	–
Senna artemisioides subsp. helmsii	8% (1.5)	–	–	–	6% (2.06)	–	–	19% (1.9)
Senna artemisioides subsp. helmsii x oligophylla	–	–	–	–	1% (1.5)	–	–	–
Senna artemisioides subsp. oligophylla	16% (1.5)	17% (1.5)	–	–	21% (2.38)	8% (2.43)	–	14% (1.5)
Senna glaucifolia	–	–	–	–	–	–	–	–
Senna glutinosa subsp. ×luerssenii	36% (1.5)	17% (1.5)	–	–	37% (2.73)	13% (3.04)	–	3% (1.5)
Senna glutinosa subsp. glutinosa	52% (1.93)	67% (1.5)	–	–	28% (2.26)	49% (2.09)	5% (1.5)	–
Senna glutinosa subsp. pruinosa	44% (2.26)	–	–	–	14% (2.71)	5% (1.5)	–	3% (1.5)
Senna notabilis	8% (1.5)	–	–	–	12% (1.5)	3% (1.5)	34% (1.5)	53% (1.65)
Senna sericea	–	–	–	–	10% (3.25)	3% (1.5)	–	–
Senna sp. Karijini (M.E.Trudgen 10392)	–	–	–	–	–	–	–	6% (1.5)
Senna sp. Meekatharra (E. Bailey 1-26)	4% (1.5)	–	–	–	–	–	–	3% (1.5)

Name	AiSgTb	AmTe	AoTe	EcAcCs	ElAbTl	ElGwTe	EvAcCc	VfAl
Senna symonii	12% (2.43)	17% (1.5)	–	–	54% (3.02)	28% (2.26)	–	–
Senna venusta	4% (1.5)	–	–	–	–	–	–	–
Seringia exastia	4% (1.5)	–	–	–	–	18% (1.5)	–	–
Seringia nephrosperma	–	–	–	–	–	–	–	–
Sesbania cannabina	–	–	–	50% (1.5)	–	–	32% (1.5)	–
Setaria verticillata	–	–	–	–	–	–	–	–
Sida ?sp. L (A.M. Ashby 4202)	–	–	–	–	3% (1.5)	–	–	3% (1.5)
Sida arenicola	4% (1.5)	–	–	–	–	10% (1.5)	–	–
Sida arsiniata	–	–	–	–	–	–	–	–
Sida brownii	–	–	–	–	–	–	–	–
Sida cardiophylla	–	33% (1.5)	–	–	1% (1.5)	–	–	–
Sida clementii	–	–	–	–	–	–	–	3% (1.5)
Sida echinocarpa	16% (1.5)	–	–	–	9% (1.5)	–	5% (1.5)	3% (1.5)
Sida ectogama	–	–	–	–	–	–	–	–
Sida fibulifera	4% (1.5)	17% (1.5)	–	–	9% (1.5)	–	8% (1.5)	50% (7.78)
Sida platycalyx	–	–	–	–	–	–	–	–
Sida rohlenae subsp. rohlenae	24% (1.5)	17% (1.5)	–	75% (1.5)	4% (1.5)	–	37% (1.7)	19% (1.5)
Sida sp. dark green fruits (S. van Leeuwen 2260)	4% (1.5)	–	–	–	1% (1.5)	–	–	–
Sida sp. Excedentifolia (J.L. Egan 1925)	4% (1.5)	17% (1.5)	–	–	–	–	–	–
Sida sp. Golden calyces glabrous (H.N. Foote 32)	–	–	–	–	1% (1.5)	3% (1.5)	–	–
Sida sp. Pilbara (A.A. Mitchell PRP 1543)	24% (1.5)	–	–	–	6% (1.5)	31% (1.5)	3% (1.5)	–
Sida sp. spiciform panicles (E. Leyland s.n. 14/8/90)	–	–	–	–	1% (1.5)	–	3% (1.5)	–
Sida spinosa	–	–	–	–	–	–	11% (1.5)	33% (1.5)
Sida trichopoda	–	–	–	–	6% (1.5)	–	16% (1.5)	42% (5.7)
Solanum aff. esuriale	–	–	–	–	–	–	–	–
Solanum aff. horridum	4% (1.5)	–	–	–	3% (1.5)	–	–	8% (1.5)
Solanum chippendalei	–	–	–	25% (1.5)	–	–	–	–
Solanum cleistogamum	12% (1.5)	–	–	–	4% (1.5)	–	3% (1.5)	11% (1.5)
Solanum diversiflorum	–	–	–	75% (1.5)	1% (4.3)	–	3% (1.5)	–
Solanum elatius	4% (1.5)	17% (1.5)	–	–	6% (1.5)	–	–	–
Solanum gabrielae	–	–	–	–	–	–	–	–
Solanum horridum	16% (1.5)	–	–	–	14% (1.5)	8% (1.5)	11% (1.5)	50% (1.5)
Solanum lasiophyllum	12% (1.5)	17% (1.5)	–	–	15% (1.5)	10% (1.5)	–	67% (1.5)
Solanum nigrum	–	–	–	–	–	–	3% (1.5)	–
Solanum phlomoides	–	–	–	–	3% (1.5)	–	3% (1.5)	–
Sonchus oleraceus	–	–	–	–	–	–	5% (1.5)	–
Sporobolus actinocladus	–	–	–	–	1% (1.5)	–	3% (1.5)	–
Sporobolus australasicus	32% (1.5)	–	–	–	9% (1.5)	–	18% (1.5)	33% (1.5)
Stackhousia muricata subsp. annual (W.R. Barker 2172)	–	–	–	–	5% (1.5)	–	–	–
Stemodia grossa	4% (1.5)	–	–	–	–	–	26% (2.06)	–
Stemodia sp. Battle Hill (A.L. Payne 1006)	–	–	–	–	–	–	–	6% (1.5)
Stemodia viscosa	–	–	–	25% (1.5)	–	–	3% (1.5)	–
Streptoglossa adscendens	–	–	–	–	3% (1.5)	–	–	6% (1.5)
Streptoglossa bubakii	–	–	–	–	3% (1.5)	–	–	19% (2.3)
Streptoglossa decurrens	–	–	–	–	–	–	3% (1.5)	–
Streptoglossa liatroides	–	–	–	–	1% (1.5)	–	–	22% (1.5)
Streptoglossa odora	–	–	–	–	–	–	–	8% (1.5)
Striga ?squamigera	–	–	–	25% (1.5)	–	–	–	–
Swainsona decurrens	–	–	–	–	–	–	–	–
Swainsona kingii	–	–	–	25% (1.5)	–	–	–	–
Swainsona stenodonta	8% (1.5)	–	–	–	1% (1.5)	–	3% (1.5)	–
Swainsona thompsoniana	–	–	–	–	–	–	–	33% (1.5)
Synaptantha tillaeacea var. tillaeacea	–	–	–	–	–	–	–	–
Tephrosia densa	–	–	–	–	–	–	–	–
Tephrosia rosea var. clementii	4% (4.3)	–	–	–	1% (1.5)	–	5% (1.5)	–

Name	AiSgTb	AmTe	AoTe	EcAcCs	ElAbTl	ElGwTe	EvAcCc	VfAl
Tephrosia rosea var. Fortescue creeks (M.I.H. Brooker 2186)	–	–	–	–	–	–	8% (3.37)	–
Tephrosia sp. Bungaroo Creek (M.E. Trudgen 11601)	–	–	–	–	–	3% (1.5)	–	–
Tephrosia sp. clay soils (S. van Leeuwen et al. PBS 0273)	4% (1.5)	–	–	–	4% (1.5)	–	–	69% (1.61)
Tephrosia sp. Newman (A.A.Mitchell PRP 29)	–	–	–	–	–	–	–	–
Tephrosia sp. NW Eremaean (S. van Leeuwen et al. PBS 0356)	16% (1.5)	–	–	–	5% (1.5)	5% (1.5)	–	–
Tephrosia supina	4% (1.5)	–	–	–	–	–	–	–
Tephrosia uniovulata	–	–	–	–	–	–	–	–
Teucrium teucriiflorum	–	–	–	–	–	–	–	–
Themeda triandra	20% (3.04)	–	–	25% (1.5)	4% (3.37)	3% (1.5)	26% (3.11)	–
Tinospora smilacina	4% (1.5)	–	–	–	–	–	–	–
Trachymene oleracea subsp. oleracea	–	–	–	50% (1.5)	–	–	–	–
Trianthema cusackianum	–	–	–	–	1% (1.5)	–	–	–
Trianthema glossostigmum	–	–	–	–	3% (1.5)	3% (1.5)	8% (2.43)	6% (1.5)
Trianthema portulacastrum	–	–	–	–	–	–	5% (1.5)	–
Trianthema triquetrum	4% (1.5)	–	–	–	4% (1.5)	–	24% (1.81)	14% (2.62)
Tribulopis angustifolia	–	–	–	–	–	–	–	–
Tribulus astrocarpus	–	–	–	–	–	–	–	–
Tribulus hirsutus	8% (1.5)	–	–	–	15% (1.73)	–	16% (1.5)	6% (1.5)
Tribulus suberosus	24% (1.5)	–	–	–	12% (2.74)	15% (2.43)	–	6% (1.5)
Tribulus terrestris	–	–	–	–	–	–	3% (4.3)	8% (1.5)
Trichodesma zeylanicum var. zeylanicum	8% (1.5)	–	–	–	1% (1.5)	–	–	6% (1.5)
Trigastrotheca molluginea	20% (1.5)	17% (1.5)	33% (1.5)	25% (1.5)	8% (1.5)	8% (1.5)	3% (1.5)	6% (1.5)
Triodia basedowii	–	–	–	–	–	3% (26.4)	–	–
Triodia brizoides	84% (19.46)	17% (9.2)	67% (17.8)	–	46% (20.19)	10% (9.82)	–	25% (5.08)
Triodia epactia	84% (18.61)	100% (19.88)	100% (25)	–	40% (10.75)	100% (27.86)	71% (6.09)	47% (7.11)
Triodia longiceps	16% (2.2)	–	67% (6.75)	100% (6.62)	65% (17.22)	8% (9.03)	63% (6.04)	17% (7.4)
Triodia scintillans	4% (39.4)	–	–	–	3% (20.45)	–	–	–
Triodia wiseana	–	–	–	–	51% (19.98)	5% (5.35)	3% (1.5)	3% (1.5)
Tripogonella loliiformis	8% (1.5)	–	–	–	3% (2.9)	–	–	6% (1.5)
Triumfetta chaetocarpa	–	–	–	50% (1.5)	1% (1.5)	–	–	–
Triumfetta clementii	–	–	–	–	–	–	–	–
Triumfetta maconochieana	4% (1.5)	–	–	–	–	3% (4.3)	–	–
Urochloa holosericea subsp. velutina	–	–	–	–	–	–	–	–
Urochloa occidentalis var. occidentalis	4% (1.5)	–	–	–	–	–	–	8% (2.43)
Vachellia farnesiana	8% (1.5)	–	–	25% (1.5)	9% (1.5)	–	79% (3.76)	86% (4.84)
Vigna lanceolata var. lanceolata	–	–	–	100% (1.5)	–	–	5% (1.5)	–
Vigna sp. Hamersley Clay (A.A. Mitchell PRP 113)	–	–	–	–	–	–	18% (1.5)	44% (1.68)
Vincetoxicum lineare	–	–	–	–	–	–	–	–
Wahlenbergia tumidifructa	–	–	–	75% (1.5)	–	–	3% (1.5)	–
Waltheria indica	–	–	–	–	–	–	3% (1.5)	–
Waltheria virgata	–	–	33% (1.5)	–	–	–	–	–
Zaleya galericulata subsp. galericulata	–	–	–	–	–	–	–	–
Zornia albiflora	–	–	–	–	–	–	–	–

[1]Values indicate the percentage of sampling sites within the vegetation type in which the taxon was recorded (constancy) and mean percent foliage cover across those sites (importance; in parentheses).

Appendix E Flora and vegetation sampling site data.

BD_E_001

Date	25/06/2023	**Site type**	Flora: Quadrat	**Botanist**	LE
Location	-21.9195, 119.97614				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Mixed	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	Minor weed cover and grazing.		
Time since fire	Long (> 3 yrs)				

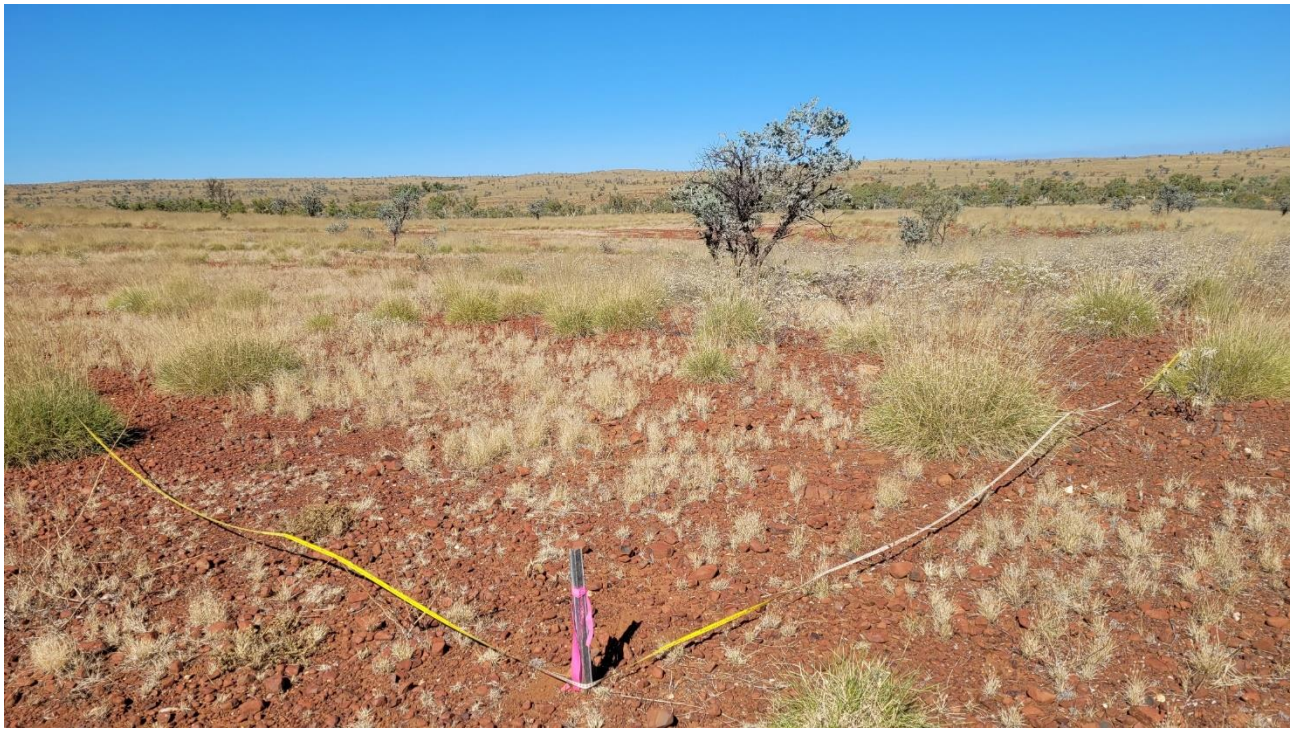


Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	< 1
Acacia inaequilatera	Shrub (>2 m)	5 – 9
Vachellia farnesiana	Shrub (1-2 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	1 – 4
Dampiera candicans	Shrub (<0.5 m)	< 1
Euploca chrysocarpa	Shrub (<0.5 m)	< 1
Hibiscus sturtii var. *platychlamys*	Shrub (<0.5 m)	< 1
Indigofera trita subsp. *trita*	Shrub (<0.5 m)	< 1
Senna ?hamersleyensis	Shrub (<0.5 m)	1 – 4
Senna symonii	Shrub (<0.5 m)	< 1
Sida ?trichopoda	Shrub (<0.5 m)	< 1
Solanum lasiophyllum	Shrub (<0.5 m)	< 1
Bulbostylis turbinata	Sedge (<0.5 m)	< 1
Arivela viscosa	Herb (<0.5 m)	< 1
Boerhavia coccinea	Herb (<0.5 m)	1 – 4
Boerhavia gardneri	Herb (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Dolichocarpa crouchiana	Herb (<0.5 m)	< 1
Euphorbia ?biconvexa	Herb (<0.5 m)	< 1
Euphorbia ?boophthona	Herb (<0.5 m)	< 1
Evolvulus alsinoides var. *villosicalyx*	Herb (<0.5 m)	< 1
Gomphrena cunninghamii	Herb (<0.5 m)	< 1
Indigofera colutea	Herb (<0.5 m)	< 1
Minuria integerrima	Herb (<0.5 m)	< 1
Nellica maderaspatensis	Herb (<0.5 m)	< 1
Pterocaulon sphacelatum	Herb (<0.5 m)	< 1
Ptilotus gomphrenoides	Herb (<0.5 m)	1 – 4
Rhynchosia minima	Herb (<0.5 m)	1 – 4
Salsola australis	Herb (<0.5 m)	< 1
Solanum horridum	Herb (<0.5 m)	1 – 4
Stemodia grossa	Herb (<0.5 m)	< 1

Name	Stratum	Percent cover (%)
Vigna sp. Hamersley Clay (A.A. Mitchell PRP 113)	Herb (<0.5 m)	< 1
Aristida latifolia	Tussock Grass (0.5-1 m)	1 – 4
Aristida contorta	Tussock Grass (<0.5 m)	< 1
Chloris pectinata	Tussock Grass (<0.5 m)	< 1
Enneapogon caerulescens	Tussock Grass (<0.5 m)	< 1
Enneapogon polyphyllus	Tussock Grass (<0.5 m)	< 1
Iseilema vaginiflorum	Tussock Grass (<0.5 m)	< 1
Sporobolus australasicus	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	10 – 24

BD_E_002

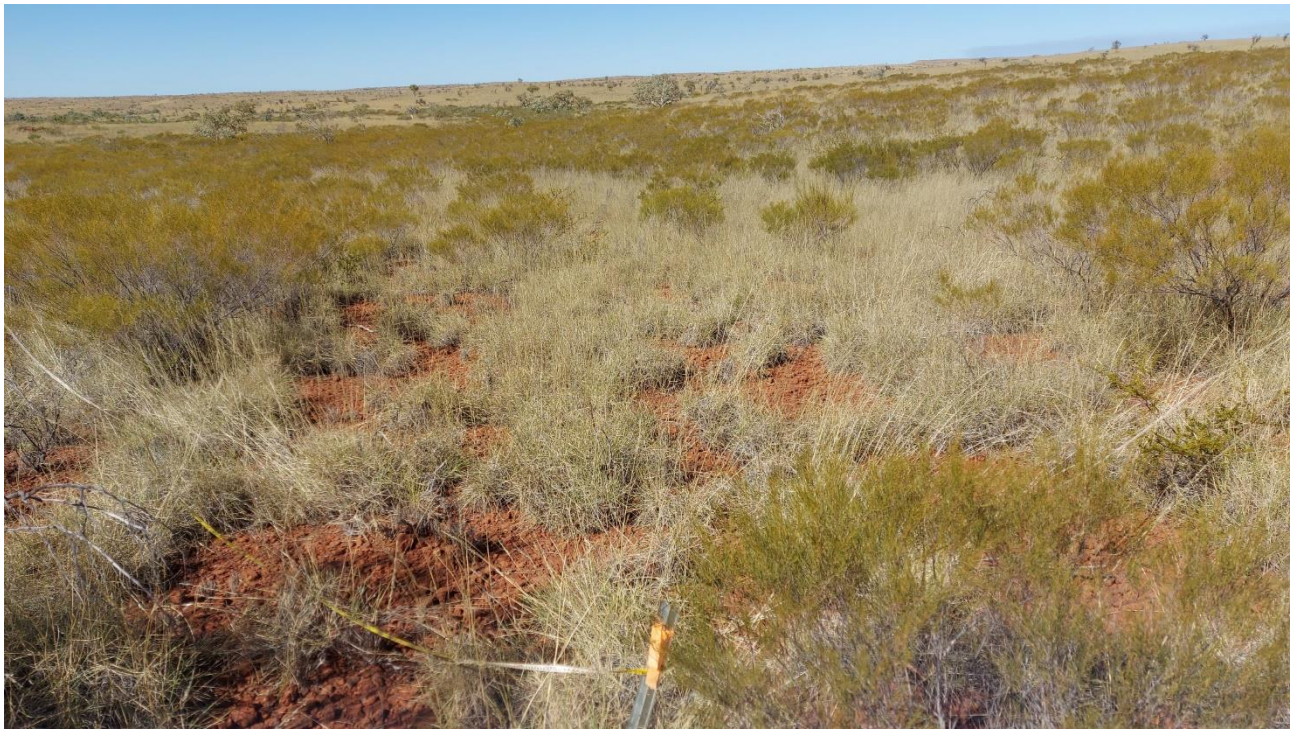
Date	24/06/2023	**Site type**	Flora: Quadrat	**Botanist**	LE
Location	-21.92801, 119.86246				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Mixed	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	Minor weed cover and grazing.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Grevillea pyramidalis subsp. *leucadendron*	Shrub (>2 m)	1 – 4
Acacia inaequilatera	Shrub (1-2 m)	1 – 4
Senna artemisioides subsp. *oligophylla*	Shrub (0.5-1 m)	< 1
Corchorus incanus	Shrub (<0.5 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	1 – 4
Sida echinocarpa	Shrub (<0.5 m)	< 1
Malvastrum americanum	Herb (0.5-1 m)	< 1
Arivela viscosa	Herb (<0.5 m)	< 1
Boerhavia gardneri	Herb (<0.5 m)	1 – 4
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Crotalaria medicaginea var. *neglecta*	Herb (<0.5 m)	< 1
Euphorbia ?biconvexa	Herb (<0.5 m)	< 1
Euphorbia careyi	Herb (<0.5 m)	< 1
Gomphrena cunninghamii	Herb (<0.5 m)	< 1
Indigofera colutea	Herb (<0.5 m)	< 1
Indigofera linifolia	Herb (<0.5 m)	< 1
Polycarpaea holtzei	Herb (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	< 1
Senna notabilis	Herb (<0.5 m)	< 1
Solanum horridum	Herb (<0.5 m)	< 1
Aristida contorta	Tussock Grass (<0.5 m)	1 – 4
Enneapogon caerulescens	Tussock Grass (<0.5 m)	1 – 4
Enneapogon polyphyllus	Tussock Grass (<0.5 m)	1 – 4
Iseilema vaginiflorum	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	10 – 24

BD_E_003

Date	24/06/2023	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-21.93045, 119.84653				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Brown	**Soil texture**	Sandy clay loam		
Rock type	Dolerite	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia colei var. *colei*	Shrub (>2 m)	Assoc.
Acacia eriopoda	Shrub (1-2 m)	< 1
Acacia maitlandii	Shrub (1-2 m)	10 – 24
Acacia orthocarpa	Shrub (1-2 m)	25 – 32
Grevillea wickhamii	Shrub (1-2 m)	< 1
Aristida contorta	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	33 – 49

BD_E_004

Date	25/06/2023	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-21.92855, 119.97433				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Dark brown	**Soil texture**	Clay loam		
Rock type	Quartz, ironstone, calcrete	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	Assoc.
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	5 – 9
Hakea lorea subsp. *lorea*	Shrub (>2 m)	1 – 4
Acacia bivenosa	Shrub (1-2 m)	< 1
Senna symonii	Shrub (1-2 m)	1 – 4
Corchorus parviflorus	Shrub (0.5-1 m)	1 – 4
Senna glutinosa subsp. *pruinosa*	Shrub (0.5-1 m)	< 1
Hibiscus sturtii var. *platychlamys*	Shrub (<0.5 m)	< 1
Goodenia stobbsiana	Herb (<0.5 m)	< 1
Hibiscus coatesii	Herb (<0.5 m)	< 1
Ptilotus clementii	Herb (<0.5 m)	< 1
Salsola australis	Herb (<0.5 m)	< 1
Sclerolaena densiflora	Herb (<0.5 m)	1 – 4
Trigastrotheca molluginea	Herb (<0.5 m)	< 1
Triodia longiceps	Hummock Grass (0.5-1 m)	25 – 32
Triodia wiseana	Hummock Grass (<0.5 m)	5 – 9

BD_E_005

Date	25/06/2023	**Site type**	Flora: Quadrat	**Botanist**	LE
Location	-21.94435, 119.91938				
Landform	Plain (clay)	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay		
Rock type	Ironstone	**Rock size**	Mixed	**Rock cover**	> 70%
Vegetation condition	Very Good	**Disturbance**	Minor weed cover and grazing.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Vachellia farnesiana	Shrub (>2 m)	1 – 4
Senna artemisioides subsp. *helmsii*	Shrub (0.5-1 m)	< 1
Euploca tanythrix	Shrub (<0.5 m)	< 1
Indigofera trita subsp. *trita*	Shrub (<0.5 m)	< 1
Sida ?trichopoda	Shrub (<0.5 m)	< 1
Solanum lasiophyllum/phlomoides	Shrub (<0.5 m)	< 1
Bulbostylis turbinata	Sedge (<0.5 m)	< 1
Abutilon malvifolium	Herb (<0.5 m)	< 1
Boerhavia coccinea	Herb (<0.5 m)	< 1
Boerhavia gardneri	Herb (<0.5 m)	1 – 4
Crotalaria medicaginea var. *neglecta*	Herb (<0.5 m)	< 1
Dolichocarpa crouchiana	Herb (<0.5 m)	< 1
Euphorbia ?biconvexa	Herb (<0.5 m)	< 1
Grona muelleri	Herb (<0.5 m)	< 1
Heliotropium crispatum	Herb (<0.5 m)	< 1
Indigofera colutea	Herb (<0.5 m)	< 1
Indigofera linifolia	Herb (<0.5 m)	< 1
Nellica maderaspatensis	Herb (<0.5 m)	< 1
Operculina aequisepala	Herb (<0.5 m)	< 1
Polygala glaucifolia	Herb (<0.5 m)	< 1
Portulaca oleracea	Herb (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	< 1
Senna notabilis	Herb (<0.5 m)	< 1
Sida rohlenae subsp. *rohlenae*	Herb (<0.5 m)	< 1
Solanum horridum	Herb (<0.5 m)	< 1
Streptoglossa bubakii	Herb (<0.5 m)	< 1
Tephrosia sp. clay soils (S. van Leeuwen et al. PBS 0273)	Herb (<0.5 m)	< 1
Trichodesma zeylanicum var. *zeylanicum*	Herb (<0.5 m)	< 1
Vigna sp. Hamersley Clay (A.A. Mitchell PRP 113)	Herb (<0.5 m)	< 1
Aristida latifolia	Tussock Grass (<0.5 m)	5 – 9
Chloris pectinata	Tussock Grass (<0.5 m)	5 – 9

Name	Stratum	Percent cover (%)
Enneapogon caerulescens	Tussock Grass (<0.5 m)	1 – 4
Enneapogon polyphyllus	Tussock Grass (<0.5 m)	1 – 4
Eriachne mucronata	Tussock Grass (<0.5 m)	5 – 9
Iseilema vaginiflorum	Tussock Grass (<0.5 m)	10 – 24
Panicum decompositum	Tussock Grass (<0.5 m)	5 – 9

BD_E_006

Date	24/06/2023	**Site type**	Flora: Quadrat	**Botanist**	LE
Location	-21.93856, 119.86586				
Landform	Major creek (5-30 m)	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Sandy clay		
Rock type	Mixed river alluvium, calcrete	**Rock size**	Mixed	**Rock cover**	10 – 30%
Vegetation condition	Poor	**Disturbance**	High weed cover and grazing.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Eucalyptus victrix	Tree (10-30 m)	10 – 24
Acacia coriacea subsp. *pendens*	Tree (<10 m)	1 – 4
Corymbia hamersleyana	Tree (<10 m)	25 – 32
Acacia ampliceps	Shrub (>2 m)	1 – 4
Acacia trachycarpa	Shrub (>2 m)	1 – 4
Grevillea wickhamii subsp. *hispidula*	Shrub (>2 m)	< 1
Melaleuca bracteata	Shrub (>2 m)	1 – 4
Melaleuca glomerata	Shrub (>2 m)	5 – 9
Vachellia farnesiana	Shrub (>2 m)	1 – 4
Acacia bivenosa	Shrub (1-2 m)	< 1
Acacia pyrifolia	Shrub (1-2 m)	5 – 9
Atalaya hemiglauca	Shrub (1-2 m)	< 1
Flueggea virosa subsp. *melanthesoides*	Shrub (1-2 m)	< 1
Gossypium australe	Shrub (0.5-1 m)	1 – 4
Corchorus incanus	Shrub (<0.5 m)	< 1
Indigofera trita subsp. *trita*	Shrub (<0.5 m)	< 1
Cyperus vaginatus	Sedge (0.5-1 m)	1 – 4
Alysicarpus muelleri	Herb (<0.5 m)	< 1
Amaranthus undulatus	Herb (<0.5 m)	< 1
Boerhavia coccinea	Herb (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Crotalaria medicaginea var. *neglecta*	Herb (<0.5 m)	< 1
Euphorbia australis var. *subtomentosa*	Herb (<0.5 m)	< 1
Euphorbia biconvexa	Herb (<0.5 m)	< 1
Nellica maderaspatensis	Herb (<0.5 m)	< 1
Polymeria ?calycina	Herb (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	< 1
Sida rohlenae subsp. *rohlenae*	Herb (<0.5 m)	< 1
Cenchrus ciliaris	Tussock Grass (<0.5 m)	< 1
Cenchrus setiger	Tussock Grass (<0.5 m)	10 – 24
Cymbopogon ambiguus	Tussock Grass (<0.5 m)	1 – 4

Name	Stratum	Percent cover (%)
Enneapogon caerulescens	Tussock Grass (<0.5 m)	< 1
Eragrostis leptocarpa	Tussock Grass (<0.5 m)	< 1
Eriachne tenuiculmis	Tussock Grass (<0.5 m)	1 – 4
Triodia epactia	Hummock Grass (<0.5 m)	1 – 4

BD_E_007

Date	24/06/2023	**Site type**	Flora: Quadrat	**Botanist**	AC
Location	-21.93936, 119.88496				
Landform	Plain (clay)	**Slope**	NA		
Soil colour	Dark brown	**Soil texture**	Clay		
Rock type	Basalt	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	30 – 70%
Vegetation condition	Excellent	**Disturbance**	Minor weed cover and grazing.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia synchronicia	Shrub (>2 m)	< 1
Senna glutinosa subsp. *pruinosa*	Shrub (1-2 m)	< 1
Vachellia farnesiana	Shrub (1-2 m)	< 1
Euploca tanythrix	Shrub (<0.5 m)	< 1
Senna artemisioides subsp. *helmsii*	Shrub (<0.5 m)	< 1
Senna artemisioides subsp. *oligophylla*	Shrub (<0.5 m)	< 1
Sida trichopoda	Shrub (<0.5 m)	5 – 9
Solanum lasiophyllum	Shrub (<0.5 m)	< 1
Bulbostylis turbinata	Sedge (<0.5 m)	< 1
Abutilon malvifolium	Herb (<0.5 m)	< 1
Arivela viscosa	Herb (<0.5 m)	< 1
Boerhavia gardneri	Herb (<0.5 m)	< 1
Crotalaria dissitiflora subsp. *benthamiana*	Herb (<0.5 m)	1 – 4
Crotalaria medicaginea var. *neglecta*	Herb (<0.5 m)	< 1
Cullen graveolens	Herb (<0.5 m)	1 – 4
Dolichocarpa crouchiana	Herb (<0.5 m)	< 1
Euphorbia ?biconvexa	Herb (<0.5 m)	< 1
Euphorbia ?boophthona	Herb (<0.5 m)	< 1
Evolvulus alsinoides var. *villosicalyx*	Herb (<0.5 m)	< 1
Gomphrena cunninghamii	Herb (<0.5 m)	< 1
Goodenia muelleriana	Herb (<0.5 m)	< 1
Grona muelleri	Herb (<0.5 m)	1 – 4
Heliotropium crispatum	Herb (<0.5 m)	< 1
Hibiscus brachysiphonius	Herb (<0.5 m)	1 – 4
Indigofera colutea	Herb (<0.5 m)	< 1
Indigofera linifolia	Herb (<0.5 m)	5 – 9
Malvastrum americanum	Herb (<0.5 m)	< 1
Nellica maderaspatensis	Herb (<0.5 m)	< 1
Portulaca oleracea	Herb (<0.5 m)	< 1
Pterocaulon sphacelatum	Herb (<0.5 m)	< 1
Ptilotus gomphrenoides	Herb (<0.5 m)	< 1

Name	Stratum	Percent cover (%)
Rhynchosia minima	Herb (<0.5 m)	< 1
Solanum horridum	Herb (<0.5 m)	< 1
Tephrosia sp. clay soils (S. van Leeuwen et al. PBS 0273)	Herb (<0.5 m)	< 1
Aristida latifolia	Tussock Grass (<0.5 m)	10 – 24
Chloris pectinata	Tussock Grass (<0.5 m)	< 1
Cynodon convergens	Tussock Grass (<0.5 m)	5 – 9
Dichanthium sericeum subsp. *humilius*	Tussock Grass (<0.5 m)	< 1
Enneapogon caerulescens	Tussock Grass (<0.5 m)	1 – 4
Enneapogon polyphyllus	Tussock Grass (<0.5 m)	< 1
Eriachne mucronata	Tussock Grass (<0.5 m)	25 – 32
Iseilema vaginiflorum	Tussock Grass (<0.5 m)	5 – 9
Panicum decompositum	Tussock Grass (<0.5 m)	5 – 9
Paspalidium retiglume	Tussock Grass (<0.5 m)	< 1
Tripogonella loliiformis	Tussock Grass (<0.5 m)	< 1
Urochloa occidentalis var. *occidentalis*	Tussock Grass (<0.5 m)	< 1
Triodia brizoides	Hummock Grass (<0.5 m)	1 – 4
Triodia epactia	Hummock Grass (<0.5 m)	5 – 9

BD_E_008

Date	25/06/2023	**Site type**	Flora: Quadrat	**Botanist**	AC
Location	-21.93905, 119.97609				
Landform	Low hill	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Basalt	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Shrub (>2 m)	1 – 4
Gossypium australe	Shrub (0.5-1 m)	< 1
Senna glutinosa subsp. *glutinosa*	Shrub (0.5-1 m)	< 1
Senna glutinosa subsp. *pruinosa*	Shrub (0.5-1 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Senna artemisioides subsp. *helmsii*	Shrub (<0.5 m)	< 1
Senna artemisioides subsp. *oligophylla*	Shrub (<0.5 m)	< 1
Sida echinocarpa	Shrub (<0.5 m)	< 1
Tribulus suberosus	Shrub (<0.5 m)	< 1
Arivela viscosa	Herb (<0.5 m)	< 1
Boerhavia coccinea	Herb (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Crotalaria medicaginea var. *neglecta*	Herb (<0.5 m)	< 1
Euphorbia australis var. *subtomentosa*	Herb (<0.5 m)	< 1
Euphorbia biconvexa	Herb (<0.5 m)	< 1
Evolvulus alsinoides var. *villosicalyx*	Herb (<0.5 m)	< 1
Gomphrena cunninghamii	Herb (<0.5 m)	< 1
Indigofera colutea	Herb (<0.5 m)	< 1
Notoleptopus decaisnei	Herb (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	< 1
Solanum horridum	Herb (<0.5 m)	< 1
Swainsona decurrens	Herb (<0.5 m)	< 1
Zaleya galericulata subsp. *galericulata*	Herb (<0.5 m)	< 1
Aristida contorta	Tussock Grass (<0.5 m)	1 – 4
Cymbopogon ambiguus	Tussock Grass (<0.5 m)	< 1
Enneapogon caerulescens	Tussock Grass (<0.5 m)	< 1
Enneapogon polyphyllus	Tussock Grass (<0.5 m)	1 – 4
Iseilema vaginiflorum	Tussock Grass (<0.5 m)	1 – 4
Paraneurachne muelleri	Tussock Grass (<0.5 m)	< 1
Sporobolus australasicus	Tussock Grass (<0.5 m)	< 1
Themeda triandra	Tussock Grass (<0.5 m)	< 1

Name	Stratum	Percent cover (%)
Triodia brizoides	Hummock Grass (<0.5 m)	50 – 74
Triodia epactia	Hummock Grass (<0.5 m)	1 – 4

BD_E_009

Date	25/06/2023	**Site type**	Flora: Quadrat	**Botanist**	AC
Location	-21.94348, 119.93301				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Dark brown	**Soil texture**	Clay		
Rock type	Basalt	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	Minor weed cover and grazing.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Shrub (>2 m)	< 1
Acacia synchronicia	Shrub (>2 m)	1 – 4
Vachellia farnesiana	Shrub (>2 m)	< 1
Hakea lorea subsp. *lorea*	Shrub (1-2 m)	< 1
Euploca tanythrix	Shrub (<0.5 m)	< 1
Senna ?hamersleyensis	Shrub (<0.5 m)	< 1
Senna artemisioides subsp. *helmsii*	Shrub (<0.5 m)	< 1
Sida trichopoda	Shrub (<0.5 m)	1 – 4
Solanum lasiophyllum	Shrub (<0.5 m)	< 1
Abutilon malvifolium	Herb (<0.5 m)	< 1
Alysicarpus muelleri	Herb (<0.5 m)	< 1
Arivela viscosa	Herb (<0.5 m)	< 1
Austrobryonia pilbarensis	Herb (<0.5 m)	< 1
Boerhavia burbidgeana	Herb (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Corchorus trilocularis	Herb (<0.5 m)	< 1
Crotalaria medicaginea var. *neglecta*	Herb (<0.5 m)	< 1
Cullen graveolens	Herb (<0.5 m)	< 1
Dolichocarpa crouchiana	Herb (<0.5 m)	< 1
Euphorbia boophthona	Herb (<0.5 m)	< 1
Euphorbia inappendiculata var. *queenslandica*	Herb (<0.5 m)	< 1
Evolvulus alsinoides var. *villosicalyx*	Herb (<0.5 m)	< 1
Gomphrena cunninghamii	Herb (<0.5 m)	< 1
Goodenia muelleriana	Herb (<0.5 m)	< 1
Grona muelleri	Herb (<0.5 m)	< 1
Heliotropium crispatum	Herb (<0.5 m)	< 1
Hibiscus brachysiphonius	Herb (<0.5 m)	< 1
Indigofera linifolia	Herb (<0.5 m)	1 – 4
Malvastrum americanum	Herb (<0.5 m)	< 1
Nellica maderaspatensis	Herb (<0.5 m)	< 1
Neptunia xanthonema	Herb (<0.5 m)	< 1

Name	Stratum	Percent cover (%)
Operculina aequisepala	Herb (<0.5 m)	< 1
Portulaca oleracea	Herb (<0.5 m)	< 1
Pterocaulon sphacelatum	Herb (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	5 – 9
Sida spinosa	Herb (<0.5 m)	< 1
Solanum horridum	Herb (<0.5 m)	< 1
Tephrosia sp. clay soils (S. van Leeuwen et al. PBS 0273)	Herb (<0.5 m)	< 1
Aristida latifolia	Tussock Grass (<0.5 m)	10 – 24
Chrysopogon fallax	Tussock Grass (<0.5 m)	< 1
Cynodon convergens	Tussock Grass (<0.5 m)	5 – 9
Dichanthium sericeum subsp. *humilius*	Tussock Grass (<0.5 m)	< 1
Enneapogon caerulescens	Tussock Grass (<0.5 m)	< 1
Enneapogon polyphyllus	Tussock Grass (<0.5 m)	1 – 4
Eragrostis desertorum	Tussock Grass (<0.5 m)	1 – 4
Eragrostis tenellula	Tussock Grass (<0.5 m)	< 1
Eriachne mucronata	Tussock Grass (<0.5 m)	33 – 49
Iseilema vaginiflorum	Tussock Grass (<0.5 m)	10 – 24
Panicum decompositum	Tussock Grass (<0.5 m)	< 1
Sporobolus australasicus	Tussock Grass (<0.5 m)	< 1
Triodia brizoides	Hummock Grass (<0.5 m)	1 – 4
Triodia epactia	Hummock Grass (<0.5 m)	1 – 4

BD_E_010

Date	25/06/2023	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-21.95095, 119.91795				
Landform	Undulating plain	**Slope**	NA		
Soil colour	Orange	**Soil texture**	Clay		
Rock type	Dolerite	**Rock size**	Mixed	**Rock cover**	> 70%
Vegetation condition	Very Good	**Disturbance**	Minor weed cover and grazing.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Acacia synchronicia	Shrub (>2 m)	< 1
Vachellia farnesiana	Shrub (>2 m)	1 – 4
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Indigofera trita subsp. *trita*	Shrub (<0.5 m)	< 1
Senna ?hamersleyensis	Shrub (<0.5 m)	< 1
Senna artemisioides subsp. *helmsii*	Shrub (<0.5 m)	< 1
Sida trichopoda	Shrub (<0.5 m)	5 – 9
Solanum lasiophyllum/phlomoides	Shrub (<0.5 m)	< 1
Fimbristylis dichotoma	Sedge (<0.5 m)	< 1
Crotalaria dissitiflora subsp. *benthamiana*	Herb (<0.5 m)	< 1
Dolichocarpa crouchiana	Herb (<0.5 m)	1 – 4
Evolvulus alsinoides var. *villosicalyx*	Herb (<0.5 m)	< 1
Gomphrena cunninghamii	Herb (<0.5 m)	< 1
Goodenia muelleriana	Herb (<0.5 m)	< 1
Grona muelleri	Herb (<0.5 m)	< 1
Heliotropium crispatum	Herb (<0.5 m)	< 1
Hibiscus brachysiphonius	Herb (<0.5 m)	< 1
Indigofera linifolia	Herb (<0.5 m)	< 1
Ipomoea muelleri	Herb (<0.5 m)	< 1
Malvastrum americanum	Herb (<0.5 m)	< 1
Nellica maderaspatensis	Herb (<0.5 m)	< 1
Neptunia sp.	Herb (<0.5 m)	< 1
Portulaca oleracea	Herb (<0.5 m)	< 1
Ptilotus gomphrenoides	Herb (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	< 1
Sclerolaena costata	Herb (<0.5 m)	1 – 4
Solanum horridum	Herb (<0.5 m)	< 1
Streptoglossa bubakii	Herb (<0.5 m)	< 1
Trigastrotheca molluginea	Herb (<0.5 m)	< 1
Aristida contorta	Tussock Grass (<0.5 m)	1 – 4
Aristida latifolia	Tussock Grass (<0.5 m)	5 – 9

Name	Stratum	Percent cover (%)
Chloris pectinata	Tussock Grass (<0.5 m)	5 – 9
Enneapogon polyphyllus	Tussock Grass (<0.5 m)	1 – 4
Eriachne mucronata	Tussock Grass (<0.5 m)	10 – 24
Iseilema vaginiflorum	Tussock Grass (<0.5 m)	< 1
Panicum decompositum	Tussock Grass (<0.5 m)	< 1
Sporobolus australasicus	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	5 – 9

BD_E_011

Date	24/06/2023	**Site type**	Flora: Quadrat	**Botanist**	AC
Location	-21.94346, 119.89337				
Landform	Undulating plain	**Slope**	NA		
Soil colour	Dark brown	**Soil texture**	Clay		
Rock type	Basalt	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	30 – 70%
Vegetation condition	Excellent	**Disturbance**	Minor weed cover and grazing.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Vachellia farnesiana	Shrub (1-2 m)	< 1
Acacia synchronicia	Shrub (0.5-1 m)	< 1
Hakea lorea subsp. *lorea*	Shrub (0.5-1 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Euploca tanythrix	Shrub (<0.5 m)	< 1
Sida trichopoda	Shrub (<0.5 m)	5 – 9
Solanum lasiophyllum	Shrub (<0.5 m)	< 1
Bulbostylis turbinata	Sedge (<0.5 m)	< 1
Fimbristylis dichotoma	Sedge (<0.5 m)	< 1
Sida spinosa	Herb (0.5-1 m)	< 1
Abutilon malvifolium	Herb (<0.5 m)	< 1
Arivela viscosa	Herb (<0.5 m)	< 1
Boerhavia gardneri	Herb (<0.5 m)	< 1
Cullen graveolens	Herb (<0.5 m)	1 – 4
Dolichocarpa crouchiana	Herb (<0.5 m)	< 1
Evolvulus alsinoides var. *villosicalyx*	Herb (<0.5 m)	< 1
Goodenia muelleriana	Herb (<0.5 m)	< 1
Grona muelleri	Herb (<0.5 m)	< 1
Hibiscus brachysiphonius	Herb (<0.5 m)	< 1
Indigofera linifolia	Herb (<0.5 m)	< 1
Ipomoea muelleri	Herb (<0.5 m)	< 1
Malvastrum americanum	Herb (<0.5 m)	< 1
Neptunia xanthonema	Herb (<0.5 m)	< 1
Operculina aequisepala	Herb (<0.5 m)	< 1
Portulaca oleracea	Herb (<0.5 m)	< 1
Ptilotus gomphrenoides	Herb (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	1 – 4
Solanum horridum	Herb (<0.5 m)	< 1
Streptoglossa bubakii	Herb (<0.5 m)	< 1
Tephrosia sp. clay soils (S. van Leeuwen et al. PBS 0273)	Herb (<0.5 m)	< 1
Aristida contorta	Tussock Grass (<0.5 m)	< 1

Name	Stratum	Percent cover (%)
Aristida latifolia	Tussock Grass (<0.5 m)	25 – 32
Cynodon convergens	Tussock Grass (<0.5 m)	5 – 9
Dichanthium sericeum subsp. *humilius*	Tussock Grass (<0.5 m)	< 1
Enneapogon caerulescens	Tussock Grass (<0.5 m)	1 – 4
Enneapogon polyphyllus	Tussock Grass (<0.5 m)	< 1
Eragrostis tenellula	Tussock Grass (<0.5 m)	< 1
Eriachne mucronata	Tussock Grass (<0.5 m)	25 – 32
Iseilema vaginiflorum	Tussock Grass (<0.5 m)	5 – 9
Panicum decompositum	Tussock Grass (<0.5 m)	< 1
Sporobolus australasicus	Tussock Grass (<0.5 m)	< 1
Tripogonella loliiformis	Tussock Grass (<0.5 m)	< 1
Triodia brizoides	Hummock Grass (<0.5 m)	1 – 4

BD_E_012

Date	25/06/2023	**Site type**	Flora: Quadrat	**Botanist**	LE
Location	-21.95453, 119.93438				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone, quartz	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	< 1
Acacia inaequilatera	Shrub (>2 m)	1 – 4
Acacia ancistrocarpa	Shrub (1-2 m)	5 – 9
Acacia colei var. *colei*	Shrub (0.5-1 m)	< 1
Acacia synchronicia	Shrub (0.5-1 m)	< 1
Hakea lorea subsp. *lorea*	Shrub (0.5-1 m)	< 1
Senna ?stricta	Shrub (0.5-1 m)	1 – 4
Corchorus parviflorus	Shrub (<0.5 m)	1 – 4
Solanum lasiophyllum/phlomoides	Shrub (<0.5 m)	< 1
Arivela viscosa	Herb (<0.5 m)	< 1
Cucumis variabilis	Herb (<0.5 m)	< 1
Evolvulus alsinoides var. *villosicalyx*	Herb (<0.5 m)	< 1
Ptilotus exaltatus	Herb (<0.5 m)	< 1
Trichodesma zeylanicum var. *zeylanicum*	Herb (<0.5 m)	< 1
Aristida contorta	Tussock Grass (<0.5 m)	< 1
Enneapogon polyphyllus	Tussock Grass (<0.5 m)	< 1
Sporobolus australasicus	Tussock Grass (<0.5 m)	< 1
Triodia brizoides	Hummock Grass (<0.5 m)	10 – 24

BD_E_013

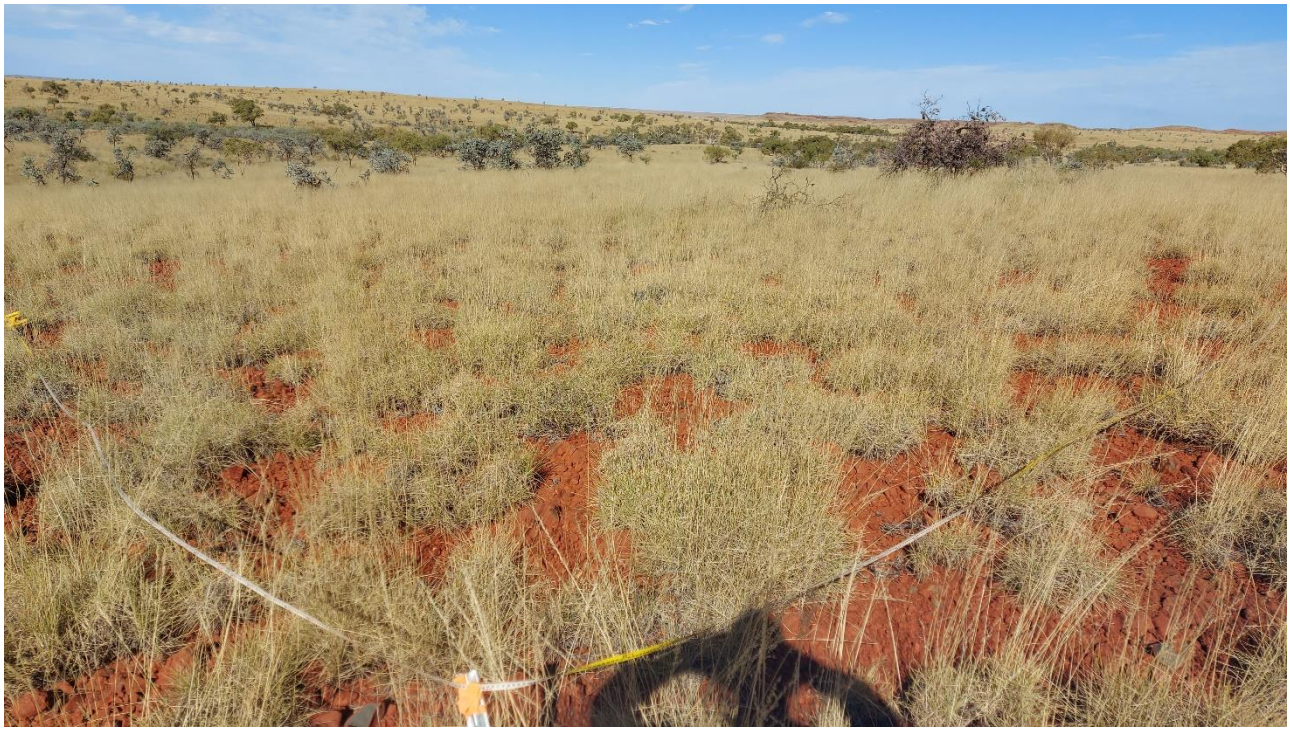
Date	25/06/2023	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-21.95592, 119.94736				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Orange	**Soil texture**	Clay loam		
Rock type	Dolerite	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia eriopoda	Shrub (>2 m)	< 1
Acacia synchronicia	Shrub (>2 m)	1 – 4
Gossypium australe	Shrub (>2 m)	1 – 4
Grevillea wickhamii	Shrub (>2 m)	1 – 4
Acacia ancistrocarpa	Shrub (1-2 m)	< 1
Acacia inaequilatera	Shrub (1-2 m)	1 – 4
Indigofera monophylla	Shrub (0.5-1 m)	5 – 9
Senna artemisioides subsp. *oligophylla*	Shrub (0.5-1 m)	< 1
Senna glutinosa subsp. *pruinosa*	Shrub (0.5-1 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Cullen ?lachnostachys	Shrub (<0.5 m)	< 1
Senna artemisioides subsp. *helmsii*	Shrub (<0.5 m)	< 1
Sida echinocarpa	Shrub (<0.5 m)	< 1
Fimbristylis dichotoma	Sedge (<0.5 m)	1 – 4
Achyranthes aspera	Herb (<0.5 m)	< 1
Alysicarpus muelleri	Herb (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Cheilanthes sieberi subsp. *sieberi*	Herb (<0.5 m)	< 1
Cucumis variabilis	Herb (<0.5 m)	< 1
Evolvulus alsinoides var. *villosicalyx*	Herb (<0.5 m)	1 – 4
Rhynchosia minima	Herb (<0.5 m)	1 – 4
Stemodia grossa	Herb (<0.5 m)	< 1
Trigastrotheca molluginea	Herb (<0.5 m)	< 1
Cymbopogon ambiguus	Tussock Grass (0.5-1 m)	1 – 4
Enneapogon polyphyllus	Tussock Grass (<0.5 m)	< 1
Sporobolus australasicus	Tussock Grass (<0.5 m)	< 1
Triodia brizoides	Hummock Grass (<0.5 m)	25 – 32
Triodia epactia	Hummock Grass (<0.5 m)	10 – 24

BD_E_014

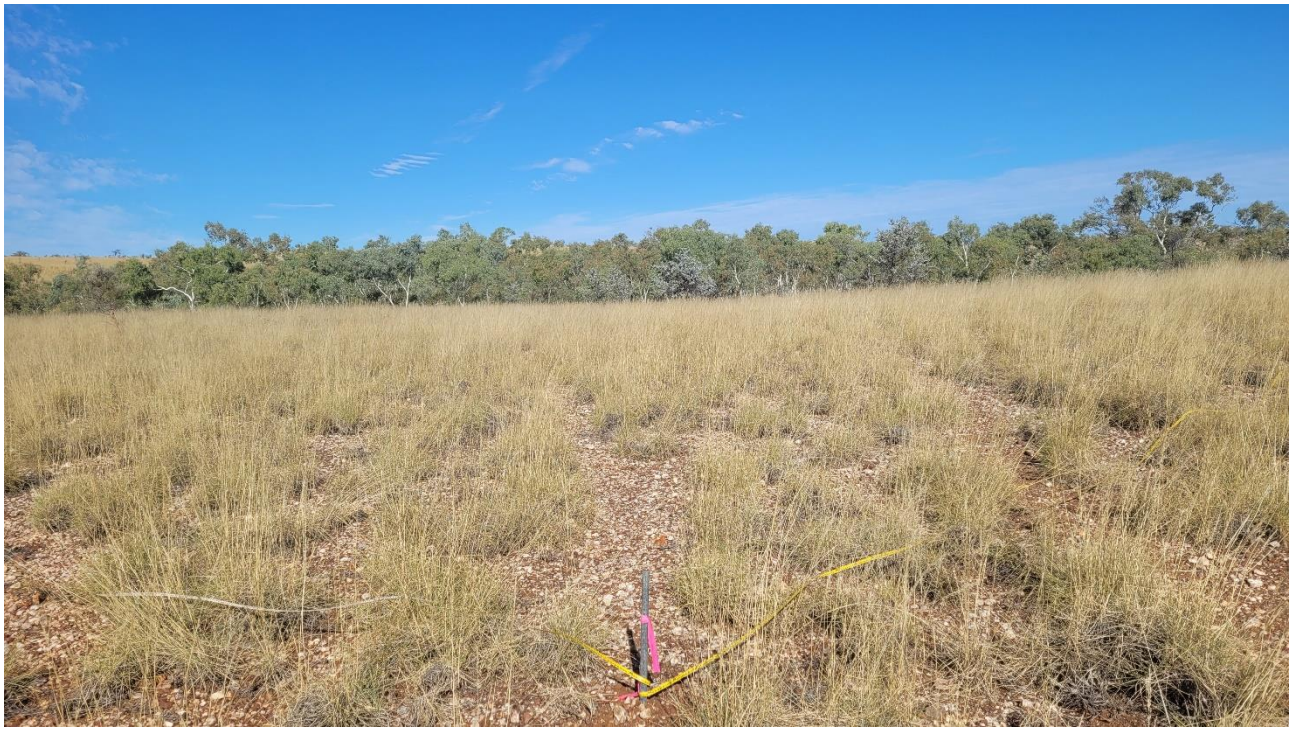
Date	25/06/2023	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-21.96602, 119.92164				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Dolerite	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Shrub (>2 m)	5 – 9
Hakea lorea subsp. *lorea*	Shrub (>2 m)	< 1
Acacia tetragonophylla	Shrub (1-2 m)	< 1
Senna glutinosa subsp. *glutinosa*	Shrub (1-2 m)	1 – 4
Senna glutinosa subsp. *pruinosa*	Shrub (1-2 m)	< 1
Senna artemisioides subsp. *oligophylla*	Shrub (0.5-1 m)	< 1
Cucumis variabilis	Herb (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	33 – 49

BD_E_015

Date	25/06/2023	**Site type**	Flora: Quadrat	**Botanist**	LE
Location	-21.97508, 119.92119				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Sandy loam		
Rock type	Quartz	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	Minor weed cover and grazing.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	1 – 4
Acacia inaequilatera	Shrub (>2 m)	5 – 9
Acacia trachycarpa	Shrub (>2 m)	1 – 4
Hakea lorea subsp. *lorea*	Shrub (>2 m)	1 – 4
Gossypium australe	Shrub (1-2 m)	1 – 4
Senna ?stricta	Shrub (0.5-1 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Sida ?trichopoda	Shrub (<0.5 m)	< 1
Arivela viscosa	Herb (<0.5 m)	< 1
Boerhavia coccinea	Herb (<0.5 m)	< 1
Cucumis variabilis	Herb (<0.5 m)	< 1
Euphorbia vaccaria var. *vaccaria*	Herb (<0.5 m)	< 1
Evolvulus alsinoides var. *villosicalyx*	Herb (<0.5 m)	< 1
Indigofera colutea	Herb (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	< 1
Cymbopogon ambiguus	Tussock Grass (0.5-1 m)	< 1
Cenchrus setiger	Tussock Grass (<0.5 m)	< 1
Enneapogon caerulescens	Tussock Grass (<0.5 m)	< 1
Sporobolus australasicus	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	25 – 32
?Amyema preissii	Parasitic/Epiphytic (1-2 m)	< 1

BD_E_016

Date	23/06/2023	**Site type**	Flora: Quadrat	**Botanist**	RS
Location	-21.98262, 120.00164				
Landform	Low hill	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Dolerite, quartz	**Rock size**	Mixed	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Shrub (>2 m)	5 – 9
Grevillea wickhamii	Shrub (1-2 m)	< 1
Hakea lorea subsp. *lorea*	Shrub (1-2 m)	< 1
Senna ?stricta	Shrub (1-2 m)	Assoc.
Senna glutinosa subsp. *glutinosa*	Shrub (0.5-1 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Sida echinocarpa	Shrub (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Aristida contorta	Tussock Grass (<0.5 m)	< 1
Eriachne lanata	Tussock Grass (<0.5 m)	1 – 4
Triodia epactia	Hummock Grass (0.5-1 m)	33 – 49

BD_E_017

Date	25/06/2023	**Site type**	Flora: Quadrat	**Botanist**	AC
Location	-21.97114, 119.91831				
Landform	Major creek (5-30 m)	**Slope**	NA		
Soil colour	Dark brown	**Soil texture**	Loam		
Rock type	Basalt	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	10 – 30%
Vegetation condition	Degraded	**Disturbance**	High weed cover and heavy grazing.		
Time since fire	Long (> 3 yrs)				

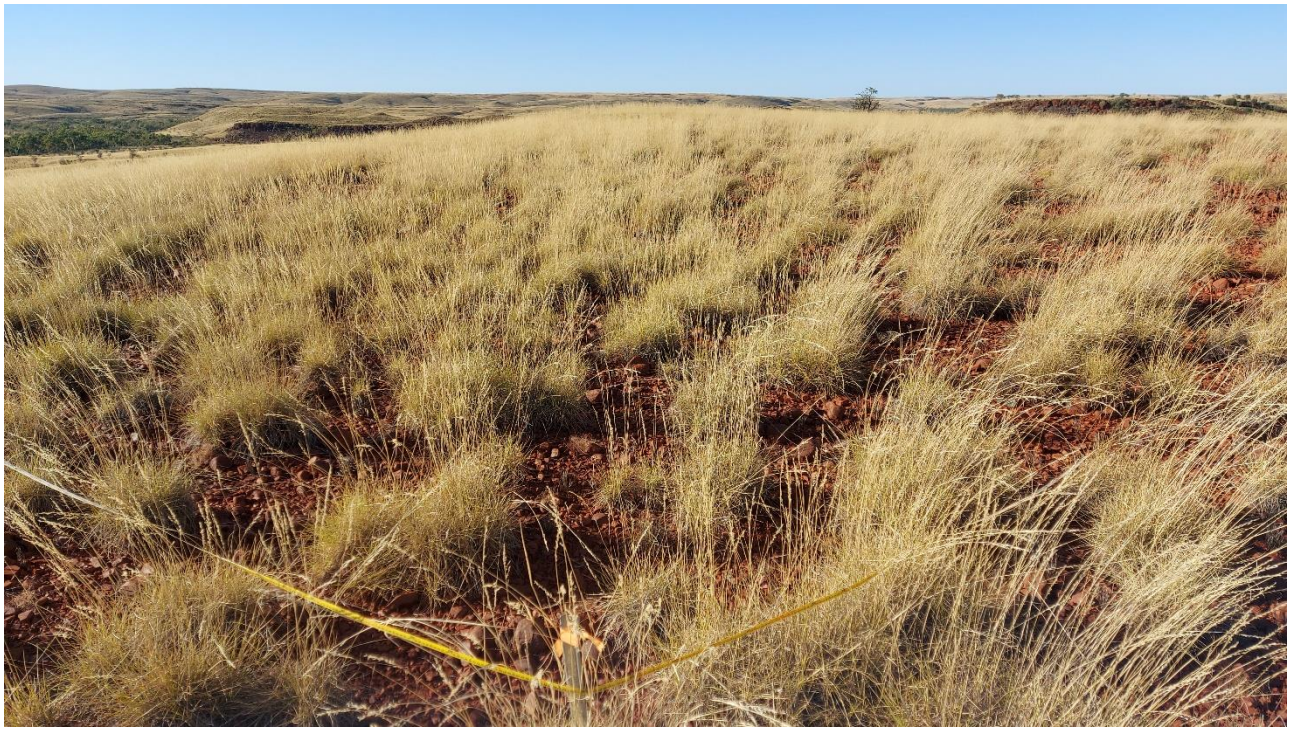


Name	Stratum	Percent cover (%)
Eucalyptus camaldulensis	Tree (10-30 m)	Assoc.
Eucalyptus victrix	Tree (10-30 m)	25 – 32
Acacia coriacea subsp. *pendens*	Tree (<10 m)	5 – 9
Acacia pyrifolia	Shrub (>2 m)	1 – 4
Acacia tetragonophylla	Shrub (>2 m)	1 – 4
Acacia trachycarpa	Shrub (>2 m)	1 – 4
Acacia tumida var. *pilbarensis*	Shrub (>2 m)	1 – 4
Atalaya hemiglauca	Shrub (>2 m)	1 – 4
Flueggea virosa subsp. *melanthesoides*	Shrub (>2 m)	< 1
Melaleuca bracteata	Shrub (>2 m)	10 – 24
Vachellia farnesiana	Shrub (>2 m)	5 – 9
Afrohybanthus aurantiacus	Shrub (<0.5 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Cullen leucanthum	Shrub (<0.5 m)	< 1
Bulbostylis turbinata	Sedge (<0.5 m)	< 1
Cyperus iria	Sedge (<0.5 m)	1 – 4
Fimbristylis microcarya	Sedge (<0.5 m)	< 1
Achyranthes aspera	Herb (<0.5 m)	< 1
Alternanthera nana	Herb (<0.5 m)	< 1
Boerhavia coccinea	Herb (<0.5 m)	< 1
Crotalaria medicaginea var. *neglecta*	Herb (<0.5 m)	< 1
Cucumis variabilis	Herb (<0.5 m)	< 1
Duperreya commixta	Herb (<0.5 m)	< 1
Euphorbia australis var. *subtomentosa*	Herb (<0.5 m)	< 1
Euphorbia biconvexa	Herb (<0.5 m)	< 1
Evolvulus alsinoides var. *decumbens*	Herb (<0.5 m)	< 1
Evolvulus alsinoides var. *villosicalyx*	Herb (<0.5 m)	< 1
Glycine canescens	Herb (<0.5 m)	< 1
Ipomoea muelleri	Herb (<0.5 m)	< 1
Ipomoea polymorpha	Herb (<0.5 m)	< 1
Malvastrum americanum	Herb (<0.5 m)	1 – 4

Name	Stratum	Percent cover (%)
Nellica maderaspatensis	Herb (<0.5 m)	< 1
Nicotiana obliqua/occidentalis	Herb (<0.5 m)	< 1
Portulaca oleracea	Herb (<0.5 m)	< 1
Rostellularia adscendens var. *clementii*	Herb (<0.5 m)	1 – 4
Sida spinosa	Herb (<0.5 m)	< 1
Vigna sp. Hamersley Clay (A.A. Mitchell PRP 113)	Herb (<0.5 m)	< 1
Cenchrus ciliaris	Tussock Grass (<0.5 m)	33 – 49
Cenchrus setiger	Tussock Grass (<0.5 m)	33 – 49
Echinochloa colona	Tussock Grass (<0.5 m)	1 – 4
Enneapogon polyphyllus	Tussock Grass (<0.5 m)	< 1
Eragrostis cumingii	Tussock Grass (<0.5 m)	< 1
Eragrostis leptocarpa	Tussock Grass (<0.5 m)	< 1
Eragrostis tenellula	Tussock Grass (<0.5 m)	< 1
Eriachne tenuiculmis	Tussock Grass (<0.5 m)	< 1
Paraneurachne muelleri	Tussock Grass (<0.5 m)	< 1
Themeda triandra	Tussock Grass (<0.5 m)	< 1
Triodia longiceps	Hummock Grass (0.5-1 m)	1 – 4
Triodia epactia	Hummock Grass (<0.5 m)	5 – 9
Amyema ?sanguinea	Parasitic/Epiphytic (<0.5 m)	< 1

BD_E_018

Date	24/06/2023	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-21.96913, 120.01533				
Landform	Low hill	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Dolerite	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Shrub (>2 m)	1 – 4
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Senna artemisioides subsp. *oligophylla*	Shrub (<0.5 m)	< 1
Fimbristylis dichotoma	Sedge (<0.5 m)	1 – 4
Arivela viscosa	Herb (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Gomphrena cunninghamii	Herb (<0.5 m)	< 1
Solanum horridum	Herb (<0.5 m)	< 1
Aristida contorta	Tussock Grass (<0.5 m)	< 1
Enneapogon caerulescens	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	33 – 49

BD_E_019

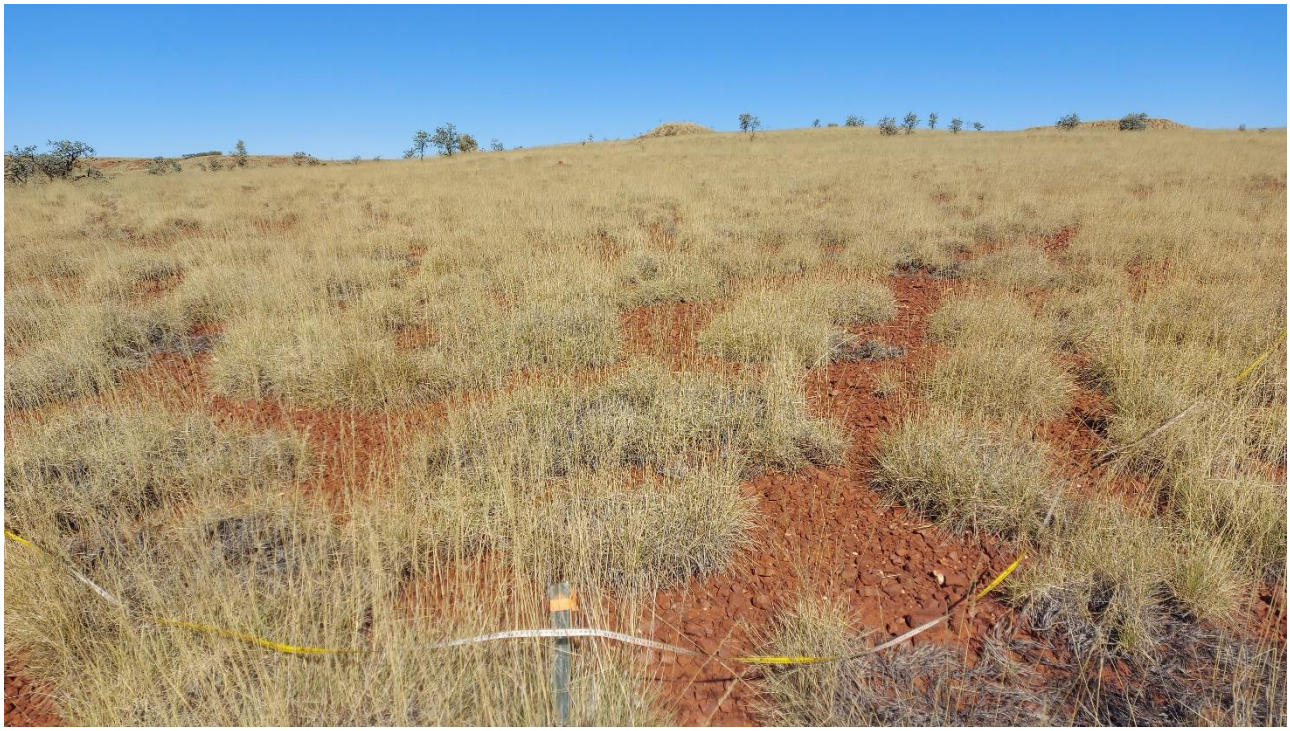
Date	25/06/2023	**Site type**	Flora: Quadrat	**Botanist**	AC
Location	-21.97069, 119.95174				
Landform	Low hill	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Calcrete, quartzite	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Moderate (2 – 3 yrs)				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	5 – 9
Acacia inaequilatera	Shrub (>2 m)	1 – 4
Hakea lorea subsp. *lorea*	Shrub (>2 m)	1 – 4
Acacia bivenosa	Shrub (1-2 m)	1 – 4
Senna glutinosa subsp. ×*luerssenii*	Shrub (1-2 m)	< 1
Capparis spinosa subsp. *nummularia*	Shrub (0.5-1 m)	< 1
Capparis umbonata	Shrub (0.5-1 m)	< 1
Grevillea pyramidalis subsp. *leucadendron*	Shrub (0.5-1 m)	< 1
Scaevola spinescens	Shrub (0.5-1 m)	< 1
Sida sp. spiciform panicles (E. Leyland s.n. 14/8/90)	Shrub (0.5-1 m)	< 1
Afrohybanthus aurantiacus	Shrub (<0.5 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	5 – 9
Hibiscus sturtii var. *campylochlamys*	Shrub (<0.5 m)	< 1
Indigofera monophylla	Shrub (<0.5 m)	< 1
Senna ?artemisioides subsp. *oligophylla*	Shrub (<0.5 m)	< 1
Sida echinocarpa	Shrub (<0.5 m)	< 1
Solanum lasiophyllum	Shrub (<0.5 m)	< 1
Evolvulus alsinoides var. *villosicalyx*	Herb (<0.5 m)	< 1
Goodenia microptera	Herb (<0.5 m)	< 1
Ptilotus calostachyus	Herb (<0.5 m)	< 1
Ptilotus clementii	Herb (<0.5 m)	< 1
Salsola australis	Herb (<0.5 m)	< 1
Tephrosia sp. NW Eremaean (S. van Leeuwen et al. PBS 0356)	Herb (<0.5 m)	< 1
Aristida contorta	Tussock Grass (<0.5 m)	< 1
Cymbopogon ambiguus	Tussock Grass (<0.5 m)	< 1
Enneapogon caerulescens	Tussock Grass (<0.5 m)	< 1
Paraneurachne muelleri	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	10 – 24
Triodia wiseana	Hummock Grass (<0.5 m)	25 – 32

BD_E_020

Date	23/06/2023	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-22.06094, 119.93045				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Orange	**Soil texture**	Clay loam		
Rock type	Dolerite	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	Assoc.
Acacia synchronicia	Shrub (1-2 m)	1 – 4
Eremophila longifolia	Shrub (1-2 m)	Assoc.
Senna artemisioides subsp. *oligophylla*	Shrub (<0.5 m)	< 1
Tribulus suberosus	Shrub (<0.5 m)	< 1
Sclerolaena costata	Herb (<0.5 m)	< 1
Solanum horridum	Herb (<0.5 m)	< 1
Trigastrotheca molluginea	Herb (<0.5 m)	< 1
Aristida contorta	Tussock Grass (<0.5 m)	< 1
Sporobolus australasicus	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	25 – 32

BD_E_021

Date	24/06/2023	**Site type**	Flora: Quadrat	**Botanist**	LE
Location	-21.97233, 119.99993				
Landform	Ridge	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Shrub (>2 m)	1 – 4
Grevillea pyramidalis subsp. *leucadendron*	Shrub (>2 m)	5 – 9
Grevillea wickhamii subsp. *hispidula*	Shrub (>2 m)	5 – 9
Acacia pruinocarpa	Shrub (1-2 m)	1 – 4
Senna glutinosa subsp. *glutinosa*	Shrub (0.5-1 m)	< 1
Dampiera candicans	Shrub (<0.5 m)	< 1
Ptilotus incanus	Shrub (<0.5 m)	< 1
Sida sp. Pilbara (A.A. Mitchell PRP 1543)	Shrub (<0.5 m)	< 1
Ptilotus calostachyus	Herb (<0.5 m)	< 1
Eriachne lanata	Tussock Grass (<0.5 m)	5 – 9
Eriachne mucronata	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	10 – 24

BD_E_022

Date	24/06/2023	**Site type**	Flora: Quadrat	**Botanist**	AC
Location	-21.9768, 120.02843				
Landform	Major creek (5-30 m)	**Slope**	NA		
Soil colour	Dark brown	**Soil texture**	Sandy loam		
Rock type	Mixed river alluvium	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	< 10%
Vegetation condition	Degraded	**Disturbance**	High weed cover and heavy grazing.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Eucalyptus camaldulensis	Tree (10-30 m)	10 – 24
Eucalyptus victrix	Tree (10-30 m)	1 – 4
Acacia coriacea subsp. *pendens*	Tree (<10 m)	1 – 4
Acacia trachycarpa	Shrub (>2 m)	< 1
Atalaya hemiglauca	Shrub (>2 m)	5 – 9
Flueggea virosa subsp. *melanthesoides*	Shrub (>2 m)	< 1
Melaleuca bracteata	Shrub (>2 m)	5 – 9
Melaleuca glomerata	Shrub (>2 m)	5 – 9
Erythrina vespertilio	Shrub (1-2 m)	< 1
Vachellia farnesiana	Shrub (1-2 m)	< 1
Cullen leucanthum	Shrub (0.5-1 m)	< 1
Aerva javanica	Shrub (<0.5 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Plumbago zeylanica	Shrub (<0.5 m)	< 1
Schoenoplectus subulatus	Sedge (1-2 m)	< 1
Cyperus bifax	Sedge (<0.5 m)	< 1
Cyperus difformis	Sedge (<0.5 m)	1 – 4
Cyperus vaginatus	Sedge (<0.5 m)	5 – 9
Sesbania cannabina	Herb (0.5-1 m)	< 1
Alternanthera denticulata var. *denticulata*	Herb (<0.5 m)	< 1
Alternanthera nana	Herb (<0.5 m)	1 – 4
Amaranthus undulatus	Herb (<0.5 m)	< 1
Ammannia baccifera	Herb (<0.5 m)	1 – 4
Argemone ochroleuca subsp. *ochroleuca*	Herb (<0.5 m)	1 – 4
Arivela viscosa	Herb (<0.5 m)	< 1
Basilicum polystachyon	Herb (<0.5 m)	< 1
Bergia pedicellaris	Herb (<0.5 m)	< 1
Bergia trimera	Herb (<0.5 m)	< 1
Boerhavia burbidgeana	Herb (<0.5 m)	< 1
Boerhavia coccinea	Herb (<0.5 m)	< 1
Centipeda minima subsp. *macrocephala*	Herb (<0.5 m)	5 – 9

Name	Stratum	Percent cover (%)
Euphorbia hirta	Herb (<0.5 m)	< 1
Indigofera colutea	Herb (<0.5 m)	< 1
Ipomoea muelleri	Herb (<0.5 m)	< 1
Ipomoea plebeia	Herb (<0.5 m)	< 1
Lepidium muelleri-ferdinandi	Herb (<0.5 m)	< 1
Lobelia arnhemiaca	Herb (<0.5 m)	< 1
Malvastrum americanum	Herb (<0.5 m)	< 1
Marsilea exarata	Herb (<0.5 m)	< 1
Nellica maderaspatensis	Herb (<0.5 m)	< 1
Nicotiana obliqua/occidentalis	Herb (<0.5 m)	< 1
Notoleptopus decaisnei	Herb (<0.5 m)	< 1
Pluchea rubelliflora	Herb (<0.5 m)	1 – 4
Portulaca oleracea	Herb (<0.5 m)	< 1
Rostellularia adscendens var. *clementii*	Herb (<0.5 m)	< 1
Sida rohlenae subsp. *rohlenae*	Herb (<0.5 m)	< 1
Sonchus oleraceus	Herb (<0.5 m)	< 1
Stemodia grossa	Herb (<0.5 m)	< 1
Vigna sp. Hamersley Clay (A.A. Mitchell PRP 113)	Herb (<0.5 m)	< 1
Dichanthium sericeum	Tussock Grass (0.5-1 m)	< 1
Cenchrus ciliaris	Tussock Grass (<0.5 m)	33 – 49
Chloris pectinata	Tussock Grass (<0.5 m)	1 – 4
Cynodon dactylon	Tussock Grass (<0.5 m)	1 – 4
Dactyloctenium radulans	Tussock Grass (<0.5 m)	1 – 4
Echinochloa colona	Tussock Grass (<0.5 m)	1 – 4
Eragrostis cumingii	Tussock Grass (<0.5 m)	1 – 4
Eragrostis tenellula	Tussock Grass (<0.5 m)	1 – 4
Triodia longiceps	Hummock Grass (1-2 m)	1 – 4
Najas sp.	Aquatic (<0.5 m)	< 1
Potamogeton tepperi	Aquatic (<0.5 m)	1 – 4

BD_E_023

Date	24/06/2023	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-21.98124, 120.03017				
Landform	Low hill	**Slope**	Gentle		
Soil colour	Orange	**Soil texture**	Clay loam		
Rock type	Dolerite	**Rock size**	Mixed	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia colei var. *colei*	Shrub (>2 m)	Assoc.
Acacia inaequilatera	Shrub (>2 m)	1 – 4
Grevillea pyramidalis subsp. *leucadendron*	Shrub (>2 m)	1 – 4
Grevillea wickhamii	Shrub (>2 m)	Assoc.
Senna glutinosa subsp. *glutinosa*	Shrub (1-2 m)	< 1
Ptilotus calostachyus	Herb (0.5-1 m)	< 1
Goodenia stobbsiana	Herb (<0.5 m)	< 1
Cymbopogon ambiguus	Tussock Grass (0.5-1 m)	Assoc.
Triodia epactia	Hummock Grass (<0.5 m)	33 – 49

BD_E_024

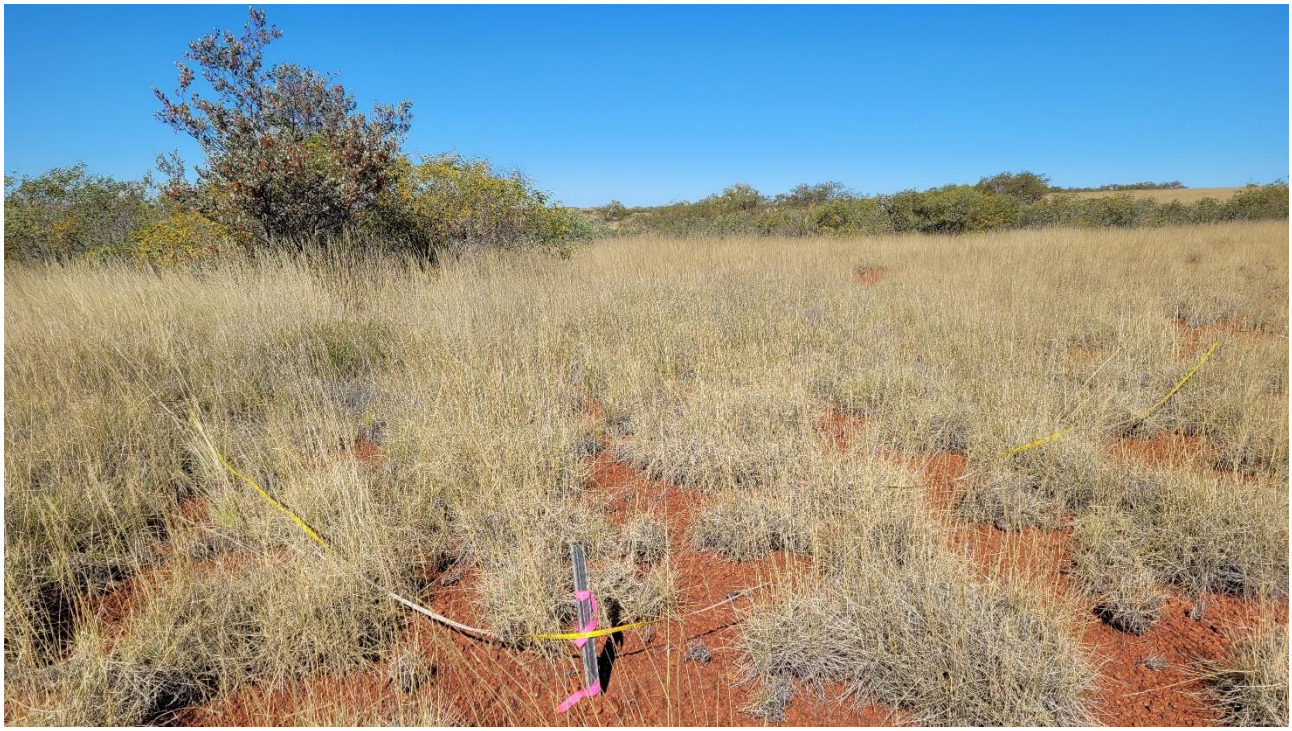
Date	24/06/2023	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-21.98475, 119.84271				
Landform	Undulating plain	**Slope**	NA		
Soil colour	Orange	**Soil texture**	Clay loam		
Rock type	Dolerite	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				

No photo.

Name	Stratum	Percent cover (%)
Acacia pruinocarpa	Shrub (>2 m)	1 – 4
Hakea lorea subsp. *lorea*	Shrub (>2 m)	Assoc.
Grevillea wickhamii	Shrub (1-2 m)	Assoc.
Senna glutinosa subsp. *pruinosa*	Shrub (0.5-1 m)	< 1
Tephrosia rosea var. *clementii*	Shrub (0.5-1 m)	Assoc.
Corchorus parviflorus	Shrub (<0.5 m)	Assoc.
Bonamia pilbarensis	Herb (<0.5 m)	Assoc.
Cucumis variabilis	Herb (<0.5 m)	< 1
Goodenia stobbsiana	Herb (<0.5 m)	Assoc.
Aristida contorta	Tussock Grass (<0.5 m)	< 1
Paraneurachne muelleri	Tussock Grass (<0.5 m)	Assoc.
Sporobolus australasicus	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	25 – 32

BD_E_025

Date	23/06/2023	**Site type**	Flora: Quadrat	**Botanist**	LE
Location	-22.05958, 119.93792				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	5 – 9
Acacia inaequilatera	Shrub (>2 m)	5 – 9
Acacia monticola	Shrub (>2 m)	5 – 9
Acacia tumida var. *pilbarensis*	Shrub (>2 m)	10 – 24
Grevillea wickhamii subsp. *hispidula*	Shrub (>2 m)	5 – 9
Indigofera monophylla	Shrub (0.5-1 m)	< 1
Senna glutinosa subsp. ×*luerssenii*	Shrub (0.5-1 m)	< 1
Senna glutinosa subsp. *glutinosa*	Shrub (0.5-1 m)	< 1
Seringia ?exastia	Shrub (0.5-1 m)	< 1
Sida sp. Pilbara (A.A. Mitchell PRP 1543)	Shrub (0.5-1 m)	< 1
Ptilotus calostachyus	Herb (0.5-1 m)	< 1
Solanum horridum	Herb (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	33 – 49

BD_E_026

Date	24/06/2023	**Site type**	Flora: Quadrat	**Botanist**	AC
Location	-21.96817, 120.02053				
Landform	Major creek (5-30 m)	**Slope**	NA		
Soil colour	Dark brown	**Soil texture**	Sandy loam		
Rock type	Mixed river alluvium	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	< 10%
Vegetation condition	Degraded	**Disturbance**	High weed cover and heavy grazing.		
Time since fire	Long (> 3 yrs)				

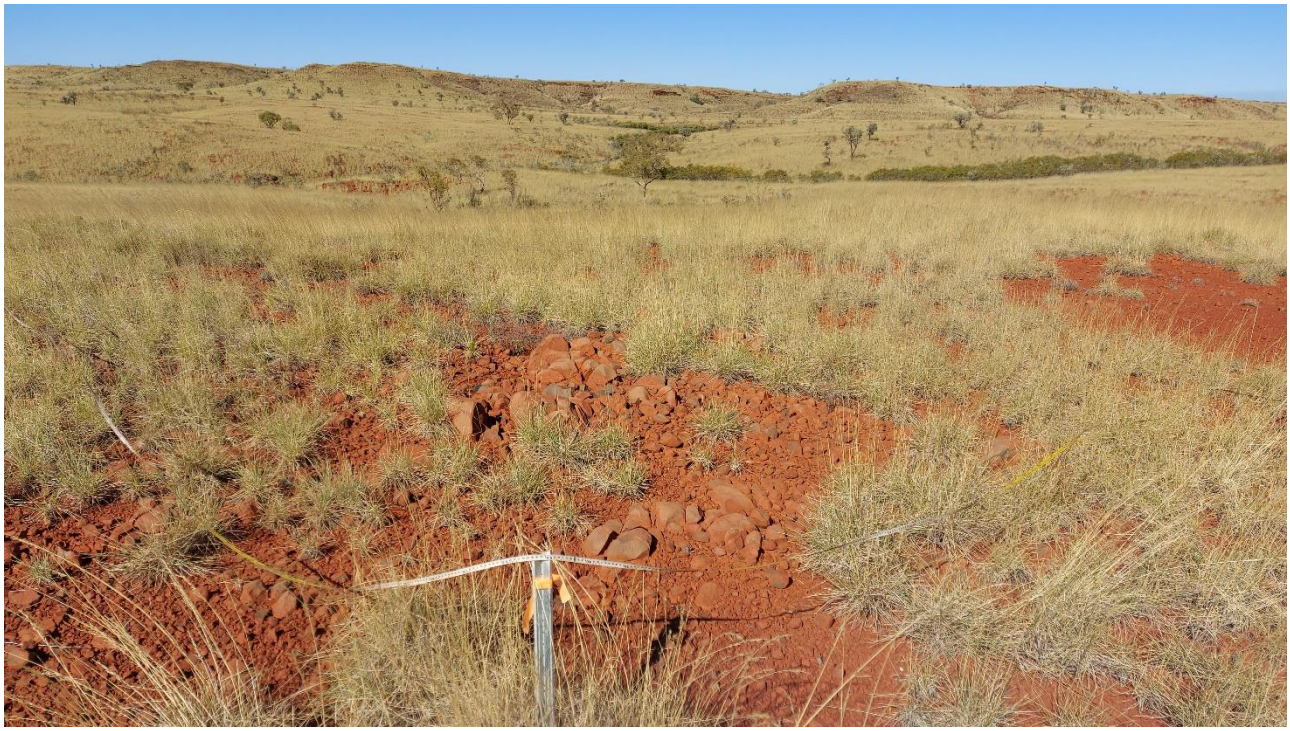


Name	Stratum	Percent cover (%)
Eucalyptus camaldulensis	Tree (10-30 m)	1 – 4
Eucalyptus victrix	Tree (10-30 m)	5 – 9
Acacia coriacea subsp. *pendens*	Tree (<10 m)	< 1
Acacia pyrifolia	Shrub (>2 m)	< 1
Acacia trachycarpa	Shrub (>2 m)	5 – 9
Acacia tumida var. *pilbarensis*	Shrub (>2 m)	1 – 4
Atalaya hemiglauca	Shrub (>2 m)	1 – 4
Flueggea virosa subsp. *melanthesoides*	Shrub (>2 m)	1 – 4
Grevillea pyramidalis subsp. *leucadendron*	Shrub (>2 m)	< 1
Melaleuca bracteata	Shrub (>2 m)	5 – 9
Melaleuca glomerata	Shrub (>2 m)	5 – 9
Gossypium australe	Shrub (1-2 m)	< 1
Grevillea wickhamii subsp. *aprica*	Shrub (1-2 m)	< 1
Cullen leucanthum	Shrub (0.5-1 m)	< 1
Aerva javanica	Shrub (<0.5 m)	< 1
Afrohybanthus aurantiacus	Shrub (<0.5 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Indigofera trita subsp. *trita*	Shrub (<0.5 m)	< 1
Solanum diversiflorum	Shrub (<0.5 m)	< 1
Cyperus vaginatus	Sedge (0.5-1 m)	5 – 9
Cyperus difformis	Sedge (<0.5 m)	< 1
Fimbristylis microcarya	Sedge (<0.5 m)	< 1
Sesbania cannabina	Herb (0.5-1 m)	< 1
Alternanthera denticulata var. *denticulata*	Herb (<0.5 m)	< 1
Alternanthera nana	Herb (<0.5 m)	< 1
Amaranthus undulatus	Herb (<0.5 m)	< 1
Ammannia baccifera	Herb (<0.5 m)	1 – 4
Argemone ochroleuca subsp. *ochroleuca*	Herb (<0.5 m)	1 – 4
Arivela viscosa	Herb (<0.5 m)	< 1
Basilicum polystachyon	Herb (<0.5 m)	< 1
Bergia pedicellaris	Herb (<0.5 m)	< 1

Name	Stratum	Percent cover (%)
Bergia trimera	Herb (<0.5 m)	< 1
Boerhavia burbidgeana	Herb (<0.5 m)	< 1
Cathetus exilis	Herb (<0.5 m)	< 1
Centipeda minima subsp. *macrocephala*	Herb (<0.5 m)	< 1
Crotalaria medicaginea var. *neglecta*	Herb (<0.5 m)	< 1
Euphorbia australis var. *subtomentosa*	Herb (<0.5 m)	< 1
Euphorbia trigonosperma	Herb (<0.5 m)	< 1
Evolvulus alsinoides var. *decumbens*	Herb (<0.5 m)	< 1
Evolvulus alsinoides var. *villosicalyx*	Herb (<0.5 m)	< 1
Glycine canescens	Herb (<0.5 m)	< 1
Indigofera colutea	Herb (<0.5 m)	< 1
Ipomoea muelleri	Herb (<0.5 m)	< 1
Ludwigia perennis	Herb (<0.5 m)	< 1
Malvastrum americanum	Herb (<0.5 m)	< 1
Marsilea exarata	Herb (<0.5 m)	5 – 9
Pluchea rubelliflora	Herb (<0.5 m)	1 – 4
Polymeria calycina	Herb (<0.5 m)	< 1
Portulaca oleracea	Herb (<0.5 m)	< 1
Rostellularia adscendens var. *clementii*	Herb (<0.5 m)	< 1
Rotala diandra	Herb (<0.5 m)	< 1
Scleromitrion galioides	Herb (<0.5 m)	< 1
Senna notabilis	Herb (<0.5 m)	< 1
Sida rohlenae subsp. *rohlenae*	Herb (<0.5 m)	< 1
Stemodia grossa	Herb (<0.5 m)	< 1
Vigna sp. Hamersley Clay (A.A. Mitchell PRP 113)	Herb (<0.5 m)	< 1
Waltheria indica	Herb (<0.5 m)	< 1
Dichanthium sericeum	Tussock Grass (0.5-1 m)	1 – 4
Cenchrus ciliaris	Tussock Grass (<0.5 m)	33 – 49
Cenchrus setiger	Tussock Grass (<0.5 m)	10 – 24
Echinochloa colona	Tussock Grass (<0.5 m)	< 1
Enneapogon caerulescens	Tussock Grass (<0.5 m)	< 1
Eragrostis cumingii	Tussock Grass (<0.5 m)	1 – 4
Eragrostis leptocarpa	Tussock Grass (<0.5 m)	< 1
Eragrostis tenellula	Tussock Grass (<0.5 m)	< 1
Triodia longiceps	Hummock Grass (0.5-1 m)	< 1

BD_E_027

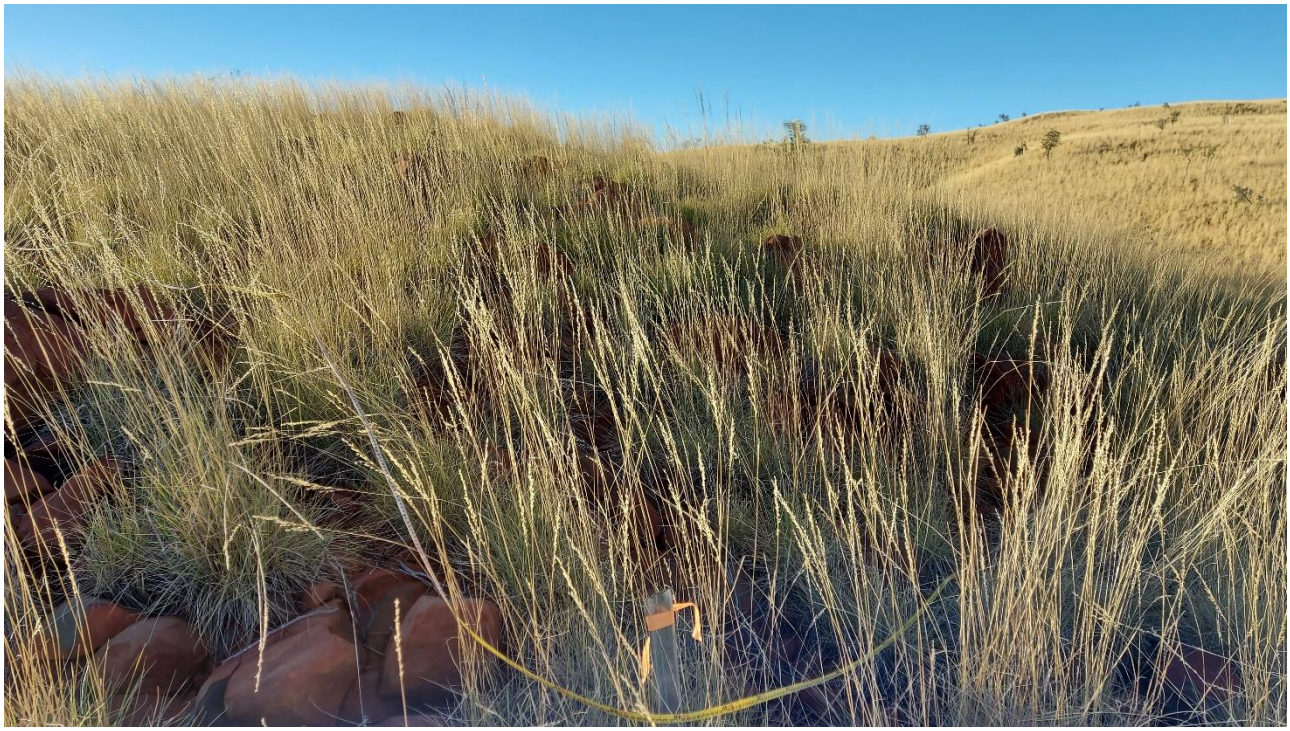
Date	24/06/2023	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-21.99116, 119.83156				
Landform	Low hill	**Slope**	Gentle		
Soil colour	Orange	**Soil texture**	Clay loam		
Rock type	Dolerite	**Rock size**	Mixed	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia orthocarpa	Shrub (>2 m)	1 – 4
Grevillea wickhamii	Shrub (>2 m)	5 – 9
Senna glutinosa subsp. *glutinosa*	Shrub (>2 m)	1 – 4
Dodonaea coriacea	Shrub (1-2 m)	< 1
Acacia colei var. *colei*	Shrub (0.5-1 m)	< 1
Indigofera monophylla	Shrub (<0.5 m)	5 – 9
Ptilotus calostachyus	Herb (0.5-1 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Goodenia stobbsiana	Herb (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	33 – 49

BD_E_028

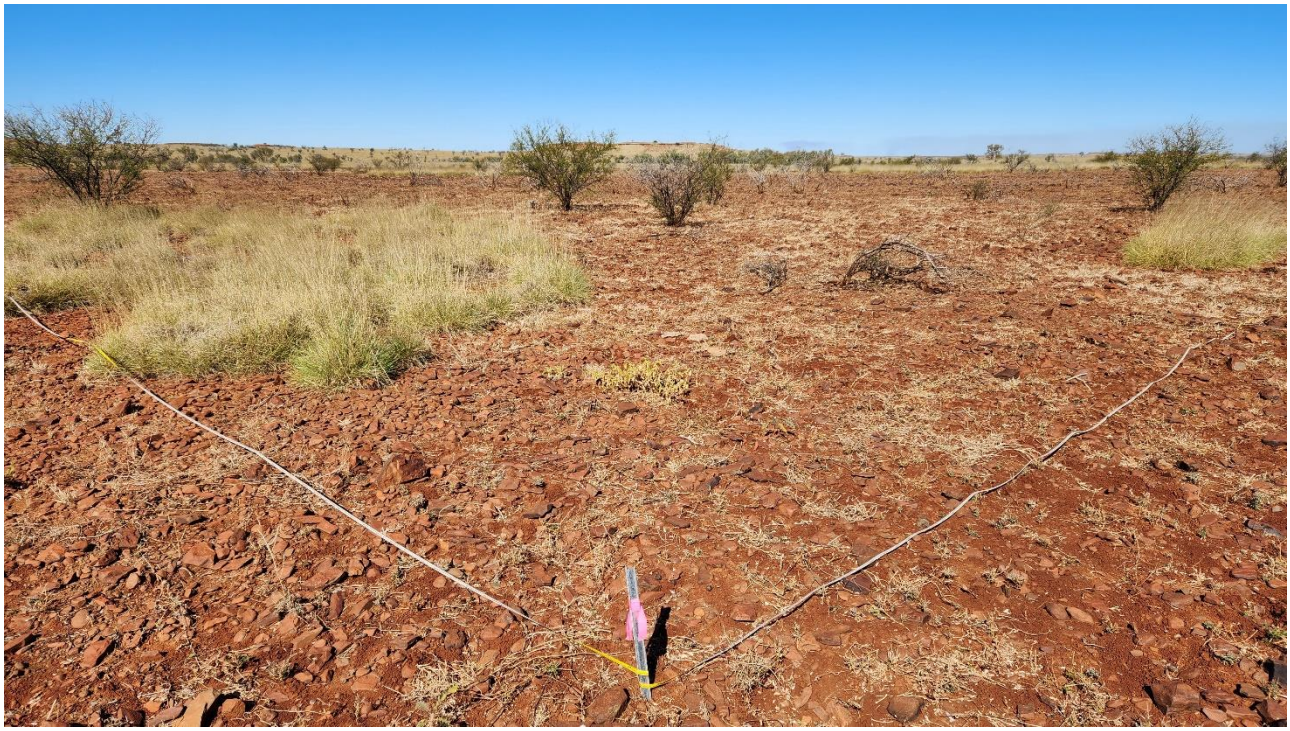
Date	23/06/2023	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-21.98887, 119.99515				
Landform	Low hill	**Slope**	Steep		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Dolerite	**Rock size**	Boulders [> 260 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Shrub (>2 m)	1 – 4
Grevillea pyramidalis subsp. *leucadendron*	Shrub (1-2 m)	< 1
Senna glutinosa subsp. *glutinosa*	Shrub (1-2 m)	< 1
Hakea lorea subsp. *lorea*	Shrub (0.5-1 m)	< 1
Senna artemisioides subsp. *oligophylla*	Shrub (0.5-1 m)	< 1
Senna glutinosa subsp. *pruinosa*	Shrub (0.5-1 m)	< 1
Fimbristylis dichotoma	Sedge (<0.5 m)	1 – 4
Triodia epactia	Hummock Grass (<0.5 m)	33 – 49

BD_E_029

Date	24/06/2023	**Site type**	Flora: Quadrat	**Botanist**	AC
Location	-21.99787, 119.85186				
Landform	Plain (clay)	**Slope**	NA		
Soil colour	Dark brown	**Soil texture**	Clay		
Rock type	Basalt	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	30 – 70%
Vegetation condition	Very Good	**Disturbance**	Minor weed cover and grazing.		
Time since fire	Long (> 3 yrs)				

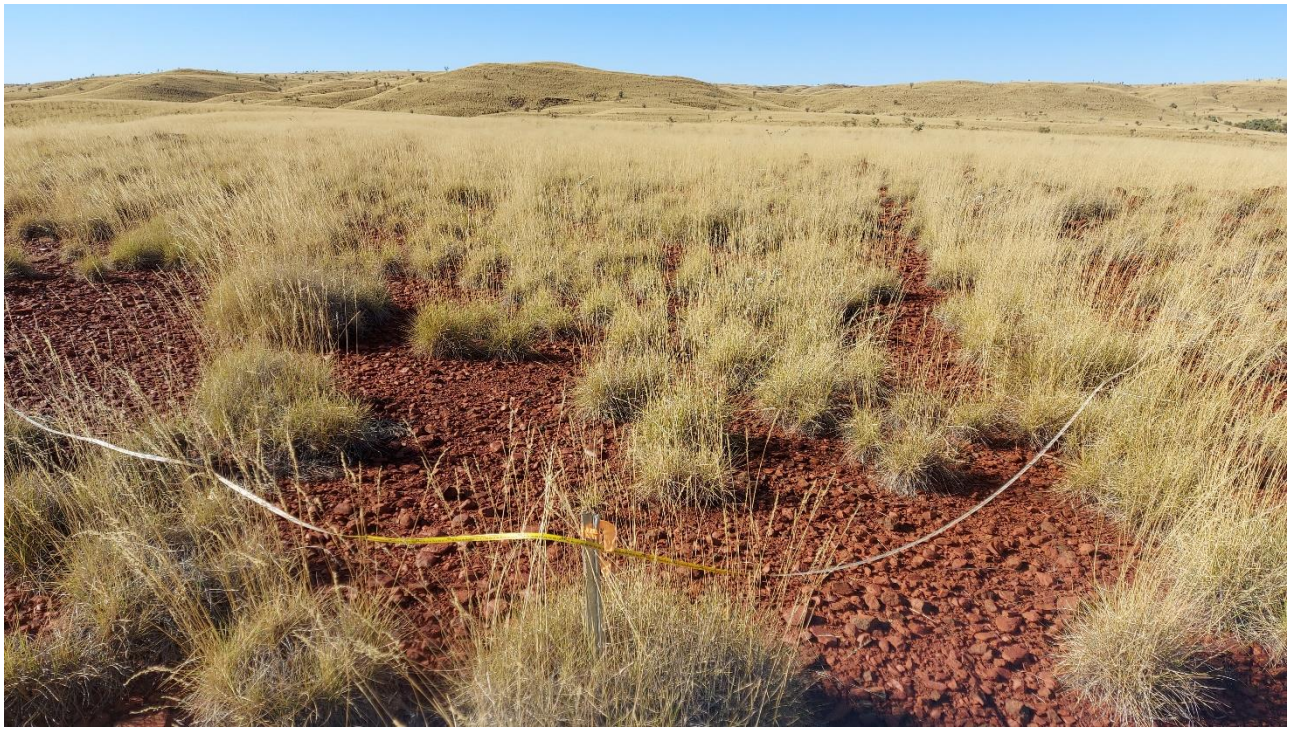


Name	Stratum	Percent cover (%)
Vachellia farnesiana	Shrub (>2 m)	1 – 4
Capparis spinosa subsp. *nummularia*	Shrub (<0.5 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Euploca tanythrix	Shrub (<0.5 m)	< 1
Indigofera trita subsp. *trita*	Shrub (<0.5 m)	1 – 4
Sida trichopoda	Shrub (<0.5 m)	5 – 9
Solanum lasiophyllum	Shrub (<0.5 m)	< 1
?*Glycine falcata*	Herb (<0.5 m)	< 1
Arivela viscosa	Herb (<0.5 m)	< 1
Austrobryonia pilbarensis	Herb (<0.5 m)	< 1
Boerhavia coccinea	Herb (<0.5 m)	< 1
Boerhavia gardneri	Herb (<0.5 m)	< 1
Corchorus trilocularis	Herb (<0.5 m)	< 1
Crotalaria medicaginea var. *neglecta*	Herb (<0.5 m)	< 1
Cucumis variabilis	Herb (<0.5 m)	< 1
Cullen graveolens	Herb (<0.5 m)	1 – 4
Dolichocarpa crouchiana	Herb (<0.5 m)	< 1
Euphorbia ?boophthona	Herb (<0.5 m)	< 1
Evolvulus alsinoides var. *villosicalyx*	Herb (<0.5 m)	< 1
Grona muelleri	Herb (<0.5 m)	5 – 9
Ipomoea muelleri	Herb (<0.5 m)	< 1
Nellica maderaspatensis	Herb (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	1 – 4
Rostellularia adscendens var. *clementii*	Herb (<0.5 m)	< 1
Senna notabilis	Herb (<0.5 m)	< 1
Solanum horridum	Herb (<0.5 m)	< 1
Tephrosia sp. clay soils (S. van Leeuwen et al. PBS 0273)	Herb (<0.5 m)	< 1
Vigna sp. Hamersley Clay (A.A. Mitchell PRP 113)	Herb (<0.5 m)	< 1
Cynodon convergens	Tussock Grass (<0.5 m)	10 – 24
Dichanthium sericeum subsp. *humilius*	Tussock Grass (<0.5 m)	< 1
Enneapogon caerulescens	Tussock Grass (<0.5 m)	< 1

Name	Stratum	Percent cover (%)
Enneapogon polyphyllus	Tussock Grass (<0.5 m)	< 1
Iseilema vaginiflorum	Tussock Grass (<0.5 m)	< 1
Paspalidium retiglume	Tussock Grass (<0.5 m)	< 1
Sporobolus australasicus	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	1 – 4

BD_E_030

Date	23/06/2023	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-22.00097, 119.98862				
Landform	Low hill	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Dolerite	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Shrub (>2 m)	Assoc.
Corchorus parviflorus	Shrub (<0.5 m)	1 – 4
Fimbristylis dichotoma	Sedge (<0.5 m)	1 – 4
Euphorbia careyi	Herb (<0.5 m)	< 1
Euphorbia tannensis subsp. *eremophila*	Herb (<0.5 m)	< 1
Triodia epactia	Hummock Grass (0.5-1 m)	33 – 49

BD_E_031

Date	23/06/2023	**Site type**	Flora: Releve	**Botanist**	RS
Location	-22.00314, 119.98574				
Landform	Major creek (5-30 m)	**Slope**	NA		
Soil colour	Brown	**Soil texture**	Sand		
Rock type	Mixed river alluvium	**Rock size**	Fine gravel [to c. 5 mm]	**Rock cover**	> 70%
Vegetation condition	Poor	**Disturbance**	High weed cover and grazing.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Acacia coriacea subsp. *pendens*	Tree (<10 m)	5 – 9
Corymbia hamersleyana	Tree (<10 m)	1 – 4
Eucalyptus victrix	Tree (<10 m)	10 – 24
Acacia ampliceps	Shrub (1-2 m)	1 – 4
Acacia colei var. *colei*	Shrub (1-2 m)	< 1
Acacia trachycarpa	Shrub (1-2 m)	1 – 4
Cullen ?leucanthum	Shrub (1-2 m)	< 1
Flueggea virosa subsp. *melanthesoides*	Shrub (1-2 m)	< 1
Hakea lorea subsp. *lorea*	Shrub (1-2 m)	< 1
Vachellia farnesiana	Shrub (0.5-1 m)	< 1
Acacia pyrifolia	Shrub (<0.5 m)	< 1
Afrohybanthus aurantiacus	Shrub (<0.5 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Indigofera trita subsp. *trita*	Shrub (<0.5 m)	< 1
Cyperus vaginatus	Sedge (0.5-1 m)	10 – 24
Stemodia grossa	Herb (0.5-1 m)	1 – 4
Arivela viscosa	Herb (<0.5 m)	< 1
Boerhavia coccinea	Herb (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Euphorbia australis var. *subtomentosa*	Herb (<0.5 m)	< 1
Euphorbia biconvexa	Herb (<0.5 m)	< 1
Indigofera colutea	Herb (<0.5 m)	< 1
Indigofera linifolia	Herb (<0.5 m)	< 1
Ipomoea muelleri	Herb (<0.5 m)	< 1
Nellica maderaspatensis	Herb (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	< 1
Senna notabilis	Herb (<0.5 m)	< 1
Sesbania cannabina	Herb (<0.5 m)	< 1
Solanum horridum	Herb (<0.5 m)	< 1
Swainsona stenodonta	Herb (<0.5 m)	< 1
Cymbopogon ambiguus	Tussock Grass (0.5-1 m)	< 1

Name	Stratum	Percent cover (%)
Cenchrus ciliaris	Tussock Grass (<0.5 m)	5 – 9
Cenchrus setiger	Tussock Grass (<0.5 m)	5 – 9
Dactyloctenium radulans	Tussock Grass (<0.5 m)	< 1
Enneapogon caerulescens	Tussock Grass (<0.5 m)	< 1
Eriachne mucronata	Tussock Grass (<0.5 m)	< 1
Sporobolus australasicus	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (0.5-1 m)	10 – 24

BD_E_032

Date	23/06/2023	**Site type**	Flora: Quadrat	**Botanist**	LE
Location	-22.0697, 119.91626				
Landform	Low hill	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Moderate (2 – 3 yrs)				



Name	Stratum	Percent cover (%)
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	5 – 9
Acacia synchronicia	Shrub (1-2 m)	< 1
Acacia bivenosa	Shrub (0.5-1 m)	< 1
Senna glutinosa subsp. ×*luerssenii*	Shrub (0.5-1 m)	< 1
Senna symonii	Shrub (0.5-1 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Euploca chrysocarpa	Shrub (<0.5 m)	< 1
Indigofera monophylla	Shrub (<0.5 m)	< 1
Ptilotus astrolasius	Shrub (<0.5 m)	< 1
Solanum lasiophyllum/phlomoides	Shrub (<0.5 m)	< 1
Goodenia cusackiana	Herb (<0.5 m)	< 1
Goodenia microptera	Herb (<0.5 m)	< 1
Goodenia stobbsiana	Herb (<0.5 m)	< 1
Hibiscus coatesii	Herb (<0.5 m)	< 1
Ptilotus exaltatus	Herb (<0.5 m)	< 1
Salsola australis	Herb (<0.5 m)	< 1
Sclerolaena ?eriacantha	Herb (<0.5 m)	< 1
Tephrosia ?sp. clay soils (S. van Leeuwen et al. PBS 0273)	Herb (<0.5 m)	< 1
Aristida contorta	Tussock Grass (<0.5 m)	< 1
Cymbopogon ambiguus	Tussock Grass (<0.5 m)	< 1
Enneapogon caerulescens	Tussock Grass (<0.5 m)	< 1
Eriachne lanata	Tussock Grass (<0.5 m)	1 – 4
Triodia brizoides	Hummock Grass (<0.5 m)	5 – 9
Triodia epactia	Hummock Grass (<0.5 m)	10 – 24
Triodia longiceps	Hummock Grass (<0.5 m)	10 – 24

BD_E_033

Date	23/06/2023	**Site type**	Flora: Quadrat	**Botanist**	AC
Location	-22.03018, 119.96877				
Landform	Major creek (5-30 m)	**Slope**	NA		
Soil colour	Dark brown	**Soil texture**	Loam		
Rock type	Mixed river alluvium	**Rock size**	Boulders [> 260 mm]	**Rock cover**	30 – 70%
Vegetation condition	Degraded	**Disturbance**	High weed cover and heavy grazing.		
Time since fire	Long (> 3 yrs)				

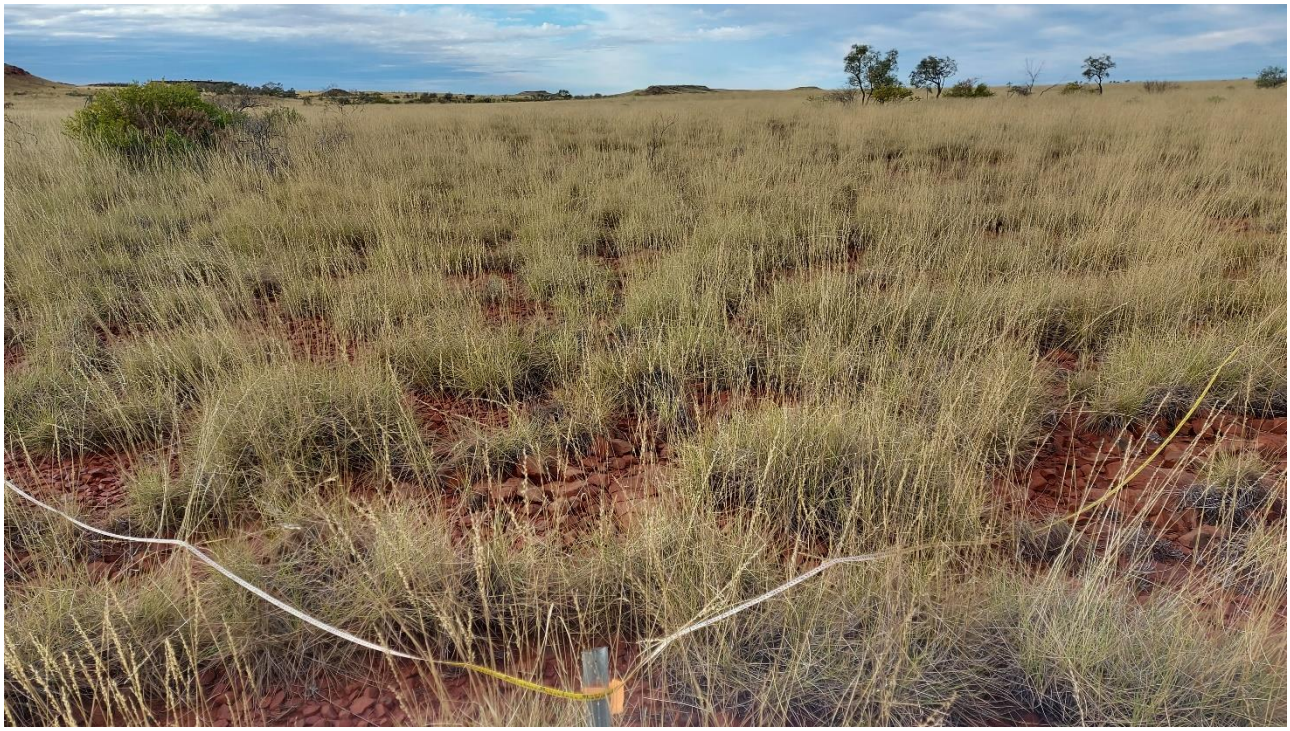


Name	Stratum	Percent cover (%)
Eucalyptus camaldulensis	Tree (10-30 m)	1 – 4
Eucalyptus victrix	Tree (10-30 m)	5 – 9
Acacia ampliceps	Shrub (>2 m)	1 – 4
Acacia pyrifolia	Shrub (>2 m)	1 – 4
Atalaya hemiglauca	Shrub (>2 m)	< 1
Melaleuca bracteata	Shrub (>2 m)	1 – 4
Melaleuca glomerata	Shrub (>2 m)	5 – 9
Acacia bivenosa	Shrub (1-2 m)	1 – 4
Vachellia farnesiana	Shrub (1-2 m)	< 1
Cullen leucanthum	Shrub (0.5-1 m)	< 1
Gossypium australe	Shrub (0.5-1 m)	< 1
Aerva javanica	Shrub (<0.5 m)	< 1
Afrohybanthus aurantiacus	Shrub (<0.5 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Melhania oblongifolia	Shrub (<0.5 m)	< 1
Sida ?trichopoda	Shrub (<0.5 m)	< 1
Cyperus difformis	Sedge (<0.5 m)	< 1
Cyperus vaginatus	Sedge (<0.5 m)	5 – 9
Abutilon sp. Dioicum (A.A. Mitchell PRP 1618)	Herb (1-2 m)	< 1
Sesbania cannabina	Herb (1-2 m)	< 1
Alternanthera denticulata var. *denticulata*	Herb (<0.5 m)	< 1
Alternanthera nana	Herb (<0.5 m)	< 1
Alysicarpus muelleri	Herb (<0.5 m)	< 1
Amaranthus cuspidifolius	Herb (<0.5 m)	< 1
Amaranthus undulatus	Herb (<0.5 m)	< 1
Ammannia baccifera	Herb (<0.5 m)	1 – 4
Arivela viscosa	Herb (<0.5 m)	< 1
Boerhavia burbidgeana	Herb (<0.5 m)	< 1
Centipeda minima subsp. *macrocephala*	Herb (<0.5 m)	< 1
Cucumis variabilis	Herb (<0.5 m)	< 1
Euphorbia australis var. *subtomentosa*	Herb (<0.5 m)	< 1

Name	Stratum	Percent cover (%)
Euphorbia trigonosperma	Herb (<0.5 m)	< 1
Evolvulus alsinoides var. *villosicalyx*	Herb (<0.5 m)	< 1
Gomphrena cunninghamii	Herb (<0.5 m)	< 1
Indigofera linifolia	Herb (<0.5 m)	< 1
Ipomoea muelleri	Herb (<0.5 m)	< 1
Malvastrum americanum	Herb (<0.5 m)	< 1
Marsilea exarata	Herb (<0.5 m)	< 1
Nellica maderaspatensis	Herb (<0.5 m)	< 1
Nicotiana obliqua/occidentalis	Herb (<0.5 m)	< 1
Notoleptopus decaisnei	Herb (<0.5 m)	< 1
Pluchea rubelliflora	Herb (<0.5 m)	1 – 4
Polycarpaea longiflora	Herb (<0.5 m)	< 1
Polymeria calycina	Herb (<0.5 m)	< 1
Ptilotus gomphrenoides	Herb (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	< 1
Sida spinosa	Herb (<0.5 m)	< 1
Sonchus oleraceus	Herb (<0.5 m)	< 1
Stemodia grossa	Herb (<0.5 m)	< 1
Trianthema portulacastrum	Herb (<0.5 m)	< 1
Trianthema triquetrum	Herb (<0.5 m)	< 1
Cenchrus ciliaris	Tussock Grass (<0.5 m)	25 – 32
Cenchrus setiger	Tussock Grass (<0.5 m)	5 – 9
Cynodon dactylon	Tussock Grass (<0.5 m)	5 – 9
Dactyloctenium radulans	Tussock Grass (<0.5 m)	< 1
Diplachne fusca	Tussock Grass (<0.5 m)	< 1
Echinochloa colona	Tussock Grass (<0.5 m)	1 – 4
Enneapogon caerulescens	Tussock Grass (<0.5 m)	< 1
Enneapogon lindleyanus	Tussock Grass (<0.5 m)	< 1
Eragrostis exigua	Tussock Grass (<0.5 m)	< 1
Eragrostis tenellula	Tussock Grass (<0.5 m)	1 – 4
Eriachne tenuiculmis	Tussock Grass (<0.5 m)	< 1
Sporobolus australasicus	Tussock Grass (<0.5 m)	< 1
Triodia longiceps	Hummock Grass (0.5-1 m)	1 – 4
Triodia epactia	Hummock Grass (<0.5 m)	1 – 4
Potamogeton tepperi	Aquatic (<0.5 m)	< 1

BD_E_034

Date	26/06/2023	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-22.02295, 119.86421				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Dolerite	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia bivenosa	Shrub (>2 m)	5 – 9
Grevillea wickhamii	Shrub (>2 m)	Assoc.
Hakea lorea subsp. *lorea*	Shrub (>2 m)	Assoc.
Senna glutinosa subsp. ×*luerssenii*	Shrub (1-2 m)	1 – 4
Hibiscus sturtii var. *platychlamys*	Shrub (<0.5 m)	< 1
Indigofera monophylla	Shrub (<0.5 m)	1 – 4
Cucumis variabilis	Herb (<0.5 m)	< 1
Pentalepis trichodesmoides subsp. *trichodesmoides*	Herb (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	1 – 4
Scaevola amblyanthera var. *centralis*	Herb (<0.5 m)	< 1
Cymbopogon ambiguus	Tussock Grass (0.5-1 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	33 – 49

BD_E_035

Date	23/06/2023	**Site type**	Flora: Quadrat	**Botanist**	AC
Location	-22.0225, 119.96681				
Landform	Major creek (5-30 m)	**Slope**	NA		
Soil colour	Dark brown	**Soil texture**	Loam		
Rock type	Mixed river alluvium	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	30 – 70%
Vegetation condition	Degraded	**Disturbance**	High weed cover and heavy grazing.		
Time since fire	Long (> 3 yrs)				

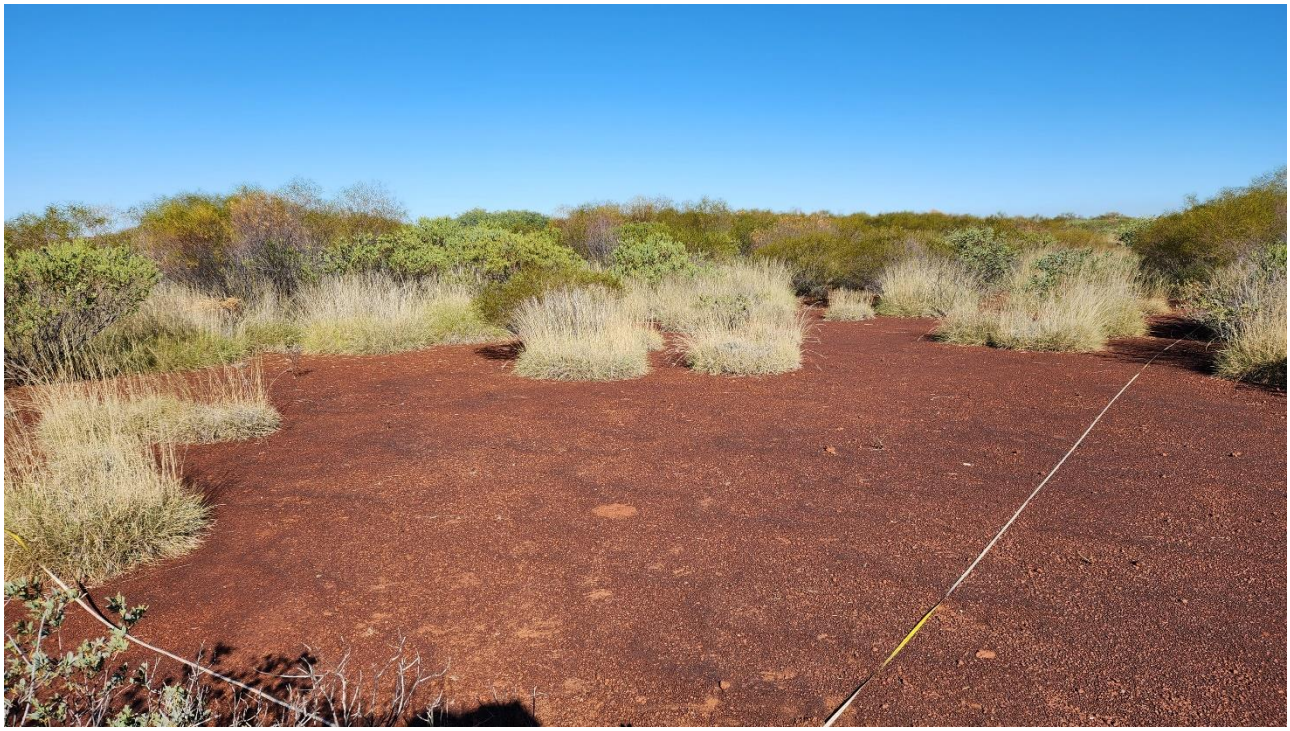


Name	Stratum	Percent cover (%)
Eucalyptus camaldulensis	Tree (10-30 m)	1 – 4
Eucalyptus victrix	Tree (10-30 m)	5 – 9
Acacia coriacea subsp. *pendens*	Tree (<10 m)	5 – 9
Corymbia hamersleyana	Tree (<10 m)	1 – 4
Acacia ampliceps	Shrub (>2 m)	5 – 9
Acacia pyrifolia	Shrub (>2 m)	1 – 4
Atalaya hemiglauca	Shrub (>2 m)	< 1
Cullen leucanthum	Shrub (>2 m)	< 1
Melaleuca glomerata	Shrub (>2 m)	10 – 24
Melaleuca linophylla	Shrub (>2 m)	1 – 4
Acacia bivenosa	Shrub (1-2 m)	1 – 4
Flueggea virosa subsp. *melanthesoides*	Shrub (1-2 m)	< 1
Capparis spinosa subsp. *nummularia*	Shrub (0.5-1 m)	< 1
Vachellia farnesiana	Shrub (0.5-1 m)	< 1
Aerva javanica	Shrub (<0.5 m)	1 – 4
Afrohybanthus aurantiacus	Shrub (<0.5 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	1 – 4
Indigofera trita subsp. *trita*	Shrub (<0.5 m)	< 1
Cyperus vaginatus	Sedge (<0.5 m)	10 – 24
Alternanthera nana	Herb (<0.5 m)	< 1
Amaranthus undulatus	Herb (<0.5 m)	< 1
Ammannia baccifera	Herb (<0.5 m)	< 1
Arivela viscosa	Herb (<0.5 m)	< 1
Boerhavia burbidgeana	Herb (<0.5 m)	< 1
Boerhavia coccinea	Herb (<0.5 m)	< 1
Cucumis variabilis	Herb (<0.5 m)	< 1
Euphorbia australis var. *subtomentosa*	Herb (<0.5 m)	1 – 4
Euphorbia trigonosperma	Herb (<0.5 m)	< 1
Gomphrena cunninghamii	Herb (<0.5 m)	< 1
Indigofera colutea	Herb (<0.5 m)	< 1
Ipomoea muelleri	Herb (<0.5 m)	< 1

Name	Stratum	Percent cover (%)
Lobelia arnhemiaca	Herb (<0.5 m)	< 1
Malvastrum americanum	Herb (<0.5 m)	< 1
Nellica maderaspatensis	Herb (<0.5 m)	< 1
Peplidium sp. E Evol. Fl. Fauna Arid Aust. (A.S. Weston 12768)	Herb (<0.5 m)	< 1
Pluchea rubelliflora	Herb (<0.5 m)	1 – 4
Portulaca oleracea	Herb (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	< 1
Sesbania cannabina	Herb (<0.5 m)	< 1
Solanum horridum	Herb (<0.5 m)	< 1
Stemodia grossa	Herb (<0.5 m)	1 – 4
Vigna sp. Hamersley Clay (A.A. Mitchell PRP 113)	Herb (<0.5 m)	< 1
Diplachne fusca	Tussock Grass (0.5-1 m)	< 1
Cenchrus ciliaris	Tussock Grass (<0.5 m)	33 – 49
Cenchrus setiger	Tussock Grass (<0.5 m)	5 – 9
Dactyloctenium radulans	Tussock Grass (<0.5 m)	< 1
Echinochloa colona	Tussock Grass (<0.5 m)	< 1
Enneapogon caerulescens	Tussock Grass (<0.5 m)	< 1
Enneapogon lindleyanus	Tussock Grass (<0.5 m)	1 – 4
Eragrostis tenellula	Tussock Grass (<0.5 m)	< 1
Eriachne tenuiculmis	Tussock Grass (<0.5 m)	5 – 9
Panicum decompositum	Tussock Grass (<0.5 m)	< 1
Triodia longiceps	Hummock Grass (0.5-1 m)	5 – 9
Triodia epactia	Hummock Grass (<0.5 m)	5 – 9

BD_E_036

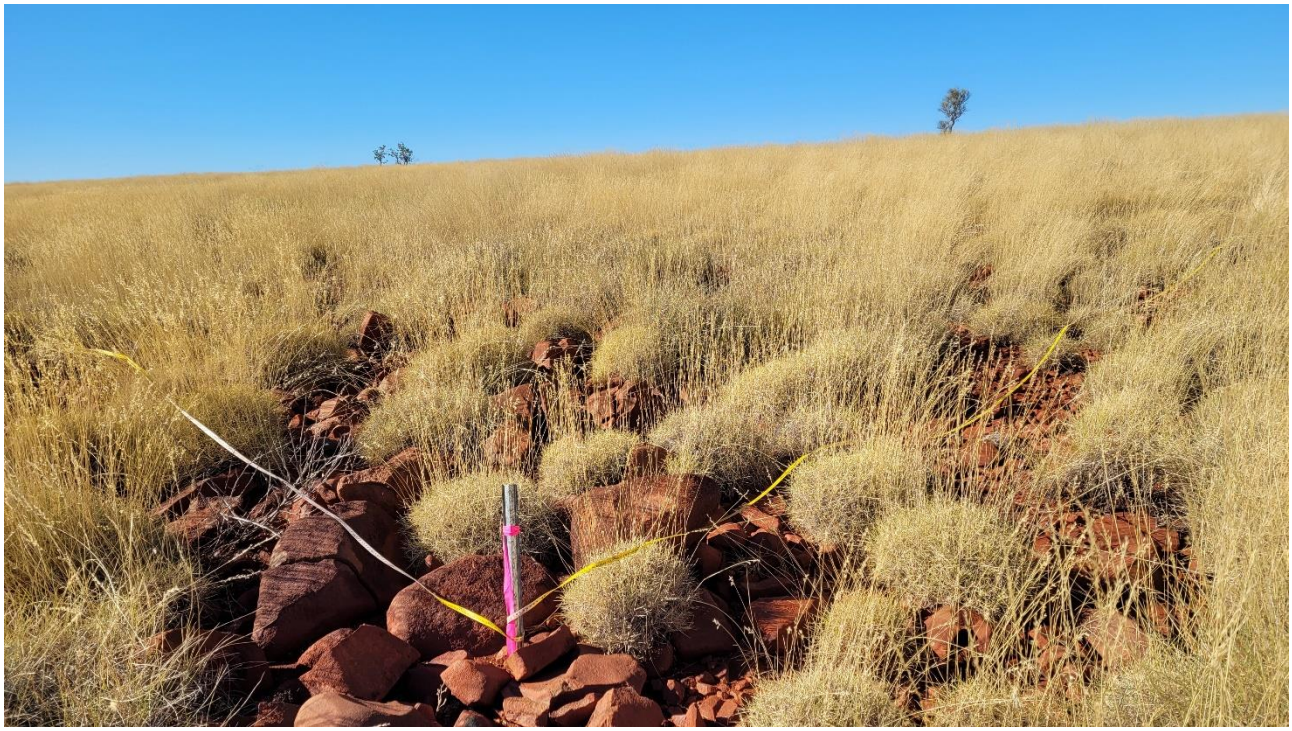
Date	24/06/2023	**Site type**	Flora: Quadrat	**Botanist**	AC
Location	-22.02351, 119.90624				
Landform	Plain	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia ancistrocarpa	Shrub (>2 m)	10 – 24
Acacia bivenosa	Shrub (>2 m)	5 – 9
Acacia pruinocarpa	Shrub (>2 m)	5 – 9
Grevillea wickhamii	Shrub (>2 m)	< 1
Hakea lorea subsp. *lorea*	Shrub (>2 m)	< 1
Senna ?stricta	Shrub (1-2 m)	1 – 4
Eremophila latrobei ?subsp. *glabra*	Shrub (0.5-1 m)	1 – 4
Senna ?artemisioides subsp. *oligophylla*	Shrub (0.5-1 m)	< 1
Hibiscus sturtii var. *campylochlamys*	Shrub (<0.5 m)	< 1
Indigofera monophylla	Shrub (<0.5 m)	1 – 4
Ptilotus astrolasius	Shrub (<0.5 m)	< 1
Sida ?arenicola	Shrub (<0.5 m)	< 1
Solanum lasiophyllum	Shrub (<0.5 m)	< 1
Duperreya commixta	Herb (<0.5 m)	< 1
Dysphania ?sphaerosperma	Herb (<0.5 m)	< 1
Goodenia stobbsiana	Herb (<0.5 m)	< 1
Hibiscus coatesii	Herb (<0.5 m)	< 1
Ptilotus calostachyus	Herb (<0.5 m)	< 1
Senna notabilis	Herb (<0.5 m)	< 1
Vincetoxicum lineare	Herb (<0.5 m)	< 1
Aristida contorta	Tussock Grass (<0.5 m)	< 1
Cymbopogon ambiguus	Tussock Grass (<0.5 m)	< 1
Paraneurachne muelleri	Tussock Grass (<0.5 m)	1 – 4
Triodia epactia	Hummock Grass (0.5-1 m)	10 – 24

BD_E_037

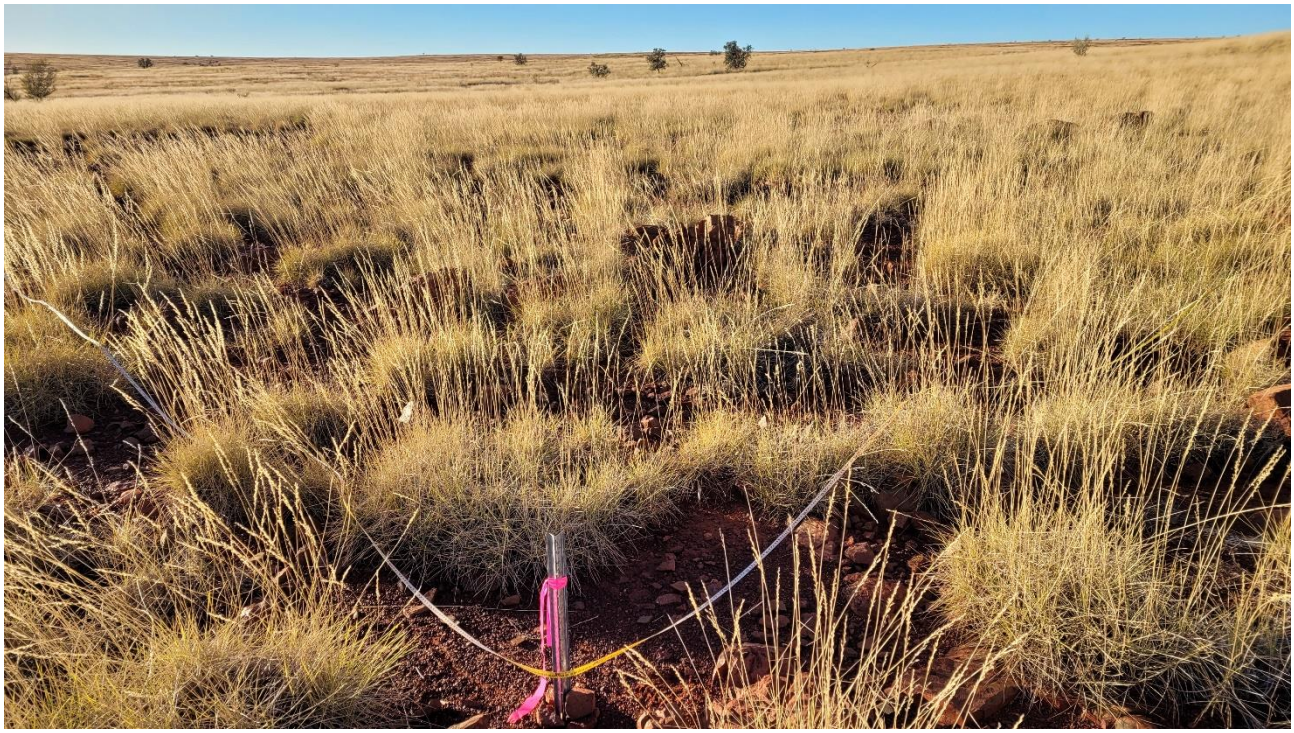
Date	23/06/2023	**Site type**	Flora: Quadrat	**Botanist**	LE
Location	-22.02877, 119.96314				
Landform	Low hill	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Shrub (>2 m)	< 1
Hakea lorea subsp. *lorea*	Shrub (1-2 m)	< 1
Senna artemisioides subsp. *oligophylla*	Shrub (0.5-1 m)	< 1
Alysicarpus muelleri	Herb (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Evolvulus alsinoides var. *villosicalyx*	Herb (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	< 1
Swainsona stenodonta	Herb (<0.5 m)	< 1
Enneapogon caerulescens	Tussock Grass (<0.5 m)	< 1
Enneapogon polyphyllus	Tussock Grass (<0.5 m)	< 1
Iseilema vaginiflorum	Tussock Grass (<0.5 m)	< 1
Sporobolus australasicus	Tussock Grass (<0.5 m)	< 1
Triodia brizoides	Hummock Grass (<0.5 m)	10 – 24
Triodia epactia	Hummock Grass (<0.5 m)	10 – 24

BD_E_038

Date	23/06/2023	**Site type**	Flora: Quadrat	**Botanist**	LE
Location	-22.028, 119.97746				
Landform	Low hill	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Rocky with outcroppings	**Rock cover**	30 – 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Grevillea pyramidalis subsp. *leucadendron*	Shrub (>2 m)	< 1
Corchorus parviflorus	Shrub (0.5-1 m)	< 1
Fimbristylis dichotoma	Sedge (<0.5 m)	< 1
Alysicarpus muelleri	Herb (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Indigofera linifolia	Herb (<0.5 m)	< 1
Polygala glaucifolia	Herb (<0.5 m)	< 1
Solanum horridum	Herb (<0.5 m)	< 1
Aristida contorta	Tussock Grass (<0.5 m)	< 1
Cymbopogon ambiguus	Tussock Grass (<0.5 m)	< 1
Dichanthium sericeum subsp. *humilius*	Tussock Grass (<0.5 m)	< 1
Enneapogon caerulescens	Tussock Grass (<0.5 m)	< 1
Iseilema vaginiflorum	Tussock Grass (<0.5 m)	< 1
Sporobolus australasicus	Tussock Grass (<0.5 m)	< 1
Tripogonella loliiformis	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	10 – 24

BD_E_039

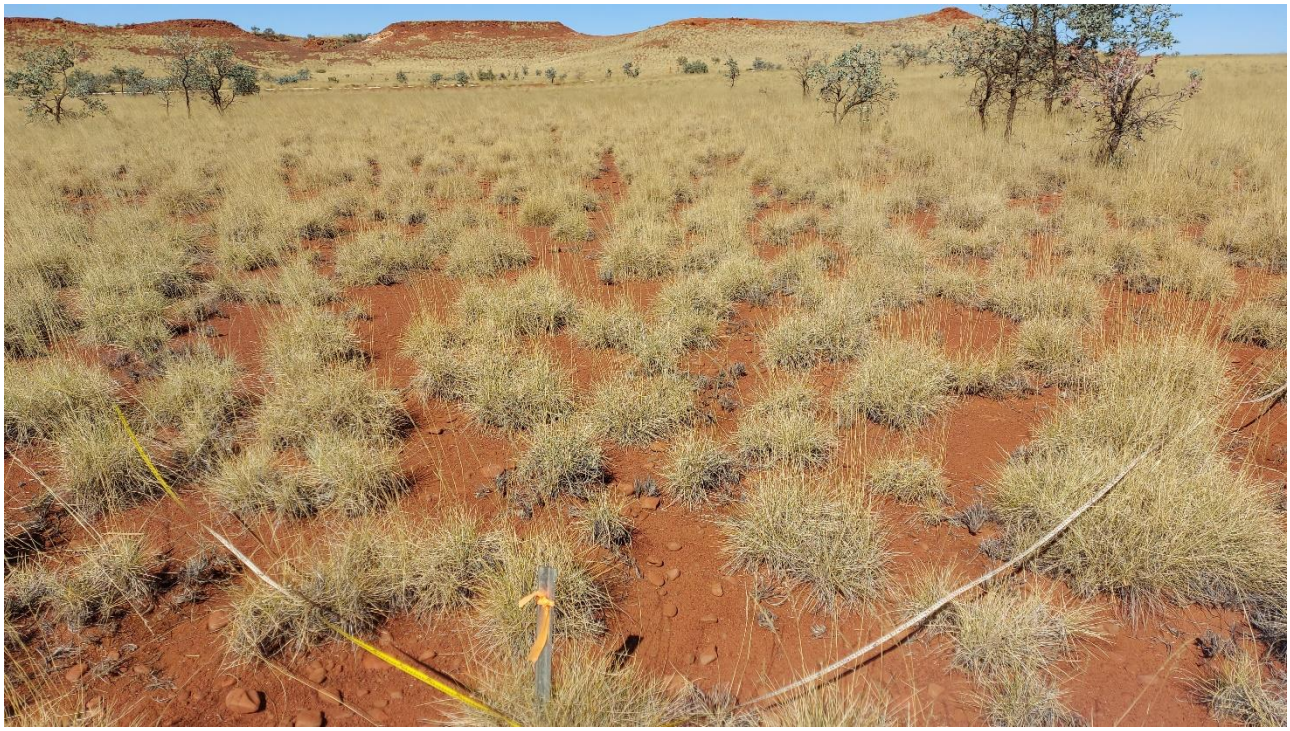
Date	26/06/2023	**Site type**	Flora: Quadrat	**Botanist**	LE
Location	-22.02424, 119.85868				
Landform	Low hill	**Slope**	Steep		
Soil colour	Reddish brown	**Soil texture**	Sandy clay loam		
Rock type	Ironstone	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	Minor weed cover and grazing.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia coriacea subsp. *pendens*	Tree (<10 m)	Assoc.
Acacia inaequilatera	Shrub (>2 m)	< 1
Ficus brachypoda	Shrub (>2 m)	Assoc.
Grevillea pyramidalis subsp. *leucadendron*	Shrub (1-2 m)	Assoc.
Senna glutinosa subsp. *glutinosa*	Shrub (1-2 m)	< 1
Senna venusta	Shrub (1-2 m)	< 1
Capparis spinosa subsp. *nummularia*	Shrub (0.5-1 m)	Assoc.
Eremophila latrobei subsp. *glabra*	Shrub (0.5-1 m)	5 – 9
Senna artemisioides subsp. *helmsii*	Shrub (0.5-1 m)	< 1
Hibiscus coatesii	Herb (1-2 m)	Assoc.
Amaranthus cuspidifolius	Herb (<0.5 m)	< 1
Arivela viscosa	Herb (<0.5 m)	< 1
Boerhavia gardneri	Herb (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Duperreya commixta	Herb (<0.5 m)	< 1
Evolvulus alsinoides var. *villosicalyx*	Herb (<0.5 m)	< 1
Gomphrena cunninghamii	Herb (<0.5 m)	< 1
Maireana villosa	Herb (<0.5 m)	< 1
Polycarpaea involucrata	Herb (<0.5 m)	< 1
Salsola australis	Herb (<0.5 m)	< 1
Sida rohlenae subsp. *rohlenae*	Herb (<0.5 m)	< 1
Cenchrus ciliaris	Tussock Grass (<0.5 m)	< 1
Cymbopogon ambiguus	Tussock Grass (<0.5 m)	< 1
Enneapogon caerulescens	Tussock Grass (<0.5 m)	< 1
Enneapogon polyphyllus	Tussock Grass (<0.5 m)	< 1
Eriachne mucronata	Tussock Grass (<0.5 m)	1 – 4
Paspalidium clementii	Tussock Grass (<0.5 m)	< 1
Sporobolus australasicus	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	10 – 24

BD_E_040

Date	21/06/2023	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-22.03582, 119.93366				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Sandy clay loam		
Rock type	Dolerite	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	< 10%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Shrub (>2 m)	5 – 9
Senna glutinosa subsp. *glutinosa*	Shrub (>2 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Indigofera monophylla	Shrub (<0.5 m)	< 1
Triodia epactia	Hummock Grass (1-2 m)	25 – 32

BD_E_041

Date	21/06/2023	**Site type**	Flora: Releve	**Botanist**	SH
Location	-22.03385, 119.92766				
Landform	Major creek (5-30 m)	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Sandy clay loam		
Rock type	Mixed river alluvium	**Rock size**	Mixed	**Rock cover**	> 70%
Vegetation condition	Poor	**Disturbance**	High weed cover and grazing.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Eucalyptus victrix	Tree (10-30 m)	10 – 24
Acacia coriacea subsp. *pendens*	Tree (<10 m)	1 – 4
Acacia bivenosa	Shrub (>2 m)	< 1
Acacia tumida var. *pilbarensis*	Shrub (>2 m)	1 – 4
Melaleuca glomerata	Shrub (>2 m)	1 – 4
Vachellia farnesiana	Shrub (>2 m)	5 – 9
Acacia inaequilatera	Shrub (0.5-1 m)	< 1
Cullen leucanthum	Shrub (<0.5 m)	< 1
Cyperus vaginatus	Sedge (0.5-1 m)	5 – 9
Crotalaria medicaginea var. *neglecta*	Herb (<0.5 m)	< 1
Indigofera linifolia	Herb (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	< 1
Cymbopogon ambiguus	Tussock Grass (0.5-1 m)	1 – 4
Cenchrus setiger	Tussock Grass (<0.5 m)	25 – 32
Triodia epactia	Hummock Grass (0.5-1 m)	1 – 4

BD_E_042

Date	26/06/2023	**Site type**	Flora: Quadrat	**Botanist**	AC
Location	-22.0204, 119.86016				
Landform	Minor creek (< 5 m)	**Slope**	NA		
Soil colour	Brown	**Soil texture**	Loam		
Rock type	Mixed river alluvium	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	10 – 30%
Vegetation condition	Poor	**Disturbance**	High weed cover and grazing.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Eucalyptus victrix	Tree (10-30 m)	5 – 9
Acacia coriacea subsp. *pendens*	Tree (<10 m)	1 – 4
Acacia ampliceps	Shrub (>2 m)	1 – 4
Atalaya hemiglauca	Shrub (>2 m)	1 – 4
Flueggea virosa subsp. *melanthesoides*	Shrub (>2 m)	< 1
Melaleuca bracteata	Shrub (>2 m)	5 – 9
Melaleuca glomerata	Shrub (>2 m)	5 – 9
Vachellia farnesiana	Shrub (>2 m)	1 – 4
Gossypium australe	Shrub (1-2 m)	< 1
Afrohybanthus aurantiacus	Shrub (<0.5 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Cullen leucanthum	Shrub (<0.5 m)	< 1
Indigofera trita subsp. *trita*	Shrub (<0.5 m)	< 1
Sida ?trichopoda	Shrub (<0.5 m)	< 1
Cyperus vaginatus	Sedge (<0.5 m)	1 – 4
Amaranthus undulatus	Herb (<0.5 m)	< 1
Boerhavia coccinea	Herb (<0.5 m)	< 1
Euphorbia ?biconvexa	Herb (<0.5 m)	< 1
Euphorbia australis var. *subtomentosa*	Herb (<0.5 m)	< 1
Evolvulus alsinoides var. *villosicalyx*	Herb (<0.5 m)	< 1
Indigofera colutea	Herb (<0.5 m)	< 1
Indigofera linifolia	Herb (<0.5 m)	< 1
Ipomoea muelleri	Herb (<0.5 m)	< 1
Malvastrum americanum	Herb (<0.5 m)	< 1
Nellica maderaspatensis	Herb (<0.5 m)	< 1
Polymeria calycina	Herb (<0.5 m)	< 1
Portulaca oleracea	Herb (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	< 1
Scaevola amblyanthera var. *centralis*	Herb (<0.5 m)	< 1
Senna notabilis	Herb (<0.5 m)	< 1
Sesbania cannabina	Herb (<0.5 m)	< 1

Name	Stratum	Percent cover (%)
Sida rohlenae subsp. *rohlenae*	Herb (<0.5 m)	< 1
Solanum horridum	Herb (<0.5 m)	< 1
Streptoglossa decurrens	Herb (<0.5 m)	< 1
Trianthema triquetrum	Herb (<0.5 m)	< 1
Vigna sp. Hamersley Clay (A.A. Mitchell PRP 113)	Herb (<0.5 m)	< 1
Cenchrus ciliaris	Tussock Grass (<0.5 m)	10 – 24
Cenchrus setiger	Tussock Grass (<0.5 m)	10 – 24
Dactyloctenium radulans	Tussock Grass (<0.5 m)	< 1
Dichanthium sericeum	Tussock Grass (<0.5 m)	< 1
Enneapogon caerulescens	Tussock Grass (<0.5 m)	< 1
Eragrostis dielsii	Tussock Grass (<0.5 m)	< 1
Eragrostis leptocarpa	Tussock Grass (<0.5 m)	< 1
Eragrostis tenellula	Tussock Grass (<0.5 m)	< 1
Eriachne tenuiculmis	Tussock Grass (<0.5 m)	< 1
Sporobolus australasicus	Tussock Grass (<0.5 m)	< 1
Triodia longiceps	Hummock Grass (0.5-1 m)	10 – 24
Triodia epactia	Hummock Grass (<0.5 m)	1 – 4
Amyema ?sanguinea	Parasitic/Epiphytic (<0.5 m)	< 1

BD_E_043

Date	21/06/2023	**Site type**	Flora: Quadrat	**Botanist**	RS
Location	-22.04114, 119.9384				
Landform	Low hill	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	Assoc.
Acacia ?aptaneura	Shrub (>2 m)	Assoc.
Acacia monticola	Shrub (>2 m)	Assoc.
Acacia pruinocarpa	Shrub (>2 m)	1 – 4
Ptilotus calostachyus	Herb (0.5-1 m)	< 1
Eriachne lanata	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (0.5-1 m)	50 – 74

BD_E_044

Date	21/06/2023	**Site type**	Flora: Quadrat	**Botanist**	RS
Location	-22.04731, 119.94107				
Landform	Low hill	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	Assoc.
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	Assoc.
Acacia ?aptaneura	Shrub (>2 m)	Assoc.
Acacia monticola	Shrub (>2 m)	Assoc.
Acacia pruinocarpa	Shrub (>2 m)	Assoc.
Grevillea wickhamii	Shrub (>2 m)	Assoc.
Santalum lanceolatum	Shrub (1-2 m)	Assoc.
Amphipogon sericeus	Tussock Grass (<0.5 m)	< 1
Eriachne lanata	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (0.5-1 m)	33 – 49

BD_E_045

Date	21/06/2023	**Site type**	Flora: Quadrat	**Botanist**	LE
Location	-22.07187, 119.91283				
Landform	Low hill	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Sandy loam		
Rock type	Ironstone	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Moderate (2 – 3 yrs)				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	Assoc.
Acacia bivenosa	Shrub (1-2 m)	1 – 4
Acacia inaequilatera	Shrub (1-2 m)	< 1
Acacia synchronicia	Shrub (1-2 m)	< 1
Hakea lorea subsp. *lorea*	Shrub (0.5-1 m)	< 1
Senna artemisioides subsp. *helmsii*	Shrub (0.5-1 m)	< 1
Senna symonii	Shrub (0.5-1 m)	1 – 4
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Euploca chrysocarpa	Shrub (<0.5 m)	< 1
Ptilotus calostachyus	Herb (0.5-1 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Goodenia cusackiana	Herb (<0.5 m)	< 1
Goodenia microptera	Herb (<0.5 m)	< 1
Goodenia stobbsiana	Herb (<0.5 m)	< 1
Ptilotus exaltatus	Herb (<0.5 m)	< 1
Streptoglossa ?adscendens	Herb (<0.5 m)	< 1
Trigastrotheca molluginea	Herb (<0.5 m)	< 1
Eriachne mucronata	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	10 – 24
Triodia wiseana	Hummock Grass (<0.5 m)	1 – 4

BD_E_046

Date	23/06/2023	**Site type**	Flora: Quadrat	**Botanist**	AC
Location	-22.06074, 119.92189				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Quartz, ironstone	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Poor	**Disturbance**	High weed cover and grazing.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia ?aptaneura	Shrub (>2 m)	5 – 9
Acacia inaequilatera	Shrub (>2 m)	1 – 4
Eremophila longifolia	Shrub (>2 m)	< 1
Hakea lorea subsp. *lorea*	Shrub (>2 m)	< 1
Acacia bivenosa	Shrub (1-2 m)	< 1
Vachellia farnesiana	Shrub (1-2 m)	< 1
Eremophila forrestii subsp. *forrestii*	Shrub (0.5-1 m)	1 – 4
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Sida ?trichopoda	Shrub (<0.5 m)	< 1
Abutilon lepidum	Herb (<0.5 m)	< 1
Abutilon macrum	Herb (<0.5 m)	< 1
Alysicarpus muelleri	Herb (<0.5 m)	< 1
Corchorus trilocularis	Herb (<0.5 m)	< 1
Crotalaria medicaginea var. *neglecta*	Herb (<0.5 m)	< 1
Euphorbia australis var. *subtomentosa*	Herb (<0.5 m)	< 1
Euphorbia trigonosperma	Herb (<0.5 m)	< 1
Evolvulus alsinoides var. *villosicalyx*	Herb (<0.5 m)	< 1
Gomphrena cunninghamii	Herb (<0.5 m)	< 1
Indigofera linifolia	Herb (<0.5 m)	< 1
Ipomoea polymorpha	Herb (<0.5 m)	< 1
Nellica maderaspatensis	Herb (<0.5 m)	< 1
Pterocaulon sphacelatum	Herb (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	< 1
Salsola australis	Herb (<0.5 m)	< 1
Sclerolaena costata	Herb (<0.5 m)	1 – 4
Senna notabilis	Herb (<0.5 m)	< 1
Sida spinosa	Herb (<0.5 m)	< 1
Solanum horridum	Herb (<0.5 m)	< 1
Trianthema triquetrum	Herb (<0.5 m)	< 1
Aristida contorta	Tussock Grass (<0.5 m)	1 – 4
Cenchrus ciliaris	Tussock Grass (<0.5 m)	5 – 9

Name	Stratum	Percent cover (%)
Cenchrus setiger	Tussock Grass (<0.5 m)	< 1
Chloris pectinata	Tussock Grass (<0.5 m)	< 1
Dichanthium sericeum subsp. *humilius*	Tussock Grass (<0.5 m)	< 1
Enneapogon caerulescens	Tussock Grass (<0.5 m)	1 – 4
Enneapogon polyphyllus	Tussock Grass (<0.5 m)	< 1
Sporobolus australasicus	Tussock Grass (<0.5 m)	< 1
Triodia longiceps	Hummock Grass (0.5-1 m)	1 – 4
Triodia brizoides	Hummock Grass (<0.5 m)	Assoc.
Triodia epactia	Hummock Grass (<0.5 m)	10 – 24

BD_E_047

Date	22/06/2023	**Site type**	Flora: Quadrat	**Botanist**	RS
Location	-22.05451, 119.89212				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone, quartz	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Shrub (>2 m)	1 – 4
Clerodendrum tomentosum	Shrub (1-2 m)	< 1
Senna glutinosa subsp. *glutinosa*	Shrub (1-2 m)	< 1
Achyranthes aspera	Shrub (0.5-1 m)	< 1
Senna ?stricta	Shrub (0.5-1 m)	< 1
Senna glutinosa subsp. *pruinosa*	Shrub (0.5-1 m)	< 1
Cucumis variabilis	Herb (<0.5 m)	< 1
Themeda triandra	Tussock Grass (0.5-1 m)	1 – 4
Triodia epactia	Hummock Grass (0.5-1 m)	50 – 74

BD_E_048

Date	20/06/2023	**Site type**	Flora: Releve	**Botanist**	AC
Location	-22.14802, 119.8905				
Landform	Minor creek (< 5 m)	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Mixed river alluvium	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	10 – 30%
Vegetation condition	Degraded	**Disturbance**	High weed cover and heavy grazing.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Eucalyptus victrix	Tree (10-30 m)	5 – 9
Acacia coriacea subsp. *pendens*	Tree (<10 m)	5 – 9
Corymbia hamersleyana	Tree (<10 m)	1 – 4
Acacia eriopoda	Shrub (>2 m)	5 – 9
Acacia pyrifolia	Shrub (>2 m)	1 – 4
Vachellia farnesiana	Shrub (>2 m)	1 – 4
Acacia monticola	Shrub (1-2 m)	< 1
Acacia tenuissima	Shrub (1-2 m)	1 – 4
Cullen leucochaites	Shrub (1-2 m)	< 1
Dodonaea lanceolata var. *lanceolata*	Shrub (1-2 m)	< 1
Gossypium australe	Shrub (0.5-1 m)	< 1
Sida sp. spiciform panicles (E. Leyland s.n. 14/8/90)	Shrub (0.5-1 m)	< 1
Afrohybanthus aurantiacus	Shrub (<0.5 m)	< 1
Corchorus incanus	Shrub (<0.5 m)	< 1
Indigofera monophylla	Shrub (<0.5 m)	< 1
Sida fibulifera	Shrub (<0.5 m)	< 1
Sida sp. Pilbara (A.A. Mitchell PRP 1543)	Shrub (<0.5 m)	< 1
Cyperus vaginatus	Sedge (0.5-1 m)	< 1
Alternanthera nana	Herb (<0.5 m)	< 1
Boerhavia coccinea	Herb (<0.5 m)	< 1
Crotalaria medicaginea var. *neglecta*	Herb (<0.5 m)	< 1
Cucumis variabilis	Herb (<0.5 m)	< 1
Euphorbia australis var. *subtomentosa*	Herb (<0.5 m)	< 1
Euphorbia careyi	Herb (<0.5 m)	< 1
Evolvulus alsinoides var. *decumbens*	Herb (<0.5 m)	< 1
Evolvulus alsinoides var. *villosicalyx*	Herb (<0.5 m)	< 1
Goodenia microptera	Herb (<0.5 m)	< 1
Indigofera linifolia	Herb (<0.5 m)	< 1
Indigofera linnaei	Herb (<0.5 m)	< 1
Notoleptopus decaisnei	Herb (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	< 1

Name	Stratum	Percent cover (%)
Salsola australis	Herb (<0.5 m)	< 1
Senna notabilis	Herb (<0.5 m)	< 1
Sida rohlenae subsp. *rohlenae*	Herb (<0.5 m)	< 1
Chrysopogon fallax	Tussock Grass (0.5-1 m)	< 1
Cenchrus ciliaris	Tussock Grass (<0.5 m)	33 – 49
Cenchrus setiger	Tussock Grass (<0.5 m)	5 – 9
Cymbopogon ambiguus	Tussock Grass (<0.5 m)	< 1
Enneapogon polyphyllus	Tussock Grass (<0.5 m)	< 1
Eriachne mucronata	Tussock Grass (<0.5 m)	< 1
Paraneurachne muelleri	Tussock Grass (<0.5 m)	< 1
Themeda triandra	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (0.5-1 m)	10 – 24
Triodia longiceps	Hummock Grass (0.5-1 m)	1 – 4

BD_E_049

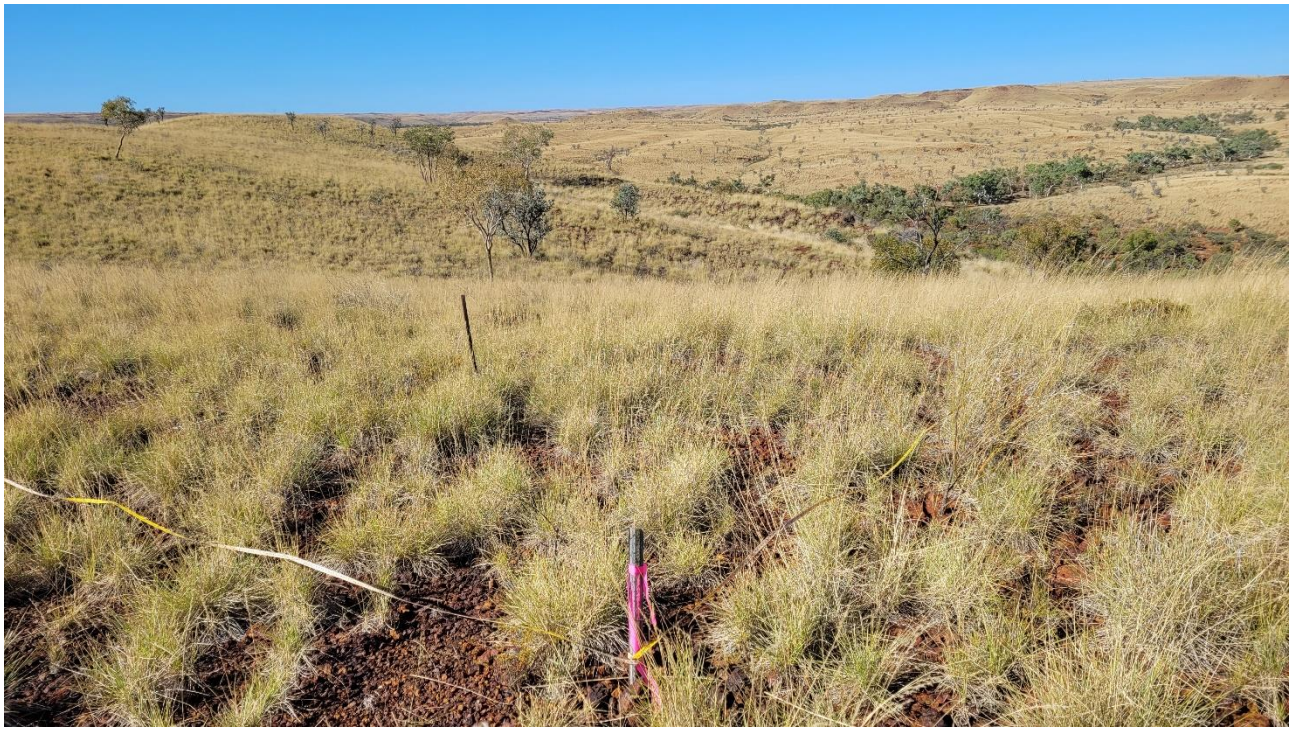
Date	21/06/2023	**Site type**	Flora: Quadrat	**Botanist**	AC
Location	-22.05644, 119.92407				
Landform	Low hill	**Slope**	Moderate		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone, laterite	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	Assoc.
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	1 – 4
Acacia ancistrocarpa	Shrub (>2 m)	1 – 4
Acacia pruinocarpa	Shrub (>2 m)	1 – 4
Hakea lorea subsp. *lorea*	Shrub (>2 m)	Assoc.
Capparis umbonata	Shrub (1-2 m)	< 1
Senna symonii	Shrub (0.5-1 m)	< 1
Seringia ?exastia	Shrub (0.5-1 m)	< 1
Sida ?arenicola	Shrub (0.5-1 m)	< 1
Acacia bivenosa	Shrub (<0.5 m)	< 1
Ptilotus calostachyus	Herb (0.5-1 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Evolvulus alsinoides var. *villosicalyx*	Herb (<0.5 m)	< 1
Goodenia stobbsiana	Herb (<0.5 m)	< 1
Hibiscus coatesii	Herb (<0.5 m)	< 1
Ptilotus exaltatus	Herb (<0.5 m)	< 1
Amphipogon sericeus	Tussock Grass (<0.5 m)	1 – 4
Eriachne lanata	Tussock Grass (<0.5 m)	5 – 9
Triodia epactia	Hummock Grass (<0.5 m)	33 – 49

BD_E_050

Date	24/06/2023	**Site type**	Flora: Quadrat	**Botanist**	LE
Location	-21.97359, 120.00678				
Landform	Low hill	**Slope**	Moderate		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	5 – 9
Acacia inaequilatera	Shrub (>2 m)	1 – 4
Grevillea wickhamii subsp. *hispidula*	Shrub (>2 m)	1 – 4
Atalaya hemiglauca	Shrub (1-2 m)	1 – 4
Senna glutinosa subsp. *glutinosa*	Shrub (0.5-1 m)	< 1
Senna symonii	Shrub (0.5-1 m)	< 1
Dampiera candicans	Shrub (<0.5 m)	< 1
Dodonaea coriacea	Shrub (<0.5 m)	1 – 4
Sida sp. Pilbara (A.A. Mitchell PRP 1543)	Shrub (<0.5 m)	< 1
Ptilotus calostachyus	Herb (0.5-1 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Euphorbia careyi	Herb (<0.5 m)	1 – 4
Goodenia cusackiana	Herb (<0.5 m)	< 1
Goodenia stobbsiana	Herb (<0.5 m)	< 1
Cymbopogon ambiguus	Tussock Grass (<0.5 m)	< 1
Paraneurachne muelleri	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	10 – 24

BD_E_051

Date	22/06/2023	**Site type**	Flora: Quadrat	**Botanist**	LE
Location	-22.12738, 119.87865				
Landform	Plain	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone, quartz	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	30 – 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia ?aptaneura	Shrub (>2 m)	10 – 24
Acacia pruinocarpa	Shrub (>2 m)	5 – 9
Acacia bivenosa	Shrub (1-2 m)	1 – 4
Eremophila latrobei subsp. *filiformis*	Shrub (1-2 m)	1 – 4
Senna glutinosa subsp. ×*luerssenii*	Shrub (1-2 m)	< 1
Senna artemisioides subsp. *oligophylla*	Shrub (0.5-1 m)	< 1
Corchorus incanus	Shrub (<0.5 m)	< 1
Grevillea wickhamii	Shrub (<0.5 m)	< 1
Indigofera monophylla	Shrub (<0.5 m)	< 1
Psydrax suaveolens	Shrub (<0.5 m)	< 1
Seringia ?exastia	Shrub (<0.5 m)	< 1
Sida ?trichopoda	Shrub (<0.5 m)	< 1
Sida sp. *S049 (sterile)*	Shrub (<0.5 m)	< 1
Cynanchum viminale	Herb (0.5-1 m)	< 1
Ptilotus calostachyus	Herb (0.5-1 m)	< 1
Duperreya commixta	Herb (<0.5 m)	< 1
Evolvulus alsinoides var. *villosicalyx*	Herb (<0.5 m)	< 1
Hibiscus burtonii	Herb (<0.5 m)	< 1
Aristida contorta	Tussock Grass (<0.5 m)	< 1
Aristida holathera var. *holathera*	Tussock Grass (<0.5 m)	< 1
Enneapogon polyphyllus	Tussock Grass (<0.5 m)	< 1
Eragrostis desertorum	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	10 – 24
Triodia wiseana	Hummock Grass (<0.5 m)	1 – 4

BD_E_052

Date	21/06/2023	**Site type**	Flora: Releve	**Botanist**	LE
Location	-22.06607, 119.91769				
Landform	Minor creek (< 5 m)	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Loamy sand		
Rock type	Mixed river alluvium	**Rock size**	Mixed	**Rock cover**	30 – 70%
Vegetation condition	Poor	**Disturbance**	High weed cover and grazing.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia coriacea subsp. *pendens*	Tree (<10 m)	5 – 9
Corymbia hamersleyana	Tree (<10 m)	10 – 24
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	5 – 9
Acacia ancistrocarpa	Shrub (>2 m)	1 – 4
Acacia bivenosa	Shrub (>2 m)	1 – 4
Acacia colei var. *colei*	Shrub (>2 m)	1 – 4
Atalaya hemiglauca	Shrub (>2 m)	1 – 4
Grevillea wickhamii subsp. *aprica*	Shrub (>2 m)	1 – 4
Vachellia farnesiana	Shrub (>2 m)	1 – 4
Acacia pyrifolia	Shrub (1-2 m)	1 – 4
Acacia tumida var. *pilbarensis*	Shrub (1-2 m)	5 – 9
Gossypium australe	Shrub (1-2 m)	1 – 4
Acacia synchronicia	Shrub (0.5-1 m)	< 1
Capparis umbonata	Shrub (0.5-1 m)	< 1
Afrohybanthus aurantiacus	Shrub (<0.5 m)	< 1
Androcalva luteiflora	Shrub (<0.5 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Indigofera monophylla	Shrub (<0.5 m)	< 1
Indigofera trita subsp. *trita*	Shrub (<0.5 m)	< 1
Sida ?trichopoda	Shrub (<0.5 m)	< 1
Cyperus vaginatus	Sedge (0.5-1 m)	< 1
Achyranthes aspera	Herb (0.5-1 m)	< 1
Abutilon fraseri subsp. *fraseri*	Herb (<0.5 m)	< 1
Aerva javanica	Herb (<0.5 m)	< 1
Alternanthera nana	Herb (<0.5 m)	< 1
Boerhavia coccinea	Herb (<0.5 m)	< 1
Crotalaria medicaginea var. *neglecta*	Herb (<0.5 m)	< 1
Duperreya commixta	Herb (<0.5 m)	< 1
Euphorbia australis var. *subtomentosa*	Herb (<0.5 m)	< 1
Evolvulus alsinoides var. *villosicalyx*	Herb (<0.5 m)	< 1
Malvastrum americanum	Herb (<0.5 m)	< 1

Name	Stratum	Percent cover (%)
Nellica maderaspatensis	Herb (<0.5 m)	< 1
Ptilotus gomphrenoides	Herb (<0.5 m)	< 1
Salsola australis	Herb (<0.5 m)	< 1
Scaevola amblyanthera var. *centralis*	Herb (<0.5 m)	< 1
Sclerolaena costata	Herb (<0.5 m)	< 1
Senna notabilis	Herb (<0.5 m)	< 1
Solanum horridum	Herb (<0.5 m)	< 1
Trianthema triquetrum	Herb (<0.5 m)	< 1
Cenchrus ciliaris	Tussock Grass (<0.5 m)	5 – 9
Cenchrus setiger	Tussock Grass (<0.5 m)	10 – 24
Cymbopogon ambiguus	Tussock Grass (<0.5 m)	< 1
Dichanthium sericeum	Tussock Grass (<0.5 m)	< 1
Echinochloa colona	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	1 – 4
Triodia longiceps	Hummock Grass (<0.5 m)	1 – 4

BD_E_053

Date	22/06/2023	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-22.06818, 119.857				
Landform	Low hill	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Silty clay loam		
Rock type	Dolerite	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Shrub (>2 m)	Assoc.
Tephrosia rosea var. *clementii*	Shrub (<0.5 m)	< 1
Salsola australis	Herb (<0.5 m)	< 1
Solanum horridum	Herb (<0.5 m)	< 1
Aristida contorta	Tussock Grass (<0.5 m)	1 – 4
Triodia epactia	Hummock Grass (0.5-1 m)	33 – 49

BD_E_054

Date	22/06/2023	**Site type**	Flora: Releve	**Botanist**	RS
Location	-22.06347, 119.89706				
Landform	Major creek (5-30 m)	**Slope**	NA		
Soil colour	Brown	**Soil texture**	Sand		
Rock type	Mixed river alluvium	**Rock size**	Fine gravel [to c. 5 mm]	**Rock cover**	> 70%
Vegetation condition	Poor	**Disturbance**	High weed cover and grazing.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Eucalyptus camaldulensis	Tree (10-30 m)	33 – 49
Acacia coriacea subsp. *pendens*	Tree (<10 m)	5 – 9
Capparis umbonata	Shrub (>2 m)	1 – 4
Acacia tetragonophylla	Shrub (1-2 m)	1 – 4
Acacia tumida var. *pilbarensis*	Shrub (1-2 m)	1 – 4
Vachellia farnesiana	Shrub (1-2 m)	1 – 4
Acacia pyrifolia	Shrub (0.5-1 m)	< 1
Achyranthes aspera	Shrub (0.5-1 m)	1 – 4
Afrohybanthus aurantiacus	Shrub (<0.5 m)	< 1
Indigofera monophylla	Shrub (<0.5 m)	< 1
Cyperus vaginatus	Sedge (0.5-1 m)	< 1
Alternanthera denticulata var. *denticulata*	Herb (<0.5 m)	< 1
Argemone ochroleuca subsp. *ochroleuca*	Herb (<0.5 m)	< 1
Boerhavia burbidgeana	Herb (<0.5 m)	< 1
Crotalaria medicaginea var. *neglecta*	Herb (<0.5 m)	< 1
Cucumis variabilis	Herb (<0.5 m)	< 1
Euphorbia australis var. *subtomentosa*	Herb (<0.5 m)	< 1
Glycine canescens	Herb (<0.5 m)	< 1
Malvastrum americanum	Herb (<0.5 m)	< 1
Rostellularia adscendens var. *clementii*	Herb (<0.5 m)	< 1
Senna notabilis	Herb (<0.5 m)	< 1
Sesbania cannabina	Herb (<0.5 m)	< 1
Themeda triandra	Tussock Grass (0.5-1 m)	1 – 4
Cenchrus ciliaris	Tussock Grass (<0.5 m)	5 – 9
Cenchrus setiger	Tussock Grass (<0.5 m)	5 – 9
Eragrostis tenellula	Tussock Grass (<0.5 m)	< 1
Eriachne mucronata	Tussock Grass (<0.5 m)	< 1
Sporobolus australasicus	Tussock Grass (<0.5 m)	< 1
Triodia longiceps	Hummock Grass (0.5-1 m)	< 1

BD_E_055

Date	21/06/2023	**Site type**	Flora: Quadrat	**Botanist**	AC
Location	-22.0686, 119.90898				
Landform	Low hill	**Slope**	Moderate		
Soil colour	Dark brown	**Soil texture**	Loam		
Rock type	Calcrete, ironstone	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	5 – 9
Acacia ancistrocarpa	Shrub (1-2 m)	< 1
Acacia bivenosa	Shrub (1-2 m)	< 1
Capparis umbonata	Shrub (0.5-1 m)	< 1
Corchorus parviflorus	Shrub (0.5-1 m)	< 1
Senna ?stricta	Shrub (0.5-1 m)	< 1
Senna artemisioides subsp. *oligophylla*	Shrub (0.5-1 m)	< 1
Senna symonii	Shrub (0.5-1 m)	< 1
Afrohybanthus aurantiacus	Shrub (<0.5 m)	< 1
Indigofera monophylla	Shrub (<0.5 m)	< 1
Ptilotus astrolasius	Shrub (<0.5 m)	1 – 4
Ptilotus incanus	Shrub (<0.5 m)	< 1
Goodenia stobbsiana	Herb (0.5-1 m)	< 1
Goodenia cusackiana	Herb (<0.5 m)	< 1
Goodenia microptera	Herb (<0.5 m)	< 1
Hibiscus coatesii	Herb (<0.5 m)	< 1
Ptilotus clementii	Herb (<0.5 m)	5 – 9
Ptilotus exaltatus	Herb (<0.5 m)	< 1
Scaevola amblyanthera var. *centralis*	Herb (<0.5 m)	< 1
Stackhousia muricata subsp. annual (W.R. Barker 2172)	Herb (<0.5 m)	< 1
Tribulus hirsutus	Herb (<0.5 m)	< 1
Amphipogon sericeus	Tussock Grass (<0.5 m)	< 1
Aristida contorta	Tussock Grass (<0.5 m)	< 1
Eriachne mucronata	Tussock Grass (<0.5 m)	< 1
Triodia wiseana	Hummock Grass (<0.5 m)	25 – 32

BD_E_056

Date	22/06/2023	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-22.07225, 119.87046				
Landform	Undulating plain	**Slope**	NA		
Soil colour	Brown	**Soil texture**	Sandy clay loam		
Rock type	Quartz	**Rock size**	Mixed	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	Minor weed cover and grazing.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Eremophila longifolia	Shrub (>2 m)	< 1
Senna glutinosa subsp. *glutinosa*	Shrub (>2 m)	< 1
Acacia synchronicia	Shrub (1-2 m)	1 – 4
Vachellia farnesiana	Shrub (1-2 m)	< 1
Acacia tetragonophylla	Shrub (0.5-1 m)	< 1
Senna artemisioides subsp. *oligophylla*	Shrub (0.5-1 m)	1 – 4
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Hakea lorea subsp. *lorea*	Shrub (<0.5 m)	< 1
Senna ?hamersleyensis	Shrub (<0.5 m)	< 1
Sida trichopoda	Shrub (<0.5 m)	< 1
Maireana georgei	Herb (<0.5 m)	< 1
Sclerolaena ?eriacantha	Herb (<0.5 m)	< 1
Sclerolaena costata	Herb (<0.5 m)	< 1
Cymbopogon ambiguus	Tussock Grass (0.5-1 m)	< 1
Themeda triandra	Tussock Grass (0.5-1 m)	1 – 4
Enneapogon caerulescens	Tussock Grass (<0.5 m)	< 1
Eriachne pulchella subsp. *dominii*	Tussock Grass (<0.5 m)	< 1
Sporobolus australasicus	Tussock Grass (<0.5 m)	< 1
Triodia brizoides	Hummock Grass (0.5-1 m)	33 – 49
Triodia longiceps	Hummock Grass (0.5-1 m)	5 – 9

BD_E_057

Date	22/06/2023	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-22.074, 119.88972				
Landform	Plain	**Slope**	Gentle		
Soil colour	Dark brown	**Soil texture**	Sandy clay loam		
Rock type	Ironstone	**Rock size**	Mixed	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				

No photo.

Name	Stratum	Percent cover (%)
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	Assoc.
Acacia bivenosa	Shrub (0.5-1 m)	Assoc.
Acacia inaequilatera	Shrub (<0.5 m)	< 1
Grevillea wickhamii	Shrub (<0.5 m)	< 1
Indigofera monophylla	Shrub (<0.5 m)	Assoc.
Ptilotus astrolasius	Shrub (<0.5 m)	< 1
Ptilotus calostachyus	Herb (0.5-1 m)	< 1
Goodenia stobbsiana	Herb (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	33 – 49
Triodia wiseana	Hummock Grass (<0.5 m)	< 1

BD_E_058

Date	22/06/2023	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-22.07519, 119.87915				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Light brown	**Soil texture**	Clay loam		
Rock type	Calcrete, ironstone	**Rock size**	Mixed	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				

No photo.

Name	Stratum	Percent cover (%)
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	5 – 9
Eucalyptus socialis subsp. *eucentrica*	Mallee (<10 m)	5 – 9
Capparis umbonata	Shrub (1-2 m)	1 – 4
Acacia bivenosa	Shrub (0.5-1 m)	1 – 4
Senna artemisioides subsp. *oligophylla*	Shrub (0.5-1 m)	1 – 4
Acacia arrecta	Shrub (<0.5 m)	5 – 9
Senna symonii	Shrub (<0.5 m)	< 1
Ptilotus clementii	Herb (<0.5 m)	< 1
Triodia longiceps	Hummock Grass (0.5-1 m)	1 – 4
Triodia epactia	Hummock Grass (<0.5 m)	1 – 4
Triodia wiseana	Hummock Grass (<0.5 m)	25 – 32

BD_E_059

Date	22/06/2023	**Site type**	Flora: Quadrat	**Botanist**	RS
Location	-22.07686, 119.85291				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Basalt	**Rock size**	Mixed	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Shrub (>2 m)	1 – 4
Grevillea pyramidalis subsp. *leucadendron*	Shrub (>2 m)	1 – 4
Grevillea wickhamii	Shrub (>2 m)	1 – 4
Acacia ancistrocarpa	Shrub (1-2 m)	< 1
Acacia pyrifolia var. *morrisonii*	Shrub (0.5-1 m)	< 1
Hakea lorea subsp. *lorea*	Shrub (0.5-1 m)	< 1
Indigofera monophylla	Shrub (0.5-1 m)	1 – 4
Senna venusta	Shrub (0.5-1 m)	< 1
Tephrosia rosea var. *clementii*	Shrub (0.5-1 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Arivela viscosa	Herb (<0.5 m)	< 1
Boerhavia coccinea	Herb (<0.5 m)	< 1
Crotalaria medicaginea var. *neglecta*	Herb (<0.5 m)	< 1
Euphorbia australis var. *subtomentosa*	Herb (<0.5 m)	< 1
Evolvulus alsinoides var. *villosicalyx*	Herb (<0.5 m)	< 1
Indigofera linifolia	Herb (<0.5 m)	< 1
Tephrosia sp. NW Eremaean (S. van Leeuwen et al. PBS 0356)	Herb (<0.5 m)	< 1
Triodia epactia	Hummock Grass (0.5-1 m)	50 – 74

BD_E_060

Date	22/06/2023	**Site type**	Flora: Quadrat	**Botanist**	RS
Location	-22.07939, 119.89116				
Landform	Low hill	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Basalt, quartz	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Acacia synchronicia	Shrub (>2 m)	5 – 9
Acacia bivenosa	Shrub (1-2 m)	1 – 4
Hakea lorea subsp. *lorea*	Shrub (1-2 m)	< 1
Senna ?stricta	Shrub (1-2 m)	< 1
Senna symonii	Shrub (1-2 m)	< 1
Acacia inaequilatera	Shrub (0.5-1 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Hibiscus sturtii var. *campylochlamys*	Shrub (<0.5 m)	< 1
Senna artemisioides subsp. *oligophylla*	Shrub (<0.5 m)	< 1
Crotalaria medicaginea var. *neglecta*	Herb (<0.5 m)	< 1
Evolvulus alsinoides var. *villosicalyx*	Herb (<0.5 m)	< 1
Pterocaulon serrulatum var. *velutinum*	Herb (<0.5 m)	< 1
Streptoglossa adscendens	Herb (<0.5 m)	< 1
Cymbopogon ambiguus	Tussock Grass (0.5-1 m)	< 1
Eriachne lanata	Tussock Grass (<0.5 m)	< 1
Triodia brizoides	Hummock Grass (0.5-1 m)	50 – 74
Triodia epactia	Hummock Grass (0.5-1 m)	1 – 4
Triodia longiceps	Hummock Grass (0.5-1 m)	25 – 32

BD_E_061

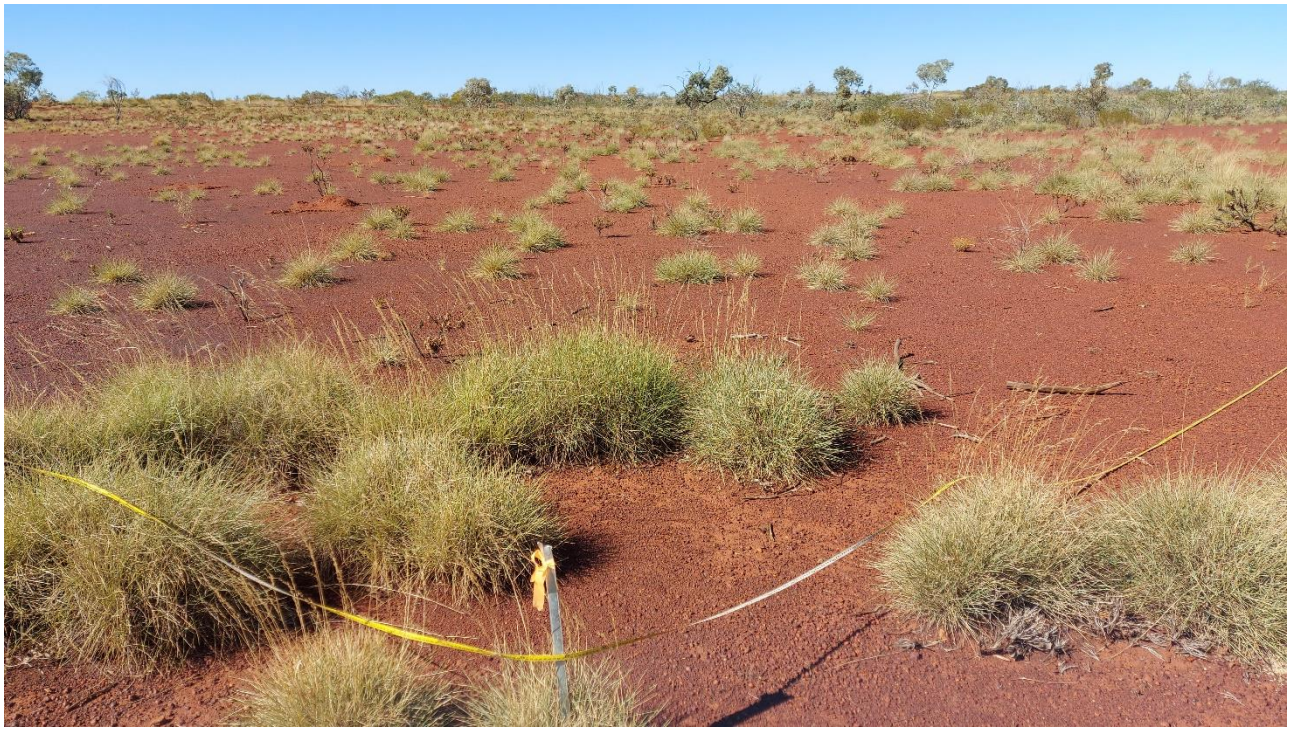
Date	22/06/2023	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-22.08647, 119.89241				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Mixed	**Rock cover**	10 – 30%
Vegetation condition	Excellent	**Disturbance**	Minor weed cover and grazing.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	< 1
Acacia inaequilatera	Shrub (>2 m)	1 – 4
Vachellia farnesiana	Shrub (>2 m)	Assoc.
Indigofera monophylla	Shrub (0.5-1 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Trichodesma zeylanicum var. *zeylanicum*	Herb (1-2 m)	< 1
Cynanchum viminale	Herb (0.5-1 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Cucumis variabilis	Herb (<0.5 m)	< 1
Hibiscus coatesii	Herb (<0.5 m)	< 1
Solanum horridum	Herb (<0.5 m)	< 1
Cymbopogon ambiguus	Tussock Grass (0.5-1 m)	< 1
Aristida contorta	Tussock Grass (<0.5 m)	< 1
Aristida latifolia	Tussock Grass (<0.5 m)	< 1
Eriachne pulchella subsp. *dominii*	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (0.5-1 m)	25 – 32

BD_E_062

Date	23/06/2023	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-22.08538, 119.92051				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Orange	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	Assoc.
Acacia tumida var. *pilbarensis*	Shrub (>2 m)	5 – 9
Grevillea wickhamii	Shrub (>2 m)	1 – 4
Acacia ancistrocarpa	Shrub (0.5-1 m)	1 – 4
Indigofera monophylla	Shrub (0.5-1 m)	1 – 4
Corchorus parviflorus	Shrub (<0.5 m)	1 – 4
Dodonaea coriacea	Shrub (<0.5 m)	< 1
Senna glutinosa subsp. *glutinosa*	Shrub (<0.5 m)	< 1
Seringia ?exastia	Shrub (<0.5 m)	< 1
Sida ?arenicola	Shrub (<0.5 m)	< 1
Sida sp. Pilbara (A.A. Mitchell PRP 1543)	Shrub (<0.5 m)	< 1
Ptilotus calostachyus	Herb (0.5-1 m)	1 – 4
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Goodenia stobbsiana	Herb (<0.5 m)	5 – 9
Trigastrotheca molluginea	Herb (<0.5 m)	< 1
Amphipogon sericeus	Tussock Grass (<0.5 m)	< 1
Aristida holathera var. *holathera*	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	10 – 24

BD_E_063

Date	23/06/2023	**Site type**	Flora: Quadrat	**Botanist**	RS
Location	-22.07692, 119.91799				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Fine gravel [to c. 5 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Moderate (2 – 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia bivenosa	Shrub (0.5-1 m)	1 – 4
Acacia synchronicia	Shrub (0.5-1 m)	< 1
Hakea lorea subsp. *lorea*	Shrub (0.5-1 m)	< 1
Indigofera monophylla	Shrub (0.5-1 m)	1 – 4
Senna ?stricta	Shrub (0.5-1 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Euploca ?pachyphylla	Shrub (<0.5 m)	< 1
Euploca heterantha	Shrub (<0.5 m)	< 1
Hibiscus sturtii var. *campylochlamys*	Shrub (<0.5 m)	< 1
Senna artemisioides subsp. *oligophylla*	Shrub (<0.5 m)	1 – 4
Sida trichopoda	Shrub (<0.5 m)	< 1
Abutilon otocarpum	Herb (<0.5 m)	< 1
Euphorbia australis var. *subtomentosa*	Herb (<0.5 m)	< 1
Minuria integerrima	Herb (<0.5 m)	< 1
Ptilotus aervoides	Herb (<0.5 m)	< 1
Ptilotus clementii	Herb (<0.5 m)	< 1
Ptilotus exaltatus	Herb (<0.5 m)	< 1
Senna notabilis	Herb (<0.5 m)	< 1
Solanum horridum	Herb (<0.5 m)	< 1
Trianthema triquetrum	Herb (<0.5 m)	< 1
Aristida contorta	Tussock Grass (<0.5 m)	1 – 4
Enneapogon caerulescens	Tussock Grass (<0.5 m)	< 1
Eriachne pulchella subsp. *pulchella*	Tussock Grass (<0.5 m)	< 1
Sporobolus australasicus	Tussock Grass (<0.5 m)	< 1
Triodia longiceps	Hummock Grass (0.5-1 m)	25 – 32

BD_E_064

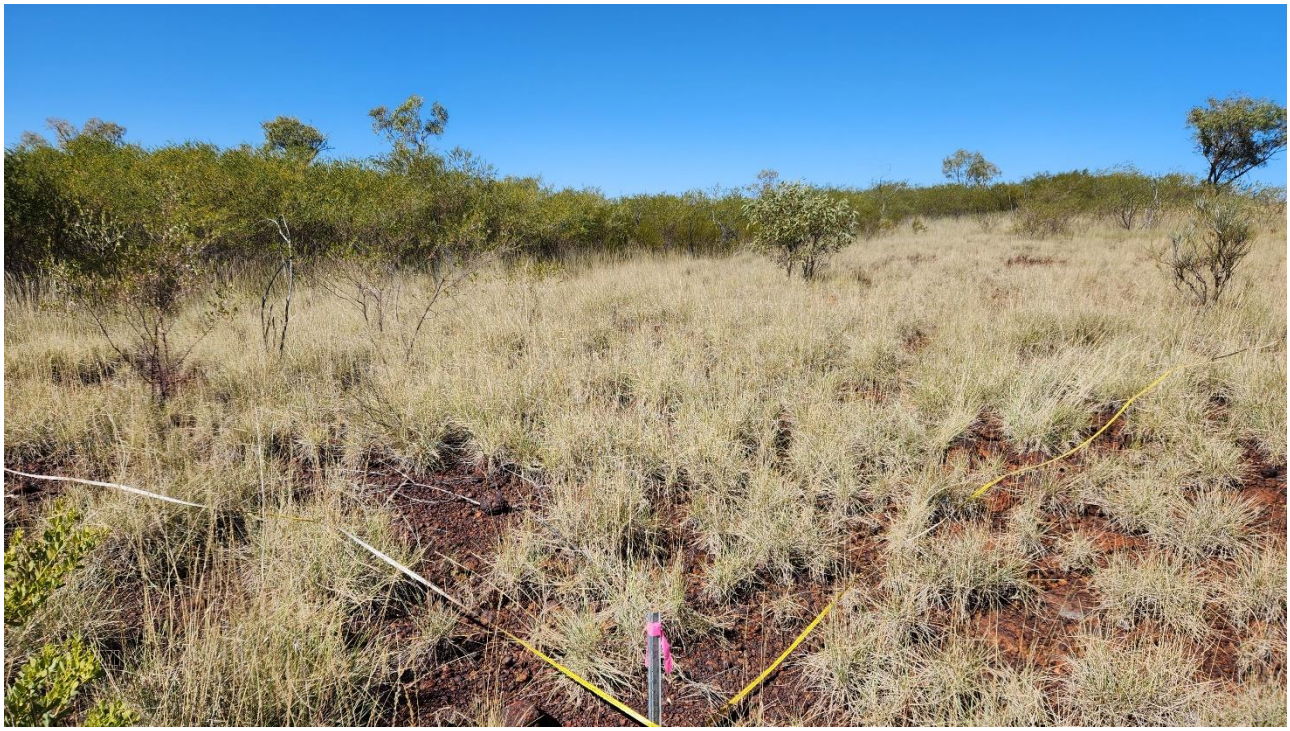
Date	22/06/2023	**Site type**	Flora: Quadrat	**Botanist**	AC
Location	-22.08771, 119.81947				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Dark brown	**Soil texture**	Clay loam		
Rock type	Ironstone, quartz	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Shrub (>2 m)	1 – 4
Acacia pruinocarpa	Shrub (>2 m)	1 – 4
Hakea lorea subsp. *lorea*	Shrub (1-2 m)	< 1
Eremophila longifolia	Shrub (0.5-1 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Sida ?echinocarpa	Shrub (<0.5 m)	< 1
Sida ?trichopoda	Shrub (<0.5 m)	< 1
Alysicarpus muelleri	Herb (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Evolvulus alsinoides var. *villosicalyx*	Herb (<0.5 m)	< 1
Ptilotus aervoides	Herb (<0.5 m)	< 1
Salsola australis	Herb (<0.5 m)	< 1
Sclerolaena costata	Herb (<0.5 m)	< 1
Solanum horridum	Herb (<0.5 m)	< 1
Aristida contorta	Tussock Grass (<0.5 m)	1 – 4
Enneapogon caerulescens	Tussock Grass (<0.5 m)	< 1
Enneapogon polyphyllus	Tussock Grass (<0.5 m)	< 1
Sporobolus australasicus	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	33 – 49

BD_E_065

Date	22/06/2023	**Site type**	Flora: Quadrat	**Botanist**	AC
Location	-22.09233, 119.85062				
Landform	Low hill	**Slope**	Moderate		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	1 – 4
Acacia ancistrocarpa	Shrub (>2 m)	5 – 9
Acacia monticola	Shrub (>2 m)	10 – 24
Acacia bivenosa	Shrub (1-2 m)	5 – 9
Acacia pyrifolia	Shrub (1-2 m)	< 1
Hakea lorea subsp. *lorea*	Shrub (1-2 m)	< 1
Petalostylis labicheoides	Shrub (1-2 m)	< 1
Acacia trachycarpa	Shrub (0.5-1 m)	< 1
Indigofera monophylla	Shrub (0.5-1 m)	1 – 4
Senna ?artemisioides subsp. *oligophylla*	Shrub (0.5-1 m)	< 1
Seringia ?exastia	Shrub (0.5-1 m)	< 1
Sida sp. Pilbara (A.A. Mitchell PRP 1543)	Shrub (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Goodenia stobbsiana	Herb (<0.5 m)	< 1
Ptilotus calostachyus	Herb (<0.5 m)	< 1
Eriachne lanata	Tussock Grass (<0.5 m)	1 – 4
Paraneurachne muelleri	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	33 – 49

BD_E_066

Date	22/06/2023	**Site type**	Flora: Quadrat	**Botanist**	RS
Location	-22.09086, 119.89886				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone, quartz	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Acacia ?*aptaneura*	Shrub (>2 m)	1 – 4
Acacia tetragonophylla	Shrub (>2 m)	1 – 4
Senna ?*stricta*	Shrub (1-2 m)	< 1
Eremophila forrestii subsp. *forrestii*	Shrub (0.5-1 m)	< 1
Indigofera monophylla	Shrub (0.5-1 m)	1 – 4
Rhagodia eremaea	Shrub (0.5-1 m)	< 1
Tribulus suberosus	Shrub (0.5-1 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Enchylaena tomentosa var. *tomentosa*	Shrub (<0.5 m)	< 1
Hibiscus sturtii var. *campylochlamys*	Shrub (<0.5 m)	< 1
Sida trichopoda	Shrub (<0.5 m)	< 1
Solanum lasiophyllum/phlomoides	Shrub (<0.5 m)	< 1
Trichodesma zeylanicum var. *zeylanicum*	Herb (0.5-1 m)	< 1
Abutilon ?sp. Dioicum (A.A. Mitchell PRP 1618)	Herb (<0.5 m)	< 1
Abutilon macrum	Herb (<0.5 m)	< 1
Alysicarpus muelleri	Herb (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Cheilanthes sieberi subsp. *sieberi*	Herb (<0.5 m)	< 1
Cucumis variabilis	Herb (<0.5 m)	< 1
Evolvulus alsinoides var. *villosicalyx*	Herb (<0.5 m)	< 1
Gomphrena cunninghamii	Herb (<0.5 m)	< 1
Goodenia microptera	Herb (<0.5 m)	< 1
Ptilotus exaltatus	Herb (<0.5 m)	< 1
Senna notabilis	Herb (<0.5 m)	< 1
Tephrosia sp. clay soils (S. van Leeuwen et al. PBS 0273)	Herb (<0.5 m)	< 1
Enneapogon polyphyllus	Tussock Grass (<0.5 m)	< 1
Iseilema vaginiflorum	Tussock Grass (<0.5 m)	< 1
Paspalidium clementii	Tussock Grass (<0.5 m)	< 1
Triodia brizoides	Hummock Grass (0.5-1 m)	50 – 74

BD_E_067

Date	22/06/2023	**Site type**	Flora: Quadrat	**Botanist**	RS
Location	-22.0862, 119.89325				
Landform	Plain	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Clay		
Rock type	Basalt	**Rock size**	Mixed	**Rock cover**	> 70%
Vegetation condition	Very Good	**Disturbance**	Minor weed cover and grazing.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Vachellia farnesiana	Shrub (1-2 m)	1 – 4
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Hibiscus sturtii var. *campylochlamys*	Shrub (<0.5 m)	< 1
Indigofera trita subsp. *trita*	Shrub (<0.5 m)	1 – 4
Sida trichopoda	Shrub (<0.5 m)	1 – 4
Solanum lasiophyllum/phlomoides	Shrub (<0.5 m)	< 1
Arivela viscosa	Herb (<0.5 m)	< 1
Boerhavia burbidgeana	Herb (<0.5 m)	< 1
Corchorus tridens	Herb (<0.5 m)	< 1
Crotalaria medicaginea var. *neglecta*	Herb (<0.5 m)	1 – 4
Dolichocarpa crouchiana	Herb (<0.5 m)	< 1
Evolvulus alsinoides var. *villosicalyx*	Herb (<0.5 m)	< 1
Grona muelleri	Herb (<0.5 m)	1 – 4
Heliotropium crispatum	Herb (<0.5 m)	< 1
Hibiscus brachysiphonius	Herb (<0.5 m)	1 – 4
Indigofera colutea	Herb (<0.5 m)	< 1
Neptunia longipila	Herb (<0.5 m)	< 1
Portulaca oleracea	Herb (<0.5 m)	< 1
Pterocaulon serrulatum var. *velutinum*	Herb (<0.5 m)	< 1
Ptilotus aervoides	Herb (<0.5 m)	5 – 9
Ptilotus carinatus	Herb (<0.5 m)	1 – 4
Ptilotus gomphrenoides	Herb (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	< 1
Sclerolaena costata	Herb (<0.5 m)	< 1
Senna notabilis	Herb (<0.5 m)	< 1
Solanum horridum	Herb (<0.5 m)	< 1
Streptoglossa adscendens	Herb (<0.5 m)	< 1
Swainsona thompsoniana	Herb (<0.5 m)	< 1
Tephrosia sp. clay soils (S. van Leeuwen et al. PBS 0273)	Herb (<0.5 m)	1 – 4
Aristida contorta	Tussock Grass (<0.5 m)	1 – 4
Aristida latifolia	Tussock Grass (<0.5 m)	< 1

Name	Stratum	Percent cover (%)
Chloris pectinata	Tussock Grass (<0.5 m)	1 – 4
Dactyloctenium radulans	Tussock Grass (<0.5 m)	< 1
Enneapogon caerulescens	Tussock Grass (<0.5 m)	1 – 4
Enneapogon polyphyllus	Tussock Grass (<0.5 m)	1 – 4
Eragrostis tenellula	Tussock Grass (<0.5 m)	< 1
Eragrostis xerophila	Tussock Grass (<0.5 m)	< 1
Panicum decompositum	Tussock Grass (<0.5 m)	1 – 4
Triodia brizoides	Hummock Grass (0.5-1 m)	1 – 4
Triodia epactia	Hummock Grass (0.5-1 m)	< 1
Triodia longiceps	Hummock Grass (0.5-1 m)	< 1

BD_E_068

Date	22/06/2023	**Site type**	Flora: Quadrat	**Botanist**	LE
Location	-22.09277, 119.86895				
Landform	Undulating plain	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Sandy loam		
Rock type	Ironstone, quartz	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	Minor weed cover and grazing.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	< 1
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	5 – 9
Acacia ancistrocarpa	Shrub (>2 m)	5 – 9
Gossypium robinsonii	Shrub (>2 m)	< 1
Acacia bivenosa	Shrub (1-2 m)	1 – 4
Acacia synchronicia	Shrub (1-2 m)	1 – 4
Acacia tenuissima	Shrub (1-2 m)	1 – 4
Acacia tumida var. *pilbarensis*	Shrub (1-2 m)	1 – 4
Indigofera monophylla	Shrub (0.5-1 m)	1 – 4
Senna glutinosa subsp. *glutinosa*	Shrub (0.5-1 m)	< 1
Senna symonii	Shrub (0.5-1 m)	< 1
Vachellia farnesiana	Shrub (0.5-1 m)	< 1
Capparis umbonata	Shrub (<0.5 m)	< 1
Euploca chrysocarpa	Shrub (<0.5 m)	< 1
Cucumis variabilis	Herb (<0.5 m)	< 1
Maireana melanocoma	Herb (<0.5 m)	< 1
Paraneurachne muelleri	Tussock Grass (<0.5 m)	< 1
Triodia longiceps	Hummock Grass (0.5-1 m)	25 – 32
Triodia brizoides	Hummock Grass (<0.5 m)	1 – 4
Triodia epactia	Hummock Grass (<0.5 m)	< 1

BD_E_069

Date	22/06/2023	**Site type**	Flora: Quadrat	**Botanist**	LE
Location	-22.09915, 119.84596				
Landform	Low hill	**Slope**	Moderate		
Soil colour	Dark brown	**Soil texture**	Sandy loam		
Rock type	Calcrete	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	5 – 9
Acacia bivenosa	Shrub (1-2 m)	1 – 4
Capparis lasiantha	Shrub (0.5-1 m)	< 1
Capparis umbonata	Shrub (0.5-1 m)	< 1
Hakea lorea subsp. *lorea*	Shrub (0.5-1 m)	< 1
Senna glutinosa subsp. *glutinosa*	Shrub (0.5-1 m)	1 – 4
Senna symonii	Shrub (0.5-1 m)	1 – 4
Acacia arrecta	Shrub (<0.5 m)	1 – 4
Afrohybanthus aurantiacus	Shrub (<0.5 m)	< 1
Indigofera monophylla	Shrub (<0.5 m)	1 – 4
Indigofera trita subsp. *trita*	Shrub (<0.5 m)	< 1
Eriachne mucronata	Tussock Grass (<0.5 m)	< 1
Paraneurachne muelleri	Tussock Grass (<0.5 m)	< 1
Triodia longiceps	Hummock Grass (<0.5 m)	1 – 4
Triodia wiseana	Hummock Grass (<0.5 m)	10 – 24

BD_E_070

Date	22/06/2023	**Site type**	Flora: Quadrat	**Botanist**	AC
Location	-22.09733, 119.83887				
Landform	Plain	**Slope**	NA		
Soil colour	Dark brown	**Soil texture**	Clay		
Rock type	Ironstone	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	10 – 30%
Vegetation condition	Good	**Disturbance**	Moderate weed cover, minor grazing.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia synchronicia	Shrub (>2 m)	5 – 9
Vachellia farnesiana	Shrub (1-2 m)	1 – 4
Acacia bivenosa	Shrub (0.5-1 m)	< 1
Eremophila forrestii subsp. *forrestii*	Shrub (0.5-1 m)	< 1
Eremophila longifolia	Shrub (0.5-1 m)	< 1
Senna glutinosa subsp. ×*luerssenii*	Shrub (0.5-1 m)	< 1
Hibiscus sturtii var. *platychlamys*	Shrub (<0.5 m)	< 1
Senna ?hamersleyensis	Shrub (<0.5 m)	1 – 4
Senna artemisioides subsp. *oligophylla*	Shrub (<0.5 m)	< 1
Sida trichopoda	Shrub (<0.5 m)	5 – 9
Bulbostylis turbinata	Sedge (<0.5 m)	< 1
Abutilon malvifolium	Herb (<0.5 m)	< 1
Arivela viscosa	Herb (<0.5 m)	< 1
Boerhavia coccinea	Herb (<0.5 m)	< 1
Citrullus colocynthis	Herb (<0.5 m)	< 1
Cullen graveolens	Herb (<0.5 m)	< 1
Dolichocarpa crouchiana	Herb (<0.5 m)	< 1
Evolvulus alsinoides var. *villosicalyx*	Herb (<0.5 m)	< 1
Goodenia muelleriana	Herb (<0.5 m)	< 1
Hibiscus brachysiphonius	Herb (<0.5 m)	< 1
Neptunia longipila	Herb (<0.5 m)	5 – 9
Portulaca oleracea	Herb (<0.5 m)	< 1
Ptilotus aervoides	Herb (<0.5 m)	< 1
Ptilotus gomphrenoides	Herb (<0.5 m)	1 – 4
Rhynchosia minima	Herb (<0.5 m)	< 1
Sclerolaena cornishiana	Herb (<0.5 m)	< 1
Senna notabilis	Herb (<0.5 m)	< 1
Sida spinosa	Herb (<0.5 m)	< 1
Solanum horridum	Herb (<0.5 m)	< 1
Streptoglossa adscendens	Herb (<0.5 m)	< 1
Trianthema triquetrum	Herb (<0.5 m)	< 1

Name	Stratum	Percent cover (%)
Aristida latifolia	Tussock Grass (<0.5 m)	< 1
Cenchrus setiger	Tussock Grass (<0.5 m)	< 1
Chloris pectinata	Tussock Grass (<0.5 m)	< 1
Cynodon convergens	Tussock Grass (<0.5 m)	1 – 4
Dactyloctenium radulans	Tussock Grass (<0.5 m)	< 1
Dichanthium sericeum subsp. *humilius*	Tussock Grass (<0.5 m)	< 1
Enneapogon caerulescens	Tussock Grass (<0.5 m)	< 1
Eragrostis leptocarpa	Tussock Grass (<0.5 m)	< 1
Eragrostis tenellula	Tussock Grass (<0.5 m)	1 – 4
Eragrostis xerophila	Tussock Grass (<0.5 m)	1 – 4
Eriachne benthamii	Tussock Grass (<0.5 m)	< 1
Eriachne pulchella subsp. *dominii*	Tussock Grass (<0.5 m)	< 1
Sporobolus australasicus	Tussock Grass (<0.5 m)	< 1
Triodia longiceps	Hummock Grass (0.5-1 m)	1 – 4
Triodia brizoides	Hummock Grass (<0.5 m)	5 – 9

BD_E_071

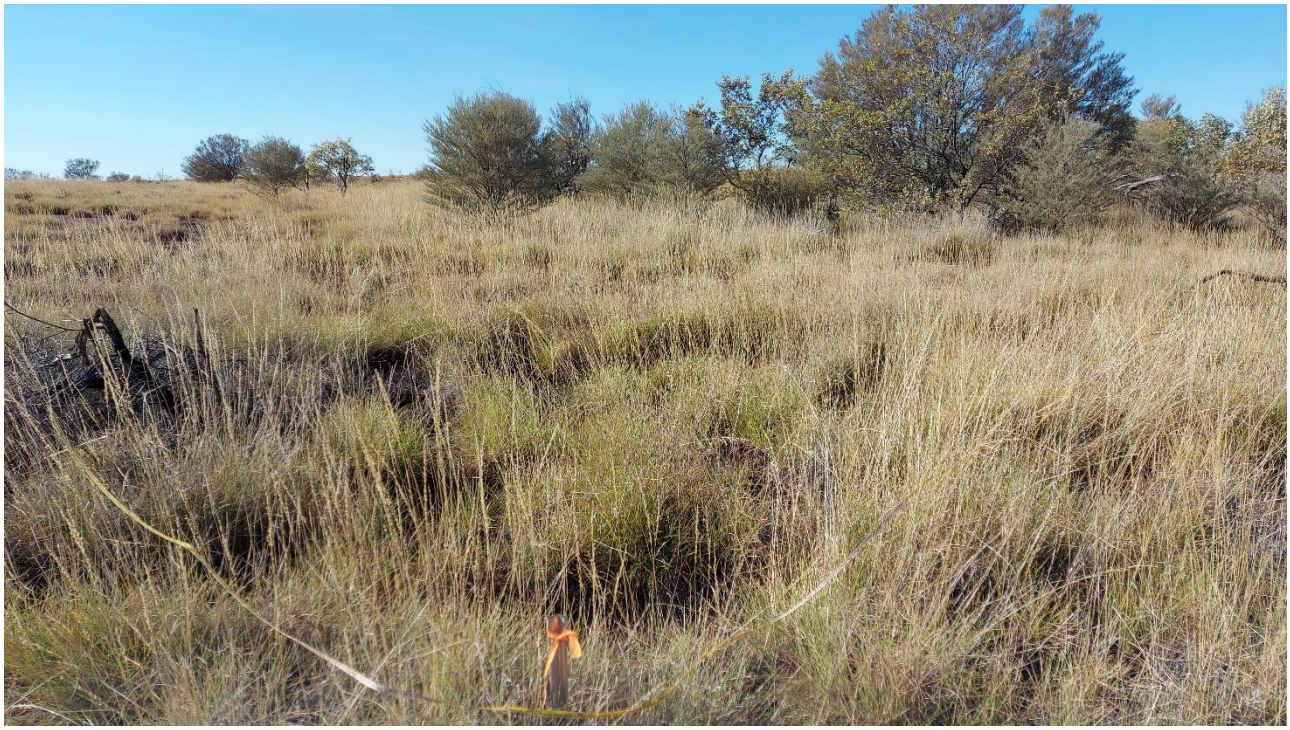
Date	21/06/2023	**Site type**	Flora: Quadrat	**Botanist**	RS
Location	-22.09497, 119.92643				
Landform	Low hill	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	1 – 4
Acacia ?aptaneura	Shrub (>2 m)	Assoc.
Acacia pruinocarpa	Shrub (>2 m)	5 – 9
Acacia ancistrocarpa	Shrub (1-2 m)	< 1
Capparis umbonata	Shrub (1-2 m)	Assoc.
Dodonaea coriacea	Shrub (<0.5 m)	< 1
Ptilotus calostachyus	Herb (0.5-1 m)	< 1
Goodenia stobbsiana	Herb (<0.5 m)	< 1
Amphipogon sericeus	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (0.5-1 m)	50 – 74

BD_E_072

Date	21/06/2023	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-22.09703, 119.9155				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Mixed	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	5 – 9
Acacia ?aptaneura	Shrub (>2 m)	10 – 24
Acacia ?sibirica	Shrub (>2 m)	1 – 4
Acacia ancistrocarpa	Shrub (>2 m)	< 1
Acacia bivenosa	Shrub (>2 m)	< 1
Acacia tumida var. *pilbarensis*	Shrub (>2 m)	< 1
Grevillea wickhamii	Shrub (>2 m)	5 – 9
Santalum lanceolatum	Shrub (>2 m)	5 – 9
Senna glutinosa subsp. *glutinosa*	Shrub (1-2 m)	< 1
Ptilotus calostachyus	Herb (0.5-1 m)	< 1
Triodia epactia	Hummock Grass (0.5-1 m)	33 – 49

BD_E_073

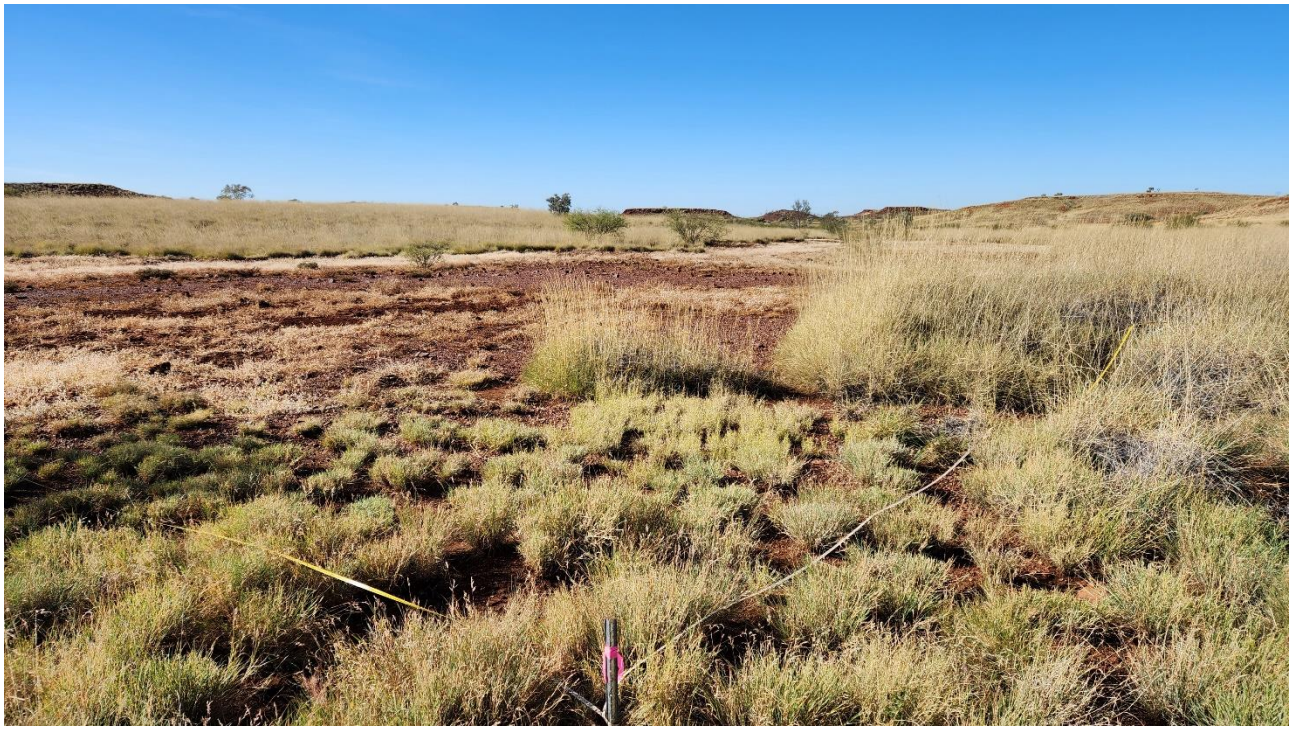
Date	22/06/2023	**Site type**	Flora: Quadrat	**Botanist**	LE
Location	-22.10088, 119.82842				
Landform	Low hill	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Sandy loam		
Rock type	Ironstone, calcrete	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Moderate (2 – 3 yrs)				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	Assoc.
Acacia ancistrocarpa	Shrub (1-2 m)	1 – 4
Acacia bivenosa	Shrub (0.5-1 m)	1 – 4
Senna ?artemisioides subsp. *oligophylla*	Shrub (0.5-1 m)	1 – 4
Senna ?stricta	Shrub (0.5-1 m)	< 1
Goodenia stobbsiana	Herb (<0.5 m)	< 1
Ptilotus calostachyus	Herb (<0.5 m)	< 1
Eriachne lanata	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	10 – 24
Triodia wiseana	Hummock Grass (<0.5 m)	5 – 9

BD_E_074

Date	21/06/2023	**Site type**	Flora: Quadrat	**Botanist**	AC
Location	-22.10034, 119.90243				
Landform	Plain (clay)	**Slope**	NA		
Soil colour	Dark brown	**Soil texture**	Clay		
Rock type	Basalt	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	30 – 70%
Vegetation condition	Good	**Disturbance**	Moderate weed cover, minor grazing.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Vachellia farnesiana	Shrub (1-2 m)	< 1
Hibiscus sturtii var. *platychlamys*	Shrub (<0.5 m)	< 1
Senna ?hamersleyensis	Shrub (<0.5 m)	< 1
Sida trichopoda	Shrub (<0.5 m)	5 – 9
Solanum lasiophyllum	Shrub (<0.5 m)	< 1
Abutilon malvifolium	Herb (<0.5 m)	< 1
Abutilon otocarpum	Herb (<0.5 m)	< 1
Boerhavia coccinea	Herb (<0.5 m)	< 1
Boerhavia gardneri	Herb (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Crotalaria dissitiflora subsp. *benthamiana*	Herb (<0.5 m)	5 – 9
Crotalaria medicaginea var. *neglecta*	Herb (<0.5 m)	< 1
Cullen graveolens	Herb (<0.5 m)	< 1
Evolvulus alsinoides var. *villosicalyx*	Herb (<0.5 m)	< 1
Hibiscus brachysiphonius	Herb (<0.5 m)	1 – 4
Indigofera linifolia	Herb (<0.5 m)	< 1
Malvastrum americanum	Herb (<0.5 m)	< 1
Nellica maderaspatensis	Herb (<0.5 m)	< 1
Neptunia longipila	Herb (<0.5 m)	< 1
Portulaca oleracea	Herb (<0.5 m)	< 1
Ptilotus aervoides	Herb (<0.5 m)	< 1
Ptilotus carinatus	Herb (<0.5 m)	< 1
Ptilotus gomphrenoides	Herb (<0.5 m)	10 – 24
Rhynchosia minima	Herb (<0.5 m)	< 1
Salsola australis	Herb (<0.5 m)	< 1
Sclerolaena cornishiana	Herb (<0.5 m)	< 1
Sclerolaena costata	Herb (<0.5 m)	< 1
Senna notabilis	Herb (<0.5 m)	< 1
Sida spinosa	Herb (<0.5 m)	< 1
Solanum horridum	Herb (<0.5 m)	< 1
Tephrosia sp. clay soils (S. van Leeuwen et al. PBS 0273)	Herb (<0.5 m)	< 1

Name	Stratum	Percent cover (%)
Trianthema triquetrum	Herb (<0.5 m)	1 – 4
Aristida latifolia	Tussock Grass (<0.5 m)	< 1
Cenchrus ciliaris	Tussock Grass (<0.5 m)	1 – 4
Chloris pectinata	Tussock Grass (<0.5 m)	< 1
Cynodon convergens	Tussock Grass (<0.5 m)	< 1
Enneapogon caerulescens	Tussock Grass (<0.5 m)	< 1
Eragrostis desertorum	Tussock Grass (<0.5 m)	< 1
Eragrostis leptocarpa	Tussock Grass (<0.5 m)	< 1
Eragrostis tenellula	Tussock Grass (<0.5 m)	< 1
Eragrostis xerophila	Tussock Grass (<0.5 m)	1 – 4
Eriachne benthamii	Tussock Grass (<0.5 m)	10 – 24
Sporobolus australasicus	Tussock Grass (<0.5 m)	< 1
Triodia longiceps	Hummock Grass (0.5-1 m)	10 – 24
Triodia epactia	Hummock Grass (<0.5 m)	10 – 24

BD_E_075

Date	22/06/2023	**Site type**	Flora: Quadrat	**Botanist**	AC
Location	-22.10394, 119.85378				
Landform	Low hill	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Shrub (>2 m)	< 1
Capparis umbonata	Shrub (>2 m)	< 1
Hakea lorea subsp. *lorea*	Shrub (>2 m)	< 1
Senna glutinosa subsp. *glutinosa*	Shrub (1-2 m)	< 1
Senna glutinosa subsp. *pruinosa*	Shrub (1-2 m)	1 – 4
Acacia bivenosa	Shrub (0.5-1 m)	< 1
Senna ?stricta	Shrub (0.5-1 m)	1 – 4
Dodonaea coriacea	Shrub (<0.5 m)	< 1
Sida echinocarpa	Shrub (<0.5 m)	< 1
Sida sp. Pilbara (A.A. Mitchell PRP 1543)	Shrub (<0.5 m)	< 1
Ptilotus calostachyus	Herb (0.5-1 m)	< 1
Hibiscus coatesii	Herb (<0.5 m)	< 1
Salsola australis	Herb (<0.5 m)	< 1
Sclerolaena densiflora	Herb (<0.5 m)	< 1
Tephrosia sp. NW Eremaean (S. van Leeuwen et al. PBS 0356)	Herb (<0.5 m)	< 1
Aristida contorta	Tussock Grass (<0.5 m)	< 1
Cymbopogon ambiguus	Tussock Grass (<0.5 m)	1 – 4
Enneapogon polyphyllus	Tussock Grass (<0.5 m)	< 1
Paraneurachne muelleri	Tussock Grass (<0.5 m)	< 1
Themeda triandra	Tussock Grass (<0.5 m)	5 – 9
Triodia brizoides	Hummock Grass (<0.5 m)	33 – 49
Triodia epactia	Hummock Grass (<0.5 m)	10 – 24

BD_E_076

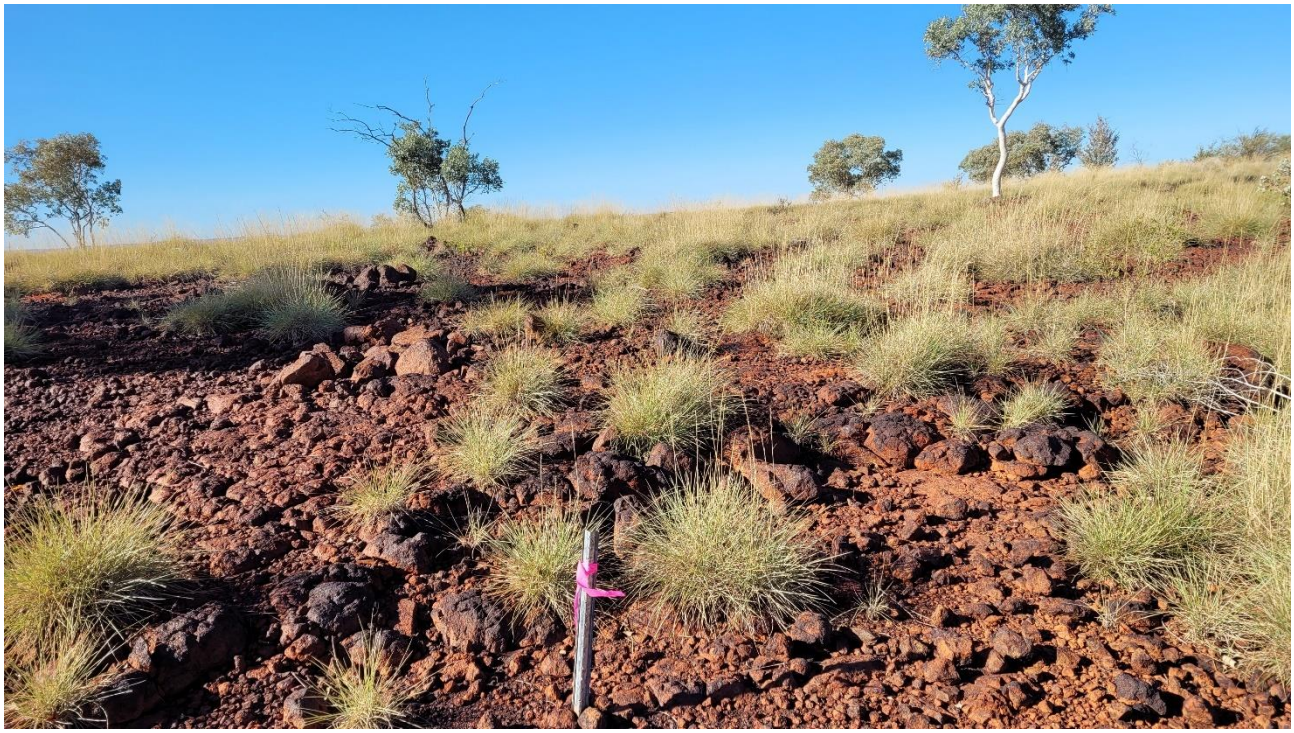
Date	22/06/2023	**Site type**	Flora: Quadrat	**Botanist**	LE
Location	-22.10598, 119.83127				
Landform	Plain	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Clay		
Rock type	Ironstone, quartz	**Rock size**	Mixed	**Rock cover**	30 – 70%
Vegetation condition	Poor	**Disturbance**	High weed cover and grazing.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Vachellia farnesiana	Shrub (>2 m)	5 – 9
Acacia synchronicia	Shrub (0.5-1 m)	1 – 4
Sida ?trichopoda	Shrub (<0.5 m)	1 – 4
Arivela viscosa	Herb (<0.5 m)	< 1
Crotalaria medicaginea var. *neglecta*	Herb (<0.5 m)	1 – 4
Cullen graveolens	Herb (<0.5 m)	< 1
Dolichocarpa crouchiana	Herb (<0.5 m)	< 1
Grona muelleri	Herb (<0.5 m)	< 1
Hibiscus brachysiphonius	Herb (<0.5 m)	< 1
Ipomoea polymorpha	Herb (<0.5 m)	< 1
Malvastrum americanum	Herb (<0.5 m)	< 1
Neptunia longipila	Herb (<0.5 m)	< 1
Portulaca oleracea	Herb (<0.5 m)	< 1
Ptilotus gomphrenoides	Herb (<0.5 m)	1 – 4
Rhynchosia minima	Herb (<0.5 m)	< 1
Sclerolaena costata	Herb (<0.5 m)	< 1
Solanum horridum	Herb (<0.5 m)	< 1
Trianthema triquetrum	Herb (<0.5 m)	1 – 4
Cenchrus setiger	Tussock Grass (<0.5 m)	< 1
Chloris pectinata	Tussock Grass (<0.5 m)	1 – 4
Dactyloctenium radulans	Tussock Grass (<0.5 m)	< 1
Dichanthium sericeum subsp. *humilius*	Tussock Grass (<0.5 m)	< 1
Enneapogon caerulescens	Tussock Grass (<0.5 m)	< 1
Sporobolus australasicus	Tussock Grass (<0.5 m)	< 1

BD_E_077

Date	21/06/2023	**Site type**	Flora: Quadrat	**Botanist**	LE
Location	-22.11272, 119.90262				
Landform	Low hill	**Slope**	Moderate		
Soil colour	Reddish brown	**Soil texture**	Sandy loam		
Rock type	Ironstone, quartz	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	5 – 9
Capparis umbonata	Shrub (1-2 m)	< 1
Grevillea wickhamii subsp. *hispidula*	Shrub (1-2 m)	1 – 4
Acacia monticola	Shrub (0.5-1 m)	< 1
Capparis lasiantha	Shrub (0.5-1 m)	< 1
Jasminum didymum subsp. *lineare*	Shrub (0.5-1 m)	< 1
Senna glutinosa subsp. *glutinosa*	Shrub (0.5-1 m)	< 1
Senna symonii	Shrub (0.5-1 m)	1 – 4
Dampiera candicans	Shrub (<0.5 m)	< 1
Dodonaea coriacea	Shrub (<0.5 m)	< 1
Ptilotus calostachyus	Herb (0.5-1 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Goodenia stobbsiana	Herb (<0.5 m)	< 1
Eriachne lanata	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	10 – 24

BD_E_078

Date	20/06/2023	**Site type**	Flora: Quadrat	**Botanist**	RS
Location	-22.138, 119.90326				
Landform	Low hill	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Dolerite, quartz	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Shrub (1-2 m)	1 – 4
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Sida echinocarpa	Shrub (<0.5 m)	< 1
Aristida contorta	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (0.5-1 m)	33 – 49

BD_E_079

Date	20/06/2023	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-22.13849, 119.89966				
Landform	Low hill	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Sandy clay loam		
Rock type	Quartz, dolerite	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	Assoc.
Acacia inaequilatera	Shrub (>2 m)	1 – 4
Corchorus parviflorus	Shrub (<0.5 m)	1 – 4
Hakea lorea subsp. *lorea*	Shrub (<0.5 m)	< 1
Solanum lasiophyllum/phlomoides	Shrub (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Triodia epactia	Hummock Grass (0.5-1 m)	33 – 49

BD_E_080

Date	20/06/2023	**Site type**	Flora: Quadrat	**Botanist**	LE
Location	-22.14905, 119.88842				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Dark brown	**Soil texture**	Clay loam		
Rock type	Ironstone, quartz	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Shrub (>2 m)	1 – 4
Hakea lorea subsp. *lorea*	Shrub (0.5-1 m)	< 1
Sida sp. Pilbara (A.A. Mitchell PRP 1543)	Shrub (<0.5 m)	< 1
Stackhousia muricata subsp. annual (W.R. Barker 2172)	Herb (<0.5 m)	1 – 4
Enneapogon caerulescens	Tussock Grass (<0.5 m)	< 1
Enneapogon polyphyllus	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	25 – 32

BD_E_081

Date	21/06/2023	**Site type**	Flora: Quadrat	**Botanist**	RS
Location	-22.15259, 119.85507				
Landform	Low hill	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	1 – 4
Capparis umbonata	Shrub (>2 m)	Assoc.
Acacia pruinocarpa	Shrub (1-2 m)	< 1
Senna sericea	Shrub (1-2 m)	1 – 4
Acacia bivenosa	Shrub (0.5-1 m)	< 1
Acacia ptychophylla	Shrub (0.5-1 m)	5 – 9
Acacia tenuissima	Shrub (0.5-1 m)	< 1
Senna ?stricta	Shrub (0.5-1 m)	1 – 4
Senna symonii	Shrub (0.5-1 m)	1 – 4
Hibiscus sturtii var. *campylochlamys*	Shrub (<0.5 m)	< 1
Solanum elatius	Shrub (<0.5 m)	< 1
Ptilotus calostachyus	Herb (0.5-1 m)	< 1
Goodenia cusackiana	Herb (<0.5 m)	< 1
Eriachne lanata	Tussock Grass (<0.5 m)	< 1
Eriachne mucronata	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (0.5-1 m)	10 – 24
Triodia brizoides	Hummock Grass (<0.5 m)	50 – 74

BD_E_082

Date	26/06/2023	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-22.0256, 119.85077				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Brown	**Soil texture**	Sandy loam		
Rock type	Calcrete	**Rock size**	Mixed	**Rock cover**	30 – 70%
Vegetation condition	Excellent	**Disturbance**	Minor weed cover and grazing.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	Assoc.
Acacia inaequilatera	Shrub (>2 m)	1 – 4
Acacia bivenosa	Shrub (1-2 m)	< 1
Acacia synchronicia	Shrub (1-2 m)	< 1
Gossypium australe	Shrub (1-2 m)	< 1
Aerva javanica	Shrub (<0.5 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	1 – 4
Indigofera monophylla	Shrub (<0.5 m)	1 – 4
Sida trichopoda	Shrub (<0.5 m)	Assoc.
Solanum lasiophyllum/phlomoides	Shrub (<0.5 m)	Assoc.
Malvastrum americanum	Herb (<0.5 m)	Assoc.
Scaevola amblyanthera var. *centralis*	Herb (<0.5 m)	< 1
Enneapogon caerulescens	Tussock Grass (<0.5 m)	< 1
Eragrostis desertorum	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	25 – 32
Triodia wiseana	Hummock Grass (<0.5 m)	5 – 9

BD_E_083

Date	19/06/2023	**Site type**	Flora: Quadrat	**Botanist**	AC/LE
Location	-22.16191, 119.928				
Landform	Plain	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Sandy loam		
Rock type	Calcrete	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	< 10%
Vegetation condition	Very Good	**Disturbance**	Minor weed cover and grazing.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	1 – 4
Acacia inaequilatera	Shrub (>2 m)	Assoc.
Acacia synchronicia	Shrub (>2 m)	1 – 4
Acacia ?coriacea subsp. *pendens*	Shrub (1-2 m)	< 1
Vachellia farnesiana	Shrub (1-2 m)	< 1
Acacia tetragonophylla	Shrub (<0.5 m)	Assoc.
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Gossypium australe	Shrub (<0.5 m)	< 1
Melhania oblongifolia	Shrub (<0.5 m)	< 1
Pluchea tetranthera	Shrub (<0.5 m)	< 1
Sida echinocarpa	Shrub (<0.5 m)	< 1
Sida fibulifera	Shrub (<0.5 m)	< 1
Boerhavia coccinea	Herb (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Euphorbia australis var. *subtomentosa*	Herb (<0.5 m)	< 1
Evolvulus alsinoides var. *villosicalyx*	Herb (<0.5 m)	< 1
Goodenia ?tenuiloba	Herb (<0.5 m)	< 1
Goodenia forrestii	Herb (<0.5 m)	< 1
Indigofera colutea	Herb (<0.5 m)	< 1
Indigofera linifolia	Herb (<0.5 m)	< 1
Indigofera linnaei	Herb (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	< 1
Scaevola amblyanthera var. *centralis*	Herb (<0.5 m)	< 1
Aristida contorta	Tussock Grass (<0.5 m)	< 1
Cenchrus ciliaris	Tussock Grass (<0.5 m)	< 1
Cenchrus setiger	Tussock Grass (<0.5 m)	< 1
Enneapogon caerulescens	Tussock Grass (<0.5 m)	< 1
Enneapogon polyphyllus	Tussock Grass (<0.5 m)	< 1
Eragrostis desertorum	Tussock Grass (<0.5 m)	< 1
Perotis rara	Tussock Grass (<0.5 m)	< 1
Sporobolus australasicus	Tussock Grass (<0.5 m)	< 1

Name	Stratum	Percent cover (%)
Triodia epactia	Hummock Grass (<0.5 m)	25 – 32
Triodia wiseana	Hummock Grass (<0.5 m)	< 1

BD_E_084

Date	21/06/2023	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-22.16611, 119.83876				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Dolerite	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	Assoc.
Capparis umbonata	Shrub (>2 m)	< 1
Grevillea wickhamii subsp. *hispidula*	Shrub (>2 m)	1 – 4
Acacia inaequilatera	Shrub (1-2 m)	1 – 4
Senna glutinosa subsp. *glutinosa*	Shrub (1-2 m)	< 1
Acacia ptychophylla	Shrub (0.5-1 m)	5 – 9
Dampiera candicans	Shrub (0.5-1 m)	1 – 4
Afrohybanthus aurantiacus	Shrub (<0.5 m)	< 1
Indigofera monophylla	Shrub (<0.5 m)	< 1
Senna symonii	Shrub (<0.5 m)	< 1
Ptilotus calostachyus	Herb (0.5-1 m)	< 1
Goodenia cusackiana	Herb (<0.5 m)	< 1
Cymbopogon ambiguus	Tussock Grass (0.5-1 m)	< 1
Eriachne lanata	Tussock Grass (<0.5 m)	< 1
Eriachne mucronata	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (0.5-1 m)	25 – 32
Triodia brizoides	Hummock Grass (<0.5 m)	1 – 4

BD_E_085

Date	19/06/2023	**Site type**	Flora: Quadrat	**Botanist**	RS
Location	-22.16595, 119.93828				
Landform	Low hill	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Dolerite	**Rock size**	Mixed	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	Minor weed cover and grazing.		
Time since fire	Moderate (2 – 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Shrub (>2 m)	5 – 9
Melaleuca linophylla	Shrub (>2 m)	10 – 24
Acacia bivenosa	Shrub (0.5-1 m)	1 – 4
Solanum phlomoides	Shrub (0.5-1 m)	< 1
Vachellia farnesiana	Shrub (0.5-1 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	1 – 4
Ptilotus incanus	Shrub (<0.5 m)	1 – 4
Sida echinocarpa	Shrub (<0.5 m)	1 – 4
Solanum diversiflorum	Shrub (<0.5 m)	< 1
Triumfetta clementii	Shrub (<0.5 m)	< 1
Abutilon sp. Dioicum (A.A. Mitchell PRP 1618)	Herb (0.5-1 m)	1 – 4
Ptilotus calostachyus	Herb (0.5-1 m)	< 1
Bonamia pannosa	Herb (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	1 – 4
Cucumis variabilis	Herb (<0.5 m)	< 1
Dysphania rhadinostachya subsp. *rhadinostachya*	Herb (<0.5 m)	< 1
Euphorbia australis var. *subtomentosa*	Herb (<0.5 m)	< 1
Evolvulus alsinoides var. *villosicalyx*	Herb (<0.5 m)	1 – 4
Gomphrena cunninghamii	Herb (<0.5 m)	< 1
Goodenia microptera	Herb (<0.5 m)	< 1
Hibiscus coatesii	Herb (<0.5 m)	< 1
Portulaca oleracea	Herb (<0.5 m)	< 1
Ptilotus auriculifolius	Herb (<0.5 m)	< 1
Ptilotus clementii	Herb (<0.5 m)	< 1
Ptilotus exaltatus	Herb (<0.5 m)	< 1
Sclerolaena cornishiana	Herb (<0.5 m)	1 – 4
Sclerolaena costata	Herb (<0.5 m)	1 – 4
Senna notabilis	Herb (<0.5 m)	10 – 24
Sida rohlenae subsp. *rohlenae*	Herb (<0.5 m)	1 – 4
Solanum horridum	Herb (<0.5 m)	< 1
Swainsona stenodonta	Herb (<0.5 m)	< 1

Name	Stratum	Percent cover (%)
Tephrosia sp. NW Eremaean (S. van Leeuwen et al. PBS 0356)	Herb (<0.5 m)	< 1
Cymbopogon ambiguus	Tussock Grass (0.5-1 m)	< 1
Paraneurachne muelleri	Tussock Grass (0.5-1 m)	1 – 4
Aristida contorta	Tussock Grass (<0.5 m)	< 1
Enneapogon polyphyllus	Tussock Grass (<0.5 m)	< 1
Sporobolus australasicus	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (0.5-1 m)	10 – 24
Triodia wiseana	Hummock Grass (<0.5 m)	1 – 4

BD_E_086

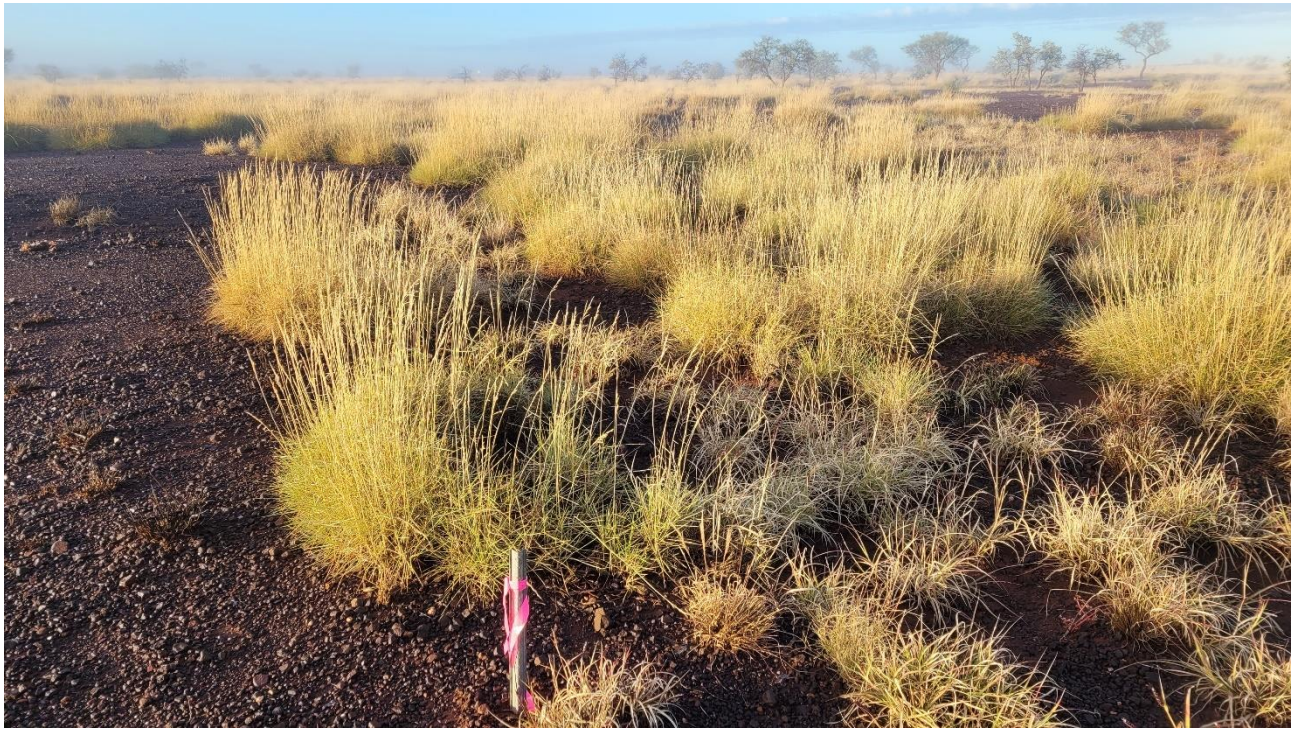
Date	21/06/2023	**Site type**	Flora: Quadrat	**Botanist**	AC
Location	-22.1826, 119.80583				
Landform	Major creek (5-30 m)	**Slope**	NA		
Soil colour	Dark brown	**Soil texture**	Loam		
Rock type	NA	**Rock size**	NA	**Rock cover**	NA
Vegetation condition	Degraded	**Disturbance**	High weed cover and heavy grazing.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Eucalyptus camaldulensis	Tree (10-30 m)	10 – 24
Acacia coriacea subsp. *pendens*	Tree (<10 m)	5 – 9
Eucalyptus victrix	Tree (<10 m)	5 – 9
Acacia ampliceps	Shrub (>2 m)	< 1
Atalaya hemiglauca	Shrub (>2 m)	1 – 4
Melaleuca bracteata	Shrub (>2 m)	1 – 4
Melaleuca glomerata	Shrub (>2 m)	5 – 9
Vachellia farnesiana	Shrub (1-2 m)	1 – 4
Cullen ?leucanthum	Shrub (<0.5 m)	< 1
Achyranthes aspera	Herb (<0.5 m)	5 – 9
Alternanthera nana	Herb (<0.5 m)	< 1
Alternanthera nodiflora	Herb (<0.5 m)	5 – 9
Alysicarpus muelleri	Herb (<0.5 m)	< 1
Amaranthus undulatus	Herb (<0.5 m)	< 1
Argemone ochroleuca subsp. *ochroleuca*	Herb (<0.5 m)	< 1
Arivela viscosa	Herb (<0.5 m)	< 1
Boerhavia burbidgeana	Herb (<0.5 m)	< 1
Chenopodium murale	Herb (<0.5 m)	< 1
Cucumis variabilis	Herb (<0.5 m)	< 1
Indigofera linifolia	Herb (<0.5 m)	< 1
Ipomoea muelleri	Herb (<0.5 m)	< 1
Ipomoea racemigera	Herb (<0.5 m)	< 1
Malvastrum americanum	Herb (<0.5 m)	< 1
Nicotiana obliqua/occidentalis	Herb (<0.5 m)	< 1
Ptilotus gomphrenoides	Herb (<0.5 m)	< 1
Salsola australis	Herb (<0.5 m)	< 1
Sesbania cannabina	Herb (<0.5 m)	< 1
Solanum nigrum	Herb (<0.5 m)	< 1
Cenchrus ciliaris	Tussock Grass (<0.5 m)	33 – 49
Cenchrus setiger	Tussock Grass (<0.5 m)	10 – 24
Echinochloa colona	Tussock Grass (<0.5 m)	< 1

BD_E_087

Date	21/06/2023	**Site type**	Flora: Quadrat	**Botanist**	LE
Location	-22.18757, 119.79917				
Landform	Undulating plain	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Basalt	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	30 – 70%
Vegetation condition	Poor	**Disturbance**	High weed cover and grazing.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Atalaya hemiglauca	Shrub (>2 m)	1 – 4
Sida trichopoda	Shrub (<0.5 m)	< 1
Ptilotus calostachyus	Herb (0.5-1 m)	< 1
Alysicarpus muelleri	Herb (<0.5 m)	< 1
Boerhavia coccinea	Herb (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Evolvulus alsinoides var. *villosicalyx*	Herb (<0.5 m)	< 1
Goodenia muelleriana	Herb (<0.5 m)	< 1
Indigofera colutea	Herb (<0.5 m)	< 1
Ptilotus aervoides	Herb (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	< 1
Salsola australis	Herb (<0.5 m)	< 1
Sclerolaena costata	Herb (<0.5 m)	< 1
Senna notabilis	Herb (<0.5 m)	< 1
Solanum horridum	Herb (<0.5 m)	< 1
Trianthema triquetrum	Herb (<0.5 m)	< 1
Tribulus ?terrestris	Herb (<0.5 m)	< 1
Aristida contorta	Tussock Grass (<0.5 m)	< 1
Cenchrus ciliaris	Tussock Grass (<0.5 m)	1 – 4
Cenchrus setiger	Tussock Grass (<0.5 m)	5 – 9
Enneapogon caerulescens	Tussock Grass (<0.5 m)	< 1
Enneapogon polyphyllus	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	10 – 24

BD_E_088

Date	20/06/2023	**Site type**	Flora: Quadrat	**Botanist**	LE
Location	-22.21799, 119.78951				
Landform	Undulating plain	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Sandy clay loam		
Rock type	Ironstone	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				

No photo.

Name	Stratum	Percent cover (%)
Hakea lorea subsp. *lorea*	Shrub (>2 m)	Assoc.
Eremophila forrestii subsp. *forrestii*	Shrub (1-2 m)	1 – 4
Senna artemisioides subsp. *helmsii*	Shrub (0.5-1 m)	< 1
Afrohybanthus aurantiacus	Shrub (<0.5 m)	< 1
Euploca heterantha	Shrub (<0.5 m)	< 1
Indigofera monophylla	Shrub (<0.5 m)	< 1
Senna ?stricta	Shrub (<0.5 m)	< 1
Sida ?echinocarpa	Shrub (<0.5 m)	< 1
Solanum lasiophyllum/phlomoides	Shrub (<0.5 m)	< 1
Boerhavia gardneri	Herb (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Gomphrena canescens subsp. *canescens*	Herb (<0.5 m)	< 1
Goodenia microptera	Herb (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	< 1
Sclerolaena cornishiana	Herb (<0.5 m)	< 1
Sclerolaena costata	Herb (<0.5 m)	< 1
Senna notabilis	Herb (<0.5 m)	< 1
Solanum horridum	Herb (<0.5 m)	< 1
Trigastrotheca molluginea	Herb (<0.5 m)	< 1
Cymbopogon obtectus	Tussock Grass (0.5-1 m)	1 – 4
Aristida contorta	Tussock Grass (<0.5 m)	1 – 4
Eriachne mucronata	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	10 – 24

BD_E_089

Date	20/06/2023	**Site type**	Flora: Quadrat	**Botanist**	RS
Location	-22.21249, 119.7937				
Landform	Major creek (5-30 m)	**Slope**	NA		
Soil colour	Dark brown	**Soil texture**	Sand		
Rock type	Mixed river alluvium	**Rock size**	Fine gravel [to c. 5 mm]	**Rock cover**	> 70%
Vegetation condition	Degraded	**Disturbance**	High weed cover and heavy grazing.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Acacia coriacea subsp. *pendens*	Tree (<10 m)	5 – 9
Eucalyptus victrix	Tree (<10 m)	5 – 9
Eremophila longifolia	Shrub (>2 m)	1 – 4
Cullen ?leucanthum	Shrub (<0.5 m)	< 1
Gossypium australe	Shrub (<0.5 m)	< 1
Alysicarpus muelleri	Herb (<0.5 m)	< 1
Amaranthus undulatus	Herb (<0.5 m)	< 1
Arivela viscosa	Herb (<0.5 m)	< 1
Boerhavia coccinea	Herb (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Crotalaria medicaginea var. *neglecta*	Herb (<0.5 m)	< 1
Cucumis variabilis	Herb (<0.5 m)	< 1
Euphorbia australis var. *subtomentosa*	Herb (<0.5 m)	< 1
Euphorbia biconvexa	Herb (<0.5 m)	< 1
Indigofera linifolia	Herb (<0.5 m)	< 1
Ipomoea muelleri	Herb (<0.5 m)	< 1
Portulaca oleracea	Herb (<0.5 m)	< 1
Senna notabilis	Herb (<0.5 m)	< 1
Tribulus hirsutus	Herb (<0.5 m)	< 1
Cenchrus setiger	Tussock Grass (0.5-1 m)	50 – 74
Cymbopogon ambiguus	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	< 1

BD_E_090

Date	20/06/2023	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-22.24064, 119.79359				
Landform	Plain	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Sandy clay loam		
Rock type	Calcrete	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	< 10%
Vegetation condition	Excellent	**Disturbance**	Minor weed cover and grazing.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Shrub (>2 m)	1 – 4
Grevillea pyramidalis subsp. *leucadendron*	Shrub (>2 m)	1 – 4
Gossypium australe	Shrub (1-2 m)	< 1
Solanum lasiophyllum/phlomoides	Shrub (0.5-1 m)	< 1
Corchorus incanus	Shrub (<0.5 m)	< 1
Euploca chrysocarpa	Shrub (<0.5 m)	< 1
Cucumis variabilis	Herb (<0.5 m)	< 1
Polymeria calycina	Herb (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	< 1
Cenchrus setiger	Tussock Grass (<0.5 m)	< 1
Eragrostis eriopoda	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (0.5-1 m)	33 – 49

BD_E_091

Date	20/06/2023	**Site type**	Flora: Quadrat	**Botanist**	LE
Location	-22.24705, 119.79578				
Landform	Major creek (5-30 m)	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Sandy loam		
Rock type	Mixed river alluvium	**Rock size**	Mixed	**Rock cover**	30 – 70%
Vegetation condition	Poor	**Disturbance**	High weed cover and grazing.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia coriacea subsp. *pendens*	Tree (<10 m)	1 – 4
Corymbia hamersleyana	Tree (<10 m)	5 – 9
Eucalyptus victrix	Tree (<10 m)	10 – 24
Acacia bivenosa	Shrub (>2 m)	5 – 9
Atalaya hemiglauca	Shrub (>2 m)	1 – 4
Melaleuca glomerata	Shrub (>2 m)	5 – 9
Acacia pyrifolia var. *pyrifolia*	Shrub (1-2 m)	1 – 4
Senna ?stricta	Shrub (1-2 m)	1 – 4
Corchorus incanus	Shrub (<0.5 m)	< 1
Indigofera monophylla	Shrub (<0.5 m)	< 1
Pluchea ferdinandi-muelleri	Shrub (<0.5 m)	< 1
Pluchea tetranthera	Shrub (<0.5 m)	< 1
Sida ?trichopoda	Shrub (<0.5 m)	< 1
Sida echinocarpa	Shrub (<0.5 m)	< 1
Cyperus vaginatus	Sedge (0.5-1 m)	1 – 4
Boerhavia coccinea	Herb (<0.5 m)	< 1
Crotalaria medicaginea var. *neglecta*	Herb (<0.5 m)	< 1
Indigofera linifolia	Herb (<0.5 m)	< 1
Neptunia xanthonema	Herb (<0.5 m)	< 1
Pluchea rubelliflora	Herb (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	< 1
Sclerolaena costata	Herb (<0.5 m)	< 1
Trianthema triquetrum	Herb (<0.5 m)	1 – 4
Cymbopogon ambiguus	Tussock Grass (0.5-1 m)	1 – 4
Enteropogon ramosus	Tussock Grass (0.5-1 m)	< 1
Cenchrus ciliaris	Tussock Grass (<0.5 m)	5 – 9
Cenchrus setiger	Tussock Grass (<0.5 m)	5 – 9
Dactyloctenium radulans	Tussock Grass (<0.5 m)	< 1
Sporobolus actinocladus	Tussock Grass (<0.5 m)	< 1
Sporobolus australasicus	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	5 – 9

BD_E_092

Date	20/06/2023	**Site type**	Flora: Quadrat	**Botanist**	RS
Location	-22.25334, 119.79191				
Landform	Low hill	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Dolerite	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	1 – 4
Acacia inaequilatera	Shrub (>2 m)	5 – 9
Senna ?stricta	Shrub (>2 m)	< 1
Senna glutinosa subsp. *pruinosa*	Shrub (>2 m)	< 1
Hakea lorea subsp. *lorea*	Shrub (1-2 m)	1 – 4
Ptilotus rotundifolius	Shrub (0.5-1 m)	< 1
Solanum lasiophyllum	Shrub (0.5-1 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Triodia epactia	Hummock Grass (0.5-1 m)	50 – 74

BD_E_093

Date	20/06/2023	**Site type**	Flora: Quadrat	**Botanist**	AC
Location	-22.26095, 119.79191				
Landform	Undulating plain	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Basalt	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	10 – 30%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Moderate (2 – 3 yrs)				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	Assoc.
Acacia inaequilatera	Shrub (>2 m)	< 1
Grevillea pyramidalis subsp. *leucadendron*	Shrub (1-2 m)	< 1
Hakea lorea subsp. *lorea*	Shrub (1-2 m)	< 1
Senna ?stricta	Shrub (0.5-1 m)	1 – 4
Euploca heterantha	Shrub (<0.5 m)	< 1
Hibiscus sturtii	Shrub (<0.5 m)	< 1
Senna artemisioides subsp. *helmsii*	Shrub (<0.5 m)	< 1
Sida echinocarpa	Shrub (<0.5 m)	< 1
Tribulus suberosus	Shrub (<0.5 m)	< 1
Bulbostylis turbinata	Sedge (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Euphorbia australis var. *hispidula*	Herb (<0.5 m)	< 1
Ptilotus calostachyus	Herb (<0.5 m)	< 1
Ptilotus clementii	Herb (<0.5 m)	< 1
Ptilotus exaltatus	Herb (<0.5 m)	< 1
Salsola australis	Herb (<0.5 m)	< 1
Sclerolaena cornishiana	Herb (<0.5 m)	< 1
Solanum horridum	Herb (<0.5 m)	< 1
Trigastrotheca molluginea	Herb (<0.5 m)	1 – 4
Aristida contorta	Tussock Grass (<0.5 m)	5 – 9
Paraneurachne muelleri	Tussock Grass (<0.5 m)	< 1
Triodia brizoides	Hummock Grass (<0.5 m)	1 – 4
Triodia epactia	Hummock Grass (<0.5 m)	50 – 74

BD_E_094

Date	20/06/2023	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-22.26767, 119.79226				
Landform	Low hill	**Slope**	Moderate		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Dolerite	**Rock size**	Boulders [> 260 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Shrub (>2 m)	1 – 4
Hakea lorea subsp. *lorea*	Shrub (>2 m)	< 1
Acacia acradenia	Shrub (1-2 m)	1 – 4
Acacia bivenosa	Shrub (0.5-1 m)	< 1
Senna glutinosa subsp. *glutinosa*	Shrub (0.5-1 m)	< 1
Senna glutinosa subsp. *pruinosa*	Shrub (0.5-1 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Triodia epactia	Hummock Grass (0.5-1 m)	33 – 49

BD_E_095

Date	20/06/2023	**Site type**	Flora: Quadrat	**Botanist**	RS
Location	-22.27741, 119.79342				
Landform	Low hill	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Dolerite	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	1 – 4
Acacia inaequilatera	Shrub (>2 m)	5 – 9
Senna ?stricta	Shrub (1-2 m)	< 1
Senna glutinosa subsp. *glutinosa*	Shrub (1-2 m)	< 1
Senna glutinosa subsp. *pruinosa*	Shrub (1-2 m)	1 – 4
Acacia acradenia	Shrub (0.5-1 m)	< 1
Acacia bivenosa	Shrub (0.5-1 m)	< 1
Acacia pruinocarpa	Shrub (0.5-1 m)	< 1
Tribulus suberosus	Shrub (0.5-1 m)	< 1
Euphorbia australis var. *subtomentosa*	Herb (<0.5 m)	< 1
Triodia epactia	Hummock Grass (0.5-1 m)	33 – 49

BD_E_096

Date	26/06/2023	**Site type**	Flora: Quadrat	**Botanist**	LE
Location	-22.02687, 119.83983				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Dark brown	**Soil texture**	Sandy loam		
Rock type	Calcrete	**Rock size**	Rocky with outcroppings	**Rock cover**	30 – 70%
Vegetation condition	Excellent	**Disturbance**	Minor weed cover and grazing.		
Time since fire	Long (> 3 yrs)				

No photo.

Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	Assoc.
Eucalyptus victrix	Tree (<10 m)	1 – 4
Acacia pyrifolia	Shrub (>2 m)	1 – 4
Grevillea pyramidalis subsp. *leucadendron*	Shrub (1-2 m)	1 – 4
Acacia inaequilatera	Shrub (0.5-1 m)	1 – 4
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Senna ?stricta	Shrub (<0.5 m)	< 1
Aerva javanica	Herb (<0.5 m)	< 1
Boerhavia gardneri	Herb (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Evolvulus alsinoides var. *villosicalyx*	Herb (<0.5 m)	< 1
Goodenia microptera	Herb (<0.5 m)	< 1
Indigofera linifolia	Herb (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	25 – 32

BD_E_097

Date	26/06/2023	**Site type**	Flora: Quadrat	**Botanist**	AC
Location	-22.03107, 119.84001				
Landform	Hill (clay)	**Slope**	Gentle		
Soil colour	Dark brown	**Soil texture**	Clay		
Rock type	Basalt	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Poor	**Disturbance**	High weed cover and grazing.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia coriacea subsp. *pendens*	Tree (<10 m)	< 1
Vachellia farnesiana	Shrub (>2 m)	5 – 9
Capparis spinosa subsp. *nummularia*	Shrub (0.5-1 m)	< 1
Gossypium australe	Shrub (0.5-1 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Indigofera trita subsp. *trita*	Shrub (<0.5 m)	1 – 4
Sida ?trichopoda	Shrub (<0.5 m)	1 – 4
Solanum lasiophyllum	Shrub (<0.5 m)	< 1
?Glycine falcata	Herb (<0.5 m)	< 1
Abutilon malvifolium	Herb (<0.5 m)	< 1
Alysicarpus muelleri	Herb (<0.5 m)	< 1
Arivela viscosa	Herb (<0.5 m)	10 – 24
Austrobryonia pilbarensis	Herb (<0.5 m)	< 1
Boerhavia gardneri	Herb (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Corchorus trilocularis	Herb (<0.5 m)	< 1
Crotalaria medicaginea var. *neglecta*	Herb (<0.5 m)	< 1
Cucumis variabilis	Herb (<0.5 m)	< 1
Dolichocarpa crouchiana	Herb (<0.5 m)	< 1
Euphorbia australis var. *subtomentosa*	Herb (<0.5 m)	< 1
Euphorbia inappendiculata var. *queenslandica*	Herb (<0.5 m)	< 1
Goodenia muelleriana	Herb (<0.5 m)	< 1
Grona muelleri	Herb (<0.5 m)	5 – 9
Heliotropium crispatum	Herb (<0.5 m)	10 – 24
Hibiscus verdcourtii	Herb (<0.5 m)	< 1
Indigofera linifolia	Herb (<0.5 m)	< 1
Ipomoea muelleri	Herb (<0.5 m)	1 – 4
Nellica maderaspatensis	Herb (<0.5 m)	< 1
Neptunia longipila	Herb (<0.5 m)	< 1
Operculina aequisepala	Herb (<0.5 m)	< 1
Ptilotus gomphrenoides	Herb (<0.5 m)	< 1

Name	Stratum	Percent cover (%)
Rhynchosia minima	Herb (<0.5 m)	< 1
Senna notabilis	Herb (<0.5 m)	< 1
Sida rohlenae subsp. *rohlenae*	Herb (<0.5 m)	< 1
Sida spinosa	Herb (<0.5 m)	< 1
Solanum horridum	Herb (<0.5 m)	< 1
Tephrosia sp. clay soils (S. van Leeuwen et al. PBS 0273)	Herb (<0.5 m)	< 1
Tribulus ?terrestris	Herb (<0.5 m)	< 1
Vigna sp. Hamersley Clay (A.A. Mitchell PRP 113)	Herb (<0.5 m)	< 1
Aristida latifolia	Tussock Grass (<0.5 m)	1 – 4
Cymbopogon ambiguus	Tussock Grass (<0.5 m)	< 1
Cynodon convergens	Tussock Grass (<0.5 m)	< 1
Enneapogon caerulescens	Tussock Grass (<0.5 m)	< 1
Enneapogon polyphyllus	Tussock Grass (<0.5 m)	1 – 4
Eragrostis desertorum	Tussock Grass (<0.5 m)	1 – 4
Eriachne mucronata	Tussock Grass (<0.5 m)	5 – 9
Iseilema vaginiflorum	Tussock Grass (<0.5 m)	1 – 4
Panicum decompositum	Tussock Grass (<0.5 m)	< 1
Sporobolus australasicus	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	5 – 9

BD_E_098

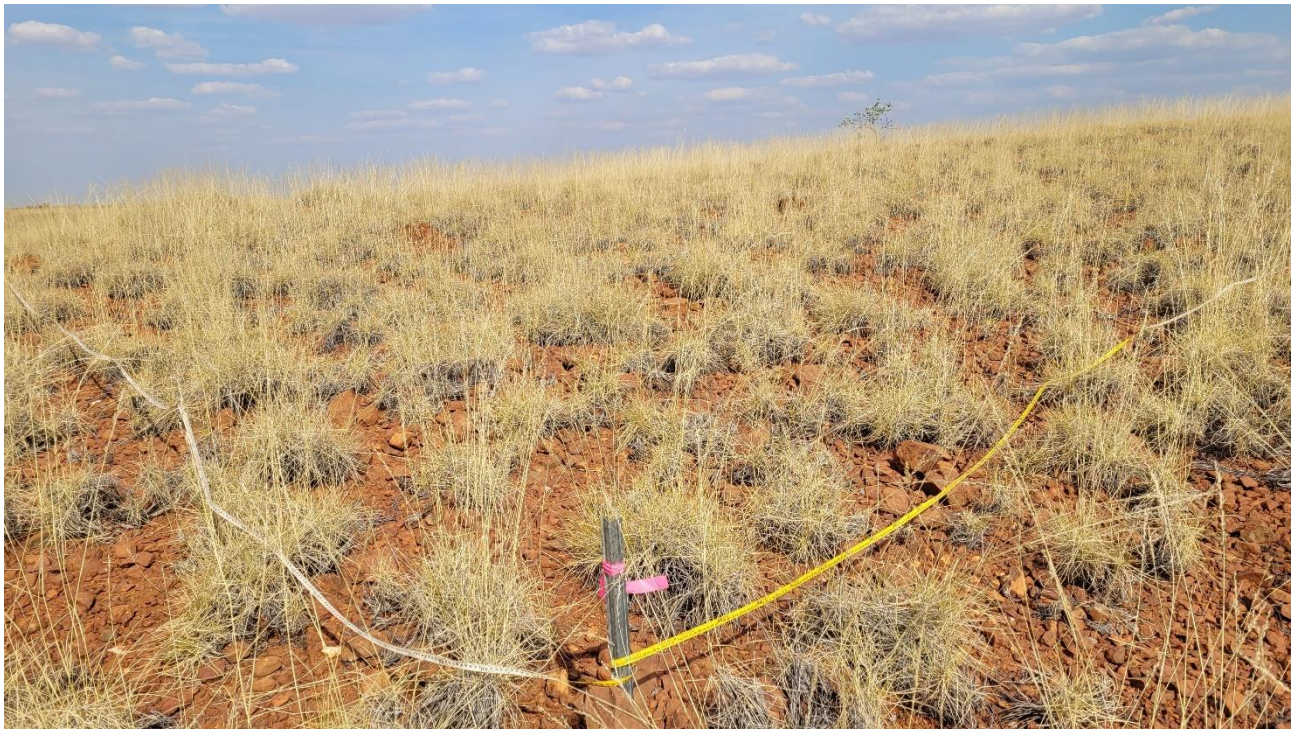
Date	19/09/2023	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-21.97096, 119.89756				
Landform	Low hill	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Shrub (>2 m)	1 – 4
Senna ?stricta	Shrub (1-2 m)	< 1
Acacia bivenosa	Shrub (0.5-1 m)	< 1
Aristida contorta	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	33 – 49

BD_E_099

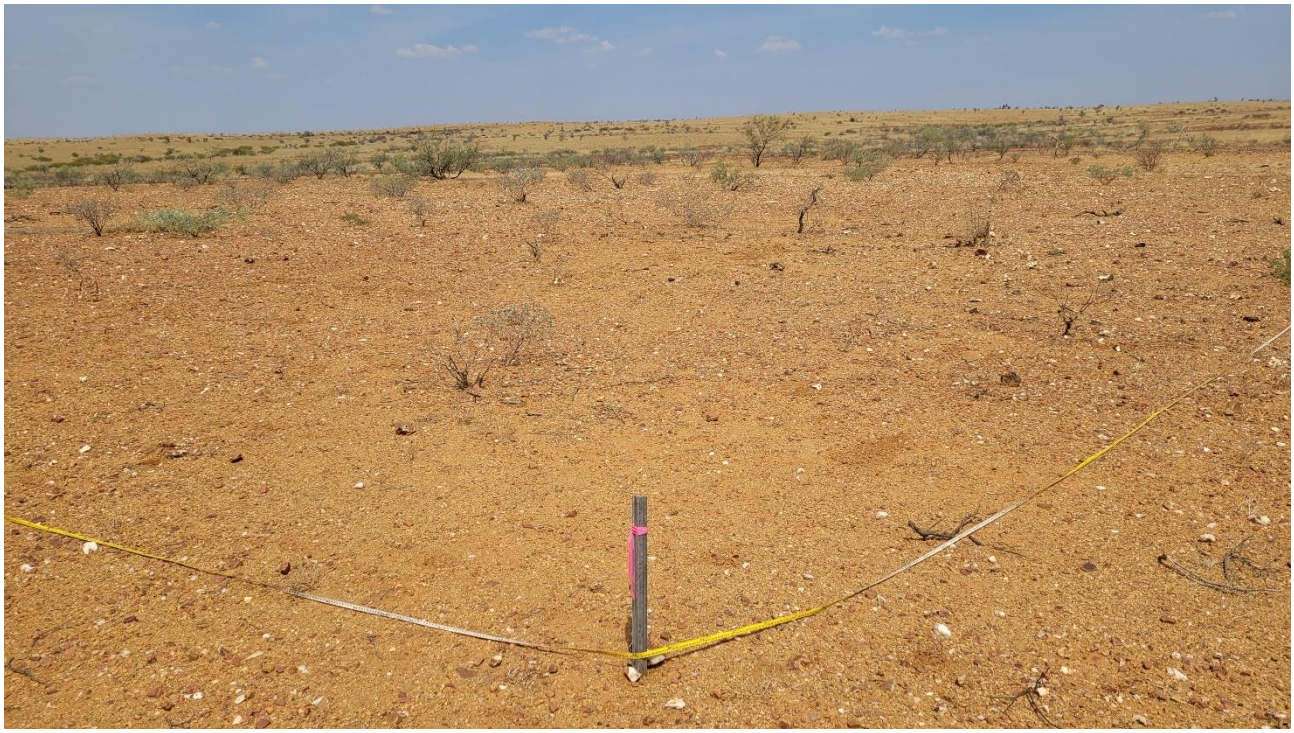
Date	19/09/2023	**Site type**	Flora: Quadrat	**Botanist**	LE
Location	-21.91799, 119.94454				
Landform	Low hill	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Shrub (1-2 m)	1 – 4
Indigofera monophylla	Shrub (0.5-1 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Senna symonii	Shrub (<0.5 m)	< 1
Trichodesma zeylanicum var. *zeylanicum*	Herb (0.5-1 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Euphorbia careyi	Herb (<0.5 m)	< 1
Cymbopogon ambiguus	Tussock Grass (0.5-1 m)	< 1
Eriachne lanata	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	10 – 24

BD_E_100

Date	19/09/2023	**Site type**	Flora: Quadrat	**Botanist**	LE
Location	-21.92053, 119.94088				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Light brown	**Soil texture**	Clay loam		
Rock type	Ironstone, quartz	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	30 – 70%
Vegetation condition	Excellent	**Disturbance**	Minor weed cover and grazing.		
Time since fire	Long (> 3 yrs)				

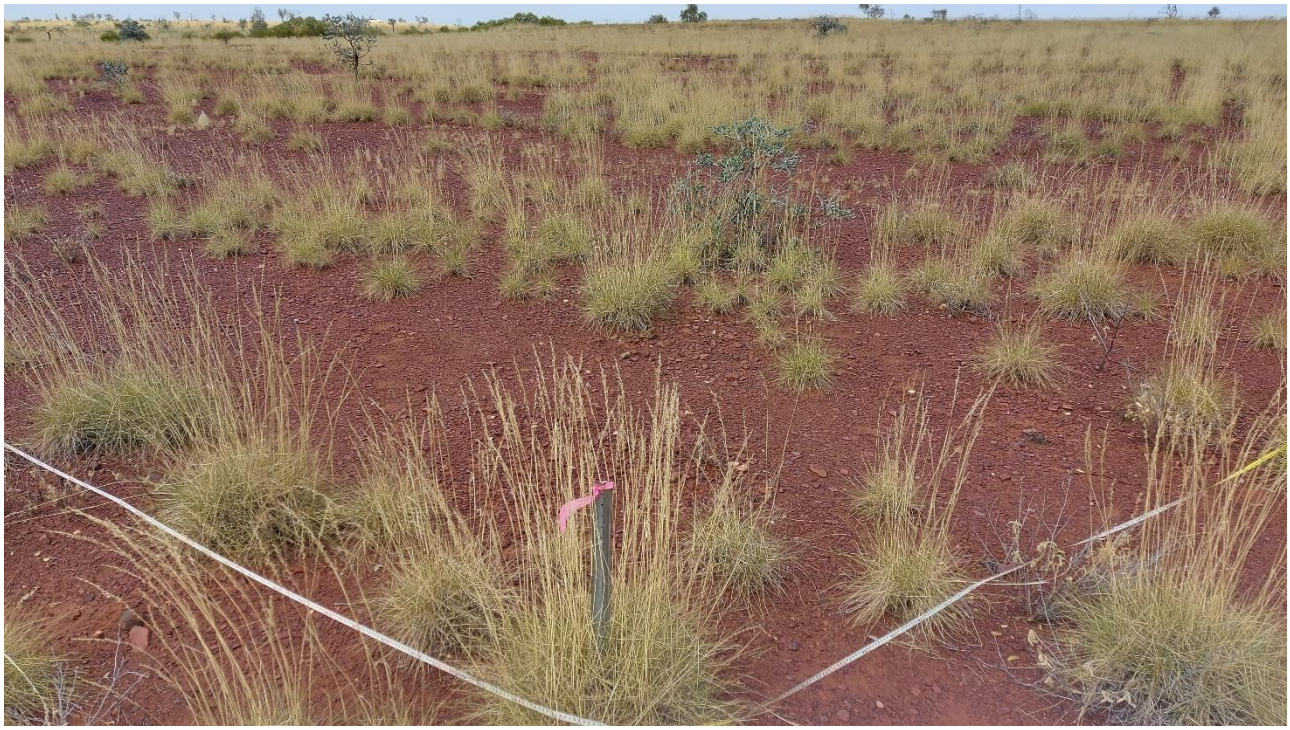


Name	Stratum	Percent cover (%)
Acacia synchronicia	Shrub (>2 m)	1 – 4
Acacia tetragonophylla	Shrub (>2 m)	1 – 4
Carissa lanceolata	Shrub (1-2 m)	< 1
Corchorus parviflorus	Shrub (0.5-1 m)	< 1
Senna artemisioides subsp. *helmsii*	Shrub (0.5-1 m)	1 – 4
Euploca cunninghamii	Shrub (<0.5 m)	< 1
Sida ?echinocarpa	Shrub (<0.5 m)	< 1
Solanum lasiophyllum/phlomoides	Shrub (<0.5 m)	< 1
Arivela viscosa	Herb (<0.5 m)	< 1
Boerhavia ?coccinea	Herb (<0.5 m)	< 1
Crotalaria medicaginea var. *neglecta*	Herb (<0.5 m)	< 1
Evolvulus alsinoides var. *villosicalyx*	Herb (<0.5 m)	< 1
Hibiscus burtonii	Herb (<0.5 m)	< 1
Malvastrum americanum	Herb (<0.5 m)	< 1
Portulaca oleracea	Herb (<0.5 m)	< 1
Ptilotus aervoides	Herb (<0.5 m)	< 1
Ptilotus gomphrenoides	Herb (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	< 1
Salsola australis	Herb (<0.5 m)	< 1
Sclerolaena costata	Herb (<0.5 m)	< 1
Solanum horridum	Herb (<0.5 m)	< 1
Streptoglossa bubakii	Herb (<0.5 m)	< 1
Trianthema triquetrum	Herb (<0.5 m)	< 1
Trigastrotheca molluginea	Herb (<0.5 m)	< 1
Aristida contorta	Tussock Grass (<0.5 m)	< 1
Cenchrus ciliaris	Tussock Grass (<0.5 m)	< 1
Chloris pectinata	Tussock Grass (<0.5 m)	< 1
Dactyloctenium radulans	Tussock Grass (<0.5 m)	< 1
Enneapogon caerulescens	Tussock Grass (<0.5 m)	< 1
Enneapogon polyphyllus	Tussock Grass (<0.5 m)	< 1
Eragrostis ?tenellula	Tussock Grass (<0.5 m)	< 1

Name	Stratum	Percent cover (%)
Triodia epactia	Hummock Grass (<0.5 m)	< 1

BD_E_101

Date	19/09/2023	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-21.92071, 119.93406				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Shrub (>2 m)	1 – 4
Senna ?stricta	Shrub (1-2 m)	< 1
Acacia bivenosa	Shrub (0.5-1 m)	< 1
Pluchea tetranthera	Shrub (0.5-1 m)	< 1
Senna glutinosa subsp. *×luerssenii*	Shrub (0.5-1 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	1 – 4
Indigofera monophylla	Shrub (<0.5 m)	< 1
Sida ?echinocarpa	Shrub (<0.5 m)	1 – 4
Arivela viscosa	Herb (<0.5 m)	< 1
Euphorbia australis var. *subtomentosa*	Herb (<0.5 m)	< 1
Evolvulus alsinoides var. *villosicalyx*	Herb (<0.5 m)	< 1
Peripleura virgata	Herb (<0.5 m)	< 1
Sclerolaena costata	Herb (<0.5 m)	< 1
Solanum horridum	Herb (<0.5 m)	< 1
Aristida contorta	Tussock Grass (<0.5 m)	1 – 4
Enneapogon caerulescens	Tussock Grass (<0.5 m)	< 1
Eriachne pulchella subsp. *dominii*	Tussock Grass (<0.5 m)	< 1
Sporobolus australasicus	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	10 – 24

BD_E_102

Date	19/09/2023	**Site type**	Flora: Quadrat	**Botanist**	LE
Location	-21.96106, 119.89079				
Landform	Ridge	**Slope**	Moderate		
Soil colour	Brown	**Soil texture**	Sandy loam		
Rock type	Calcrete	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	Minor weed cover and grazing.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia colei var. *colei*	Shrub (>2 m)	< 1
Grevillea wickhamii	Shrub (>2 m)	5 – 9
Acacia pruinocarpa	Shrub (1-2 m)	1 – 4
Eremophila longifolia	Shrub (1-2 m)	1 – 4
Gossypium australe	Shrub (0.5-1 m)	< 1
Senna glutinosa subsp. *glutinosa*	Shrub (0.5-1 m)	1 – 4
Tephrosia rosea var. *clementii*	Shrub (0.5-1 m)	1 – 4
Acacia synchronicia	Shrub (<0.5 m)	< 1
Fimbristylis dichotoma	Sedge (<0.5 m)	< 1
Arivela viscosa	Herb (0.5-1 m)	< 1
?*Digitaria ctenantha*	Herb (<0.5 m)	< 1
Alternanthera nana	Herb (<0.5 m)	< 1
Boerhavia coccinea	Herb (<0.5 m)	< 1
Duperreya commixta	Herb (<0.5 m)	< 1
Evolvulus alsinoides var. *villosicalyx*	Herb (<0.5 m)	< 1
Gomphrena cunninghamii	Herb (<0.5 m)	< 1
Malvastrum americanum	Herb (<0.5 m)	< 1
Rhodanthe margarethae	Herb (<0.5 m)	< 1
Senna notabilis	Herb (<0.5 m)	< 1
Sida rohlenae subsp. *rohlenae*	Herb (<0.5 m)	< 1
Solanum cleistogamum	Herb (<0.5 m)	< 1
Solanum horridum	Herb (<0.5 m)	< 1
Cymbopogon ambiguus	Tussock Grass (0.5-1 m)	< 1
?*Paspalidium clementii*	Tussock Grass (<0.5 m)	< 1
Aristida ?*inaequiglumis*	Tussock Grass (<0.5 m)	< 1
Enneapogon caerulescens	Tussock Grass (<0.5 m)	< 1
Eriachne mucronata	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	10 – 24

BD_E_103

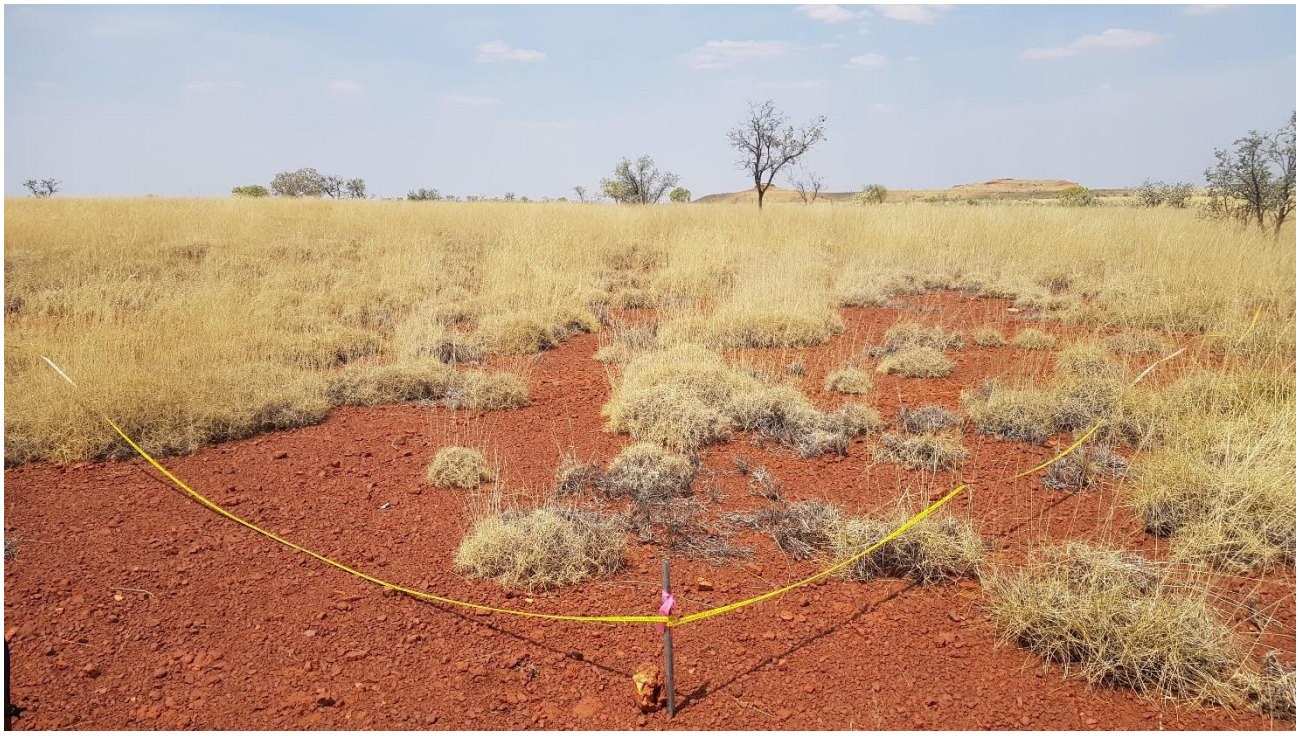
Date	19/09/2023	**Site type**	Flora: Quadrat	**Botanist**	LE
Location	-21.96485, 119.89125				
Landform	Low hill	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				

No photo.

Name	Stratum	Percent cover (%)
Acacia inaequilatera	Shrub (>2 m)	1 – 4
Senna glutinosa subsp. *glutinosa*	Shrub (1-2 m)	< 1
Corchorus parviflorus	Shrub (0.5-1 m)	1 – 4
Eremophila longifolia	Shrub (0.5-1 m)	< 1
Carissa lanceolata	Shrub (<0.5 m)	< 1
Gossypium australe	Shrub (<0.5 m)	< 1
Indigofera monophylla	Shrub (<0.5 m)	< 1
Fimbristylis dichotoma	Sedge (<0.5 m)	< 1
Alternanthera nana	Herb (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Hibiscus burtonii	Herb (<0.5 m)	< 1
Sida rohlenae subsp. *rohlenae*	Herb (<0.5 m)	< 1
Aristida ?inaequiglumis	Tussock Grass (<0.5 m)	< 1
Aristida contorta	Tussock Grass (<0.5 m)	< 1
Cymbopogon ambiguus	Tussock Grass (<0.5 m)	< 1
Triodia brizoides	Hummock Grass (<0.5 m)	10 – 24
Triodia epactia	Hummock Grass (<0.5 m)	5 – 9

BD_E_104

Date	18/09/2023	**Site type**	Flora: Quadrat	**Botanist**	SN/AC
Location	-21.96621, 119.87681				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	Assoc.
Acacia ancistrocarpa	Shrub (>2 m)	Assoc.
Acacia inaequilatera	Shrub (>2 m)	1 – 4
Acacia orthocarpa	Shrub (>2 m)	Assoc.
Hakea lorea subsp. *lorea*	Shrub (>2 m)	1 – 4
Acacia tumida var. *pilbarensis*	Shrub (1-2 m)	< 1
Acacia bivenosa	Shrub (0.5-1 m)	Assoc.
Grevillea wickhamii	Shrub (0.5-1 m)	Assoc.
Gossypium australe	Shrub (<0.5 m)	< 1
Indigofera monophylla	Shrub (<0.5 m)	< 1
Senna glutinosa subsp. ×*luerssenii*	Shrub (<0.5 m)	< 1
Tribulus suberosus	Shrub (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Sporobolus australasicus	Tussock Grass (<0.5 m)	< 1
Triodia brizoides	Hummock Grass (<0.5 m)	10 – 24
Triodia epactia	Hummock Grass (<0.5 m)	10 – 24

BD_E_105

Date	19/09/2023	**Site type**	Flora: Quadrat	**Botanist**	SN/AC
Location	-21.96834, 119.90302				
Landform	Undulating plain	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	Minor weed cover and grazing.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia ?*aptaneura*	Shrub (>2 m)	25 – 32
Acacia synchronicia	Shrub (>2 m)	Assoc.
Acacia tetragonophylla	Shrub (>2 m)	5 – 9
Carissa lanceolata	Shrub (<0.5 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Eremophila forrestii subsp. *forrestii*	Shrub (<0.5 m)	1 – 4
Eremophila latrobei ?subsp. *glabra*	Shrub (<0.5 m)	5 – 9
Hibiscus sturtii	Shrub (<0.5 m)	< 1
Senna artemisioides subsp. *helmsii*	Shrub (<0.5 m)	< 1
Sida ?*trichopoda*	Shrub (<0.5 m)	< 1
Solanum lasiophyllum/phlomoides	Shrub (<0.5 m)	< 1
Bulbostylis barbata	Sedge (<0.5 m)	< 1
Fimbristylis dichotoma	Sedge (<0.5 m)	< 1
Abutilon macrum	Herb (<0.5 m)	< 1
Boerhavia coccinea	Herb (<0.5 m)	< 1
Calocephalus knappii	Herb (<0.5 m)	< 1
Cheilanthes sieberi subsp. *sieberi*	Herb (<0.5 m)	< 1
Duperreya commixta	Herb (<0.5 m)	< 1
Euphorbia ?*boophthona*	Herb (<0.5 m)	< 1
Euphorbia australis var. *subtomentosa*	Herb (<0.5 m)	< 1
Evolvulus alsinoides var. *villosicalyx*	Herb (<0.5 m)	< 1
Gomphrena cunninghamii	Herb (<0.5 m)	< 1
Indigofera colutea	Herb (<0.5 m)	< 1
Maireana planifolia	Herb (<0.5 m)	< 1
Sclerolaena cornishiana	Herb (<0.5 m)	< 1
Solanum horridum	Herb (<0.5 m)	< 1
Tephrosia ?sp. NW Eremaean (S. van Leeuwen et al. PBS 0356)	Herb (<0.5 m)	< 1
Aristida contorta	Tussock Grass (<0.5 m)	< 1
Cenchrus setiger	Tussock Grass (<0.5 m)	< 1
Chrysopogon fallax	Tussock Grass (<0.5 m)	< 1
Enneapogon caerulescens	Tussock Grass (<0.5 m)	1 – 4

Name	Stratum	Percent cover (%)
Enneapogon polyphyllus	Tussock Grass (<0.5 m)	1 – 4
Eragrostis cumingii	Tussock Grass (<0.5 m)	< 1
Eriachne mucronata	Tussock Grass (<0.5 m)	< 1
Paspalidium clementii	Tussock Grass (<0.5 m)	< 1
Sporobolus australasicus	Tussock Grass (<0.5 m)	< 1
Tripogonella loliiformis	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	25 – 32

BD_E_106

Date	18/09/2023	**Site type**	Flora: Quadrat	**Botanist**	SN/AC
Location	-21.96947, 119.87264				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Shrub (>2 m)	1 – 4
Acacia pruinocarpa	Shrub (>2 m)	Assoc.
Acacia tenuissima	Shrub (>2 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Hakea lorea subsp. *lorea*	Shrub (<0.5 m)	< 1
Indigofera monophylla	Shrub (<0.5 m)	< 1
Senna glutinosa subsp. *pruinosa*	Shrub (<0.5 m)	< 1
Fimbristylis dichotoma	Sedge (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Crotalaria medicaginea var. *neglecta*	Herb (<0.5 m)	< 1
Euphorbia careyi	Herb (<0.5 m)	< 1
Goodenia microptera	Herb (<0.5 m)	< 1
Pentalepis trichodesmoides subsp. *trichodesmoides*	Herb (<0.5 m)	< 1
Trichodesma zeylanicum var. *zeylanicum*	Herb (<0.5 m)	< 1
Sporobolus australasicus	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	25 – 32

BD_E_107

Date	19/09/2023	**Site type**	Flora: Quadrat	**Botanist**	SN/AC
Location	-21.97294, 119.90841				
Landform	Major creek (5-30 m)	**Slope**	NA		
Soil colour	Brown	**Soil texture**	Sand		
Rock type	Mixed river alluvium	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Degraded	**Disturbance**	High weed cover and heavy grazing.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Eucalyptus victrix	Tree (10-30 m)	10 – 24
Acacia coriacea subsp. *pendens*	Tree (<10 m)	1 – 4
Acacia tetragonophylla	Shrub (>2 m)	< 1
Acacia trachycarpa	Shrub (>2 m)	1 – 4
Acacia tumida var. *pilbarensis*	Shrub (1-2 m)	10 – 24
Vachellia farnesiana	Shrub (1-2 m)	1 – 4
Acacia ampliceps	Shrub (0.5-1 m)	< 1
Acacia pyrifolia	Shrub (<0.5 m)	< 1
Afrohybanthus aurantiacus	Shrub (<0.5 m)	< 1
Carissa lanceolata	Shrub (<0.5 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Cullen leucanthum	Shrub (<0.5 m)	< 1
Gossypium australe	Shrub (<0.5 m)	< 1
Melaleuca bracteata	Shrub (<0.5 m)	< 1
Sida ?trichopoda	Shrub (<0.5 m)	< 1
Tephrosia rosea var. *clementii*	Shrub (<0.5 m)	< 1
Cyperus vaginatus	Sedge (0.5-1 m)	1 – 4
Bulbostylis barbata	Sedge (<0.5 m)	< 1
Achyranthes aspera	Herb (<0.5 m)	< 1
Alternanthera ?denticulata var. *denticulata*	Herb (<0.5 m)	< 1
Alternanthera nana	Herb (<0.5 m)	< 1
Alysicarpus muelleri	Herb (<0.5 m)	< 1
Centipeda minima subsp. *macrocephala*	Herb (<0.5 m)	< 1
Corchorus tridens	Herb (<0.5 m)	< 1
Crotalaria medicaginea var. *neglecta*	Herb (<0.5 m)	< 1
Euphorbia australis var. *subtomentosa*	Herb (<0.5 m)	< 1
Evolvulus alsinoides var. *villosicalyx*	Herb (<0.5 m)	< 1
Goodenia microptera	Herb (<0.5 m)	< 1
Indigofera linifolia	Herb (<0.5 m)	< 1
Indigofera linnaei	Herb (<0.5 m)	< 1
Ipomoea muelleri	Herb (<0.5 m)	< 1

Name	Stratum	Percent cover (%)
Malvastrum americanum	Herb (<0.5 m)	< 1
Polymeria calycina	Herb (<0.5 m)	< 1
Pterocaulon sphacelatum	Herb (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	< 1
Rostellularia adscendens var. *clementii*	Herb (<0.5 m)	< 1
Sida rohlenae subsp. *rohlenae*	Herb (<0.5 m)	< 1
Sida spinosa	Herb (<0.5 m)	< 1
Stemodia grossa	Herb (<0.5 m)	< 1
Vigna sp. Hamersley Clay (A.A. Mitchell PRP 113)	Herb (<0.5 m)	< 1
Wahlenbergia tumidifructa	Herb (<0.5 m)	< 1
Chrysopogon fallax	Tussock Grass (0.5-1 m)	< 1
Themeda triandra	Tussock Grass (0.5-1 m)	1 – 4
Cenchrus ciliaris	Tussock Grass (<0.5 m)	25 – 32
Cenchrus setiger	Tussock Grass (<0.5 m)	25 – 32
Dichanthium sericeum	Tussock Grass (<0.5 m)	< 1
Eragrostis cumingii	Tussock Grass (<0.5 m)	< 1
Eragrostis exigua	Tussock Grass (<0.5 m)	< 1
Eragrostis leptocarpa	Tussock Grass (<0.5 m)	< 1
Eriachne benthamii	Tussock Grass (<0.5 m)	< 1
Eriachne tenuiculmis	Tussock Grass (<0.5 m)	< 1
Panicum decompositum	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	< 1

BD_E_108

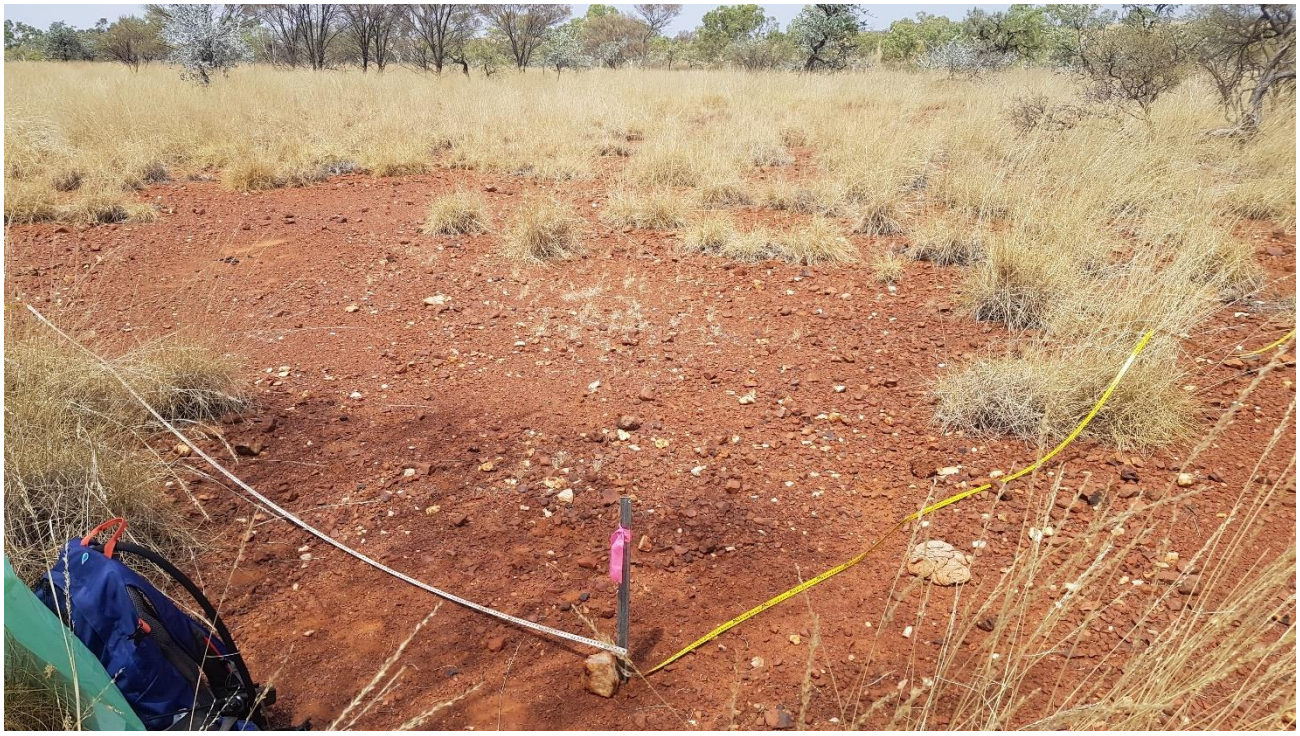
Date	19/09/2023	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-21.97097, 119.89698				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia ?aptaneura	Shrub (>2 m)	1 – 4
Acacia inaequilatera	Shrub (>2 m)	5 – 9
Eremophila longifolia	Shrub (>2 m)	5 – 9
Hakea lorea subsp. *lorea*	Shrub (>2 m)	1 – 4
Acacia tetragonophylla	Shrub (1-2 m)	1 – 4
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Eremophila latrobei ?subsp. *glabra*	Shrub (<0.5 m)	1 – 4
Indigofera monophylla	Shrub (<0.5 m)	< 1
Ptilotus astrolasius	Shrub (<0.5 m)	< 1
Ptilotus incanus	Shrub (<0.5 m)	< 1
Alysicarpus muelleri	Herb (<0.5 m)	< 1
Cymbopogon ambiguus	Tussock Grass (0.5-1 m)	< 1
Eriachne lanata	Tussock Grass (<0.5 m)	1 – 4
Sporobolus australasicus	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	33 – 49

BD_E_109

Date	19/09/2023	**Site type**	Flora: Quadrat	**Botanist**	SN/AC
Location	-21.97088, 119.90925				
Landform	Plain	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	Minor weed cover and grazing.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Eucalyptus victrix	Tree (<10 m)	< 1
Acacia ?aptaneura	Shrub (>2 m)	5 – 9
Acacia inaequilatera	Shrub (>2 m)	1 – 4
Acacia synchronicia	Shrub (>2 m)	1 – 4
Acacia tetragonophylla	Shrub (>2 m)	1 – 4
Hakea lorea subsp. *lorea*	Shrub (>2 m)	< 1
Carissa lanceolata	Shrub (1-2 m)	< 1
Gossypium australe	Shrub (0.5-1 m)	< 1
Pluchea tetranthera	Shrub (0.5-1 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Hibiscus sturtii	Shrub (<0.5 m)	< 1
Melhania oblongifolia	Shrub (<0.5 m)	< 1
Sida ?trichopoda	Shrub (<0.5 m)	< 1
Solanum phlomoides	Shrub (<0.5 m)	< 1
Fimbristylis dichotoma	Sedge (<0.5 m)	< 1
Abutilon macrum	Herb (<0.5 m)	< 1
Alysicarpus muelleri	Herb (<0.5 m)	< 1
Cheilanthes sieberi subsp. *sieberi*	Herb (<0.5 m)	< 1
Cucumis variabilis	Herb (<0.5 m)	< 1
Digitaria ctenantha	Herb (<0.5 m)	< 1
Evolvulus alsinoides var. *villosicalyx*	Herb (<0.5 m)	< 1
Gomphrena cunninghamii	Herb (<0.5 m)	< 1
Malvastrum americanum	Herb (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	< 1
Rostellularia adscendens var. *clementii*	Herb (<0.5 m)	< 1
Sclerolaena cornishiana	Herb (<0.5 m)	< 1
Trichodesma zeylanicum var. *zeylanicum*	Herb (<0.5 m)	< 1
Aristida contorta	Tussock Grass (<0.5 m)	< 1
Chrysopogon fallax	Tussock Grass (<0.5 m)	< 1
Cymbopogon ambiguus	Tussock Grass (<0.5 m)	1 – 4
Enneapogon polyphyllus	Tussock Grass (<0.5 m)	< 1

Name	Stratum	Percent cover (%)
Iseilema vaginiflorum	Tussock Grass (<0.5 m)	< 1
Paspalidium clementii	Tussock Grass (<0.5 m)	< 1
Sporobolus australasicus	Tussock Grass (<0.5 m)	< 1
Tripogonella loliiformis	Tussock Grass (<0.5 m)	< 1
Urochloa occidentalis var. *occidentalis*	Tussock Grass (<0.5 m)	< 1
Triodia brizoides	Hummock Grass (<0.5 m)	1 – 4
Triodia epactia	Hummock Grass (<0.5 m)	25 – 32

BD_E_110

Date	19/09/2023	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-21.97185, 119.89464				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	Assoc.
Acacia inaequilatera	Shrub (>2 m)	1 – 4
Senna glutinosa subsp. ×*luerssenii*	Shrub (1-2 m)	< 1
Acacia bivenosa	Shrub (0.5-1 m)	1 – 4
Pluchea ferdinandi-muelleri	Shrub (0.5-1 m)	< 1
Acacia synchronicia	Shrub (<0.5 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Indigofera monophylla	Shrub (<0.5 m)	1 – 4
Pluchea tetranthera	Shrub (<0.5 m)	1 – 4
Ptilotus incanus	Shrub (<0.5 m)	1 – 4
Sida sp. Pilbara (A.A. Mitchell PRP 1543)	Shrub (<0.5 m)	< 1
Ptilotus calostachyus	Herb (<0.5 m)	< 1
Senna notabilis	Herb (<0.5 m)	< 1
Cymbopogon ambiguus	Tussock Grass (<0.5 m)	1 – 4
Eriachne lanata	Tussock Grass (<0.5 m)	< 1
Sporobolus australasicus	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	25 – 32

BD_E_111

Date	18/09/2023	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-21.98092, 119.87415				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Shrub (1-2 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Indigofera monophylla	Shrub (<0.5 m)	< 1
Euphorbia careyi	Herb (<0.5 m)	< 1
Eriachne lanata	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	33 – 49

BD_E_112

Date	18/09/2023	**Site type**	Flora: Quadrat	**Botanist**	LE
Location	-21.98255, 119.87176				
Landform	Undulating plain	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Mixed river alluvium	**Rock size**	Mixed	**Rock cover**	30 – 70%
Vegetation condition	Poor	**Disturbance**	High weed cover and grazing.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia coriacea subsp. *pendens*	Tree (<10 m)	1 – 4
Acacia colei var. *colei*	Shrub (>2 m)	< 1
Acacia synchronicia	Shrub (>2 m)	1 – 4
Acacia tetragonophylla	Shrub (>2 m)	< 1
Grevillea pyramidalis subsp. *leucadendron*	Shrub (>2 m)	1 – 4
Acacia bivenosa	Shrub (1-2 m)	< 1
Acacia inaequilatera	Shrub (1-2 m)	1 – 4
Vachellia farnesiana	Shrub (1-2 m)	10 – 24
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Cullen leucanthum	Shrub (<0.5 m)	< 1
Cyperus vaginatus	Sedge (0.5-1 m)	< 1
Pentalepis trichodesmoides subsp. *trichodesmoides*	Herb (0.5-1 m)	< 1
Alysicarpus muelleri	Herb (<0.5 m)	< 1
Cucumis variabilis	Herb (<0.5 m)	< 1
Malvastrum americanum	Herb (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	< 1
Senna notabilis	Herb (<0.5 m)	< 1
Solanum horridum	Herb (<0.5 m)	< 1
Cenchrus ciliaris	Tussock Grass (<0.5 m)	5 – 9
Cenchrus setiger	Tussock Grass (<0.5 m)	5 – 9
Dactyloctenium radulans	Tussock Grass (<0.5 m)	< 1
Eragrostis ?tenellula	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	10 – 24

BD_E_113

Date	18/09/2023	**Site type**	Flora: Quadrat	**Botanist**	LE
Location	-21.98989, 119.8691				
Landform	Undulating plain	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	30 – 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Shrub (1-2 m)	5 – 9
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Indigofera monophylla	Shrub (<0.5 m)	< 1
Senna symonii	Shrub (<0.5 m)	< 1
Alysicarpus muelleri	Herb (<0.5 m)	< 1
Crotalaria medicaginea var. *neglecta*	Herb (<0.5 m)	< 1
Cucumis variabilis	Herb (<0.5 m)	< 1
Evolvulus alsinoides var. *villosicalyx*	Herb (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	< 1
Scaevola amblyanthera var. *centralis*	Herb (<0.5 m)	< 1
Solanum horridum	Herb (<0.5 m)	< 1
Aristida contorta	Tussock Grass (<0.5 m)	< 1
Triodia brizoides	Hummock Grass (<0.5 m)	1 – 4
Triodia epactia	Hummock Grass (<0.5 m)	10 – 24

BD_E_114

Date	18/09/2023	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-21.99137, 119.87211				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Shrub (>2 m)	Assoc.
Pluchea ferdinandi-muelleri	Shrub (0.5-1 m)	< 1
Euphorbia careyi	Herb (<0.5 m)	< 1
Triodia brizoides	Hummock Grass (<0.5 m)	5 – 9
Triodia epactia	Hummock Grass (<0.5 m)	25 – 32

BD_E_115

Date	16/09/2023	**Site type**	Flora: Quadrat	**Botanist**	SN/AC
Location	-22.00255, 119.98147				
Landform	Ridge	**Slope**	Steep		
Soil colour	Reddish brown	**Soil texture**	Loamy sand		
Rock type	Ironstone	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia pruinocarpa	Shrub (1-2 m)	1 – 4
Senna ?stricta	Shrub (1-2 m)	< 1
Acacia ?coriacea subsp. *pendens*	Shrub (0.5-1 m)	< 1
Senna glutinosa subsp. *pruinosa*	Shrub (0.5-1 m)	< 1
Afrohybanthus aurantiacus	Shrub (<0.5 m)	< 1
Capparis spinosa subsp. *nummularia*	Shrub (<0.5 m)	< 1
Tribulus suberosus	Shrub (<0.5 m)	< 1
Ptilotus calostachyus	Herb (<0.5 m)	< 1
Ptilotus clementii	Herb (<0.5 m)	< 1
Salsola australis	Herb (<0.5 m)	< 1
Sclerolaena ?densiflora	Herb (<0.5 m)	< 1
Cymbopogon ambiguus	Tussock Grass (0.5-1 m)	< 1
Eriachne lanata	Tussock Grass (<0.5 m)	1 – 4
Eriachne mucronata	Tussock Grass (<0.5 m)	1 – 4
Triodia epactia	Hummock Grass (<0.5 m)	10 – 24

BD_E_116

Date	16/09/2023	**Site type**	Flora: Quadrat	**Botanist**	SN/AC
Location	-21.9931, 119.98286				
Landform	Major creek (5-30 m)	**Slope**	NA		
Soil colour	Brown	**Soil texture**	Loam		
Rock type	Mixed river alluvium	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Poor	**Disturbance**	High weed cover and grazing.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Eucalyptus camaldulensis	Tree (10-30 m)	1 – 4
Eucalyptus victrix	Tree (10-30 m)	1 – 4
Acacia coriacea subsp. *pendens*	Tree (<10 m)	< 1
Acacia ampliceps	Shrub (>2 m)	1 – 4
Melaleuca glomerata	Shrub (>2 m)	5 – 9
Acacia trachycarpa	Shrub (1-2 m)	1 – 4
Melaleuca linophylla	Shrub (1-2 m)	25 – 32
Corchorus parviflorus	Shrub (0.5-1 m)	1 – 4
Flueggea virosa subsp. *melanthesoides*	Shrub (0.5-1 m)	1 – 4
Acacia pyrifolia	Shrub (<0.5 m)	< 1
Atalaya hemiglauca	Shrub (<0.5 m)	< 1
Cullen leucanthum	Shrub (<0.5 m)	< 1
Vachellia farnesiana	Shrub (<0.5 m)	< 1
Amaranthus undulatus	Herb (0.5-1 m)	< 1
Argemone ochroleuca subsp. *ochroleuca*	Herb (0.5-1 m)	< 1
Sesbania cannabina	Herb (0.5-1 m)	< 1
Achyranthes aspera	Herb (<0.5 m)	< 1
Aerva javanica	Herb (<0.5 m)	< 1
Alternanthera nana	Herb (<0.5 m)	< 1
Alysicarpus muelleri	Herb (<0.5 m)	< 1
Ammannia baccifera	Herb (<0.5 m)	< 1
Boerhavia burbidgeana	Herb (<0.5 m)	< 1
Crotalaria medicaginea var. *neglecta*	Herb (<0.5 m)	< 1
Cucumis variabilis	Herb (<0.5 m)	< 1
Cyperus vaginatus	Herb (<0.5 m)	< 1
Duperreya commixta	Herb (<0.5 m)	< 1
Dysphania rhadinostachya subsp. *rhadinostachya*	Herb (<0.5 m)	< 1
Euphorbia australis var. *subtomentosa*	Herb (<0.5 m)	< 1
Euphorbia trigonosperma	Herb (<0.5 m)	< 1
Evolvulus alsinoides var. *villosicalyx*	Herb (<0.5 m)	< 1
Ipomoea muelleri	Herb (<0.5 m)	< 1

Name	Stratum	Percent cover (%)
Malvastrum americanum	Herb (<0.5 m)	< 1
Marsilea exarata	Herb (<0.5 m)	< 1
Nellica maderaspatensis	Herb (<0.5 m)	< 1
Pluchea rubelliflora	Herb (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	< 1
Rostellularia adscendens var. *clementii*	Herb (<0.5 m)	< 1
Sida spinosa	Herb (<0.5 m)	< 1
Stemodia grossa	Herb (<0.5 m)	< 1
Trianthema glossostigmum	Herb (<0.5 m)	< 1
Vigna sp. Hamersley Clay (A.A. Mitchell PRP 113)	Herb (<0.5 m)	< 1
Cenchrus ciliaris	Tussock Grass (0.5-1 m)	10 – 24
Cenchrus setiger	Tussock Grass (0.5-1 m)	10 – 24
Eriachne tenuiculmis	Tussock Grass (0.5-1 m)	1 – 4
Cymbopogon ambiguus	Tussock Grass (<0.5 m)	< 1
Eragrostis cumingii	Tussock Grass (<0.5 m)	< 1
Eragrostis tenellula	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	< 1
Triodia longiceps	Hummock Grass (<0.5 m)	< 1

BD_E_117

Date	17/09/2023	**Site type**	Flora: Quadrat	**Botanist**	LE
Location	-22.00051, 119.87367				
Landform	Undulating plain	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Moderate (2 – 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Shrub (1-2 m)	5 – 9
Acacia colei var. *colei*	Shrub (0.5-1 m)	< 1
Acacia bivenosa	Shrub (<0.5 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Euploca heterantha	Shrub (<0.5 m)	< 1
Ptilotus calostachyus	Herb (0.5-1 m)	< 1
Boerhavia gardneri	Herb (<0.5 m)	< 1
Evolvulus alsinoides var. *villosicalyx*	Herb (<0.5 m)	< 1
Aristida contorta	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	10 – 24

BD_E_118

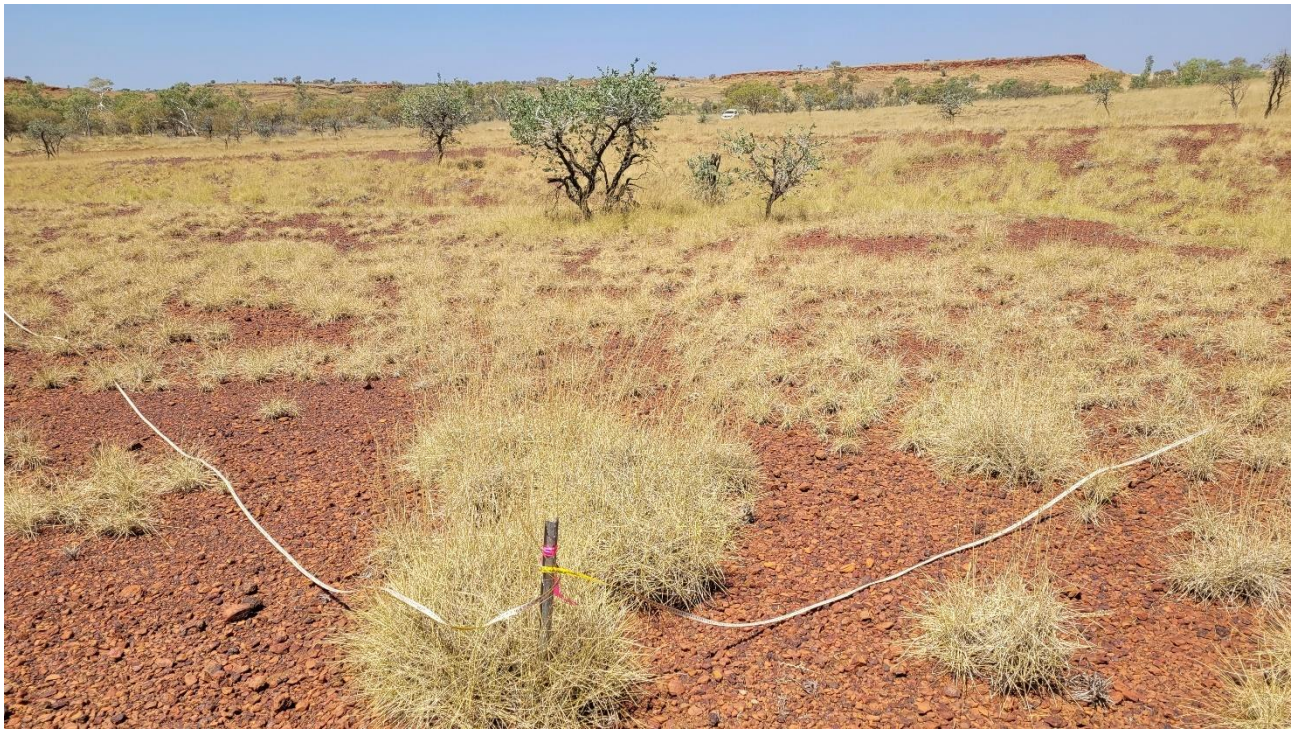
Date	17/09/2023	**Site type**	Flora: Releve	**Botanist**	SH
Location	-22.00208, 119.87482				
Landform	Ridge	**Slope**	Gentle		
Soil colour	Brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Shrub (>2 m)	1 – 4
Grevillea wickhamii	Shrub (1-2 m)	< 1
Senna ?stricta	Shrub (1-2 m)	< 1
Ptilotus calostachyus	Herb (<0.5 m)	< 1
Ptilotus clementii	Herb (<0.5 m)	< 1
Eriachne lanata	Tussock Grass (<0.5 m)	1 – 4
Eriachne mucronata	Tussock Grass (<0.5 m)	1 – 4
Triodia epactia	Hummock Grass (<0.5 m)	10 – 24

BD_E_119

Date	17/09/2023	**Site type**	Flora: Quadrat	**Botanist**	LE
Location	-22.01086, 119.87566				
Landform	Undulating plain	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Moderate (2 – 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Shrub (1-2 m)	5 – 9
Corchorus parviflorus	Shrub (0.5-1 m)	< 1
Abutilon lepidum	Herb (<0.5 m)	< 1
Evolvulus alsinoides var. *villosicalyx*	Herb (<0.5 m)	< 1
Scaevola amblyanthera var. *centralis*	Herb (<0.5 m)	< 1
Aristida contorta	Tussock Grass (<0.5 m)	< 1
Cynodon convergens	Tussock Grass (<0.5 m)	< 1
Eriachne lanata	Tussock Grass (<0.5 m)	< 1
Triodia brizoides	Hummock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	10 – 24

BD_E_120

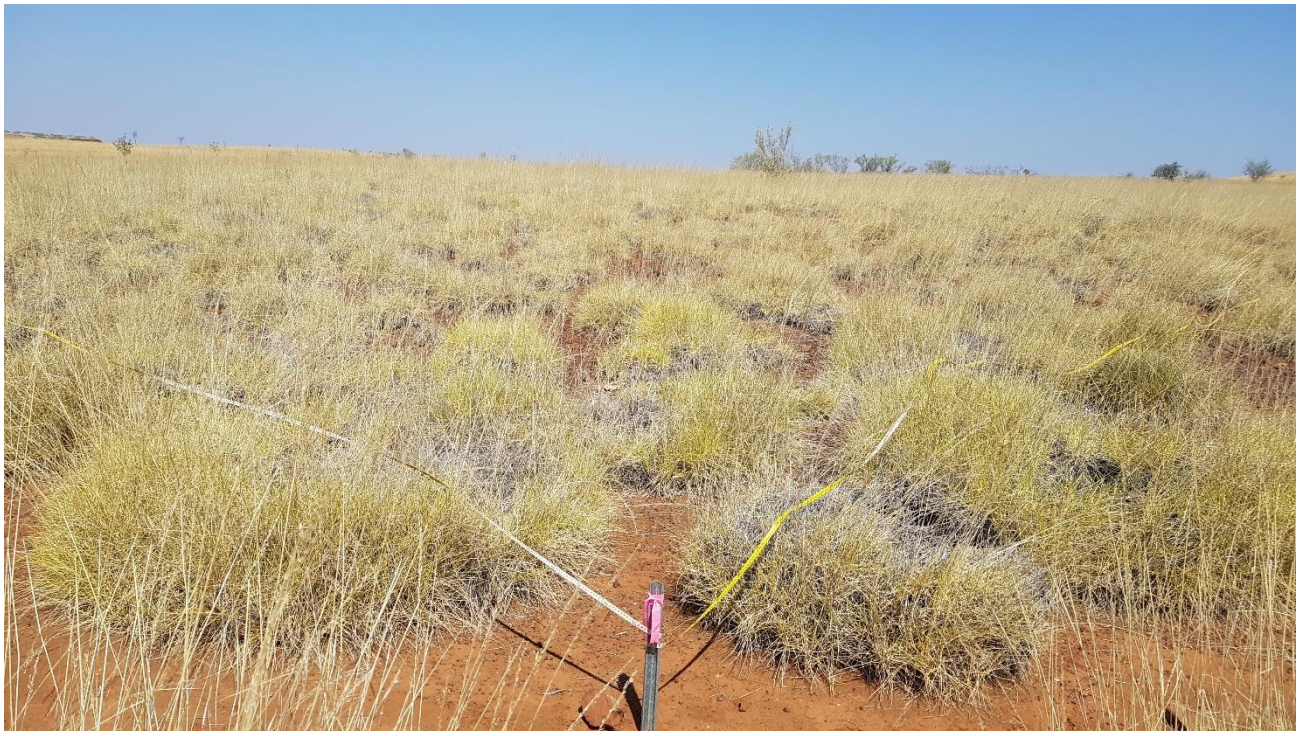
Date	17/09/2023	**Site type**	Flora: Releve	**Botanist**	SH
Location	-22.01168, 119.87459				
Landform	Ridge	**Slope**	NA		
Soil colour	Brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	5 – 9
Acacia pruinocarpa	Shrub (>2 m)	1 – 4
Acacia monticola	Shrub (1-2 m)	1 – 4
Dodonaea coriacea	Shrub (1-2 m)	1 – 4
Senna ?stricta	Shrub (1-2 m)	1 – 4
Acacia ancistrocarpa	Shrub (0.5-1 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Sida sp. Pilbara (A.A. Mitchell PRP 1543)	Shrub (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Ptilotus calostachyus	Herb (<0.5 m)	< 1
Cymbopogon ambiguus	Tussock Grass (0.5-1 m)	< 1
Eriachne lanata	Tussock Grass (<0.5 m)	5 – 9
Eriachne mucronata	Tussock Grass (<0.5 m)	1 – 4
Triodia epactia	Hummock Grass (<0.5 m)	25 – 32

BD_E_121

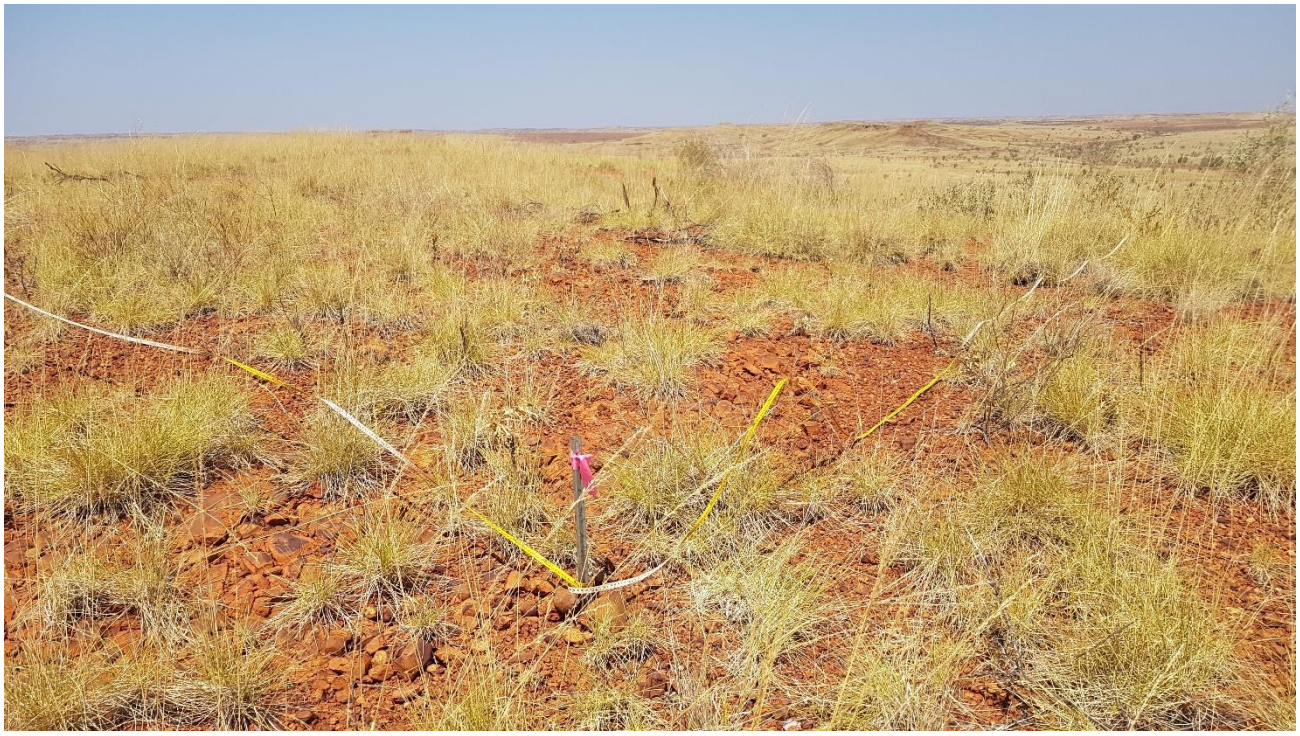
Date	17/09/2023	**Site type**	Flora: Quadrat	**Botanist**	SN/AC
Location	-22.02101, 119.8744				
Landform	Undulating plain	**Slope**	NA		
Soil colour	Brown	**Soil texture**	Sandy loam		
Rock type	Ironstone	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Shrub (>2 m)	Assoc.
Grevillea pyramidalis subsp. *leucadendron*	Shrub (>2 m)	1 – 4
Grevillea wickhamii	Shrub (>2 m)	1 – 4
Senna ?stricta	Shrub (0.5-1 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Hakea lorea subsp. *lorea*	Shrub (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Crotalaria medicaginea var. *neglecta*	Herb (<0.5 m)	< 1
Indigofera colutea	Herb (<0.5 m)	< 1
Indigofera linifolia	Herb (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	1 – 4
Scaevola amblyanthera var. *centralis*	Herb (<0.5 m)	< 1
Sclerolaena costata	Herb (<0.5 m)	< 1
Solanum horridum	Herb (<0.5 m)	< 1
Aristida contorta	Tussock Grass (<0.5 m)	< 1
Cynodon prostratus	Tussock Grass (<0.5 m)	< 1
Enneapogon caerulescens	Tussock Grass (<0.5 m)	< 1
Eriachne pulchella subsp. *dominii*	Tussock Grass (<0.5 m)	< 1
Sporobolus australasicus	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	25 – 32

BD_E_122

Date	17/09/2023	**Site type**	Flora: Quadrat	**Botanist**	SN/AC
Location	-22.02382, 119.87388				
Landform	Ridge	**Slope**	Moderate		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	Minor weed cover and grazing.		
Time since fire	Long (> 3 yrs)				

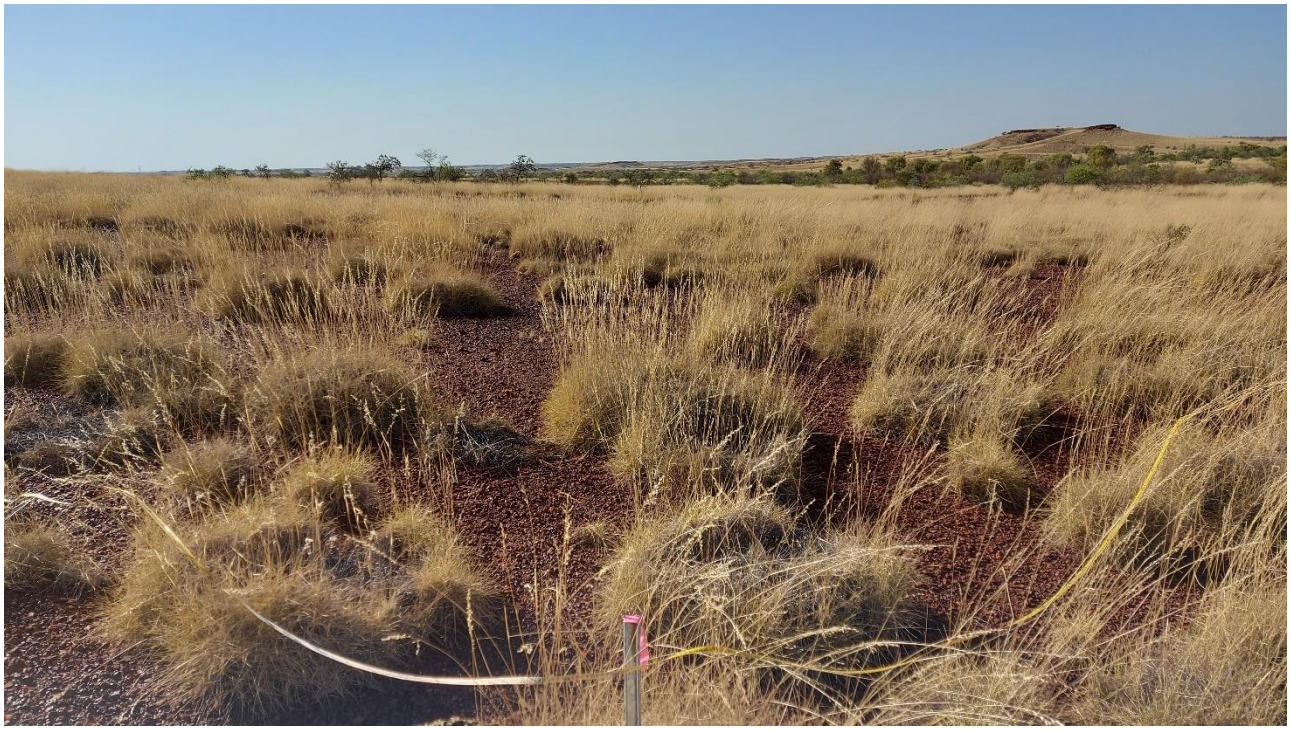


Name	Stratum	Percent cover (%)
Senna glutinosa subsp. *glutinosa*	Shrub (0.5-1 m)	< 1
Acacia monticola	Shrub (<0.5 m)	< 1
Capparis umbonata	Shrub (<0.5 m)	< 1
Dodonaea coriacea	Shrub (<0.5 m)	< 1
Grevillea wickhamii	Shrub (<0.5 m)	5 – 9
Hibiscus sturtii	Shrub (<0.5 m)	< 1
Senna glutinosa subsp. *pruinosa*	Shrub (<0.5 m)	1 – 4
Sida sp. Pilbara (A.A. Mitchell PRP 1543)	Shrub (<0.5 m)	< 1
Vachellia farnesiana	Shrub (<0.5 m)	< 1
Trichodesma zeylanicum var. *zeylanicum*	Herb (0.5-1 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Evolvulus alsinoides var. *villosicalyx*	Herb (<0.5 m)	< 1
Gomphrena cunninghamii	Herb (<0.5 m)	< 1
Goodenia stobbsiana	Herb (<0.5 m)	1 – 4
Hibiscus coatesii	Herb (<0.5 m)	< 1
Maireana villosa	Herb (<0.5 m)	< 1
Nicotiana benthamiana	Herb (<0.5 m)	< 1
Polycarpaea longiflora	Herb (<0.5 m)	< 1
Ptilotus calostachyus	Herb (<0.5 m)	< 1
Rhodanthe margarethae	Herb (<0.5 m)	< 1
Salsola australis	Herb (<0.5 m)	< 1
Scaevola amblyanthera var. *centralis*	Herb (<0.5 m)	< 1
Sida rohlenae subsp. *rohlenae*	Herb (<0.5 m)	< 1
Solanum horridum	Herb (<0.5 m)	< 1
Cymbopogon ambiguus	Tussock Grass (0.5-1 m)	< 1
Aristida contorta	Tussock Grass (<0.5 m)	< 1
Eriachne mucronata	Tussock Grass (<0.5 m)	< 1
Paraneurachne muelleri	Tussock Grass (<0.5 m)	< 1
Sporobolus australasicus	Tussock Grass (<0.5 m)	< 1
Themeda triandra	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (0.5-1 m)	25 – 32

Name	Stratum	Percent cover (%)
Triodia brizoides	Hummock Grass (<0.5 m)	< 1

BD_E_123

Date	17/09/2023	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-22.02952, 119.88289				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Shrub (>2 m)	< 1
Acacia synchronicia	Shrub (>2 m)	1 – 4
Senna ?stricta	Shrub (0.5-1 m)	< 1
Gossypium australe	Shrub (<0.5 m)	< 1
Sclerolaena costata	Herb (<0.5 m)	1 – 4
Solanum horridum	Herb (<0.5 m)	< 1
Aristida contorta	Tussock Grass (<0.5 m)	1 – 4
Eriachne pulchella subsp. *dominii*	Tussock Grass (<0.5 m)	< 1
Sporobolus australasicus	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	25 – 32
Triodia wiseana	Hummock Grass (<0.5 m)	5 – 9

BD_E_124

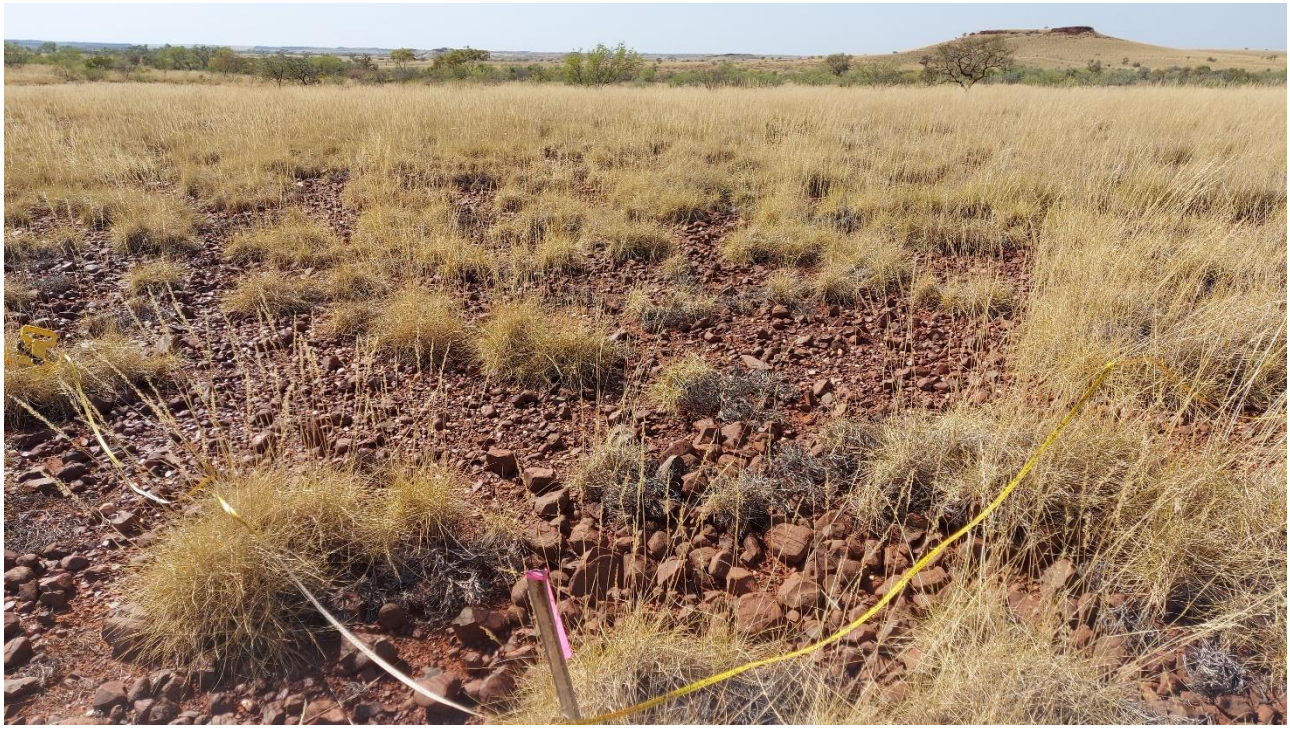
Date	16/09/2023	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-22.03116, 119.91408				
Landform	Low hill	**Slope**	Moderate		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone, calcrete	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	Minor weed cover and grazing.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Acacia coriacea subsp. *pendens*	Tree (<10 m)	< 1
Corymbia hamersleyana	Tree (<10 m)	5 – 9
Acacia ancistrocarpa	Shrub (>2 m)	1 – 4
Acacia inaequilatera	Shrub (>2 m)	5 – 9
Grevillea wickhamii	Shrub (>2 m)	1 – 4
Hakea lorea subsp. *lorea*	Shrub (>2 m)	1 – 4
Acacia bivenosa	Shrub (1-2 m)	1 – 4
Capparis umbonata	Shrub (1-2 m)	< 1
Gossypium australe	Shrub (1-2 m)	< 1
Senna symonii	Shrub (1-2 m)	1 – 4
Senna ?stricta	Shrub (0.5-1 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Hibiscus sturtii var. *campylochlamys*	Shrub (<0.5 m)	< 1
Indigofera monophylla	Shrub (<0.5 m)	< 1
Senna glutinosa subsp. ×*luerssenii*	Shrub (<0.5 m)	< 1
Vachellia farnesiana	Shrub (<0.5 m)	< 1
Cassytha ?capillaris	Herb (<0.5 m)	1 – 4
Cucumis variabilis	Herb (<0.5 m)	< 1
Euphorbia australis var. *subtomentosa*	Herb (<0.5 m)	< 1
Goodenia cusackiana	Herb (<0.5 m)	1 – 4
Ptilotus calostachyus	Herb (<0.5 m)	< 1
Ptilotus clementii	Herb (<0.5 m)	< 1
Ptilotus exaltatus	Herb (<0.5 m)	< 1
Scaevola amblyanthera var. *centralis*	Herb (<0.5 m)	< 1
Solanum horridum	Herb (<0.5 m)	< 1
Cymbopogon ambiguus	Tussock Grass (0.5-1 m)	< 1
Themeda triandra	Tussock Grass (0.5-1 m)	1 – 4
Triodia epactia	Hummock Grass (0.5-1 m)	10 – 24
Triodia longiceps	Hummock Grass (0.5-1 m)	5 – 9
Triodia wiseana	Hummock Grass (<0.5 m)	10 – 24
?Amyema preissii	Parasitic/Epiphytic	1 – 4

BD_E_125

Date	17/09/2023	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-22.03242, 119.88236				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Shrub (>2 m)	1 – 4
Hakea lorea subsp. *lorea*	Shrub (>2 m)	1 – 4
Acacia synchronicia	Shrub (1-2 m)	5 – 9
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Alysicarpus muelleri	Herb (<0.5 m)	< 1
Boerhavia gardneri	Herb (<0.5 m)	< 1
Indigofera linifolia	Herb (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	< 1
Sclerolaena costata	Herb (<0.5 m)	< 1
Solanum horridum	Herb (<0.5 m)	< 1
Aristida latifolia	Tussock Grass (0.5-1 m)	< 1
Eriachne pulchella subsp. *dominii*	Tussock Grass (<0.5 m)	< 1
Sporobolus australasicus	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	33 – 49

BD_E_126

Date	16/09/2023	**Site type**	Flora: Quadrat	**Botanist**	LE
Location	-22.03254, 119.91536				
Landform	Major creek (5-30 m)	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Mixed river alluvium	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	< 10%
Vegetation condition	Degraded	**Disturbance**	High weed cover and heavy grazing.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Eucalyptus camaldulensis	Tree (10-30 m)	10 – 24
Acacia coriacea subsp. *pendens*	Tree (<10 m)	10 – 24
Melaleuca linophylla	Shrub (>2 m)	5 – 9
Atalaya hemiglauca	Shrub (1-2 m)	1 – 4
Calotropis procera	Shrub (1-2 m)	< 1
Eremophila longifolia	Shrub (1-2 m)	< 1
Vachellia farnesiana	Shrub (1-2 m)	1 – 4
Plumbago zeylanica	Shrub (0.5-1 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Cullen leucanthum	Shrub (<0.5 m)	< 1
Flueggea virosa subsp. *melanthesoides*	Shrub (<0.5 m)	< 1
Cyperus vaginatus	Sedge (0.5-1 m)	1 – 4
Achyranthes aspera	Herb (<0.5 m)	< 1
Alternanthera denticulata var. *denticulata*	Herb (<0.5 m)	< 1
Ammannia baccifera	Herb (<0.5 m)	< 1
Argemone ochroleuca subsp. *ochroleuca*	Herb (<0.5 m)	< 1
Blumea tenella	Herb (<0.5 m)	< 1
Centipeda minima subsp. *macrocephala*	Herb (<0.5 m)	< 1
Cucumis variabilis	Herb (<0.5 m)	< 1
Euphorbia careyi	Herb (<0.5 m)	< 1
Malvastrum americanum	Herb (<0.5 m)	< 1
Marsilea exarata	Herb (<0.5 m)	< 1
Pluchea rubelliflora	Herb (<0.5 m)	< 1
Sida rohlenae subsp. *rohlenae*	Herb (<0.5 m)	< 1
Stemodia grossa	Herb (<0.5 m)	< 1
Cymbopogon ambiguus	Tussock Grass (0.5-1 m)	< 1
Cenchrus ciliaris	Tussock Grass (<0.5 m)	10 – 24
Cenchrus setiger	Tussock Grass (<0.5 m)	10 – 24
Eragrostis ?tenellula	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	< 1

BD_E_127

Date	17/09/2023	**Site type**	Flora: Quadrat	**Botanist**	LE
Location	-22.03377, 119.87879				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Light brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	Minor weed cover and grazing.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Hakea lorea subsp. *lorea*	Shrub (0.5-1 m)	< 1
Senna glutinosa subsp. *glutinosa*	Shrub (0.5-1 m)	< 1
Senna symonii	Shrub (0.5-1 m)	< 1
Acacia bivenosa	Shrub (<0.5 m)	< 1
Acacia synchronicia	Shrub (<0.5 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Eremophila longifolia	Shrub (<0.5 m)	< 1
Hibiscus sturtii	Shrub (<0.5 m)	< 1
Boerhavia ?coccinea	Herb (<0.5 m)	< 1
Euphorbia australis var. *subtomentosa*	Herb (<0.5 m)	< 1
Evolvulus alsinoides var. *villosicalyx*	Herb (<0.5 m)	< 1
Hibiscus burtonii	Herb (<0.5 m)	< 1
Hibiscus coatesii	Herb (<0.5 m)	< 1
Malvastrum americanum	Herb (<0.5 m)	< 1
Salsola australis	Herb (<0.5 m)	< 1
Senna notabilis	Herb (<0.5 m)	< 1
Solanum horridum	Herb (<0.5 m)	< 1
Trianthema triquetrum	Herb (<0.5 m)	< 1
Tribulus ?hirsutus	Herb (<0.5 m)	< 1
Aristida contorta	Tussock Grass (<0.5 m)	1 – 4
Enneapogon caerulescens	Tussock Grass (<0.5 m)	1 – 4
Eragrostis ?tenellula	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	5 – 9
Triodia longiceps	Hummock Grass (<0.5 m)	10 – 24

BD_E_128

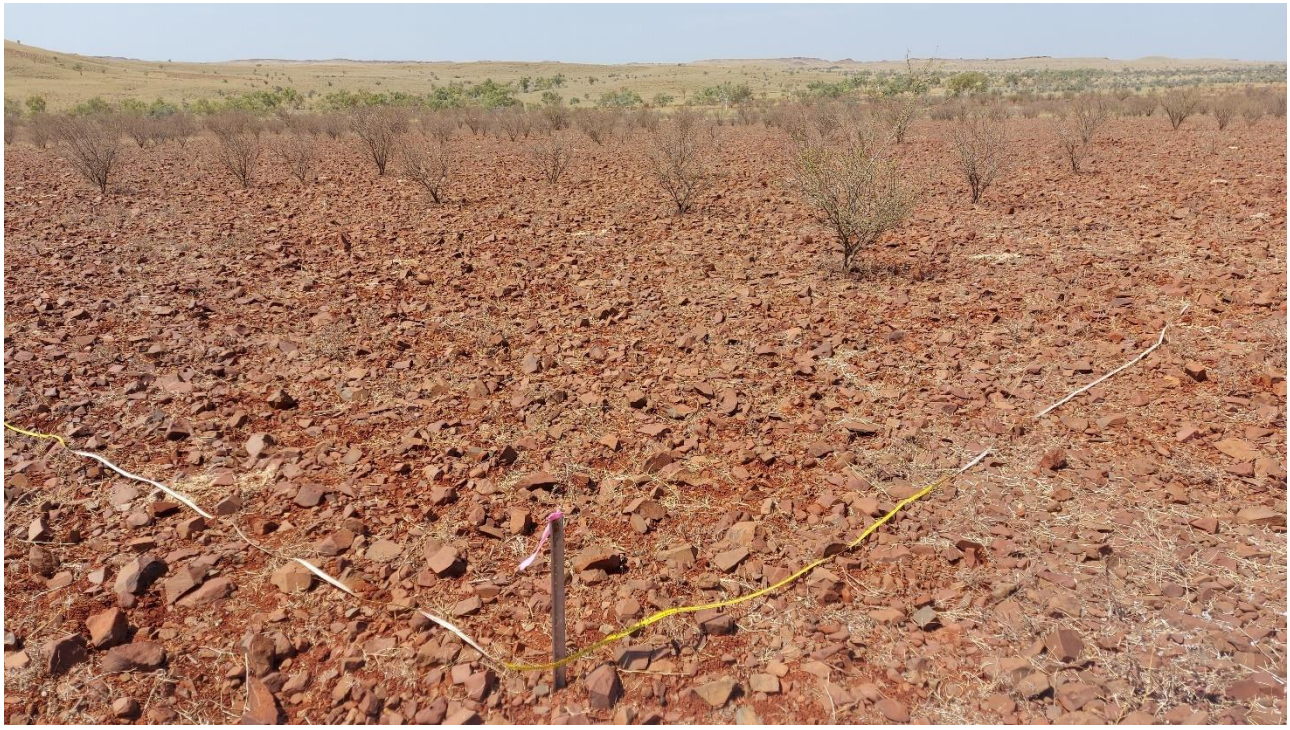
Date	17/09/2023	**Site type**	Flora: Quadrat	**Botanist**	LE
Location	-22.03419, 119.87738				
Landform	Ridge	**Slope**	Steep		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Grevillea wickhamii	Shrub (1-2 m)	5 – 9
Gossypium australe	Shrub (0.5-1 m)	1 – 4
Senna glutinosa subsp. *glutinosa*	Shrub (0.5-1 m)	1 – 4
Senna symonii	Shrub (0.5-1 m)	< 1
Triumfetta maconochieana	Shrub (0.5-1 m)	1 – 4
Dampiera candicans	Shrub (<0.5 m)	1 – 4
Ptilotus astrolasius	Shrub (<0.5 m)	< 1
Sida sp. Pilbara (A.A. Mitchell PRP 1543)	Shrub (<0.5 m)	< 1
Tribulus suberosus	Shrub (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Cymbopogon ambiguus	Tussock Grass (0.5-1 m)	< 1
Eriachne lanata	Tussock Grass (<0.5 m)	1 – 4
Eriachne mucronata	Tussock Grass (<0.5 m)	< 1
Paraneurachne muelleri	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	10 – 24

BD_E_129

Date	18/09/2023	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-22.03782, 119.84292				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay		
Rock type	Ironstone	**Rock size**	Boulders [> 260 mm]	**Rock cover**	30 – 70%
Vegetation condition	Poor	**Disturbance**	High weed cover and grazing.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Vachellia farnesiana	Shrub (1-2 m)	10 – 24
Indigofera trita subsp. *trita*	Shrub (<0.5 m)	1 – 4
Sida trichopoda	Shrub (<0.5 m)	< 1
Solanum lasiophyllum	Shrub (<0.5 m)	< 1
Arivela viscosa	Herb (<0.5 m)	1 – 4
Dolichocarpa crouchiana	Herb (<0.5 m)	< 1
Heliotropium crispatum	Herb (<0.5 m)	5 – 9
Rhynchosia minima	Herb (<0.5 m)	< 1
Senna notabilis	Herb (<0.5 m)	1 – 4
Cynodon convergens	Tussock Grass (<0.5 m)	1 – 4

BD_E_130

Date	18/09/2023	**Site type**	Flora: Quadrat	**Botanist**	LE
Location	-22.0454, 119.84988				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Grevillea pyramidalis subsp. *leucadendron*	Shrub (>2 m)	1 – 4
Swainsona decurrens	Herb (0.5-1 m)	1 – 4
Boerhavia ?coccinea	Herb (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	< 1
Cymbopogon ambiguus	Tussock Grass (0.5-1 m)	1 – 4
Aristida contorta	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	10 – 24

BD_E_131

Date	18/09/2023	**Site type**	Flora: Quadrat	**Botanist**	LE
Location	-22.05122, 119.85164				
Landform	Minor creek (< 5 m)	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Sandy loam		
Rock type	Mixed river alluvium	**Rock size**	Mixed	**Rock cover**	30 – 70%
Vegetation condition	Poor	**Disturbance**	High weed cover and grazing.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia coriacea subsp. *pendens*	Tree (<10 m)	10 – 24
Eucalyptus victrix	Tree (<10 m)	< 1
Hakea lorea subsp. *lorea*	Shrub (>2 m)	1 – 4
Vachellia farnesiana	Shrub (>2 m)	5 – 9
Acacia inaequilatera	Shrub (1-2 m)	5 – 9
Atalaya hemiglauca	Shrub (1-2 m)	1 – 4
Gossypium australe	Shrub (1-2 m)	1 – 4
Capparis spinosa subsp. *nummularia*	Shrub (<0.5 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Cullen leucanthum	Shrub (<0.5 m)	< 1
Cyperus vaginatus	Sedge (0.5-1 m)	< 1
?*Sida* sp. *(indet.)*	Herb (<0.5 m)	< 1
Boerhavia ?*coccinea*	Herb (<0.5 m)	< 1
Crotalaria medicaginea var. *neglecta*	Herb (<0.5 m)	< 1
Dysphania rhadinostachya subsp. *rhadinostachya*	Herb (<0.5 m)	< 1
Euphorbia australis var. *subtomentosa*	Herb (<0.5 m)	< 1
Euphorbia biconvexa	Herb (<0.5 m)	< 1
Evolvulus alsinoides var. *villosicalyx*	Herb (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	< 1
Salsola australis	Herb (<0.5 m)	< 1
Sclerolaena costata	Herb (<0.5 m)	< 1
Senna notabilis	Herb (<0.5 m)	< 1
Sida rohlenae subsp. *rohlenae*	Herb (<0.5 m)	< 1
Trianthema triquetrum	Herb (<0.5 m)	< 1
Tribulus astrocarpus	Herb (<0.5 m)	< 1
Cymbopogon ambiguus	Tussock Grass (0.5-1 m)	< 1
Aristida contorta	Tussock Grass (<0.5 m)	< 1
Cenchrus ciliaris	Tussock Grass (<0.5 m)	10 – 24
Cenchrus setiger	Tussock Grass (<0.5 m)	1 – 4
Dactyloctenium radulans	Tussock Grass (<0.5 m)	< 1
Enneapogon caerulescens	Tussock Grass (<0.5 m)	< 1

Name	Stratum	Percent cover (%)
Enneapogon polyphyllus	Tussock Grass (<0.5 m)	< 1
Eragrostis ?tenellula	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	10 – 24

BD_E_132

Date	18/09/2023	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-22.05195, 119.84055				
Landform	Plain (clay)	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay		
Rock type	Ironstone	**Rock size**	Boulders [> 260 mm]	**Rock cover**	30 – 70%
Vegetation condition	Poor	**Disturbance**	High weed cover and grazing.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Vachellia farnesiana	Shrub (>2 m)	10 – 24
Indigofera trita subsp. *trita*	Shrub (<0.5 m)	< 1
Sida trichopoda	Shrub (<0.5 m)	1 – 4
Arivela viscosa	Herb (<0.5 m)	< 1
Dolichocarpa crouchiana	Herb (<0.5 m)	< 1
Grona muelleri	Herb (<0.5 m)	< 1
Heliotropium crispatum	Herb (<0.5 m)	1 – 4
Hibiscus brachysiphonius	Herb (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	1 – 4
Senna notabilis	Herb (<0.5 m)	< 1
Solanum horridum	Herb (<0.5 m)	< 1
Aristida contorta	Tussock Grass (<0.5 m)	< 1
Cynodon convergens	Tussock Grass (<0.5 m)	25 – 32
Sporobolus australasicus	Tussock Grass (<0.5 m)	< 1

BD_E_133

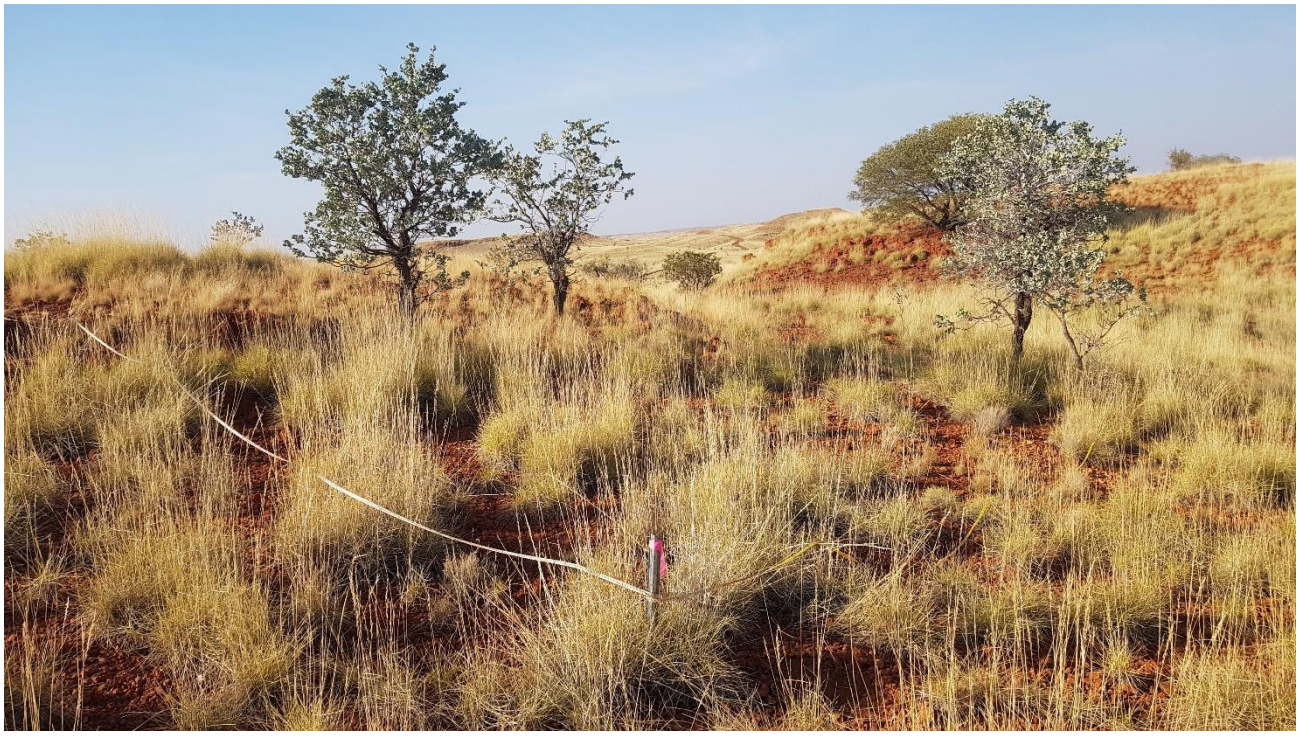
Date	18/09/2023	**Site type**	Flora: Quadrat	**Botanist**	SN/AC
Location	-22.0909, 119.84978				
Landform	Minor creek (< 5 m)	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Sandy loam		
Rock type	Mixed river alluvium	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Poor	**Disturbance**	High weed cover and grazing.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia coriacea subsp. *pendens*	Tree (<10 m)	1 – 4
Corymbia hamersleyana	Tree (<10 m)	5 – 9
Eucalyptus victrix	Tree (<10 m)	5 – 9
Acacia bivenosa	Shrub (>2 m)	5 – 9
Acacia pyrifolia	Shrub (>2 m)	1 – 4
Acacia tumida var. *pilbarensis*	Shrub (>2 m)	5 – 9
Gossypium robinsonii	Shrub (>2 m)	1 – 4
Vachellia farnesiana	Shrub (>2 m)	1 – 4
Acacia ancistrocarpa	Shrub (0.5-1 m)	1 – 4
Androcalva luteiflora	Shrub (0.5-1 m)	< 1
Capparis lasiantha	Shrub (0.5-1 m)	< 1
Atalaya hemiglauca	Shrub (<0.5 m)	< 1
Jasminum didymum subsp. *lineare*	Shrub (<0.5 m)	< 1
Cyperus vaginatus	Sedge (0.5-1 m)	< 1
Crotalaria medicaginea var. *neglecta*	Herb (<0.5 m)	< 1
Glycine canescens	Herb (<0.5 m)	< 1
Malvastrum americanum	Herb (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	< 1
Cymbopogon ambiguus	Tussock Grass (0.5-1 m)	< 1
Themeda triandra	Tussock Grass (0.5-1 m)	5 – 9
Cenchrus ciliaris	Tussock Grass (<0.5 m)	10 – 24
Cenchrus setiger	Tussock Grass (<0.5 m)	10 – 24
Triodia longiceps	Hummock Grass (0.5-1 m)	5 – 9
Triodia epactia	Hummock Grass (<0.5 m)	1 – 4

BD_E_134

Date	18/09/2023	**Site type**	Flora: Quadrat	**Botanist**	SN/AC
Location	-22.07055, 119.85274				
Landform	Ridge	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	Minor weed cover and grazing.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Shrub (>2 m)	1 – 4
Acacia pruinocarpa	Shrub (>2 m)	< 1
Gossypium australe	Shrub (>2 m)	< 1
Hakea lorea subsp. *lorea*	Shrub (1-2 m)	< 1
Senna glutinosa subsp. *glutinosa*	Shrub (1-2 m)	1 – 4
Afrohybanthus aurantiacus	Shrub (<0.5 m)	< 1
Clerodendrum floribundum	Shrub (<0.5 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Dodonaea coriacea	Shrub (<0.5 m)	< 1
Eremophila longifolia	Shrub (<0.5 m)	< 1
Jasminum didymum subsp. *lineare*	Shrub (<0.5 m)	< 1
Tribulus suberosus	Shrub (<0.5 m)	< 1
Triumfetta maconochieana	Shrub (<0.5 m)	< 1
Vachellia farnesiana	Shrub (<0.5 m)	< 1
Amaranthus undulatus	Herb (<0.5 m)	< 1
Bidens bipinnata	Herb (<0.5 m)	< 1
Cucumis variabilis	Herb (<0.5 m)	< 1
Dysphania rhadinostachya subsp. *rhadinostachya*	Herb (<0.5 m)	< 1
Gomphrena cunninghamii	Herb (<0.5 m)	< 1
Goodenia stobbsiana	Herb (<0.5 m)	< 1
Hibiscus coatesii	Herb (<0.5 m)	< 1
Ptilotus calostachyus	Herb (<0.5 m)	< 1
Sida rohlenae subsp. *rohlenae*	Herb (<0.5 m)	< 1
Solanum horridum	Herb (<0.5 m)	< 1
Trigastrotheca molluginea	Herb (<0.5 m)	< 1
Cymbopogon ambiguus	Tussock Grass (0.5-1 m)	< 1
Amphipogon sericeus	Tussock Grass (<0.5 m)	< 1
Eriachne lanata	Tussock Grass (<0.5 m)	1 – 4
Eriachne mucronata	Tussock Grass (<0.5 m)	1 – 4
Iseilema vaginiflorum	Tussock Grass (<0.5 m)	< 1
Paraneurachne muelleri	Tussock Grass (<0.5 m)	< 1

Name	Stratum	Percent cover (%)
Paspalidium clementii	Tussock Grass (<0.5 m)	< 1
Triodia brizoides	Hummock Grass (<0.5 m)	1 – 4
Triodia epactia	Hummock Grass (<0.5 m)	25 – 32
Tinospora smilacina	Vine (<0.5 m)	< 1

BD_E_135

Date	17/09/2023	**Site type**	Flora: Quadrat	**Botanist**	SN/AC
Location	-22.07393, 119.89451				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Mixed	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia coriacea subsp. *pendens*	Tree (<10 m)	< 1
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	1 – 4
Acacia ?aptaneura	Shrub (>2 m)	1 – 4
Acacia synchronicia	Shrub (>2 m)	1 – 4
Acacia ancistrocarpa	Shrub (1-2 m)	< 1
Acacia bivenosa	Shrub (1-2 m)	1 – 4
Acacia pruinocarpa	Shrub (1-2 m)	< 1
Acacia tenuissima	Shrub (1-2 m)	1 – 4
Senna symonii	Shrub (1-2 m)	< 1
Senna ?stricta	Shrub (0.5-1 m)	1 – 4
Acacia tetragonophylla	Shrub (<0.5 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Goodenia stobbsiana	Herb (<0.5 m)	< 1
Ptilotus calostachyus	Herb (<0.5 m)	< 1
Trianthema glossostigmum	Herb (<0.5 m)	< 1
Aristida contorta	Tussock Grass (0.5-1 m)	< 1
Eriachne lanata	Tussock Grass (<0.5 m)	< 1
Eriachne pulchella subsp. *dominii*	Tussock Grass (<0.5 m)	< 1
Triodia brizoides	Hummock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	10 – 24

BD_E_136

Date	17/09/2023	**Site type**	Flora: Quadrat	**Botanist**	SN/AC
Location	-22.07468, 119.89948				
Landform	Undulating plain	**Slope**	NA		
Soil colour	Brown	**Soil texture**	Sandy loam		
Rock type	Calcrete	**Rock size**	Mixed	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	1 – 4
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	1 – 4
Senna symonii	Shrub (1-2 m)	< 1
Acacia bivenosa	Shrub (<0.5 m)	< 1
Afrohybanthus aurantiacus	Shrub (<0.5 m)	< 1
Ptilotus astrolasius	Shrub (<0.5 m)	< 1
Senna ?stricta	Shrub (<0.5 m)	< 1
Senna artemisioides subsp. *helmsii*	Shrub (<0.5 m)	< 1
Sida ?trichopoda	Shrub (<0.5 m)	< 1
Solanum lasiophyllum/phlomoides	Shrub (<0.5 m)	< 1
Abutilon ?lepidum	Herb (<0.5 m)	< 1
Dysphania sphaerosperma	Herb (<0.5 m)	< 1
Euphorbia australis var. *subtomentosa*	Herb (<0.5 m)	< 1
Goodenia microptera	Herb (<0.5 m)	< 1
Goodenia stobbsiana	Herb (<0.5 m)	< 1
Ptilotus clementii	Herb (<0.5 m)	< 1
Ptilotus exaltatus	Herb (<0.5 m)	< 1
Scaevola amblyanthera var. *centralis*	Herb (<0.5 m)	< 1
Senna notabilis	Herb (<0.5 m)	< 1
Streptoglossa bubakii	Herb (<0.5 m)	< 1
Cymbopogon ambiguus	Tussock Grass (0.5-1 m)	< 1
Aristida contorta	Tussock Grass (<0.5 m)	< 1
Dactyloctenium radulans	Tussock Grass (<0.5 m)	< 1
Enneapogon caerulescens	Tussock Grass (<0.5 m)	< 1
Eragrostis ?eriopoda	Tussock Grass (<0.5 m)	< 1
Paraneurachne muelleri	Tussock Grass (<0.5 m)	< 1
Paspalidium clementii	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	1 – 4
Triodia wiseana	Hummock Grass (<0.5 m)	25 – 32

BD_E_137

Date	15/09/2023	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-22.10525, 119.87552				
Landform	Low hill	**Slope**	Gentle		
Soil colour	Brown	**Soil texture**	Clay loam		
Rock type	Ironstone, quartz	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	Assoc.
Senna ?stricta	Shrub (1-2 m)	1 – 4
Senna glutinosa subsp. ×*luerssenii*	Shrub (1-2 m)	< 1
Senna sericea	Shrub (1-2 m)	< 1
Senna symonii	Shrub (1-2 m)	1 – 4
Gossypium australe	Shrub (0.5-1 m)	< 1
Acacia ancistrocarpa	Shrub (<0.5 m)	< 1
Acacia synchronicia	Shrub (<0.5 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	1 – 4
Ptilotus calostachyus	Herb (0.5-1 m)	< 1
Ptilotus exaltatus	Herb (<0.5 m)	< 1
Triodia brizoides	Hummock Grass (<0.5 m)	10 – 24
Triodia epactia	Hummock Grass (<0.5 m)	5 – 9
Triodia longiceps	Hummock Grass (<0.5 m)	5 – 9

BD_E_138

Date	15/09/2023	**Site type**	Flora: Quadrat	**Botanist**	LE
Location	-22.10954, 119.87013				
Landform	Plain	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Sandy clay loam		
Rock type	Ironstone	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	1 – 4
Acacia ?aptaneura	Shrub (>2 m)	10 – 24
Acacia pruinocarpa	Shrub (>2 m)	5 – 9
Acacia bivenosa	Shrub (1-2 m)	5 – 9
Senna glutinosa subsp. *glutinosa*	Shrub (1-2 m)	< 1
Acacia synchronicia	Shrub (0.5-1 m)	< 1
Anthobolus leptomerioides	Shrub (0.5-1 m)	< 1
Psydrax suaveolens	Shrub (0.5-1 m)	< 1
Senna artemisioides subsp. *helmsii*	Shrub (<0.5 m)	< 1
Duperreya commixta	Herb (<0.5 m)	< 1
Hibiscus burtonii	Herb (<0.5 m)	< 1
Trigastrotheca molluginea	Herb (<0.5 m)	< 1
Cymbopogon ambiguus	Tussock Grass (0.5-1 m)	< 1
Triodia epactia	Hummock Grass (0.5-1 m)	10 – 24

BD_E_139

Date	16/09/2023	**Site type**	Flora: Quadrat	**Botanist**	LE
Location	-22.11609, 119.92237				
Landform	Undulating plain	**Slope**	NA		
Soil colour	Light brown	**Soil texture**	Clay loam		
Rock type	Calcrete, quartz, ironstone	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	Minor weed cover and grazing.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	10 – 24
Eucalyptus victrix	Tree (<10 m)	5 – 9
Acacia synchronicia	Shrub (<0.5 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Pluchea tetranthera	Shrub (<0.5 m)	< 1
Euphorbia australis var. *subtomentosa*	Herb (<0.5 m)	< 1
Evolvulus alsinoides var. *villosicalyx*	Herb (<0.5 m)	< 1
Hibiscus burtonii	Herb (<0.5 m)	< 1
Indigofera linnaei	Herb (<0.5 m)	< 1
Cenchrus ciliaris	Tussock Grass (<0.5 m)	< 1
Enneapogon caerulescens	Tussock Grass (<0.5 m)	< 1
Eragrostis desertorum	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	10 – 24

BD_E_140

Date	15/09/2023	**Site type**	Flora: Quadrat	**Botanist**	SN/AC
Location	-22.11696, 119.88112				
Landform	Low hill	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Sandy clay loam		
Rock type	Quartz, ironstone	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Moderate (2 – 3 yrs)				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	1 – 4
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	1 – 4
Acacia ancistrocarpa	Shrub (1-2 m)	5 – 9
Hakea lorea subsp. *lorea*	Shrub (1-2 m)	1 – 4
Acacia bivenosa	Shrub (0.5-1 m)	5 – 9
Santalum lanceolatum	Shrub (0.5-1 m)	1 – 4
Senna ?*stricta*	Shrub (0.5-1 m)	1 – 4
Senna glutinosa subsp. ×*luerssenii*	Shrub (0.5-1 m)	1 – 4
Acacia ?*sibirica*	Shrub (<0.5 m)	< 1
Afrohybanthus aurantiacus	Shrub (<0.5 m)	< 1
Corchorus incanus	Shrub (<0.5 m)	< 1
Dampiera candicans	Shrub (<0.5 m)	< 1
Euploca chrysocarpa	Shrub (<0.5 m)	< 1
Euploca heterantha	Shrub (<0.5 m)	< 1
Hibiscus sturtii	Shrub (<0.5 m)	< 1
Ptilotus astrolasius	Shrub (<0.5 m)	< 1
Senna artemisioides subsp. *oligophylla*	Shrub (<0.5 m)	< 1
Senna symonii	Shrub (<0.5 m)	1 – 4
Triumfetta chaetocarpa	Shrub (<0.5 m)	< 1
Goodenia stobbsiana	Herb (0.5-1 m)	1 – 4
Goodenia cusackiana	Herb (<0.5 m)	< 1
Goodenia microptera	Herb (<0.5 m)	< 1
Haloragis trigonocarpa	Herb (<0.5 m)	< 1
Hibiscus coatesii	Herb (<0.5 m)	< 1
Ptilotus exaltatus	Herb (<0.5 m)	< 1
Solanum horridum	Herb (<0.5 m)	< 1
Streptoglossa bubakii	Herb (<0.5 m)	< 1
Aristida latifolia	Tussock Grass (<0.5 m)	< 1
Eriachne mucronata	Tussock Grass (<0.5 m)	< 1
Eriachne pulchella subsp. *dominii*	Tussock Grass (<0.5 m)	< 1
Paraneurachne muelleri	Tussock Grass (<0.5 m)	< 1

Name	Stratum	Percent cover (%)
Triodia brizoides	Hummock Grass (<0.5 m)	33 – 49
Triodia epactia	Hummock Grass (<0.5 m)	5 – 9

BD_E_141

Date	15/09/2023	**Site type**	Flora: Quadrat	**Botanist**	SN/AC
Location	-22.11859, 119.87576				
Landform	Plain	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Fine gravel [to c. 5 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				

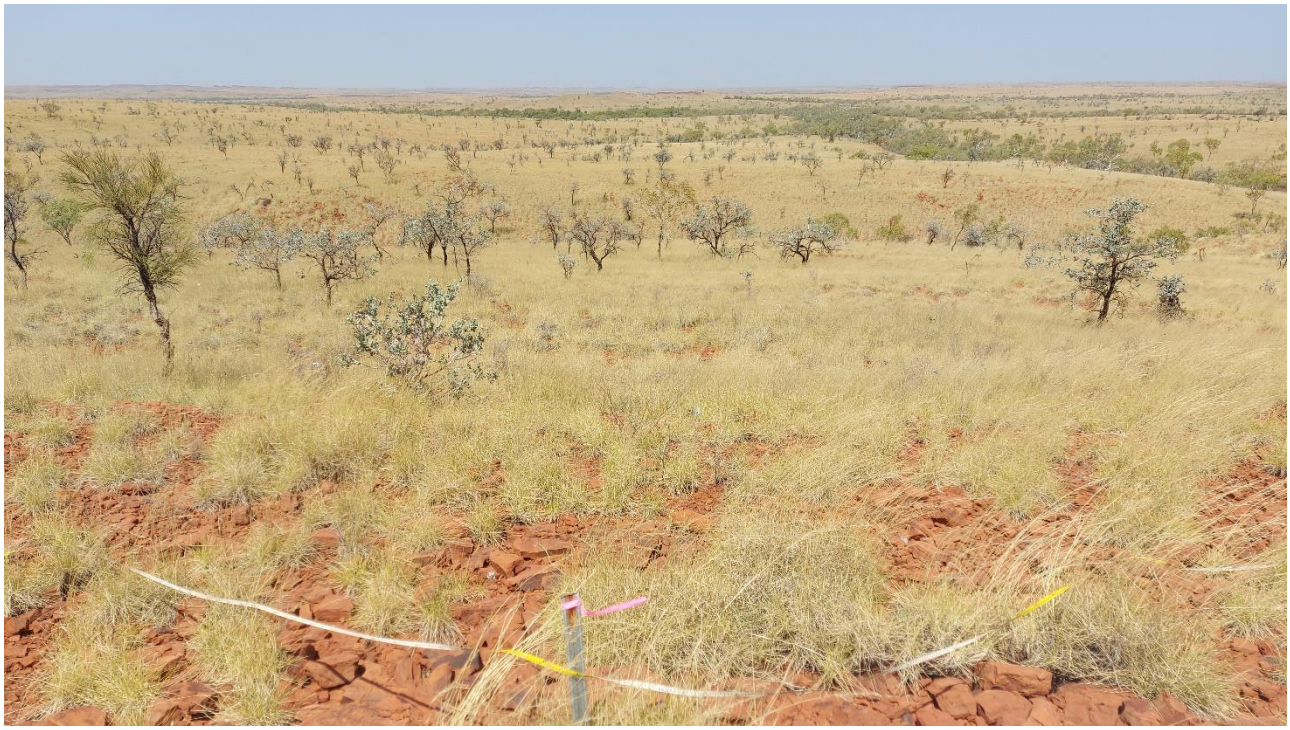


Name	Stratum	Percent cover (%)
Acacia aptaneura	Shrub (>2 m)	33 – 49
Acacia tumida var. *pilbarensis*	Shrub (>2 m)	1 – 4
Acacia adsurgens	Shrub (1-2 m)	1 – 4
Acacia ancistrocarpa	Shrub (1-2 m)	5 – 9
Acacia pruinocarpa	Shrub (1-2 m)	5 – 9
Acacia tenuissima	Shrub (1-2 m)	1 – 4
Indigofera monophylla	Shrub (1-2 m)	10 – 24
Acacia bivenosa	Shrub (0.5-1 m)	10 – 24
Acacia pyrifolia	Shrub (0.5-1 m)	1 – 4
Anthobolus leptomerioides	Shrub (0.5-1 m)	< 1
Capparis lasiantha	Shrub (0.5-1 m)	1 – 4
Dodonaea petiolaris	Shrub (0.5-1 m)	1 – 4
Eremophila latrobei subsp. *filiformis*	Shrub (0.5-1 m)	1 – 4
Jasminum didymum subsp. *lineare*	Shrub (0.5-1 m)	1 – 4
Psydrax suaveolens	Shrub (0.5-1 m)	1 – 4
Senna glutinosa subsp. *glutinosa*	Shrub (0.5-1 m)	< 1
Seringia ?exastia	Shrub (0.5-1 m)	10 – 24
Androcalva luteiflora	Shrub (<0.5 m)	< 1
Enchylaena tomentosa var. *tomentosa*	Shrub (<0.5 m)	< 1
Sida ?trichopoda	Shrub (<0.5 m)	< 1
Abutilon ?lepidum	Herb (<0.5 m)	< 1
Alternanthera nana	Herb (<0.5 m)	< 1
Duperreya commixta	Herb (<0.5 m)	< 1
Evolvulus alsinoides var. *villosicalyx*	Herb (<0.5 m)	< 1
Goodenia stobbsiana	Herb (<0.5 m)	1 – 4
Senna notabilis	Herb (<0.5 m)	< 1
Aristida ?inaequiglumis	Tussock Grass (0.5-1 m)	1 – 4
Cymbopogon ambiguus	Tussock Grass (0.5-1 m)	1 – 4
Paraneurachne muelleri	Tussock Grass (0.5-1 m)	10 – 24
Aristida contorta	Tussock Grass (<0.5 m)	< 1
Triodia longiceps	Hummock Grass (1-2 m)	1 – 4

Name	Stratum	Percent cover (%)
Triodia brizoides	Hummock Grass (0.5-1 m)	1 – 4
Triodia epactia	Hummock Grass (0.5-1 m)	33 – 49

BD_E_142

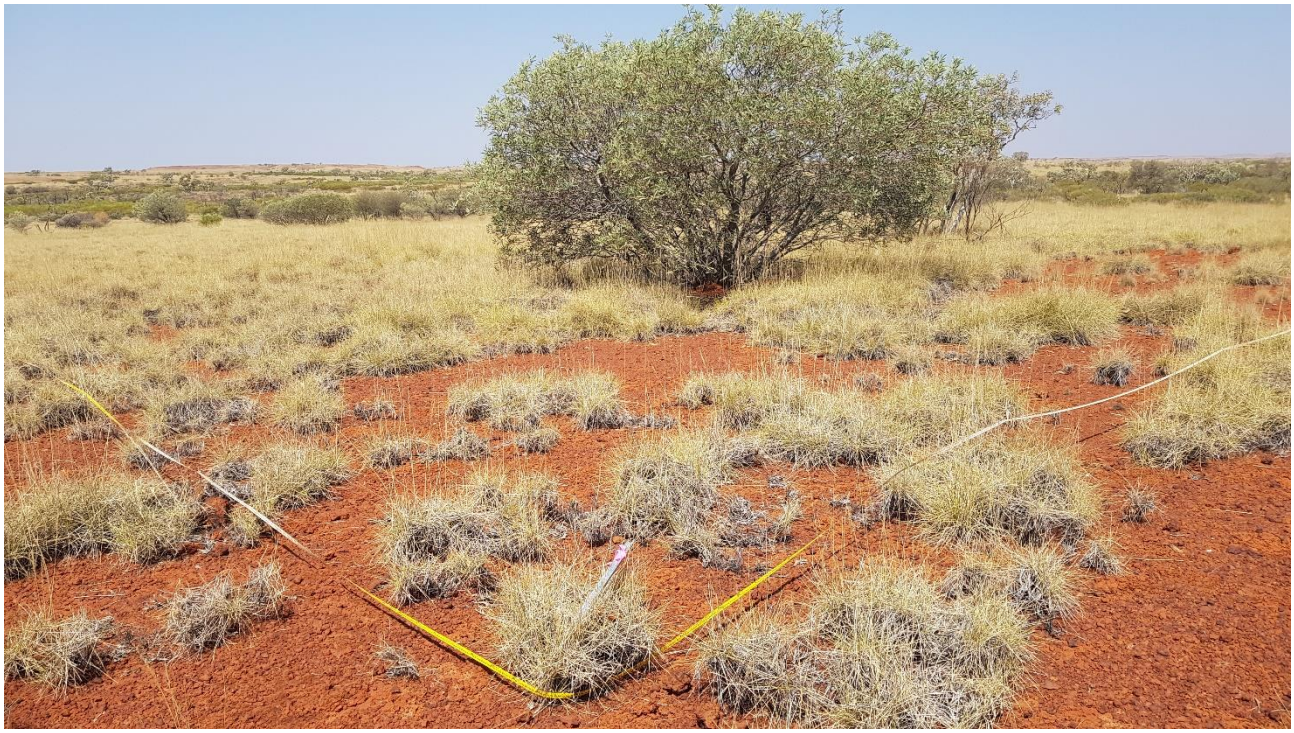
Date	16/09/2023	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-22.11818, 119.92591				
Landform	Hill	**Slope**	Moderate		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	1 – 4
Acacia inaequilatera	Shrub (>2 m)	5 – 9
Hakea lorea subsp. *lorea*	Shrub (>2 m)	1 – 4
Acacia ancistrocarpa	Shrub (1-2 m)	1 – 4
Senna glutinosa subsp. ×*luerssenii*	Shrub (1-2 m)	< 1
Senna ?stricta	Shrub (0.5-1 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Indigofera monophylla	Shrub (<0.5 m)	5 – 9
Tephrosia sp. NW Eremaean (S. van Leeuwen et al. PBS 0356)	Herb (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	33 – 49

BD_E_143

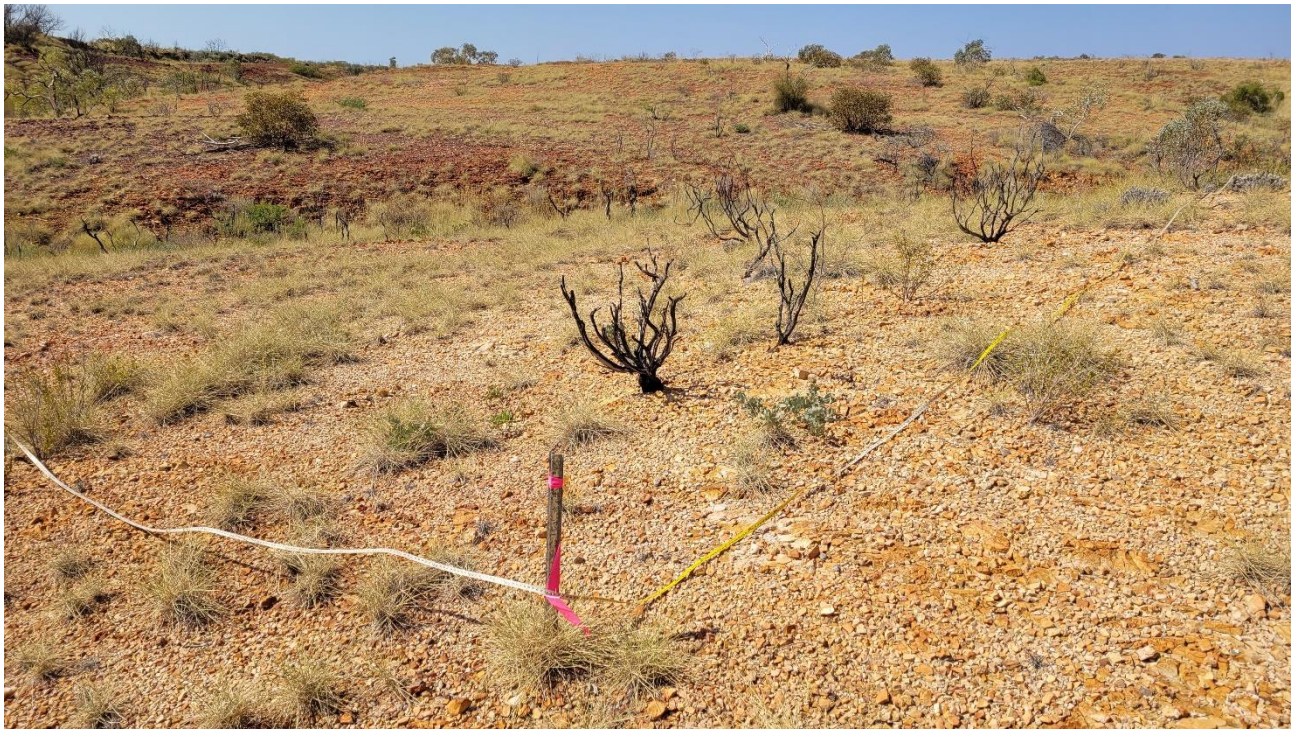
Date	14/09/2023	**Site type**	Flora: Quadrat	**Botanist**	SN/AC
Location	-22.12574, 119.81647				
Landform	Undulating plain	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	1 – 4
Acacia pruinocarpa	Shrub (>2 m)	1 – 4
Acacia tetragonophylla	Shrub (1-2 m)	< 1
Eriachne lanata	Tussock Grass (<0.5 m)	5 – 9
Triodia epactia	Hummock Grass (0.5-1 m)	50 – 74

BD_E_144

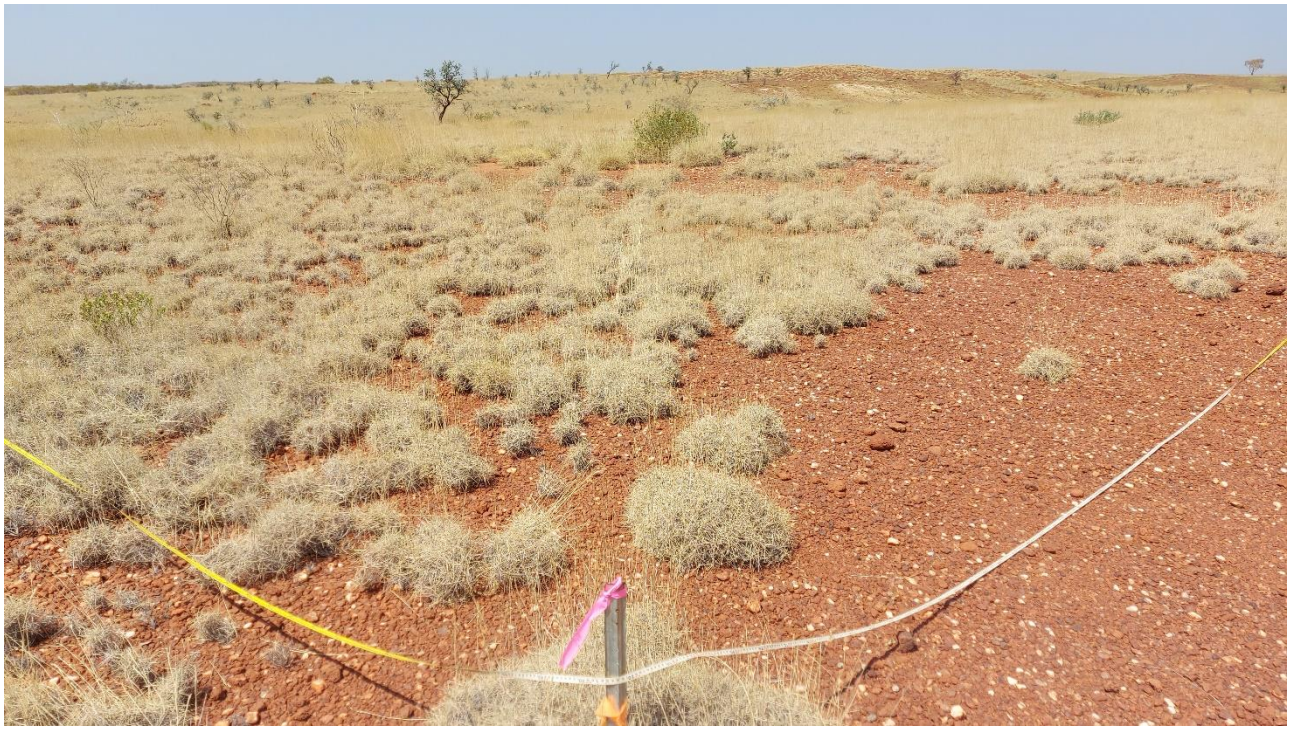
Date	15/09/2023	**Site type**	Flora: Quadrat	**Botanist**	LE
Location	-22.12531, 119.87276				
Landform	Low hill	**Slope**	Gentle		
Soil colour	Grey	**Soil texture**	Loamy sand		
Rock type	Calcrete	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Moderate (2 – 3 yrs)				



Name	Stratum	Percent cover (%)
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	10 – 24
Acacia tumida var. *pilbarensis*	Shrub (>2 m)	Assoc.
Acacia ?sibirica	Shrub (1-2 m)	< 1
Acacia ancistrocarpa	Shrub (0.5-1 m)	< 1
Acacia bivenosa	Shrub (0.5-1 m)	1 – 4
Androcalva luteiflora	Shrub (0.5-1 m)	< 1
Capparis umbonata	Shrub (0.5-1 m)	< 1
Hakea lorea subsp. *lorea*	Shrub (0.5-1 m)	< 1
Indigofera monophylla	Shrub (0.5-1 m)	1 – 4
Senna glutinosa subsp. *glutinosa*	Shrub (0.5-1 m)	< 1
Senna symonii	Shrub (0.5-1 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Euploca chrysocarpa	Shrub (<0.5 m)	< 1
Hibiscus sturtii var. *campylochlamys*	Shrub (<0.5 m)	< 1
Lepidium pedicellosum	Shrub (<0.5 m)	< 1
Pluchea tetranthera	Shrub (<0.5 m)	< 1
Ptilotus incanus	Shrub (<0.5 m)	< 1
Scaevola spinescens	Shrub (<0.5 m)	< 1
Senna glutinosa subsp. ×*luerssenii*	Shrub (<0.5 m)	< 1
Tribulus suberosus	Shrub (<0.5 m)	< 1
Goodenia cusackiana	Herb (<0.5 m)	< 1
Ptilotus exaltatus	Herb (<0.5 m)	1 – 4
Scaevola amblyanthera var. *centralis*	Herb (<0.5 m)	< 1
Enneapogon caerulescens	Tussock Grass (<0.5 m)	< 1
Eragrostis desertorum	Tussock Grass (<0.5 m)	< 1
Eriachne mucronata	Tussock Grass (<0.5 m)	< 1
Triodia brizoides	Hummock Grass (<0.5 m)	1 – 4
Triodia epactia	Hummock Grass (<0.5 m)	1 – 4
Triodia longiceps	Hummock Grass (<0.5 m)	10 – 24

BD_E_145

Date	14/09/2023	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-22.12681, 119.80778				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone, quartz	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	1 – 4
Acacia inaequilatera	Shrub (>2 m)	1 – 4
Senna ?stricta	Shrub (1-2 m)	< 1
Senna symonii	Shrub (1-2 m)	1 – 4
Acacia bivenosa	Shrub (0.5-1 m)	5 – 9
Acacia tenuissima	Shrub (0.5-1 m)	1 – 4
Capparis umbonata	Shrub (0.5-1 m)	1 – 4
Hakea lorea subsp. *lorea*	Shrub (0.5-1 m)	< 1
Pluchea ferdinandi-muelleri	Shrub (0.5-1 m)	< 1
Pluchea tetranthera	Shrub (<0.5 m)	< 1
Ptilotus astrolasius	Shrub (<0.5 m)	< 1
Senna glutinosa subsp. ×*luerssenii*	Shrub (<0.5 m)	< 1
Goodenia cusackiana	Herb (<0.5 m)	< 1
Ptilotus calostachyus	Herb (<0.5 m)	< 1
Triodia longiceps	Hummock Grass (0.5-1 m)	5 – 9
Triodia brizoides	Hummock Grass (<0.5 m)	33 – 49
Triodia wiseana	Hummock Grass (<0.5 m)	5 – 9

BD_E_146

Date	14/09/2023	**Site type**	Flora: Quadrat	**Botanist**	SN/AC
Location	-22.1285, 119.81568				
Landform	Plain	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	10 – 30%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia ?*aptaneura*	Shrub (>2 m)	10 – 24
Acacia ancistrocarpa	Shrub (>2 m)	1 – 4
Acacia bivenosa	Shrub (>2 m)	< 1
Acacia pruinocarpa	Shrub (>2 m)	1 – 4
Grevillea wickhamii	Shrub (>2 m)	< 1
Senna ?*stricta*	Shrub (>2 m)	< 1
Senna glutinosa subsp. *glutinosa*	Shrub (>2 m)	< 1
Acacia tenuissima	Shrub (1-2 m)	5 – 9
Eremophila latrobei ?subsp. *glabra*	Shrub (0.5-1 m)	< 1
Hibiscus sturtii	Shrub (<0.5 m)	< 1
Seringia ?*exastia*	Shrub (<0.5 m)	< 1
Sida sp. Pilbara (A.A. Mitchell PRP 1543)	Shrub (<0.5 m)	< 1
Ptilotus calostachyus	Herb (0.5-1 m)	< 1
Duperreya commixta	Herb (<0.5 m)	< 1
Goodenia stobbsiana	Herb (<0.5 m)	< 1
Hibiscus burtonii	Herb (<0.5 m)	< 1
Solanum horridum	Herb (<0.5 m)	< 1
Trichodesma zeylanicum var. *zeylanicum*	Herb (<0.5 m)	< 1
Amphipogon sericeus	Tussock Grass (<0.5 m)	< 1
Aristida contorta	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (0.5-1 m)	33 – 49

BD_E_147

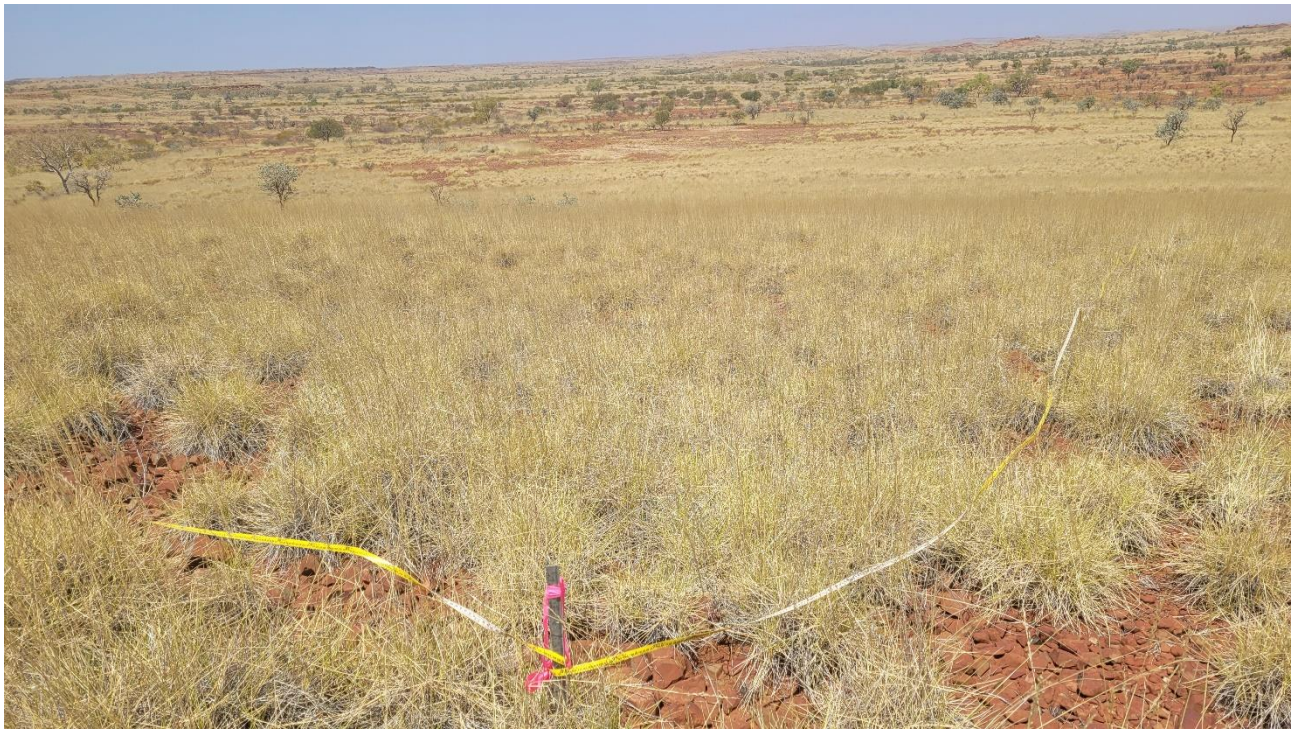
Date	15/09/2023	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-22.1281, 119.87124				
Landform	Low hill	**Slope**	Gentle		
Soil colour	Light grey	**Soil texture**	Sandy clay loam		
Rock type	Calcrete	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Eucalyptus socialis subsp. *eucentrica*	Mallee (<10 m)	5 – 9
Acacia bivenosa	Shrub (1-2 m)	1 – 4
Melaleuca eleuterostachya	Shrub (1-2 m)	10 – 24
Petalostylis labicheoides	Shrub (1-2 m)	1 – 4
Santalum lanceolatum	Shrub (1-2 m)	5 – 9
Senna ?stricta	Shrub (1-2 m)	1 – 4
Acacia ?sibirica	Shrub (0.5-1 m)	1 – 4
Senna glutinosa subsp. ×*luerssenii*	Shrub (0.5-1 m)	< 1
Senna symonii	Shrub (0.5-1 m)	1 – 4
Anthobolus leptomerioides	Shrub (<0.5 m)	< 1
Euploca chrysocarpa	Shrub (<0.5 m)	< 1
Goodenia cusackiana	Herb (<0.5 m)	5 – 9
Ptilotus exaltatus	Herb (<0.5 m)	< 1
Scaevola amblyanthera var. *centralis*	Herb (<0.5 m)	< 1
Triodia longiceps	Hummock Grass (0.5-1 m)	10 – 24
Triodia wiseana	Hummock Grass (<0.5 m)	10 – 24

BD_E_148

Date	14/09/2023	**Site type**	Flora: Quadrat	**Botanist**	LE
Location	-22.13025, 119.8102				
Landform	Low hill	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Basalt	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	Assoc.
Acacia inaequilatera	Shrub (>2 m)	1 – 4
Hakea lorea subsp. *lorea*	Shrub (1-2 m)	< 1
Senna artemisioides subsp. *oligophylla*	Shrub (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	< 1
Triodia epactia	Hummock Grass (0.5-1 m)	25 – 32

BD_E_149

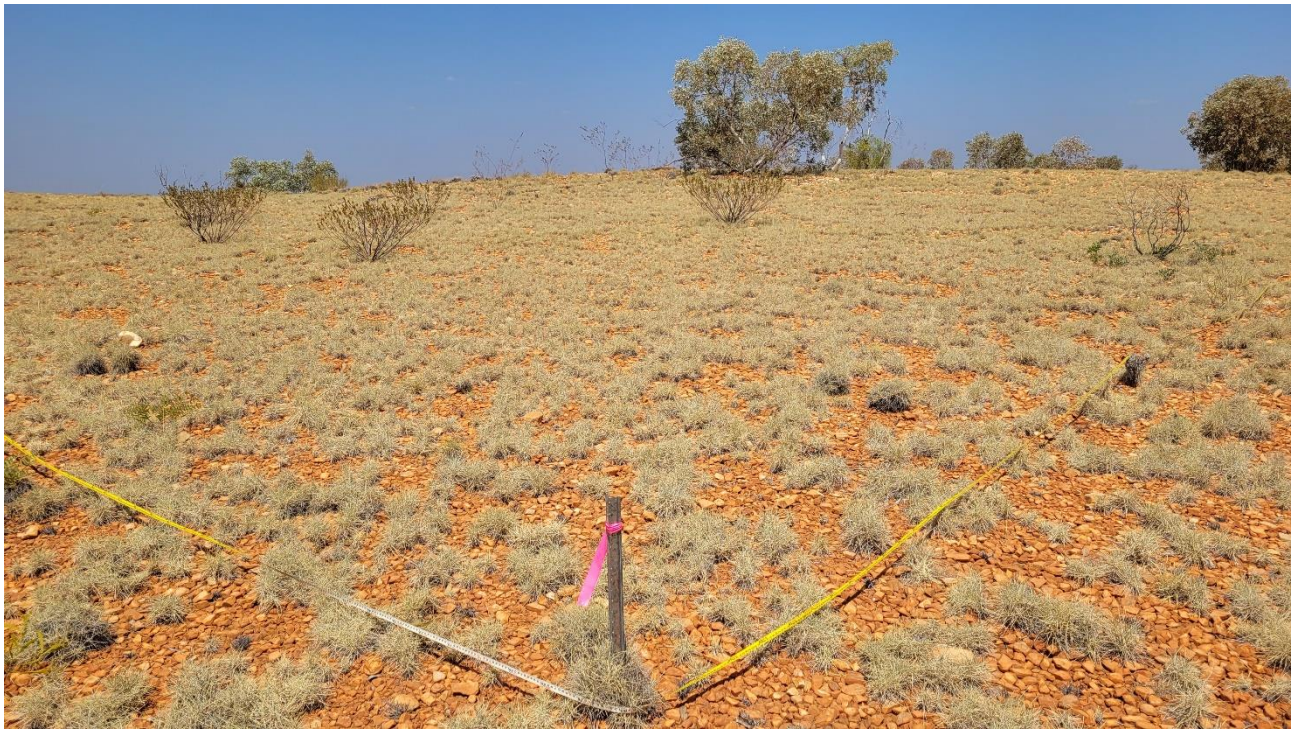
Date	14/09/2023	**Site type**	Flora: Quadrat	**Botanist**	LE
Location	-22.13353, 119.81267				
Landform	Undulating plain	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	5 – 9
Acacia ancistrocarpa	Shrub (1-2 m)	10 – 24
Acacia bivenosa	Shrub (1-2 m)	< 1
Petalostylis labicheoides	Shrub (1-2 m)	1 – 4
Senna glutinosa subsp. ×*luerssenii*	Shrub (1-2 m)	< 1
Acacia synchronicia	Shrub (0.5-1 m)	< 1
Capparis lasiantha	Shrub (0.5-1 m)	< 1
Indigofera monophylla	Shrub (0.5-1 m)	< 1
Abutilon ?lepidum	Herb (<0.5 m)	< 1
Ptilotus exaltatus	Herb (<0.5 m)	< 1
Scaevola amblyanthera var. *centralis*	Herb (<0.5 m)	< 1
Cymbopogon ambiguus	Tussock Grass (0.5-1 m)	< 1
Paraneurachne muelleri	Tussock Grass (0.5-1 m)	< 1
Triodia brizoides	Hummock Grass (0.5-1 m)	10 – 24
Triodia longiceps	Hummock Grass (0.5-1 m)	10 – 24

BD_E_150

Date	15/09/2023	**Site type**	Flora: Quadrat	**Botanist**	LE
Location	-22.13323, 119.88011				
Landform	Low hill	**Slope**	Gentle		
Soil colour	Brown	**Soil texture**	Clay loam		
Rock type	Calcrete	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Moderate (2 – 3 yrs)				



Name	Stratum	Percent cover (%)
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	10 – 24
Acacia bivenosa	Shrub (0.5-1 m)	< 1
Acacia pruinocarpa	Shrub (0.5-1 m)	< 1
Acacia tenuissima	Shrub (0.5-1 m)	< 1
Capparis lasiantha	Shrub (0.5-1 m)	< 1
Capparis umbonata	Shrub (0.5-1 m)	< 1
Senna glutinosa subsp. ×*luerssenii*	Shrub (0.5-1 m)	< 1
Senna glutinosa subsp. *glutinosa*	Shrub (0.5-1 m)	< 1
Senna sericea	Shrub (0.5-1 m)	1 – 4
Acacia ?aptaneura	Shrub (<0.5 m)	< 1
Acacia ancistrocarpa	Shrub (<0.5 m)	< 1
Acacia ptychophylla	Shrub (<0.5 m)	< 1
Dodonaea coriacea	Shrub (<0.5 m)	< 1
Senna symonii	Shrub (<0.5 m)	1 – 4
Fimbristylis dichotoma	Sedge (<0.5 m)	< 1
Ptilotus calostachyus	Herb (0.5-1 m)	< 1
Abutilon ?fraseri	Herb (<0.5 m)	< 1
Goodenia cusackiana	Herb (<0.5 m)	< 1
Goodenia stobbsiana	Herb (<0.5 m)	< 1
Ptilotus exaltatus	Herb (<0.5 m)	< 1
Eriachne mucronata	Tussock Grass (<0.5 m)	1 – 4
Triodia brizoides	Hummock Grass (<0.5 m)	10 – 24
Triodia epactia	Hummock Grass (<0.5 m)	1 – 4
Triodia longiceps	Hummock Grass (<0.5 m)	5 – 9

BD_E_151

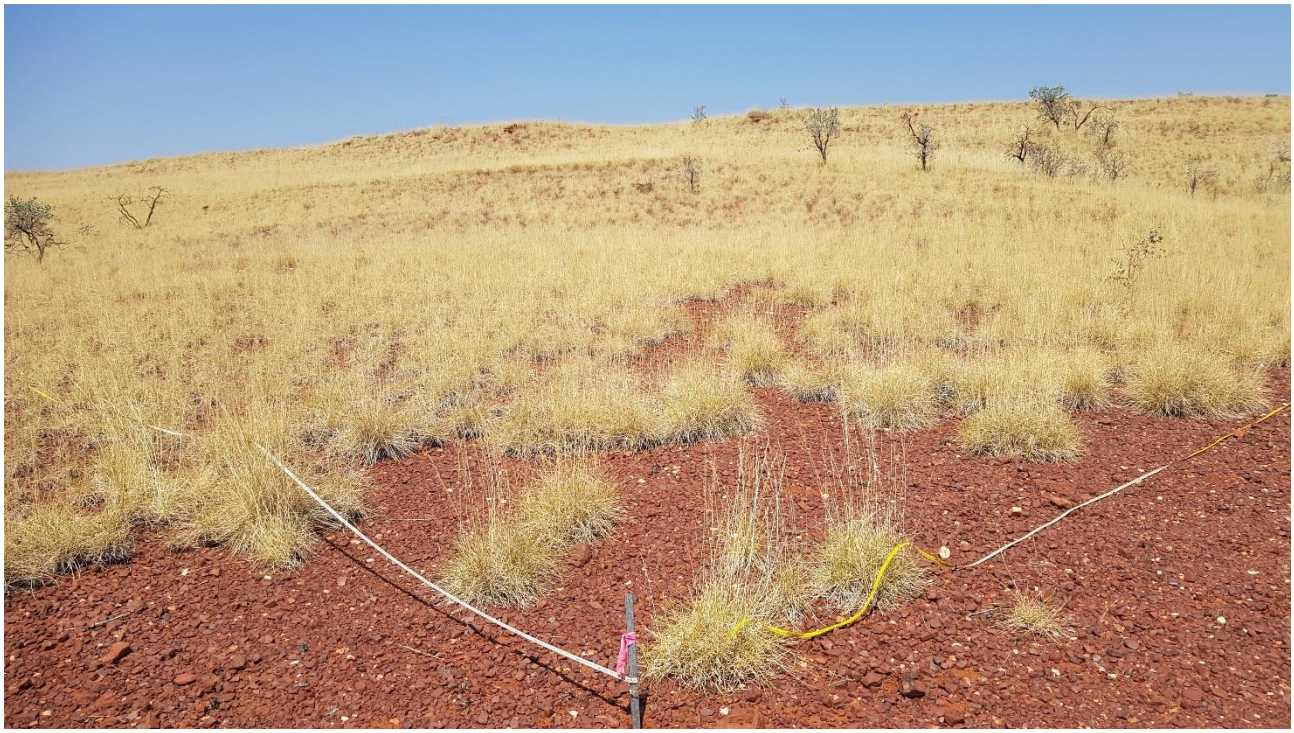
Date	14/09/2023	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-22.13505, 119.81752				
Landform	Low hill	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	1 – 4
Acacia tenuissima	Shrub (0.5-1 m)	< 1
Amphipogon sericeus	Tussock Grass (<0.5 m)	1 – 4
Triodia epactia	Hummock Grass (<0.5 m)	33 – 49

BD_E_152

Date	15/09/2023	**Site type**	Flora: Quadrat	**Botanist**	SN/AC
Location	-22.13598, 119.89186				
Landform	Low hill	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Shrub (>2 m)	1 – 4
Senna glutinosa subsp. *pruinosa*	Shrub (0.5-1 m)	Assoc.
Corchorus incanus	Shrub (<0.5 m)	< 1
Hibiscus sturtii var. *platychlamys*	Shrub (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Ptilotus calostachyus	Herb (<0.5 m)	< 1
Triodia epactia	Hummock Grass (0.5-1 m)	33 – 49

BD_E_153

Date	15/09/2023	**Site type**	Flora: Quadrat	**Botanist**	SN/AC
Location	-22.13624, 119.88943				
Landform	Ridge	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Basalt	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	Minor weed cover and grazing.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	Assoc.
Acacia inaequilatera	Shrub (>2 m)	5 – 9
Clerodendrum floribundum	Shrub (>2 m)	1 – 4
Capparis umbonata	Shrub (1-2 m)	< 1
Capparis lasiantha	Shrub (0.5-1 m)	< 1
Corchorus incanus	Shrub (0.5-1 m)	1 – 4
Indigofera monophylla	Shrub (0.5-1 m)	< 1
Senna glutinosa subsp. ×*luerssenii*	Shrub (0.5-1 m)	< 1
Senna glutinosa subsp. *glutinosa*	Shrub (0.5-1 m)	< 1
Senna glutinosa subsp. *pruinosa*	Shrub (0.5-1 m)	1 – 4
Acacia ancistrocarpa	Shrub (<0.5 m)	< 1
Acacia ptychophylla	Shrub (<0.5 m)	5 – 9
Dampiera candicans	Shrub (<0.5 m)	< 1
Hibiscus sturtii	Shrub (<0.5 m)	< 1
Pluchea ferdinandi-muelleri	Shrub (<0.5 m)	< 1
Ptilotus incanus	Shrub (<0.5 m)	< 1
Sida sp. Pilbara (A.A. Mitchell PRP 1543)	Shrub (<0.5 m)	< 1
Nicotiana benthamiana	Herb (0.5-1 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Cucumis variabilis	Herb (<0.5 m)	< 1
Euphorbia careyi	Herb (<0.5 m)	1 – 4
Gomphrena cunninghamii	Herb (<0.5 m)	< 1
Goodenia cusackiana	Herb (<0.5 m)	< 1
Goodenia stobbsiana	Herb (<0.5 m)	< 1
Hibiscus coatesii	Herb (<0.5 m)	< 1
Ptilotus calostachyus	Herb (<0.5 m)	< 1
Tephrosia ?sp. NW Eremaean (S. van Leeuwen et al. PBS 0356)	Herb (<0.5 m)	< 1
Cenchrus ciliaris	Tussock Grass (0.5-1 m)	< 1
Cymbopogon ambiguus	Tussock Grass (0.5-1 m)	< 1
Eriachne mucronata	Tussock Grass (<0.5 m)	1 – 4
Triodia epactia	Hummock Grass (0.5-1 m)	33 – 49

BD_E_154

Date	16/09/2023	**Site type**	Flora: Quadrat	**Botanist**	SN/AC
Location	-22.1357, 119.92716				
Landform	Ridge	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Sandy loam		
Rock type	Ironstone	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Shrub (>2 m)	1 – 4
Indigofera monophylla	Shrub (0.5-1 m)	1 – 4
Afrohybanthus aurantiacus	Shrub (<0.5 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Indigofera trita subsp. *trita*	Shrub (<0.5 m)	< 1
Cucumis variabilis	Herb (<0.5 m)	< 1
Euphorbia australis var. *subtomentosa*	Herb (<0.5 m)	< 1
Euphorbia careyi	Herb (<0.5 m)	< 1
Gomphrena cunninghamii	Herb (<0.5 m)	1 – 4
Pentalepis trichodesmoides subsp. *trichodesmoides*	Herb (<0.5 m)	< 1
Solanum horridum	Herb (<0.5 m)	< 1
Swainsona stenodonta	Herb (<0.5 m)	< 1
Trigastrotheca molluginea	Herb (<0.5 m)	< 1
Aristida contorta	Tussock Grass (<0.5 m)	< 1
Enneapogon polyphyllus	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	33 – 49

BD_E_155

Date	14/09/2023	**Site type**	Flora: Quadrat	**Botanist**	LE
Location	-22.13947, 119.80282				
Landform	Low hill	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Moderate (2 – 3 yrs)				



Name	Stratum	Percent cover (%)
Hakea lorea subsp. *lorea*	Shrub (>2 m)	< 1
Acacia inaequilatera	Shrub (1-2 m)	1 – 4
Senna glutinosa subsp. *glutinosa*	Shrub (0.5-1 m)	< 1
Corchorus incanus	Shrub (<0.5 m)	< 1
Pluchea tetranthera	Shrub (<0.5 m)	< 1
Sida ?echinocarpa	Shrub (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	10 – 24

BD_E_156

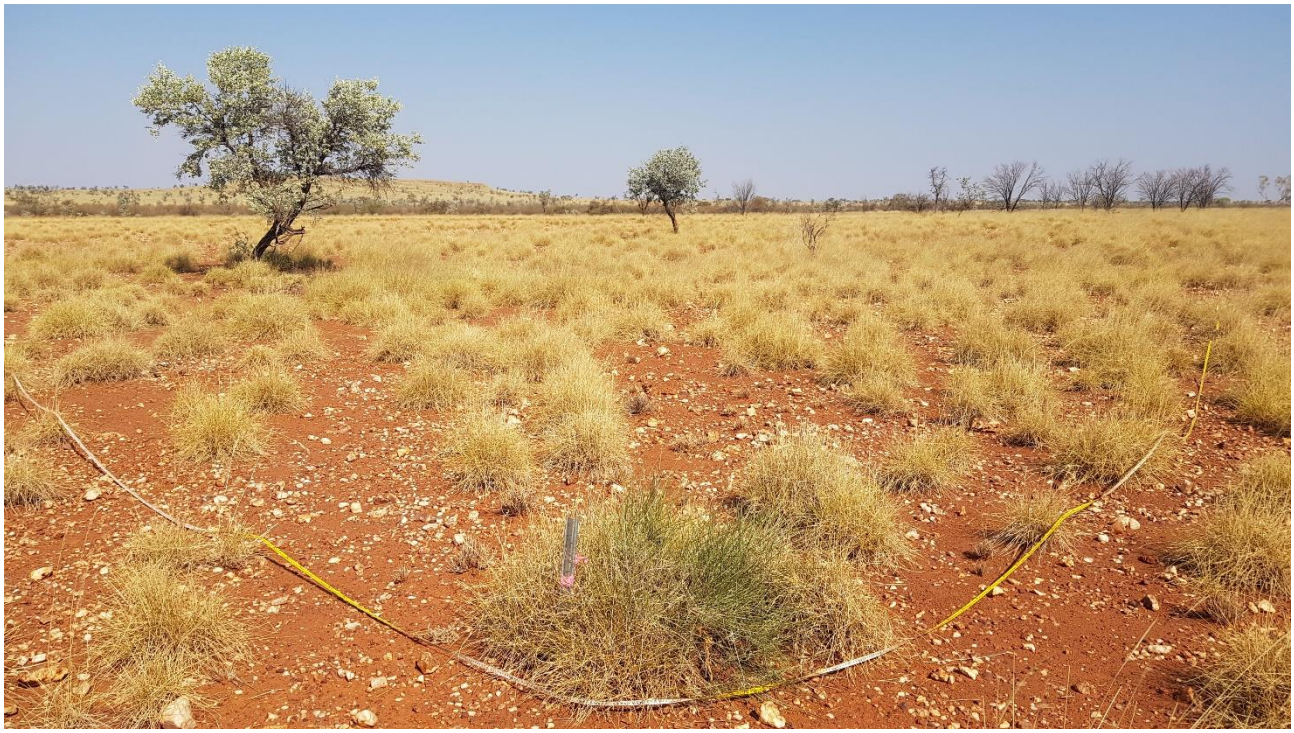
Date	15/09/2023	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-22.13961, 119.87471				
Landform	Hill	**Slope**	Gentle		
Soil colour	Light brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Senna glutinosa subsp. ×*luerssenii*	Shrub (1-2 m)	< 1
Acacia bivenosa	Shrub (0.5-1 m)	1 – 4
Senna ?stricta	Shrub (0.5-1 m)	< 1
Dampiera candicans	Shrub (<0.5 m)	1 – 4
Dodonaea coriacea	Shrub (<0.5 m)	< 1
Senna symonii	Shrub (<0.5 m)	< 1
Goodenia cusackiana	Herb (<0.5 m)	1 – 4
Goodenia stobbsiana	Herb (<0.5 m)	1 – 4
Ptilotus calostachyus	Herb (<0.5 m)	< 1
Trianthema glossostigmum	Herb (<0.5 m)	< 1
Amphipogon sericeus	Tussock Grass (0.5-1 m)	10 – 24
Eriachne lanata	Tussock Grass (<0.5 m)	10 – 24
Triodia brizoides	Hummock Grass (<0.5 m)	1 – 4
Triodia epactia	Hummock Grass (<0.5 m)	10 – 24

BD_E_157

Date	16/09/2023	**Site type**	Flora: Quadrat	**Botanist**	SN/AC
Location	-22.13145, 119.92203				
Landform	Undulating plain	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Quartz	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	30 – 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Shrub (>2 m)	1 – 4
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Hakea lorea subsp. *lorea*	Shrub (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Calocephalus knappii	Herb (<0.5 m)	< 1
Euphorbia australis var. *subtomentosa*	Herb (<0.5 m)	< 1
Ptilotus aervoides	Herb (<0.5 m)	< 1
Sclerolaena costata	Herb (<0.5 m)	< 1
Solanum horridum	Herb (<0.5 m)	< 1
Aristida contorta	Tussock Grass (<0.5 m)	1 – 4
Enneapogon caerulescens	Tussock Grass (<0.5 m)	< 1
Enneapogon polyphyllus	Tussock Grass (<0.5 m)	< 1
Sporobolus australasicus	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	25 – 32

BD_E_158

Date	14/09/2023	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-22.14101, 119.818				
Landform	Plain	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone, quartz	**Rock size**	Mixed	**Rock cover**	10 – 30%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Acacia synchronicia	Shrub (0.5-1 m)	1 – 4
Eremophila longifolia	Shrub (0.5-1 m)	< 1
Senna ?stricta	Shrub (0.5-1 m)	1 – 4
Hibiscus sturtii var. *campylochlamys*	Shrub (<0.5 m)	< 1
Sida ?trichopoda	Shrub (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	< 1
Salsola australis	Herb (<0.5 m)	< 1
Sclerolaena costata	Herb (<0.5 m)	< 1
Solanum horridum	Herb (<0.5 m)	< 1
Triodia longiceps	Hummock Grass (0.5-1 m)	25 – 32
Triodia brizoides	Hummock Grass (<0.5 m)	33 – 49

BD_E_159

Date	14/09/2023	**Site type**	Flora: Quadrat	**Botanist**	SN/AC
Location	-22.14594, 119.80938				
Landform	Undulating plain	**Slope**	NA		
Soil colour	Light brown	**Soil texture**	Clay loam		
Rock type	Calcrete, quartz	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	1 – 4
Acacia inaequilatera	Shrub (1-2 m)	1 – 4
Capparis umbonata	Shrub (1-2 m)	< 1
Senna ?stricta	Shrub (1-2 m)	1 – 4
Senna glutinosa subsp. ×*luerssenii*	Shrub (1-2 m)	< 1
Acacia bivenosa	Shrub (0.5-1 m)	< 1
Senna symonii	Shrub (0.5-1 m)	1 – 4
Corchorus ?incanus	Shrub (<0.5 m)	1 – 4
Euploca chrysocarpa	Shrub (<0.5 m)	1 – 4
Hibiscus sturtii	Shrub (<0.5 m)	< 1
Pluchea ferdinandi-muelleri	Shrub (<0.5 m)	< 1
Senna artemisioides subsp. *oligophylla*	Shrub (<0.5 m)	1 – 4
Abutilon ?lepidum	Herb (<0.5 m)	< 1
Scaevola amblyanthera var. *centralis*	Herb (<0.5 m)	< 1
Eragrostis desertorum	Tussock Grass (<0.5 m)	10 – 24
Sporobolus australasicus	Tussock Grass (<0.5 m)	< 1
Triodia brizoides	Hummock Grass (<0.5 m)	1 – 4

BD_E_160

Date	14/09/2023	**Site type**	Flora: Quadrat	**Botanist**	SN/AC
Location	-22.14718, 119.8136				
Landform	Major creek (5-30 m)	**Slope**	NA		
Soil colour	Brown	**Soil texture**	Sandy clay loam		
Rock type	Mixed river alluvium	**Rock size**	Mixed	**Rock cover**	10 – 30%
Vegetation condition	Degraded	**Disturbance**	High weed cover and heavy grazing.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia coriacea subsp. *pendens*	Tree (<10 m)	10 – 24
Corymbia hamersleyana	Tree (<10 m)	5 – 9
Eucalyptus victrix	Tree (<10 m)	1 – 4
Acacia eriopoda	Shrub (>2 m)	1 – 4
Atalaya hemiglauca	Shrub (>2 m)	5 – 9
Gossypium robinsonii	Shrub (>2 m)	1 – 4
Acacia ancistrocarpa	Shrub (1-2 m)	1 – 4
Acacia pyrifolia	Shrub (1-2 m)	1 – 4
Acacia synchronicia	Shrub (1-2 m)	1 – 4
Androcalva luteiflora	Shrub (1-2 m)	1 – 4
Capparis lasiantha	Shrub (0.5-1 m)	< 1
Corchorus incanus	Shrub (<0.5 m)	< 1
Gossypium australe	Shrub (<0.5 m)	1 – 4
Indigofera monophylla	Shrub (<0.5 m)	< 1
Jasminum didymum subsp. *lineare*	Shrub (<0.5 m)	< 1
Sida ?trichopoda	Shrub (<0.5 m)	< 1
Solanum phlomoides	Shrub (<0.5 m)	< 1
Tephrosia rosea var. *clementii*	Shrub (<0.5 m)	< 1
Vachellia farnesiana	Shrub (<0.5 m)	< 1
Cyperus vaginatus	Sedge (<0.5 m)	1 – 4
Sida rohlenae subsp. *rohlenae*	Herb (0.5-1 m)	1 – 4
Alternanthera nana	Herb (<0.5 m)	< 1
Bonamia pannosa	Herb (<0.5 m)	< 1
Cheilanthes sieberi subsp. *sieberi*	Herb (<0.5 m)	< 1
Cucumis variabilis	Herb (<0.5 m)	< 1
Euphorbia australis var. *subtomentosa*	Herb (<0.5 m)	< 1
Euphorbia biconvexa	Herb (<0.5 m)	< 1
Evolvulus alsinoides var. *decumbens*	Herb (<0.5 m)	< 1
Glycine canescens	Herb (<0.5 m)	< 1
Goodenia ?tenuiloba	Herb (<0.5 m)	< 1
Malvastrum americanum	Herb (<0.5 m)	< 1

Name	Stratum	Percent cover (%)
Nellica maderaspatensis	Herb (<0.5 m)	< 1
Notoleptopus decaisnei	Herb (<0.5 m)	< 1
Senna notabilis	Herb (<0.5 m)	< 1
Cenchrus ciliaris	Tussock Grass (<0.5 m)	33 – 49
Cenchrus setiger	Tussock Grass (<0.5 m)	33 – 49
Dichanthium sericeum	Tussock Grass (<0.5 m)	1 – 4
Eragrostis exigua	Tussock Grass (<0.5 m)	1 – 4
Eragrostis leptocarpa	Tussock Grass (<0.5 m)	< 1
Themeda triandra	Tussock Grass (<0.5 m)	1 – 4
Triodia longiceps	Hummock Grass (1-2 m)	5 – 9

BD_E_161

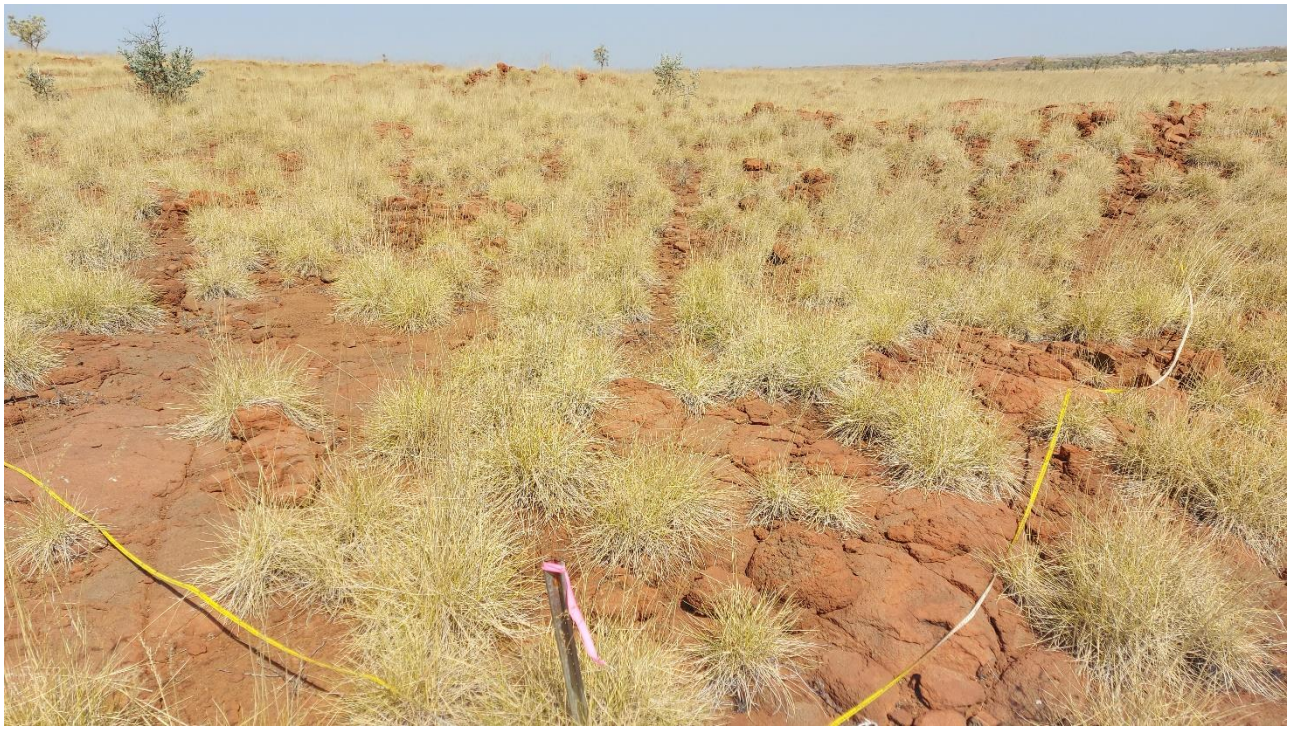
Date	14/09/2023	**Site type**	Flora: Quadrat	**Botanist**	AC
Location	-22.15061, 119.86372				
Landform	Low hill	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Moderate (2 – 3 yrs)				



Name	Stratum	Percent cover (%)
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	< 1
Dodonaea coriacea	Shrub (0.5-1 m)	< 1
Acacia ptychophylla	Shrub (<0.5 m)	1 – 4
Dampiera candicans	Shrub (<0.5 m)	5 – 9
Senna symonii	Shrub (<0.5 m)	< 1
Seringia ?exastia	Shrub (<0.5 m)	< 1
Ptilotus calostachyus	Herb (0.5-1 m)	< 1
Goodenia cusackiana	Herb (<0.5 m)	< 1
Goodenia stobbsiana	Herb (<0.5 m)	1 – 4
Trigastrotheca molluginea	Herb (<0.5 m)	< 1
Amphipogon sericeus	Tussock Grass (<0.5 m)	5 – 9
Eriachne lanata	Tussock Grass (<0.5 m)	5 – 9
Eriachne mucronata	Tussock Grass (<0.5 m)	< 1
Paraneurachne muelleri	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (0.5-1 m)	33 – 49

BD_E_162

Date	16/09/2023	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-22.14965, 119.93249				
Landform	Low hill	**Slope**	Gentle		
Soil colour	Brown	**Soil texture**	Sandy loam		
Rock type	Ironstone	**Rock size**	Rocky with outcroppings	**Rock cover**	30 – 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Shrub (>2 m)	1 – 4
Grevillea pyramidalis subsp. *leucadendron*	Shrub (>2 m)	1 – 4
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	33 – 49

BD_E_163

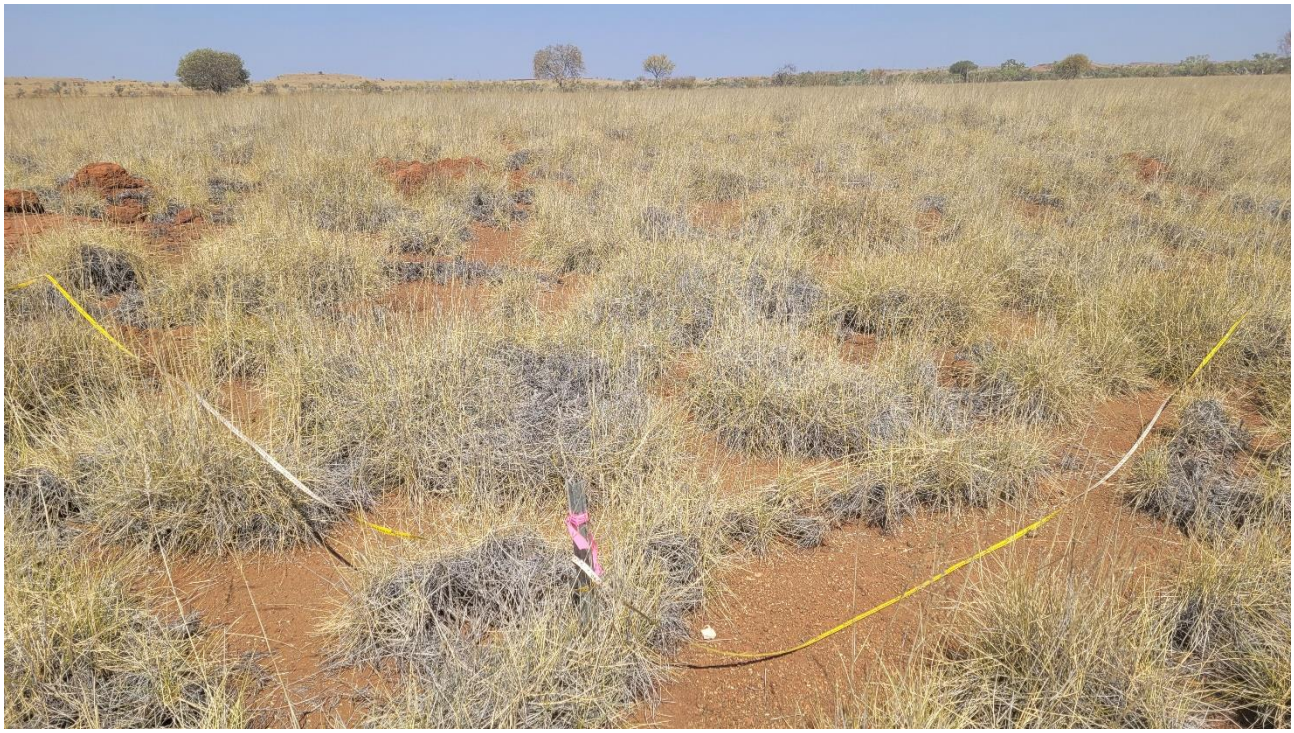
Date	14/09/2023	**Site type**	Flora: Releve	**Botanist**	SN
Location	-22.15115, 119.86725				
Landform	Minor creek (< 5 m)	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Basalt	**Rock size**	Mixed	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	5 – 9
Acacia eriopoda	Shrub (>2 m)	< 1
Acacia ptychophylla	Shrub (1-2 m)	10 – 24
Acacia pyrifolia	Shrub (1-2 m)	< 1
Acacia tenuissima	Shrub (1-2 m)	10 – 24
Acacia tetragonophylla	Shrub (1-2 m)	< 1
Capparis umbonata	Shrub (1-2 m)	1 – 4
Senna symonii	Shrub (1-2 m)	5 – 9
Acacia ancistrocarpa	Shrub (0.5-1 m)	1 – 4
Acacia bivenosa	Shrub (0.5-1 m)	< 1
Dodonaea coriacea	Shrub (0.5-1 m)	< 1
Afrohybanthus aurantiacus	Shrub (<0.5 m)	< 1
Corchorus incanus	Shrub (<0.5 m)	< 1
Senna glutinosa subsp. *pruinosa*	Shrub (<0.5 m)	< 1
Solanum phlomoides	Shrub (<0.5 m)	< 1
Tephrosia rosea var. *clementii*	Shrub (<0.5 m)	< 1
Cassytha ?capillaris	Herb (0.5-1 m)	1 – 4
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Euphorbia biconvexa	Herb (<0.5 m)	< 1
Goodenia cusackiana	Herb (<0.5 m)	1 – 4
Sida rohlenae subsp. *rohlenae*	Herb (<0.5 m)	< 1
Solanum horridum	Herb (<0.5 m)	< 1
Cymbopogon ambiguus	Tussock Grass (<0.5 m)	< 1
Cymbopogon obtectus	Tussock Grass (<0.5 m)	< 1
Eriachne lanata	Tussock Grass (<0.5 m)	< 1
Eriachne mucronata	Tussock Grass (<0.5 m)	1 – 4
Themeda triandra	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (0.5-1 m)	10 – 24
Triodia brizoides	Hummock Grass (<0.5 m)	1 – 4
Triodia longiceps	Hummock Grass (<0.5 m)	< 1

BD_E_164

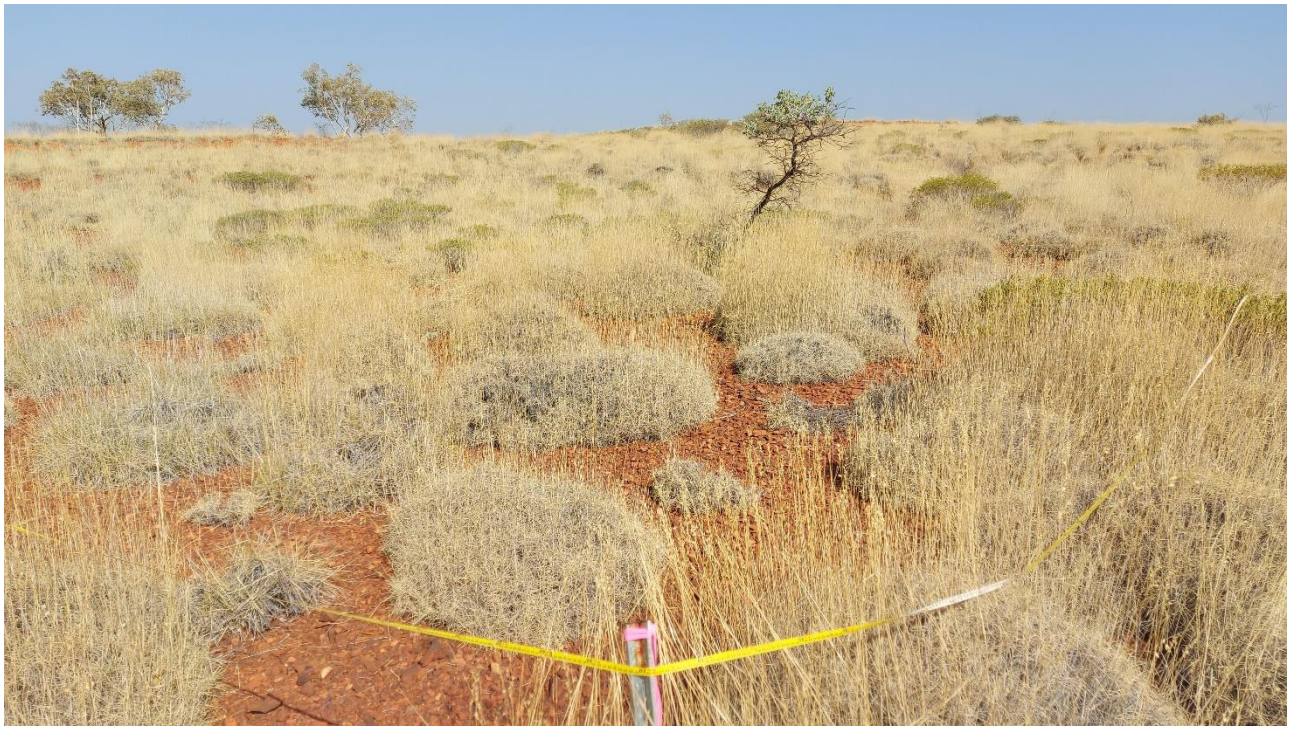
Date	16/09/2023	**Site type**	Flora: Quadrat	**Botanist**	LE
Location	-22.1562, 119.9293				
Landform	Undulating plain	**Slope**	NA		
Soil colour	Brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Isolated outcroppings	**Rock cover**	30 – 70%
Vegetation condition	Excellent	**Disturbance**	Minor weed cover and grazing.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia coriacea subsp. *pendens*	Tree (<10 m)	< 1
Vachellia farnesiana	Shrub (1-2 m)	Assoc.
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Pluchea tetranthera	Shrub (<0.5 m)	1 – 4
Rhynchosia minima	Herb (<0.5 m)	< 1
Stemodia grossa	Herb (<0.5 m)	< 1
Cymbopogon ambiguus	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	25 – 32

BD_E_165

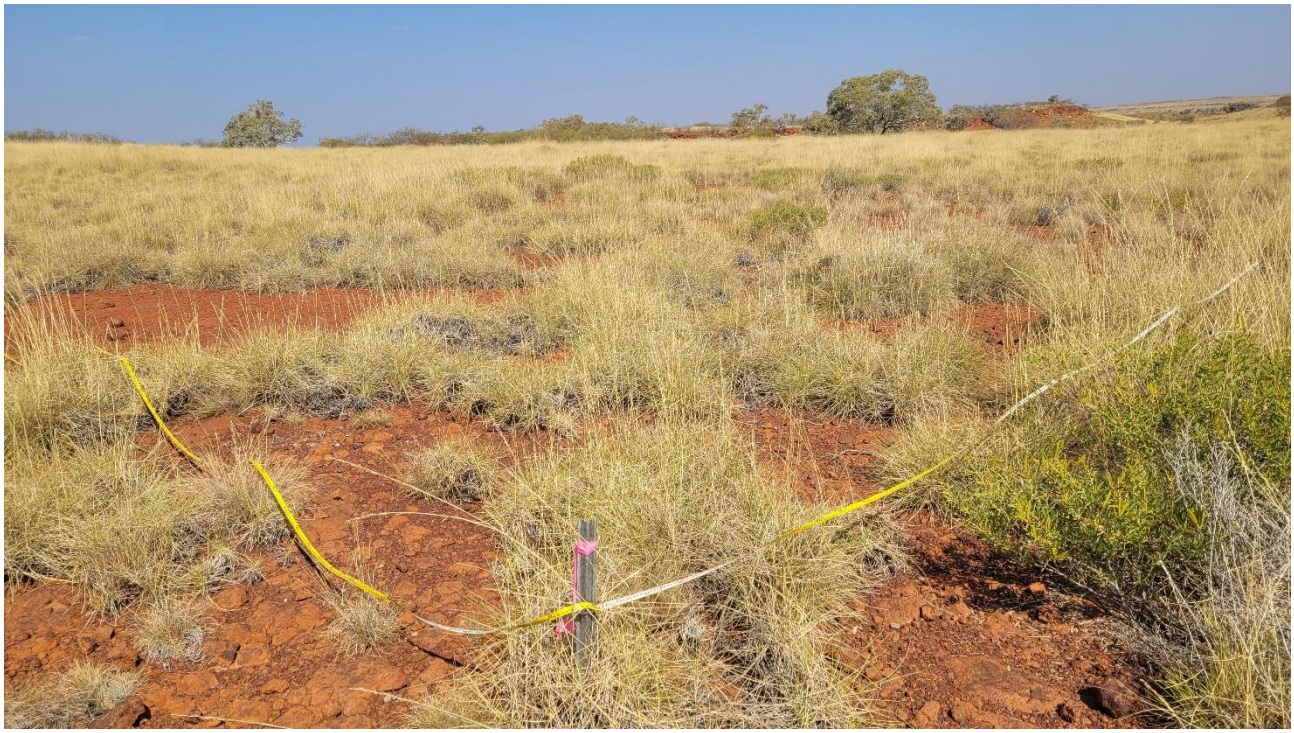
Date	14/09/2023	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-22.15826, 119.84167				
Landform	Undulating plain	**Slope**	Moderate		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	5 – 9
Acacia inaequilatera	Shrub (>2 m)	1 – 4
Acacia bivenosa	Shrub (1-2 m)	1 – 4
Senna glutinosa subsp. ×*luerssenii*	Shrub (1-2 m)	1 – 4
Senna symonii	Shrub (1-2 m)	< 1
Acacia ancistrocarpa	Shrub (0.5-1 m)	< 1
Acacia ptychophylla	Shrub (<0.5 m)	10 – 24
Pluchea tetranthera	Shrub (<0.5 m)	< 1
Senna sericea	Shrub (<0.5 m)	< 1
Goodenia cusackiana	Herb (<0.5 m)	< 1
Ptilotus calostachyus	Herb (<0.5 m)	< 1
Eriachne lanata	Tussock Grass (<0.5 m)	1 – 4
Triodia longiceps	Hummock Grass (0.5-1 m)	5 – 9
Triodia wiseana	Hummock Grass (0.5-1 m)	33 – 49

BD_E_166

Date	14/09/2023	**Site type**	Flora: Quadrat	**Botanist**	LE
Location	-22.16099, 119.83558				
Landform	Low hill	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Grevillea wickhamii	Shrub (>2 m)	Assoc.
Acacia ancistrocarpa	Shrub (1-2 m)	1 – 4
Acacia ptychophylla	Shrub (0.5-1 m)	1 – 4
Dampiera candicans	Shrub (<0.5 m)	< 1
Goodenia stobbsiana	Herb (<0.5 m)	< 1
Ptilotus exaltatus	Herb (<0.5 m)	< 1
Amphipogon sericeus	Tussock Grass (<0.5 m)	< 1
Eriachne lanata	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (0.5-1 m)	10 – 24

BD_E_167

Date	15/09/2023	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-22.15881, 119.94532				
Landform	Low hill	**Slope**	Moderate		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	1 – 4
Acacia inaequilatera	Shrub (>2 m)	1 – 4
Acacia pruinocarpa	Shrub (>2 m)	1 – 4
Hakea lorea subsp. *lorea*	Shrub (>2 m)	Assoc.
Senna ?stricta	Shrub (1-2 m)	1 – 4
Senna glutinosa subsp. ×*luerssenii*	Shrub (1-2 m)	1 – 4
Senna symonii	Shrub (1-2 m)	< 1
Acacia bivenosa	Shrub (0.5-1 m)	< 1
Acacia tetragonophylla	Shrub (0.5-1 m)	< 1
Indigofera monophylla	Shrub (<0.5 m)	1 – 4
Sida sp. Pilbara (A.A. Mitchell PRP 1543)	Shrub (<0.5 m)	< 1
Ptilotus calostachyus	Herb (<0.5 m)	< 1
Amphipogon sericeus	Tussock Grass (<0.5 m)	1 – 4
Triodia epactia	Hummock Grass (<0.5 m)	25 – 32

BD_E_168

Date	15/09/2023	**Site type**	Flora: Quadrat	**Botanist**	LE
Location	-22.16601, 119.94805				
Landform	Undulating plain	**Slope**	NA		
Soil colour	Light brown	**Soil texture**	Clay loam		
Rock type	Calcrete	**Rock size**	Fine gravel/pebbles	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	Minor weed cover and grazing.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	10 – 24
Acacia inaequilatera	Shrub (1-2 m)	5 – 9
Acacia pyrifolia	Shrub (1-2 m)	1 – 4
Acacia synchronicia	Shrub (0.5-1 m)	< 1
Anthobolus leptomerioides	Shrub (0.5-1 m)	< 1
Acacia sclerosperma subsp. *sclerosperma*	Shrub (<0.5 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Euploca chrysocarpa	Shrub (<0.5 m)	< 1
Pluchea ferdinandi-muelleri	Shrub (<0.5 m)	< 1
Pluchea tetranthera	Shrub (<0.5 m)	< 1
Sida echinocarpa	Shrub (<0.5 m)	< 1
Solanum lasiophyllum/phlomoides	Shrub (<0.5 m)	< 1
Evolvulus alsinoides var. *villosicalyx*	Herb (<0.5 m)	< 1
Cenchrus ciliaris	Tussock Grass (<0.5 m)	< 1
Enneapogon caerulescens	Tussock Grass (<0.5 m)	< 1
Eragrostis desertorum	Tussock Grass (<0.5 m)	< 1
Triodia brizoides	Hummock Grass (<0.5 m)	10 – 24
Triodia longiceps	Hummock Grass (<0.5 m)	1 – 4

BD_E_169

Date	19/09/2023	**Site type**	Flora: Quadrat	**Botanist**	SN/AC
Location	-21.93308, 119.93784				
Landform	Plain	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone, quartz	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia ancistrocarpa	Shrub (>2 m)	Assoc.
Acacia tetragonophylla	Shrub (>2 m)	1 – 4
Hakea lorea subsp. *lorea*	Shrub (>2 m)	1 – 4
Eremophila latrobei ?subsp. *glabra*	Shrub (0.5-1 m)	< 1
Senna artemisioides subsp. *helmsii*	Shrub (0.5-1 m)	1 – 4
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Indigofera monophylla	Shrub (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Evolvulus alsinoides var. *villosicalyx*	Herb (<0.5 m)	< 1
Salsola australis	Herb (<0.5 m)	< 1
Sclerolaena cornishiana	Herb (<0.5 m)	< 1
Solanum horridum	Herb (<0.5 m)	< 1
Aristida contorta	Tussock Grass (<0.5 m)	5 – 9
Chrysopogon fallax	Tussock Grass (<0.5 m)	< 1
Cymbopogon ambiguus	Tussock Grass (<0.5 m)	< 1
Enneapogon polyphyllus	Tussock Grass (<0.5 m)	< 1
Eriachne mucronata	Tussock Grass (<0.5 m)	< 1
Eriachne pulchella subsp. *pulchella*	Tussock Grass (<0.5 m)	< 1
Sporobolus australasicus	Tussock Grass (<0.5 m)	< 1
Tripogonella loliiformis	Tussock Grass (<0.5 m)	1 – 4
Triodia longiceps	Hummock Grass (0.5-1 m)	< 1
Triodia brizoides	Hummock Grass (<0.5 m)	1 – 4
Triodia epactia	Hummock Grass (<0.5 m)	25 – 32

BD_E_170

Date	20/09/2023	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-22.04436, 119.94784				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay		
Rock type	Ironstone	**Rock size**	Boulders [> 260 mm]	**Rock cover**	30 – 70%
Vegetation condition	Very Good	**Disturbance**	Minor weed cover and grazing.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Vachellia farnesiana	Shrub (1-2 m)	5 – 9
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Euploca tanythrix	Shrub (<0.5 m)	1 – 4
Indigofera trita subsp. *trita*	Shrub (<0.5 m)	1 – 4
Sida trichopoda	Shrub (<0.5 m)	1 – 4
Alysicarpus muelleri	Herb (<0.5 m)	< 1
Arivela viscosa	Herb (<0.5 m)	1 – 4
Crotalaria medicaginea var. *neglecta*	Herb (<0.5 m)	< 1
Dolichocarpa crouchiana	Herb (<0.5 m)	< 1
Grona muelleri	Herb (<0.5 m)	1 – 4
Nellica maderaspatensis	Herb (<0.5 m)	< 1
Operculina aequisepala	Herb (<0.5 m)	< 1
Ptilotus gomphrenoides	Herb (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	< 1
Senna notabilis	Herb (<0.5 m)	< 1
Sida spinosa	Herb (<0.5 m)	< 1
Solanum horridum	Herb (<0.5 m)	< 1
Streptoglossa bubakii	Herb (<0.5 m)	1 – 4
Aristida contorta	Tussock Grass (<0.5 m)	10 – 24
Aristida latifolia	Tussock Grass (<0.5 m)	10 – 24
Cynodon convergens	Tussock Grass (<0.5 m)	10 – 24
Eriachne mucronata	Tussock Grass (<0.5 m)	5 – 9
Iseilema vaginiflorum	Tussock Grass (<0.5 m)	5 – 9
Panicum decompositum	Tussock Grass (<0.5 m)	5 – 9
Triodia epactia	Hummock Grass (<0.5 m)	1 – 4

BD_E_171

Date	20/09/2023	**Site type**	Flora: Quadrat	**Botanist**	LE
Location	-22.05398, 119.9472				
Landform	Undulating plain	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Clay		
Rock type	Ironstone	**Rock size**	Boulders [> 260 mm]	**Rock cover**	30 – 70%
Vegetation condition	Very Good	**Disturbance**	Minor weed cover and grazing.		
Time since fire	Long (> 3 yrs)				

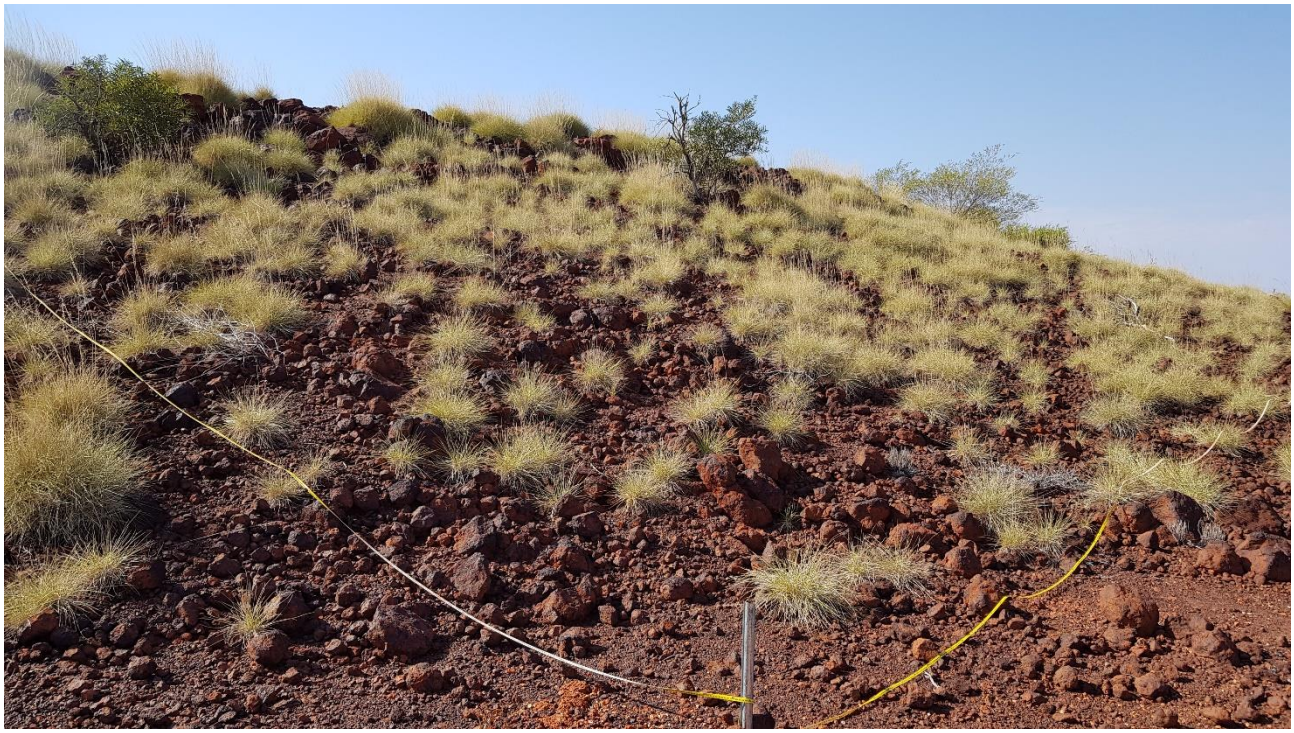


Name	Stratum	Percent cover (%)
Vachellia farnesiana	Shrub (1-2 m)	1 – 4
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Euploca tanythrix	Shrub (<0.5 m)	< 1
Senna ?hamersleyensis	Shrub (<0.5 m)	< 1
Abutilon malvifolium	Herb (<0.5 m)	< 1
Alysicarpus muelleri	Herb (<0.5 m)	< 1
Arivela viscosa	Herb (<0.5 m)	< 1
Boerhavia ?coccinea	Herb (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Crotalaria medicaginea var. *neglecta*	Herb (<0.5 m)	< 1
Dolichocarpa crouchiana	Herb (<0.5 m)	< 1
Goodenia ?muelleriana	Herb (<0.5 m)	< 1
Heliotropium crispatum	Herb (<0.5 m)	< 1
Hibiscus brachysiphonius	Herb (<0.5 m)	< 1
Hibiscus burtonii	Herb (<0.5 m)	1 – 4
Indigofera colutea	Herb (<0.5 m)	< 1
Indigofera linifolia	Herb (<0.5 m)	< 1
Malvastrum americanum	Herb (<0.5 m)	< 1
Nellica maderaspatensis	Herb (<0.5 m)	< 1
Operculina aequisepala	Herb (<0.5 m)	< 1
Ptilotus aervoides	Herb (<0.5 m)	1 – 4
Ptilotus gomphrenoides	Herb (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	< 1
Sida spinosa	Herb (<0.5 m)	< 1
Solanum horridum	Herb (<0.5 m)	< 1
Streptoglossa bubakii	Herb (<0.5 m)	1 – 4
Streptoglossa odora	Herb (<0.5 m)	< 1
Tephrosia sp. clay soils (S. van Leeuwen et al. PBS 0273)	Herb (<0.5 m)	< 1
Aristida ?inaequiglumis	Tussock Grass (0.5-1 m)	1 – 4
Aristida contorta	Tussock Grass (<0.5 m)	10 – 24
Chloris pectinata	Tussock Grass (<0.5 m)	1 – 4

Name	Stratum	Percent cover (%)
Dichanthium sericeum subsp. *humilius*	Tussock Grass (<0.5 m)	< 1
Iseilema vaginiflorum	Tussock Grass (<0.5 m)	< 1
Panicum decompositum	Tussock Grass (<0.5 m)	< 1
Triodia brizoides	Hummock Grass (<0.5 m)	1 – 4
Triodia epactia	Hummock Grass (<0.5 m)	5 – 9

BD_E_172

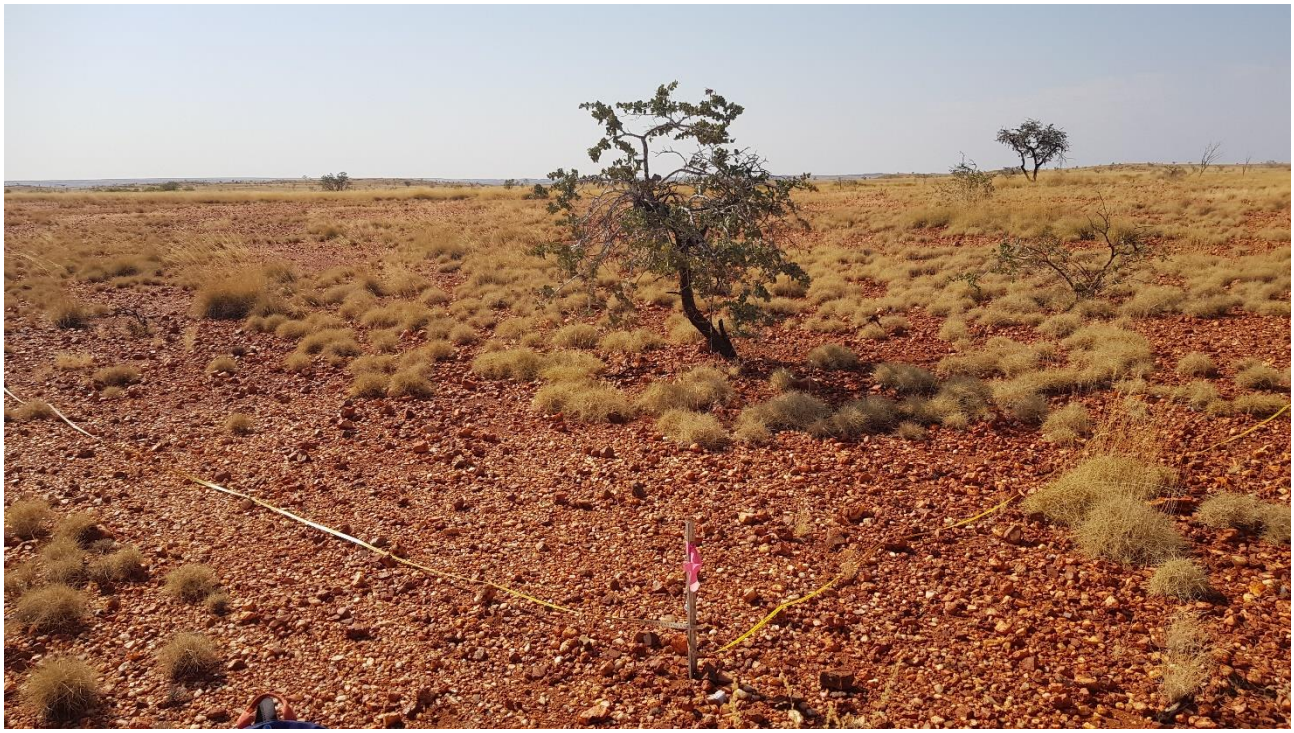
Date	20/09/2023	**Site type**	Flora: Quadrat	**Botanist**	AC
Location	-22.07009, 119.9439				
Landform	Ridge	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	Assoc.
Acacia monticola	Shrub (1-2 m)	1 – 4
Acacia pruinocarpa	Shrub (1-2 m)	1 – 4
Seringia ?exastia	Shrub (0.5-1 m)	< 1
Acacia ptychophylla	Shrub (<0.5 m)	1 – 4
Dampiera candicans	Shrub (<0.5 m)	< 1
Tribulus suberosus	Shrub (<0.5 m)	< 1
Goodenia stobbsiana	Herb (<0.5 m)	< 1
Ptilotus calostachyus	Herb (<0.5 m)	< 1
Ptilotus clementii	Herb (<0.5 m)	< 1
Solanum horridum	Herb (<0.5 m)	< 1
Amphipogon sericeus	Tussock Grass (<0.5 m)	< 1
Aristida contorta	Tussock Grass (<0.5 m)	< 1
Eriachne lanata	Tussock Grass (<0.5 m)	1 – 4
Eriachne mucronata	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	25 – 32

BD_E_173

Date	20/09/2023	**Site type**	Flora: Quadrat	**Botanist**	SN
Location	-22.0819, 119.93783				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Quartz	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	Assoc.
Acacia inaequilatera	Shrub (>2 m)	1 – 4
Acacia bivenosa	Shrub (<0.5 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Indigofera monophylla	Shrub (<0.5 m)	< 1
Senna ?stricta	Shrub (<0.5 m)	< 1
Tribulus suberosus	Shrub (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Ptilotus calostachyus	Herb (<0.5 m)	Assoc.
Enneapogon caerulescens	Tussock Grass (<0.5 m)	< 1
Enneapogon polyphyllus	Tussock Grass (<0.5 m)	5 – 9
Eriachne mucronata	Tussock Grass (<0.5 m)	1 – 4
Sporobolus australasicus	Tussock Grass (<0.5 m)	< 1
Triodia brizoides	Hummock Grass (<0.5 m)	10 – 24
Triodia epactia	Hummock Grass (<0.5 m)	5 – 9

BD_E_174

Date	10/03/2024	**Site type**	Flora: Releve	**Botanist**	BN
Location	-21.8918, 119.7722				
Landform	Crest/hill top	**Slope**	NA		
Soil colour	Red	**Soil texture**	Clay		
Rock type	Ironstone	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	< 1
Acacia monticola	Shrub (1-2 m)	5 – 9
Eriachne mucronata	Tussock Grass (<0.5 m)	5 – 9
Triodia epactia	Hummock Grass (0.5-1 m)	33 – 49

BD_E_175

Date	10/03/2024	**Site type**	Flora: Quadrat	**Botanist**	SN/AC
Location	-21.88916, 119.78493				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Light brown	**Soil texture**	Clay loam		
Rock type	Calcrete	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	Minor weed cover and grazing.		
Time since fire	Very recent (< 1 yr)				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	Assoc.
Acacia inaequilatera	Shrub (>2 m)	< 1
Acacia bivenosa	Shrub (1-2 m)	< 1
Acacia orthocarpa	Shrub (0.5-1 m)	< 1
Pluchea ferdinandi-muelleri	Shrub (0.5-1 m)	1 – 4
Senna glutinosa subsp. *glutinosa*	Shrub (0.5-1 m)	< 1
Abutilon ?sp. Dioicum (A.A. Mitchell PRP 1618)	Shrub (<0.5 m)	1 – 4
Capparis spinosa subsp. *nummularia*	Shrub (<0.5 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Euploca cunninghamii	Shrub (<0.5 m)	< 1
Indigofera monophylla	Shrub (<0.5 m)	< 1
Senna glutinosa subsp. ×*luerssenii*	Shrub (<0.5 m)	< 1
Senna notabilis	Shrub (<0.5 m)	< 1
Senna symonii	Shrub (<0.5 m)	< 1
Sida echinocarpa	Shrub (<0.5 m)	< 1
Sida sp. Pilbara (A.A. Mitchell PRP 1543)	Shrub (<0.5 m)	< 1
Solanum lasiophyllum/phlomoides	Shrub (<0.5 m)	< 1
Tephrosia sp. clay soils (S. van Leeuwen et al. PBS 0273)	Shrub (<0.5 m)	< 1
Tribulus suberosus	Shrub (<0.5 m)	< 1
Solanum diversiflorum	Herb (0.5-1 m)	1 – 4
Tribulus ?*hirsutus*	Herb (0.5-1 m)	< 1
Afrohybanthus aurantiacus	Herb (<0.5 m)	< 1
Boerhavia ?*coccinea*	Herb (<0.5 m)	1 – 4
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Dolichocarpa crouchiana	Herb (<0.5 m)	< 1
Euphorbia ?*australis* var. *subtomentosa*	Herb (<0.5 m)	< 1
Hibiscus sp.	Herb (<0.5 m)	< 1
Polymeria ambigua	Herb (<0.5 m)	< 1
Sida ?*fibulifera*	Herb (<0.5 m)	< 1
Sida rohlenae subsp. *rohlenae*	Herb (<0.5 m)	< 1

Name	Stratum	Percent cover (%)
Solanum cleistogamum/horridum	Herb (<0.5 m)	< 1
Solanum horridum	Herb (<0.5 m)	< 1
Cenchrus ciliaris	Tussock Grass (<0.5 m)	< 1
Triodia wiseana	Hummock Grass (<0.5 m)	10 – 24

BD_E_176

Date	10/03/2024	**Site type**	Flora: Releve	**Botanist**	SH
Location	-21.89359, 119.80419				
Landform	Ridge	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Dolerite	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Acacia maitlandii	Shrub (1-2 m)	1 – 4
Acacia pyrifolia var. *pyrifolia*	Shrub (1-2 m)	1 – 4
Grevillea wickhamii	Shrub (1-2 m)	5 – 9
Corchorus parviflorus	Shrub (0.5-1 m)	< 1
Tribulus suberosus	Shrub (0.5-1 m)	< 1
Indigofera monophylla	Shrub (<0.5 m)	< 1
Solanum horridum	Herb (<0.5 m)	< 1
Cymbopogon ambiguus	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (0.5-1 m)	10 – 24

BD_E_177

Date	10/03/2024	**Site type**	Flora: Mapping Notes	**Botanist**	BN
Location	-21.89988, 119.88354				
Landform	Gorge	**Slope**	NA		
Soil colour	Brown	**Soil texture**	Clay		
Rock type	Ironstone	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	< 1
Acacia cyperophylla var. *omearana*	Shrub (>2 m)	25 – 32
Melaleuca linophylla	Shrub (>2 m)	< 1
Dodonaea petiolaris	Shrub (1-2 m)	10 – 24
Ficus brachypoda	Shrub (1-2 m)	< 1
Flueggea virosa subsp. *melanthesoides*	Shrub (1-2 m)	< 1
Prostanthera albiflora	Shrub (1-2 m)	1 – 4
Senna glutinosa subsp. *glutinosa*	Shrub (1-2 m)	< 1
Tinospora smilacina	Shrub (<0.5 m)	< 1
Cynanchum viminale	Herb (1-2 m)	1 – 4
Arivela viscosa	Herb (<0.5 m)	< 1
Cheilanthes sieberi subsp. *sieberi*	Herb (<0.5 m)	< 1
Cucumis variabilis	Herb (<0.5 m)	< 1
Cymbopogon ambiguus	Tussock Grass (0.5-1 m)	1 – 4
Eriachne tenuiculmis	Tussock Grass (<0.5 m)	10 – 24
Triodia longiceps	Hummock Grass (0.5-1 m)	10 – 24

BD_E_178

Date	8/03/2024	**Site type**	Flora: Quadrat	**Botanist**	AC
Location	-21.90065, 119.97243				
Landform	Undulating plain	**Slope**	NA		
Soil colour	Dark brown	**Soil texture**	Clay loam		
Rock type	Calcrete, quartz, basalt	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	5 – 9
Acacia bivenosa	Shrub (1-2 m)	< 1
Capparis umbonata	Shrub (1-2 m)	< 1
Senna symonii	Shrub (1-2 m)	1 – 4
Ptilotus calostachyus	Shrub (0.5-1 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Indigofera monophylla	Shrub (<0.5 m)	< 1
Triodia longiceps	Hummock Grass (0.5-1 m)	1 – 4
Triodia wiseana	Hummock Grass (<0.5 m)	25 – 32

BD_E_179

Date	9/03/2024	**Site type**	Flora: Quadrat	**Botanist**	BN
Location	-21.9013, 119.85167				
Landform	Midslope	**Slope**	Gentle		
Soil colour	Orange	**Soil texture**	Clay loam		
Rock type	Granite	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Very recent (< 1 yr)				



Name	Stratum	Percent cover (%)
Acacia orthocarpa	Shrub (1-2 m)	5 – 9
Grevillea wickhamii	Shrub (1-2 m)	< 1
Eriachne lanata	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (0.5-1 m)	10 – 24
Triodia longiceps	Hummock Grass (0.5-1 m)	5 – 9

BD_E_180

Date	8/03/2024	**Site type**	Flora: Quadrat	**Botanist**	SN
Location	-21.90276, 120.00596				
Landform	Low hill	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Sandy clay		
Rock type	Ironstone, quartz	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Moderate (2 – 3 yrs)				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	< 1
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	1 – 4
Acacia pyrifolia	Shrub (>2 m)	1 – 4
Acacia arrecta	Shrub (1-2 m)	1 – 4
Senna glutinosa subsp. *glutinosa*	Shrub (0.5-1 m)	1 – 4
Senna glutinosa subsp. *pruinosa*	Shrub (0.5-1 m)	5 – 9
Enchylaena tomentosa var. *tomentosa*	Shrub (<0.5 m)	< 1
Indigofera monophylla	Shrub (<0.5 m)	< 1
Pluchea tetranthera	Shrub (<0.5 m)	< 1
Ptilotus calostachyus	Shrub (<0.5 m)	< 1
Sida sp. Pilbara (A.A. Mitchell PRP 1543)	Shrub (<0.5 m)	< 1
Tribulus suberosus	Shrub (<0.5 m)	< 1
Bulbostylis turbinata	Sedge (<0.5 m)	1 – 4
Goodenia stobbsiana	Herb (<0.5 m)	< 1
Portulaca cyclophylla	Herb (<0.5 m)	< 1
Salsola australis	Herb (<0.5 m)	< 1
Sida ?fibulifera	Herb (<0.5 m)	< 1
Streptoglossa sp.	Herb (<0.5 m)	< 1
Triodia brizoides	Hummock Grass (<0.5 m)	5 – 9
Triodia epactia	Hummock Grass (<0.5 m)	1 – 4
Triodia wiseana	Hummock Grass (<0.5 m)	10 – 24

BD_E_181

Date	9/03/2024	**Site type**	Flora: Quadrat	**Botanist**	BN
Location	-21.90265, 119.80827				
Landform	Crest/hill top	**Slope**	Steep		
Soil colour	Red	**Soil texture**	Clay		
Rock type	Granite	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	< 1
Acacia retivenea subsp. *clandestina*	Shrub (1-2 m)	5 – 9
Grevillea wickhamii	Shrub (1-2 m)	< 1
Eriachne mucronata	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (0.5-1 m)	10 – 24

BD_E_182

Date	9/03/2024	**Site type**	Flora: Quadrat	**Botanist**	SN
Location	-21.90275, 119.90497				
Landform	Crest/hill top	**Slope**	Steep		
Soil colour	Reddish brown	**Soil texture**	Sandy clay		
Rock type	Ironstone	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	1 – 4
Acacia ?adsurgens	Shrub (1-2 m)	< 1
Acacia maitlandii	Shrub (1-2 m)	1 – 4
Acacia orthocarpa	Shrub (1-2 m)	10 – 24
Acacia adoxa var. *adoxa*	Shrub (0.5-1 m)	1 – 4
Grevillea wickhamii	Shrub (0.5-1 m)	< 1
Portulaca cyclophylla	Herb (<0.5 m)	< 1
Paraneurachne muelleri	Tussock Grass (<0.5 m)	< 1
Triodia brizoides	Hummock Grass (0.5-1 m)	5 – 9
Triodia epactia	Hummock Grass (0.5-1 m)	25 – 32
Triodia longiceps	Hummock Grass (<0.5 m)	5 – 9

BD_E_183

Date	9/03/2024	**Site type**	Flora: Quadrat	**Botanist**	SN
Location	-21.90583, 119.83024				
Landform	Undulating plain	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Very recent (< 1 yr)				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	< 1
Acacia inaequilatera	Shrub (1-2 m)	1 – 4
Senna glutinosa subsp. ×*luerssenii*	Shrub (0.5-1 m)	1 – 4
Tribulus suberosus	Shrub (0.5-1 m)	< 1
Sida sp. Pilbara (A.A. Mitchell PRP 1543)	Shrub (<0.5 m)	< 1
Arivela viscosa	Herb (<0.5 m)	1 – 4
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Portulaca cyclophylla	Herb (<0.5 m)	< 1
Senna notabilis	Herb (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	75 – 94

BD_E_184

Date	9/03/2024	**Site type**	Flora: Quadrat	**Botanist**	AC
Location	-21.90595, 119.81167				
Landform	Hill	**Slope**	Moderate		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Granite	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	< 1
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	< 1
Acacia ?adsurgens	Shrub (1-2 m)	10 – 24
Acacia bivenosa	Shrub (1-2 m)	1 – 4
Acacia sp. (indet.)	Shrub (1-2 m)	1 – 4
Acacia arrecta	Shrub (<0.5 m)	< 1
Eriachne lanata	Tussock Grass (<0.5 m)	1 – 4
Eriachne mucronata	Tussock Grass (<0.5 m)	1 – 4
Triodia brizoides	Hummock Grass (<0.5 m)	5 – 9
Triodia epactia	Hummock Grass (<0.5 m)	5 – 9
Triodia wiseana	Hummock Grass (<0.5 m)	25 – 32

BD_E_185

Date	12/03/2024	**Site type**	Flora: Quadrat	**Botanist**	AC
Location	-22.17109, 119.80096				
Landform	Major creek (5-30 m)	**Slope**	NA		
Soil colour	Brown	**Soil texture**	Loamy sand		
Rock type	Mixed river alluvium	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Poor	**Disturbance**	High weed cover and grazing.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Eucalyptus camaldulensis	Tree (10-30 m)	5 – 9
Eucalyptus victrix	Tree (10-30 m)	5 – 9
Acacia ?adsurgens	Shrub (>2 m)	1 – 4
Acacia ancistrocarpa	Shrub (>2 m)	1 – 4
Acacia aptaneura	Shrub (>2 m)	< 1
Acacia coriacea subsp. *pendens*	Shrub (>2 m)	1 – 4
Acacia pyrifolia	Shrub (>2 m)	5 – 9
Atalaya hemiglauca	Shrub (>2 m)	1 – 4
Gossypium robinsonii	Shrub (>2 m)	1 – 4
Grevillea wickhamii	Shrub (>2 m)	1 – 4
Melaleuca ?linophylla	Shrub (>2 m)	1 – 4
Vachellia farnesiana	Shrub (>2 m)	1 – 4
Acacia sclerosperma subsp. *sclerosperma*	Shrub (1-2 m)	< 1
Androcalva luteiflora	Shrub (1-2 m)	< 1
Gossypium australe	Shrub (1-2 m)	< 1
Aerva javanica	Shrub (<0.5 m)	< 1
Corchorus lasiocarpus subsp. *parvus*	Shrub (<0.5 m)	< 1
Hibiscus sturtii var. *campylochlamys*	Shrub (<0.5 m)	< 1
Alternanthera nana	Herb (<0.5 m)	< 1
Amaranthus ?undulatus	Herb (<0.5 m)	< 1
Arivela viscosa	Herb (<0.5 m)	< 1
Boerhavia burbidgeana	Herb (<0.5 m)	< 1
Boerhavia coccinea	Herb (<0.5 m)	< 1
Cheilanthes sieberi subsp. *sieberi*	Herb (<0.5 m)	< 1
Corchorus tridens/trilocularis	Herb (<0.5 m)	< 1
Cucumis variabilis	Herb (<0.5 m)	< 1
Euphorbia ?trigonosperma	Herb (<0.5 m)	< 1
Euphorbia australis var. *subtomentosa*	Herb (<0.5 m)	< 1
Evolvulus alsinoides var. *decumbens*	Herb (<0.5 m)	< 1
Indigofera trita subsp. *trita*	Herb (<0.5 m)	< 1
Ipomoea muelleri	Herb (<0.5 m)	< 1

Name	Stratum	Percent cover (%)
Ipomoea plebeia	Herb (<0.5 m)	< 1
Ipomoea polymorpha	Herb (<0.5 m)	< 1
Notoleptopus decaisnei	Herb (<0.5 m)	< 1
Pluchea dentex	Herb (<0.5 m)	< 1
Portulaca oleracea	Herb (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	< 1
Rutidosis helichrysoides subsp. *helichrysoides*	Herb (<0.5 m)	< 1
Salsola australis	Herb (<0.5 m)	< 1
Sclerolaena costata	Herb (<0.5 m)	< 1
Trianthema triquetrum	Herb (<0.5 m)	< 1
Tribulus hirsutus	Herb (<0.5 m)	< 1
Cenchrus ciliaris	Tussock Grass (<0.5 m)	5 – 9
Cenchrus setiger	Tussock Grass (<0.5 m)	5 – 9
Dactyloctenium radulans	Tussock Grass (<0.5 m)	< 1
Sporobolus australasicus	Tussock Grass (<0.5 m)	< 1
Themeda triandra	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (0.5-1 m)	1 – 4
Triodia longiceps	Hummock Grass (0.5-1 m)	5 – 9

BD_E_186

Date	8/03/2024	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-21.90761, 119.95875				
Landform	Low hill	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Sandy clay loam		
Rock type	Ironstone	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	5 – 9
Senna symonii	Shrub (1-2 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Dodonaea coriacea	Shrub (<0.5 m)	< 1
Indigofera monophylla	Shrub (<0.5 m)	< 1
Ptilotus calostachyus	Shrub (<0.5 m)	< 1
Senna glutinosa subsp. *glutinosa*	Shrub (<0.5 m)	1 – 4
Tephrosia sp. NW Eremaean (S. van Leeuwen et al. PBS 0356)	Shrub (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Trigastrotheca molluginea	Herb (<0.5 m)	< 1
Eriachne lanata	Tussock Grass (<0.5 m)	1 – 4
Eriachne mucronata	Tussock Grass (<0.5 m)	< 1
Triodia brizoides	Hummock Grass (<0.5 m)	10 – 24
Triodia longiceps	Hummock Grass (<0.5 m)	5 – 9
Triodia wiseana	Hummock Grass (<0.5 m)	10 – 24

BD_E_187

Date	8/03/2024	**Site type**	Flora: Quadrat	**Botanist**	BN
Location	-21.90884, 119.98638				
Landform	Low hill	**Slope**	Steep		
Soil colour	Red	**Soil texture**	Clay		
Rock type	Ironstone	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	5 – 9
Senna symonii	Shrub (1-2 m)	< 1
Sida ?sp. *Golden calyces glabrous (H.N. Foote 32)*	Shrub (0.5-1 m)	< 1
Ptilotus calostachyus	Shrub (<0.5 m)	< 1
Dampiera candicans	Herb (<0.5 m)	< 1
Tribulus hirsutus	Herb (<0.5 m)	< 1
Eriachne lanata	Tussock Grass (<0.5 m)	< 1
Eriachne mucronata	Tussock Grass (<0.5 m)	1 – 4
Triodia brizoides	Hummock Grass (<0.5 m)	10 – 24
Triodia longiceps	Hummock Grass (<0.5 m)	10 – 24

BD_E_188

Date	10/03/2024	**Site type**	Flora: Quadrat	**Botanist**	SN
Location	-21.91051, 119.8731				
Landform	Crest/hill top	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Sand		
Rock type	Quartz, mixed ironstone	**Rock size**	Mixed	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Very recent (< 1 yr)				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	< 1
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	< 1
Acacia ?adsurgens	Shrub (>2 m)	5 – 9
Acacia orthocarpa	Shrub (>2 m)	10 – 24
Grevillea wickhamii	Shrub (>2 m)	1 – 4
Portulaca cyclophylla	Herb (<0.5 m)	< 1
Senna notabilis	Herb (<0.5 m)	< 1
Eriachne lanata	Tussock Grass (<0.5 m)	5 – 9
Paraneurachne muelleri	Tussock Grass (<0.5 m)	1 – 4
Triodia epactia	Hummock Grass (<0.5 m)	10 – 24
Triodia wiseana	Hummock Grass (<0.5 m)	1 – 4

BD_E_189

Date	8/03/2024	**Site type**	Flora: Releve	**Botanist**	AC
Location	-21.91447, 120.01468				
Landform	Major creek (5-30 m)	**Slope**	NA		
Soil colour	Brown	**Soil texture**	Loamy sand		
Rock type	Mixed river alluvium	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Eucalyptus victrix	Tree (10-30 m)	< 1
Corymbia candida subsp. *candida*	Tree (<10 m)	1 – 4
Acacia cyperophylla var. *omearana*	Shrub (>2 m)	5 – 9
Acacia tumida var. *pilbarensis*	Shrub (>2 m)	5 – 9
Grevillea wickhamii	Shrub (>2 m)	< 1
Santalum lanceolatum	Shrub (>2 m)	< 1
Acacia spondylophylla	Shrub (0.5-1 m)	< 1
Cyperus hesperius	Sedge (0.5-1 m)	< 1
Afrohybanthus aurantiacus	Herb (<0.5 m)	< 1
Arivela viscosa	Herb (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Cathetus exilis	Herb (<0.5 m)	< 1
Euphorbia ?trigonosperma	Herb (<0.5 m)	< 1
Goodenia lamprosperma	Herb (<0.5 m)	< 1
Pluchea dentex	Herb (<0.5 m)	< 1
Polymeria ambigua	Herb (<0.5 m)	< 1
Senna notabilis	Herb (<0.5 m)	< 1
Sesbania cannabina	Herb (<0.5 m)	< 1
Solanum horridum	Herb (<0.5 m)	< 1
Cymbopogon ambiguus	Tussock Grass (<0.5 m)	1 – 4
Eriachne mucronata	Tussock Grass (<0.5 m)	10 – 24
Eriachne tenuiculmis	Tussock Grass (<0.5 m)	1 – 4
Triodia longiceps	Hummock Grass (1-2 m)	5 – 9
Triodia epactia	Hummock Grass (0.5-1 m)	5 – 9

BD_E_190

Date	8/03/2024	**Site type**	Flora: Quadrat	**Botanist**	SN
Location	-21.91036, 120.01066				
Landform	Hill	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Sandy clay		
Rock type	Ironstone	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Moderate (2 – 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia colei var. *colei*	Shrub (1-2 m)	1 – 4
Acacia pruinocarpa	Shrub (1-2 m)	1 – 4
Acacia spondylophylla	Shrub (0.5-1 m)	< 1
Ptilotus calostachyus	Shrub (0.5-1 m)	< 1
Senna glutinosa subsp. ×*luerssenii*	Shrub (0.5-1 m)	1 – 4
Senna symonii	Shrub (<0.5 m)	1 – 4
Sida sp. Pilbara (A.A. Mitchell PRP 1543)	Shrub (<0.5 m)	< 1
Bulbostylis turbinata	Sedge (<0.5 m)	1 – 4
Arivela viscosa	Herb (<0.5 m)	< 1
Goodenia stobbsiana	Herb (<0.5 m)	< 1
Portulaca cyclophylla	Herb (<0.5 m)	1 – 4
Salsola australis	Herb (<0.5 m)	< 1
Solanum cleistogamum/horridum	Herb (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	< 1
Triodia longiceps	Hummock Grass (<0.5 m)	5 – 9
Triodia wiseana	Hummock Grass (<0.5 m)	25 – 32

BD_E_191

Date	9/03/2024	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-21.9103, 119.8501				
Landform	Ridge	**Slope**	Moderate		
Soil colour	Brown	**Soil texture**	Sandy loam		
Rock type	Granite, quartz	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Very recent (< 1 yr)				



Name	Stratum	Percent cover (%)
Acacia ?adsurgens	Shrub (>2 m)	5 – 9
Acacia orthocarpa	Shrub (1-2 m)	1 – 4
Eriachne lanata	Tussock Grass (<0.5 m)	1 – 4
Eriachne mucronata	Tussock Grass (<0.5 m)	1 – 4
Triodia epactia	Hummock Grass (<0.5 m)	10 – 24

BD_E_192

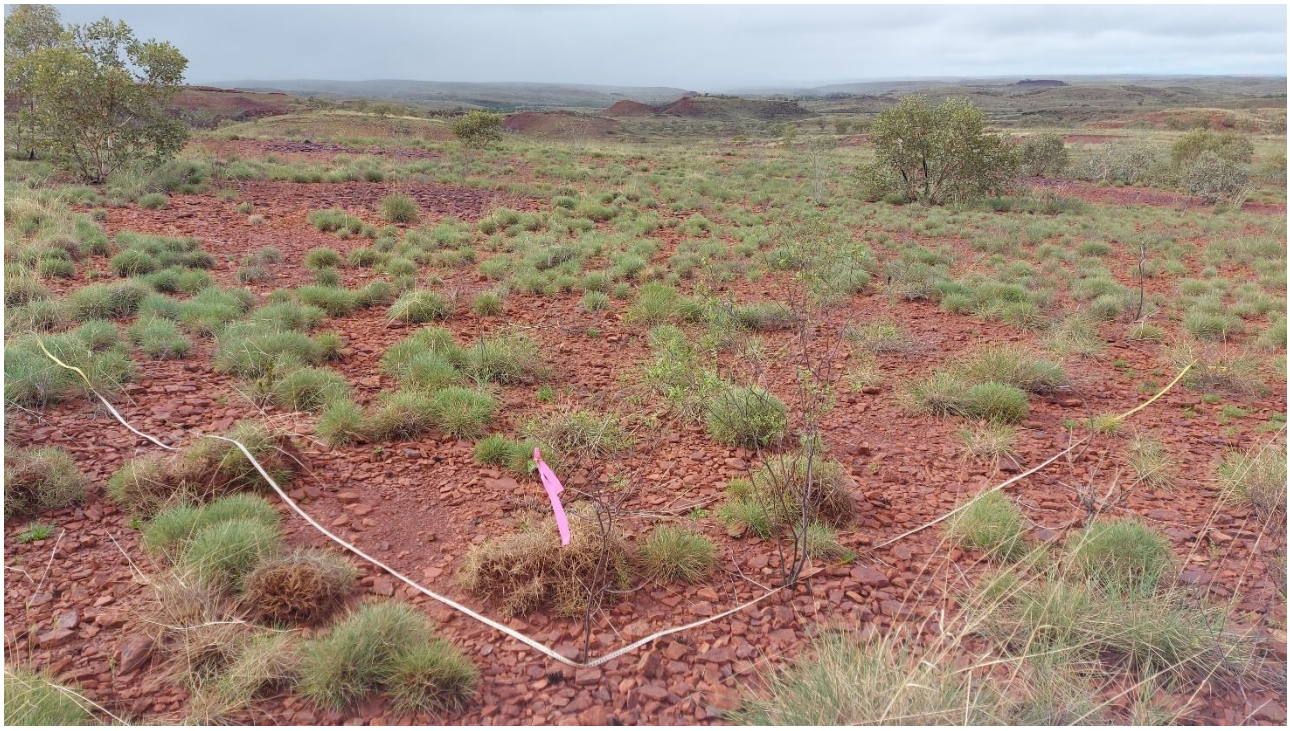
Date	9/03/2024	**Site type**	Flora: Releve	**Botanist**	SH
Location	-21.90972, 119.86522				
Landform	Gorge	**Slope**	NA		
Soil colour	Light brown	**Soil texture**	Sand		
Rock type	Granite	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Very Good	**Disturbance**	Minor weed cover and grazing.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Eucalyptus camaldulensis	Tree (10-30 m)	5 – 9
Eucalyptus victrix	Tree (10-30 m)	5 – 9
Corymbia ?ferriticola	Tree (<10 m)	1 – 4
Acacia coriacea subsp. *pendens*	Shrub (>2 m)	1 – 4
Acacia tumida var. *pilbarensis*	Shrub (>2 m)	1 – 4
Grevillea wickhamii	Shrub (>2 m)	1 – 4
Melaleuca glomerata	Shrub (>2 m)	5 – 9
Ficus brachypoda	Shrub (1-2 m)	< 1
Senna glutinosa subsp. *glutinosa*	Shrub (0.5-1 m)	< 1
Acacia pyrifolia	Shrub (<0.5 m)	< 1
Cyperus vaginatus	Sedge (0.5-1 m)	< 1
Arivela viscosa	Herb (<0.5 m)	< 1
Boerhavia coccinea	Herb (<0.5 m)	< 1
Euphorbia ?biconvexa	Herb (<0.5 m)	< 1
Ipomoea muelleri	Herb (<0.5 m)	< 1
Operculina aequisepala	Herb (<0.5 m)	< 1
Cymbopogon ambiguus	Tussock Grass (0.5-1 m)	1 – 4
Cenchrus ciliaris	Tussock Grass (<0.5 m)	1 – 4
Eriachne mucronata	Tussock Grass (<0.5 m)	1 – 4
Eriachne tenuiculmis	Tussock Grass (<0.5 m)	1 – 4
Triodia epactia	Hummock Grass (<0.5 m)	5 – 9

BD_E_193

Date	8/03/2024	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-21.91601, 120.00415				
Landform	Low hill	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Sandy clay loam		
Rock type	Ironstone	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	5 – 9
Senna glutinosa subsp. ×*luerssenii*	Shrub (0.5-1 m)	1 – 4
Senna glutinosa subsp. *pruinosa*	Shrub (0.5-1 m)	1 – 4
Senna symonii	Shrub (0.5-1 m)	1 – 4
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Dodonaea coriacea	Shrub (<0.5 m)	< 1
Indigofera monophylla	Shrub (<0.5 m)	1 – 4
?Enchylaena tomentosa	Herb (<0.5 m)	< 1
Ptilotus exaltatus	Herb (<0.5 m)	< 1
Trianthema ?glossostigmum	Herb (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	10 – 24
Triodia wiseana	Hummock Grass (<0.5 m)	5 – 9

BD_E_194

Date	8/03/2024	**Site type**	Flora: Quadrat	**Botanist**	BN
Location	-21.91711, 119.98406				
Landform	Plain	**Slope**	NA		
Soil colour	Dark brown	**Soil texture**	Clay		
Rock type	Ironstone	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	30 – 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	< 1
Acacia bivenosa	Shrub (>2 m)	1 – 4
Acacia synchronicia	Shrub (1-2 m)	< 1
Senna symonii	Shrub (0.5-1 m)	< 1
Tribulus suberosus	Shrub (<0.5 m)	1 – 4
Triodia epactia	Hummock Grass (0.5-1 m)	10 – 24
Triodia wiseana	Hummock Grass (<0.5 m)	10 – 24

BD_E_195

Date	9/03/2024	**Site type**	Flora: Quadrat	**Botanist**	SN
Location	-21.91875, 119.87708				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Very recent (< 1 yr)				



Name	Stratum	Percent cover (%)
Hakea lorea subsp. *lorea*	Shrub (<0.5 m)	< 1
Bulbostylis turbinata	Sedge (<0.5 m)	5 – 9
Afrohybanthus aurantiacus	Herb (<0.5 m)	5 – 9
Arivela viscosa	Herb (<0.5 m)	1 – 4
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Portulaca cyclophylla	Herb (<0.5 m)	1 – 4
Senna notabilis	Herb (<0.5 m)	< 1
Tribulus ?hirsutus	Herb (<0.5 m)	1 – 4
Triodia brizoides	Hummock Grass (<0.5 m)	1 – 4
Triodia epactia	Hummock Grass (<0.5 m)	10 – 24

BD_E_196

Date	10/03/2024	**Site type**	Flora: Releve	**Botanist**	SH
Location	-21.92025, 119.76551				
Landform	Crest/hill top	**Slope**	Steep		
Soil colour	Brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Very recent (< 1 yr)				



Name	Stratum	Percent cover (%)
Grevillea pyramidalis subsp. *leucadendron*	Shrub (>2 m)	< 1
Hakea lorea subsp. *lorea*	Shrub (>2 m)	1 – 4
Acacia inaequilatera	Shrub (1-2 m)	< 1
Tribulus suberosus	Shrub (0.5-1 m)	1 – 4
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Indigofera monophylla	Shrub (<0.5 m)	1 – 4
Pentalepis trichodesmoides subsp. *trichodesmoides*	Shrub (<0.5 m)	1 – 4
Ptilotus astrolasius	Shrub (<0.5 m)	< 1
Arivela viscosa	Herb (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Euphorbia careyi	Herb (<0.5 m)	1 – 4
Cymbopogon ambiguus	Tussock Grass (0.5-1 m)	< 1
Eriachne mucronata	Tussock Grass (<0.5 m)	1 – 4
Triodia epactia	Hummock Grass (<0.5 m)	5 – 9
Triodia wiseana	Hummock Grass (<0.5 m)	25 – 32

BD_E_197

Date	8/03/2024	**Site type**	Flora: Quadrat	**Botanist**	AC
Location	-21.92051, 119.98789				
Landform	Major creek (5-30 m)	**Slope**	NA		
Soil colour	Brown	**Soil texture**	Loamy sand		
Rock type	Mixed river alluvium	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Very Good	**Disturbance**	Minor weed cover and grazing.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Eucalyptus victrix	Tree (10-30 m)	5 – 9
Acacia cyperophylla var. *omearana*	Shrub (>2 m)	5 – 9
Acacia tumida var. *pilbarensis*	Shrub (>2 m)	1 – 4
Atalaya hemiglauca	Shrub (>2 m)	1 – 4
Grevillea wickhamii	Shrub (>2 m)	< 1
Flueggea virosa subsp. *melanthesoides*	Shrub (<0.5 m)	< 1
Indigofera monophylla	Shrub (<0.5 m)	< 1
Vachellia farnesiana	Shrub (<0.5 m)	< 1
Cyperus vaginatus	Sedge (0.5-1 m)	< 1
?*Malvastrum americanum*	Herb (<0.5 m)	< 1
Afrohybanthus aurantiacus	Herb (<0.5 m)	< 1
Alternanthera nana	Herb (<0.5 m)	< 1
Arivela viscosa	Herb (<0.5 m)	1 – 4
Boerhavia burbidgeana	Herb (<0.5 m)	< 1
Boerhavia coccinea	Herb (<0.5 m)	< 1
Cathetus exilis	Herb (<0.5 m)	< 1
Corchorus tridens/trilocularis	Herb (<0.5 m)	< 1
Crotalaria medicaginea var. *neglecta*	Herb (<0.5 m)	< 1
Euphorbia ?trigonosperma	Herb (<0.5 m)	< 1
Evolvulus alsinoides	Herb (<0.5 m)	< 1
Ipomoea muelleri	Herb (<0.5 m)	< 1
Ipomoea polymorpha	Herb (<0.5 m)	< 1
Nellica maderaspatensis	Herb (<0.5 m)	< 1
Rostellularia adscendens var. *clementii*	Herb (<0.5 m)	< 1
Sesbania cannabina	Herb (<0.5 m)	< 1
Cenchrus ciliaris	Tussock Grass (<0.5 m)	1 – 4
Dactyloctenium radulans	Tussock Grass (<0.5 m)	< 1
Eriachne tenuiculmis	Tussock Grass (<0.5 m)	1 – 4
Paspalidium rarum	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (0.5-1 m)	5 – 9
Triodia longiceps	Hummock Grass (0.5-1 m)	5 – 9

BD_E_198

Date	9/03/2024	**Site type**	Flora: Quadrat	**Botanist**	AC
Location	-21.92238, 119.80167				
Landform	Footslope	**Slope**	Gentle		
Soil colour	Light brown	**Soil texture**	Loamy sand		
Rock type	Granite	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	< 1
Acacia orthocarpa	Shrub (>2 m)	10 – 24
Grevillea wickhamii	Shrub (>2 m)	1 – 4
Acacia tumida var. *pilbarensis*	Shrub (1-2 m)	< 1
Acacia bivenosa	Shrub (0.5-1 m)	1 – 4
Acacia adoxa var. *adoxa*	Shrub (<0.5 m)	< 1
Waltheria virgata	Shrub (<0.5 m)	< 1
Bulbostylis turbinata	Sedge (<0.5 m)	1 – 4
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Cassytha ?capillaris	Herb (<0.5 m)	1 – 4
Trigastrotheca molluginea	Herb (<0.5 m)	< 1
Enneapogon caerulescens	Tussock Grass (<0.5 m)	< 1
Triodia longiceps	Hummock Grass (0.5-1 m)	1 – 4
Triodia brizoides	Hummock Grass (<0.5 m)	25 – 32
Triodia epactia	Hummock Grass (<0.5 m)	5 – 9

BD_E_199

Date	10/03/2024	**Site type**	Flora: Quadrat	**Botanist**	AC
Location	-21.92298, 119.91599				
Landform	Hill	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Granite, quartz	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	< 1
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	5 – 9
Senna symonii	Shrub (0.5-1 m)	1 – 4
Acacia adoxa var. *adoxa*	Shrub (<0.5 m)	< 1
Acacia arrecta	Shrub (<0.5 m)	1 – 4
Acacia maitlandii	Shrub (<0.5 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Dodonaea coriacea	Shrub (<0.5 m)	1 – 4
Indigofera monophylla	Shrub (<0.5 m)	1 – 4
Tephrosia sp. clay soils (S. van Leeuwen et al. PBS 0273)	Shrub (<0.5 m)	< 1
Bulbostylis turbinata	Sedge (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Goodenia cusackiana	Herb (<0.5 m)	< 1
Goodenia stobbsiana	Herb (<0.5 m)	< 1
Portulaca ?cyclophylla	Herb (<0.5 m)	< 1
Sida ?echinocarpa	Herb (<0.5 m)	< 1
Eriachne mucronata	Tussock Grass (<0.5 m)	1 – 4
Tripogonella loliiformis	Tussock Grass (<0.5 m)	1 – 4
Triodia brizoides	Hummock Grass (<0.5 m)	25 – 32
Triodia epactia	Hummock Grass (<0.5 m)	1 – 4

BD_E_200

Date	10/03/2024	**Site type**	Flora: Quadrat	**Botanist**	AC
Location	-21.92459, 119.75219				
Landform	Low hill	**Slope**	Gentle		
Soil colour	Brown	**Soil texture**	Clay loam		
Rock type	Calcrete	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	1 – 4
Hakea chordophylla	Shrub (>2 m)	< 1
Acacia bivenosa	Shrub (1-2 m)	1 – 4
Acacia inaequilatera	Shrub (1-2 m)	< 1
Acacia tumida var. *pilbarensis*	Shrub (1-2 m)	1 – 4
Grevillea wickhamii	Shrub (1-2 m)	< 1
Acacia pyrifolia	Shrub (0.5-1 m)	< 1
Pluchea ferdinandi-muelleri	Shrub (0.5-1 m)	< 1
Senna glutinosa subsp. ×*luerssenii*	Shrub (0.5-1 m)	< 1
Senna glutinosa subsp. *glutinosa*	Shrub (0.5-1 m)	< 1
Senna glutinosa subsp. *pruinosa*	Shrub (0.5-1 m)	< 1
Senna symonii	Shrub (0.5-1 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	1 – 4
Corchorus walcottii	Shrub (<0.5 m)	< 1
Indigofera monophylla	Shrub (<0.5 m)	1 – 4
Senna artemisioides subsp. *oligophylla*	Shrub (<0.5 m)	< 1
Boerhavia coccinea	Herb (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Cassytha ?capillaris	Herb (<0.5 m)	1 – 4
Euphorbia careyi	Herb (<0.5 m)	< 1
Goodenia stobbsiana	Herb (<0.5 m)	1 – 4
Eriachne mucronata	Tussock Grass (<0.5 m)	< 1
Triodia wiseana	Hummock Grass (0.5-1 m)	33 – 49

BD_E_201

Date	10/03/2024	**Site type**	Flora: Quadrat	**Botanist**	SN
Location	-21.92396, 119.75713				
Landform	Undulating plain	**Slope**	NA		
Soil colour	Brown	**Soil texture**	Clay loam		
Rock type	Calcrete	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	Minor weed cover and grazing.		
Time since fire	Very recent (< 1 yr)				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	1 – 4
Acacia bivenosa	Shrub (1-2 m)	1 – 4
Acacia inaequilatera	Shrub (1-2 m)	1 – 4
Senna symonii	Shrub (1-2 m)	1 – 4
Acacia synchronicia	Shrub (0.5-1 m)	< 1
Pluchea ferdinandi-muelleri	Shrub (0.5-1 m)	< 1
Euploca cunninghamii	Shrub (<0.5 m)	< 1
Tephrosia sp. clay soils (S. van Leeuwen et al. PBS 0273)	Shrub (<0.5 m)	< 1
Dolichocarpa crouchiana	Herb (0.5-1 m)	< 1
Afrohybanthus aurantiacus	Herb (<0.5 m)	< 1
Arivela viscosa	Herb (<0.5 m)	< 1
Tribulus ?hirsutus	Herb (<0.5 m)	< 1
Cenchrus ciliaris	Tussock Grass (<0.5 m)	< 1
Triodia brizoides	Hummock Grass (0.5-1 m)	25 – 32

BD_E_202

Date	9/03/2024	**Site type**	Flora: Quadrat	**Botanist**	SN
Location	-21.92259, 119.79685				
Landform	Ridge	**Slope**	Steep		
Soil colour	Reddish brown	**Soil texture**	Sandy loam		
Rock type	Ironstone	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	1 – 4
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	1 – 4
Acacia monticola	Shrub (1-2 m)	1 – 4
Acacia bivenosa	Shrub (0.5-1 m)	< 1
Grevillea wickhamii	Shrub (0.5-1 m)	1 – 4
Hakea lorea subsp. *lorea*	Shrub (<0.5 m)	< 1
Dampiera candicans	Herb (0.5-1 m)	1 – 4
Afrohybanthus aurantiacus	Herb (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Portulaca cyclophylla	Herb (<0.5 m)	< 1
Triodia brizoides	Hummock Grass (<0.5 m)	1 – 4
Triodia epactia	Hummock Grass (<0.5 m)	50 – 74

BD_E_203

Date	8/03/2024	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-21.92663, 120.00612				
Landform	Crest/hill top	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	1 – 4
Acacia monticola	Shrub (1-2 m)	5 – 9
Acacia pruinocarpa	Shrub (1-2 m)	1 – 4
Senna glutinosa subsp. ×*luerssenii*	Shrub (1-2 m)	< 1
Senna symonii	Shrub (1-2 m)	1 – 4
Ptilotus calostachyus	Shrub (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Ptilotus exaltatus	Herb (<0.5 m)	< 1
Eriachne lanata	Tussock Grass (<0.5 m)	5 – 9
Eriachne mucronata	Tussock Grass (<0.5 m)	1 – 4
Triodia epactia	Hummock Grass (<0.5 m)	10 – 24

BD_E_204

Date	9/03/2024	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-21.93138, 119.82977				
Landform	Ridge	**Slope**	Moderate		
Soil colour	Reddish brown	**Soil texture**	Sandy clay loam		
Rock type	Granite	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Very recent (< 1 yr)				

No photo.

Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	1 – 4
Grevillea wickhamii	Shrub (>2 m)	5 – 9
Acacia retivenea subsp. *clandestina*	Shrub (0.5-1 m)	1 – 4
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Tribulus ?hirsutus	Herb (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	1 – 4
Triodia wiseana	Hummock Grass (<0.5 m)	10 – 24

BD_E_205

Date	8/03/2024	**Site type**	Flora: Quadrat	**Botanist**	BN
Location	-21.92901, 120.01525				
Landform	Hill	**Slope**	Moderate		
Soil colour	Red	**Soil texture**	Clay		
Rock type	Granite	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Tree (<10 m)	1 – 4
Grevillea pyramidalis subsp. *leucadendron*	Shrub (>2 m)	< 1
Triodia epactia	Hummock Grass (0.5-1 m)	50 – 74

BD_E_206

Date	11/03/2024	**Site type**	Flora: Quadrat	**Botanist**	AC
Location	-22.05323, 119.83067				
Landform	Upland plain	**Slope**	Gentle		
Soil colour	Brown	**Soil texture**	Heavy clay		
Rock type	Basalt	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Very Good	**Disturbance**	Minor weed cover and grazing.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Euploca ?cunninghamii	Shrub (<0.5 m)	< 1
Solanum lasiophyllum/phlomoides	Shrub (<0.5 m)	< 1
Tephrosia sp. clay soils (S. van Leeuwen et al. PBS 0273)	Shrub (<0.5 m)	< 1
Alysicarpus muelleri	Herb (<0.5 m)	< 1
Arivela viscosa	Herb (<0.5 m)	5 – 9
Boerhavia coccinea	Herb (<0.5 m)	1 – 4
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Corchorus tridens/trilocularis	Herb (<0.5 m)	< 1
Crotalaria dissitiflora subsp. *benthamiana*	Herb (<0.5 m)	< 1
Desmodiopsis campylocaulon	Herb (<0.5 m)	< 1
Dolichocarpa crouchiana	Herb (<0.5 m)	< 1
Euphorbia australis var. *subtomentosa*	Herb (<0.5 m)	< 1
Gomphrena cunninghamii	Herb (<0.5 m)	< 1
Indigofera colutea	Herb (<0.5 m)	< 1
Indigofera linifolia	Herb (<0.5 m)	< 1
Ipomoea muelleri	Herb (<0.5 m)	< 1
Ipomoea polymorpha	Herb (<0.5 m)	< 1
Nellica maderaspatensis	Herb (<0.5 m)	< 1
Panicum decompositum	Herb (<0.5 m)	< 1
Ptilotus gomphrenoides	Herb (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	< 1
Senna notabilis	Herb (<0.5 m)	< 1
Sida fibulifera	Herb (<0.5 m)	< 1
Solanum cleistogamum/horridum	Herb (<0.5 m)	< 1
Tribulus terrestris	Herb (<0.5 m)	< 1
Aristida latifolia	Tussock Grass (<0.5 m)	1 – 4
Cymbopogon ambiguus	Tussock Grass (<0.5 m)	< 1
Cynodon prostratus	Tussock Grass (<0.5 m)	< 1
Enneapogon caerulescens	Tussock Grass (<0.5 m)	1 – 4
Triodia epactia	Hummock Grass (0.5-1 m)	5 – 9

BD_E_207

Date	9/03/2024	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-21.93514, 119.80175				
Landform	Midslope	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Sandy clay loam		
Rock type	Granite	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Very recent (< 1 yr)				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Shrub (1-2 m)	5 – 9
Grevillea wickhamii	Shrub (1-2 m)	< 1
Acacia adoxa var. *adoxa*	Shrub (<0.5 m)	5 – 9
Acacia arrecta	Shrub (<0.5 m)	1 – 4
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	25 – 32

BD_E_208

Date	10/03/2024	**Site type**	Flora: Quadrat	**Botanist**	BN
Location	-21.93742, 119.76078				
Landform	Hill	**Slope**	Gentle		
Soil colour	Red	**Soil texture**	Clay		
Rock type	Granite	**Rock size**	Mixed	**Rock cover**	30 – 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Very recent (< 1 yr)				



Name	Stratum	Percent cover (%)
Acacia bivenosa	Shrub (1-2 m)	< 1
Acacia inaequilatera	Shrub (1-2 m)	1 – 4
Arivela viscosa	Herb (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Triodia longiceps	Hummock Grass (0.5-1 m)	33 – 49

BD_E_209

Date	10/03/2024	**Site type**	Flora: Quadrat	**Botanist**	SN
Location	-21.94292, 119.77098				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Brown	**Soil texture**	Sandy clay		
Rock type	Basalt	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Moderate (2 – 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Shrub (>2 m)	1 – 4
Indigofera monophylla	Shrub (0.5-1 m)	5 – 9
Senna symonii	Shrub (0.5-1 m)	1 – 4
Tribulus suberosus	Shrub (0.5-1 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	10 – 24
Ptilotus calostachyus	Shrub (<0.5 m)	< 1
Bulbostylis turbinata	Sedge (<0.5 m)	< 1
Arivela viscosa	Herb (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Senna notabilis	Herb (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	75 – 94

BD_E_210

Date	9/03/2024	**Site type**	Flora: Quadrat	**Botanist**	BN
Location	-21.94182, 119.81821				
Landform	Crest/hill top	**Slope**	Gentle		
Soil colour	Red	**Soil texture**	Clay		
Rock type	Ironstone	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Very recent (< 1 yr)				



Name	Stratum	Percent cover (%)
Grevillea pyramidalis subsp. *leucadendron*	Shrub (>2 m)	< 1
Acacia pruinocarpa	Shrub (1-2 m)	< 1
Triodia epactia	Hummock Grass (0.5-1 m)	10 – 24
Triodia longiceps	Hummock Grass (0.5-1 m)	1 – 4

BD_E_211

Date	8/03/2024	**Site type**	Flora: Quadrat	**Botanist**	BN
Location	-21.94477, 119.98493				
Landform	Hill	**Slope**	Gentle		
Soil colour	Red	**Soil texture**	Clay		
Rock type	Granite	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Tree (<10 m)	1 – 4
Fimbristylis dichotoma	Sedge (<0.5 m)	< 1
Arivela viscosa	Herb (<0.5 m)	< 1
Aristida contorta	Tussock Grass (<0.5 m)	< 1
Triodia brizoides	Hummock Grass (<0.5 m)	10 – 24
Triodia epactia	Hummock Grass (<0.5 m)	10 – 24

BD_E_212

Date	10/03/2024	**Site type**	Flora: Quadrat	**Botanist**	BN
Location	-21.9529, 119.76469				
Landform	Major creek (5-30 m)	**Slope**	NA		
Soil colour	Orange	**Soil texture**	Clay loam		
Rock type	Quartz	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	< 10%
Vegetation condition	Good	**Disturbance**	Moderate weed cover, minor grazing.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Shrub (>2 m)	1 – 4
Acacia trachycarpa	Shrub (>2 m)	10 – 24
Atalaya hemiglauca	Shrub (>2 m)	< 1
Gossypium australe	Shrub (1-2 m)	< 1
Petalostylis labicheoides	Shrub (1-2 m)	< 1
Arivela viscosa	Herb (<0.5 m)	< 1
Boerhavia burbidgeana	Herb (<0.5 m)	1 – 4
Ipomoea muelleri	Herb (<0.5 m)	< 1
Tribulus ?hirsutus	Herb (<0.5 m)	1 – 4
Cenchrus ciliaris	Tussock Grass (<0.5 m)	10 – 24
Triodia epactia	Hummock Grass (0.5-1 m)	5 – 9

BD_E_213

Date	9/03/2024	**Site type**	Flora: Quadrat	**Botanist**	AC
Location	-21.95562, 119.84149				
Landform	Upland plain	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Heavy clay		
Rock type	Basalt	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				

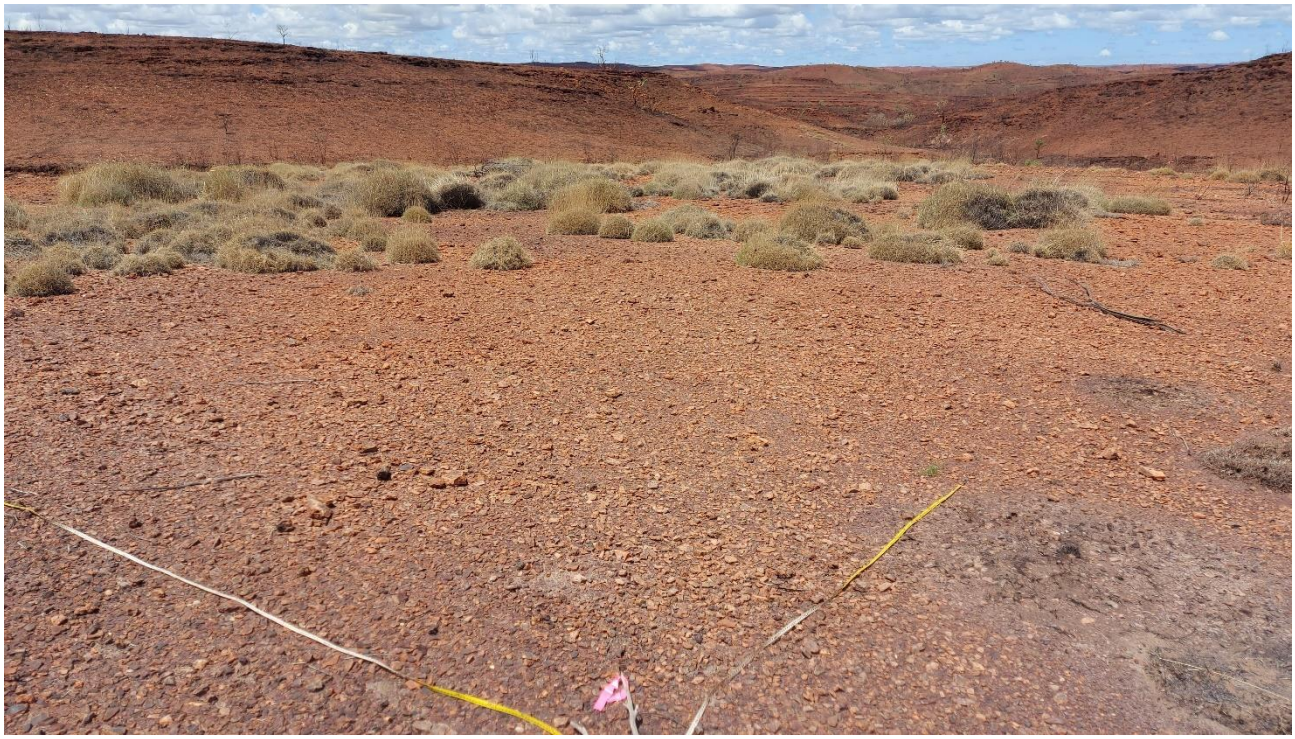


Name	Stratum	Percent cover (%)
Acacia synchronicia	Shrub (1-2 m)	< 1
Acacia tetragonophylla	Shrub (0.5-1 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Euploca ?cunninghamii	Shrub (<0.5 m)	1 – 4
Senna artemisioides subsp. *helmsii*	Shrub (<0.5 m)	< 1
Senna artemisioides subsp. *oligophylla*	Shrub (<0.5 m)	< 1
Tephrosia sp. clay soils (S. van Leeuwen et al. PBS 0273)	Shrub (<0.5 m)	< 1
Bulbostylis turbinata	Sedge (<0.5 m)	< 1
Arivela viscosa	Herb (<0.5 m)	1 – 4
Boerhavia coccinea	Herb (<0.5 m)	< 1
Boerhavia paludosa	Herb (<0.5 m)	1 – 4
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Corchorus tridens/trilocularis	Herb (<0.5 m)	1 – 4
Crotalaria dissitiflora subsp. *benthamiana*	Herb (<0.5 m)	< 1
Crotalaria medicaginea var. *neglecta*	Herb (<0.5 m)	< 1
Cucumis variabilis	Herb (<0.5 m)	< 1
Desmodiopsis campylocaulon	Herb (<0.5 m)	< 1
Euphorbia ?tannensis subsp. *eremophila*	Herb (<0.5 m)	< 1
Euphorbia ?trigonosperma	Herb (<0.5 m)	< 1
Gomphrena cunninghamii	Herb (<0.5 m)	< 1
Goodenia muelleriana	Herb (<0.5 m)	< 1
Ipomoea muelleri	Herb (<0.5 m)	< 1
Ipomoea polymorpha	Herb (<0.5 m)	< 1
Nellica maderaspatensis	Herb (<0.5 m)	< 1
Portulaca filifolia	Herb (<0.5 m)	< 1
Portulaca oleracea	Herb (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	< 1
Sida fibulifera	Herb (<0.5 m)	1 – 4
Trichodesma zeylanicum var. *zeylanicum*	Herb (<0.5 m)	< 1
Aristida latifolia	Tussock Grass (<0.5 m)	10 – 24
Cymbopogon ambiguus	Tussock Grass (<0.5 m)	1 – 4

Name	Stratum	Percent cover (%)
Dichanthium sericeum subsp. *humilius*	Tussock Grass (<0.5 m)	< 1
Enneapogon caerulescens	Tussock Grass (<0.5 m)	< 1
Eriachne mucronata	Tussock Grass (<0.5 m)	< 1
Iseilema vaginiflorum	Tussock Grass (<0.5 m)	1 – 4
Triodia brizoides	Hummock Grass (<0.5 m)	5 – 9
Triodia epactia	Hummock Grass (<0.5 m)	5 – 9

BD_E_214

Date	10/03/2024	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-21.9562, 119.81113				
Landform	Midslope	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Very recent (< 1 yr)				



Name	Stratum	Percent cover (%)
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	< 1
Acacia maitlandii	Shrub (<0.5 m)	< 1
Senna glutinosa subsp. ×*luerssenii*	Shrub (<0.5 m)	1 – 4
Triodia longiceps	Hummock Grass (0.5-1 m)	1 – 4
Triodia wiseana	Hummock Grass (<0.5 m)	10 – 24

BD_E_215

Date	8/03/2024	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-21.96002, 119.97458				
Landform	Midslope	**Slope**	Moderate		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Shrub (>2 m)	1 – 4
Grevillea pyramidalis subsp. *leucadendron*	Shrub (>2 m)	1 – 4
Gossypium australe	Shrub (1-2 m)	< 1
Senna glutinosa subsp. *glutinosa*	Shrub (0.5-1 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Euphorbia careyi	Herb (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	25 – 32

BD_E_216

Date	10/03/2024	**Site type**	Flora: Quadrat	**Botanist**	SN
Location	-21.96219, 119.75456				
Landform	Ridge	**Slope**	Moderate		
Soil colour	Reddish brown	**Soil texture**	Sandy clay		
Rock type	Ironstone	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Acacia pyrifolia	Shrub (>2 m)	1 – 4
Acacia inaequilatera	Shrub (1-2 m)	1 – 4
Corchorus parviflorus	Shrub (0.5-1 m)	< 1
Indigofera monophylla	Shrub (0.5-1 m)	1 – 4
Ptilotus calostachyus	Shrub (0.5-1 m)	< 1
Senna glutinosa subsp. ×*luerssenii*	Shrub (0.5-1 m)	1 – 4
Senna symonii	Shrub (0.5-1 m)	1 – 4
Tephrosia rosea var. *clementii*	Shrub (0.5-1 m)	1 – 4
Dampiera candicans	Herb (0.5-1 m)	< 1
Arivela viscosa	Herb (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Euphorbia ?australis var. *subtomentosa*	Herb (<0.5 m)	< 1
Portulaca cyclophylla	Herb (<0.5 m)	< 1
Triodia longiceps	Hummock Grass (0.5-1 m)	1 – 4
Triodia epactia	Hummock Grass (<0.5 m)	75 – 94

BD_E_217

Date	8/03/2024	**Site type**	Flora: Quadrat	**Botanist**	SN
Location	-21.96325, 119.97147				
Landform	Hill	**Slope**	Moderate		
Soil colour	Reddish brown	**Soil texture**	Sandy loam		
Rock type	Ironstone	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Moderate (2 – 3 yrs)				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	Assoc.
Acacia inaequilatera	Shrub (>2 m)	1 – 4
Ptilotus calostachyus	Shrub (0.5-1 m)	< 1
Bulbostylis turbinata	Sedge (<0.5 m)	1 – 4
Goodenia stobbsiana	Herb (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	33 – 49

BD_E_218

Date	10/03/2024	**Site type**	Flora: Quadrat	**Botanist**	AC
Location	-21.96848, 119.77332				
Landform	Undulating plain	**Slope**	NA		
Soil colour	Dark brown	**Soil texture**	Sandy clay loam		
Rock type	Quartz, ironstone, basalt	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	Minor weed cover and grazing.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	1 – 4
Acacia bivenosa	Shrub (>2 m)	1 – 4
Acacia inaequilatera	Shrub (>2 m)	1 – 4
Senna glutinosa subsp. ×*luerssenii*	Shrub (>2 m)	< 1
Senna symonii	Shrub (>2 m)	1 – 4
Eremophila longifolia	Shrub (1-2 m)	< 1
Indigofera monophylla	Shrub (0.5-1 m)	< 1
Hibiscus sturtii var. *campylochlamys*	Shrub (<0.5 m)	< 1
Afrohybanthus aurantiacus	Herb (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Cucumis variabilis	Herb (<0.5 m)	< 1
Evolvulus alsinoides	Herb (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	< 1
Cenchrus ciliaris	Tussock Grass (<0.5 m)	< 1
Triodia wiseana	Hummock Grass (0.5-1 m)	33 – 49

BD_E_219

Date	10/03/2024	**Site type**	Flora: Quadrat	**Botanist**	AC
Location	-21.9428, 119.78654				
Landform	Major creek (5-30 m)	**Slope**	NA		
Soil colour	Brown	**Soil texture**	Loamy sand		
Rock type	Mixed river alluvium	**Rock size**	Fine gravel [to c. 5 mm]	**Rock cover**	30 – 70%
Vegetation condition	Good	**Disturbance**	Moderate weed cover, minor grazing.		
Time since fire	Long (> 3 yrs)				

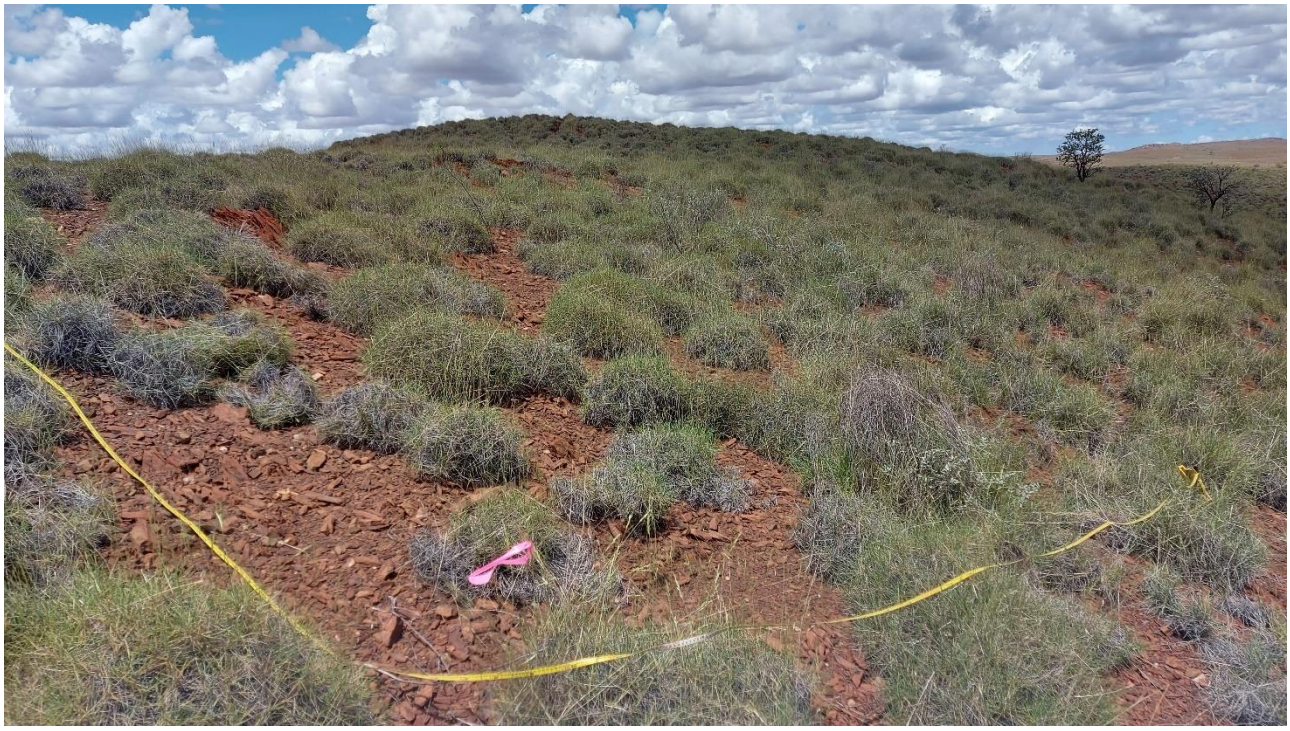


Name	Stratum	Percent cover (%)
Eucalyptus camaldulensis	Tree (10-30 m)	10 – 24
Eucalyptus victrix	Tree (10-30 m)	5 – 9
Acacia coriacea subsp. *pendens*	Shrub (>2 m)	1 – 4
Acacia pyrifolia	Shrub (>2 m)	1 – 4
Atalaya hemiglauca	Shrub (>2 m)	5 – 9
Melaleuca glomerata	Shrub (>2 m)	5 – 9
Melaleuca linophylla	Shrub (>2 m)	5 – 9
Acacia trachycarpa	Shrub (1-2 m)	1 – 4
Ehretia saligna var. *saligna*	Shrub (1-2 m)	< 1
Flueggea virosa subsp. *melanthesoides*	Shrub (1-2 m)	1 – 4
Grevillea wickhamii	Shrub (0.5-1 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Cyperus vaginatus	Sedge (0.5-1 m)	1 – 4
Afrohybanthus aurantiacus	Herb (<0.5 m)	< 1
Alternanthera nana	Herb (<0.5 m)	1 – 4
Arivela viscosa	Herb (<0.5 m)	1 – 4
Boerhavia burbidgeana	Herb (<0.5 m)	< 1
Corchorus tridens/trilocularis	Herb (<0.5 m)	< 1
Cullen leucanthum	Herb (<0.5 m)	< 1
Euphorbia ?trigonosperma	Herb (<0.5 m)	< 1
Euphorbia australis var. *subtomentosa*	Herb (<0.5 m)	< 1
Evolvulus alsinoides	Herb (<0.5 m)	< 1
Ipomoea muelleri	Herb (<0.5 m)	< 1
Ipomoea racemigera	Herb (<0.5 m)	< 1
Nellica maderaspatensis	Herb (<0.5 m)	< 1
Polymeria ambigua	Herb (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	< 1
Senna notabilis	Herb (<0.5 m)	< 1
Sesbania cannabina	Herb (<0.5 m)	< 1
Cenchrus ciliaris	Tussock Grass (<0.5 m)	5 – 9
Cenchrus setiger	Tussock Grass (<0.5 m)	< 1

Name	Stratum	Percent cover (%)
Cymbopogon ambiguus	Tussock Grass (<0.5 m)	< 1
Eriachne tenuiculmis	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	< 1

BD_E_220

Date	10/03/2024	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-21.98884, 119.75704				
Landform	Crest/hill top	**Slope**	Steep		
Soil colour	Brown	**Soil texture**	Clay loam		
Rock type	Shale	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Senna glutinosa subsp. *glutinosa*	Shrub (1-2 m)	1 – 4
Senna artemisioides subsp. *helmsii*	Shrub (0.5-1 m)	1 – 4
Tribulus suberosus	Shrub (0.5-1 m)	1 – 4
Indigofera monophylla	Shrub (<0.5 m)	1 – 4
Boerhavia ?gardneri	Herb (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	< 1
Triodia wiseana	Hummock Grass (<0.5 m)	33 – 49

BD_E_221

Date	8/03/2024	**Site type**	Flora: Quadrat	**Botanist**	SN/AC
Location	-21.99432, 119.94039				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Sandy loam		
Rock type	Ironstone	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Moderate (2 – 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Shrub (1-2 m)	1 – 4
Grevillea wickhamii	Shrub (1-2 m)	< 1
Corchorus parviflorus	Shrub (0.5-1 m)	1 – 4
Ptilotus calostachyus	Shrub (0.5-1 m)	< 1
Senna glutinosa subsp. ×*luerssenii*	Shrub (0.5-1 m)	< 1
Sida sp. Pilbara (A.A. Mitchell PRP 1543)	Shrub (0.5-1 m)	1 – 4
Senna artemisioides subsp. *helmsii*	Shrub (<0.5 m)	< 1
Bulbostylis turbinata	Sedge (<0.5 m)	5 – 9
Arivela viscosa	Herb (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Goodenia stobbsiana	Herb (<0.5 m)	< 1
Trigastrotheca molluginea	Herb (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	25 – 32

BD_E_222

Date	10/03/2024	**Site type**	Flora: Quadrat	**Botanist**	BN
Location	-21.99542, 119.76397				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Red	**Soil texture**	Clay		
Rock type	Quartz	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Tree (<10 m)	1 – 4
Corymbia hamersleyana	Tree (<10 m)	< 1
Acacia orthocarpa	Shrub (>2 m)	1 – 4
Acacia trachycarpa	Shrub (>2 m)	< 1
Senna glutinosa subsp. *glutinosa*	Shrub (1-2 m)	< 1
Senna symonii	Shrub (1-2 m)	< 1
Indigofera deserticola	Shrub (<0.5 m)	< 1
Ptilotus auriculifolius	Shrub (<0.5 m)	< 1
Cymbopogon ambiguus	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (0.5-1 m)	50 – 74

BD_E_223

Date	8/03/2024	**Site type**	Flora: Quadrat	**Botanist**	BN
Location	-22.00349, 119.95505				
Landform	Hill	**Slope**	Moderate		
Soil colour	Red	**Soil texture**	Clay		
Rock type	Granite	**Rock size**	Mixed	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Tree (<10 m)	1 – 4
Corchorus parviflorus	Shrub (1-2 m)	5 – 9
Senna glutinosa subsp. *glutinosa*	Shrub (1-2 m)	< 1
Acacia colei var. *colei*	Shrub (0.5-1 m)	< 1
Tribulus suberosus	Shrub (0.5-1 m)	< 1
Tribulus ?hirsutus	Herb (0.5-1 m)	< 1
Euphorbia careyi	Herb (<0.5 m)	< 1
Triodia longiceps	Hummock Grass (<0.5 m)	33 – 49

BD_E_224

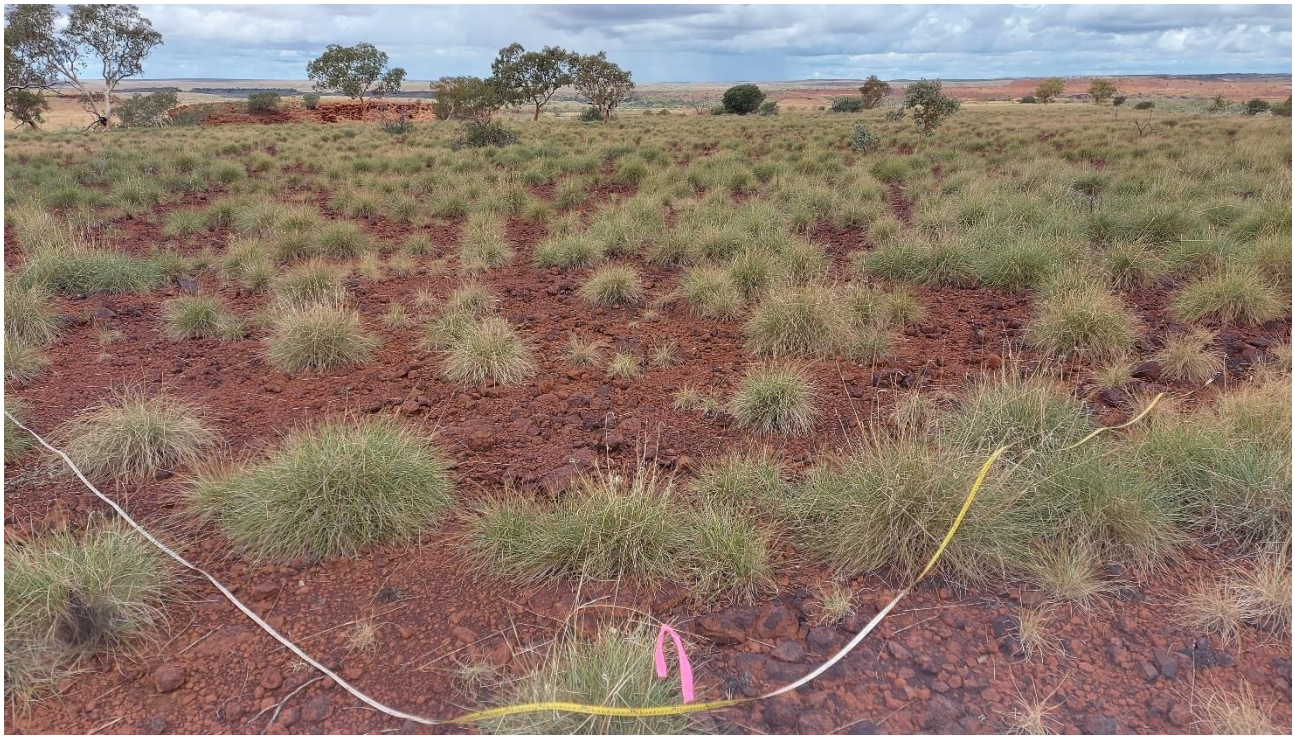
Date	7/03/2024	**Site type**	Flora: Quadrat	**Botanist**	BN
Location	-22.00569, 120.00908				
Landform	Low hill	**Slope**	Moderate		
Soil colour	Red	**Soil texture**	Clay		
Rock type	Granite	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Very Good	**Disturbance**	Minor weed cover and grazing.		
Time since fire	No evidence				

No photo.

Name	Stratum	Percent cover (%)
Acacia synchronicia	Shrub (1-2 m)	< 1
Corchorus parviflorus	Shrub (0.5-1 m)	< 1
Vachellia farnesiana	Shrub (0.5-1 m)	< 1
Arivela viscosa	Herb (<0.5 m)	1 – 4
Boerhavia ?gardneri	Herb (<0.5 m)	< 1
Citrullus amarus	Herb (<0.5 m)	< 1
Heliotropium crispatum	Herb (<0.5 m)	< 1
Josephinia eugeniae	Herb (<0.5 m)	< 1
Operculina aequisepala	Herb (<0.5 m)	< 1
Sida ?sp. L (A.M. Ashby 4202)	Herb (<0.5 m)	< 1
Aristida latifolia	Tussock Grass (<0.5 m)	5 – 9
Cymbopogon ambiguus	Tussock Grass (<0.5 m)	10 – 24
Triodia epactia	Hummock Grass (<0.5 m)	5 – 9

BD_E_225

Date	8/03/2024	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-22.00667, 119.928				
Landform	Ridge	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Sandy clay loam		
Rock type	Ironstone	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Eucalyptus leucophloia subsp. *leucophloia*	Tree (10-30 m)	5 – 9
Acacia pruinocarpa	Shrub (0.5-1 m)	1 – 4
Ptilotus calostachyus	Shrub (<0.5 m)	< 1
Sida sp. Pilbara (A.A. Mitchell PRP 1543)	Shrub (<0.5 m)	< 1
Dampiera candicans	Herb (<0.5 m)	< 1
Ptilotus exaltatus	Herb (<0.5 m)	< 1
Eriachne lanata	Tussock Grass (<0.5 m)	5 – 9
Triodia epactia	Hummock Grass (<0.5 m)	25 – 32

BD_E_226

Date	10/03/2024	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-22.02808, 119.80317				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Shrub (>2 m)	5 – 9
Acacia pruinocarpa	Shrub (1-2 m)	< 1
Indigofera monophylla	Shrub (<0.5 m)	< 1
Senna artemisioides subsp. *helmsii*	Shrub (<0.5 m)	1 – 4
Fimbristylis dichotoma	Sedge (<0.5 m)	5 – 9
Triodia epactia	Hummock Grass (<0.5 m)	25 – 32

BD_E_227

Date	11/03/2024	**Site type**	Flora: Quadrat	**Botanist**	SN/AC
Location	-22.02818, 119.8295				
Landform	Major creek (5-30 m)	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Sandy clay loam		
Rock type	Ironstone	**Rock size**	Boulders [> 260 mm]	**Rock cover**	> 70%
Vegetation condition	Good	**Disturbance**	Moderate weed cover, minor grazing.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Eucalyptus camaldulensis	Tree (<10 m)	1 – 4
Eucalyptus victrix	Tree (<10 m)	1 – 4
Acacia coriacea subsp. *pendens*	Shrub (>2 m)	1 – 4
Atalaya hemiglauca	Shrub (>2 m)	< 1
Grevillea pyramidalis subsp. *leucadendron*	Shrub (>2 m)	< 1
Melaleuca glomerata	Shrub (>2 m)	1 – 4
Acacia pyrifolia	Shrub (1-2 m)	< 1
Acacia trachycarpa	Shrub (1-2 m)	< 1
Melaleuca linophylla	Shrub (1-2 m)	10 – 24
Vachellia farnesiana	Shrub (1-2 m)	< 1
Corchorus parviflorus	Shrub (0.5-1 m)	< 1
Indigofera monophylla	Shrub (<0.5 m)	< 1
Cyperus vaginatus	Sedge (0.5-1 m)	1 – 4
Afrohybanthus aurantiacus	Herb (<0.5 m)	< 1
Arivela viscosa	Herb (<0.5 m)	1 – 4
Boerhavia burbidgeana	Herb (<0.5 m)	< 1
Boerhavia coccinea	Herb (<0.5 m)	1 – 4
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Crotalaria medicaginea var. *neglecta*	Herb (<0.5 m)	< 1
Cucumis variabilis	Herb (<0.5 m)	< 1
Euphorbia ?trigonosperma	Herb (<0.5 m)	< 1
Euphorbia careyi	Herb (<0.5 m)	< 1
Goodenia microptera	Herb (<0.5 m)	< 1
Indigofera linifolia	Herb (<0.5 m)	< 1
Ipomoea muelleri	Herb (<0.5 m)	< 1
Marsilea ?exarata	Herb (<0.5 m)	< 1
Notoleptopus decaisnei	Herb (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	< 1
Scaevola amblyanthera var. *centralis*	Herb (<0.5 m)	< 1
Senna notabilis	Herb (<0.5 m)	< 1
Trianthema triquetrum	Herb (<0.5 m)	< 1

Name	Stratum	Percent cover (%)
Tribulus hirsutus	Herb (<0.5 m)	< 1
Cenchrus ciliaris	Tussock Grass (<0.5 m)	5 – 9
Cenchrus setiger	Tussock Grass (<0.5 m)	1 – 4
Cymbopogon ambiguus	Tussock Grass (<0.5 m)	< 1
Cynodon dactylon	Tussock Grass (<0.5 m)	1 – 4
Eriachne tenuiculmis	Tussock Grass (<0.5 m)	1 – 4
Triodia longiceps	Hummock Grass (0.5-1 m)	1 – 4
Triodia epactia	Hummock Grass (<0.5 m)	5 – 9

BD_E_228

Date	7/03/2024	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-22.02921, 119.99591				
Landform	Undulating plain	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Heavy clay		
Rock type	Ironstone	**Rock size**	Boulders [> 260 mm]	**Rock cover**	30 – 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Arivela viscosa	Herb (<0.5 m)	5 – 9
Boerhavia paludosa	Herb (<0.5 m)	1 – 4
Crotalaria medicaginea var. *neglecta*	Herb (<0.5 m)	< 1
Cucumis melo	Herb (<0.5 m)	< 1
Dolichocarpa crouchiana	Herb (<0.5 m)	< 1
Euphorbia inappendiculata var. *queenslandica*	Herb (<0.5 m)	< 1
Heliotropium crispatum	Herb (<0.5 m)	< 1
Ipomoea lonchophylla	Herb (<0.5 m)	< 1
Josephinia eugeniae	Herb (<0.5 m)	1 – 4
Nellica maderaspatensis	Herb (<0.5 m)	< 1
Operculina aequisepala	Herb (<0.5 m)	1 – 4
Rhynchosia minima	Herb (<0.5 m)	1 – 4
Sida ?rohlenae subsp. *rohlenae*	Herb (<0.5 m)	< 1
Sida fibulifera	Herb (<0.5 m)	< 1
Trianthema ?glossostigmum	Herb (<0.5 m)	< 1
Vigna sp. Hamersley Clay (A.A. Mitchell PRP 113)	Herb (<0.5 m)	1 – 4
Aristida latifolia	Tussock Grass (<0.5 m)	10 – 24
Cynodon convergens	Tussock Grass (<0.5 m)	1 – 4
Eriachne mucronata	Tussock Grass (<0.5 m)	5 – 9

BD_E_229

Date	11/03/2024	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-22.02329, 119.82777				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	< 1
Acacia inaequilatera	Shrub (>2 m)	5 – 9
Corchorus parviflorus	Shrub (0.5-1 m)	1 – 4
Senna glutinosa subsp. *glutinosa*	Shrub (0.5-1 m)	< 1
Indigofera monophylla	Shrub (<0.5 m)	< 1
Tephrosia rosea var. Fortescue creeks (M.I.H. Brooker 2186)	Shrub (<0.5 m)	< 1
Arivela viscosa	Herb (<0.5 m)	< 1
Boerhavia ?gardneri	Herb (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Euphorbia careyi	Herb (<0.5 m)	< 1
Iseilema vaginiflorum	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	33 – 49

BD_E_230

Date	11/03/2024	**Site type**	Flora: Mapping Notes	**Botanist**	BN
Location	-22.03664, 119.80756				
Landform	Crest/hill top	**Slope**	NA		
Soil colour	Red	**Soil texture**	Clay		
Rock type	Ironstone	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	< 1
Acacia ?coriacea subsp. *pendens*	Shrub (>2 m)	< 1
Atalaya hemiglauca	Shrub (>2 m)	< 1
Eremophila longifolia	Shrub (>2 m)	1 – 4
Capparis spinosa subsp. *nummularia*	Shrub (1-2 m)	< 1
Dodonaea petiolaris	Shrub (1-2 m)	1 – 4
Ficus brachypoda	Shrub (1-2 m)	< 1
Flueggea virosa subsp. *melanthesoides*	Shrub (1-2 m)	< 1
Senna glutinosa subsp. *glutinosa*	Shrub (1-2 m)	< 1
Tribulus suberosus	Shrub (0.5-1 m)	< 1
Hibiscus goldsworthii	Herb (0.5-1 m)	< 1
Boerhavia burbidgeana	Herb (<0.5 m)	< 1
Euphorbia careyi	Herb (<0.5 m)	< 1
Cymbopogon ambiguus	Tussock Grass (0.5-1 m)	1 – 4
Eriachne tenuiculmis	Tussock Grass (<0.5 m)	5 – 9
Triodia longiceps	Hummock Grass (0.5-1 m)	33 – 49

BD_E_231

Date	11/03/2024	**Site type**	Flora: Quadrat	**Botanist**	SN
Location	-22.04074, 119.79607				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Sandy clay		
Rock type	Ironstone, quartz	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	Assoc.
Acacia inaequilatera	Shrub (1-2 m)	1 – 4
Atalaya hemiglauca	Shrub (1-2 m)	5 – 9
Corchorus parviflorus	Shrub (0.5-1 m)	1 – 4
Senna glutinosa subsp. ×*luerssenii*	Shrub (0.5-1 m)	< 1
Senna symonii	Shrub (0.5-1 m)	1 – 4
Abutilon ?sp. Dioicum (A.A. Mitchell PRP 1618)	Shrub (<0.5 m)	< 1
Arivela viscosa	Herb (<0.5 m)	< 1
Boerhavia gardneri	Herb (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Euphorbia ?biconvexa	Herb (<0.5 m)	< 1
Portulaca cyclophylla	Herb (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	Assoc.
Solanum cleistogamum/horridum	Herb (<0.5 m)	< 1
Tribulus ?hirsutus	Herb (<0.5 m)	< 1
Triodia brizoides	Hummock Grass (0.5-1 m)	1 – 4
Triodia epactia	Hummock Grass (0.5-1 m)	50 – 74

BD_E_232

Date	10/03/2024	**Site type**	Flora: Quadrat	**Botanist**	AC
Location	-22.0414, 119.81126				
Landform	Major creek (5-30 m)	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Loamy sand		
Rock type	Mixed river alluvium	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	30 – 70%
Vegetation condition	Poor	**Disturbance**	High weed cover and grazing.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Eucalyptus camaldulensis	Tree (10-30 m)	5 – 9
Eucalyptus victrix	Tree (10-30 m)	5 – 9
Acacia ampliceps	Shrub (>2 m)	< 1
Acacia coriacea subsp. *pendens*	Shrub (>2 m)	1 – 4
Acacia pyrifolia	Shrub (>2 m)	1 – 4
Acacia trachycarpa	Shrub (>2 m)	1 – 4
Atalaya hemiglauca	Shrub (>2 m)	1 – 4
Grevillea pyramidalis subsp. *leucadendron*	Shrub (>2 m)	< 1
Hakea lorea subsp. *lorea*	Shrub (>2 m)	< 1
Melaleuca glomerata	Shrub (>2 m)	5 – 9
Melaleuca linophylla	Shrub (>2 m)	5 – 9
Vachellia farnesiana	Shrub (>2 m)	1 – 4
Flueggea virosa subsp. *melanthesoides*	Shrub (0.5-1 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Gossypium australe	Shrub (<0.5 m)	< 1
Cyperus vaginatus	Sedge (<0.5 m)	5 – 9
Afrohybanthus aurantiacus	Herb (1-2 m)	< 1
Alternanthera ?nana	Herb (<0.5 m)	< 1
Arivela viscosa	Herb (<0.5 m)	< 1
Boerhavia burbidgeana	Herb (<0.5 m)	1 – 4
Euphorbia australis var. *hispidula*	Herb (<0.5 m)	< 1
Indigofera linnaei	Herb (<0.5 m)	< 1
Ipomoea muelleri	Herb (<0.5 m)	< 1
Malvastrum americanum	Herb (<0.5 m)	< 1
Nellica maderaspatensis	Herb (<0.5 m)	< 1
Portulaca oleracea	Herb (<0.5 m)	1 – 4
Senna notabilis	Herb (<0.5 m)	< 1
Sida ?rohlenae subsp. *rohlenae*	Herb (<0.5 m)	< 1
Sida fibulifera	Herb (<0.5 m)	< 1
Solanum cleistogamum/horridum	Herb (<0.5 m)	< 1
Trianthema triquetrum	Herb (<0.5 m)	< 1

Name	Stratum	Percent cover (%)
Tribulus terrestris	Herb (<0.5 m)	1 – 4
?*Eulalia aurea*	Tussock Grass (0.5-1 m)	< 1
Cenchrus ciliaris	Tussock Grass (<0.5 m)	10 – 24
Triodia epactia	Hummock Grass (0.5-1 m)	1 – 4
Triodia longiceps	Hummock Grass (0.5-1 m)	5 – 9

BD_E_233

Date	11/03/2024	**Site type**	Flora: Quadrat	**Botanist**	BN
Location	-22.05044, 119.82111				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Red	**Soil texture**	Clay		
Rock type	Ironstone	**Rock size**	Mixed	**Rock cover**	30 – 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Tree (<10 m)	1 – 4
Acacia trachycarpa	Shrub (>2 m)	< 1
Corchorus parviflorus	Shrub (1-2 m)	< 1
Gossypium australe	Shrub (0.5-1 m)	< 1
Senna artemisioides subsp. *helmsii*	Shrub (<0.5 m)	< 1
Fimbristylis dichotoma	Sedge (<0.5 m)	< 1
Boerhavia burbidgeana	Herb (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Scaevola amblyanthera var. *centralis*	Herb (<0.5 m)	< 1
Aristida holathera var. *holathera*	Tussock Grass (<0.5 m)	1 – 4
Triodia epactia	Hummock Grass (0.5-1 m)	50 – 74

BD_E_234

Date	7/03/2024	**Site type**	Flora: Quadrat	**Botanist**	SN/AC
Location	-22.05059, 119.96991				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Heavy clay		
Rock type	Ironstone	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Very Good	**Disturbance**	Minor weed cover and grazing.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Vachellia farnesiana	Shrub (0.5-1 m)	< 1
Euploca ?cunninghamii	Shrub (<0.5 m)	< 1
Solanum lasiophyllum/phlomoides	Shrub (<0.5 m)	< 1
Tribulus suberosus	Shrub (<0.5 m)	< 1
Abutilon malvifolium	Herb (<0.5 m)	< 1
Afrohybanthus aurantiacus	Herb (<0.5 m)	< 1
Arivela viscosa	Herb (<0.5 m)	1 – 4
Austrobryonia pilbarensis	Herb (<0.5 m)	< 1
Boerhavia burbidgeana	Herb (<0.5 m)	< 1
Commicarpus australis	Herb (<0.5 m)	< 1
Corchorus tridens/trilocularis	Herb (<0.5 m)	< 1
Crotalaria medicaginea var. *neglecta*	Herb (<0.5 m)	< 1
Dolichocarpa crouchiana	Herb (<0.5 m)	< 1
Heliotropium crispatum	Herb (<0.5 m)	< 1
Josephinia eugeniae	Herb (<0.5 m)	< 1
Nellica maderaspatensis	Herb (<0.5 m)	< 1
Neptunia xanthonema	Herb (<0.5 m)	< 1
Operculina aequisepala	Herb (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	1 – 4
Sida ?trichopoda	Herb (<0.5 m)	< 1
Tribulus ?hirsutus	Herb (<0.5 m)	< 1
Vigna sp. Hamersley Clay (A.A. Mitchell PRP 113)	Herb (<0.5 m)	< 1
Aristida latifolia	Tussock Grass (<0.5 m)	< 1
Enneapogon caerulescens	Tussock Grass (<0.5 m)	< 1
Eriachne mucronata	Tussock Grass (<0.5 m)	< 1
Iseilema vaginiflorum	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	5 – 9

BD_E_235

Date	7/03/2024	**Site type**	Flora: Quadrat	**Botanist**	AC
Location	-22.05255, 119.99668				
Landform	Major creek (5-30 m)	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Sandy loam		
Rock type	Mixed river alluvium	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	30 – 70%
Vegetation condition	Poor	**Disturbance**	High weed cover and grazing.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Eucalyptus camaldulensis	Tree (10-30 m)	10 – 24
Eucalyptus victrix	Tree (<10 m)	1 – 4
Acacia ampliceps	Shrub (>2 m)	1 – 4
Acacia coriacea subsp. *pendens*	Shrub (>2 m)	1 – 4
Acacia pyrifolia	Shrub (>2 m)	1 – 4
Acacia trachycarpa	Shrub (>2 m)	1 – 4
Atalaya hemiglauca	Shrub (>2 m)	5 – 9
Melaleuca glomerata	Shrub (>2 m)	5 – 9
Petalostylis labicheoides	Shrub (>2 m)	< 1
Vachellia farnesiana	Shrub (>2 m)	< 1
Adriana tomentosa var. *tomentosa*	Shrub (1-2 m)	< 1
Flueggea virosa subsp. *melanthesoides*	Shrub (1-2 m)	< 1
Erythrina vespertilio	Shrub (0.5-1 m)	< 1
Cyperus vaginatus	Sedge (0.5-1 m)	5 – 9
Schoenoplectus subulatus	Sedge (0.5-1 m)	< 1
Sesbania cannabina	Herb (0.5-1 m)	< 1
Alternanthera nana	Herb (<0.5 m)	< 1
Amaranthus ?undulatus	Herb (<0.5 m)	< 1
Argemone ochroleuca subsp. *ochroleuca*	Herb (<0.5 m)	< 1
Arivela viscosa	Herb (<0.5 m)	5 – 9
Boerhavia burbidgeana	Herb (<0.5 m)	< 1
Citrullus colocynthis	Herb (<0.5 m)	< 1
Cucumis melo	Herb (<0.5 m)	< 1
Euphorbia australis var. *subtomentosa*	Herb (<0.5 m)	< 1
Euphorbia hirta	Herb (<0.5 m)	< 1
Euphorbia trigonosperma	Herb (<0.5 m)	< 1
Evolvulus alsinoides var. *villosicalyx*	Herb (<0.5 m)	< 1
Indigofera trita subsp. *trita*	Herb (<0.5 m)	< 1
Ipomoea muelleri	Herb (<0.5 m)	< 1
Malvastrum americanum	Herb (<0.5 m)	< 1
Nellica maderaspatensis	Herb (<0.5 m)	< 1

Name	Stratum	Percent cover (%)
Plumbago zeylanica	Herb (<0.5 m)	< 1
Polymeria ambigua	Herb (<0.5 m)	< 1
Portulaca oleracea	Herb (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	< 1
Tribulus hirsutus	Herb (<0.5 m)	< 1
Vigna lanceolata var. *lanceolata*	Herb (<0.5 m)	< 1
Cenchrus ciliaris	Tussock Grass (<0.5 m)	10 – 24
Cynodon dactylon	Tussock Grass (<0.5 m)	5 – 9
Triodia longiceps	Hummock Grass (0.5-1 m)	1 – 4
Potamogeton tepperi	Aquatic (<0.5 m)	< 1

BD_E_236

Date	11/03/2024	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-22.05173, 119.83045				
Landform	Midslope	**Slope**	Steep		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Grevillea pyramidalis subsp. *leucadendron*	Shrub (>2 m)	< 1
Grevillea wickhamii	Shrub (>2 m)	< 1
Acacia inaequilatera	Shrub (1-2 m)	1 – 4
Corchorus parviflorus	Shrub (<0.5 m)	1 – 4
Pentalepis trichodesmoides subsp. *trichodesmoides*	Shrub (<0.5 m)	1 – 4
Arivela viscosa	Herb (<0.5 m)	< 1
Boerhavia ?gardneri	Herb (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Euphorbia careyi	Herb (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	25 – 32

BD_E_237

Date	7/03/2024	**Site type**	Flora: Quadrat	**Botanist**	SN
Location	-22.05766, 119.99276				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Brown	**Soil texture**	Sandy clay		
Rock type	Calcrete	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Moderate (2 – 3 yrs)				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	1 – 4
Acacia inaequilatera	Shrub (>2 m)	1 – 4
Indigofera deserticola	Shrub (1-2 m)	1 – 4
Corchorus parviflorus	Shrub (0.5-1 m)	1 – 4
Senna ?stricta	Shrub (0.5-1 m)	< 1
Senna artemisioides subsp. *oligophylla*	Shrub (0.5-1 m)	< 1
Senna symonii	Shrub (0.5-1 m)	1 – 4
Acacia bivenosa	Shrub (<0.5 m)	1 – 4
Euploca chrysocarpa	Shrub (<0.5 m)	< 1
Senna glutinosa subsp. *glutinosa*	Shrub (<0.5 m)	1 – 4
Sida echinocarpa	Shrub (<0.5 m)	< 1
Solanum horridum	Herb (<0.5 m)	< 1
Paraneurachne muelleri	Tussock Grass (<0.5 m)	< 1
Triodia longiceps	Hummock Grass (<0.5 m)	5 – 9
Triodia wiseana	Hummock Grass (<0.5 m)	1 – 4

BD_E_238

Date	11/03/2024	**Site type**	Flora: Quadrat	**Botanist**	BN
Location	-22.06025, 119.79839				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Red	**Soil texture**	Clay		
Rock type	Ironstone	**Rock size**	Mixed	**Rock cover**	30 – 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Tree (<10 m)	1 – 4
Hakea lorea subsp. *lorea*	Shrub (>2 m)	< 1
Acacia adsurgens	Shrub (1-2 m)	1 – 4
Solanum lasiophyllum/phlomoides	Shrub (<0.5 m)	< 1
Arivela viscosa	Herb (<0.5 m)	< 1
Boerhavia ?gardneri	Herb (<0.5 m)	< 1
Euphorbia careyi	Herb (<0.5 m)	< 1
Sida ?sp. L (A.M. Ashby 4202)	Herb (<0.5 m)	< 1
Solanum horridum	Herb (<0.5 m)	< 1
Tribulus ?hirsutus	Herb (<0.5 m)	< 1
?Eriachne pulchella	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (0.5-1 m)	50 – 74

BD_E_239

Date	7/03/2024	**Site type**	Flora: Quadrat	**Botanist**	BN
Location	-22.06064, 119.99018				
Landform	Low hill	**Slope**	Moderate		
Soil colour	Red	**Soil texture**	Clay		
Rock type	Granite	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Tree (<10 m)	1 – 4
Senna glutinosa subsp. *glutinosa*	Shrub (1-2 m)	< 1
Alysicarpus muelleri	Herb (<0.5 m)	< 1
Arivela viscosa	Herb (<0.5 m)	1 – 4
Boerhavia ?gardneri	Herb (<0.5 m)	< 1
Indigofera trita subsp. *trita*	Herb (<0.5 m)	< 1
Sida ?sp. L (A.M. Ashby 4202)	Herb (<0.5 m)	< 1
Triodia brizoides	Hummock Grass (0.5-1 m)	10 – 24
Triodia longiceps	Hummock Grass (0.5-1 m)	10 – 24

BD_E_240

Date	7/03/2024	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-22.09448, 119.96133				
Landform	Undulating plain	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Sandy clay loam		
Rock type	Quartz	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	30 – 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Shrub (>2 m)	5 – 9
Hakea lorea subsp. *lorea*	Shrub (>2 m)	1 – 4
Acacia bivenosa	Shrub (<0.5 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Senna artemisioides subsp. *helmsii*	Shrub (<0.5 m)	< 1
Arivela viscosa	Herb (<0.5 m)	< 1
Boerhavia ?coccinea	Herb (<0.5 m)	< 1
Cucumis variabilis	Herb (<0.5 m)	< 1
Euphorbia ?tannensis subsp. *eremophila*	Herb (<0.5 m)	< 1
Goodenia muelleriana	Herb (<0.5 m)	< 1
Indigofera colutea	Herb (<0.5 m)	< 1
Nellica maderaspatensis	Herb (<0.5 m)	< 1
Ptilotus ?axillaris	Herb (<0.5 m)	< 1
Sclerolaena cornishiana	Herb (<0.5 m)	1 – 4
Trianthema ?glossostigmum	Herb (<0.5 m)	< 1
Tribulus ?hirsutus	Herb (<0.5 m)	< 1
Iseilema vaginiflorum	Tussock Grass (<0.5 m)	< 1
Triodia longiceps	Hummock Grass (0.5-1 m)	1 – 4
Triodia epactia	Hummock Grass (<0.5 m)	10 – 24

BD_E_241

Date	7/03/2024	**Site type**	Flora: Quadrat	**Botanist**	AC
Location	-22.07476, 119.98299				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Heavy clay		
Rock type	Basalt	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Very Good	**Disturbance**	Minor weed cover and grazing.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Vachellia farnesiana	Shrub (1-2 m)	1 – 4
Tribulus suberosus	Shrub (0.5-1 m)	< 1
Tephrosia sp. clay soils (S. van Leeuwen et al. PBS 0273)	Shrub (<0.5 m)	< 1
Bulbostylis turbinata	Sedge (<0.5 m)	1 – 4
Abutilon malvifolium	Herb (<0.5 m)	< 1
Arivela viscosa	Herb (<0.5 m)	5 – 9
Austrobryonia pilbarensis	Herb (<0.5 m)	< 1
Boerhavia burbidgeana	Herb (<0.5 m)	< 1
Boerhavia paludosa	Herb (<0.5 m)	< 1
Corchorus tridens/trilocularis	Herb (<0.5 m)	< 1
Crotalaria medicaginea var. *neglecta*	Herb (<0.5 m)	1 – 4
Cucumis variabilis	Herb (<0.5 m)	< 1
Dolichocarpa crouchiana	Herb (<0.5 m)	< 1
Euphorbia inappendiculata var. *queenslandica*	Herb (<0.5 m)	< 1
Goodenia muelleriana	Herb (<0.5 m)	< 1
Heliotropium crispatum	Herb (<0.5 m)	< 1
Josephinia eugeniae	Herb (<0.5 m)	< 1
Nellica maderaspatensis	Herb (<0.5 m)	< 1
Neptunia xanthonema	Herb (<0.5 m)	1 – 4
Operculina aequisepala	Herb (<0.5 m)	1 – 4
Senna notabilis	Herb (<0.5 m)	< 1
Sida fibulifera	Herb (<0.5 m)	1 – 4
Solanum cleistogamum/horridum	Herb (<0.5 m)	< 1
Streptoglossa ?odora	Herb (<0.5 m)	< 1
Tribulus ?hirsutus	Herb (<0.5 m)	< 1
Vigna sp. Hamersley Clay (A.A. Mitchell PRP 113)	Herb (<0.5 m)	< 1
Aristida latifolia	Tussock Grass (<0.5 m)	10 – 24
Dichanthium sericeum subsp. *humilius*	Tussock Grass (<0.5 m)	1 – 4
Eriachne mucronata	Tussock Grass (<0.5 m)	1 – 4
Iseilema vaginiflorum	Tussock Grass (<0.5 m)	5 – 9
Triodia brizoides	Hummock Grass (<0.5 m)	1 – 4

Name	Stratum	Percent cover (%)
Triodia epactia	Hummock Grass (<0.5 m)	5 – 9

BD_E_242

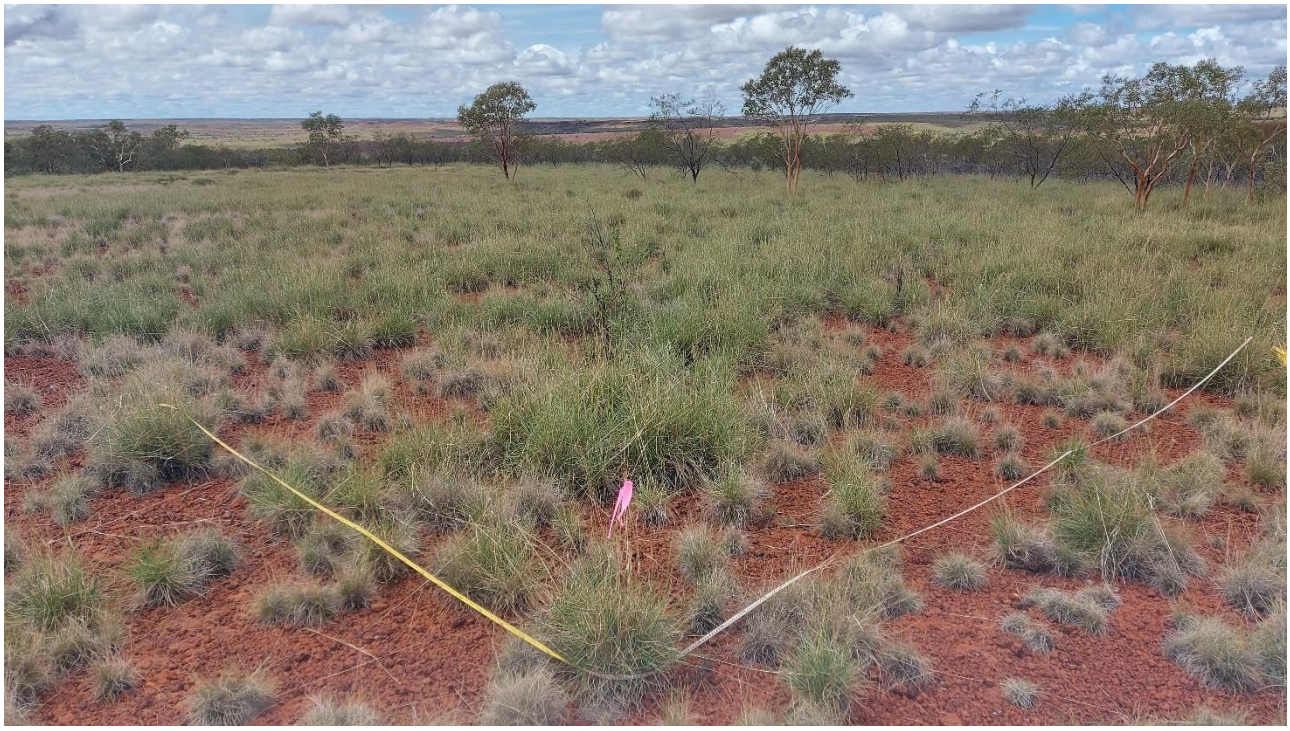
Date	11/03/2024	**Site type**	Flora: Quadrat	**Botanist**	SN/AC
Location	-22.07814, 119.81344				
Landform	Major creek (5-30 m)	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Sandy clay		
Rock type	Mixed river alluvium	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	< 10%
Vegetation condition	Degraded	**Disturbance**	High weed cover and heavy grazing.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Eucalyptus camaldulensis	Tree (<10 m)	10 – 24
Eucalyptus victrix	Tree (<10 m)	5 – 9
Acacia coriacea subsp. *pendens*	Shrub (>2 m)	1 – 4
Atalaya hemiglauca	Shrub (>2 m)	1 – 4
Vachellia farnesiana	Shrub (>2 m)	1 – 4
Melaleuca glomerata	Shrub (1-2 m)	5 – 9
Melaleuca linophylla	Shrub (1-2 m)	1 – 4
Acacia pyrifolia	Shrub (0.5-1 m)	< 1
Gossypium australe	Shrub (<0.5 m)	< 1
Afrohybanthus aurantiacus	Herb (<0.5 m)	< 1
Arivela viscosa	Herb (<0.5 m)	< 1
Boerhavia ?coccinea	Herb (<0.5 m)	< 1
Boerhavia coccinea	Herb (<0.5 m)	1 – 4
Cucumis variabilis	Herb (<0.5 m)	< 1
Euphorbia ?biconvexa	Herb (<0.5 m)	< 1
Ipomoea muelleri	Herb (<0.5 m)	< 1
Portulaca cyclophylla	Herb (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	< 1
Trianthema ?glossostigmum	Herb (<0.5 m)	1 – 4
Cenchrus ciliaris	Tussock Grass (<0.5 m)	50 – 74
Cenchrus setiger	Tussock Grass (<0.5 m)	< 1
Triodia longiceps	Hummock Grass (0.5-1 m)	10 – 24

BD_E_243

Date	11/03/2024	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-22.08176, 119.79988				
Landform	Crest/hill top	**Slope**	Gentle		
Soil colour	Brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	5 – 9
Acacia monticola	Shrub (>2 m)	5 – 9
Senna glutinosa subsp. ×*luerssenii*	Shrub (>2 m)	5 – 9
Senna glutinosa subsp. *glutinosa*	Shrub (>2 m)	1 – 4
Senna symonii	Shrub (0.5-1 m)	1 – 4
Indigofera monophylla	Shrub (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Euphorbia ?biconvexa	Herb (<0.5 m)	< 1
Ptilotus exaltatus	Herb (<0.5 m)	< 1
Solanum horridum	Herb (<0.5 m)	< 1
Eriachne lanata	Tussock Grass (<0.5 m)	10 – 24
Eriachne mucronata	Tussock Grass (<0.5 m)	1 – 4
Triodia epactia	Hummock Grass (<0.5 m)	25 – 32

BD_E_244

Date	7/03/2024	**Site type**	Flora: Quadrat	**Botanist**	AC
Location	-22.08509, 119.93835				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone, quartz	**Rock size**	Fine gravel [to c. 5 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia pruinocarpa	Shrub (>2 m)	1 – 4
Acacia ?aptaneura	Shrub (1-2 m)	1 – 4
Acacia ancistrocarpa	Shrub (1-2 m)	1 – 4
Acacia bivenosa	Shrub (1-2 m)	5 – 9
Acacia tenuissima	Shrub (1-2 m)	< 1
Capparis umbonata	Shrub (1-2 m)	< 1
Senna glutinosa subsp. ×*luerssenii*	Shrub (1-2 m)	5 – 9
Senna glutinosa subsp. *glutinosa*	Shrub (1-2 m)	< 1
Eremophila forrestii subsp. *forrestii*	Shrub (0.5-1 m)	< 1
Senna artemisioides subsp. *helmsii*	Shrub (0.5-1 m)	< 1
Senna symonii	Shrub (0.5-1 m)	1 – 4
Indigofera monophylla	Shrub (<0.5 m)	< 1
Paraneurachne muelleri	Tussock Grass (<0.5 m)	< 1
Triodia longiceps	Hummock Grass (0.5-1 m)	25 – 32
Triodia brizoides	Hummock Grass (<0.5 m)	< 1

BD_E_245

Date	7/03/2024	**Site type**	Flora: Quadrat	**Botanist**	BN
Location	-22.08633, 119.9533				
Landform	Crest/hill top	**Slope**	Moderate		
Soil colour	Red	**Soil texture**	Clay		
Rock type	Granite	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Tree (<10 m)	1 – 4
Senna glutinosa subsp. *glutinosa*	Shrub (1-2 m)	< 1
Pentalepis trichodesmoides subsp. *trichodesmoides*	Shrub (0.5-1 m)	< 1
Arivela viscosa	Herb (<0.5 m)	< 1
Euphorbia careyi	Herb (<0.5 m)	< 1
Sida ?sp. L (A.M. Ashby 4202)	Herb (<0.5 m)	< 1
Tribulus ?*hirsutus*	Herb (<0.5 m)	< 1
Triodia longiceps	Hummock Grass (0.5-1 m)	33 – 49

BD_E_246

Date	11/03/2024	**Site type**	Flora: Quadrat	**Botanist**	AC
Location	-22.08702, 119.80926				
Landform	Upland plain	**Slope**	Gentle		
Soil colour	Brown	**Soil texture**	Heavy clay		
Rock type	Basalt	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Very Good	**Disturbance**	Minor weed cover and grazing.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Vachellia farnesiana	Shrub (>2 m)	5 – 9
Acacia synchronicia	Shrub (0.5-1 m)	< 1
Solanum lasiophyllum/phlomoides	Shrub (<0.5 m)	< 1
Tephrosia sp. clay soils (S. van Leeuwen et al. PBS 0273)	Shrub (<0.5 m)	< 1
Arivela viscosa	Herb (<0.5 m)	< 1
Boerhavia ?burbidgeana	Herb (<0.5 m)	1 – 4
Boerhavia coccinea	Herb (<0.5 m)	< 1
Corchorus tridens/trilocularis	Herb (<0.5 m)	< 1
Desmodiopsis campylocaulon	Herb (<0.5 m)	< 1
Dolichocarpa crouchiana	Herb (<0.5 m)	< 1
Heliotropium crispatum	Herb (<0.5 m)	< 1
Indigofera trita subsp. *trita*	Herb (<0.5 m)	< 1
Ipomoea muelleri	Herb (<0.5 m)	< 1
Nellica maderaspatensis	Herb (<0.5 m)	< 1
Portulaca oleracea	Herb (<0.5 m)	< 1
Ptilotus gomphrenoides	Herb (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	1 – 4
Senna notabilis	Herb (<0.5 m)	< 1
Sida ?rohlenae subsp. *rohlenae*	Herb (<0.5 m)	< 1
Sida fibulifera	Herb (<0.5 m)	< 1
Enneapogon caerulescens	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (0.5-1 m)	1 – 4
Triodia longiceps	Hummock Grass (<0.5 m)	< 1

BD_E_247

Date	11/03/2024	**Site type**	Flora: Mapping Notes	**Botanist**	BN
Location	-22.08812, 119.79835				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Red	**Soil texture**	Clay		
Rock type	Ironstone	**Rock size**	Mixed	**Rock cover**	30 – 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	1 – 4
Acacia bivenosa	Shrub (1-2 m)	< 1
Senna symonii	Shrub (0.5-1 m)	< 1
Triodia epactia	Hummock Grass (0.5-1 m)	33 – 49

BD_E_248

Date	6/03/2024	**Site type**	Flora: Quadrat	**Botanist**	BN
Location	-22.33799, 119.72244				
Landform	Undulating plain	**Slope**	Moderate		
Soil colour	Red	**Soil texture**	Clay		
Rock type	Ironstone	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	1 – 4
Acacia adsurgens	Shrub (1-2 m)	< 1
Hakea lorea subsp. *lorea*	Shrub (1-2 m)	< 1
Senna glutinosa subsp. *glutinosa*	Shrub (1-2 m)	< 1
Senna symonii	Shrub (0.5-1 m)	< 1
Triodia brizoides	Hummock Grass (0.5-1 m)	33 – 49
Triodia longiceps	Hummock Grass (0.5-1 m)	5 – 9

BD_E_249

Date	7/03/2024	**Site type**	Flora: Releve	**Botanist**	SH
Location	-22.07359, 119.96593				
Landform	Major creek (5-30 m)	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Sand		
Rock type	Mixed river alluvium	**Rock size**	Rocky with outcroppings	**Rock cover**	30 – 70%
Vegetation condition	Good	**Disturbance**	Moderate weed cover, minor grazing.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Eucalyptus victrix	Tree (10-30 m)	10 – 24
Acacia coriacea subsp. *pendens*	Shrub (>2 m)	1 – 4
Acacia inaequilatera	Shrub (>2 m)	5 – 9
Acacia tumida var. *pilbarensis*	Shrub (>2 m)	10 – 24
Atalaya hemiglauca	Shrub (>2 m)	5 – 9
Grevillea wickhamii	Shrub (>2 m)	1 – 4
Acacia bivenosa	Shrub (1-2 m)	< 1
Gossypium australe	Shrub (0.5-1 m)	< 1
Indigofera monophylla	Shrub (<0.5 m)	< 1
Sida echinocarpa	Shrub (<0.5 m)	< 1
Tephrosia rosea var. Fortescue creeks (M.I.H. Brooker 2186)	Shrub (<0.5 m)	< 1
Cyperus vaginatus	Sedge (<0.5 m)	1 – 4
Afrohybanthus aurantiacus	Herb (<0.5 m)	< 1
Arivela viscosa	Herb (<0.5 m)	< 1
Ipomoea muelleri	Herb (<0.5 m)	< 1
Nellica maderaspatensis	Herb (<0.5 m)	< 1
Polymeria ambigua	Herb (<0.5 m)	< 1
Cymbopogon ambiguus	Tussock Grass (1-2 m)	1 – 4
Cenchrus ciliaris	Tussock Grass (<0.5 m)	10 – 24
Triodia epactia	Hummock Grass (0.5-1 m)	5 – 9

BD_E_250

Date	12/03/2024	**Site type**	Flora: Quadrat	**Botanist**	AC
Location	-22.3124, 119.78842				
Landform	Major creek (5-30 m)	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Loamy sand		
Rock type	Mixed river alluvium	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Good	**Disturbance**	Moderate weed cover, minor grazing.		
Time since fire	Long (> 3 yrs)				

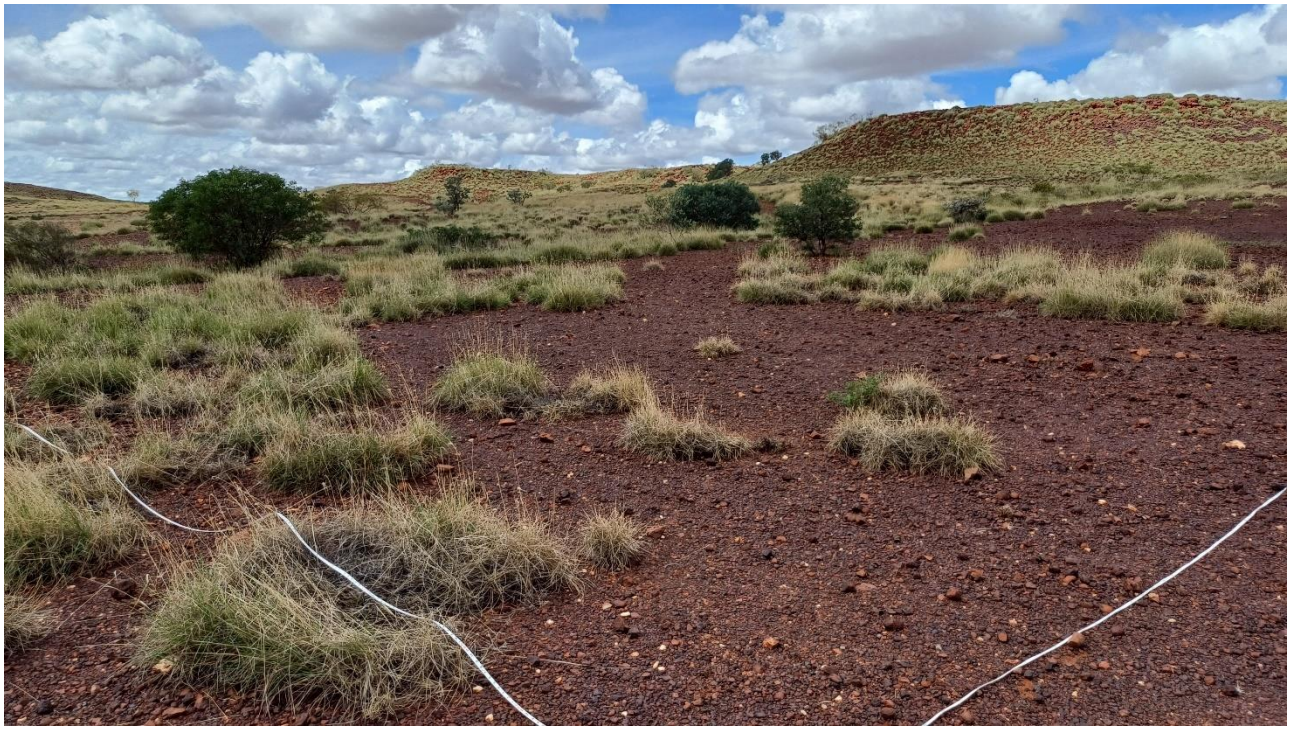


Name	Stratum	Percent cover (%)
Eucalyptus camaldulensis	Tree (10-30 m)	1 – 4
Eucalyptus victrix	Tree (10-30 m)	5 – 9
Acacia bivenosa	Shrub (>2 m)	< 1
Acacia coriacea subsp. *pendens*	Shrub (>2 m)	5 – 9
Acacia pyrifolia	Shrub (>2 m)	< 1
Acacia trachycarpa	Shrub (>2 m)	5 – 9
Atalaya hemiglauca	Shrub (>2 m)	1 – 4
Gossypium robinsonii	Shrub (>2 m)	< 1
Grevillea wickhamii subsp. *hispidula*	Shrub (>2 m)	< 1
Melaleuca glomerata	Shrub (>2 m)	1 – 4
Melaleuca linophylla	Shrub (>2 m)	1 – 4
Indigofera monophylla	Shrub (0.5-1 m)	1 – 4
Jasminum didymum subsp. *lineare*	Shrub (0.5-1 m)	< 1
Aerva javanica	Shrub (<0.5 m)	< 1
Corchorus lasiocarpus subsp. *parvus*	Shrub (<0.5 m)	< 1
Tephrosia rosea	Shrub (<0.5 m)	1 – 4
Cyperus vaginatus	Sedge (<0.5 m)	1 – 4
Abutilon ?amplum	Herb (<0.5 m)	< 1
Afrohybanthus aurantiacus	Herb (<0.5 m)	< 1
Alternanthera denticulata var. *denticulata*	Herb (<0.5 m)	< 1
Amaranthus ?undulatus	Herb (<0.5 m)	< 1
Arivela viscosa	Herb (<0.5 m)	< 1
Boerhavia burbidgeana	Herb (<0.5 m)	< 1
Boerhavia coccinea	Herb (<0.5 m)	< 1
Cucumis variabilis	Herb (<0.5 m)	< 1
Duperreya commixta	Herb (<0.5 m)	< 1
Euphorbia ?trigonosperma	Herb (<0.5 m)	< 1
Euphorbia australis var. *subtomentosa*	Herb (<0.5 m)	< 1
Evolvulus alsinoides var. *decumbens*	Herb (<0.5 m)	< 1
Glycine canescens	Herb (<0.5 m)	< 1
Indigofera trita subsp. *trita*	Herb (<0.5 m)	< 1

Name	Stratum	Percent cover (%)
Ipomoea plebeia	Herb (<0.5 m)	< 1
Nellica maderaspatensis	Herb (<0.5 m)	< 1
Notoleptopus decaisnei	Herb (<0.5 m)	< 1
Polycarpaea longiflora	Herb (<0.5 m)	< 1
Polymeria ambigua	Herb (<0.5 m)	< 1
Portulaca oleracea	Herb (<0.5 m)	< 1
Ptilotus exaltatus	Herb (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	< 1
Scaevola amblyanthera var. *centralis*	Herb (<0.5 m)	< 1
Senna notabilis	Herb (<0.5 m)	< 1
Trianthema triquetrum	Herb (<0.5 m)	< 1
Tribulus ?hirsutus	Herb (<0.5 m)	< 1
Trigastrotheca molluginea	Herb (<0.5 m)	< 1
Eriachne tenuiculmis	Tussock Grass (0.5-1 m)	1 – 4
Cenchrus ciliaris	Tussock Grass (<0.5 m)	5 – 9
Cenchrus setiger	Tussock Grass (<0.5 m)	5 – 9
Cymbopogon ambiguus	Tussock Grass (<0.5 m)	< 1
Themeda triandra	Tussock Grass (<0.5 m)	< 1
Triodia longiceps	Hummock Grass (0.5-1 m)	1 – 4
Triodia epactia	Hummock Grass (<0.5 m)	5 – 9

BD_E_251

Date	11/03/2024	**Site type**	Flora: Quadrat	**Botanist**	AC
Location	-22.10209, 119.80935				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone, basalt	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia bivenosa	Shrub (>2 m)	< 1
Acacia inaequilatera	Shrub (>2 m)	< 1
Acacia pruinocarpa	Shrub (>2 m)	5 – 9
Grevillea wickhamii	Shrub (>2 m)	< 1
Senna glutinosa subsp. *×luerssenii*	Shrub (0.5-1 m)	< 1
Euploca ?cunninghamii	Shrub (<0.5 m)	< 1
Hibiscus sturtii var. *campylochlamys*	Shrub (<0.5 m)	< 1
Sida echinocarpa	Shrub (<0.5 m)	< 1
Tribulus suberosus	Shrub (<0.5 m)	< 1
Arivela viscosa	Herb (<0.5 m)	< 1
Boerhavia coccinea	Herb (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Euphorbia trigonosperma	Herb (<0.5 m)	< 1
Euploca heterantha	Herb (<0.5 m)	< 1
Ptilotus obovatus var. *obovatus*	Herb (<0.5 m)	< 1
Sclerolaena ?densiflora	Herb (<0.5 m)	< 1
Solanum cleistogamum/horridum	Herb (<0.5 m)	< 1
Cymbopogon ambiguus	Tussock Grass (<0.5 m)	< 1
Sporobolus australasicus	Tussock Grass (<0.5 m)	< 1
Tripogonella loliiformis	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (0.5-1 m)	10 – 24
Triodia longiceps	Hummock Grass (0.5-1 m)	< 1
Triodia brizoides	Hummock Grass (<0.5 m)	1 – 4

BD_E_252

Date	15/07/2024	**Site type**	Flora: Quadrat	**Botanist**	SN/AS
Location	-22.39745, 119.68915				
Landform	Plain	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Sandy clay		
Rock type	Ironstone	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia ?aptaneura	Shrub (>2 m)	5 – 9
Acacia synchronicia	Shrub (>2 m)	5 – 9
Acacia tetragonophylla	Shrub (>2 m)	Assoc.
Acacia pruinocarpa	Shrub (1-2 m)	< 1
Senna artemisioides subsp. *oligophylla*	Shrub (1-2 m)	1 – 4
Eremophila latrobei subsp. *filiformis*	Shrub (0.5-1 m)	< 1
Abutilon lepidum	Herb (<0.5 m)	< 1
Arivela viscosa	Herb (<0.5 m)	5 – 9
Goodenia prostrata	Herb (<0.5 m)	< 1
Portulaca oleracea	Herb (<0.5 m)	< 1
Ptilotus exaltatus	Herb (<0.5 m)	1 – 4
Sclerolaena costata	Herb (<0.5 m)	< 1
Aristida contorta	Tussock Grass (<0.5 m)	5 – 9
Enneapogon polyphyllus	Tussock Grass (<0.5 m)	1 – 4
Sporobolus australasicus	Tussock Grass (<0.5 m)	< 1

BD_E_253

Date	7/03/2024	**Site type**	Flora: Quadrat	**Botanist**	SN
Location	-22.10532, 119.94294				
Landform	Major creek (5-30 m)	**Slope**	NA		
Soil colour	Brown	**Soil texture**	Sand		
Rock type	Mixed river alluvium	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Poor	**Disturbance**	High weed cover and grazing.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Eucalyptus camaldulensis	Tree (10-30 m)	Assoc.
Eucalyptus victrix	Tree (10-30 m)	10 – 24
Acacia tumida var. *pilbarensis*	Shrub (>2 m)	5 – 9
Acacia colei var. *colei*	Shrub (1-2 m)	1 – 4
Acacia coriacea subsp. *pendens*	Shrub (1-2 m)	< 1
Acacia pyrifolia var. *pyrifolia*	Shrub (1-2 m)	1 – 4
Melaleuca linophylla	Shrub (1-2 m)	5 – 9
Grevillea wickhamii	Shrub (0.5-1 m)	< 1
Senna glutinosa subsp. *glutinosa*	Shrub (0.5-1 m)	< 1
Atalaya hemiglauca	Shrub (<0.5 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Hibiscus coatesii	Shrub (<0.5 m)	< 1
Hibiscus sturtii var. *platychlamys*	Shrub (<0.5 m)	< 1
Tephrosia rosea var. Fortescue creeks (M.I.H. Brooker 2186)	Shrub (<0.5 m)	1 – 4
Cyperus vaginatus	Sedge (0.5-1 m)	5 – 9
Afrohybanthus aurantiacus	Herb (<0.5 m)	< 1
Alternanthera nana	Herb (<0.5 m)	< 1
Arivela viscosa	Herb (<0.5 m)	< 1
Boerhavia coccinea	Herb (<0.5 m)	< 1
Boerhavia gardneri	Herb (<0.5 m)	1 – 4
Dysphania rhadinostachya	Herb (<0.5 m)	< 1
Euphorbia biconvexa	Herb (<0.5 m)	1 – 4
Evolvulus alsinoides	Herb (<0.5 m)	< 1
Indigofera trita subsp. *trita*	Herb (<0.5 m)	< 1
Ipomoea polymorpha	Herb (<0.5 m)	< 1
Nellica maderaspatensis	Herb (<0.5 m)	< 1
Polymeria ambigua	Herb (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	1 – 4
Scaevola amblyanthera var. *centralis*	Herb (<0.5 m)	1 – 4
Tribulus ?hirsutus	Herb (<0.5 m)	< 1
Cenchrus ciliaris	Tussock Grass (0.5-1 m)	25 – 32

Name	Stratum	Percent cover (%)
Cenchrus setiger	Tussock Grass (0.5-1 m)	1 – 4
Cymbopogon ambiguus	Tussock Grass (0.5-1 m)	1 – 4
Paraneurachne muelleri	Tussock Grass (0.5-1 m)	< 1
Sporobolus australasicus	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (0.5-1 m)	10 – 24

BD_E_254

Date	11/03/2024	**Site type**	Flora: Quadrat	**Botanist**	SN
Location	-22.10792, 119.80081				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay		
Rock type	Ironstone	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Very Good	**Disturbance**	Minor weed cover and grazing.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Shrub (>2 m)	1 – 4
Senna symonii	Shrub (0.5-1 m)	< 1
Sida sp. Pilbara (A.A. Mitchell PRP 1543)	Shrub (<0.5 m)	< 1
Afrohybanthus aurantiacus	Herb (<0.5 m)	< 1
Arivela viscosa	Herb (<0.5 m)	< 1
Boerhavia ?coccinea	Herb (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Euphorbia ?biconvexa	Herb (<0.5 m)	1 – 4
Ipomoea muelleri	Herb (<0.5 m)	< 1
Portulaca cyclophylla	Herb (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	< 1
Senna notabilis	Herb (<0.5 m)	< 1
Solanum cleistogamum/horridum	Herb (<0.5 m)	< 1
Trianthema ?glossostigmum	Herb (<0.5 m)	< 1
Cenchrus ciliaris	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (0.5-1 m)	50 – 74

BD_E_255

Date	7/03/2024	**Site type**	Flora: Quadrat	**Botanist**	BN
Location	-22.11173, 119.97341				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Red	**Soil texture**	Clay		
Rock type	Ironstone	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	< 1
Acacia bivenosa	Shrub (1-2 m)	1 – 4
Grevillea wickhamii subsp. *aprica*	Shrub (1-2 m)	< 1
Senna symonii	Shrub (0.5-1 m)	< 1
Ptilotus astrolasius	Shrub (<0.5 m)	< 1
Senna glutinosa subsp. *glutinosa*	Shrub (<0.5 m)	< 1
Goodenia stobbsiana	Herb (<0.5 m)	< 1
Cymbopogon ambiguus	Tussock Grass (0.5-1 m)	< 1
Eriachne lanata	Tussock Grass (<0.5 m)	< 1
Eriachne mucronata	Tussock Grass (<0.5 m)	1 – 4
Triodia longiceps	Hummock Grass (0.5-1 m)	5 – 9
Triodia epactia	Hummock Grass (<0.5 m)	5 – 9

BD_E_256

Date	7/03/2024	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-22.11251, 119.96017				
Landform	Low hill	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	Assoc.
Acacia inaequilatera	Shrub (>2 m)	1 – 4
Senna glutinosa subsp. *glutinosa*	Shrub (1-2 m)	1 – 4
Indigofera monophylla	Shrub (<0.5 m)	< 1
Tribulus suberosus	Shrub (<0.5 m)	1 – 4
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	10 – 24
Triodia wiseana	Hummock Grass (<0.5 m)	25 – 32

BD_E_257

Date	7/03/2024	**Site type**	Flora: Quadrat	**Botanist**	BN
Location	-22.11545, 119.94928				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Red	**Soil texture**	Clay		
Rock type	Granite	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Tree (<10 m)	< 1
Corchorus lasiocarpus	Shrub (0.5-1 m)	< 1
Senna artemisioides subsp. *oligophylla*	Shrub (0.5-1 m)	< 1
Arivela viscosa	Herb (<0.5 m)	1 – 4
Euphorbia careyi	Herb (<0.5 m)	< 1
Triodia longiceps	Hummock Grass (0.5-1 m)	33 – 49

BD_E_258

Date	7/03/2024	**Site type**	Flora: Quadrat	**Botanist**	AC
Location	-22.11994, 119.93828				
Landform	Low hill	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Basalt	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Shrub (>2 m)	1 – 4
Grevillea pyramidalis subsp. *leucadendron*	Shrub (>2 m)	1 – 4
Hakea lorea subsp. *lorea*	Shrub (>2 m)	< 1
Senna glutinosa subsp. *glutinosa*	Shrub (1-2 m)	< 1
Senna glutinosa subsp. *pruinosa*	Shrub (1-2 m)	1 – 4
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Sida sp. Pilbara (A.A. Mitchell PRP 1543)	Shrub (<0.5 m)	< 1
Tephrosia sp. NW Eremaean (S. van Leeuwen et al. PBS 0356)	Shrub (<0.5 m)	< 1
Tribulus suberosus	Shrub (<0.5 m)	< 1
Arivela viscosa	Herb (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Dolichocarpa crouchiana	Herb (<0.5 m)	< 1
Tribulus hirsutus	Herb (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	50 – 74

BD_E_259

Date	7/03/2024	**Site type**	Flora: Quadrat	**Botanist**	BN
Location	-22.12229, 119.97187				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Red	**Soil texture**	Clay		
Rock type	Ironstone	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Tree (<10 m)	1 – 4
Acacia ?coriacea subsp. *pendens*	Shrub (1-2 m)	< 1
Corchorus parviflorus	Shrub (0.5-1 m)	< 1
Hibiscus sturtii var. *platychlamys*	Shrub (<0.5 m)	< 1
Pterocaulon ?sphacelatum	Shrub (<0.5 m)	< 1
Indigofera trita subsp. *trita*	Herb (<0.5 m)	< 1
Senna notabilis	Herb (<0.5 m)	< 1
Triodia brizoides	Hummock Grass (0.5-1 m)	10 – 24
Triodia longiceps	Hummock Grass (0.5-1 m)	10 – 24

BD_E_260

Date	12/03/2024	**Site type**	Flora: Quadrat	**Botanist**	SN/AC
Location	-22.12214, 119.97323				
Landform	River (> 30 m)	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Mixed river alluvium	**Rock size**	NA	**Rock cover**	NA
Vegetation condition	Degraded	**Disturbance**	High weed cover and heavy grazing.		
Time since fire	No evidence				

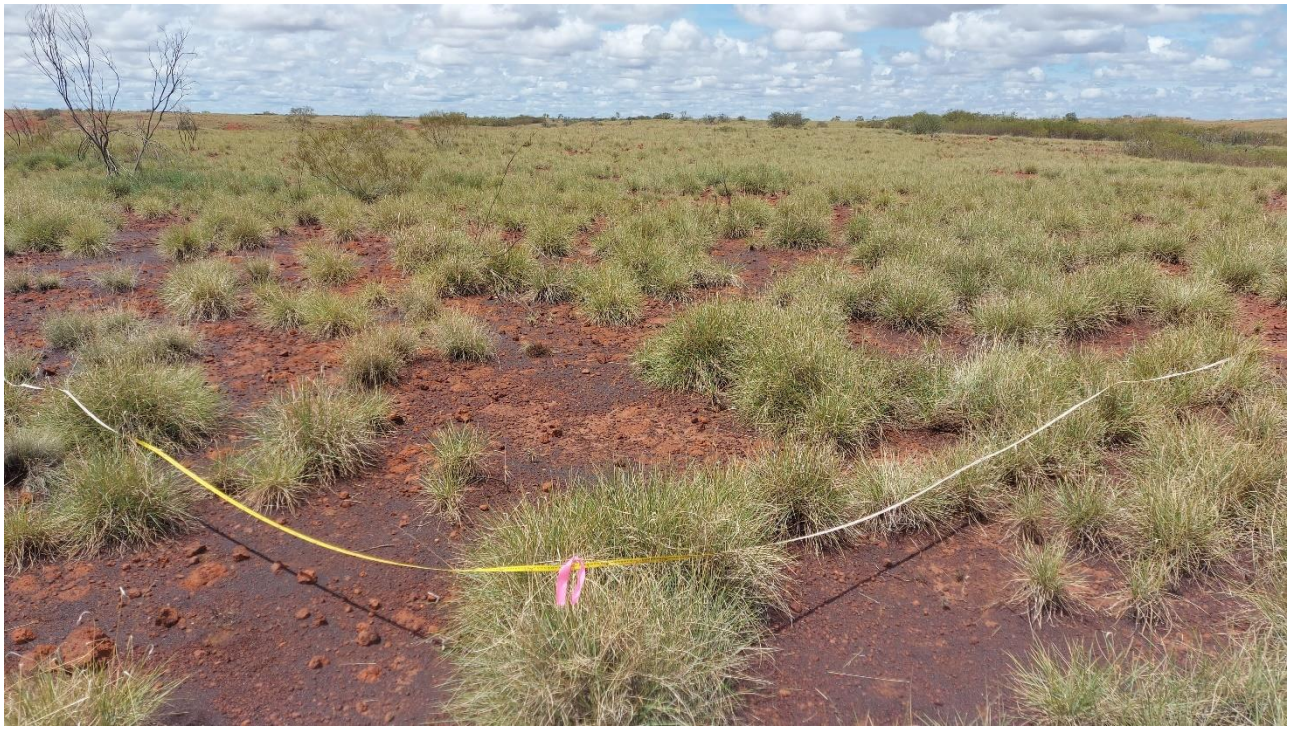


Name	Stratum	Percent cover (%)
Eucalyptus camaldulensis	Tree (10-30 m)	5 – 9
Eucalyptus victrix	Tree (10-30 m)	5 – 9
Acacia ampliceps	Shrub (>2 m)	< 1
Acacia coriacea subsp. *pendens*	Shrub (>2 m)	5 – 9
Acacia trachycarpa	Shrub (>2 m)	1 – 4
Atalaya hemiglauca	Shrub (>2 m)	5 – 9
Melaleuca glomerata	Shrub (>2 m)	5 – 9
Melaleuca linophylla	Shrub (>2 m)	5 – 9
Petalostylis labicheoides	Shrub (>2 m)	< 1
Vachellia farnesiana	Shrub (1-2 m)	1 – 4
Acacia pyrifolia	Shrub (0.5-1 m)	< 1
Crotalaria cunninghamii subsp. *sturtii*	Shrub (0.5-1 m)	< 1
Aerva javanica	Shrub (<0.5 m)	< 1
Eremophila longifolia	Shrub (<0.5 m)	< 1
Cyperus vaginatus	Sedge (0.5-1 m)	5 – 9
Alternanthera denticulata var. *denticulata*	Herb (<0.5 m)	< 1
Amaranthus ?undulatus	Herb (<0.5 m)	< 1
Arivela viscosa	Herb (<0.5 m)	< 1
Boerhavia burbidgeana	Herb (<0.5 m)	< 1
Citrullus colocynthis	Herb (<0.5 m)	< 1
Corchorus tridens/trilocularis	Herb (<0.5 m)	< 1
Cucumis variabilis	Herb (<0.5 m)	< 1
Euphorbia ?biconvexa	Herb (<0.5 m)	< 1
Euphorbia australis var. *subtomentosa*	Herb (<0.5 m)	< 1
Euphorbia hirta	Herb (<0.5 m)	< 1
Euphorbia trigonosperma	Herb (<0.5 m)	< 1
Indigofera linnaei	Herb (<0.5 m)	< 1
Ipomoea muelleri	Herb (<0.5 m)	< 1
Ipomoea plebeia	Herb (<0.5 m)	< 1
Ipomoea polymorpha	Herb (<0.5 m)	< 1
Malvastrum americanum	Herb (<0.5 m)	< 1

Name	Stratum	Percent cover (%)
Marsilea ?*exarata*	Herb (<0.5 m)	< 1
Nellica maderaspatensis	Herb (<0.5 m)	< 1
Portulaca oleracea	Herb (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	< 1
Rostellularia adscendens var. *clementii*	Herb (<0.5 m)	< 1
Sesbania cannabina	Herb (<0.5 m)	< 1
Stemodia grossa	Herb (<0.5 m)	< 1
Trianthema ?*glossostigmum*	Herb (<0.5 m)	< 1
Trianthema portulacastrum	Herb (<0.5 m)	< 1
Trianthema triquetrum	Herb (<0.5 m)	< 1
Vigna lanceolata var. *lanceolata*	Herb (<0.5 m)	< 1
Cenchrus ciliaris	Tussock Grass (<0.5 m)	75 – 94
Cenchrus setiger	Tussock Grass (<0.5 m)	10 – 24
Cynodon dactylon	Tussock Grass (<0.5 m)	< 1
Dactyloctenium radulans	Tussock Grass (<0.5 m)	< 1
Triodia longiceps	Hummock Grass (1-2 m)	5 – 9
?*Amyema benthamii*	Parasitic/Epiphytic	< 1

BD_E_261

Date	11/03/2024	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-22.13049, 119.84303				
Landform	Low hill	**Slope**	Gentle		
Soil colour	Orange	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Rocky with outcroppings	**Rock cover**	30 – 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Acacia ?adsurgens	Shrub (1-2 m)	1 – 4
Acacia monticola	Shrub (1-2 m)	< 1
Acacia pruinocarpa	Shrub (1-2 m)	1 – 4
Eriachne lanata	Tussock Grass (<0.5 m)	1 – 4
Eriachne mucronata	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	25 – 32

BD_E_262

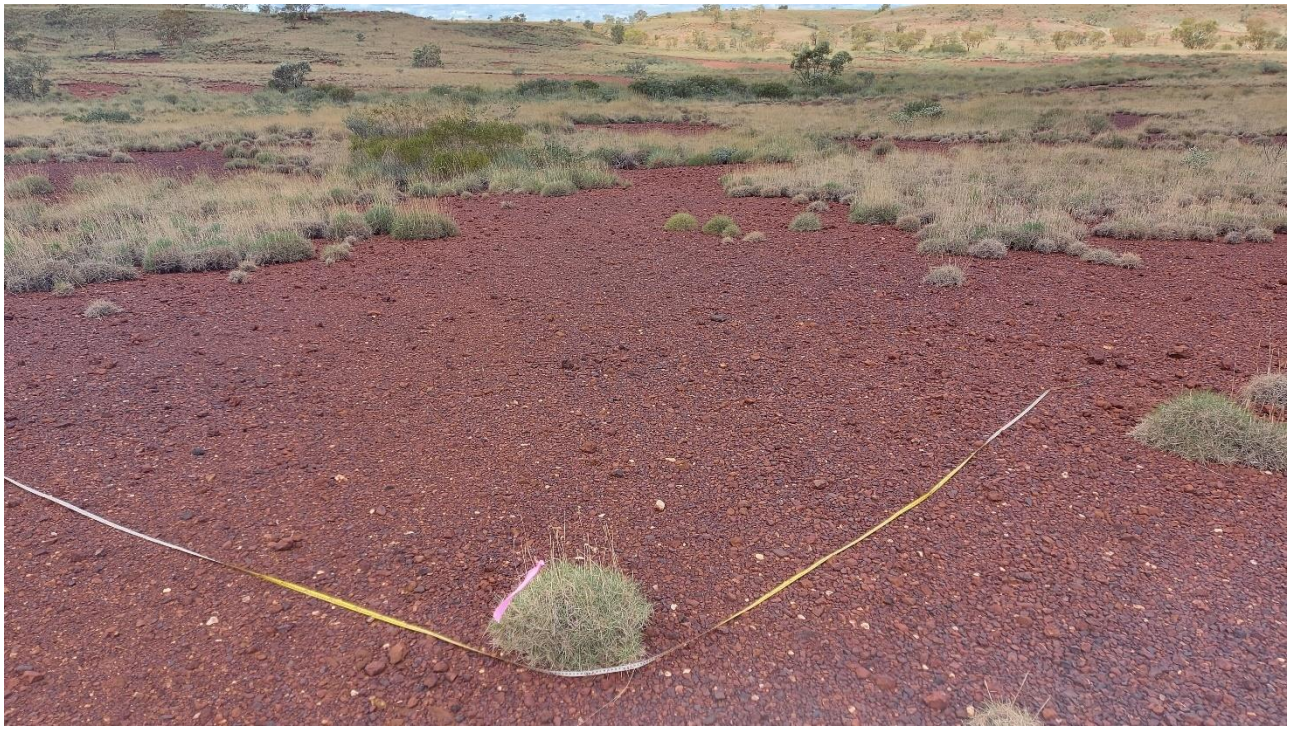
Date	11/03/2024	**Site type**	Flora: Quadrat	**Botanist**	BN
Location	-22.13214, 119.85001				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Orange	**Soil texture**	Clay loam		
Rock type	Quartz	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	1 – 4
Acacia bivenosa	Shrub (1-2 m)	< 1
Senna symonii	Shrub (0.5-1 m)	< 1
Pluchea tetranthera	Shrub (<0.5 m)	< 1
Triodia longiceps	Hummock Grass (0.5-1 m)	50 – 74

BD_E_263

Date	11/03/2024	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-22.13573, 119.83468				
Landform	Midslope	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Sandy clay loam		
Rock type	Ironstone	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Senna glutinosa subsp. ×*luerssenii*	Shrub (1-2 m)	1 – 4
Senna sericea	Shrub (1-2 m)	1 – 4
Acacia ?adsurgens	Shrub (0.5-1 m)	1 – 4
Acacia bivenosa	Shrub (0.5-1 m)	1 – 4
Senna glutinosa subsp. *pruinosa*	Shrub (0.5-1 m)	< 1
Senna symonii	Shrub (0.5-1 m)	1 – 4
Triodia longiceps	Hummock Grass (0.5-1 m)	5 – 9
Triodia wiseana	Hummock Grass (<0.5 m)	25 – 32

BD_E_264

Date	7/03/2024	**Site type**	Flora: Quadrat	**Botanist**	SN
Location	-22.14141, 119.96026				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Light brown	**Soil texture**	Sand		
Rock type	Calcrete	**Rock size**	Fine gravel [to c. 5 mm]	**Rock cover**	> 70%
Vegetation condition	Very Good	**Disturbance**	Minor weed cover and grazing.		
Time since fire	Moderate (2 – 3 yrs)				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	< 1
Acacia inaequilatera	Shrub (1-2 m)	1 – 4
Acacia synchronicia	Shrub (0.5-1 m)	1 – 4
Atalaya hemiglauca	Shrub (<0.5 m)	< 1
Enchylaena tomentosa var. *tomentosa*	Shrub (<0.5 m)	< 1
Solanum phlomoides	Shrub (<0.5 m)	< 1
Arivela viscosa	Herb (<0.5 m)	1 – 4
Boerhavia gardneri	Herb (<0.5 m)	1 – 4
Euphorbia ?biconvexa	Herb (<0.5 m)	1 – 4
Evolvulus alsinoides	Herb (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	1 – 4
Senna notabilis	Herb (<0.5 m)	< 1
Tribulus ?hirsutus	Herb (<0.5 m)	< 1
Cenchrus setiger	Tussock Grass (<0.5 m)	< 1
Triodia longiceps	Hummock Grass (0.5-1 m)	1 – 4
Triodia wiseana	Hummock Grass (<0.5 m)	5 – 9

BD_E_265

Date	11/03/2024	**Site type**	Flora: Quadrat	**Botanist**	AC
Location	-22.1428, 119.82906				
Landform	Crest/hill top	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	1 – 4
Acacia monticola	Shrub (>2 m)	5 – 9
Grevillea wickhamii	Shrub (>2 m)	5 – 9
Acacia bivenosa	Shrub (1-2 m)	< 1
Senna glutinosa subsp. *glutinosa*	Shrub (1-2 m)	< 1
Dampiera candicans	Herb (<0.5 m)	1 – 4
Goodenia stobbsiana	Herb (<0.5 m)	< 1
Amphipogon sericeus	Tussock Grass (<0.5 m)	< 1
Eriachne lanata	Tussock Grass (<0.5 m)	5 – 9
Eriachne mucronata	Tussock Grass (<0.5 m)	Assoc.
Triodia epactia	Hummock Grass (<0.5 m)	25 – 32

BD_E_266

Date	7/03/2024	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-22.1431, 119.96275				
Landform	Low hill	**Slope**	NA		
Soil colour	Brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	1 – 4
Acacia inaequilatera	Shrub (>2 m)	< 1
Hakea lorea subsp. *lorea*	Shrub (>2 m)	< 1
Senna glutinosa subsp. *glutinosa*	Shrub (<0.5 m)	< 1
Sida sp. Pilbara (A.A. Mitchell PRP 1543)	Shrub (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	10 – 24

BD_E_267

Date	7/03/2024	**Site type**	Flora: Quadrat	**Botanist**	AC
Location	-22.15199, 119.97054				
Landform	Low hill	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Basalt	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Shrub (>2 m)	1 – 4
Grevillea pyramidalis subsp. *leucadendron*	Shrub (>2 m)	Assoc.
Acacia pruinocarpa	Shrub (1-2 m)	< 1
Acacia trachycarpa	Shrub (1-2 m)	1 – 4
Gossypium australe	Shrub (1-2 m)	< 1
Acacia tetragonophylla	Shrub (0.5-1 m)	< 1
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Tephrosia sp. NW Eremaean (S. van Leeuwen et al. PBS 0356)	Shrub (<0.5 m)	< 1
Arivela viscosa	Herb (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Cucumis variabilis	Herb (<0.5 m)	< 1
Euphorbia ?tannensis subsp. *eremophila*	Herb (<0.5 m)	< 1
Polygala glaucifolia	Herb (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	< 1
Senna notabilis	Herb (<0.5 m)	< 1
Tribulus hirsutus	Herb (<0.5 m)	< 1
Sporobolus australasicus	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	5 – 9
Triodia wiseana	Hummock Grass (<0.5 m)	50 – 74

BD_E_268

Date	11/03/2024	**Site type**	Flora: Quadrat	**Botanist**	SN/AC/SH
Location	-22.15761, 119.80685				
Landform	Crest/hill top	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Sandy clay		
Rock type	Ironstone	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	1 – 4
Acacia ?aptaneura	Shrub (1-2 m)	< 1
Senna symonii	Shrub (1-2 m)	1 – 4
Acacia bivenosa	Shrub (0.5-1 m)	< 1
Senna sericea	Shrub (0.5-1 m)	1 – 4
Acacia synchronicia	Shrub (<0.5 m)	1 – 4
Capparis umbonata	Shrub (<0.5 m)	< 1
Senna glutinosa subsp. *pruinosa*	Shrub (<0.5 m)	< 1
Fimbristylis dichotoma	Sedge (<0.5 m)	< 1
Eriachne lanata	Tussock Grass (<0.5 m)	1 – 4
Eriachne mucronata	Tussock Grass (<0.5 m)	1 – 4
Triodia brizoides	Hummock Grass (<0.5 m)	25 – 32
Triodia epactia	Hummock Grass (<0.5 m)	10 – 24

BD_E_269

Date	7/03/2024	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-22.16777, 119.96313				
Landform	Plain	**Slope**	Gentle		
Soil colour	Brown	**Soil texture**	Loam		
Rock type	Ironstone	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	1 – 4
Acacia bivenosa	Shrub (1-2 m)	5 – 9
Acacia synchronicia	Shrub (0.5-1 m)	1 – 4
Petalostylis labicheoides	Shrub (0.5-1 m)	1 – 4
Corchorus parviflorus	Shrub (<0.5 m)	< 1
Euploca chrysocarpa	Shrub (<0.5 m)	< 1
Indigofera monophylla	Shrub (<0.5 m)	< 1
Tribulus ?hirsutus	Herb (<0.5 m)	< 1
Triodia longiceps	Hummock Grass (<0.5 m)	1 – 4
Triodia wiseana	Hummock Grass (<0.5 m)	25 – 32

BD_E_270

Date	12/03/2024	**Site type**	Flora: Quadrat	**Botanist**	SN
Location	-22.16924, 119.8083				
Landform	Plain	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Sandy clay		
Rock type	Quartz	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	1 – 4
Hakea lorea subsp. *lorea*	Shrub (>2 m)	1 – 4
Acacia inaequilatera	Shrub (1-2 m)	1 – 4
Acacia orthocarpa	Shrub (1-2 m)	< 1
Acacia bivenosa	Shrub (0.5-1 m)	1 – 4
Senna symonii	Shrub (0.5-1 m)	< 1
Acacia synchronicia	Shrub (<0.5 m)	5 – 9
Euploca chrysocarpa	Shrub (<0.5 m)	< 1
Arivela viscosa	Herb (<0.5 m)	< 1
Boerhavia gardneri	Herb (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	Assoc.
Rhynchosia minima	Herb (<0.5 m)	< 1
Salsola australis	Herb (<0.5 m)	< 1
Senna notabilis	Herb (<0.5 m)	< 1
Tribulus ?hirsutus	Herb (<0.5 m)	< 1
Triodia epactia	Hummock Grass (0.5-1 m)	33 – 49

BD_E_271

Date	12/03/2024	**Site type**	Flora: Quadrat	**Botanist**	SH/BN
Location	-22.17148, 119.97356				
Landform	Plain	**Slope**	NA		
Soil colour	Orange	**Soil texture**	Clay loam		
Rock type	Quartz	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	30 – 70%
Vegetation condition	Very Good	**Disturbance**	Minor weed cover and grazing.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia synchronicia	Shrub (>2 m)	10 – 24
Acacia inaequilatera	Shrub (1-2 m)	1 – 4
Vachellia farnesiana	Shrub (1-2 m)	< 1
Senna glutinosa subsp. ×*luerssenii*	Shrub (0.5-1 m)	1 – 4
Corchorus parviflorus	Shrub (<0.5 m)	1 – 4
Solanum lasiophyllum	Shrub (<0.5 m)	< 1
?*Enchylaena tomentosa*	Herb (<0.5 m)	< 1
Abutilon sp. Dioicum (A.A. Mitchell PRP 1618)	Herb (<0.5 m)	< 1
Arivela viscosa	Herb (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Corchorus tridens/trilocularis	Herb (<0.5 m)	< 1
Euphorbia ?biconvexa	Herb (<0.5 m)	< 1
Euphorbia vaccaria var. *vaccaria*	Herb (<0.5 m)	< 1
Polymeria ambigua	Herb (<0.5 m)	< 1
Senna notabilis	Herb (<0.5 m)	< 1
Sida fibulifera	Herb (<0.5 m)	< 1
Solanum horridum	Herb (<0.5 m)	< 1
Cenchrus ciliaris	Tussock Grass (<0.5 m)	1 – 4
Triodia longiceps	Hummock Grass (0.5-1 m)	1 – 4
Triodia brizoides	Hummock Grass (<0.5 m)	10 – 24

BD_E_272

Date	12/03/2024	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-22.18346, 119.83739				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Shrub (>2 m)	1 – 4
Grevillea pyramidalis subsp. *leucadendron*	Shrub (>2 m)	1 – 4
Tephrosia sp. NW Eremaean (S. van Leeuwen et al. PBS 0356)	Shrub (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	25 – 32

BD_E_273

Date	12/03/2024	**Site type**	Flora: Quadrat	**Botanist**	BN
Location	-22.19009, 119.8116				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Red	**Soil texture**	Clay		
Rock type	Ironstone	**Rock size**	Mixed	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	1 – 4
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	< 1
Acacia adsurgens	Shrub (>2 m)	1 – 4
Eremophila latrobei subsp. *latrobei*	Shrub (>2 m)	1 – 4
Grevillea pyramidalis subsp. *leucadendron*	Shrub (>2 m)	1 – 4
Hakea lorea subsp. *lorea*	Shrub (1-2 m)	< 1
Fimbristylis dichotoma	Sedge (<0.5 m)	< 1
Indigofera trita subsp. *trita*	Herb (0.5-1 m)	< 1
Arivela viscosa	Herb (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Trigastrotheca molluginea	Herb (<0.5 m)	< 1
Triodia brizoides	Hummock Grass (0.5-1 m)	25 – 32
Triodia epactia	Hummock Grass (0.5-1 m)	10 – 24

BD_E_274

Date	12/03/2024	**Site type**	Flora: Quadrat	**Botanist**	SN
Location	-22.247, 119.8133				
Landform	Undulating plain	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Sandy clay		
Rock type	Ironstone	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	Assoc.
Senna glutinosa subsp. ×*luerssenii*	Shrub (1-2 m)	< 1
Acacia bivenosa	Shrub (0.5-1 m)	< 1
Grevillea pyramidalis subsp. *leucadendron*	Shrub (0.5-1 m)	< 1
Ptilotus calostachyus	Shrub (0.5-1 m)	< 1
Indigofera monophylla	Shrub (<0.5 m)	1 – 4
Goodenia stobbsiana	Herb (<0.5 m)	< 1
Triodia brizoides	Hummock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	75 – 94

BD_E_275

Date	12/03/2024	**Site type**	Flora: Quadrat	**Botanist**	BN
Location	-22.25276, 119.81924				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Red	**Soil texture**	Clay		
Rock type	Granite	**Rock size**	Mixed	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Tree (<10 m)	1 – 4
Corymbia hamersleyana	Tree (<10 m)	1 – 4
Acacia pruinocarpa	Shrub (>2 m)	1 – 4
Grevillea pyramidalis subsp. *leucadendron*	Shrub (>2 m)	1 – 4
Hakea lorea subsp. *lorea*	Shrub (>2 m)	1 – 4
Acacia bivenosa	Shrub (1-2 m)	< 1
Acacia tetragonophylla	Shrub (1-2 m)	< 1
Corchorus parviflorus	Shrub (0.5-1 m)	< 1
Senna glutinosa subsp. *pruinosa*	Shrub (0.5-1 m)	< 1
Gossypium australe	Shrub (<0.5 m)	< 1
Solanum lasiophyllum/phlomoides	Shrub (<0.5 m)	< 1
Afrohybanthus aurantiacus	Herb (<0.5 m)	< 1
Boerhavia coccinea	Herb (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Cucumis variabilis	Herb (<0.5 m)	< 1
Euphorbia tannensis subsp. *eremophila*	Herb (<0.5 m)	< 1
Cymbopogon ambiguus	Tussock Grass (<0.5 m)	< 1
Paraneurachne muelleri	Tussock Grass (<0.5 m)	< 1
Paspalidium clementii	Tussock Grass (<0.5 m)	< 1
Paspalidium rarum	Tussock Grass (<0.5 m)	< 1
Triodia brizoides	Hummock Grass (0.5-1 m)	50 – 74

BD_E_276

Date	12/03/2024	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-22.25397, 119.81087				
Landform	Undulating plain	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Heavy clay		
Rock type	Ironstone	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	30 – 70%
Vegetation condition	Very Good	**Disturbance**	Minor weed cover and grazing.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Vachellia farnesiana	Shrub (0.5-1 m)	< 1
Euploca cunninghamii	Shrub (<0.5 m)	< 1
Fimbristylis dichotoma	Sedge (<0.5 m)	10 – 24
Arivela viscosa	Herb (<0.5 m)	1 – 4
Boerhavia ?coccinea	Herb (<0.5 m)	1 – 4
Boerhavia ?gardneri	Herb (<0.5 m)	1 – 4
Boerhavia ?schomburgkiana	Herb (<0.5 m)	< 1
Crotalaria dissitiflora subsp. *benthamiana*	Herb (<0.5 m)	5 – 9
Crotalaria medicaginea var. *neglecta*	Herb (<0.5 m)	5 – 9
Euphorbia ?biconvexa	Herb (<0.5 m)	1 – 4
Grona muelleri	Herb (<0.5 m)	5 – 9
Indigofera linifolia	Herb (<0.5 m)	< 1
Ipomoea lonchophylla	Herb (<0.5 m)	1 – 4
Ipomoea polymorpha	Herb (<0.5 m)	< 1
Josephinia eugeniae	Herb (<0.5 m)	< 1
Neptunia longipila	Herb (<0.5 m)	1 – 4
Operculina aequisepala	Herb (<0.5 m)	25 – 32
Rhynchosia minima	Herb (<0.5 m)	1 – 4
Sida ?fibulifera	Herb (<0.5 m)	< 1
Streptoglossa ?odora	Herb (<0.5 m)	< 1
Trianthema ?glossostigmum	Herb (<0.5 m)	< 1
Aristida latifolia	Tussock Grass (<0.5 m)	10 – 24
Cenchrus ciliaris	Tussock Grass (<0.5 m)	< 1
Cynodon convergens	Tussock Grass (<0.5 m)	5 – 9
Eragrostis setifolia	Tussock Grass (<0.5 m)	< 1
Eriachne mucronata	Tussock Grass (<0.5 m)	10 – 24

BD_E_277

Date	12/03/2024	**Site type**	Flora: Quadrat	**Botanist**	AC
Location	-22.27079, 119.80983				
Landform	Crest/hill top	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Basalt	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	Assoc.
Acacia pruinocarpa	Shrub (>2 m)	5 – 9
Hakea lorea subsp. *lorea*	Shrub (>2 m)	< 1
Eremophila latrobei subsp. *latrobei*	Shrub (1-2 m)	< 1
Senna glutinosa subsp. ×*luerssenii*	Shrub (1-2 m)	1 – 4
Senna glutinosa subsp. *glutinosa*	Shrub (1-2 m)	1 – 4
Tephrosia rosea	Shrub (0.5-1 m)	< 1
Hibiscus sturtii var. *campylochlamys*	Shrub (<0.5 m)	< 1
Indigofera monophylla	Shrub (<0.5 m)	< 1
Solanum lasiophyllum/phlomoides	Shrub (<0.5 m)	< 1
Arivela viscosa	Herb (<0.5 m)	< 1
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Cucumis variabilis	Herb (<0.5 m)	< 1
Portulaca oleracea	Herb (<0.5 m)	< 1
Eriachne pulchella subsp. *dominii*	Tussock Grass (<0.5 m)	< 1
Tripogonella loliiformis	Tussock Grass (<0.5 m)	1 – 4
Triodia epactia	Hummock Grass (0.5-1 m)	33 – 49

BD_E_278

Date	12/03/2024	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-22.28693, 119.7911				
Landform	Crest/hill top	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	1 – 4
Acacia bivenosa	Shrub (1-2 m)	< 1
Ehretia saligna var. *saligna*	Shrub (1-2 m)	1 – 4
Grevillea wickhamii	Shrub (1-2 m)	< 1
Senna glutinosa subsp. *pruinosa*	Shrub (1-2 m)	1 – 4
Acacia inaequilatera	Shrub (0.5-1 m)	1 – 4
Grevillea pyramidalis subsp. *leucadendron*	Shrub (0.5-1 m)	< 1
Hakea lorea subsp. *lorea*	Shrub (0.5-1 m)	< 1
Indigofera monophylla	Shrub (<0.5 m)	1 – 4
Arivela viscosa	Herb (<0.5 m)	< 1
Rhynchosia minima	Herb (<0.5 m)	< 1
Eriachne lanata	Tussock Grass (<0.5 m)	5 – 9
Iseilema vaginiflorum	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	33 – 49

BD_E_279

Date	12/03/2024	**Site type**	Flora: Quadrat	**Botanist**	BN
Location	-22.29237, 119.79641				
Landform	Hill	**Slope**	Moderate		
Soil colour	Red	**Soil texture**	Clay		
Rock type	Ironstone, quartz	**Rock size**	Rocky with outcroppings	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	1 – 4
Acacia pruinocarpa	Shrub (>2 m)	1 – 4
Acacia tenuissima	Shrub (>2 m)	< 1
Acacia acradenia	Shrub (1-2 m)	< 1
Acacia inaequilatera	Shrub (1-2 m)	< 1
Triodia epactia	Hummock Grass (<0.5 m)	25 – 32

BD_E_280

Date	12/03/2024	**Site type**	Flora: Quadrat	**Botanist**	SN
Location	-22.3017, 119.78839				
Landform	Hill	**Slope**	Steep		
Soil colour	Reddish brown	**Soil texture**	Sandy clay		
Rock type	Ironstone	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Acacia bivenosa	Shrub (1-2 m)	< 1
Acacia inaequilatera	Shrub (1-2 m)	< 1
Acacia synchronicia	Shrub (1-2 m)	< 1
Ptilotus calostachyus	Shrub (1-2 m)	< 1
Senna glutinosa subsp. ×*luerssenii*	Shrub (1-2 m)	< 1
Senna glutinosa subsp. *glutinosa*	Shrub (1-2 m)	< 1
Senna glutinosa subsp. *pruinosa*	Shrub (1-2 m)	< 1
Senna symonii	Shrub (1-2 m)	< 1
Pluchea ferdinandi-muelleri	Shrub (0.5-1 m)	Assoc.
Tribulus suberosus	Shrub (<0.5 m)	< 1
Senna notabilis	Herb (<0.5 m)	< 1
Triodia brizoides	Hummock Grass (0.5-1 m)	< 1
Triodia epactia	Hummock Grass (0.5-1 m)	< 1
Triodia longiceps	Hummock Grass (0.5-1 m)	< 1

BD_E_281

Date	12/03/2024	**Site type**	Flora: Releve	**Botanist**	SH
Location	-22.30524, 119.79089				
Landform	Minor creek (< 5 m)	**Slope**	NA		
Soil colour	Brown	**Soil texture**	Sand		
Rock type	Mixed river alluvium	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	10 – 30%
Vegetation condition	Poor	**Disturbance**	High weed cover and grazing.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Eucalyptus victrix	Tree (10-30 m)	25 – 32
Acacia coriacea subsp. *pendens*	Shrub (>2 m)	1 – 4
Acacia pyrifolia	Shrub (>2 m)	5 – 9
Acacia trachycarpa	Shrub (>2 m)	5 – 9
Capparis umbonata	Shrub (>2 m)	1 – 4
Vachellia farnesiana	Shrub (0.5-1 m)	< 1
Ehretia saligna var. *saligna*	Shrub (<0.5 m)	< 1
Indigofera monophylla	Shrub (<0.5 m)	1 – 4
Cyperus vaginatus	Sedge (<0.5 m)	1 – 4
Abutilon sp. Dioicum (A.A. Mitchell PRP 1618)	Herb (<0.5 m)	< 1
Alternanthera nana	Herb (<0.5 m)	< 1
Arivela viscosa	Herb (<0.5 m)	1 – 4
Boerhavia ?coccinea	Herb (<0.5 m)	< 1
Euphorbia ?biconvexa	Herb (<0.5 m)	< 1
Ipomoea muelleri	Herb (<0.5 m)	< 1
Ipomoea plebeia	Herb (<0.5 m)	< 1
Cymbopogon ambiguus	Tussock Grass (0.5-1 m)	1 – 4
Cenchrus ciliaris	Tussock Grass (<0.5 m)	25 – 32
Eriachne mucronata	Tussock Grass (<0.5 m)	< 1
Triodia longiceps	Hummock Grass (0.5-1 m)	5 – 9
Triodia epactia	Hummock Grass (<0.5 m)	1 – 4

BD_E_282

Date	6/03/2024	**Site type**	Flora: Quadrat	**Botanist**	SN
Location	-22.31767, 119.74061				
Landform	Plain	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Sandy clay loam		
Rock type	Calcrete	**Rock size**	Fine gravel [to c. 5 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	5 – 9
Acacia synchronicia	Shrub (1-2 m)	< 1
Eremophila longifolia	Shrub (0.5-1 m)	1 – 4
Jasminum didymum subsp. *lineare*	Shrub (0.5-1 m)	< 1
Senna ?stricta	Shrub (0.5-1 m)	1 – 4
Senna glutinosa subsp. ×*luerssenii*	Shrub (0.5-1 m)	1 – 4
Acacia bivenosa	Shrub (<0.5 m)	< 1
Ehretia saligna var. *saligna*	Shrub (<0.5 m)	< 1
Euploca chrysocarpa	Shrub (<0.5 m)	1 – 4
Psydrax suaveolens	Shrub (<0.5 m)	< 1
Scaevola spinescens	Shrub (<0.5 m)	Assoc.
Senna artemisioides subsp. *oligophylla*	Shrub (<0.5 m)	1 – 4
Scaevola amblyanthera var. *centralis*	Herb (<0.5 m)	< 1
Tribulus ?hirsutus	Herb (<0.5 m)	< 1
Eragrostis desertorum	Tussock Grass (<0.5 m)	< 1
Paraneurachne muelleri	Tussock Grass (<0.5 m)	< 1
Triodia longiceps	Hummock Grass (0.5-1 m)	1 – 4
Triodia wiseana	Hummock Grass (<0.5 m)	10 – 24

BD_E_283

Date	6/03/2024	**Site type**	Flora: Quadrat	**Botanist**	AC
Location	-22.32035, 119.76534				
Landform	Plain	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Basalt	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia ?aptaneura	Shrub (>2 m)	10 – 24
Acacia ayersiana	Shrub (>2 m)	1 – 4
Acacia pruinocarpa	Shrub (>2 m)	1 – 4
Acacia synchronicia	Shrub (>2 m)	5 – 9
Senna glutinosa subsp. *×luerssenii*	Shrub (>2 m)	1 – 4
Acacia bivenosa	Shrub (1-2 m)	< 1
Psydrax suaveolens	Shrub (1-2 m)	< 1
Senna ?stricta	Shrub (1-2 m)	< 1
Dodonaea petiolaris	Shrub (0.5-1 m)	< 1
Eremophila cuneifolia	Shrub (0.5-1 m)	1 – 4
Eremophila latrobei subsp. *filiformis*	Shrub (0.5-1 m)	1 – 4
Senna artemisioides subsp. *oligophylla*	Shrub (0.5-1 m)	< 1
Solanum lasiophyllum	Shrub (0.5-1 m)	< 1
Eremophila forrestii subsp. *forrestii*	Shrub (<0.5 m)	< 1
Hibiscus burtonii	Shrub (<0.5 m)	< 1
Hibiscus sturtii var. *campylochlamys*	Shrub (<0.5 m)	< 1
Ptilotus schwartzii	Shrub (<0.5 m)	1 – 4
Duperreya commixta	Herb (1-2 m)	< 1
Afrohybanthus aurantiacus	Herb (0.5-1 m)	< 1
Cheilanthes sieberi subsp. *sieberi*	Herb (<0.5 m)	< 1
Tribulus hirsutus	Herb (<0.5 m)	< 1
Eriachne mucronata	Tussock Grass (<0.5 m)	< 1
Sporobolus australasicus	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (0.5-1 m)	5 – 9
Triodia longiceps	Hummock Grass (<0.5 m)	5 – 9

BD_E_284

Date	6/03/2024	**Site type**	Flora: Quadrat	**Botanist**	SN
Location	-22.3189, 119.75643				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Sandy clay		
Rock type	Ironstone	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Acacia ?aptaneura	Shrub (>2 m)	5 – 9
Acacia pruinocarpa	Shrub (1-2 m)	1 – 4
Acacia bivenosa	Shrub (0.5-1 m)	1 – 4
Eremophila cuneifolia	Shrub (0.5-1 m)	1 – 4
Senna ?stricta	Shrub (0.5-1 m)	< 1
Senna glutinosa subsp. ×*luerssenii*	Shrub (0.5-1 m)	1 – 4
Ptilotus schwartzii	Shrub (<0.5 m)	< 1
Cheilanthes sieberi subsp. *sieberi*	Herb (<0.5 m)	< 1
Sida ?fibulifera	Herb (<0.5 m)	< 1
Aristida contorta	Tussock Grass (<0.5 m)	< 1
Triodia longiceps	Hummock Grass (0.5-1 m)	1 – 4
Triodia brizoides	Hummock Grass (<0.5 m)	5 – 9

BD_E_285

Date	6/03/2024	**Site type**	Flora: Quadrat	**Botanist**	AC
Location	-22.32202, 119.74539				
Landform	Hill	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Basalt	**Rock size**	Cobbles [c. 60 - 260 mm]	**Rock cover**	> 70%
Vegetation condition	Very Good	**Disturbance**	Minor weed cover and grazing.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	Assoc.
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	Assoc.
Grevillea wickhamii	Shrub (>2 m)	1 – 4
Ptilotus calostachyus	Shrub (1-2 m)	< 1
Aerva javanica	Shrub (0.5-1 m)	< 1
Corchorus lasiocarpus subsp. *parvus*	Shrub (0.5-1 m)	1 – 4
Senna glutinosa subsp. *glutinosa*	Shrub (0.5-1 m)	1 – 4
Solanum lasiophyllum/phlomoides	Shrub (0.5-1 m)	< 1
Tribulus suberosus	Shrub (0.5-1 m)	1 – 4
Sida sp. Pilbara (A.A. Mitchell PRP 1543)	Shrub (<0.5 m)	< 1
Goodenia stobbsiana	Herb (0.5-1 m)	1 – 4
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Dampiera candicans	Herb (<0.5 m)	< 1
Senna notabilis	Herb (<0.5 m)	< 1
Cymbopogon ambiguus	Tussock Grass (1-2 m)	< 1
Eriachne mucronata	Tussock Grass (<0.5 m)	1 – 4
Triodia basedowii	Hummock Grass (<0.5 m)	25 – 32
Triodia epactia	Hummock Grass (<0.5 m)	25 – 32

BD_E_286

Date	6/03/2024	**Site type**	Flora: Quadrat	**Botanist**	SH/BN
Location	-22.32772, 119.71995				
Landform	Low hill	**Slope**	Moderate		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	5 – 9
Acacia ?aptaneura	Shrub (>2 m)	5 – 9
Senna glutinosa subsp. *glutinosa*	Shrub (1-2 m)	< 1
Corchorus lasiocarpus	Shrub (0.5-1 m)	< 1
Indigofera monophylla	Shrub (<0.5 m)	< 1
Sida ?sp. *Golden calyces glabrous (H.N. Foote 32)*	Shrub (<0.5 m)	< 1
Tribulus suberosus	Shrub (<0.5 m)	< 1
Afrohybanthus aurantiacus	Herb (0.5-1 m)	< 1
Goodenia cusackiana	Herb (<0.5 m)	< 1
Goodenia stobbsiana	Herb (<0.5 m)	< 1
Triodia epactia	Hummock Grass (0.5-1 m)	10 – 24
Triodia longiceps	Hummock Grass (0.5-1 m)	10 – 24

BD_E_287

Date	6/03/2024	**Site type**	Flora: Releve	**Botanist**	SH
Location	-22.33515, 119.7199				
Landform	Crest/hill top	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Sandy clay		
Rock type	Ironstone	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Eucalyptus leucophloia subsp. *leucophloia*	Tree (<10 m)	1 – 4
Acacia pruinocarpa	Shrub (>2 m)	5 – 9
Grevillea wickhamii	Shrub (>2 m)	1 – 4
Dodonaea coriacea	Shrub (1-2 m)	< 1
Senna glutinosa subsp. *glutinosa*	Shrub (1-2 m)	1 – 4
Senna sericea	Shrub (0.5-1 m)	< 1
Tribulus suberosus	Shrub (0.5-1 m)	1 – 4
Ptilotus astrolasius	Shrub (<0.5 m)	1 – 4
Ptilotus schwartzii	Shrub (<0.5 m)	< 1
Dampiera candicans	Herb (<0.5 m)	< 1
Duperreya commixta	Herb (<0.5 m)	< 1
Ptilotus exaltatus	Herb (<0.5 m)	< 1
Trigastrotheca molluginea	Herb (<0.5 m)	< 1
Eriachne mucronata	Tussock Grass (<0.5 m)	< 1
Triodia brizoides	Hummock Grass (<0.5 m)	25 – 32
Triodia epactia	Hummock Grass (<0.5 m)	10 – 24

BD_E_288

Date	15/07/2024	**Site type**	Flora: Quadrat	**Botanist**	AC
Location	-22.39413, 119.68722				
Landform	Plain	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Mixed	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	< 10%
Vegetation condition	Very Good	**Disturbance**	Minor weed cover and grazing.		
Time since fire	Long (> 3 yrs)				

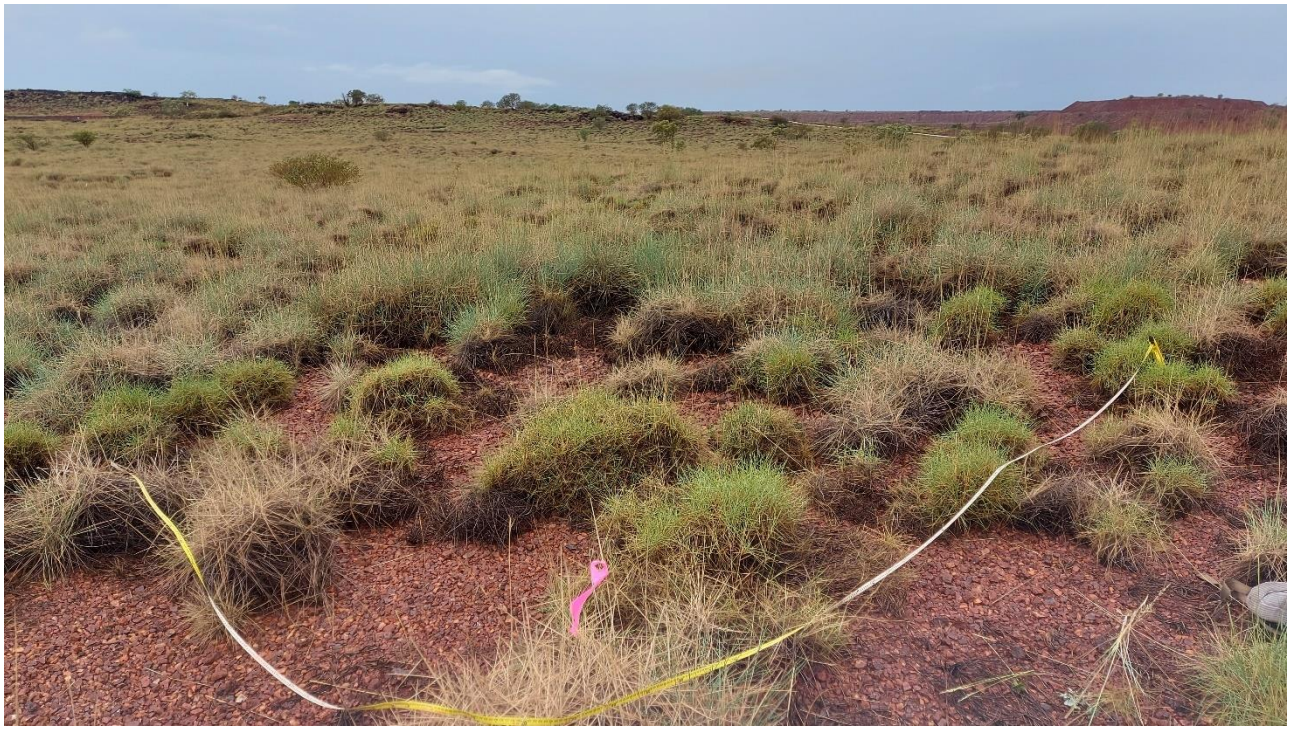


Name	Stratum	Percent cover (%)
Acacia ?aptaneura	Shrub (>2 m)	25 – 32
Acacia pruinocarpa	Shrub (>2 m)	< 1
Hakea lorea subsp. *lorea*	Shrub (>2 m)	< 1
Psydrax latifolia	Shrub (>2 m)	< 1
Acacia tetragonophylla	Shrub (1-2 m)	1 – 4
Senna artemisioides subsp. *helmsii*	Shrub (1-2 m)	< 1
Eremophila forrestii subsp. *forrestii*	Shrub (0.5-1 m)	< 1
Eremophila latrobei subsp. *filiformis*	Shrub (<0.5 m)	< 1
Maireana planifolia	Shrub (<0.5 m)	< 1
Ptilotus obovatus var. *obovatus*	Shrub (<0.5 m)	< 1
Fimbristylis dichotoma	Sedge (<0.5 m)	< 1
Abutilon lepidum	Herb (<0.5 m)	< 1
Arivela viscosa	Herb (<0.5 m)	< 1
Boerhavia coccinea	Herb (<0.5 m)	< 1
Calandrinia ?stagnensis	Herb (<0.5 m)	< 1
Cheilanthes sieberi subsp. *sieberi*	Herb (<0.5 m)	< 1
Corchorus tridens/trilocularis	Herb (<0.5 m)	< 1
Cucumis variabilis	Herb (<0.5 m)	< 1
Euphorbia tannensis subsp. *eremophila*	Herb (<0.5 m)	< 1
Euphorbia trigonosperma	Herb (<0.5 m)	< 1
Evolvulus alsinoides var. *villosicalyx*	Herb (<0.5 m)	< 1
Gomphrena canescens subsp. *canescens*	Herb (<0.5 m)	< 1
Goodenia prostrata	Herb (<0.5 m)	< 1
Portulaca oleracea	Herb (<0.5 m)	< 1
Ptilotus exaltatus	Herb (<0.5 m)	< 1
Ptilotus gomphrenoides	Herb (<0.5 m)	< 1
Ptilotus helipteroides	Herb (<0.5 m)	< 1
Ptilotus polystachyus	Herb (<0.5 m)	< 1
Rostellularia adscendens var. *clementii*	Herb (<0.5 m)	< 1
Sclerolaena cornishiana	Herb (<0.5 m)	< 1
Sida platycalyx	Herb (<0.5 m)	< 1

Name	Stratum	Percent cover (%)
Trianthema triquetrum	Herb (<0.5 m)	< 1
Tribulopis angustifolia	Herb (<0.5 m)	< 1
Aristida contorta	Tussock Grass (<0.5 m)	< 1
Cenchrus ciliaris	Tussock Grass (<0.5 m)	1 – 4
Cenchrus setiger	Tussock Grass (<0.5 m)	< 1
Dactyloctenium radulans	Tussock Grass (<0.5 m)	1 – 4
Enneapogon polyphyllus	Tussock Grass (<0.5 m)	10 – 24
Eragrostis leptocarpa	Tussock Grass (<0.5 m)	< 1
Eragrostis tenellula	Tussock Grass (<0.5 m)	< 1
Eriachne pulchella subsp. *dominii*	Tussock Grass (<0.5 m)	< 1
Iseilema vaginiflorum	Tussock Grass (<0.5 m)	< 1
Setaria verticillata	Tussock Grass (<0.5 m)	< 1

BD_E_289

Date	6/03/2024	**Site type**	Flora: Quadrat	**Botanist**	SH
Location	-22.34991, 119.70101				
Landform	Low hill	**Slope**	Moderate		
Soil colour	Reddish brown	**Soil texture**	Clay		
Rock type	Ironstone	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Senna sericea	Shrub (>2 m)	1 – 4
Acacia bivenosa	Shrub (1-2 m)	< 1
Senna glutinosa subsp. ×*luerssenii*	Shrub (1-2 m)	1 – 4
Senna artemisioides subsp. *helmsii*	Shrub (0.5-1 m)	< 1
Solanum lasiophyllum/phlomoides	Shrub (<0.5 m)	< 1
Ptilotus exaltatus	Herb (<0.5 m)	< 1
Triodia longiceps	Hummock Grass (0.5-1 m)	33 – 49
Triodia brizoides	Hummock Grass (<0.5 m)	1 – 4
Triodia wiseana	Hummock Grass (<0.5 m)	5 – 9

BD_E_290

Date	6/03/2024	**Site type**	Flora: Quadrat	**Botanist**	SN
Location	-22.36781, 119.69383				
Landform	Plain	**Slope**	NA		
Soil colour	Red	**Soil texture**	Clay loam		
Rock type	Ironstone	**Rock size**	Fine gravel [to c. 5 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Acacia ?aptaneura	Shrub (>2 m)	5 – 9
Acacia pruinocarpa	Shrub (>2 m)	1 – 4
Grevillea berryana	Shrub (>2 m)	1 – 4
Anthobolus leptomerioides	Shrub (1-2 m)	1 – 4
Senna ?stricta	Shrub (1-2 m)	1 – 4
Senna glutinosa subsp. *×luerssenii*	Shrub (1-2 m)	1 – 4
Acacia tetragonophylla	Shrub (0.5-1 m)	1 – 4
Eremophila forrestii subsp. *forrestii*	Shrub (0.5-1 m)	< 1
Enchylaena tomentosa var. *tomentosa*	Shrub (<0.5 m)	< 1
Psydrax suaveolens	Shrub (<0.5 m)	< 1
Ptilotus schwartzii	Shrub (<0.5 m)	1 – 4
Sida ?sp. *dark green fruits (S. van Leeuwen 2260)*	Herb (0.5-1 m)	< 1
Eragrostis desertorum	Tussock Grass (<0.5 m)	< 1
Eriachne mucronata	Tussock Grass (<0.5 m)	1 – 4
Triodia brizoides	Hummock Grass (<0.5 m)	5 – 9

BD_E_291

Date	6/03/2024	**Site type**	Flora: Quadrat	**Botanist**	AC
Location	-22.37136, 119.68897				
Landform	Plain	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Clay		
Rock type	Basalt, chert	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	30 – 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia ?aptaneura	Shrub (>2 m)	25 – 32
Acacia pruinocarpa	Shrub (>2 m)	Assoc.
Grevillea berryana	Shrub (>2 m)	1 – 4
Acacia ayersiana	Shrub (1-2 m)	1 – 4
Anthobolus leptomerioides	Shrub (1-2 m)	< 1
Dodonaea petiolaris	Shrub (1-2 m)	< 1
Eremophila forrestii subsp. *forrestii*	Shrub (1-2 m)	1 – 4
Eremophila latrobei subsp. *filiformis*	Shrub (1-2 m)	< 1
Psydrax latifolia	Shrub (1-2 m)	< 1
Psydrax suaveolens	Shrub (1-2 m)	< 1
Ptilotus calostachyus	Shrub (1-2 m)	< 1
Senna artemisioides subsp. *helmsii*	Shrub (1-2 m)	< 1
Senna glutinosa subsp. ×*luerssenii*	Shrub (1-2 m)	1 – 4
Seringia ?exastia	Shrub (1-2 m)	1 – 4
Senna glutinosa subsp. *glutinosa*	Shrub (0.5-1 m)	< 1
Enchylaena tomentosa var. *tomentosa*	Shrub (<0.5 m)	< 1
Hibiscus burtonii	Shrub (<0.5 m)	< 1
Ptilotus schwartzii	Shrub (<0.5 m)	1 – 4
Solanum lasiophyllum/phlomoides	Shrub (<0.5 m)	< 1
Duperreya commixta	Herb (0.5-1 m)	< 1
Areocleome oxalidea	Herb (<0.5 m)	< 1
Cheilanthes sieberi subsp. *sieberi*	Herb (<0.5 m)	< 1
Evolvulus alsinoides	Herb (<0.5 m)	< 1
Goodenia prostrata	Herb (<0.5 m)	< 1
Ptilotus exaltatus	Herb (<0.5 m)	< 1
Senna notabilis	Herb (<0.5 m)	< 1
Sida platycalyx	Herb (<0.5 m)	< 1
Sida sp. *dark green fruits (S. van Leeuwen 2260)*	Herb (<0.5 m)	< 1
Tribulus astrocarpus	Herb (<0.5 m)	< 1
Eragrostis desertorum	Tussock Grass (0.5-1 m)	1 – 4
Eriachne mucronata	Tussock Grass (0.5-1 m)	< 1

Name	Stratum	Percent cover (%)
Triodia brizoides	Hummock Grass (<0.5 m)	10 – 24

BD_E_292

Date	12/03/2024	**Site type**	Flora: Quadrat	**Botanist**	AC
Location	-22.31395, 119.77308				
Landform	Undulating plain	**Slope**	NA		
Soil colour	Reddish brown	**Soil texture**	Clay loam		
Rock type	Ironstone, basalt	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	1 – 4
Acacia inaequilatera	Shrub (>2 m)	1 – 4
Acacia pyrifolia	Shrub (>2 m)	< 1
Hakea lorea subsp. *lorea*	Shrub (>2 m)	< 1
Acacia bivenosa	Shrub (1-2 m)	< 1
Acacia tetragonophylla	Shrub (1-2 m)	< 1
Androcalva luteiflora	Shrub (1-2 m)	1 – 4
Scaevola spinescens	Shrub (1-2 m)	< 1
Senna glutinosa subsp. ×*luerssenii*	Shrub (1-2 m)	< 1
Senna glutinosa subsp. *glutinosa*	Shrub (0.5-1 m)	< 1
Senna glutinosa subsp. *pruinosa*	Shrub (0.5-1 m)	< 1
Solanum elatius	Shrub (0.5-1 m)	< 1
Enchylaena tomentosa var. *tomentosa*	Shrub (<0.5 m)	< 1
Indigofera monophylla	Shrub (<0.5 m)	< 1
Ptilotus astrolasius	Shrub (<0.5 m)	< 1
Sida sp. Pilbara (A.A. Mitchell PRP 1543)	Shrub (<0.5 m)	< 1
Boerhavia coccinea	Herb (<0.5 m)	< 1
Goodenia stobbsiana	Herb (<0.5 m)	< 1
Nellica maderaspatensis	Herb (<0.5 m)	< 1
Ptilotus aervoides	Herb (<0.5 m)	< 1
Ptilotus exaltatus	Herb (<0.5 m)	< 1
Salsola australis	Herb (<0.5 m)	< 1
Senna notabilis	Herb (<0.5 m)	< 1
Solanum cleistogamum	Herb (<0.5 m)	< 1
Tribulus ?hirsutus	Herb (<0.5 m)	< 1
Trigastrotheca molluginea	Herb (<0.5 m)	< 1
Paraneurachne muelleri	Tussock Grass (<0.5 m)	< 1
Sporobolus australasicus	Tussock Grass (<0.5 m)	< 1
Triodia longiceps	Hummock Grass (0.5-1 m)	25 – 32
Triodia brizoides	Hummock Grass (<0.5 m)	5 – 9
Triodia wiseana	Hummock Grass (<0.5 m)	25 – 32

BD_E_293

Date	12/03/2024	**Site type**	Flora: Quadrat	**Botanist**	SN
Location	-22.31345, 119.79011				
Landform	Undulating plain	**Slope**	Gentle		
Soil colour	Reddish brown	**Soil texture**	Sandy clay		
Rock type	Ironstone	**Rock size**	Gravel/pebbles [c. 5 - 60 mm]	**Rock cover**	> 70%
Vegetation condition	Excellent	**Disturbance**	Minor weed cover and grazing.		
Time since fire	No evidence				



Name	Stratum	Percent cover (%)
Corymbia hamersleyana	Tree (<10 m)	1 – 4
Acacia ancistrocarpa	Shrub (1-2 m)	1 – 4
Acacia bivenosa	Shrub (1-2 m)	1 – 4
Acacia pyrifolia	Shrub (1-2 m)	1 – 4
Acacia trachycarpa	Shrub (1-2 m)	< 1
Senna glutinosa subsp. ×*luerssenii*	Shrub (1-2 m)	1 – 4
Acacia maitlandii	Shrub (0.5-1 m)	1 – 4
Indigofera monophylla	Shrub (0.5-1 m)	1 – 4
Pentalepis trichodesmoides subsp. *trichodesmoides*	Shrub (0.5-1 m)	< 1
Ptilotus calostachyus	Shrub (0.5-1 m)	< 1
Senna symonii	Shrub (0.5-1 m)	< 1
Sida sp. Pilbara (A.A. Mitchell PRP 1543)	Shrub (<0.5 m)	< 1
Fimbristylis simulans	Sedge (<0.5 m)	10 – 24
Arivela viscosa	Herb (<0.5 m)	1 – 4
Bonamia pilbarensis	Herb (<0.5 m)	< 1
Euphorbia ?biconvexa	Herb (<0.5 m)	< 1
Goodenia ?cusackiana	Herb (<0.5 m)	< 1
Salsola australis	Herb (<0.5 m)	< 1
Tribulus ?hirsutus	Herb (<0.5 m)	1 – 4
Trigastrotheca molluginea	Herb (<0.5 m)	< 1
Cenchrus ciliaris	Tussock Grass (<0.5 m)	< 1
Triodia epactia	Hummock Grass (0.5-1 m)	25 – 32
Triodia wiseana	Hummock Grass (<0.5 m)	1 – 4

BD_E_294

Date	12/03/2024	**Site type**	Flora: Quadrat	**Botanist**	BN
Location	-22.30017, 119.79235				
Landform	Plain	**Slope**	NA		
Soil colour	Red	**Soil texture**	Clay		
Rock type	Ironstone	**Rock size**	Mixed	**Rock cover**	30 – 70%
Vegetation condition	Excellent	**Disturbance**	No significant disturbance.		
Time since fire	Long (> 3 yrs)				



Name	Stratum	Percent cover (%)
Acacia inaequilatera	Tree (<10 m)	< 1
Acacia ?aptaneura	Shrub (>2 m)	1 – 4
Acacia bivenosa	Shrub (>2 m)	1 – 4
Acacia pruinocarpa	Shrub (>2 m)	1 – 4
Acacia synchronicia	Shrub (>2 m)	1 – 4
Eremophila latrobei subsp. *latrobei*	Shrub (>2 m)	1 – 4
Eremophila latrobei subsp. *filiformis*	Shrub (1-2 m)	< 1
Jasminum didymum subsp. *lineare*	Shrub (1-2 m)	< 1
Senna artemisioides subsp. *oligophylla*	Shrub (1-2 m)	< 1
Senna glutinosa subsp. ×*luerssenii*	Shrub (0.5-1 m)	< 1
Triodia epactia	Hummock Grass (0.5-1 m)	33 – 49

Appendix F DBCA Significant Species Report Forms.

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

Threatened and Priority Flora Report Form

Version 1.4 March 2021

Please complete as much of the form as possible, with emphasis on those sections bordered in black. For information on how to complete the form please refer to the Threatened & Priority Flora Report Form (TPRF) manual on the DBCA website at www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/threatened-plants

TAXON: Acacia cyperophylla var. omearana **TPFL Pop. No:**

OBSERVATION DATE: 8/03/2024 **CONSERVATION STATUS:** P1 **New population** ☐

OBSERVER/S: A. Craigie **PHONE** 61687200

ROLE: Botanist **ORGANISATION:** Ecologia Environment

EMAIL: andrew.craigie@ecologia.com.au

DESCRIPTION OF LOCATION (Provide at least nearest town/named locality, and the distance and direction to that place)**:**

Bonney Downs Station, ca. 15 km southwest of Nullagine, WA.

Reserve No:

DBCA DISTRICT: **LGA:** Shire of East Pilbara Land manager present: ☐

DATUM:

GDA94 / MGA94 ☒

AGD84 / AMG84 ☐

WGS84 ☐

Unknown ☐

COORDINATES: (If UTM coords provided, **Zone** is also required)

DecDegrees ☐ DegMinSec ☐ UTMs ☐

Lat / Northing: -21.914478

Long / Easting: 120.014686

ZONE:

METHOD USED:

GPS ☒ Differential GPS ☐ Map ☐

No. satellites: ____ Map used: _____

Boundary polygon captured: ☐ Map scale: _____

LAND TENURE:

Nature reserve ☐ Timber reserve ☐ Private property ☐ Rail reserve ☐ Shire road reserve ☐

National park ☐ State forest ☐ Pastoral lease ☐ MRWA road reserve ☐ Other Crown reserve ☐

Conservation park ☐ Water reserve ☐ UCL ☐ SLK/Pole _____ to _____ Specify other: _____

AREA ASSESSMENT: Edge survey ☐ Partial survey ☒ Full survey ☐ Area observed (m²): _____

EFFORT: Time spent surveying (minutes): _____ No. of minutes spent / 100 m²: _____

POP'N COUNT ACCURACY: Actual ☐ Extrapolation ☐ Estimate ☐ Count method: _____ (Refer to field manual for list)

WHAT COUNTED: Plants ☒ Clumps ☐ Clonal stems ☐

TOTAL POP'N STRUCTURE:	**Mature:**	**Juveniles:**	**Seedlings:**	**Totals:**
Alive	1000			1000
Dead				

Area of pop (m²): _____

Note: Pls record count as numbers (not percentages) for database.

QUADRATS PRESENT: No. ___ Size _____ Data attached ☐ Total area of quadrats (m²): _____

Summary Quad. Totals: Alive				

REPRODUCTIVE STATE: Clonal ☐ Vegetative ☐ Flowerbud ☐ Flower ☒

Immature fruit ☐ Fruit ☐ Dehisced fruit ☐ Percentage in flower: _____%

CONDITION OF PLANTS: Healthy ☒ Moderate ☐ Poor ☐ Senescent ☐

COMMENT:

THREATS - type, agent and supporting information: Eg clearing, too frequent fire, weed, disease. Refer to field manual for list of threats & agents. **Specify agent** where relevant. Rate current and potential threat impact: N=Nil, L=Low, M=Medium, H=High, E=Extreme Estimate time to potential impact: S=Short (<12mths), M=Medium (<5yrs), L=Long (5yrs+)	**Current impact (N-E)**	**Potential Impact (L-E)**	**Potential Threat Onset (S-L)**
•			
•			
•			

Please return completed form to **Species And Communities Program** DBCA,

Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983 **OR** email to: flora.data@dbca.wa.gov.au

RECORDS: Please forward to **Flora Administrative Officer,** Species and Communities Program.

Record entered by:_____ **Sheet No.:**_____ **Record Entered in Database** ❑

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

Threatened and Priority Flora Report Form

Version 1.4 March 2021

HABITAT INFORMATION:

LANDFORM:
Crest ☐
Hill ☐
Ridge ☐
Outcrop ☐
Slope ☐
Flat ☐
Open depression ☐
Drainage line ☒
Closed depression ☐
Wetland ☐

ROCK TYPE:
Granite ☐
Dolerite ☐
Laterite ☐
Ironstone ☐
Limestone ☐
Quartz ☐
Specify other: ____

LOOSE ROCK:
(on soil surface; eg gravel, quartz fields)
0-10% ☐
10-30% ☐
30-50% ☐
50-100% ☐

SOIL TYPE:
Sand ☐
Sandy loam ☐
Loam ☐
Clay loam ☐
Light clay ☐
Peat ☐
Specify other: Clay loam

SOIL COLOUR:
Red ☐
Brown ☒
Yellow ☐
White ☐
Grey ☐
Black ☐
Specify other: ____

DRAINAGE:
Well drained ☐
Seasonally inundated ☒
Permanently inundated ☐
Tidal ☐

Specific **Landform** Element: ____
(Refer to field manual for additional values)

CONDITION OF SOIL: Dry ☐ Moist ☐ Waterlogged ☐ Inundated ☐

VEGETATION CLASSIFICATION*:
Eg: **1**. Banksia woodland (B. attenuata, B. ilicifolia); **2**. Open shrubland (Hibbertia sp., Acacia spp.) ; **3**. Isolated clumps of sedges (M.tetragona)

1. Acacia cyperophylla var. omearana (P1), Acacia tumida var. pilbarensis tall sparse shrubland
2.. Triodia epactia, Triodia longiceps mid sparse hummock grassland.
3.
4.

ASSOCIATED SPECIES:

Other (non-dominant) spp

* Please record up to four of the most representative vegetation layers (with up to three dominant species in each layer). Structural Formations should follow 2009 *Australian Soil and Land Survey Field Handbook* guidelines – refer to field manual for further information and structural formation table.

CONDITION OF HABITAT: Pristine ☐ Excellent ☒ Very good ☐ Good ☐ Degraded ☐ Completely degraded ☐

COMMENT:

FIRE HISTORY: **Last Fire:** Season/Month: ____ Year: ____ **Fire Intensity:** High ☐ Medium ☐ Low ☐ No signs of fire ☐

FENCING: Not required ☐ Present ☐ Replace / repair ☐ Required ☐ Length req'd: ____

ROADSIDE MARKERS: Not required ☐ Present ☐ Replace / reposition ☐ Required ☐ Quantity req'd: ____

OTHER COMMENTS: (Please include recommended management actions and/or implemented actions - include date. Also include details of additional data available, and how to locate it.)

FLORA AUTHORISATION / LICENCE No: ____ Note if only observing plants (i.e. no specimens or plant matieral is taken) then no authorisation/licence is required. For further information on authorisation and licening requirements see the Threatened Flora and Wildlife Licensing pages on DBCA's website. Any actions carried out under authorisations/licences should be recorded above in the OTHER COMMENTS section.

SPECIMEN: Collectors No: ____ WA Herb. ☐ Regional Herb. ☐ District Herb. ☐ Other: ____

LODGEMENT: WA Herb Lodgement No: ____

ATTACHED: Map ☐ Mudmap ☐ Photo ☐ GIS data ☐ Field notes ☐ Other: ____

COPY SENT TO: Regional Office ☐ District Office ☐ Other: ____

Submitter of Record: A. Craigie Role: Botanist Signed: ____ Date: 13/1/2025

Please return completed form to **Species And Communities Program** DBCA,
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983 **OR** email to: flora.data@dbca.wa.gov.au

RECORDS: Please forward to **Flora Administrative Officer,** Species and Communities Program.

Record entered by:____ **Sheet No.:**____ **Record Entered in Database** ❑

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

Threatened and Priority Flora Report Form

Version 1.4 March 2021

Please complete as much of the form as possible, with emphasis on those sections bordered in black. For information on how to complete the form please refer to the Threatened & Priority Flora Report Form (TPRF) manual on the DBCA website at www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/threatened-plants

TAXON: Euphorbia inappendiculata var. queenslandica **TPFL Pop. No:**

OBSERVATION DATE: 26/06/2023 **CONSERVATION STATUS:** P2 **New population** ☐

OBSERVER/S: A. Craigie **PHONE** 61687200

ROLE: Botanist **ORGANISATION:** Ecologia Environment

EMAIL: andrew.craigie@ecologia.com.au

DESCRIPTION OF LOCATION (Provide at least nearest town/named locality, and the distance and direction to that place)**:**

Bonney Downs Station, ca. 15 km southwest of Nullagine, WA.

Reserve No:

DBCA DISTRICT: **LGA:** Shire of East Pilbara Land manager present: ☐

DATUM:
GDA94 / MGA94 ☒
AGD84 / AMG84 ☐
WGS84 ☐
Unknown ☐

COORDINATES: (If UTM coords provided, **Zone** is also required)
DecDegrees ☐ DegMinSec ☐ UTMs ☒
Lat / Northing: 7561006.19
Long / Easting: 793171.90
ZONE: 50

METHOD USED:
GPS ☒ Differential GPS ☐ Map ☐
No. satellites: ____ Map used: _____
Boundary polygon captured: ☐ Map scale: _____

LAND TENURE:

Nature reserve ☐	Timber reserve ☐	Private property ☐	Rail reserve ☐	Shire road reserve ☐
National park ☐	State forest ☐	Pastoral lease ☐	MRWA road reserve ☐	Other Crown reserve ☐
Conservation park ☐	Water reserve ☐	UCL ☐	SLK/Pole _____ to _____	Specify other: _____

AREA ASSESSMENT: Edge survey ☐ Partial survey ☒ Full survey ☐ Area observed (m²): _____

EFFORT: Time spent surveying (minutes): _____ No. of minutes spent / 100 m²: _____

POP'N COUNT ACCURACY: Actual ☐ Extrapolation ☐ Estimate ☐ Count method: _____ (Refer to field manual for list)

WHAT COUNTED: Plants ☒ Clumps ☐ Clonal stems ☐

TOTAL POP'N STRUCTURE:

	Mature:	Juveniles:	Seedlings:	Totals:
Alive	1			1
Dead				

Area of pop (m²): _____

Note: Pls record count as numbers (not percentages) for database.

QUADRATS PRESENT: No. ___ Size _____ Data attached ☐ Total area of quadrats (m²): _____

Summary Quad. Totals: Alive				

REPRODUCTIVE STATE: Clonal ☐ Vegetative ☐ Flowerbud ☐ Flower ☒
Immature fruit ☐ Fruit ☒ Dehisced fruit ☐ Percentage in flower: _____%

CONDITION OF PLANTS: Healthy ☐ Moderate ☐ Poor ☐ Senescent ☐

COMMENT:

THREATS - type, agent and supporting information: Eg clearing, too frequent fire, weed, disease. Refer to field manual for list of threats & agents. **Specify agent** where relevant. Rate current and potential threat impact: N=Nil, L=Low, M=Medium, H=High, E=Extreme Estimate time to potential impact: S=Short (<12mths), M=Medium (<5yrs), L=Long (5yrs+)	**Current impact (N-E)**	**Potential Impact (L-E)**	**Potential Threat Onset (S-L)**
•			
•			
•			

Please return completed form to **Species And Communities Program** DBCA,
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983 **OR** email to: flora.data@dbca.wa.gov.au

RECORDS: Please forward to **Flora Administrative Officer,** Species and Communities Program.

Record entered by:_____ **Sheet No.:**_____ **Record Entered in Database** ❑

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

Threatened and Priority Flora Report Form

Version 1.4 March 2021

HABITAT INFORMATION:

LANDFORM:
Crest ☐
Hill ☒
Ridge ☐
Outcrop ☐
Slope ☐
Flat ☐
Open depression ☐
Drainage line ☐
Closed depression ☐
Wetland ☐

ROCK TYPE:
Granite ☐
Dolerite ☐
Laterite ☐
Ironstone ☐
Limestone ☐
Quartz ☐
Specify other:
Basalt

LOOSE ROCK:
(on soil surface; eg gravel, quartz fields)
0-10% ☐
10-30% ☐
30-50% ☐
50-100% ☐

SOIL TYPE:
Sand ☐
Sandy loam ☐
Loam ☐
Clay loam ☐
Light clay ☐
Peat ☐
Specify other:
Clay

SOIL COLOUR:
Red ☐
Brown ☒
Yellow ☐
White ☐
Grey ☐
Black ☐
Specify other:

DRAINAGE:
Well drained ☒
Seasonally inundated ☐
Permanently inundated ☐
Tidal ☐

Specific **Landform** Element:
(Refer to field manual for additional values)

CONDITION OF SOIL: Dry ☐ Moist ☐ Waterlogged ☐ Inundated ☐

VEGETATION CLASSIFICATION*:
Eg: **1**. Banksia woodland (B. attenuata, B. ilicifolia); **2**. Open shrubland (Hibbertia sp., Acacia spp.) ; **3**. Isolated clumps of sedges (M.tetragona)

1. Vachellia farnesiana mid open shrubland
2. Arivela viscosa, Heliotropium crispatum, Aristida latifolia low herbland/tussock grassland.
3.
4.

ASSOCIATED SPECIES:

Other (non-dominant) spp

* Please record up to four of the most representative vegetation layers (with up to three dominant species in each layer). Structural Formations should follow 2009 *Australian Soil and Land Survey Field Handbook* guidelines – refer to field manual for further information and structural formation table.

CONDITION OF HABITAT: Pristine ☐ Excellent ☒ Very good ☐ Good ☐ Degraded ☐ Completely degraded ☐

COMMENT:

FIRE HISTORY: **Last Fire:** Season/Month: _____ Year: _____ **Fire Intensity:** High ☐ Medium ☐ Low ☐ No signs of fire ☐

FENCING: Not required ☐ Present ☐ Replace / repair ☐ Required ☐ Length req'd: _____

ROADSIDE MARKERS: Not required ☐ Present ☐ Replace / reposition ☐ Required ☐ Quantity req'd: _____

OTHER COMMENTS: (Please include recommended management actions and/or implemented actions - include date. Also include details of additional data available, and how to locate it.)

FLORA AUTHORISATION / LICENCE No: _____ Note if only observing plants (i.e. no specimens or plant matieral is taken) then no authorisation/licence is required. For further information on authorisation and licening requirements see the Threatened Flora and Wildlife Licensing pages on DBCA's website. Any actions carried out under authorisations/licences should be recorded above in the OTHER COMMENTS section.

SPECIMEN: Collectors No: _____ WA Herb. ☐ Regional Herb. ☐ District Herb. ☐ Other: _____

LODGEMENT: WA Herb Lodgement No: _____

ATTACHED: Map ☐ Mudmap ☐ Photo ☐ GIS data ☐ Field notes ☐ Other: _____

COPY SENT TO: Regional Office ☐ District Office ☐ Other: _____

Submitter of Record: A. Craigie Role: Botanist Signed: _____ Date: 11/12/2023

Please return completed form to **Species And Communities Program** DBCA,
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983 **OR** email to: flora.data@dbca.wa.gov.au

RECORDS: Please forward to **Flora Administrative Officer,** Species and Communities Program.

Record entered by:_____ **Sheet No.:**_____ **Record Entered in Database** ❑

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

Threatened and Priority Flora Report Form

Version 1.4 March 2021

Please complete as much of the form as possible, with emphasis on those sections bordered in black. For information on how to complete the form please refer to the Threatened & Priority Flora Report Form (TPRF) manual on the DBCA website at www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/threatened-plants

TAXON: Indigofera ixocarpa **TPFL Pop. No:**

OBSERVATION DATE: 16/07/2024 **CONSERVATION STATUS:** P2 **New population** ☐

OBSERVER/S: A. Craigie **PHONE** 61687200

ROLE: Botanist **ORGANISATION:** Ecologia Environment

EMAIL: andrew.craigie@ecologia.com.au

DESCRIPTION OF LOCATION (Provide at least nearest town/named locality, and the distance and direction to that place)**:**

Bonney Downs Station, ca. 15 km southwest of Nullagine, WA.

Reserve No:

DBCA DISTRICT: **LGA:** Shire of East Pilbara Land manager present: ☐

DATUM:
GDA94 / MGA94 ☒
AGD84 / AMG84 ☐
WGS84 ☐
Unknown ☐

COORDINATES: (If UTM coords provided, **Zone** is also required)
DecDegrees ☒ DegMinSec ☐ UTMs ☐

Lat / Northing: -21.889958

Long / Easting: 119.767749

ZONE:

METHOD USED:
GPS ☒ Differential GPS ☐ Map ☐

No. satellites: ___ Map used: _____

Boundary polygon captured: ☐ Map scale: _____

LAND TENURE:

Nature reserve ☐	Timber reserve ☐	Private property ☐	Rail reserve ☐	Shire road reserve ☐
National park ☐	State forest ☐	Pastoral lease ☐	MRWA road reserve ☐	Other Crown reserve ☐
Conservation park ☐	Water reserve ☐	UCL ☐	SLK/Pole _____ to _____	Specify other: _____

AREA ASSESSMENT: Edge survey ☐ Partial survey ☒ Full survey ☐ Area observed (m²): _____

EFFORT: Time spent surveying (minutes): _____ No. of minutes spent / 100 m²: _____

POP'N COUNT ACCURACY: Actual ☐ Extrapolation ☐ Estimate ☐ Count method: _____ (Refer to field manual for list)

WHAT COUNTED: Plants ☒ Clumps ☐ Clonal stems ☐

TOTAL POP'N STRUCTURE:

	Mature:	Juveniles:	Seedlings:	Totals:
Alive	20			20
Dead				

Area of pop (m²): _____

Note: Pls record count as numbers (not percentages) for database.

QUADRATS PRESENT: No. ___ Size _____ Data attached ☐ Total area of quadrats (m²): _____

Summary Quad. Totals: Alive				

REPRODUCTIVE STATE: Clonal ☐ Vegetative ☐ Flowerbud ☐ Flower ☒
Immature fruit ☐ Fruit ☒ Dehisced fruit ☐ Percentage in flower: _____%

CONDITION OF PLANTS: Healthy ☒ Moderate ☐ Poor ☐ Senescent ☐

COMMENT:

THREATS - type, agent and supporting information: Eg clearing, too frequent fire, weed, disease. Refer to field manual for list of threats & agents. **Specify agent** where relevant. Rate current and potential threat impact: N=Nil, L=Low, M=Medium, H=High, E=Extreme Estimate time to potential impact: S=Short (<12mths), M=Medium (<5yrs), L=Long (5yrs+)	**Current impact (N-E)**	**Potential Impact (L-E)**	**Potential Threat Onset (S-L)**
•			
•			
•			

Please return completed form to **Species And Communities Program** DBCA,
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983 **OR** email to: flora.data@dbca.wa.gov.au

RECORDS: Please forward to **Flora Administrative Officer,** Species and Communities Program.

Record entered by:_____ **Sheet No.:**_____ **Record Entered in Database** ❑

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

Threatened and Priority Flora Report Form

Version 1.4 March 2021

HABITAT INFORMATION:

LANDFORM:
Crest ☐
Hill ☒
Ridge ☐
Outcrop ☐
Slope ☐
Flat ☐
Open depression ☐
Drainage line ☐
Closed depression ☐
Wetland ☐

ROCK TYPE:
Granite ☐
Dolerite ☐
Laterite ☐
Ironstone ☐
Limestone ☐
Quartz ☐
Specify other: ____

LOOSE ROCK:
(on soil surface; eg gravel, quartz fields)
0-10% ☐
10-30% ☐
30-50% ☐
50-100% ☐

SOIL TYPE:
Sand ☐
Sandy loam ☐
Loam ☐
Clay loam ☐
Light clay ☐
Peat ☐
Specify other: Clay loam

SOIL COLOUR:
Red ☐
Brown ☒
Yellow ☐
White ☐
Grey ☐
Black ☐
Specify other: ____

DRAINAGE:
Well drained ☒
Seasonally inundated ☐
Permanently inundated ☐
Tidal ☐

Specific **Landform** Element: ____
(Refer to field manual for additional values)

CONDITION OF SOIL: Dry ☐ Moist ☐ Waterlogged ☐ Inundated ☐

VEGETATION CLASSIFICATION*:
Eg: **1**. Banksia woodland (B. attenuata, B. ilicifolia); **2**. Open shrubland (Hibbertia sp., Acacia spp.) ; **3**. Isolated clumps of sedges (M.tetragona)

1. Eucalyptus leucophloia subsp. leucophloia, ±Corymbia hamersleyana low isolated trees
2. Acacia monticola, Grevillea wickhamii mid sparse shrubland.
3. Triodia wiseana low hummock grassland.
4.

ASSOCIATED SPECIES:

Other (non-dominant) spp

* Please record up to four of the most representative vegetation layers (with up to three dominant species in each layer). Structural Formations should follow 2009 *Australian Soil and Land Survey Field Handbook* guidelines – refer to field manual for further information and structural formation table.

CONDITION OF HABITAT: Pristine ☐ Excellent ☒ Very good ☐ Good ☐ Degraded ☐ Completely degraded ☐

COMMENT:

FIRE HISTORY: **Last Fire:** Season/Month: ____ Year: ____ **Fire Intensity:** High ☐ Medium ☐ Low ☐ No signs of fire ☐

FENCING: Not required ☐ Present ☐ Replace / repair ☐ Required ☐ Length req'd: ____

ROADSIDE MARKERS: Not required ☐ Present ☐ Replace / reposition ☐ Required ☐ Quantity req'd: ____

OTHER COMMENTS: (Please include recommended management actions and/or implemented actions - include date. Also include details of additional data available, and how to locate it.)

FLORA AUTHORISATION / LICENCE No: ____ Note if only observing plants (i.e. no specimens or plant matieral is taken) then no authorisation/licence is required. For further information on authorisation and licening requirements see the Threatened Flora and Wildlife Licensing pages on DBCA's website. Any actions carried out under authorisations/licences should be recorded above in the OTHER COMMENTS section.

SPECIMEN: Collectors No: ____ WA Herb. ☐ Regional Herb. ☐ District Herb. ☐ Other: ____

LODGEMENT: WA Herb Lodgement No: ____

ATTACHED: Map ☐ Mudmap ☐ Photo ☐ GIS data ☐ Field notes ☐ Other: ____

COPY SENT TO: Regional Office ☐ District Office ☐ Other: ____

Submitter of Record: A. Craigie Role: Botanist Signed: ____ Date: 13/1/2025

Please return completed form to **Species And Communities Program** DBCA,
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983 **OR** email to: flora.data@dbca.wa.gov.au

RECORDS: Please forward to **Flora Administrative Officer,** Species and Communities Program.

Record entered by:____ **Sheet No.:**____ **Record Entered in Database** ❑

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

Threatened and Priority Flora Report Form

Version 1.4 March 2021

Please complete as much of the form as possible, with emphasis on those sections bordered in black. For information on how to complete the form please refer to the Threatened & Priority Flora Report Form (TPRF) manual on the DBCA website at www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/threatened-plants

TAXON: Ipomoea racemigera **TPFL Pop. No:**

OBSERVATION DATE: 21/06/2023 **CONSERVATION STATUS:** P2 **New population** ☐

OBSERVER/S: A. Craigie **PHONE** 61687200

ROLE: Botanist **ORGANISATION:** Ecologia Environment

EMAIL: andrew.craigie@ecologia.com.au

DESCRIPTION OF LOCATION (Provide at least nearest town/named locality, and the distance and direction to that place)**:**

Bonney Downs Station, ca. 15 km southwest of Nullagine, WA.

Reserve No:

DBCA DISTRICT: **LGA:** Shire of East Pilbara Land manager present: ☐

DATUM:
GDA94 / MGA94 ☒
AGD84 / AMG84 ☐
WGS84 ☐
Unknown ☐

COORDINATES: (If UTM coords provided, **Zone** is also required)
DecDegrees ☐ DegMinSec ☐ UTMs ☒

Lat / Northing: 7544285.17

Long / Easting: 789331.87

ZONE: 50

METHOD USED:
GPS ☒ Differential GPS ☐ Map ☐

No. satellites: ____ Map used: _____

Boundary polygon captured: ☐ Map scale: _____

LAND TENURE:

Nature reserve ☐	Timber reserve ☐	Private property ☐	Rail reserve ☐	Shire road reserve ☐
National park ☐	State forest ☐	Pastoral lease ☐	MRWA road reserve ☐	Other Crown reserve ☐
Conservation park ☐	Water reserve ☐	UCL ☐	SLK/Pole _____ to _____	Specify other: _____

AREA ASSESSMENT: Edge survey ☐ Partial survey ☒ Full survey ☐ Area observed (m²): _____

EFFORT: Time spent surveying (minutes): _____ No. of minutes spent / 100 m²: _____

POP'N COUNT ACCURACY: Actual ☐ Extrapolation ☐ Estimate ☐ Count method: _____ (Refer to field manual for list)

WHAT COUNTED: Plants ☒ Clumps ☐ Clonal stems ☐

TOTAL POP'N STRUCTURE:

	Mature:	Juveniles:	Seedlings:	Totals:
Alive	1			1
Dead				

Area of pop (m²): _____

Note: Pls record count as numbers (not percentages) for database.

QUADRATS PRESENT: No. ___ Size _____ Data attached ☐ Total area of quadrats (m²): _____

Summary Quad. Totals: Alive				

REPRODUCTIVE STATE: Clonal ☐ Vegetative ☐ Flowerbud ☐ Flower ☐
Immature fruit ☐ Fruit ☒ Dehisced fruit ☐ Percentage in flower: _____%

CONDITION OF PLANTS: Healthy ☐ Moderate ☐ Poor ☐ Senescent ☐

COMMENT:

THREATS - type, agent and supporting information: Eg clearing, too frequent fire, weed, disease. Refer to field manual for list of threats & agents. **Specify agent** where relevant. Rate current and potential threat impact: N=Nil, L=Low, M=Medium, H=High, E=Extreme Estimate time to potential impact: S=Short (<12mths), M=Medium (<5yrs), L=Long (5yrs+)	**Current impact (N-E)**	**Potential Impact (L-E)**	**Potential Threat Onset (S-L)**
•			
•			
•			

Please return completed form to **Species And Communities Program** DBCA,
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983 **OR** email to: flora.data@dbca.wa.gov.au

RECORDS: Please forward to **Flora Administrative Officer,** Species and Communities Program.

Record entered by:_____ **Sheet No.:**_____ **Record Entered in Database** ❑

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

Threatened and Priority Flora Report Form

Version 1.4 March 2021

HABITAT INFORMATION:

LANDFORM:
Crest ☐
Hill ☐
Ridge ☐
Outcrop ☐
Slope ☐
Flat ☐
Open depression ☐
Drainage line ☒
Closed depression ☐
Wetland ☐

ROCK TYPE:
Granite ☐
Dolerite ☐
Laterite ☐
Ironstone ☐
Limestone ☐
Quartz ☐
Specify other: _____

LOOSE ROCK:
(on soil surface; eg gravel, quartz fields)
0-10% ☐
10-30% ☐
30-50% ☐
50-100% ☐

SOIL TYPE:
Sand ☐
Sandy loam ☒
Loam ☐
Clay loam ☐
Light clay ☐
Peat ☐
Specify other: _____

SOIL COLOUR:
Red ☐
Brown ☒
Yellow ☐
White ☐
Grey ☐
Black ☐
Specify other: _____

DRAINAGE:
Well drained ☐
Seasonally inundated ☐
Permanently inundated ☐
Tidal ☐

Specific **Landform** Element: _____
(Refer to field manual for additional values)

CONDITION OF SOIL: Dry ☐ Moist ☐ Waterlogged ☐ Inundated ☐

VEGETATION CLASSIFICATION*:
Eg: **1**. Banksia woodland (B. attenuata, B. ilicifolia); **2**. Open shrubland (Hibbertia sp., Acacia spp.) ; **3**. Isolated clumps of sedges (M.tetragona)

1. Eucalyptus camaldulensis, Eucalyptus victrix, Acacia coriacea subsp. pendens woodland.
2. Cenchrus ciliaris, Cenchrus setiger tussock grassland.
3.
4.

ASSOCIATED SPECIES:

Other (non-dominant) spp

* Please record up to four of the most representative vegetation layers (with up to three dominant species in each layer). Structural Formations should follow 2009 *Australian Soil and Land Survey Field Handbook* guidelines – refer to field manual for further information and structural formation table.

CONDITION OF HABITAT: Pristine ☐ Excellent ☒ Very good ☐ Good ☐ Degraded ☐ Completely degraded ☐

COMMENT: _____

FIRE HISTORY: **Last Fire:** Season/Month: _____ Year: _____ **Fire Intensity:** High ☐ Medium ☐ Low ☐ No signs of fire ☐

FENCING: Not required ☐ Present ☐ Replace / repair ☐ Required ☐ Length req'd: _____

ROADSIDE MARKERS: Not required ☐ Present ☐ Replace / reposition ☐ Required ☐ Quantity req'd: _____

OTHER COMMENTS: (Please include recommended management actions and/or implemented actions - include date. Also include details of additional data available, and how to locate it.)

FLORA AUTHORISATION / LICENCE No: _____ Note if only observing plants (i.e. no specimens or plant matieral is taken) then no authorisation/licence is required. For further information on authorisation and licening requirements see the Threatened Flora and Wildlife Licensing pages on DBCA's website. Any actions carried out under authorisations/licences should be recorded above in the OTHER COMMENTS section.

SPECIMEN: Collectors No: _____ WA Herb. ☐ Regional Herb. ☐ District Herb. ☐ Other: _____

LODGEMENT: WA Herb Lodgement No: _____

ATTACHED: Map ☐ Mudmap ☐ Photo ☐ GIS data ☐ Field notes ☐ Other: _____

COPY SENT TO: Regional Office ☐ District Office ☐ Other: _____

Submitter of Record: A. Craigie Role: Botanist Signed: _____ Date: 11/12/2023

Please return completed form to **Species And Communities Program** DBCA,
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983 **OR** email to: flora.data@dbca.wa.gov.au

RECORDS: Please forward to **Flora Administrative Officer,** Species and Communities Program.

Record entered by:_____ **Sheet No.:**_____ **Record Entered in Database** ❑

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

Threatened and Priority Flora Report Form

Version 1.4 March 2021

Please complete as much of the form as possible, with emphasis on those sections bordered in black. For information on how to complete the form please refer to the Threatened & Priority Flora Report Form (TPRF) manual on the DBCA website at www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/threatened-plants

TAXON: Neptunia longipila **TPFL Pop. No:**

OBSERVATION DATE: 26/06/2023 **CONSERVATION STATUS:** P2 **New population** ☐

OBSERVER/S: A. Craigie **PHONE** 61687200

ROLE: Botanist **ORGANISATION:** Ecologia Environment

EMAIL: andrew.craigie@ecologia.com.au

DESCRIPTION OF LOCATION (Provide at least nearest town/named locality, and the distance and direction to that place)**:**

Bonney Downs Station, ca. 15 km southwest of Nullagine, WA.

Reserve No:

DBCA DISTRICT: **LGA:** Shire of East Pilbara Land manager present: ☐

DATUM:
GDA94 / MGA94 ☒
AGD84 / AMG84 ☐
WGS84 ☐
Unknown ☐

COORDINATES: (If UTM coords provided, **Zone** is also required)
DecDegrees ☐ DegMinSec ☐ UTMs ☒
Lat / Northing: 7561006.19
Long / Easting: 793171.90
ZONE: 50

METHOD USED:
GPS ☒ Differential GPS ☐ Map ☐
No. satellites: ____ Map used: _____
Boundary polygon captured: ☐ Map scale: _____

LAND TENURE:

Nature reserve ☐	Timber reserve ☐	Private property ☐	Rail reserve ☐	Shire road reserve ☐
National park ☐	State forest ☐	Pastoral lease ☐	MRWA road reserve ☐	Other Crown reserve ☐
Conservation park ☐	Water reserve ☐	UCL ☐	SLK/Pole _____ to _____	Specify other: _____

AREA ASSESSMENT: Edge survey ☐ Partial survey ☒ Full survey ☐ Area observed (m²): _____

EFFORT: Time spent surveying (minutes): _____ No. of minutes spent / 100 m²: _____

POP'N COUNT ACCURACY: Actual ☐ Extrapolation ☐ Estimate ☐ Count method: _____ (Refer to field manual for list)

WHAT COUNTED: Plants ☒ Clumps ☐ Clonal stems ☐

TOTAL POP'N STRUCTURE:

	Mature:	Juveniles:	Seedlings:	Totals:
Alive	1			1
Dead				

Area of pop (m²): _____

Note: Pls record count as numbers (not percentages) for database.

QUADRATS PRESENT: No. ___ Size _____ Data attached ☐ Total area of quadrats (m²): _____

Summary Quad. Totals: Alive				

REPRODUCTIVE STATE: Clonal ☐ Vegetative ☐ Flowerbud ☐ Flower ☐
Immature fruit ☐ Fruit ☒ Dehisced fruit ☐ Percentage in flower: _____%

CONDITION OF PLANTS: Healthy ☐ Moderate ☐ Poor ☐ Senescent ☐

COMMENT:

THREATS - type, agent and supporting information: Eg clearing, too frequent fire, weed, disease. Refer to field manual for list of threats & agents. **Specify agent** where relevant. Rate current and potential threat impact: N=Nil, L=Low, M=Medium, H=High, E=Extreme Estimate time to potential impact: S=Short (<12mths), M=Medium (<5yrs), L=Long (5yrs+)	**Current impact (N-E)**	**Potential Impact (L-E)**	**Potential Threat Onset (S-L)**
•			
•			
•			

Please return completed form to **Species And Communities Program** DBCA,
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983 **OR** email to: flora.data@dbca.wa.gov.au

RECORDS: Please forward to **Flora Administrative Officer,** Species and Communities Program.

Record entered by:_____ **Sheet No.:**_____ **Record Entered in Database** ❑

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

Threatened and Priority Flora Report Form

Version 1.4 March 2021

HABITAT INFORMATION:

LANDFORM:
Crest ☐
Hill ☒
Ridge ☐
Outcrop ☐
Slope ☐
Flat ☐
Open depression ☐
Drainage line ☐
Closed depression ☐
Wetland ☐

ROCK TYPE:
Granite ☐
Dolerite ☐
Laterite ☐
Ironstone ☐
Limestone ☐
Quartz ☐
Specify other: _____

LOOSE ROCK:
(on soil surface; eg gravel, quartz fields)
0-10% ☐
10-30% ☐
30-50% ☐
50-100% ☐

SOIL TYPE:
Sand ☐
Sandy loam ☐
Loam ☐
Clay loam ☐
Light clay ☐
Peat ☐
Specify other: Clay

SOIL COLOUR:
Red ☐
Brown ☒
Yellow ☐
White ☐
Grey ☐
Black ☐
Specify other: _____

DRAINAGE:
Well drained ☐
Seasonally inundated ☐
Permanently inundated ☐
Tidal ☐

Specific **Landform** Element: _____
(Refer to field manual for additional values)

CONDITION OF SOIL: Dry ☐ Moist ☐ Waterlogged ☐ Inundated ☐

VEGETATION CLASSIFICATION*:
Eg: **1**. Banksia woodland (B. attenuata, B. ilicifolia); **2**. Open shrubland (Hibbertia sp., Acacia spp.) ; **3**. Isolated clumps of sedges (M.tetragona)

1. Vachellia farnesiana mid open shrubland.
2. Arivela viscosa, Heliotropium crispatum, Aristida latifolia low herbland/tussock grassland.
3.
4.

ASSOCIATED SPECIES:

Other (non-dominant) spp

* Please record up to four of the most representative vegetation layers (with up to three dominant species in each layer). Structural Formations should follow 2009 *Australian Soil and Land Survey Field Handbook* guidelines – refer to field manual for further information and structural formation table.

CONDITION OF HABITAT: Pristine ☐ Excellent ☒ Very good ☐ Good ☐ Degraded ☐ Completely degraded ☐

COMMENT:

FIRE HISTORY: **Last Fire:** Season/Month: _____ Year: _____ **Fire Intensity:** High ☐ Medium ☐ Low ☐ No signs of fire ☐

FENCING: Not required ☐ Present ☐ Replace / repair ☐ Required ☐ Length req'd: _____

ROADSIDE MARKERS: Not required ☐ Present ☐ Replace / reposition ☐ Required ☐ Quantity req'd: _____

OTHER COMMENTS: (Please include recommended management actions and/or implemented actions - include date. Also include details of additional data available, and how to locate it.)

FLORA AUTHORISATION / LICENCE No: _____ Note if only observing plants (i.e. no specimens or plant matieral is taken) then no authorisation/licence is required. For further information on authorisation and licening requirements see the Threatened Flora and Wildlife Licensing pages on DBCA's website. Any actions carried out under authorisations/licences should be recorded above in the OTHER COMMENTS section.

SPECIMEN: Collectors No: _____ WA Herb. ☐ Regional Herb. ☐ District Herb. ☐ Other: _____

LODGEMENT: WA Herb Lodgement No: _____

ATTACHED: Map ☐ Mudmap ☐ Photo ☐ GIS data ☐ Field notes ☐ Other: _____

COPY SENT TO: Regional Office ☐ District Office ☐ Other: _____

Submitter of Record: A. Craigie Role: Botanist Signed: _____ Date: 11/12/2023

Please return completed form to **Species And Communities Program** DBCA,
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983 **OR** email to: flora.data@dbca.wa.gov.au

RECORDS: Please forward to **Flora Administrative Officer,** Species and Communities Program.

Record entered by:_____ **Sheet No.:**_____ **Record Entered in Database** ❑

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

Threatened and Priority Flora Report Form

Version 1.4 March 2021

Please complete as much of the form as possible, with emphasis on those sections bordered in black. For information on how to complete the form please refer to the Threatened & Priority Flora Report Form (TPRF) manual on the DBCA website at www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/threatened-plants

TAXON: Paspalidium retiglume **TPFL Pop. No:**

OBSERVATION DATE: 24/06/2023 **CONSERVATION STATUS:** P2 **New population** ☐

OBSERVER/S: A. Craigie **PHONE** 61687200

ROLE: Botanist **ORGANISATION:** Ecologia Environment

EMAIL: andrew.craigie@ecologia.com.au

DESCRIPTION OF LOCATION (Provide at least nearest town/named locality, and the distance and direction to that place)**:**

Bonney Downs Station, ca. 15 km southwest of Nullagine, WA.

Reserve No:

DBCA DISTRICT: **LGA:** Shire of East Pilbara Land manager present: ☐

DATUM:
GDA94 / MGA94 ☒
AGD84 / AMG84 ☐
WGS84 ☐
Unknown ☐

COORDINATES: (If UTM coords provided, **Zone** is also required)
DecDegrees ☐ DegMinSec ☐ UTMs ☒

Lat / Northing: 7564661.78

Long / Easting: 794464.68

ZONE: 50

METHOD USED:
GPS ☒ Differential GPS ☐ Map ☐

No. satellites: ____ Map used: _____

Boundary polygon captured: ☐ Map scale: _____

LAND TENURE:

Nature reserve ☐	Timber reserve ☐	Private property ☐	Rail reserve ☐	Shire road reserve ☐
National park ☐	State forest ☐	Pastoral lease ☐	MRWA road reserve ☐	Other Crown reserve ☐
Conservation park ☐	Water reserve ☐	UCL ☐	SLK/Pole _____ to _____	Specify other: _____

AREA ASSESSMENT: Edge survey ☐ Partial survey ☒ Full survey ☐ Area observed (m²): _____

EFFORT: Time spent surveying (minutes): _____ No. of minutes spent / 100 m²: _____

POP'N COUNT ACCURACY: Actual ☐ Extrapolation ☐ Estimate ☐ Count method: _____ (Refer to field manual for list)

WHAT COUNTED: Plants ☒ Clumps ☐ Clonal stems ☐

TOTAL POP'N STRUCTURE:

	Mature:	Juveniles:	Seedlings:	Totals:
Alive	1			1
Dead				

Area of pop (m²): _____

Note: Pls record count as numbers (not percentages) for database.

QUADRATS PRESENT: No. ___ Size _____ Data attached ☐ Total area of quadrats (m²): _____

Summary Quad. Totals: Alive				

REPRODUCTIVE STATE: Clonal ☐ Vegetative ☐ Flowerbud ☐ Flower ☐
Immature fruit ☐ Fruit ☒ Dehisced fruit ☐ Percentage in flower: _____%

CONDITION OF PLANTS: Healthy ☐ Moderate ☐ Poor ☐ Senescent ☐

COMMENT:

THREATS - type, agent and supporting information: Eg clearing, too frequent fire, weed, disease. Refer to field manual for list of threats & agents. **Specify agent** where relevant. Rate current and potential threat impact: N=Nil, L=Low, M=Medium, H=High, E=Extreme Estimate time to potential impact: S=Short (<12mths), M=Medium (<5yrs), L=Long (5yrs+)	**Current impact (N-E)**	**Potential Impact (L-E)**	**Potential Threat Onset (S-L)**
•			
•			
•			

Please return completed form to **Species And Communities Program** DBCA,
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983 **OR** email to: flora.data@dbca.wa.gov.au

RECORDS: Please forward to **Flora Administrative Officer,** Species and Communities Program.

Record entered by:_____ **Sheet No.:**_____ **Record Entered in Database** ❑

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

Threatened and Priority Flora Report Form

Version 1.4 March 2021

HABITAT INFORMATION:

LANDFORM:
Crest ☐
Hill ☐
Ridge ☐
Outcrop ☐
Slope ☐
Flat ☒
Open depression ☐
Drainage line ☐
Closed depression ☐
Wetland ☐

ROCK TYPE:
Granite ☐
Dolerite ☐
Laterite ☐
Ironstone ☐
Limestone ☐
Quartz ☐
Specify other:
Basalt

LOOSE ROCK:
(on soil surface; eg gravel, quartz fields)
0-10% ☐
10-30% ☐
30-50% ☐
50-100% ☐

SOIL TYPE:
Sand ☐
Sandy loam ☐
Loam ☐
Clay loam ☐
Light clay ☐
Peat ☐
Specify other:
Clay

SOIL COLOUR:
Red ☐
Brown ☒
Yellow ☐
White ☐
Grey ☐
Black ☐
Specify other:

DRAINAGE:
Well drained ☐
Seasonally inundated ☐
Permanently inundated ☐
Tidal ☐

Specific **Landform** Element:
(Refer to field manual for additional values)

CONDITION OF SOIL: Dry ☐ Moist ☐ Waterlogged ☐ Inundated ☐

VEGETATION CLASSIFICATION*:
Eg: **1**. Banksia woodland (B. attenuata, B. ilicifolia); **2**. Open shrubland (Hibbertia sp., Acacia spp.) ; **3**. Isolated clumps of sedges (M.tetragona)

1. Vachellia farnesiana mid open shrubland.
2. Sida trichopoda, Grona muelleri, Cynodon convergens low herbland/tussock grassland.
3.
4.

ASSOCIATED SPECIES:
Other (non-dominant) spp

* Please record up to four of the most representative vegetation layers (with up to three dominant species in each layer). Structural Formations should follow 2009 *Australian Soil and Land Survey Field Handbook* guidelines – refer to field manual for further information and structural formation table.

CONDITION OF HABITAT: Pristine ☐ Excellent ☒ Very good ☐ Good ☐ Degraded ☐ Completely degraded ☐

COMMENT:

FIRE HISTORY: **Last Fire:** Season/Month: _____ Year: _____ **Fire Intensity:** High ☐ Medium ☐ Low ☐ No signs of fire ☐

FENCING: Not required ☐ Present ☐ Replace / repair ☐ Required ☐ Length req'd: _____

ROADSIDE MARKERS: Not required ☐ Present ☐ Replace / reposition ☐ Required ☐ Quantity req'd: _____

OTHER COMMENTS: (Please include recommended management actions and/or implemented actions - include date. Also include details of additional data available, and how to locate it.)

FLORA AUTHORISATION / LICENCE No: _____ Note if only observing plants (i.e. no specimens or plant matieral is taken) then no authorisation/licence is required. For further information on authorisation and licening requirements see the Threatened Flora and Wildlife Licensing pages on DBCA's website. Any actions carried out under authorisations/licences should be recorded above in the OTHER COMMENTS section.

SPECIMEN: Collectors No: _____ WA Herb. ☐ Regional Herb. ☐ District Herb. ☐ Other: _____

LODGEMENT: WA Herb Lodgement No: _____

ATTACHED: Map ☐ Mudmap ☐ Photo ☐ GIS data ☐ Field notes ☐ Other: _____

COPY SENT TO: Regional Office ☐ District Office ☐ Other: _____

Submitter of Record: A. Craigie Role: Botanist Signed: _____ Date: 11/12/2023

Please return completed form to **Species And Communities Program** DBCA,
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983 **OR** email to: flora.data@dbca.wa.gov.au

RECORDS: Please forward to **Flora Administrative Officer,** Species and Communities Program.

Record entered by:_____ **Sheet No.:**_____ **Record Entered in Database** ❑

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

Threatened and Priority Flora Report Form

Version 1.4 March 2021

Please complete as much of the form as possible, with emphasis on those sections bordered in black. For information on how to complete the form please refer to the Threatened & Priority Flora Report Form (TPRF) manual on the DBCA website at www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/threatened-plants

TAXON: Ptiotus mollis **TPFL Pop. No:**

OBSERVATION DATE: 16/09/2023 **CONSERVATION STATUS:** P4 **New population** ☐

OBSERVER/S: L. Elwood **PHONE** 61687200

ROLE: Botanist **ORGANISATION:** Ecologia Environment

EMAIL: andrew.craigie@ecologia.com.au

DESCRIPTION OF LOCATION (Provide at least nearest town/named locality, and the distance and direction to that place)**:**

Bonney Downs Station, ca. 15 km southwest of Nullagine, WA.

Reserve No:

DBCA DISTRICT: **LGA:** Shire of East Pilbara Land manager present: ☐

DATUM:
GDA94 / MGA94 ☒
AGD84 / AMG84 ☐
WGS84 ☐
Unknown ☐

COORDINATES: (If UTM coords provided, **Zone** is also required)
DecDegrees ☐ DegMinSec ☐ UTMs ☒
Lat / Northing: 7548731.57
Long / Easting: 797441.16
ZONE: 50

METHOD USED:
GPS ☒ Differential GPS ☐ Map ☐
No. satellites: ____ Map used: _____
Boundary polygon captured: ☐ Map scale: _____

LAND TENURE:

Nature reserve ☐	Timber reserve ☐	Private property ☐	Rail reserve ☐	Shire road reserve ☐
National park ☐	State forest ☐	Pastoral lease ☐	MRWA road reserve ☐	Other Crown reserve ☐
Conservation park ☐	Water reserve ☐	UCL ☐	SLK/Pole _____ to _____	Specify other: _____

AREA ASSESSMENT: Edge survey ☐ Partial survey ☒ Full survey ☐ Area observed (m²): _____

EFFORT: Time spent surveying (minutes): _____ No. of minutes spent / 100 m²: _____

POP'N COUNT ACCURACY: Actual ☐ Extrapolation ☐ Estimate ☐ Count method: _____ (Refer to field manual for list)

WHAT COUNTED: Plants ☒ Clumps ☐ Clonal stems ☐

TOTAL POP'N STRUCTURE:

	Mature:	Juveniles:	Seedlings:	Totals:
Alive	268			268
Dead				

Area of pop (m²): _____

Note: Pls record count as numbers (not percentages) for database.

QUADRATS PRESENT: No. ___ Size _____ Data attached ☐ Total area of quadrats (m²): _____

Summary Quad. Totals: Alive				

REPRODUCTIVE STATE: Clonal ☐ Vegetative ☐ Flowerbud ☐ Flower ☐
Immature fruit ☐ Fruit ☐ Dehisced fruit ☐ Percentage in flower: _____%

CONDITION OF PLANTS: Healthy ☐ Moderate ☐ Poor ☐ Senescent ☐

COMMENT:

THREATS - type, agent and supporting information: Eg clearing, too frequent fire, weed, disease. Refer to field manual for list of threats & agents. **Specify agent** where relevant. Rate current and potential threat impact: N=Nil, L=Low, M=Medium, H=High, E=Extreme Estimate time to potential impact: S=Short (<12mths), M=Medium (<5yrs), L=Long (5yrs+)	**Current impact (N-E)**	**Potential Impact (L-E)**	**Potential Threat Onset (S-L)**
•			
•			
•			

Please return completed form to **Species And Communities Program** DBCA,
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983 **OR** email to: flora.data@dbca.wa.gov.au

RECORDS: Please forward to **Flora Administrative Officer,** Species and Communities Program.

Record entered by:_____ **Sheet No.:**_____ **Record Entered in Database** ❑

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

Threatened and Priority Flora Report Form

Version 1.4 March 2021

HABITAT INFORMATION:

LANDFORM:
Crest ☐
Hill ☒
Ridge ☐
Outcrop ☐
Slope ☐
Flat ☐
Open depression ☐
Drainage line ☐
Closed depression ☐
Wetland ☐

ROCK TYPE:
Granite ☐
Dolerite ☐
Laterite ☐
Ironstone ☐
Limestone ☐
Quartz ☐
Specify other:
Basalt

LOOSE ROCK:
(on soil surface; eg gravel, quartz fields)
0-10% ☐
10-30% ☐
30-50% ☐
50-100% ☐

SOIL TYPE:
Sand ☐
Sandy loam ☐
Loam ☐
Clay loam ☒
Light clay ☐
Peat ☐
Specify other:

SOIL COLOUR:
Red ☐
Brown ☒
Yellow ☐
White ☐
Grey ☐
Black ☐
Specify other:

DRAINAGE:
Well drained ☒
Seasonally inundated ☐
Permanently inundated ☐
Tidal ☐

Specific **Landform** Element:
(Refer to field manual for additional values)

CONDITION OF SOIL: Dry ☐ Moist ☐ Waterlogged ☐ Inundated ☐

VEGETATION CLASSIFICATION*:
Eg: **1**. Banksia woodland (B. attenuata, B. ilicifolia); **2**. Open shrubland (Hibbertia sp., Acacia spp.) ; **3**. Isolated clumps of sedges (M.tetragona)

1. Senna glutinosa subsp. glutinosa mid sparse shrubland
2. Triodia epactia, Triodia brizoides, Cymbopogon ambiguus low hummock/tussock grassland.
3.
4.

ASSOCIATED SPECIES:
Other (non-dominant) spp

* Please record up to four of the most representative vegetation layers (with up to three dominant species in each layer). Structural Formations should follow 2009 *Australian Soil and Land Survey Field Handbook* guidelines – refer to field manual for further information and structural formation table.

CONDITION OF HABITAT: Pristine ☐ Excellent ☒ Very good ☐ Good ☐ Degraded ☐ Completely degraded ☐

COMMENT:

FIRE HISTORY: **Last Fire:** Season/Month: _____ Year: _____ **Fire Intensity:** High ☐ Medium ☐ Low ☐ No signs of fire ☐

FENCING: Not required ☐ Present ☐ Replace / repair ☐ Required ☐ Length req'd: _____

ROADSIDE MARKERS: Not required ☐ Present ☐ Replace / reposition ☐ Required ☐ Quantity req'd: _____

OTHER COMMENTS: (Please include recommended management actions and/or implemented actions - include date. Also include details of additional data available, and how to locate it.)

FLORA AUTHORISATION / LICENCE No: _____ Note if only observing plants (i.e. no specimens or plant matieral is taken) then no authorisation/licence is required. For further information on authorisation and licening requirements see the Threatened Flora and Wildlife Licensing pages on DBCA's website. Any actions carried out under authorisations/licences should be recorded above in the OTHER COMMENTS section.

SPECIMEN: Collectors No: _____ WA Herb. ☐ Regional Herb. ☐ District Herb. ☐ Other: _____

LODGEMENT: WA Herb Lodgement No: _____

ATTACHED: Map ☐ Mudmap ☐ Photo ☐ GIS data ☐ Field notes ☐ Other: _____

COPY SENT TO: Regional Office ☐ District Office ☐ Other: _____

Submitter of Record: A. Craigie Role: Botanist Signed: _____ Date: 11/12/2023

Please return completed form to **Species And Communities Program** DBCA,
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983 **OR** email to: flora.data@dbca.wa.gov.au

RECORDS: Please forward to **Flora Administrative Officer,** Species and Communities Program.

Record entered by:_____ **Sheet No.:**_____ **Record Entered in Database** ❑

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

Threatened and Priority Flora Report Form

Version 1.4 March 2021

Please complete as much of the form as possible, with emphasis on those sections bordered in black. For information on how to complete the form please refer to the Threatened & Priority Flora Report Form (TPRF) manual on the DBCA website at www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/threatened-plants

TAXON: Swainsona thompsoniana **TPFL Pop. No:**

OBSERVATION DATE: 22/06/2023 **CONSERVATION STATUS:** P3 **New population** ☐

OBSERVER/S: A. Craigie **PHONE** 61687200

ROLE: Botanist **ORGANISATION:** Ecologia Environment

EMAIL: andrew.craigie@ecologia.com.au

DESCRIPTION OF LOCATION (Provide at least nearest town/named locality, and the distance and direction to that place)**:**

Bonney Downs Station, ca. 15 km southwest of Nullagine, WA.

Reserve No:

DBCA DISTRICT: **LGA:** Shire of East Pilbara Land manager present: ☐

DATUM:
GDA94 / MGA94 ☒
AGD84 / AMG84 ☐
WGS84 ☐
Unknown ☐

COORDINATES: (If UTM coords provided, **Zone** is also required)
DecDegrees ☐ DegMinSec ☐ UTMs ☒
Lat / Northing: 7554794.89
Long / Easting: 798554.91
ZONE: 50

METHOD USED:
GPS ☒ Differential GPS ☐ Map ☐
No. satellites: ___ Map used: _____
Boundary polygon captured: ☐ Map scale: _____

LAND TENURE:

Nature reserve ☐	Timber reserve ☐	Private property ☐	Rail reserve ☐	Shire road reserve ☐
National park ☐	State forest ☐	Pastoral lease ☐	MRWA road reserve ☐	Other Crown reserve ☐
Conservation park ☐	Water reserve ☐	UCL ☐	SLK/Pole _____ to _____	Specify other: _____

AREA ASSESSMENT: Edge survey ☐ Partial survey ☒ Full survey ☐ Area observed (m²): _____

EFFORT: Time spent surveying (minutes): _____ No. of minutes spent / 100 m²: _____

POP'N COUNT ACCURACY: Actual ☐ Extrapolation ☐ Estimate ☐ Count method: _____ (Refer to field manual for list)

WHAT COUNTED: Plants ☒ Clumps ☐ Clonal stems ☐

TOTAL POP'N STRUCTURE:

	Mature:	Juveniles:	Seedlings:	Totals:
Alive	1			1
Dead				

Area of pop (m²): _____

Note: Pls record count as numbers (not percentages) for database.

QUADRATS PRESENT: No. ___ Size _____ Data attached ☐ Total area of quadrats (m²): _____

Summary Quad. Totals: Alive				

REPRODUCTIVE STATE: Clonal ☐ Vegetative ☒ Flowerbud ☐ Flower ☐
Immature fruit ☐ Fruit ☐ Dehisced fruit ☐ Percentage in flower: _____%

CONDITION OF PLANTS: Healthy ☐ Moderate ☐ Poor ☐ Senescent ☐

COMMENT:

THREATS - type, agent and supporting information: Eg clearing, too frequent fire, weed, disease. Refer to field manual for list of threats & agents. **Specify agent** where relevant. Rate current and potential threat impact: N=Nil, L=Low, M=Medium, H=High, E=Extreme Estimate time to potential impact: S=Short (<12mths), M=Medium (<5yrs), L=Long (5yrs+)	**Current impact (N-E)**	**Potential Impact (L-E)**	**Potential Threat Onset (S-L)**
•			
•			
•			

Please return completed form to **Species And Communities Program** DBCA,
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983 **OR** email to: flora.data@dbca.wa.gov.au

RECORDS: Please forward to **Flora Administrative Officer,** Species and Communities Program.

Record entered by:_____ **Sheet No.:**_____ **Record Entered in Database** ❑

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

Threatened and Priority Flora Report Form

Version 1.4 March 2021

HABITAT INFORMATION:

LANDFORM:
Crest ☐
Hill ☐
Ridge ☐
Outcrop ☐
Slope ☐
Flat ☒
Open depression ☐
Drainage line ☐
Closed depression ☐
Wetland ☐

ROCK TYPE:
Granite ☐
Dolerite ☐
Laterite ☐
Ironstone ☐
Limestone ☐
Quartz ☐
Specify other:
Basalt

LOOSE ROCK:
(on soil surface; eg gravel, quartz fields)
0-10% ☐
10-30% ☐
30-50% ☐
50-100% ☐

SOIL TYPE:
Sand ☐
Sandy loam ☐
Loam ☐
Clay loam ☐
Light clay ☐
Peat ☐
Specify other:
Clay

SOIL COLOUR:
Red ☐
Brown ☒
Yellow ☐
White ☐
Grey ☐
Black ☐
Specify other:

DRAINAGE:
Well drained ☐
Seasonally inundated ☐
Permanently inundated ☐
Tidal ☐

Specific **Landform** Element:
(Refer to field manual for additional values)

CONDITION OF SOIL: Dry ☐ Moist ☐ Waterlogged ☐ Inundated ☐

VEGETATION CLASSIFICATION*:
Eg: **1**. Banksia woodland (B. attenuata, B. ilicifolia); **2**. Open shrubland (Hibbertia sp., Acacia spp.) ; **3**. Isolated clumps of sedges (M.tetragona)

1. Vachellia farnesiana mid open shrubland.
2. Sida trichopoda, Grona muelleri, Aristida contorta low herbland/tussock grassland.
3.
4.

ASSOCIATED SPECIES:
Other (non-dominant) spp

* Please record up to four of the most representative vegetation layers (with up to three dominant species in each layer). Structural Formations should follow 2009 *Australian Soil and Land Survey Field Handbook* guidelines – refer to field manual for further information and structural formation table.

CONDITION OF HABITAT: Pristine ☐ Excellent ☒ Very good ☐ Good ☐ Degraded ☐ Completely degraded ☐

COMMENT:

FIRE HISTORY: **Last Fire:** Season/Month: _____ Year: _____ **Fire Intensity:** High ☐ Medium ☐ Low ☐ No signs of fire ☐

FENCING: Not required ☐ Present ☐ Replace / repair ☐ Required ☐ Length req'd: _____

ROADSIDE MARKERS: Not required ☐ Present ☐ Replace / reposition ☐ Required ☐ Quantity req'd: _____

OTHER COMMENTS: (Please include recommended management actions and/or implemented actions - include date. Also include details of additional data available, and how to locate it.)

FLORA AUTHORISATION / LICENCE No: _____ Note if only observing plants (i.e. no specimens or plant matieral is taken) then no authorisation/licence is required. For further information on authorisation and licening requirements see the Threatened Flora and Wildlife Licensing pages on DBCA's website. Any actions carried out under authorisations/licences should be recorded above in the OTHER COMMENTS section.

SPECIMEN: Collectors No: _____ WA Herb. ☐ Regional Herb. ☐ District Herb. ☐ Other: _____

LODGEMENT: WA Herb Lodgement No: _____

ATTACHED: Map ☐ Mudmap ☐ Photo ☐ GIS data ☐ Field notes ☐ Other: _____

COPY SENT TO: Regional Office ☐ District Office ☐ Other: _____

Submitter of Record: A. Craigie Role: Botanist Signed: _____ Date: 11/12/2023

Please return completed form to **Species And Communities Program** DBCA,
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983 **OR** email to: flora.data@dbca.wa.gov.au

RECORDS: Please forward to **Flora Administrative Officer,** Species and Communities Program.

Record entered by:_____ **Sheet No.:**_____ **Record Entered in Database** ❑

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

Threatened and Priority Flora Report Form

Version 1.4 March 2021

Please complete as much of the form as possible, with emphasis on those sections bordered in black. For information on how to complete the form please refer to the Threatened & Priority Flora Report Form (TPRF) manual on the DBCA website at www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/threatened-plants

TAXON: Quoya zonalis **TPFL Pop. No:**

OBSERVATION DATE: 18/07/2024 **CONSERVATION STATUS:** T **New population** ☐

OBSERVER/S: A. Craigie, S. Ng **PHONE** 61687200

ROLE: Botanist **ORGANISATION:** Ecologia Environment

EMAIL: andrew.craigie@ecologia.com.au

DESCRIPTION OF LOCATION (Provide at least nearest town/named locality, and the distance and direction to that place)**:**

Bonney Downs Station, ca. 15 km southwest of Nullagine, WA.

Reserve No:

DBCA DISTRICT: **LGA:** Shire of East Pilbara Land manager present: ☐

DATUM:
GDA94 / MGA94 ☒
AGD84 / AMG84 ☐
WGS84 ☐
Unknown ☐

COORDINATES: (If UTM coords provided, **Zone** is also required)
DecDegrees ☒ DegMinSec ☐ UTMs ☐

Lat / Northing: -21.944596

Long / Easting: 119.796154

ZONE:

METHOD USED:
GPS ☒ Differential GPS ☐ Map ☐

No. satellites: ___ Map used: _____

Boundary polygon captured: ☐ Map scale: _____

LAND TENURE:

Nature reserve ☐	Timber reserve ☐	Private property ☐	Rail reserve ☐	Shire road reserve ☐
National park ☐	State forest ☐	Pastoral lease ☐	MRWA road reserve ☐	Other Crown reserve ☐
Conservation park ☐	Water reserve ☐	UCL ☐	SLK/Pole _____ to _____	Specify other: _____

AREA ASSESSMENT: Edge survey ☐ Partial survey ☒ Full survey ☐ Area observed (m²): _____

EFFORT: Time spent surveying (minutes): _____ No. of minutes spent / 100 m²: _____

POP'N COUNT ACCURACY: Actual ☐ Extrapolation ☐ Estimate ☐ Count method: _____ (Refer to field manual for list)

WHAT COUNTED: Plants ☒ Clumps ☐ Clonal stems ☐

TOTAL POP'N STRUCTURE:

	Mature:	Juveniles:	Seedlings:	Totals:
Alive	21			21
Dead				

Area of pop (m²): _____

Note: Pls record count as numbers (not percentages) for database.

QUADRATS PRESENT: No. ___ Size _____ Data attached ☐ Total area of quadrats (m²): _____

Summary Quad. Totals: Alive				

REPRODUCTIVE STATE: Clonal ☐ Vegetative ☒ Flowerbud ☐ Flower ☐
Immature fruit ☐ Fruit ☐ Dehisced fruit ☐ Percentage in flower: _____%

CONDITION OF PLANTS: Healthy ☒ Moderate ☐ Poor ☐ Senescent ☐

COMMENT:

THREATS - type, agent and supporting information: Eg clearing, too frequent fire, weed, disease. Refer to field manual for list of threats & agents. **Specify agent** where relevant. Rate current and potential threat impact: N=Nil, L=Low, M=Medium, H=High, E=Extreme Estimate time to potential impact: S=Short (<12mths), M=Medium (<5yrs), L=Long (5yrs+)	**Current impact (N-E)**	**Potential Impact (L-E)**	**Potential Threat Onset (S-L)**
•			
•			
•			

Please return completed form to **Species And Communities Program** DBCA,
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983 **OR** email to: flora.data@dbca.wa.gov.au

RECORDS: Please forward to **Flora Administrative Officer,** Species and Communities Program.

Record entered by:_____ **Sheet No.:**_____ **Record Entered in Database** ❑

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

Threatened and Priority Flora Report Form

Version 1.4 March 2021

HABITAT INFORMATION:

LANDFORM:
Crest ☐
Hill ☒
Ridge ☒
Outcrop ☐
Slope ☐
Flat ☐
Open depression ☐
Drainage line ☐
Closed depression ☐
Wetland ☐

ROCK TYPE:
Granite ☒
Dolerite ☐
Laterite ☐
Ironstone ☐
Limestone ☐
Quartz ☐
Specify other: ____

LOOSE ROCK:
(on soil surface; eg gravel, quartz fields)
0-10% ☐
10-30% ☐
30-50% ☐
50-100% ☒

SOIL TYPE:
Sand ☐
Sandy loam ☐
Loam ☐
Clay loam ☒
Light clay ☐
Peat ☐
Specify other: ____

SOIL COLOUR:
Red ☐
Brown ☒
Yellow ☐
White ☐
Grey ☐
Black ☐
Specify other: ____

DRAINAGE:
Well drained ☒
Seasonally inundated ☐
Permanently inundated ☐
Tidal ☐

Specific **Landform** Element: ____
(Refer to field manual for additional values)

CONDITION OF SOIL: Dry ☐ Moist ☐ Waterlogged ☐ Inundated ☐

VEGETATION CLASSIFICATION*:
Eg: **1**. Banksia woodland (B. attenuata, B. ilicifolia); **2**. Open shrubland (Hibbertia sp., Acacia spp.) ; **3**. Isolated clumps of sedges (M.tetragona)

1. Eucalyptus leucophloia subsp. leucophloia, Corymbia hamersleyana low isolated trees
2. Acacia monticola, Grevillea wickhamii mid sparse shrubland.
3. Triodia epactia low hummock grassland.
4.

ASSOCIATED SPECIES:

Other (non-dominant) spp

* Please record up to four of the most representative vegetation layers (with up to three dominant species in each layer). Structural Formations should follow 2009 *Australian Soil and Land Survey Field Handbook* guidelines – refer to field manual for further information and structural formation table.

CONDITION OF HABITAT: Pristine ☐ Excellent ☒ Very good ☐ Good ☐ Degraded ☐ Completely degraded ☐

COMMENT:

FIRE HISTORY: **Last Fire:** Season/Month: ____ Year: ____ **Fire Intensity:** High ☐ Medium ☐ Low ☐ No signs of fire ☐

FENCING: Not required ☐ Present ☐ Replace / repair ☐ Required ☐ Length req'd: ____

ROADSIDE MARKERS: Not required ☐ Present ☐ Replace / reposition ☐ Required ☐ Quantity req'd: ____

OTHER COMMENTS: (Please include recommended management actions and/or implemented actions - include date. Also include details of additional data available, and how to locate it.)

FLORA AUTHORISATION / LICENCE No: ____ Note if only observing plants (i.e. no specimens or plant matieral is taken) then no authorisation/licence is required. For further information on authorisation and licening requirements see the Threatened Flora and Wildlife Licensing pages on DBCA's website. Any actions carried out under authorisations/licences should be recorded above in the OTHER COMMENTS section.

SPECIMEN: Collectors No: ____ WA Herb. ☐ Regional Herb. ☐ District Herb. ☐ Other: ____

LODGEMENT: WA Herb Lodgement No: ____

ATTACHED: Map ☐ Mudmap ☐ Photo ☐ GIS data ☐ Field notes ☐ Other: ____

COPY SENT TO: Regional Office ☐ District Office ☐ Other: ____

Submitter of Record: A. Craigie Role: Botanist Signed: ____ Date: 13/1/2025

Please return completed form to **Species And Communities Program** DBCA,
Locked Bag 104, BENTLEY DELIVERY CENTRE WA 6983 **OR** email to: flora.data@dbca.wa.gov.au

RECORDS: Please forward to **Flora Administrative Officer,** Species and Communities Program.

Record entered by:____ **Sheet No.:**____ **Record Entered in Database** ❑

Appendix 2: Annual Fauna Monitoring Program 2023 (Spectrum, 2024a)

FORTESCUE

ANNUAL FAUNA MONITORING PROGRAM 2023 – OPERATIONAL SITES, NULLAGINE AND NORTH STAR

PREPARED FOR: FORTESCUE



Spectrum
ECOLOGY & SPATIAL

© Spectrum Ecology Pty Ltd
ABN 68 615 115 243
PO Box 314 Leederville
Western Australia 6902
Ph: (08) 9317 8233
Email: info@spectrumecology.com.au

Report Details			
Project Description:	Fortescue Annual Fauna Monitoring Program 2023 – Operational Sites, Nullagine and North Star		
Prepared For:	Fortescue		
Project ID:	2300		
Version History	Author	Reviewer	Date of Issue
Version 1	M. Henderson Dr D. Mihindukulasooriya A. Heidrich	A. Heidrich	10-Nov-2023
Version 2	A. Heidrich	E. MacIntyre	25-Jan-2024

This document has been prepared to the requirements of the client identified on the cover page and no representation is made to any third party. It may be cited for the purposes of scientific research or other fair use, but it may not be reproduced or distributed to any third party by any physical or electronic means without the express permission of the client for whom it was prepared or Spectrum Ecology Pty Ltd.

TABLE OF CONTENTS

EXECUTIVE SUMMARY 1
1. INTRODUCTION 14
1.1. PROJECT BACKGROUND 14
1.2. MONITORING REQUIREMENTS 15
1.2.1. Fortescue Operational Sites 17
1.2.2. Nullagine Mine Site 17
1.2.3. North Star (FMG Iron Bridge) 18
1.2.4. Additional Monitoring Objectives 18
1.2.5. Legislation and Relevant Guidance 19
2. METHODS 21
2.1. ENVIRONMENTAL CONDITIONS 24
2.1.1. Rainfall 24
2.1.2. Fire History Data 24
2.2. SITE-BASED RECORDS 24
2.3. NORTHERN QUOLL 24
2.3.1. GPS Radio-tracking 25
2.3.2. Statistical Analysis 25
2.4. GREATER BILBY 26
2.5. PILBARA LEAF-NOSED BAT AND GHOST BAT 26
2.6. PILBARA OLIVE PYTHON 26
2.7. CONSERVATION SIGNIFICANT BIRDS 27
2.8. NIGHT PARROT 28
2.9. ADDITIONAL MONITORING 28
2.10. PERMIT AND FIELD TEAM 29
3. RESULTS AND DISCUSSION 39
3.1. RAINFALL 39
3.2. SITE-BASED RECORDS 40
3.3. NORTHERN QUOLL 41
3.3.1. Control Sites 45
3.3.2. Potential Impact Sites 46
3.4. GREATER BILBY 57
3.4.1. Control Sites 57
3.4.2. Main Line Rail 57
3.5. PILBARA LEAF-NOSED BAT 61
3.5.1. Control Sites 61
3.5.2. Potential Impact Sites 62
3.6. GHOST BAT 64
3.6.1. Control Sites 64
3.6.2. Potential Impact Sites 65
3.7. PILBARA OLIVE PYTHON 67

3.7.1. Control Sites 67
3.7.2. Potential Impact Sites 67
3.8. Conservation Significant Birds 70
3.8.1. Control Sites 74
3.8.2. Potential Impact Sites 74
3.9. Night Parrot 77
3.10. Rehabilitation Areas 80
3.11. Culvert Sites 83
3.11.1. Hamersley Line Rail 83
3.11.2. Main Line Rail 83
3.11.3. Eliwana Line Rail 84
3.12. Introduced Fauna 84
3.13. Millipede *Antichiropus* '1021DNA02' 87
3.14. Limitations 87
4. COMPLIANCE WITH FAUNA MANAGEMENT PLANS 89
4.1. Fortescue's Operational Sites 89
4.2. Iron Bridge's North Star 94
5. REFERENCES 95

TABLES

Table 1.1: Site-specific monitoring requirements summary 16
Table 2.1: Details of site-specific monitoring methods completed in 2023 22
Table 2.2: Northern Quoll monitoring methods compared between projects 25
Table 2.3: Greater Bilby monitoring methods along the Main Line Rail 26
Table 2.4: Field staff and qualifications 29
Table 3.1: Number of Northern Quoll recorded from each site 41
Table 3.2: Northern Quoll records and environmental variable at each control and impact area 42
Table 3.3: Northern Quoll population at North Star potential impact sites ..... Error! Bookmark not defined.
Table 3.4: Northern Quoll home range sizes based on radio-collar data 51
Table 3.5: Greater Bilby scats and individuals recorded 58
Table 3.6: Greater Bilby records from potential impact occupancy sites 59
Table 3.7: Pilbara Leaf-nosed Bat call detections at each location 61
Table 3.8: Ghost Bat call detections at each site 64
Table 3.9: Ghost Bats secondary evidence recorded during dry season monitoring 65
Table 3.10: Pilbara Olive Pythons records from across all sites 67
Table 3.11: Conservation significant birds recorded 71
Table 3.12: Conservation significant fauna and feral predators recorded from culvert sites 83
Table 3.13: Population trends of key introduced predator species at each site in comparison to 2022 85
Table 3.14: Details of Red Fox records 85
Table 3.15: Limitations and constraints 87
Table 4.1: Compliance with objectives of CSFMP – Fortescue Operational Sites 89

Table 4.2: Compliance with Objectives of NQMMP – Nullagine 93
Table 4.3: Performance indicators as per NQMP – North Star 94
Table 5.1: Monitoring site locations 115
Table 5.2: Rainfall recorded at each site since the start of monitoring 129
Table 5.3: Site-based records of conservation significant fauna 134
Table 5.4: Total number of Northern Quoll captures recorded from each site 143
Table 5.5: Northern Quolls recorded at Nullagine 145
Table 5.6: Historic Northern Quoll records at Nullagine 147
Table 5.7: Details of Northern Quoll records at each site to date 148
Table 5.8: Abundance estimates of Northern Quoll at North Star monitoring sites using CMR 169
Table 5.9: Greater Bilby records 171
Table 5.10: Pilbara Leaf-nosed Bat records 176
Table 5.11: Ghost Bat Records 182
Table 5.12: Details of Pilbara Olive Python records at each site to date 191
Table 5.13: MARK Parameters for Pilbara Olive Pythons 193
Table 5.14: Fauna usage of rehabilitation sites 199
Table 5.15: Introduced Fauna recorded 204

MAPS

Map 2.1: Location of Northern Quoll monitoring sites 30
Map 2.2: Location of Greater Bilby monitoring sites 31
Map 2.3: Location of Pilbara Leaf-nosed Bat and Ghost Bat monitoring sites 32
Map 2.4: Location of Pilbara Olive Python monitoring sites 33
Map 2.5: Location of Migratory Bird monitoring sites 34
Map 2.6: Location of Grassland and Aerial bird monitoring sites 35
Map 2.7: Location of Night Parrot monitoring sites 36
Map 2.8: Location of Rehabilitation, and Culvert and Red Fox monitoring sites 37
Map 2.9: Location of Millipede *Antichiropus* '1021DNA02' monitoring sites 38
Map 3.1: Locations of Northern Quoll records 52
Map 3.2: Locations of Northern Quoll records at North Star 53
Map 3.3: Northern Quoll and Feral Cat presence at LT MC sites 54
Map 3.4: GPS Radio-collaring Results (female) 55
Map 3.5: GPS Radio-collar Results (male) 56
Map 3.6: Locations of Greater Bilby records 60
Map 3.7: Locations of Pilbara Leaf-nosed Bat & Ghost Bat records 63
Map 3.8: Locations of Pilbara Olive Python records 69
Map 3.9: Location of Conservation Significant Bird records 76
Map 3.10: Location of Night Parrot records 79

FIGURES

Figure 1.1: Location of mine sites and rail infrastructure 15

Figure 3.1: Annual rainfall deviation from long-term average (closest BoM stations or SILO) 39
Figure 3.2: Bar Plot displaying the estimated abundance of Northern Quolls at potential impact and control sites 49
Figure 3.3: EWMA control chart for a) female, b) male and c) female and male Northern Quolls abundance at monitored sites. 49
Figure 3.4: Introduced fauna recorded per trap night in 2023 in comparison to Northern Quoll sites 82
Figure 3.5: Records of Red Fox at Main Line Rail in 2023 (MR CU 04 and MR RE C37) 85
Figure 3.6: Number of Feral Cat records per trap/camera nights 86

APPENDICES

Appendix A: Site-Specific Monitoring Requirements 100
Appendix B: Species-Specific Monitoring Methods 103
Appendix C: Site Locations 114
Appendix D: Climate Data 128
Appendix E: Site-Based Records (BMS) 133
Appendix F: Northern Quoll Details 142
Appendix G: Statistical Analysis of Northern Quoll Data 168
Appendix H: Greater Bilby records 170
Appendix I: Greater Bilby DNA Analysis Report 173
Appendix J: Pilbara Leaf-Nosed Bat and Ghost Bat Records 175
Appendix K: Bat Identifications 188
Appendix L: Pilbara Olive Python records 190
Appendix M: Pilbara Olive Python eDNA Report 194
Appendix N: Night Parrot Report (Adaptive NRM) 196
Appendix O: Fauna Monitoring at Rehabilitation Sites 198
Appendix P: Introduced Fauna Recorded 203

EXECUTIVE SUMMARY

Fortescue operational sites are required to undertake conservation significant fauna monitoring, as outlined in the Conservation Significant Fauna Management Plan: 100-PL-EN-0022_Rev 7 (CSFMP). The Plan is required by approvals granted under Ministerial Statements (MS) 690, 899, 1033, 1062, 1108 and 1109, as well as under Controlled Actions EPBC 2005/2205, 2010/5513, 2010/5567, 2010/5696, 2013/7055, 2017/8024 and 2017/8025.

Species included in this monitoring program are defined in section 1.3. of the CSFMP and comprise conservation significant fauna species listed as Critically Endangered, Endangered, Vulnerable or Migratory under the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 or as Schedule species under the *Biodiversity Conservation Act* 2016.

Monitoring requirements for Nullagine mine site are outlined in the Northern Quoll Management and Monitoring Plan: NU-PL-EN-0001 (NQMMP). The Plan is required by approvals granted under Controlled Actions EPBC 2009/4930 and 2013/6887.

For the North Star Project, Iron Bridge Operation (IBO) is required to implement the Northern Quoll Fauna Management Plan: 662MI-5500-PL-EN-0001 (NQMP), as required under EPBC 2012/6689 and MS 993.

Monitoring methods have been developed to be in accordance with Fortescue's relevant management plans and State and Commonwealth Guidelines. Methods for Northern Quoll and Greater Bilby are aligned with the methods used by the Department of Biodiversity Conservation and Attractions (DBCA).

Cloudbreak

Fauna monitoring completed in 2023 at Cloudbreak consisted of Night Parrot (16 December 2022 – 24 June 2023), conservation significant bird monitoring (8-9 March & 25 June 2023) and fauna usage of rehabilitation sites (6 March – 25 June 2023). Northern Quoll monitoring within tenement M45/1142 (outside the existing mine approval boundary) will be conducted every five years, recommencing in 2025, due to the lack of records during the previous five years of monitoring indicating the species to be absent from site.

Conservation Significant Birds

Monitoring was conducted for conservation significant birds (falcons and species associated with water, grassland, and aerial insectivorous habitats) at three potential impact and three control sites for each bird group. The control sites were located in habitats comparable to the potential impact sites. Each site was monitored using 20-minute ornithological surveys. Conservation significant birds were also recorded if observed during other activities (such as camera installation). No conservation significant bird species were recorded from the potential impact sites or the control sites in 2023. The result from the recent monitoring was similar to previous monitoring. The lack of records from the potential impact sites is due to the low suitability of the habitats present within the mine site.

An additional three control sites located at the Fortescue Marsh were also monitored. The data indicates a slight decrease in conservation significant birds recorded from the Fortescue Marsh control sites since 2021 when compared to previous years, records have been consistently low across all years.

There is currently insufficient data of conservation significant bird populations from the mine site to address target 1 (relative abundance) and target 2 (ongoing presence) of the CSFMP. Conservation significant birds are more likely to utilise suitable habitats in the Fortescue Marsh and are only likely to overfly the Cloudbreak mine site as part of their travel to suitable foraging habitats.

Night Parrot

The monitoring for the Night Parrot was completed in the wet season with one acoustic recorder installed at 13 sites between December 2022 and June 2023. Potential calls were recorded during three call events in February and March, with call structure indicating three different individuals passing through. No permanent roost or breeding location was recorded.

Rehabilitation Areas

Fauna usage of three rehabilitation sites was monitored at the Cloudbreak mine site with particular focus on conservation significant fauna. Each site was searched for secondary evidence and one motion camera was deployed over three months at each site. Methods and site locations have been consistent since 2016, with the camera deployment period extended in 2022 from four nights to three months.

No conservation significant fauna species were recorded from Cloudbreak rehabilitation sites in 2023, which is consistent with previous monitoring. A very high level of activity by introduced species was recorded at the rehabilitation sites in comparison to rehabilitation control sites, primarily driven by a large number of Rabbits and European Cattle. Both species were also recorded in similar numbers in 2022.

Christmas Creek

Fauna monitoring completed in 2023 at Christmas Creek included monitoring of Pilbara Olive Python (15 - 22 February 2023), conservation significant birds (8-9 March & 25 June 2023), and fauna usage of rehabilitation sites (6 March – 25 June 2023). Monitoring of Pilbara Leaf-nosed Bat, Ghost Bat, Northern Quoll and Greater Bilby was suspended in 2022 due to the lack of records (Pilbara Leaf-nosed Bat, Ghost Bat and Northern Quoll) or very sparse sporadic records (Greater Bilby) during previous years indicating the species to be absent from the mine site (bats and Northern Quoll) or only infrequently traversing through site (Greater Bilby). Monitoring of Greater Bilby will recommence in 2024.

Pilbara Olive Python

Pilbara Olive Python monitoring was completed at four potential impact sites and four control sites. Each site was searched for one-person hour per night for seven consecutive nights. No Pilbara Olive Pythons were recorded from the potential impact sites, and one adult individual was recorded from control site CC POP C3 during the 2023 monitoring. In 2022, one individual was recorded within the mine (Fortescue's Plant and Animal register). To date, records from the mine are limited to six confirmed records made by site personnel between 2013 and 2022. An additional Pilbara Olive Python was recorded just north of the mine during the 2020 monitoring. Critical habitat for the species is not present within the Christmas Creek mine and the sporadic records made to date confirm that the Pilbara Olive Python is not a resident species on site. Individuals are believed to occasionally travel south along creeklines from the rocky hills habitat north of the Christmas Creek mine site.

An insufficient number of Pilbara Olive Python have been recorded to date to address target 1 (abundance) of the CSFMP. Target 2 (ongoing presence) of the CSFMP has been satisfied, with site-based records made in 2021 and 2022.

Conservation Significant Birds

Monitoring was conducted for conservation significant birds (falcons and species associated with water, grassland, and aerial insectivorous habitats) at three potential impact and three control sites for each bird group. Each site was monitored using 20-minute ornithological surveys. No conservation significant bird species were recorded from the potential impact sites, or the control sites. The lack of records from the

potential impact sites is consistent with results from previous years and is due to the low suitability of the habitats present within the mine site.

Additional control sites located at the Fortescue Marsh were also monitored. No conservation significant bird species were recorded in 2023.

Records have been sporadic and infrequent with counts being consistently low. An insufficient number of conservation significant bird individuals have been recorded to date to address targets 1 and 2 of the CSFMP.

Rehabilitation Areas

Fauna usage of three rehabilitation sites was monitored at the Christmas Creek mine site with particular focus on conservation significant fauna. Each site was searched for secondary evidence and one motion camera was deployed over three months at each site. Methods and site locations were consistent with previous monitoring completed since 2016 with the camera deployment period extended in 2023 (from four nights).

No conservation significant fauna species were recorded from Christmas Creek rehabilitation sites in 2023, which is consistent with previous monitoring. A very high level of activity by introduced species was recorded at the rehabilitation sites in comparison to rehabilitation control sites, primarily driven by a large number of Rabbits and European Cattle. Both species were also recorded in similar numbers in 2022.

Solomon Hub

Fauna monitoring completed at Solomon Hub included monitoring of Northern Quoll (6-10 June 2023, cameras from 21 March – 15 June 2023), fauna usage of rehabilitation sites (21 March - 15 June 2023), Ghost Bat & Pilbara Leaf-nosed Bat (surveillance level only, 11-18 January 2023), Pilbara Olive Python (11-18 January 2023), and conservation significant birds (11-13 January & 10 June 2023).

Northern Quoll

Northern Quoll monitoring at Solomon Hub was completed at three potential impact and three control sites. Each site was monitored using 50 cage traps over four consecutive nights, five motion cameras (downwards-facing manner on star pickets and baited) over three months and searches for secondary evidence (10 person hours). No Northern Quolls were captured during the trapping event, however one Northern Quoll was recorded on motion camera from one potential impact site (SM NQ I3) in 2023. The trapping result is comparable with the baseline monitoring in 2012 (no individuals). Previous monitoring events (2013 to 2021) recorded numbers of Northern Quolls varying between zero and twelve individuals, with a peak in 2018. Favourable environmental conditions between 2015 to 2018 have likely contributed to the increase in population size. Analysis using Generalised Linear Models (GLMs) did not indicate a correlation between Feral Cats, bushfire extent, rainfall and the number of Northern Quolls recorded on site (likely due to limited power of statistical analysis) despite an extensive fire in 2018 which coincided with the decrease in Northern Quolls on site.

Target 1 of the CSFMP regarding Northern Quolls is satisfied for Solomon Hub. Data suggests that the population at the Solomon Hub increased between 2012 and 2018 and declined between 2019 and 2023 due to environmental conditions, but the population size is now comparable to the baseline monitoring in 2012 (zero individuals). Target 2 is not applicable as the species was not originally recorded at the monitoring sites in 2012.

Conservation Significant Bats

Monitoring for Ghost Bat and Pilbara Leaf-nosed Bat was completed at 12 potential impact and 12 control sites. One bat recorder (SM4Bat FS) was deployed at each site for seven consecutive nights. Methods were consistent with monitoring conducted between 2017 to 2023 and site locations used since 2016. The Pilbara Leaf-nosed Bat was not recorded from the potential impact sites and was detected at five control sites in 2023. The Ghost Bat was not recorded from potential impact or control sites in 2023.

Between 2017 and 2021, the two bat species were recorded infrequently from three potential impact sites (SM Bat I5 – I7). These sites are located at caves with heritage restrictions, and direct access was not possible in 2023, however monitoring was conducted nearby. To date, Pilbara Leaf-nosed Bat call timing indicate foraging behaviour at Solomon Hub. During the baseline and previous monitoring, both species were recorded in low numbers.

Monitoring data is insufficient to address relative abundance (T1) due to the very low population density and/or detection difficulties (Ghost Bats). Target 2 (continued presence) is satisfied based on the ongoing infrequent record during previous year.

Pilbara Olive Python

Pilbara Olive Python monitoring was completed at four potential impact sites and four control sites. Each site was searched for one (person) hour per night for seven consecutive nights in the wet season, and water samples were taken for eDNA analysis from selected sites during both the wet and dry season. No Pilbara Olive Pythons were recorded from the potential impact sites or control sites (search results and eDNA). The 2023 results are comparable with previous years' monitoring during which a low number of individuals (zero to three) were recorded during each monitoring event.

Pilbara Olive Python data collected to date indicates that there is no significant change in relative abundance on site, therefore satisfying target 1 of the CSFMP. Records of Pilbara Olive Pythons from the Solomon Hub (recorded by site personnel in 2023) satisfy target 2 (ongoing presence) of the CSFMP.

Conservation Significant Birds

Monitoring was conducted for conservation significant birds (falcons and species associated with water, grassland, and aerial insectivorous habitats) at three potential impact and three control sites for each bird group. Each site was monitored using 20-minute ornithological surveys. Significant bird species were also opportunistically targeted during the Northern Quoll monitoring during the dry season (along Kangeenarina Creek). No conservation significant bird species were recorded from the potential impact sites, or the control sites. The lack of records from the potential impact sites is consistent with results from previous years and is due to the low suitability of the habitats present within the mine and surrounding.

Conservation significant birds are absent from the site and the targets (T1 and T2) of the CSFMP cannot be addressed.

Rehabilitation Areas

Fauna usage of three rehabilitation sites was monitored at the Solomon Hub with focus on conservation significant fauna. Each site was searched for secondary evidence and one motion camera was deployed over three months. Methods and site locations have been consistent since the 2016 monitoring with the duration of motion cameras increased since 2022 from four nights to three months. No conservation significant fauna was recorded from the rehabilitation sites in 2023. Previous records show that one of the rehabilitated sites is suitable for use by Northern Quoll for foraging purposes due to its close proximity to suitable Northern Quoll habitat (SM RE 06). In 2023, the Rabbit was recorded from rehabilitation site SM RE 11 which is the first

record of the species from Solomon Hub to date. In addition, three species of introduced species were also recorded during previous monitoring: House Mouse, Dingo/Dog and Feral Cat.

The activity level of introduced fauna at the rehabilitation sites was found to be higher than at the potential impact and comparable to rehabilitation control sites in 2023. The current level of rehabilitation at the sites is considered suitable for the utilisation by generalist species.

Hamersley Line Rail

Fauna monitoring completed along the Hamersley Line Rail included monitoring of Northern Quoll (4-8 July 2023, cameras from 23 March – 10 July 2023), conservation significant birds (5 March 2023), fauna usage of culverts (18 April - 12 July 2023), and fauna usage of rehabilitation sites (22 March – 10 July 2023).

Northern Quoll

Northern Quoll trapping along the Hamersley Line Rail was completed at three potential impact and three control sites. Each impact and two of the three control sites were monitored using 50 cage traps over four consecutive nights, five motion cameras (downwards-facing manner on star pickets and baited) over three months and searches for secondary evidence (10-person hours). The third control site was monitored using five motion cameras over three months and searches for secondary evidence (no trapping was completed due to travel times to the site and animal welfare considerations). The five cameras at each site were set up as per DBCA monitoring methods, in a downwards-facing manner on star pickets and baited (non-reward bait).

No Northern Quoll were trapped at the potential impact sites and control sites. The species was recorded on motion camera at potential impact sites HL NQ I3 and control sites HL NQ C2 in 2023. There was a decline between 2014 and 2016 at the potential impact sites, with five individuals recorded in 2014, secondary evidence recorded in 2015 and 2016. Between 2017 - 2023, Northern Quoll records were minimal and opportunistic in nature (single scat and single camera images), with a single individual male was captured at the potential impact sites in 2022.

The species decline at the Hamersley Line Rail is thought to be in response to fires, and associated increase in Feral Cats, impacting the monitoring sites in 2015 and 2018. However, this relationship was not found to be statistically significant due to the low sample size (i.e., not supported by GLM), and it is hypothesised that a naturally low population of Northern Quolls occupies the local area. Fortescue has implemented biannual Feral Cat control along Hamersley Rail since 2021 to reduce predation pressures of Northern Quoll.

Target 1 of the CSFMP is satisfied due to the 2023 results being comparable with the 2012 monitoring data and the decline since 2016 is not considered to be associated with rail activities. Target 2 is satisfied with the continued presence of the species confirmed along the Hamersley Line Rail.

Conservation Significant Birds

Monitoring was conducted for conservation significant birds (falcons and species associated with water, grassland, and aerial insectivorous habitats) at three potential impact and three control sites for each bird group. Each site was monitored using 20-minute ornithological surveys. No conservation significant bird species were recorded from the potential impact or control sites associated with the Hamersley Line Rail due to the lack of suitable habitat. This is consistent with previous monitoring results.

The conservation significant bird data is insufficient to address target 1 (relative abundance) and target 2 (continued presence) of the CSFMP along the Hamersley Line Rail.

Rehabilitation Areas

Fauna usage of three rehabilitation sites was monitored along the Hamersley Line Rail with a focus on conservation significant fauna. Each site was searched for secondary evidence and one motion camera was deployed over three months. Methods and site locations have been consistent since the 2016 monitoring with the duration of motion cameras increased since 2022 from four nights to three months. No conservation significant species were recorded at the rehabilitation sites in 2023. The structure and density of native vegetation at all rehabilitation sites are considered suitable for use by generalist fauna species. Northern Quolls were recorded in 2013 and 2014, foraging at previously rehabilitated sites that contained large granite boulder piles. The activity of introduced species at the rehabilitation sites was lower than that at the potential impact sites and higher than at the rehabilitation control sites. To date, House Mouse, Dingo/Dog, European Cattle, and Feral Cat have been recorded from the rehabilitation sites.

Fauna Use of Culverts

Monitoring of fauna usage of culverts was completed at five culverts located along the Hamersley Line Rail. Each culvert was searched for secondary evidence and a baited (non-reward) motion camera was deployed for three months. No conservation significant fauna species was recorded from the culvert sites. Three Feral Cats were recorded from culvert sites HL CU 01, HL CU 03 and HL CU 04. This is consistent with recent years during which between one and three Feral Cats were recorded.

Main Line Rail

Fauna monitoring completed along the Main Line Rail included monitoring of fauna usage of culverts, Greater Bilby (21-25 June 2023), Pilbara Leaf-nosed Bat & Ghost Bat (1-8 March 2023), conservation significant birds (6-7 March 2023), fauna usage of rehabilitation sites (18 April – 13 July 2023), and surveillance of introduced species, including the Red Fox. Monitoring of Northern Quoll was suspended after 2021 because the monitoring results confirmed the populations were stable with no changes in abundance or spatial distribution attributed to the operation of the rail. Monitoring will be conducted every three years and will recommence in 2024.

Greater Bilby

Monitoring of Greater Bilby was completed along the Main Line Rail during both the dry and wet season in 2023. Methods have been consistent since 2017, with site locations selected based on a review of 2013-2016 monitoring data. Occupancy searches for Greater Bilby secondary evidence were conducted at 40 potential impact sites during the dry season. A sub-set of 20 sites were searched during the wet season. An additional seven control sites were also searched. Abundance monitoring was completed at two sites where the species was recorded in recent years.

Evidence of Greater Bilby (fresh scats, tracks and diggings) was recorded from three of the 20 wet season occupancy monitoring sites, and from six of the 40 dry season occupancy sites in 2023. DNA analysis of scats recorded from MR GB OS23 identified one individual which was previously recorded in 2021 and 2022. The species was not recorded from the abundance monitoring impact site (MR GB AS I14) in 2023. This is consistent with recent years' monitoring where some secondary evidence was recorded (fresh tracks) but no recent signs such as burrows and scats. During a recent baseline fauna survey located adjacent to the Main Line Rail, a resident female bilby was recorded from a location near culvert MR CU 02 in May and October 2023 (Spectrum, in prep).

Current data indicates that there is no significant impact to the Greater Bilby populations located along the Main Line Rail. At the control abundance monitoring site (MR GB AS C16), evidence of Greater Bilby was

recorded in the form of active burrows, tracks and motion camera images which is consistent with previous years. The control occupancy sites were monitored for the second time in 2023 with no evidence of the Greater Bilby recorded.

Target 1 and 2 of the CSFMP regarding Greater Bilby are satisfied for the Main Line Rail. Fresh scats were collected from site MR GB OS23 indicating that the individual present on site is a resident which has been recorded since 2021. The data suggests that the Greater Bilby populations along the Main Line Rail are continuing with no changes in the species' relative abundance (T1), or ongoing presence (T2).

Conservation Significant Bats

Monitoring of Ghost Bat and Pilbara Leaf-nosed Bat was completed at 12 potential impact and 12 control sites. One bat recorder (SM4Bat FS) was deployed at each site for seven consecutive nights. Methods have been consistent since 2017, based on a review of data collected during 2013-2016 monitoring events. The Pilbara Leaf-nosed Bat was recorded from five potential impact sites and four control sites in 2023 (all representing foraging individuals). This is a slight decrease of Pilbara Leaf-nosed Bat activity since 2022, however the number of potential impact sites the species has been recorded from has been stable overall (one to nine sites). No Ghost Bat calls were recorded in 2023 from the bat monitoring sites, but secondary evidence (prey remains) was recorded from two culverts indicating foraging individuals being present.

Target 1 (relative abundance) is satisfied with a comparable Pilbara Leaf-nosed Bat activity in 2023 across impact and control sites. Ghost Bat activity has been consistent with secondary evidence recorded from a comparable number of sites therefore satisfying T1. Target 2 (ongoing presence) is also satisfied for both species.

Conservation Significant Birds

Monitoring of conservation significant birds (falcons and species associated with water, grassland, and aerial insectivorous habitats) was completed during the wet season at three potential impact sites and three control sites. Each site was monitored using 20-minute ornithological surveys. Conservation significant birds were also recorded during other monitoring events (such as Greater Bilby searches and culvert monitoring). No conservation significant birds were recorded from the Mail Line Rail potential impact sites in 2023, however a pair of Grey Falcons were observed opportunistically along the Main Line Rail during a recent baseline survey in May 2023. The results are consistent with the control sites data and comparable to the results recorded during previous monitoring along the Main Line Rail. Records have been sporadic, and numbers of individuals recorded have been very low over the overall monitoring period.

The number of conservation significant bird records are insufficient (due to sporadic occurrence) to address the two targets of the CSFMP due to low population densities recorded along the Main Line Rail.

Rehabilitation Areas

Fauna usage of three rehabilitation sites was monitored along the Main Line Rail with particular focus on conservation significant fauna. Each site was searched for secondary evidence and one motion camera was deployed over three months. Methods and site locations have been consistent since the 2016 monitoring with the duration of motion cameras increased since 2022 from four nights to three months. In 2023, no conservation significant fauna was recorded from the rehabilitation sites. In 2022, the Spectacled Hare-wallaby (DBCA Priority 4) was recorded at one rehabilitation site, MR RE 01. The structure and density of native vegetation at the three rehabilitation sites are considered suitable for use by generalist fauna species. Introduced species recorded from the rehabilitations site include Dingo/Dog, European Cattle, and Feral Cat.

The Red Fox was recorded from the rehabilitation control site MR RE C37 in 2023. Activity levels of introduced species at the rehabilitation sites were comparable to rehabilitation control sites in 2023.

Fauna Use of Culverts

Monitoring of fauna usage of culverts was completed during the dry season at ten culverts along the Main Line Rail. Each culvert was searched for secondary evidence and a baited (non-reward) motion camera was deployed for three months. The Northern Quoll was recorded from two culvert sites (MR CU 07 & MR CU 12) in 2023. A total of seven individual Feral Cats were recorded from five culvert sites (MR CU 04, MR CU 05, MR CU 06, MR CU 10 and MR CU 12) along the Main Line Rail in 2023. This is a slight decrease from 2022 (nine individuals) and comparable to the results in 2021 (seven individuals). Fortescue has implemented biannual trapping of feral predators including Feral Cats along the Main Line Rail to reduce the population.

Red Fox Surveillance

Surveillance of Red Fox was completed during the dry season at ten culvert sites located along the Main Line Rail, using searches and motion cameras deployed for three months and baited with a non-reward bait. The Red Fox were recorded from one culvert (MR CU 04) and one rehabilitation control site (MR RE C37) in 2023. The sites were 40 km apart, with the records made in April and June 2023, indicating the records belong to two individuals The species was not recorded in 2021 and 2022. In 2019, the species was recorded over multiple nights from one culvert site (MR CU 10). Fortescue has implemented biannual feral predator control along the Main Line Rail since 2021.

Eliwana Mine

Fauna monitoring completed at the Eliwana Mine included monitoring of Northern Quoll (cameras were installed from 3 May to 24 August 2023), Pilbara Olive Python (31 January – 8 February 2023), Pilbara Leaf-nosed Bat & Ghost Bat (31 January – 8 February 2023), conservation significant birds (31 January, 10 February and 23 August 2023) and the Short Range Endemic (SRE) millipede *Antichiropus* '1021DNA02' (8-9 February 2023).

Northern Quoll

Northern Quoll monitoring at the Eliwana Mine site consisted of the installation of motion cameras at four potential impact sites and three control sites. Each site was monitored using five downward-facing motion cameras spaced at 100 m intervals (downwards-facing manner on star pickets and baited), which were left in place for three months. Each site was also searched for secondary evidence (10-person hours).

Four Northern Quolls were recorded on motion cameras at two potential impact sites (EM NQ I3 and EM NQ I4) in 2023. Camera images indicate that at least one female was recorded from site EM NQ I3 (based on body conditions and size), the remaining records were likely males. The current monitoring data indicates an increase in population size in comparison to 2022 (two individuals) and 2021 (no individuals) at the impact sites.

There have been four years of above median rainfall at Eliwana Mine and no fires impacting the trapping sites since 2018. In addition, normalised Feral Cat numbers peaked in 2021, followed by a slight decrease. This combination of factors is likely to have driven an increase in Northern Quoll numbers at the site.

The monitoring data indicates an increase in abundance satisfying target 1 (T1), and the species presence has been confirmed to continue (T2).

Conservation Significant Bats

Monitoring of Ghost Bat and Pilbara Leaf-nosed Bat was completed during the wet season at 12 potential impact sites and 12 control sites. One bat recorder (SM4Bat FS) was installed at each site for seven consecutive nights. The Pilbara Leaf-nosed Bat was recorded from six potential impact sites at the Eliwana Mine in 2023, a small increase from the 2022 monitoring. No Ghost Bat calls were recorded in 2023, however Ghost Bat calls were recorded opportunistically at a cave near the OPF in August 2023 on recorders that were installed following a potential sighting. The monitoring results are comparable to the 2022 monitoring, with a slight decrease in activity at the potential impact sites and a slight increase in activity at the control sites, however both are comparable to 2022. The Ghost Bat was recorded during the baseline surveys, however the lack of records at monitoring sites does not indicate absence as the species, as the species is difficult to detect when outside of caves or overhangs.

Target 1 (relative abundance) and target 2 (ongoing presence) regarding Pilbara Leaf-nosed Bats is satisfied. Target 1 regarding Ghost Bat cannot be addressed at this stage due to insufficient data. The opportunistic records indicate no change in relative abundance on site. Target 2 is satisfied due to the opportunistic recordings.

Pilbara Olive Python

Pilbara Olive Python monitoring was completed at five potential impact sites and three control sites during the wet season. Each monitoring site was searched for one-person hour over a seven-night period in the wet season, and water samples (for eDNA analysis) were taken from select sites in the wet season. One Pilbara Olive Python individual was recorded from one potential impact site (EM POP I4) at the Eliwana Mine during the 2023 monitoring which is comparable to 2022. No individuals were recorded from the control sites in 2023.

Target 1 (relative abundance) has been satisfied and the species' presence is ongoing (T2 of the CSFMP).

Conservation Significant Birds

Monitoring of conservation significant birds (aerial insectivores and falcons) was completed during the wet season at three potential impact sites and three control sites. Each site was monitored using 20-minute ornithological surveys. No conservation significant bird species were recorded from the potential impact sites, or the control sites. This is consistent with the 2020-2022 monitoring results. The lack of records from the potential impact sites is due to the low suitability of the habitats present within the mine site. The monitoring data is currently insufficient to address the targets of the CSFMP.

Millipede *Antichiropus* '1021DNA02'

Monitoring of the original record location and an additional ten control sites was completed in 2023. Monitoring methods included leaf litter collected for Tullgren funnel extraction and targeted searches during the wet season 2023. One specimen belonging to *Antichiropus uvulus* was collected which is a widespread species. No *Antichiropus* '1021DNA02' were recorded at Eliwana Mine in 2023. No disturbance was recorded to date at the original location of the species record at Eliwana Mine.

Rehabilitation Areas

Fauna usage of one rehabilitation site was monitored at the Eliwana Mine during the 2023 dry season with particular focus on conservation significant fauna. The site was searched for secondary evidence and one motion camera was deployed over three months. This was the first year of monitoring fauna usage of rehabilitation sites at Eliwana Mine. No conservation significant species were recorded, likely due to a lack of suitable microhabitats such as rocky boulders. The Feral Cat and European Cattle have been recorded from the sites in 2023. The level of introduced fauna per trap night was found to be higher at the rehabilitation site, than the potential impact and rehabilitation control sites at the Eliwana Mine. This is likely due to the recent age of the rehabilitation sites, and the fact that feral predators are attracted to open and disturbed areas.

Eliwana Line Rail

Fauna monitoring completed at the Eliwana Mine included monitoring of Northern Quoll (cameras were installed from 3 May to 24 August 2023), Pilbara Olive Python (31 January – 8 February 2023), Pilbara Leaf-nosed Bat & Ghost Bat (31 January – 8 February 2023), conservation significant birds (31 January, 10 February and 23 August 2023) and fauna monitoring of rehabilitation sites and culverts (3 May – 24 August 2023).

Northern Quoll

Northern Quoll monitoring at the Eliwana Line Rail was completed during the dry season and consisted of the deployment of motion cameras at three potential impact and three control sites. Each site was monitored using five downward-facing motion cameras spaced at 100 m intervals, and searched for secondary evidence for 10 person hours. The Northern Quoll was not recorded from the potential impact sites in 2023. This is consistent with previous monitoring during which no Northern Quolls were recorded from the Eliwana Line Rail potential impact sites. In 2022, additional cameras installed at site ER NQ I1 as part of a PhD study recorded a single image of a Northern Quoll indicating a roaming male (pers. comms, M. Cowan, 2022). Six individual Northern Quolls were recorded from control site EM NQ C2 in 2023 which indicates that there is a stable population at the Eliwana control sites.

Target 1 (relative abundance) and Target 2 (ongoing presence) of the CSFMP is satisfied due to the 2023 results being comparable with the baseline data and previous monitoring (occasional roaming male).

Pilbara Olive Python

Pilbara Olive Python monitoring was completed at four potential impact sites and four control sites during the wet season. Each site was searched for one (person) hour per night for seven consecutive nights in the wet season, and water samples were taken for eDNA analysis from selected sites during both, the wet and dry season. The Pilbara Olive Python was not recorded from the Eliwana Line Rail in 2023. This is consistent with the 2020 - 2022 monitoring when no individuals were recorded.

Target 1 and 2 of the CSFMP cannot be addressed at this stage due to the lack of records. Habitat along the Eliwana Line Rail is sub-optimal for the species and individuals are likely to only pass through the area infrequently.

Conservation Significant Bats

Monitoring of Ghost Bat and Pilbara Leaf-nosed Bat was completed during the wet season at 12 potential impact sites and 12 control sites. One bat recorder (SM4Bat FS) was deployed at each site for seven consecutive nights. The Pilbara Leaf-nosed Bat was recorded from two potential impact sites (ER Bat I8 & I9) along the Eliwana Line Rail in 2023 and five control sites in 2023. This represents a slight decrease in Pilbara Leaf-nosed Bat activity at the Eliwana Line Rail in 2022 and is similar to the 2019/20 and 2021 results. Control site data increased in 2023, however only in activity (call numbers), whereas the number of sites was consistent with 2022.

The impact site results are comparable to the baseline survey during which the Pilbara Leaf-nosed Bat was recorded from four sites at the Eliwana Line Rail. The Ghost Bat was not recorded from the potential impact sites in 2023. A record was made (single call) in 2022 from one site (ER Bat I8). This was the only record of the species since monitoring commenced in 2019/20. The 2023 monitoring result is comparable to the baseline surveys in 2012 and 2017 during which the species was recorded through single calls (likely foraging individuals) in the vicinity of the rail.

Targets 1 and 2 for the Pilbara Leaf-nosed Bat are satisfied. The two targets for the Ghost Bat are difficult to address with infrequent records of foraging individuals, but the target is likely satisfied with no significant decline in relative abundance (T1) and ongoing presence of foraging individuals (T2).

Conservation Significant Birds

Monitoring of conservation significant birds (falcons and species associated with aerial insectivorous habitats) was completed during the wet season at three potential impact sites and three control sites. Each site was monitored using 20-minute ornithological surveys. No conservation significant bird species were recorded from the potential impact sites, or the control sites. The lack of records from the potential impact sites is consistent with results from the baseline survey and previous monitoring and is due to the low suitability of the habitats present along the rail. The monitoring data is currently insufficient to address the targets of the CSFMP.

Rehabilitation Areas

Fauna usage of three rehabilitation sites was monitored at the Eliwana Line Rail during the 2023 dry season with particular focus on conservation significant fauna. The sites were searched for secondary evidence and one motion camera was deployed over three months. This was the second year of monitoring fauna usage of rehabilitation sites along the Eliwana Line Rail. No conservation significant species were recorded. Four introduced species were recorded to date – Feral Cat, Dingo/Dog, Donkey and European Cattle. Activity levels of introduced species at the rehabilitation sites were comparable (slightly lower) to those at potential impact sites and higher than those at rehabilitation control sites in 2023. This is likely due to the recent age of the rehabilitation sites, and the fact that feral predators are attracted to open and disturbed areas.

Nullagine

Fauna monitoring completed at Nullagine targeted Northern Quoll and was completed during the dry season from 29 June – 29 August 2023, although the first 30 nights of camera recording were used for data analysis (29 June – 30 July 2023).

Northern Quoll

Northern Quoll monitoring at the Nullagine mine site was completed during the dry season across two mining areas: Bonnie East and Warrigal. Twenty motion cameras were deployed for 30 nights and searches for secondary evidence (10-person hours) were completed. Northern Quolls were recorded from 18 of the 20 camera locations at Nullagine in 2023: nine locations at Bonnie East and nine at Warrigal. This is the highest count of camera sites recording Northern Quolls to date (12 sites in 2020 and 2022, and 14 sites in 2021 and 2022). Records included resident individuals (likely females) indicating that the resident population at Nullagine is persisting.

Targets 1 and 2 of the NQMMP have been met by completing an ongoing monitoring program on site and by adding information to the species' regional distribution (by providing data of a potential resident population). Target 3 of the NQMMP (monitoring of rehabilitation sites) cannot be tested until rehabilitation has been undertaken at the site.

North Star

Fauna monitoring completed at the North Star mine site included monitoring of Northern Quoll (25 – 29 July 2023, cameras were installed from 18 April – 24 August 2023), conservation significant birds (17 January and 27 July 2023) and fauna usage of rehabilitation sites (18 April – 24 August 2023). Northern Quoll monitoring included radio-collar component and camera installation from 26 July - 25 August 2023.

Northern Quoll

Northern Quoll monitoring at the North Star mine site was completed during the dry season and consisted of a trapping program at four potential impact sites and three control sites. Each site was monitored using 50 cage traps and ten motion cameras. Trapping was completed over four consecutive nights. Five of the ten motion cameras were left in place for 12 nights with the remaining five cameras installed for three months. Searches for secondary evidence were completed for ten person hours. Eighteen long-term motion camera sites (nine impact and nine control) were also deployed for a minimum of 46 nights.

A total of 21 Northern Quoll individuals (15 males and six females) were trapped at four potential impact sites in 2023 with females recorded from three of the four potential impact sites (NS NQ I1, I3 and I4). Camera recordings were also made at all potential impact sites. Capture-Mark-Recapture (CMR) analysis indicates that the abundance of female Northern Quolls decreased between 2015 and 2018, which was followed by an increase until 2023 at a higher rate than that at the control sites. This was supported by Exponentially Weighted Moving Average (EWMA) analysis that showed an impact to the population in 2015 from which the population is slowly returning to the baseline level. The Generalised Additive Modelling shows that fire was a driving factor for the decline in Northern Quoll abundance, in particular when considering control site data. Quoll population recover faster after small and infrequent fires than after large frequent fires. The statistical analysis indicates that the local population of Northern Quolls (particularly females) have not been negatively impacted by the operation of the mine to date.

When comparing the last three years of monitoring with the first three years of monitoring, the female population of Northern Quoll has undergone a 19% decline across the potential impact sites. Considering

normalised numbers for quoll captures, the population has undergone a 20% decline since the first three years. This decline does not trigger the performance indicators of the NQMP.

Rehabilitation Areas

Fauna usage of three rehabilitation sites was monitored at North Star during the dry season with particular focus on conservation significant fauna. Each site was searched for secondary evidence and one motion camera was deployed over three months. Methods have been consistent since 2016, however the camera deployment period was extended in 2022 from four nights to three months.

The Northern Quoll was recorded from one rehabilitation site (NS RE 02) in 2023. Two introduced species were recorded – the Feral Cat and European Cattle. The activity levels of introduced species recorded at the rehabilitation sites was greater than at the impact and control sites in 2023.

1. INTRODUCTION

1.1. Project Background

Fortescue Limited (Fortescue) operates two regional mining hubs with associated infrastructure. Environmental Approvals relevant for this program are listed below and described in more detail in Appendix A:

- The Chichester Hub is located in the Chichester Ranges and consists of three mine sites; Cloudbreak, Christmas Creek and Nullagine;
    - Cloudbreak:
        - Condition 1 of EPBC 2005/2205 – Night Parrot (*Pezoporus occidentalis*);
        - Condition 13 of EPBC 2010/5696 – Night Parrot (*Pezoporus occidentalis*); and
        - Condition 10 of MS 899 – EPBC and BC Act listed species.
    - Christmas Creek:
        - Condition 4 of EPBC 2013/7055 and Condition 8 of MS 1033 – conservation significant fauna.
    - Nullagine:
        - Condition 4 of EPBC 2009/6887 and Condition 5, 6 and 7 of EPBC 2013/6887 – Northern Quoll (*Dasyurus hallucatus*).
- The Western Hub is located in the Hamersley ranges and consists of Solomon Hub and Eliwana.
  Solomon Hub consists of six key mining areas; Kings, Queens, Trinity, Firetail North, Firetail South and Fredericks:
    - Condition 4 of EPBC 2010/5567 and Condition 3(h) of EPBC 2014/7275 – EPBC Act listed species; and
    - Condition 12 of MS 1062 – Northern Quoll, Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia)* and Pilbara Olive Python (*Liasis olivaceus barroni*).

  Eliwana Mine:
        - Condition 10 of MS 1109 – Northern Quoll, Pilbara Leaf-nosed Bat, Ghost Bat (*Macroderma gigas*), Pilbara Olive Python and Pacific Swift (*Apus pacificus*), and
        - Condition 10-1(2) of MS 1109 – Millipede *Antichiropus* '1021DNA02'.
- Associated rail and port infrastructure connecting the three mine hubs includes Main Line Rail, Hamersley Line Rail, East-West Rail Line, Eliwana Line Rail and the Herb Elliott Port:
    - Herb Elliott Port:
        - Condition 7 of MS 690 – EPBC Act listed species;
    - Main Line Rail:
        - Condition 2 of EPBC 2010/5513 – EPBC Act listed species;
    - Hamersley Line Rail:
        - Condition 3 of EPBC 2010/5567 & Condition 3(h) of EPBC 2014/7275 – EPBC Act listed species;
    - Eliwana Line Rail:
        - Condition 10 of MS 1108 – Northern Quoll, Pilbara Leaf-nosed Bat, Ghost Bat, Pilbara Olive Python and Pacific Swift.
- The Iron Bridge North Star Magnetite Project is located 110 km southeast of Port Hedland and consists of one mine site with associated infrastructure:
        - Condition 11-6 of MS 993 and Condition 2b of EPBC 2012/6689 – Northern Quoll.

Locations of all sites are shown in Figure 1.1.

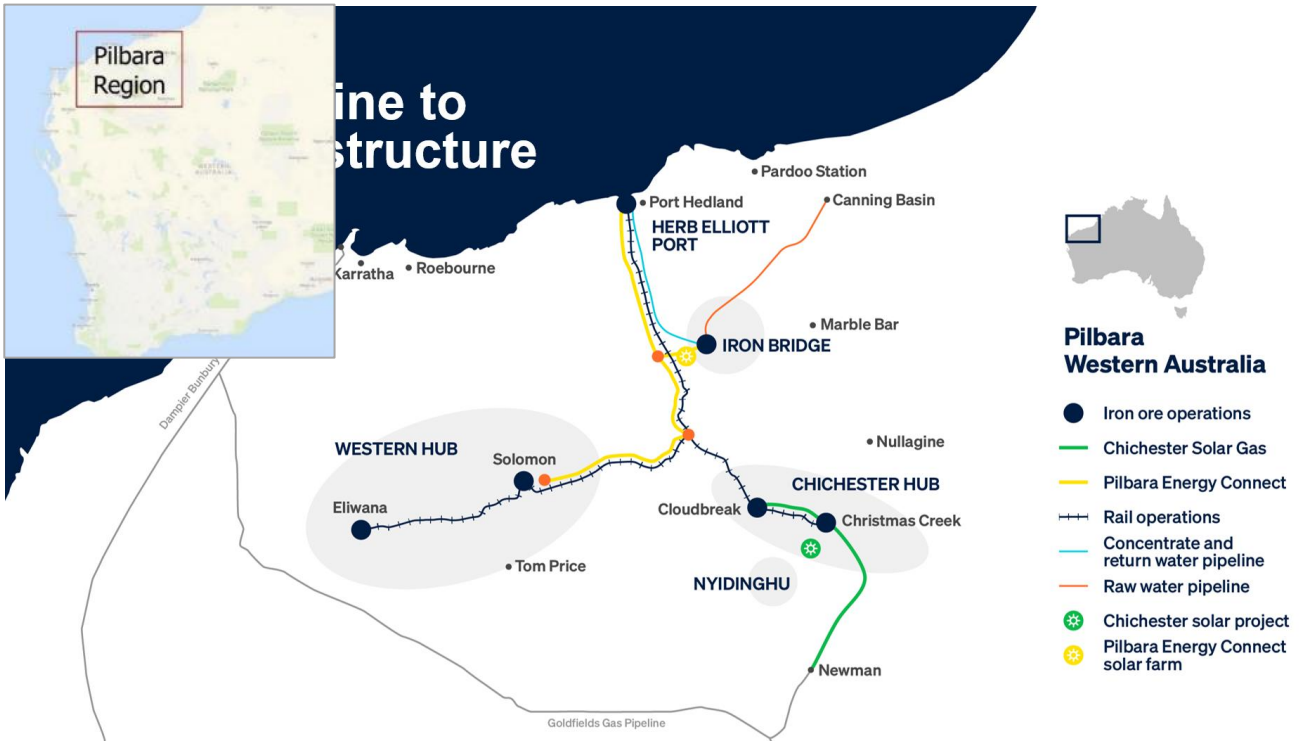


Figure 1.1: Location of mine sites and rail infrastructure

1.2. Monitoring Requirements

Fortescue requires the monitoring of conservation significant fauna to comply with the above environmental approvals. Specific requirements for each site are detailed in Appendix A.

Species included in this monitoring program are defined in the Conservation Significant Fauna Management Plan: 100-PL-EN-0022_Rev 7 (CSFMP), Northern Quoll Management Plan: 662MI-5500-PL-EN-0001 (NQMP), Northern Quoll Management and Monitoring Plan: NU-PL-EN-0001 (NQMMP), and the Fortescue Night Parrot Monitoring Procedure and Program: 100-PP-EN-0041 (FNPMPP). Monitoring is predominately focused on conservation significant fauna species which are species listed as Critically Endangered, Endangered, Vulnerable or Migratory under the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) or as Schedule species under the *Biodiversity Conservation Act 2016* (BC Act). Site-specific monitoring requirements are listed in Table 1.1.

*All documents are revision one unless stated otherwise

Table 1.1: Site-specific monitoring requirements summary

Species	Cloudbreak	Christmas Creek	Solomon Hub	Hamersley Line Rail	Main Line Rail	Eliwana Mine	Eliwana Line Rail	Nullagine	North Star
Northern Quoll (*Dasyurus hallucatus*)	# (2025)*	NR (2021)	●	●	# (2024)	●	●	●	●
Greater Bilby (*Macrotis lagotis*)		# (2024)			●				
Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*)		S # (2024)	S		S	●	●		
Ghost Bat (*Macrodermas gigas*)		# (2024)	●		●	●	●		
Pilbara Olive Python (*Liasis olivaceus barroni*)		●	●			●	●		
Night Parrot (*Pezoporus occidentalis*)	●								
Conservation Significant Birds	●	●	●	●	●	●	●		
Fauna Usage of Rehabilitation Sites	●	●	●	●	●	●	●		●
Fauna usage of Culverts				●	●		●		
Introduced Species	●	●	O	●	●	O	O	O	●
Antichiropus '1021DNA02'						●			

●=Monitoring required; #=monitoring not completed this year as frequency reduced (Davis and Craig, 2021) (the next planned monitoring event is listed in brackets); NR=Monitoring no longer required (last year monitored in brackets), O=Opportunistic sightings to be reported; S=Surveillance level only, data for Ghost Bats to be analysed for PLNB, * Tenement M45/1142 only

1.2.1. Fortescue Operational Sites

The objective of the CSFMP is to identify the potential direct and indirect impacts from approved mining activities on conservation significant fauna species and develop management and monitoring measures that maximise the ongoing protection and long-term conservation of these species within and adjacent to Fortescue managed sites.

The guiding objectives of the monitoring program are:

- Determine presence of conservation significant fauna and their critical habitats within Fortescue controlled sites.
- When baseline surveys have recorded conservation significant fauna and/or their critical habitat:
    - Measure impacts of Fortescue's activities on conservation significant fauna within Fortescue controlled sites.
    - Monitor and measure spatial and temporal changes in the abundance and distribution of conservation significant fauna within Fortescue controlled sites.
    - Monitor and measure the success of management measures to inform an adaptive management approach.
    - Conduct an independent expert review of monitoring data every three years to inform monitoring frequency and ongoing monitoring requirements.

Conservation significant fauna are those defined in the CSFMP, that is, species that are listed as Critically Endangered, Endangered, Vulnerable or Migratory under the EPBC Act or in accordance with the BC Act. Conservation significant fauna are limited to terrestrial vertebrate fauna species that meet these criteria and have been recorded within Fortescue controlled sites or where monitoring requirements have been specified in State and/or Commonwealth approval conditions.

There are two targets to be met by the CSFMP in regard to conservation significant fauna:

Target One: No statistically significant decline in the relative abundance of conservation significant species across impact sites compared to reference sites; and

Target Two: Conservation significant species recorded within the area of impact for the project will continue to have an ongoing presence.

An independent expert review of the fauna monitoring program was completed in 2021 (Davis and Craig, 2021). Changes were made to the methods based on recommendations made in this review including reducing the monitoring frequency of Northern Quolls at the Main Line Rail, and Greater Bilbies, Pilbara Leaf-nosed Bats and Ghosts Bats at Christmas Creek. Furthermore, the monitoring of conservation significant birds was revised to include dedicated sites for grassland birds, water birds, aerial birds and falcons.

1.2.2. Nullagine Mine Site

The monitoring objectives of the Nullagine mine site are separate to the objectives described above for other Fortescue operational sites. The Nullagine mine site only requires monitoring of Northern Quoll and the monitoring objectives, as outlined in the NQMMP are:

- Monitor Northern Quoll and any potential impact of mining.
- Add to the regional ecological knowledge of Northern Quoll.
- Assess how Northern Quoll responds to rehabilitation measures.

The following targets have been set in NQMMP for monitoring at the Nullagine mine site:

- No detrimental effect on Northern Quoll population as a result of mining activities.
- Establish further information on population density, preferred habitat, patterns of movement, reproductive status, population structure, morphometrics on a control population not impacted by the invasion of the Cane Toad across Queensland and the Northern Territory.
- Northern Quoll colonise rehabilitated areas within 5 years of the rehabilitation being completed.

1.2.3. North Star (FMG Iron Bridge)

The objective of the NQMP is to monitor and measure the success of management measures in protecting the EPBC listed Northern Quoll. Detailed objectives of the North Star monitoring program are:

- Measure the impacts of the project over time (by undertaking ongoing annual monitoring of EPBC Act listed Northern Quoll).
- Measure the success of management measures (based on Northern Quoll monitoring results) against performance indicators to inform an adaptive management approach that may be implemented during construction of the life of the project.

As part of the NQMP the following two performance indicators have been developed:

- Trigger level: A 25% decline in Northern Quoll trap captures and estimated density
- Threshold level: A 50% decline in Northern Quoll trap captures and estimated density

The decline must be recorded over three monitoring events, be attributed to the project, and be independent of climate and DBCA regional Northern Quoll control site population trends. If either performance indicators are met, contingency actions are required to be implemented. It should be noted that DBCA regional monitoring for the Northern Quoll was suspended in 2020 with monitoring using camera traps resuming in 2022. Therefore, additional control sites were added to the monitoring program in 2021.

1.2.4. Additional Monitoring Objectives

1.2.4.1. Rehabilitation Areas

Monitoring of fauna use of rehabilitation sites and the suitability of the rehabilitated vegetation as fauna habitat is required at all Fortescue operation sites and the North Star mine site. The monitoring of usage by and suitability for conservation significant fauna is also required.

1.2.4.2. Rail Culverts

Monitoring of culvert sites is required along the Hamersley Line Rail and Main Line Rail infrastructure to demonstrate conservation significant fauna use of culverts. Northern Quoll have been demonstrated to utilise culverts along the Main Line Rail, so the focus is targeted toward other conservation significant fauna species not previously recorded using culverts (i.e. Greater Bilby).

1.2.4.3. Feral Species

All opportunistic sightings of feral species are reported as a component of the annual monitoring report. Any feral predator scats shall be collected and sent to Georgeanna Storey (ScatsAbout) for content analysis. Targeted feral species searches were completed along the Main Line Rail as part of the Red Fox Surveillance, at the North Star mine site and along the Hamersley Line Rail to monitor Feral Cat numbers in response to the detection of a decrease in Northern Quolls.

1.2.4.4. Felixer Research Project

Ecological Horizon Pty Ltd have developed a potential new tool for Feral Cat management – an automated Feral Cat grooming trap ("the Felixer"). Three Felixer units were installed at the North Star mine site in a three-part trial. The first two stages of the Felixer trial program have been completed and the program moved into the third stage on 29 January 2021, with the Felixer units set up in toxic mode. As part of this program, eight unbaited motion-sensing cameras (Reconyx Hyperfire HP2X) were deployed at the baseline Feral Cat monitoring sites on a permanent basis. Data from these permanently installed motion cameras are reviewed and reported separately.

1.2.4.5. Red Fox Surveillance

Red Fox (*Vulpes vulpes*) were identified as a key risk to the Greater Bilby along Main Line Rail (Equinox, 2016). A risk assessment was completed and identified a series of recommendations to reduce the risks (Ecoscape 2018b). Monitoring in 2018 did not record any Red Fox along the Main Line Rail. Surveillance monitoring was therefore implemented since 2019:

Monitor Red Fox presence along the Mainline Rail Line (including at water points), using:

- motion cameras
- on-ground searches for secondary evidence
- opportunistic observations

Determine if any feral control (rabbits and foxes) is required following review of monitoring data.

1.2.4.6. Millipede *Antichiropus* '1021DNA02'

Monitoring of the type locality of the millipede *Antichiropus* '1021DNA02' is required at the Eliwana Mine under MS 1109 Condition 10-2. The target is:

- No direct or indirect impact to known locations of the Short Range Endemic species *Antichiropus* '1021DNA02' or the associated within the project area as described in the Eliwana Iron Ore Mine Project: Environmental Review Document.

1.2.5. Legislation and Relevant Guidance

Species included in this monitoring program comprise conservation significant fauna species listed as Critically Endangered, Endangered, Vulnerable or Migratory under the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) or as Schedule species under the *Biodiversity Conservation Act* 2016 (BC Act).

The BC Act provides for the conservation, protection and ecologically sustainable use of biodiversity and biodiversity components in Western Australia.

Monitoring works reported in this report are intended to comply with all relevant Commonwealth and State environmental legislation, as well as with the following standards and guidelines:

- Environmental Protection Authority (EPA) Environmental Factor Guideline: Terrestrial Fauna (EPA 2016);
- EPA Statement of Environmental Principles, Factors and Objectives (EPA 2018);
- EPA Technical Guidance – Terrestrial Fauna (EPA 2020);
- EPBC Act *Referral guidelines for the Endangered Northern Quoll Dasyurus hallucatus* (Commonwealth of Australia [CoA] 2016b);
- *EPBC Act Survey Guidelines for Australia's Threatened Bats* ((DEWHA 2010a);
- *EPBC Act Survey Guidelines for Australia's Threatened Birds* (DEWHA 2010b);
- *EPBC Act Survey Guidelines for Australia's Threatened Mammals* (DSEWPaC 2011a); and

- *EPBC Act Survey Guidelines for Australia's Threatened Reptiles* (DSEWPaC 2011b).

The monitoring program also takes into consideration any revisions of species-specific survey guidelines due to updated scientific advice and published information on the respective Species Profile and Threats Database (SPRAT) profile (DAWE 2021).

2. METHODS

The fauna monitoring program was completed in accordance with the objectives and methods outlined in the following documents:

- CSFMP (100-PL-EN-0022_Rev7) for Fortescue operational sites (Fortescue 2020);
- NQMMP (NU-PL-EN-0001) for the Nullagine mine site (BC Iron Nullagine, 2016a); and
- NQMP (662MI-5500-PL-EN-0001) for the North Star mine site (Iron Bridge, 2016).

Methods applied to Northern Quoll and Greater Bilby monitoring are aligned with methods used by DBCA Pilbara wide monitoring (Dunlop, 2017; Dziminski and Carpenter, 2017) and are based on the EPBC Act referral guidelines for Northern Quoll (DotE 2016b) and the most recent Greater Bilby guidelines (Southgate *et al.*, 2018).

Methods for Pilbara Olive Python and conservation significant bat and bird monitoring were developed for this project and are based on species-specific guidelines (DEWHA 2010b, DEWHA 2010a; DSEWPaC 2011b). Monitoring methods and locations were kept consistent with previous monitoring wherever possible. Changes were only applied where access restrictions were encountered (e.g. heritage sites, flooding of tracks, and construction areas).

Liaison with DBCA staff (Dr Judy Dunlop and Dr Martin Dziminski) at the start of the monitoring in 2019 and 2020 and communication with Dr Harry Moore in 2022 ensured that methods used were up to date and aligned with the Pilbara wide monitoring. Downward-facing camera set ups for Northern Quolls were aligned with methods used as part of a PhD thesis (Dr Harry Moore) (Moore, 2021).

The monitoring was conducted as per the CSFMP, NQMMP, and NQMP:

- Within impact zones
- Outside of direct impact zones
- Control sites (to eliminate the possibility of any other environmental factors to population decline, not related to operations)
- In rehabilitation areas (previous impact areas) in vicinity to potential habitat of significance within the project area
- At culvert monitoring sites along the Hamersley Line Rail and Main Line Rail in potentially suitable habitat for the Northern Quoll and Greater Bilby

A summary of the monitoring methods, timing and person hours are listed in Table 2.1 with detailed methods described in Appendix B.

Table 2.1: Details of site-specific monitoring methods completed in 2023

Species/Objective	Cloudbreak	Christmas Creek	Solomon Hub	Hamersley Rail Line	Main Line Rail	Eliwana Mine	Eliwana Line Rail	Nullagine	North Star
Site-specific FMP	CSFMP		CSFMP			CSFMP		NQMMP	NQMP
Northern Quoll (*Dasyurus hallucatus*)	-		12th year of monitoring Three potential impact sites: 50 cage traps for four nights & five motion cameras for three months Trapping: 6-10 Jun 2023 MC: 21 Mar – 15 June 2023	Trapping: 4– 8 July 2023 MC: 23 Mar – 10 July 2023	-	4th year of monitoring Four potential impact sites: five motion cameras for three months	Three potential impact sites: five motion cameras for three months	9th year of monitoring 20 sites: 1 x motion camera for 30 days & active searches	10th year of monitoring Four potential impact sites: 50 cage traps for four nights & 5 motion cameras for three months, and 10 motion cameras for 12 nights
						MC: 2 May – 23 Aug 2023		MC: 29 Jun – 29 Aug 2023	Trapping: 25-29 July 2023 MC: 18 Apr-24 Aug 2023
			Three control sites: 50 cage traps for four nights & five motion cameras for three months Trapping: 11-15 Jun 2023 MC: 21 Mar – 15 June 2023	Three control sites: 50 cage traps for four nights (at two sites) & five motion cameras for three months Trapping: 8-12 July 2023 MC: 23 Mar – 10 July 2023		Three control sites: five motion cameras for three months MC: 3 May – 23 Aug 2023		-	Three control sites: 50 cage traps for four nights & 5 motion cameras for three months, plus five motion cameras for 12 nights Trapping: 25 – 29 July 2023 MC: 18 Apr – 24 Aug 2023
Greater Bilby (*Macrotis lagotis*)	-	-	-	-	11th year of monitoring Abundance monitoring (DNA scat searches, food plots, four long-term motion cameras) at one potential impact site and one control site. Occupancy monitoring at 20 sites during wet season; 40 sites during dry season Occupancy monitoring at nine control sites Dates: 1-6 Mar 2023 21– 25 June 2023 MCs: 5 Mar 2022 - present	-	-	-	-
Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*) Ghost Bat (*Macrodermas gigas*)	-	-	9th year monitoring PLNB 6th year monitoring GB Bat recorder at 12 potential impact sites and 12 control sites for seven nights Dates: 11 – 18 Jan 2022	-	9th year monitoring PLNB 6th year monitoring GB Bat recorder at 12 potential impact sites and 12 control sites for seven nights Dates: 1-8 Mar 2023	4th year of monitoring PLNB & GB Bat recorder at 12 potential impact sites and 12 control sites for seven nights Dates: 31 Jan – 8 Feb 2023	4th year of monitoring PLNB & GB Bat recorder at 12 potential impact sites and 12 control sites for seven nights Dates: 31 Jan – 8 Feb 2023	-	-
Pilbara Olive Python (*Liasis olivaceus barroni*)	-	11th year of monitoring Active searches at four potential impact sites and four control sites Dates: 15-22 Feb 2023	11th year of monitoring Active searches at three potential impact sites and three control sites Dates: 11-18 Jan 2023	-	-	4th year of monitoring Active searches at three potential impact sites and three control sites Dates: 31 Jan – 8 Feb 2023	4th year of monitoring Active searches at three potential impact sites and three control sites Dates: 31 Jan – 8 Feb 2023	-	-
Water birds	16th year of monitoring Searches of wetland area at three potential impact sites and three control sites per project area		8th year monitoring Searches of wetland area at three potential impact sites and three control sites per project area			4th year of monitoring Searches of wetland area at three potential impact sites and three control sites per project area		-	1st year of monitoring Searches of wetland area at three potential impact sites and three control sites per project area

Species/Objective	Cloudbreak	Christmas Creek	Solomon Hub	Hamersley Rail Line	Main Line Rail	Eliwana Mine	Eliwana Line Rail	Nullagine	North Star
	Dates: 8-9 Mar 2023		Dates: 11-13 Jan 2023	Date:5 Mar 2023	Dates: 6-7 Mar 2023	Date: 31 Jan 2023			Date: 17 Jan 2023
Grassland birds	16th year of monitoring		8th year monitoring			4th year of monitoring		-	1st year of monitoring
	Walking Transect at three potential impact sites and three control sites per project		Walking Transect at three potential impact sites and three control sites			Walking Transect at three potential impact sites and three control sites per project			Walking Transect at three potential impact sites and three control sites per project
	Dates: 8-9 Mar 2023		Dates: 11-13 Jan 2023	Date:5 Mar 2023	Dates: 6-7 Mar 2023	Date: 10 Feb 2023			Date: 17 Jan 2023
Aerial Insectivores	16th year of monitoring		8th year monitoring			4th year of monitoring		-	1st year of monitoring
	20-minute survey at three potential impact sites and three control sites per project		20-minute survey at three potential impact sites and three control sites per project			20-minute survey at three potential impact sites and three control sites per project			20-minute survey at three potential impact sites and three control sites per project
	Dates: 8-9 Mar 2023		Dates: 11-13 Jan 2023	Date:5 Mar 2023	Dates: 6-7 Mar 2023	Date: 10 Feb 2023			Date: 17 Jan 2023
Falcons	16th year of monitoring		8th year monitoring			4th year of monitoring		-	1st year of monitoring
	Check potential breeding habitat for nests that may be used								Check potential breeding habitat for nests
	Dates: 25 Jun 2023		Date: 10 Jun 2023	Date: 8 July 2023	Date: 13 Jul 2023	Date: 23 Aug 2023			27 July 2023
Night Parrot (*Pezoporus occidentalis*)	2nd year of monitoring	-	-	-	-	-	-	-	-
	Passive acoustic recorder at 13 sites for three months								
	Dates: 16 Dec 2022 – 24 Jun 2023								
Rehabilitation Sites	7th year of monitoring		8th year of monitoring			2nd year of monitoring		-	8th year of monitoring
	Searches and motion camera set up at three rehabilitation sites.					Searches and motion camera set up at one rehabilitation site	Searches and motion camera set up at three rehabilitation sites		Searches and motion camera set three rehabilitation sites
	Searches: 6 Mar 2023 MC: 6 Mar – 25 Jun 2023		Searches: 21 Mar 2023 MC: 21 Mar – 25 June 2023	Searches: 22-23 Mar 2023 MC: 22 Mar – 10 July 2023	Searches: 21 Mar 2023 MC: 18 Apr– 13 Jul 2023	Searches 3 May 2023 MC: 3 May – 23 Aug 2023			Searches: 18 Apr 2023 MC: 18 Apr-24 Aug 2023
Fauna usage of Culverts	-	-	-	12th year of monitoring		-	2nd year of monitoring	-	-
				Searches and long-term motion cameras at five sites over three months	Searches and long-term motion cameras at 10 sites over three months		Searches and long-term motion cameras at three sites over three months		
				Searches 18 Apr 2023 MC: 18 Apr - 12 Jul 2023			Searches 3 May 2023 MC: 3 May – 24 Aug 2023		
Red Fox (*Vulpes vulpes*) Surveillance	-	-	-	-	6th year of surveillance	-	-	-	-
					Motion cameras at 10 sites for three months. Searches and sightings				
					Searches 18 Apr 2023 MC: 18 Apr - 12 Jul 2023				
***Antichiropus* '1021DNA02'**	-	-	-	-	-	Foraging, leaf litter collection and eDNA samples at nine sites	-	-	-
						Dates: 8-9 Feb 2023			

2.1. Environmental Conditions

2.1.1. Rainfall

Monthly total rainfall from each site was utilised to indicate changes in environmental conditions between monitoring events. Weather station data recorded from each project area was used and, where required, supplemented with long-term data from nearby government weather stations (Bureau of Meteorology, BoM) if local data was not available. Rainfall data was either classed as per calendar year (January to December), seasonally (Spring, Summer, Autumn Winter) or 12-month prior to trapping (July to June – to align with the Northern Quoll trapping data collected in the dry season (around July each year). Appendix B lists the weather stations relevant to each mine site or rail line.

2.1.2. Fire History Data

Fire history has been mapped for Northern Quoll monitoring sites by utilising annual data from Northern Australian Fire Information (NAFI) (Charles Darwin University, 2023). Fortescue provided monthly fire extents for the North Star mine site and the surrounding area which was categorised into 12 months prior to trapping (July to June) so that the data is relevant to the trapping results recorded each year (completed in July/August).

2.2. Site-Based Records

Fortescue's Business Management System's (BMS) Plant and Animal Register (fauna sightings) and Incident Register (fauna death) was reviewed, and all conservation significant species records were collated. In 2023, all records are verified records (i.e., photograph available), and confirmed by Fortescue environment personnel.

2.3. Northern Quoll

In 2023, Northern Quoll monitoring was completed at the Solomon Hub, Hamersley Line Rail, Eliwana Mine, Eliwana Line Rail, Nullagine and North Star (Table 2.2) using a combination of cage trapping and motion cameras. Specific details of monitoring methods used at each site and statistical analysis are detailed in Appendix B. Results from DBCA's Northern Quoll monitoring are used to provide regional context for the monitoring results.

The methods used to monitor Northern Quoll populations at the Solomon Hub, Hamersley Line Rail, Eliwana Mine and Eliwana Line Rail were conducted in accordance with the requirements of the CSFMP, at the North Star mine under the NQMP, and at Nullagine under the NQMMP. Methods were also aligned with the Pilbara regional monitoring developed by DBCA (Dunlop, Cook and Morris, 2014; Johnson and Anderson, 2014; Dunlop, 2017) and recent research conducted on Northern Quolls in the Pilbara (Moore, 2021). Methods used at these sites have been consistent since 2016, with similar methods used at the same locations prior. Control sites consisted of camera trapping and were established at the Hamersley Line Rail and Eliwana in 2021. In addition, a trapping program was re-commenced at the North Star control sites in 2021 and initiated at Hamersley Line Rail control sites in 2022. Monitoring of Northern Quoll at the Cloudbreak (tenement M45/1142) and Christmas Creek mine sites was suspended since 2022 due to the lack of records during previous years indicating the species to be absent at Christmas Creek and low density at Cloudbreak (Davis and Craig, 2021). Northern Quoll monitoring at the Main Line Rail has been reduced because previous monitoring indicated that the populations were stable with no changes in abundance or spatial distribution attributed to the operation of the rail (Northern Quoll) (Davis and Craig, 2021). The monitoring will recommence in 2024. Comparability of methods between the project areas is listed in Table 2.2. Site

locations are listed in Appendix C and displayed in Map 2.1. The timing of each monitoring event is listed in Table 2.1.

Table 2.2: Northern Quoll monitoring methods compared between projects

Project		Methods			
		No. Traps	Total Trap nights	No. of Cameras	Total Camera nights
Control	Solomon	50 x 3 sites	600	5 x 3 sites	1,350
	Eliwana Mine and Rail	-	-	5 x 3 sites	1,350
	Hamersley Line Rail	50 x 2 sites	400	5 x 3 sites	1,350
	North Star	50 x 3 sites	600	5 x 3 sites 10 x 3 sites (12 nights) 1 x 9 sites (long-term)	1,350 360 405
	DBCA regional sites*	-	-	TBA	TBA
Impact	Solomon Hub	50 x 3 sites	600	5 x 3 sites	1,350
	Hamersley Line Rail	50 x 3 sites	600	5 x 3 sites	1,350
	Eliwana Mine	-	-	5 x 4 sites	2,840
	Eliwana Line Rail	-	-	5 x 3 sites	1,350
	Nullagine	-	-	1 x 20 sites	600
	North Star	50 x 4 sites	800	5 x 4 sites 10 x 4 (12 nights) 1 x 9 sites (long-term)	1,800 480 405

*results from current monitoring year are not available as yet, previous years have been incorporated.

2.3.1. GPS Radio-tracking

GPS radio-tracking was completed at the North Star mine site (one male and one female). The collars were programmed to record a GPS location at 6pm, 10pm, 12pm, 2am and 5am each night. A five-day collar retrieval field event was completed to retrieve the collars (21-25 August 2023). Detailed methods are provided in Appendix B.

2.3.2. Statistical Analysis

Statistical analysis of Northern Quoll data was completed for projects with sufficient data. This includes Generalised Linear Models (GLM) to identify potential correlation between environmental variables (rainfall, bushfire and Feral Cats) and the number of Northern Quolls recorded.

Statistical analysis was completed for the North Star data due to a suitable dataset (capture records). Analysis included Capture-Mark-Recapture (CMR), Exponentially Weighted Moving Averages (EWMA) and Generalised Additive Modelling (GAM). Details of the analysis are provided in Appendix B. GPS radio-tracking data collected at North Star was utilised to determine the home range of individuals by using the Kernel Density tool in ArcGIS Pro v3.0.1. Analysis of trapping data (North Star) was conducted via the open population, spatially explicit capture-recapture analysis in the R package openCR 1.4.0 with multi-capture traps. Details of the statistical analysis methods are provided in Appendix B.

2.4. Greater Bilby

Monitoring of Greater Bilby populations was completed along the Main Line Rail in 2023. The methods aligned with the DBCA Greater Bilby monitoring methods (Dziminski and Carpenter, 2017; Southgate *et al.*, 2018), and were consistent with the 2017 – 2022 monitoring and the CSFMP. The methods for Greater Bilby monitoring include both abundance monitoring (i.e., searches, scat collection for DNA analysis and motion cameras) and occupancy monitoring techniques (i.e., searches) (Table 2.3). Monitoring frequency of Greater Bilby at Christmas Creek has been reduced due to very sporadic records during previous years, indicating individuals infrequently traverse through the site (Davis and Craig, 2021). The next monitoring event will be conducted in 2024. Details of the monitoring methods used at each site are provided in Appendix B. All sites are listed in Appendix C and displayed in Map 2.2. The timing of each monitoring event is listed in Table 2.1.

Table 2.3: Greater Bilby monitoring methods along the Main Line Rail

Project	Occupancy monitoring	Abundance monitoring	No. Cameras
Impact	40 dry season sites	One site – DNA analysis of scats	Four cameras at one abundance site for three months
	20 wet season sites	-	Four cameras at one abundance site for three months
Control	9 dry season sites	One site – DNA analysis of scats	Four cameras at one abundance site for three months
	9 wet season sites	-	Four cameras at one abundance site for three months

2.5. Pilbara Leaf-nosed Bat and Ghost Bat

Monitoring of Pilbara Leaf-nosed Bat and Ghost Bat populations was completed at Solomon Hub, Main Line Rail, Eliwana Mine and Eliwana Line Rail during the wet season 2023. Monitoring for the two species was carried out concurrently due to the similar ecology and habitat requirements associated with each species. Methods aligned with the CSFMP. Twelve potential impact and twelve control sites were monitored at each project.

Monitoring of Pilbara Leaf-nosed Bat and Ghost Bat at Christmas Creek has been reduced in frequency due to the lack of records during previous years indicating the species to be absent from site (Davis and Craig, 2021) and will recommence in 2026. Appendix B outlines additional details of the species-specific monitoring methods used at each site. A number of sites were relocated in 2022 as wet conditions prevented access (see section 3.14). The site locations are listed in Appendix C and shown in Map 2.3. The timing for each monitoring event is listed in Table 2.1.

2.6. Pilbara Olive Python

Monitoring of Pilbara Olive Python populations was completed at Christmas Creek, Solomon Hub, Eliwana Mine and Eliwana Line Rail during the wet season of 2023. Monitoring methods followed the CSFMP for Christmas Creek, Solomon Hub, Eliwana Mine and Eliwana Line Rail and were consistent with previous monitoring.

Monitoring was conducted at four potential impact and four control sites at Christmas Creek, three potential impact and three control sites at Solomon Hub, five potential impact sites at Eliwana Mine, and two potential impact sites at Eliwana Line Rail. An additional three control sites were associated with the Eliwana Mine and Eliwana Line Rail. Each site was searched for one-person hour per night over a seven-night period.

All Pilbara Olive Python individuals captured were marked using Passive Integrated Transponders (PITs) which enabled accurate identification when re-captured. In addition, each individual was weighed, and a scale clip taken. The scale clip was stored in 100% ethanol and submitted to the WA Museum for future DNA analysis. Field team leaders were endorsed by a veterinarian (Ausvet Animal Hospital & Unusual Pet Vet) for the implantation of microchips/PITs.

Appendix B outlines additional details of the species-specific monitoring methods. Where possible, monitoring site locations were consistent with previous monitoring events with access restrictions noted in section 3.14. Site locations are listed in Appendix C and shown in Map 2.4. The timing of each monitoring event is listed in Table 2.1.

eDNA Analysis

eDNA sampling was used to confirm the absence or presence of Pilbara Olive Pythons at Solomon Hub, Eliwana Mine, Eliwana Line Rail and North Star. A set of three water samples were taken from each potential impact and control site at Solomon Hub, Eliwana Mine & Rail and North Star, where suitable surface water was present. The samples were sent to EnviroDNA to be analysed (Appendix M).

In 2023, eDNA sampling at Solomon Hub was completed at three sites at Kangeenarina Creek during both the dry season and during the wet season, and from two control sites during the wet season. Water samples were taken at Eliwana Mine from four potential impact sites and two control sites during the wet season. Two potential impact sites at the Eliwana Rail Line were also sampled during the wet season, and one positive control sample was taken for comparison.

2.7. Conservation Significant Birds

Monitoring of conservation significant bird populations was completed at Cloudbreak, Christmas Creek, Solomon Hub, Hamersley Line Rail, Main Line Rail, Eliwana Mine and Eliwana Line Rail during the wet season of early 2023. Methods for monitoring migratory birds were consistent with previous years of monitoring and follow the CSFMP.

In response to recommendations made in the peer review in 2021 (Davis and Craig, 2021), additional monitoring sites were established since 2022 for grassland and aerial insectivorous bird species that may not be detected at the existing migratory bird monitoring sites.

Conservation significant bird species of this monitoring program include the following species that have previously been recorded and are known to occur within the region:

- Water birds:
  - Common Greenshank (*Tringa nebularia*, EPBC/ BC Act Migratory);
  - Wood Sandpiper (*Tringa Glareola*, EPBC/ BC Act Migratory);
  - Gull-billed Tern (*Gelochelidon nilotica*, EPBC/ BC Act Migratory);
  - Osprey (*Pandion haliaetus*, EPBC/ BC Act Migratory);
  - Common Sandpiper (*Actitis hypoleucos*, EPBC/ BC Act Migratory);
- Grassland birds:
  - Oriental Plover (*Charadrius veredus*, EPBC/ BC Act Migratory); and
- Aerial Insectivores:
  - Pacific Swift (*Apus pacificus*, EPBC/ BC Act Migratory);
- Falcons:
  - Peregrine Falcon (*Falco peregrinus*, DBCA OS);
  - Grey Falcon (*Falco hypoleucos*, EPBC/ BC Act Vulnerable).

Bird surveys focused on the water edges (Water birds), grassland transects (Grassland birds), elevated structures (radio towers, power lines etc; falcon nests) and free aerial space (falcons and Aerial Insectivores). To ensure data was relevant to each site, the control sites were established in comparable habitat to the potential impact sites associated with the project area such as major creeklines, the edge of the Fortescue Marsh and rivers. Surface water can be present at some of the sites but is reliant on significant rainfall events. Conditions may be sub-optimal during dry periods and the lack of conservation significant bird records at these sites may not be unusual during these times.

Appendix B outlines additional details of the species-specific monitoring methods used at each site. Conservation significant birds were also opportunistically targeted during other activities (such as camera installation or trap check within suitable habitat). Monitoring site locations are listed in Appendix C and shown in Map 2.5 and Map 2.6. Timing for each monitoring event is listed in Table 2.1.

2.8. Night Parrot

Monitoring of the Night Parrot was conducted at Cloudbreak in 2023. Monitoring methods aligned with the Fortescue Night Parrot Monitoring Procedure and Program and were consistent with those used in 2022. Details of the monitoring methods are provided in Appendix B and site locations are listed in Appendix C. The timing of monitoring is provided in Table 2.1.

2.9. Additional Monitoring

Additional monitoring was completed as per the following.

- Monitoring of fauna usage of rehabilitation areas at:
  - Cloudbreak
  - Christmas Creek
  - Solomon Hub
  - Hamersley Line Rail
  - Main Line Rail
  - Eliwana Mine
  - Eliwana Line Rail
  - North Star
- Monitoring of fauna usage of culverts at:
  - Hamersley Line Rail
  - Main Line Rail
  - Eliwana Line Rail
- Introduced fauna, at all sites (Red Fox targeted at Main Line Rail)
- Millipede (*Antichiropus* '1021DNA02') searches at Eliwana Mine

Specific monitoring methods used at each site are detailed in Appendix B. Site locations are listed in Appendix C and shown in Map 2.8 and Map 2.9. The timing of each monitoring event is listed in Table 2.1.

2.10. Permit and Field Team

The monitoring events were completed under the Regulation 27 No. BA27000666 and BA27000666-2, Section 40 Authorisation No. TFA 2020-0079-3 and TFA 2223-0264 (includes access to Hamersley Gorge). All field staff are listed in Table 2.4.

Table 2.4: Field staff and qualifications

Name	Qualification	Experience	Role
Astrid Heidrich	MSc (Biol)	15 years	Project management, field work, data management, report writing & QA
Melinda Henderson	BSc (Hons)	5 years	Field work, data management, report writing
Nicola Palmer	BSc (Hons)	8 years	Field work, data management
Dr Dilanka Mihindukulasooriya	PhD	3 years	Data analysis, reporting
Dr Rohan Sadler	PhD	18 years	Data analysis
Louise Ridgeway	BSc	3 years	Field work, data management
Dan Kamien	BSc (Hons)	27 years	Field work
Samantha Lostrom	BSc (Hons)	13 years	Field work
Erica MacIntyre	BSc (Hons)	12 years	Field work
Steven Spragg	BSc	3 years	Field work
Dr Gabrielle Beca	PhD	2 years	Field work
Luciana Liberoff Banados	BSc	1 year	Field work

500000 600000 700000 800000

7700000 7600000 7500000

SM NQ C1 SM NQ C2 SM NQ C3 SM NQ I1 SM NQ I2 SM NQ I3

NS NQ C3 NS MC C3 NS MC C1 NS NQ C2 NS MC C5 NS NQ C4 NS MC I1 NS MC C6 NS MC C4 NS MC I6 NS NQ I1 NS MC I9 NS NQ I4 NS NQ I3 NS NQ I4 NS MC I8 NS MC I2 NS NQ I2 NS MC I3 NS MC C9

HL NQ C3 HL NQ I1 HL NQ C1 HL NQ I2 HL NQ C2 HL NQ I3

NS MC C1 NS MC I8 NS MC I2 NS MC C9

NL NQ W NL NQ BE

HL NQ C3 HL NQ I1 HL NQ C1 HL NQ I2 HL NQ C2 HL NQ I3

SM NQ C1 SM NQ C2 SM NQ C3 SM NQ I1 SM NQ I2 SM NQ I3

NL NQ W NL NQ BE

ER NQ I3 ER NQ I2 ER NQ I1

EMR NQ C1 EM NQ I2 EM NQ I1 EMR NQ C3 EM NQ I4 EMR NQ C2 EM NQ I3

Port Hedland Wedgefield South Hedland Boodarie Strelley Ripon Island Depuch Island Balla Balla Munda Djalanga Wallareenya Whim Creek Sherlock Indee Cooya Pooya Barnkangarra Campsite Temporarily closed Mungaroona Range Nature Reserve Chichester Mulga Downs Ex Mt Florence Witenoom Hamersley Range Mount Sheila Karijini Karijini National Park Tom Price Juna Downs

Legend

Northern Quoll Monitoring Sites

- Long-term Camera (Control)
- Long-term Camera (Impact)
- Trap site (Control)
- Trap site (Impact)
- Eliwana
- North Star
- Nullagine
- Main Line & Hamersley Line Rail
- Solomon Hub
- Eliwana Line Rail
- Not Applicable



N

0 10 20 30 km

Scale 1:1,100,000 @ A3

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Units: Meter

Spectrum Ecology & Spatial

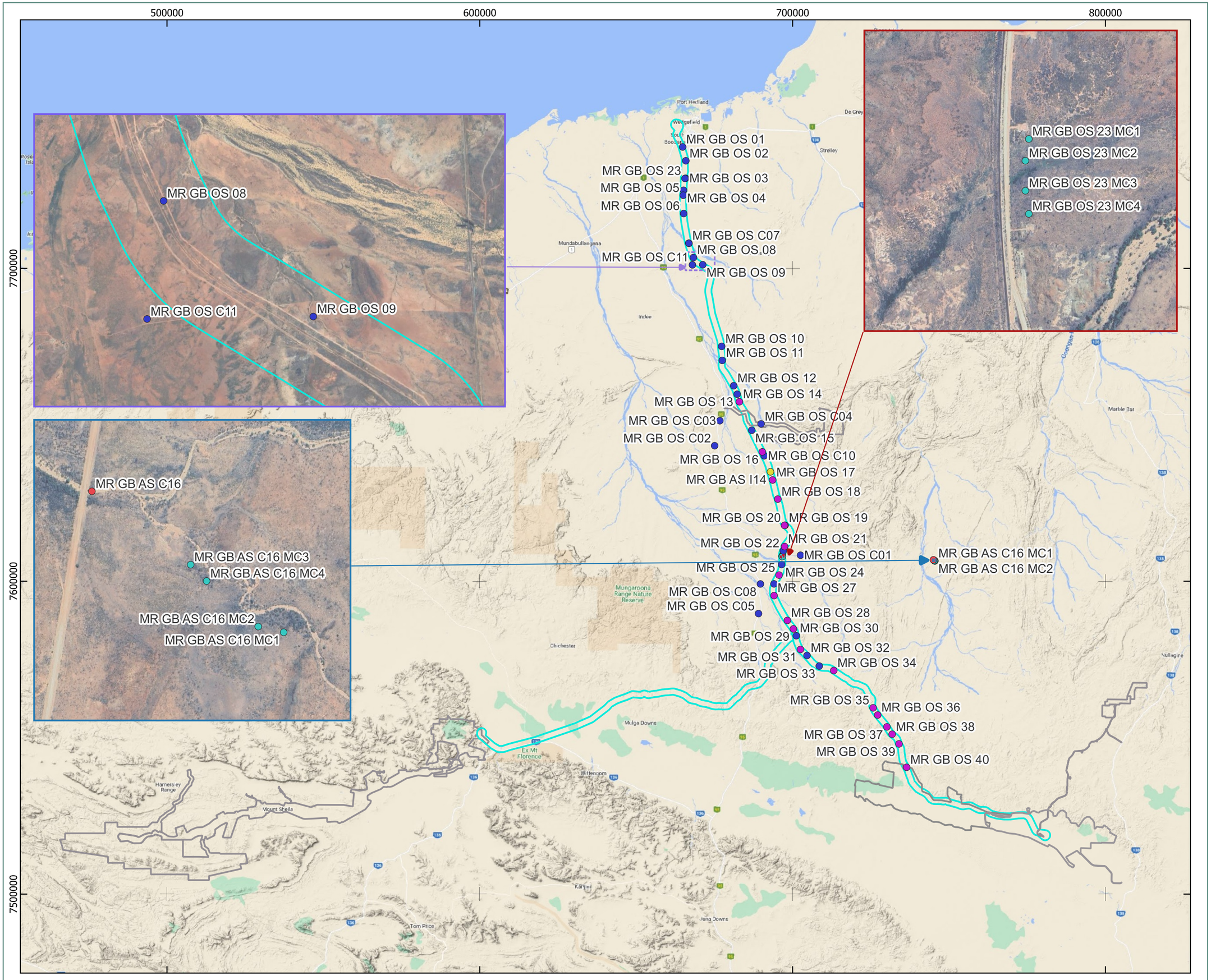
Author: MH Approved: AH Date: 17-01-2024

Location of Northern Quoll Monitoring Sites

Annual Fauna Monitoring Program 2023

Prepared for Fortescue Metals Group

Map 2.1



Legend

Bilby Monitoring Sites

- Abundance Control
- Abundance Impact
- Dry season
- Motion Camera
- Wet & dry
- Main Line Rail & Hamersley Line Rail
- Not Applicable



N

0 10 20 30 km

Scale 1:1,100,000 @ A3

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Units: Meter

Spectrum ECOLOGY & SPATIAL

Author: MH Approved: AH Date: 21-09-2023

Location of Bilby Monitoring Sites

Annual Fauna Monitoring Program 2023

Map 2.2

Prepared for Fortescue Metals Group

500000 600000 700000 800000

7700000 7600000 7500000

EM Bat C1 EM Bat C2 EM Bat C3 EM Bat C4 EM Bat C5 EM Bat C6 EM Bat C7 EM Bat C9 EM Bat C10 EM Bat C11 EM/ER Bat C12 EM Bat I1 EM Bat I2 EM Bat I3 EM Bat I4 EM Bat I5 EM Bat I6 EM Bat I7 EM Bat I8 EM Bat I9 ER Bat I2/EM Bat I11 ER Bat I1/EM Bat I10 ER Bat I3/EM Bat I12 ER Bat I4 ER Bat I5 ER Bat I6 ER Bat I7 EM/ER Bat C8 SM / ER Bat C12

MR BAT C8 MR BAT C1 MR BAT C9 MR BAT I1 MR BAT I2 MR BAT C6 MR BAT I3 MR BAT C12 MR BAT C7 MR BAT C4 MR BAT C3 MR BAT C2 MR BAT C5 MR BAT I4 MR BAT I7 MR BAT I5 MR BAT I8 MR BAT I6 MR BAT C10 MR BAT I9 MR BAT I10 MR BAT I11 MR BAT I12 MR BAT C11

Millstream Chichester National Park

Mungaroona Range Nature Reserve

Port Hedland Wedgefield South Hedland Boodarie De Grey Strelley Wallareenya Marble Bar Ripon Island Fortescue Tom Price Hamersley Range Mount Sheila

SM / ER Bat C4 SM / ER Bat C9 SM / ER Bat C12 SM / ER Bat C3 SM / ER Bat C5 SM / ER Bat C6 SM / ER BAT C2 SM / ER Bat C1 SM / ER Bat C10 SM / ER Bat C7 SM / ER Bat C11 SM BAT I3 SM BAT I10 SM BAT I8 SM BAT I1 ER Bat I12 SM BAT I11 SM BAT I7 ER Bat I9 ER Bat I8 SM BAT C8 SM BAT I9 SM BAT I2 SM BAT I4 SM BAT I1 SM BAT I8 SM BAT I6 SM BAT I12/ER Bat I11 SM BAT I5 /ER I10 ER Bat I12

Pelican rail camp FMG Bonnie Doon Solomon Airport Mount Sheila Summit

Legend

Conservation Significant Bat Sites

- Eliwana - Control
- Eliwana - Impact
- Main Line Rail - Control
- Main Line Rail - Impact
- Solomon - Control
- Solomon - Impact
- Eliwana Mine
- North Star
- Main Line and Hamersly Line Rail
- Solomon
- Eliwana Lie Rail
- Not Applicable



N

0 10 20 30 km

Scale 1:1,100,000 @ A3

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Units: Meter

Spectrum ECOLOGY & SPATIAL

Author: MH Approved: AH Date: 18-01-2024

Location of Pilbara Leaf-nosed Bat and Ghost Bat Monitoring Sites

Annual Fauna Monitoring Program 2023

Map 2.3

Prepared for Fortescue Metals Group

500000
600000
700000
800000
7700000
7600000
7500000

Barnkangarra Campsite
SM POP I1
SM POP I2
FMG Support
Wirrahnan Solomon

EM POP I5
ER POP I1
EM POP I1
EM POP Add S1
EM POP I3
EM POP I2
EM POP I4
EM POP C1
TCD Group
Eliwana Compound

SM POP I2
SM POP I1
SM POP I3
SM POP C1
SM POP C3
SM POP C2
EM POP C3
EM POP C2
ER POP I2
EM POP I5
ER POP I1
EM POP I1
EM POP I3
EM POP I2
EM POP I4
EM POP C1

CC POP C1
CC POP C3
CC POP C4
CC POP C2
CC POP I1
CC POP I2
CC POP I4
CC POP I3

Ripon Island
Port Hedland
Wedgefield
South Hedland
Boodarie
De Grey
Strelley
Mundabullangana
Wallareenya
Indee
Marble Bar
Mungaroona Range Nature Reserve
Chichester
Mulga Downs
Wittenoom
Hamersley Range
Mount Stella
Karijini
Karijini National Park
Tom Price
Juna Downs
Nullagine

Legend

Pilbara Olive Python Monitoring Sites

- Christmas Creek - Control
- Christmas Creek - Impact
- Eliwana - Control
- Eliwana - Impact
- Eliwana Rail - Impact
- Solomon - Control
- Solomon - Impact

Pilbara Olive Python eDNA sites

- Dry Season
- Wet Season
- Eliwana Mine
- Christmas Creek
- Solomon
- Eliwana Rail Line
- Not Applicable



N

0 10 20 30 km

Scale 1:1,100,000 @ A3

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Units: Meter

Spectrum Ecology & Spatial

Author: MH Approved: AH Date: 10-11-2023

Location of Pilbara Olive Python Monitoring Sites

Annual Fauna Monitoring Program 2023

Prepared for
Fortescue Metals Group

Map
2.4

500000
600000
700000
800000
7700000
7600000
7500000

MR WB C1
MR WB C3
MR WB I3
MR WB I2
MR WB I1
MR WB C2
NS WB C3
NS WB C1
NS WB I1
NS WB C2
NS WB I3
HL WB C3
HL WB C2
HL WB C1
HL WB I3
HL WB I2
HL WB I1
SM WB C2
SM WB C1
SM WB I2
SM WB I1
SM MiB C3
SM WB I3
ER WB C2
ER WB C3
ER WB I3
ER WB C1
ER WB I1
ER WB I2
EM WB C1
EM WB C2
EM WB I3
EM WB I1
EM WB I2
EM WB C3
CB WB I3
CB WB I2
CB WB I1
CB/CC WB C6
CB/CC WB C4
CB/CC WB C5
CC WB I1
CC WB I2
CB/CC WB C1
CB/CC WB C3
CB/CC WB C2

Ripon Island
Port Hedland
Wedgefield
South Hedland
Boodarie
De Grey
Strelley
Legendre Island
Gidley Island
Dolphin Island
Rosemary Island
Dampier Archipelago
West Lewis Island
Burrup
Dampier
West Intercourse Island
Cleaverville
Point Samson
Wickham
Mount Anketell
Karratha
Karratha Industrial Estate
Roebourne
Depuch Island
Bella Bella
Mundabullangana
Wallareenya
Whim Creek
Sherlock
Cooya Pooya
Indee
Georgina River
Marble Bar
Millstream
Millstream Chichester National Park
Fortescue
Mungaroona Range Nature Reserve
Chichester
Nullagine
Mulga Downs
Ex Mt Florence
Wittenoom
Hamersley Range
Karijini
Karijini National Park
Tom Price
Juna Downs

Legend

Water Bird Sites

- Control
- Impact
- Eliwana Mine
- North Star
- Christmas Creek
- Cloudbreak
- Solomon Hub
- Main Line & Hamersley Line Rail
- Eliwana Line Rail
- Nullagine



N

0 10 20 30 km

Scale 1:1,100,000 @ A3

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Units: Meter

Spectrum ECOLOGY & SPATIAL

Author: LR Approved: AH Date: 18-01-2024

Location of Water Bird Sites

Annual Fauna Monitoring Program 2023

Prepared for Fortescue Metals Group

Map 2.5

500000 600000 700000 800000

7700000 7600000 7500000

SM GAB C3
SM GAB C2
SM GAB I1
SM GAB C1

EM GAB C1
EM GAB C2
EM GAB I3
EM GAB I1
EM GAB I2
EM GAB C3

MR GAB I1

NS GAB C3
NS GAB C2
MR GAB C1
NS GAB I1
NS GAB I2
NS GAB C1
NS GAB I3
MR GAB C3
MR GAB C2

NS GAB C2
NS GAB C3
MR GAB C1
MR GAB C3
MR GAB C2
NS GAB I2

MR GAB I3
HL GAB C2
HL GAB C3
HL GAB C1
HL GAB I1
HL GAB I2
HL GAB I3

SM GAB C2
SM GAB C3
SM GAB C1
SM GAB I1

CB/CC GAB C3
CB/CC GAB C1
CB/CC GAB C2
CB GAB I3
CB GAB I2
CC GAB I3
CB GAB I1
CC GAB I2
CC GAB I1
CB/CC GAB C6
CB/CC GAB C5
CB/CC GAB C4

Ripon Island
Port Hedland
Wedgefield
South Boodarie
De Grey
Strelley
Mundabullangana
Iron Creek
Iron Bridge
Marble Bar
Nullagine
Mungaroona Range Nature Reserve
Chichester
Mulga Downs
Ex Mt Florence
Wittenoom
Hamersley Range
Mount Sheila
Karijini
Juna Downs
Tom Price
Solomon
Roseberry Island
Hamersley Gorge
Nanutarra - Munjina Rd
Nanutarra Rd
Great Northern Hwy
Iron Bridge Rd
Port Hedland Rd
Marble Bar Rd
Nullagine Rd
Tom Price Rd
Wittenoom Rd
Mount Sheila Rd
Hamersley Gorge Rd
Karijini Rd
Juna Downs Rd
IBG Group Eliwana Compound

Legend

Grassland & Aerial Bird Sites

- Control
- Impact
- Eliwana
- North Star
- Maine Line & Hamersley Line Rail
- Solomon Hub
- Cloudbreak
- Christmas Creek
- Nullagine
- Eliwana Line Rail



N

0 10 20 30 km

Scale 1:1,100,000 @ A3

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Units: Meter

Spectrum Ecology & Spatial

Author: LR Approved: AH Date: 16-10-2023

Location of Grassland and Aerial Bird Monitoring Sites

Annual Fauna Monitoring Program 2023

Prepared for
Fortescue Metals Group

Map
2.6

500000
600000
700000
800000
7700000
7600000
7500000

NP 21
NP 05
NP 20
NP 03
NP 18
NP 02
NP 01.PA
NP 01.NP
NP 08
NP 06

NP 07
NP 04
NP 15
NP 13

NP 21
NP 01
NP
NP 05
NP 08
NP 04
NP 15
NP 13

Ripon Island
Port Hedland
Wedgefield
South Hedland
Boodarie
De Grey
Strelley
Wallareenya
Indee
Millstream
Millstream Chichester National Park
Fortescue
Mungaroona Range Nature Reserve
Chichester
Nullagine
Mulga Downs
Ex Mt Florence
Wittenoom
Hamersley Range
Mount Stella
Karijini
Karijini National Park
Tom Price
Juna Downs

Legend

- Night Parrot Monitoring Sites
- Cloudbreak
- Not Applicable



N

0 10 20 30 km

Scale 1:1,100,000 @ A3

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Units: Meter

Spectrum ECOLOGY & SPATIAL

Author: LR Approved: AH Date: 25-01-2024

Location of Night Parrot Monitoring Sites

Annual Fauna Monitoring Program 2023

Prepared for
Fortescue Metals Group

Map 2.7

500000
600000
700000
800000
7700000
7600000
7500000

SM RE 06
SM RE 10
SM RE C10
SM RE 11
SM RE C11
HL RE C63
HL RE 63
ER RE 01
Nanutarra - Munjina Rd
Ex Mt Florence

EM RE C01
EM RE 01
ER RE 02
ER CU 02
ER RE 03
ER CU 03
ER CU 01
ER RE C02
Hamersley Range

MR RE C37
MR CU 10
MR CU 04
MR RE 01
MR CU 02
MR CU 12
NS RE6
NS RE3
NS RE C6
NS RE C2
NS RE2
MR CU 01
MR CU 05
MR CU 07
MR CU 08
MR RE 37
MR RE C92
HL CU 01
HL CU 04
MR RE 92
MR CU 11
MR CU 06
HL RE 87
HL RE C87
HL RE 74
HL RE C74
HL CU 02
HL CU 03
Ripon Island
Port Hedland
Wedgefield
South Hedland
Boodarie
De Grey
Strelley
Mundabullangana
Wallareenya
Indee
Marble Bar
Mungaroona Range Nature Reserve
Chichester
Mulga Downs
Wittenoom
Karijini
Karijini National Park
Tom Price
Juna Downs
Nullagine

CB RE 07
CB RE Cocos
CB01.2
CB RE 05
CC RE 02
CC RE VAS1
CC RE VAS1.1

Legend

Rehabilitation Sites
- Christmas Creek
- Cloudbreak
- Eliwana Line Rail
- Eliwana Mine
- Hamersley Line Rail
- Main Line Rail
- North Star
- Solomon Hub

Culvert and Red Fox Sites
- Eliwana Line Rail
- Hamersley Line Rail
- Main Line Rail
- Cloudbreak
- Christmas Creek
- Solomon Hub
- Maine Line and Hamersley Line Rail
- Eliwana Mine
- Eliwana Line Rail
- North Star
- Not Applicable



N

0 10 20 30 km

Scale 1:1,100,000 @ A3

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Units: Meter

Spectrum Ecology & Spatial

Author: LR Approved: AH Date: 17-01-2024

Location of Rehabilitation, and Culvert and Red Fox Monitoring Sites

Annual Fauna Monitoring Program 2023

Prepared for Fortescue Metals Group

Map 2.8

500000

7500000

Hamersley Range

TCD Group Eliwana Compound

EM SRE 09

EM SRE 08

EM SRE 07

EM POP I5

EM SRE 10

EM Original Millipede

EM SRE 06

EM SRE 01

EM SRE 02

EM SRE 03

EM SRE 04

EM SRE 05

Legend

Antichiropus Monitoring Locations

- Leaf Litter Sieving
- Millipede Collection Site
- Photo Monitoring
- Eliwana Mine
- Not Applicable



N

0 2 4 6 km

Scale 1:190,000 @ A3

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Units: Meter

Spectrum Ecology & Spatial

Author: LR Approved: AH Date: 08-11-2023

Location of Millipede Antichiropus '1021DNA02' Monitoring Sites

Annual Fauna Monitoring Program 2023

Map 2.9

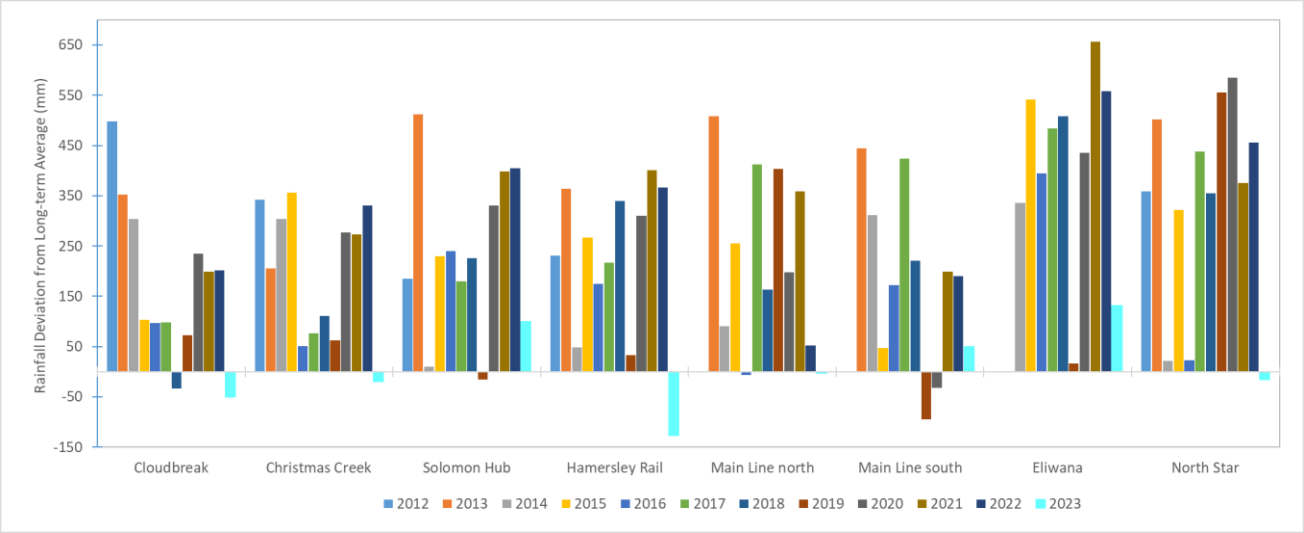
Prepared for Fortescue Metals Group

3. RESULTS AND DISCUSSION

3.1. Rainfall

Rainfall data relevant to the fauna monitoring program is presented below. A summary of monthly rainfall recorded at each project in comparison to the median rainfall (BoM stations) is summarised in Figure 3.1 and more detail is provided in Table 5.2 in Appendix D.

Rainfall deviation from median rainfall data at each site since 2012 is shown in Figure 3.1. Rainfall was above the median rainfall at Solomon Hub, Main Line Rail and Eliwana (Mine and Rail), whereas rainfall was below median rainfall at Cloudbreak, Christmas Creek, Hamersley Line Rail and North Star in 2023. The wet season was relatively dry when compared to the annual median. Monthly rainfall and long-term median are displayed in Appendix D (BoM 2023).



Note: Total annual rainfall in 2023 was estimated by using available recorded rainfall data. Median rainfall data was used for the remaining months (Sep-Dec 2023). Previous annual rainfall data contained recorded data from Jan – Dec of the respective year.

Figure 3.1: Annual rainfall deviation from long-term average (closest BoM stations or SILO)

3.2. Site-Based Records

A summary of records in 2023 are provided below, and a full list of records over the years is presented in Table 5.3 in Appendix E:

- Cloudbreak
  - No conservation significant fauna was confirmed in 2023;
- Christmas Creek
  - No conservation significant fauna was confirmed in 2023;
- Solomon Hub
  - Three Northern Quolls were recorded in 2023;
  - Five Pilbara Olive Pythons were recorded in 2023.
- Hamersley Line Rail
  - No conservation significant fauna was recorded in 2023;
- Main Line Rail
  - No conservation significant fauna was recorded in 2023;
- Eliwana Mine
  - One Northern Quoll was sighted in September 2023;
  - One Pilbara Olive Python was recorded in 2023;
- Eliwana Rail Line
  - No conservation significant fauna was recorded in 2023;
- North Star
  - Nine Northern Quoll records in 2023 (six fauna deaths and three sightings); and
  - One Pilbara Olive Python record in 2023.

3.3. Northern Quoll

A summary of all Northern Quoll captures recorded at each mine site to date is listed in Table 3.1. Results from the DBCA regional monitoring are also summarised where data is available (Table 3.1). Details of Northern Quoll specific information (number of records/captures, Feral Cat numbers, rainfall and fire history) at each site are provided in Table 3.2. Monitoring results from each mine site, rail line or control area are described in the sections below.

Details of each Northern Quoll capture including site location, individual microchip number, sex, capture date, trap number, measurements, weight, reproductive status and health condition are recorded in Table 5.7 in Appendix F.

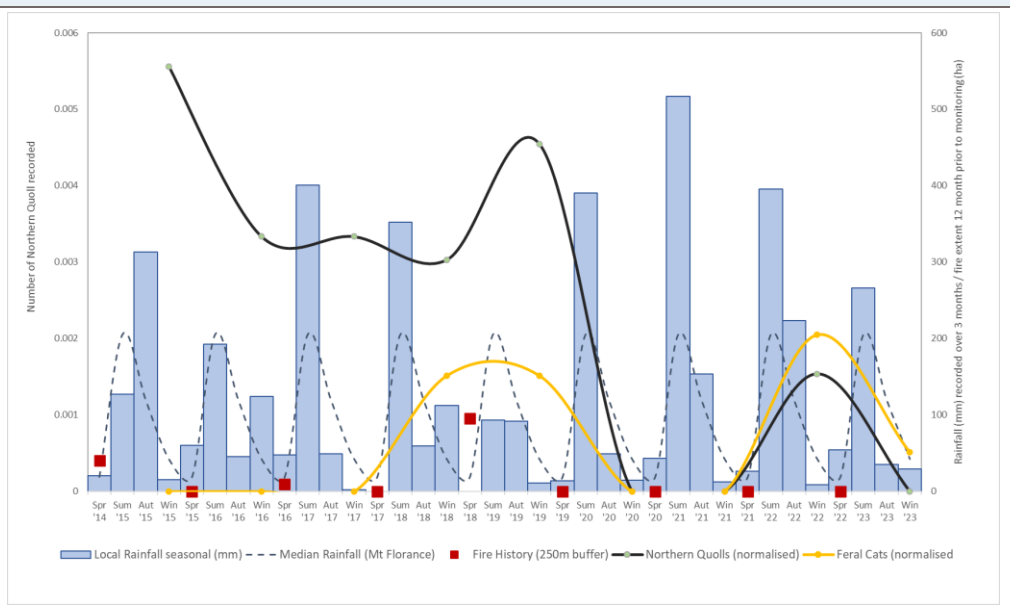
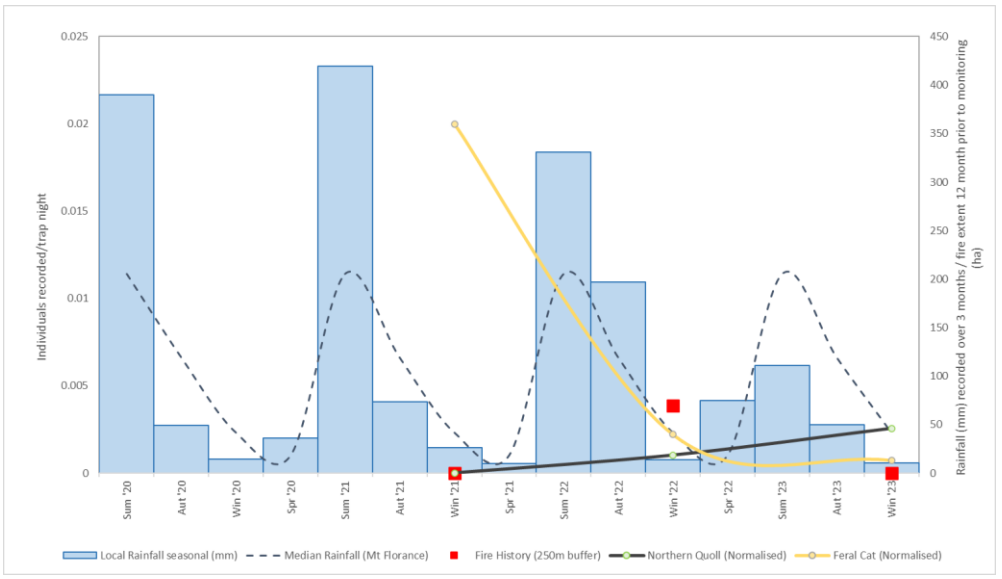
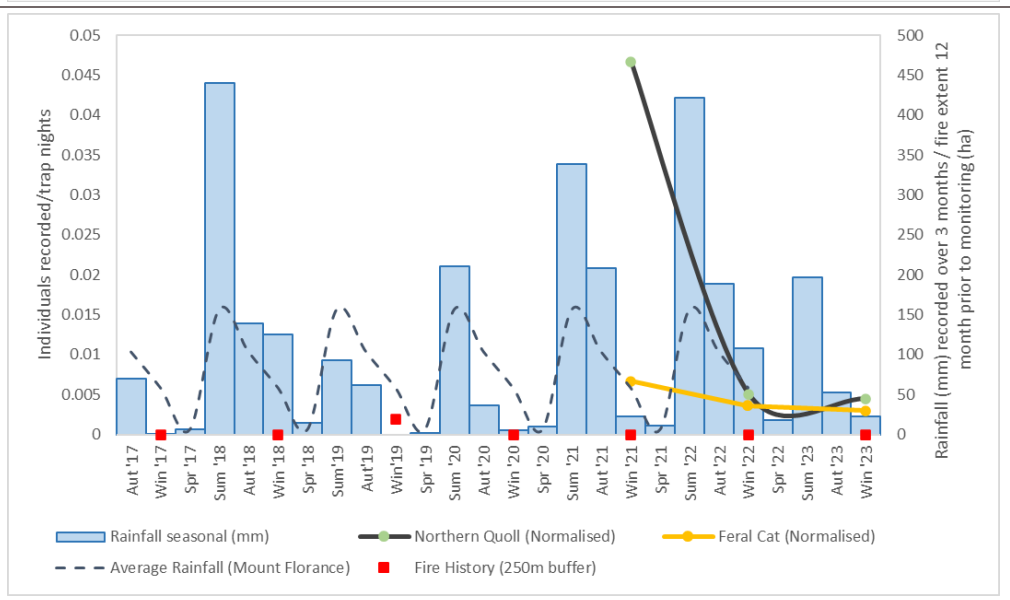
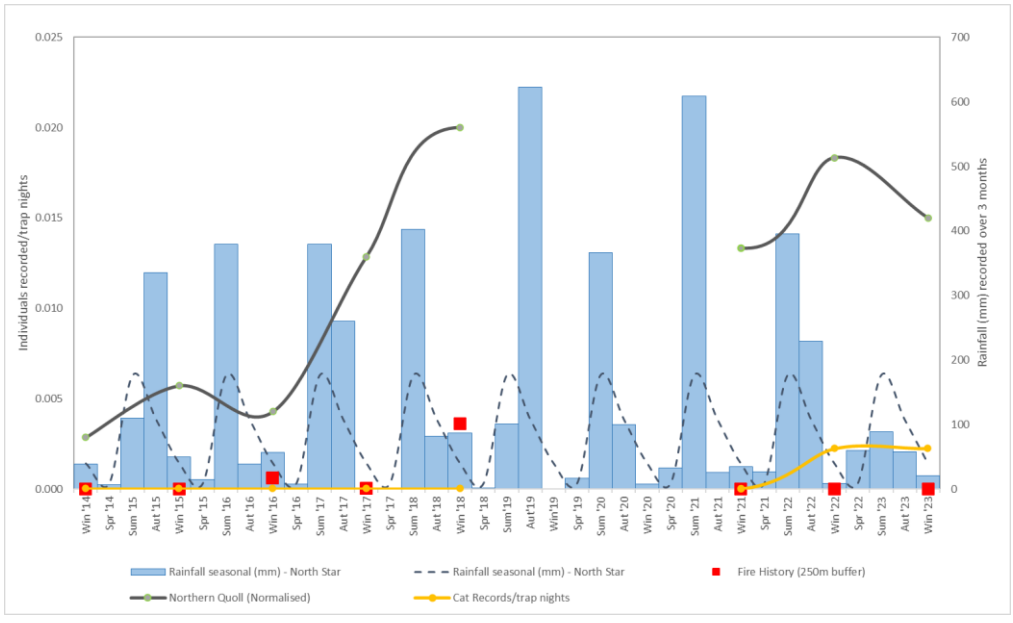
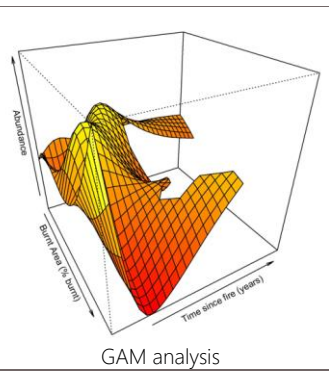
Overall, the number of Northern Quoll individuals recorded at the control sites decreased slightly between 2022 and 2023, whereas numbers at potential impact sites increased, mostly attributed to the high capture rate at North Star (Table 3.1). Results from the DBCA regional monitoring in 2023 are not finalised yet and will be made available when the analysis of motion camera images (individual Identification) has been completed.

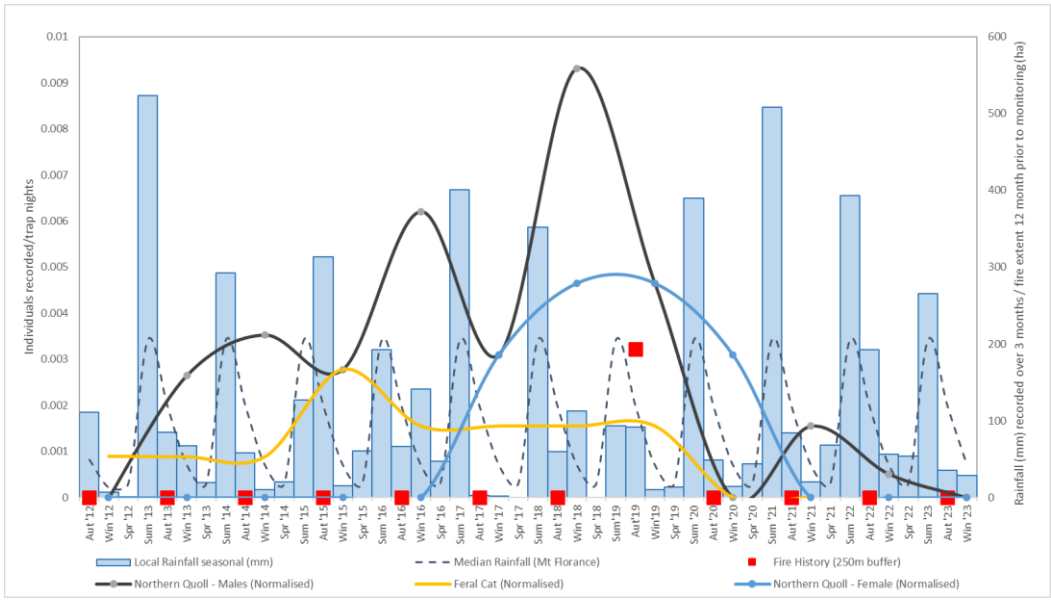
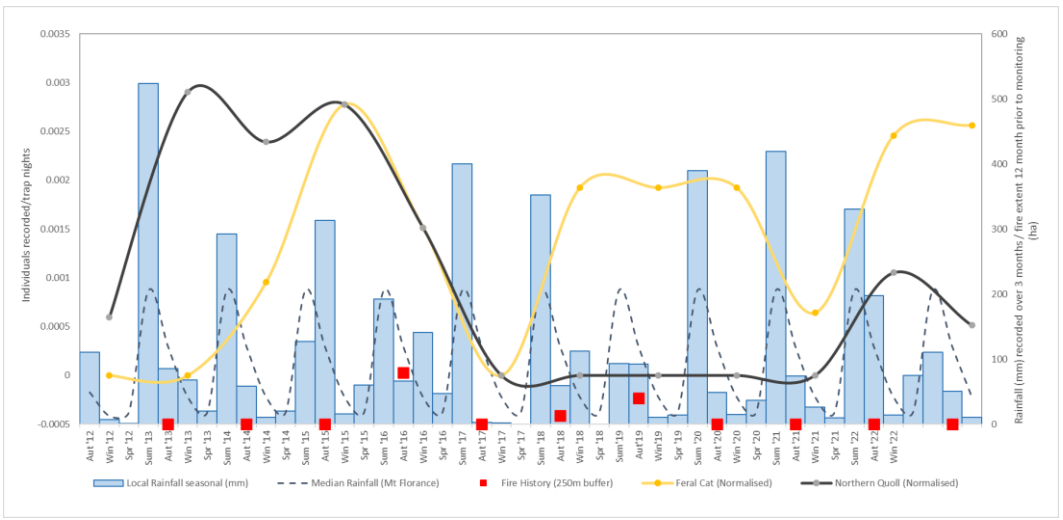
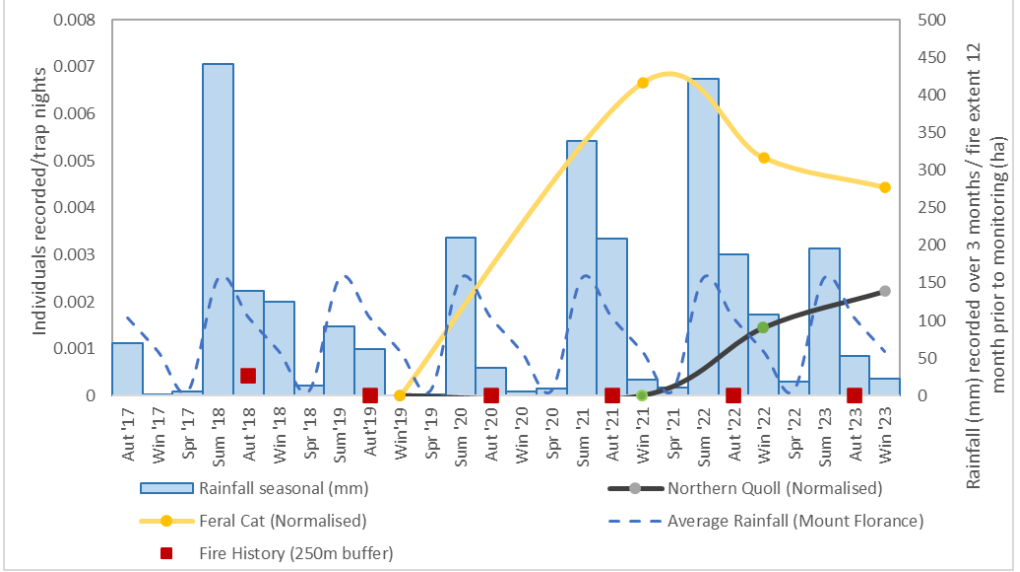
Table 3.1: Number of Northern Quoll recorded from each site

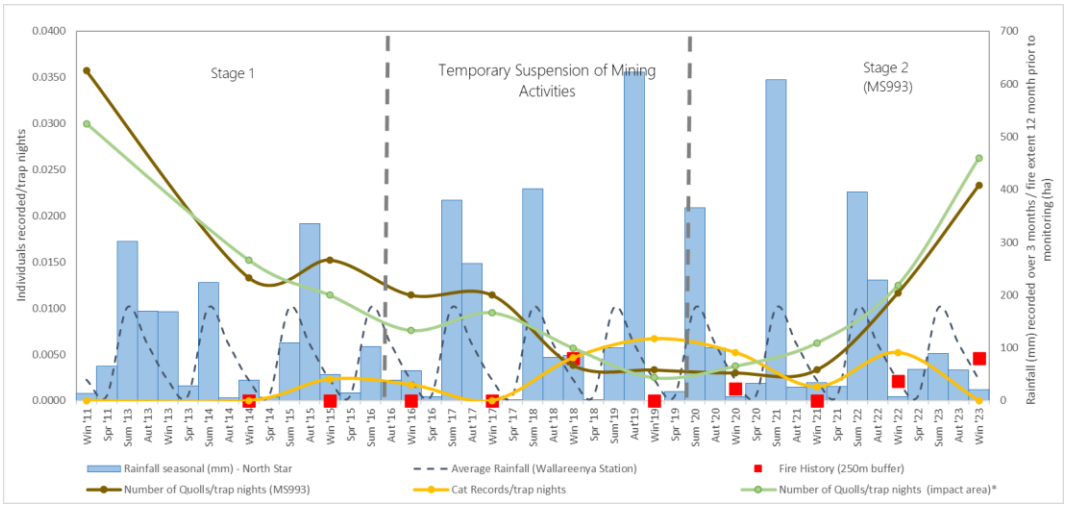
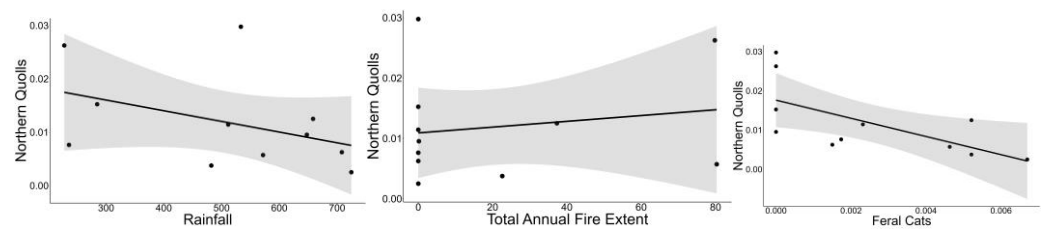
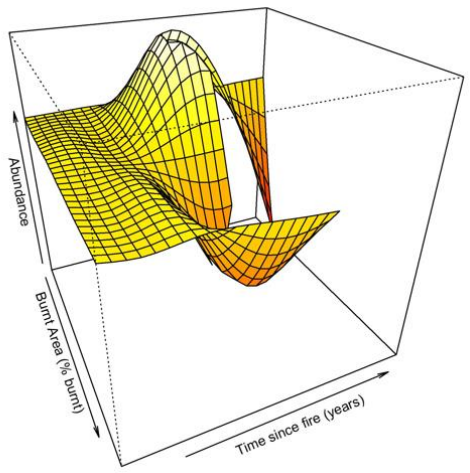
Project/Site	Individuals recorded											
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Control Sites												
Solomon	-	-	-	2#	2	2	3	3	0	0	3MC	0
Hamersley Line Rail	-	0	0	1#	-	-	-	-	-	0	2MC	5 MC
Eliwana Mine and Rail	-	-	-	-	-	-	-	-	-	7MC	7MC	6MC
North Star	-	-	2	4	3	9	7	-	-	8	11	9
Total control sites	**-**	**-**	**2**	**6**	**5**	**11**	**10**	**3**	**0**	**15**	**23**	**20**
Red Rock (Indee station)	-	-	22	25	13	23	32	8	-	-	13 MC	TBA
Ngirribungynha (Dales Gorge, Karijini NP)	-	-	-	-	-	4	4	1	-	-	5 MC	TBA
Baranggunjiyarra / Black Hill Pool (Millstream, Chichester NP)	-	-	9	1	1	3	0	1	-	-	3 MC	TBA
Euro Springs (Mt Florance)	-	-	6 MC	5 MC	3 MC	11 MC	8 MC	2 MC	-	-	1 MC	TBA
Hooley station	-	-	0 MC	0 MC	0 MC	3 MC	1 MC	2 MC	-	-	-	-
Total DBCA sites			**37**	**31**	**17**	**44**	**45**	**14**	**-**	**-**	**22**	**TBA**
Potential Impact Sites												
Solomon Hub	0	3	4	1#	4 1R	4	9	6	2	1	2MC	1MC
Hamersley Line Rail	1	6	5	3#	2	0	0	1#	1#	0	1 + 2MC	1MC
Main Line Rail	2	3	2	2#	1	5	6	5	10	7	-	-
Eliwana Mine	-	-	-	-	-	-	-	0	-	0	2MC	4 MC
Eliwana Line Rail	-	-	-	-	-	-	-	0	-	0	0	0
North Star	-	-	9	9	5	3	2	3	5	5	10	21
Total impact sites	**3**	**12**	**20**	**15**	**11**	**12**	**17**	**14**	**17**	**13**	**17**	**27**

Green highlighted cells indicate camera use only; blue highlighted cells indicate opportunistic records; # Secondary evidence; MC Recorded on motion camera only, data only provides estimate for individual count; 1R One individual was previously trapped at another site.

Table 3.2: Northern Quoll records and environmental variable at each control and impact area

Area	Summary	Graph
Control Sites		
Control Sites - Solomon	• High number normalised number of Northern Quolls in 2015 due to low trap effort. • No recent fires (last one recorded in 2019) • Northern Quoll numbers declined since 2019, possibly as a response to fire in late 2018. • Feral Cat numbers have remained low (slight increase between 2018/2019 and 2021/2022).	
Control Sites – Hamersley Line Rail	• Third year of monitoring at the sites – limited data: Increase in Northern Quoll numbers from zero in 2021 to five (including one female) in 2023. • Fire at the site recorded prior to 2022 monitoring. • Feral Cat numbers appeared to decrease from three individuals in 2022 to one in 2023.	
Control Sites – Eliwana	• Third year of monitoring – limited data. • Estimated six Northern Quoll individuals recorded at two control sites in 2023. • Seven individuals recorded in 2021 (one site) and in 2022 (two sites). Camera trapping effort increased in 2022 resulting in an indicated decrease of the population when data was normalised. • Slight decrease of Feral Cat numbers (normalised data).	
Control Sites – North Star	• Northern Quoll numbers peaked in 2017 (individuals) and 2018 (normalised numbers). Northern Quoll numbers in 2021 - 2023 are comparable to 2017 – 2018. • Feral Cat numbers have also started to increase slightly after 2021 but have been stable since. • Significant fire in 2018 • No data available for 2019 and 2020 (monitoring of control sites temporarily suspended) • GAM analysis indicates that fire has an impact on quoll abundance at the control sites – populations recover fast after small fires, but collapse as a response to large fires. Populations recover with time passed since fire.	
	 GAM analysis	

Area	Summary	Graph
Impact Sites		
Impact Sites – Solomon Hub	• Northern Quoll numbers peaked in 2018 following above average rainfall over successive years (2013-2018). A fire impacting the sites prior to the 2019 monitoring was followed by below average rainfall. This coincided with a decrease in Northern Quoll numbers since 2019. Sites have not been impacted by fire since then. Female Northern Quoll numbers peaked in 2018 and 2019. • Feral Cat numbers consistently low (attributed to ongoing feral control on site). • GLM analysis identified no correlation between Northern Quoll number, fire, fire frequency, rainfall and Feral Cat records, as the null model was among the best models explaining the variance in total Northern Quoll abundance. However, the long-term effects of fire over multiple years are not considered by GLMs (only considers data from each year) and the effect of burnt areas even after numerous months should not be discounted. Low number of records of Feral Cats and Northern Quolls limits the suitability of the data for statistical analysis.	 GLM analysis
Impact Site – Hamersley Line Rail	• One individual on motion camera- slight decrease in Northern Quoll numbers between 2022 and 2023, but overall increase to 2017 – 2021 data (no records). • Above average rainfall over successive years (2013-2015) was followed by an increase in Northern Quoll records. A fire impacted the sites in late 2015, 2018 and 2019 followed by below average rainfall in 2019, coincided with a decrease in Northern Quoll numbers since 2019. • Feral Cat numbers increased in 2022 compared to 2021, stayed consistent in 2023. Similar levels to 2015 and 2018-2020. • GLM analysis identified no correlation between Northern Quoll number, fire, fire frequency, rainfall, and Feral Cat, since the null model was among the best models explaining the variance in total Northern Quoll abundance; however long-term effects from fire over multiple years are not considered by GLMs (only considers data from each year) and the effect of burnt areas even after numerous months should not be discounted. Low number of records of Feral Cats and Northern Quolls limits the suitability of the data for statistical analysis.	 GLM analysis
Impact Site – Eliwana Mine	• Data suggests increase in Northern Quoll numbers, however low numbers recorded to date (zero to four individuals). • Fires recorded in 2017 and 2018 prior to monitoring. • Feral Cat numbers (normalised) peaked in 2021. • Decline in cat numbers coincides with increase in Northern Quoll numbers. • GLM analysis will be completed after four years' worth of data.	
Impact Site – Eliwana Rail Line	• Limited data (three years) and no Northern Quoll recorded to date. One incidental record from ER NQ I1 in 2022 (PhD research project). • Above average rainfall between 2020 and 2022 (favourable conditions). • Fires recorded in 2016 and 2020 before monitoring commenced. • GLM analysis will be completed after four years' worth of data.	-

Area	Summary	Graph
Impact Site – North Star	• Northern Quoll population increased in 2023. • Feral Cats decreased in 2023 (no records from monitoring sites). • Numbers of Northern Quoll were lowest between 2018 and 2021 when cat numbers were highest. • Statistical analysis indicates that there was an impact to the Northern Quoll population, in particular females at the potential impact sites between 2015 - 2018 (EWMA, Appendix G). • GAM analysis indicates that fire has an impact on quoll abundance on site – quoll abundance increases with age of fire. Large extent and frequent fires have a negative impact on quoll abundance. • GLM analysis suggests that the Feral Cat numbers correlate with the number of Northern Quolls (normalised numbers). The correlation could potentially be linked by other factors (food sources). No correlation was identified with rainfall or total annual fire extent. However, low number of records of Feral Cats and Northern Quolls limits the suitability of the data for GLM analysis.	  GLM analysis
	 GAM analysis	

3.3.1. Control Sites

3.3.1.1. Solomon Control

There were no Northern Quolls recorded at the Solomon Hub control sites in 2023. This is consistent with the previous results with between zero and three individuals recorded (Table 3.1). The site was subject to repeated fires in 2018. Feral Cat numbers have remained low at the monitoring sites (Table 3.2). Despite the habitat at the sites being suitable, Northern Quoll records to date have been consistently low.

3.3.1.2. Hamersley Line Rail Control

No Northern Quolls were trapped at the control sites associated with the Hamersley Line Rail. Five individuals were recorded on camera from one control site (HL NQ C2) where no trapping was conducted. This was the third year of monitoring at these sites. In 2022, at least two individuals were recorded on motion cameras, all from site HL NQ C2. The site could not be accessed for trapping due to travel times to the site and associated animal welfare considerations, so the nature of the population is not known but is likely a resident population based on the numerous recordings across all five cameras.

3.3.1.3. Eliwana Mine and Eliwana Line Rail Control

Six individual Northern Quolls were recorded from control site EM NQ C2 in 2023. During the previous two years of monitoring (2021 and 2022), seven individuals were recorded from one to two Eliwana control sites (EMR NQ C1 and C2). The data indicates that there is a stable population present at the Eliwana control sites.

3.3.1.4. North Star

A total of nine Northern Quolls were trapped at the three control sites associated with North Star in 2023. This is a slight decrease from 2022, however data between 2021 and 2023 are comparable (8-11 individuals) (Table 3.1, Table 3.2). Statistical analysis of the trapping data indicates that there was an increase in female quoll abundance at the control sites between 2018 and 2023, however this increase was less significant than at the potential impact sites (Table 3.2, Table 5.8). GAM analysis indicates that bush fires are a driving factor with an increase in fire frequency and extent having a negative effect on quoll abundance (Table 3.2).

3.3.1.5. DBCA Control Sites

Monitoring data from the DBCA control sites in 2023 is still being analysed and final individual counts are not available at this stage. In 2022, Northern Quolls were recorded on motion cameras at Red Rock (Indee Station), Karijini National Park, Millstream National Park, Baranggunjiyarra / Black Hill Pool (Millstream, Chichester NP) and Euro Springs (Mount Florance) monitoring sites (Table 3.1). Monitoring has not been conducted at Hooley Station since 2019. Previous data from the sites consisted of live trapping data, therefore population trends recorded are difficult to compare between the years due to changed methodology.

3.3.2. Potential Impact Sites

3.3.2.1. Solomon Hub

There were no Northern Quolls trapped at the Solomon Hub potential impact sites in 2023, however one individual was recorded on the motion cameras at one potential impact site (SM NQ I3). The trapping result in 2023 (no individual) is comparable to the baseline monitoring in 2012 (one male captured). There has been a continuing decline in the trapping results following a peak of nine individuals in 2018 which is mostly attributed to an extensive fire followed by below average rainfall and dry conditions (Map 3.1, Table 3.1, Table 5.7 in Appendix F). Favourable environmental conditions between 2015 to 2018 have likely contributed to the increase in population size. Females were recorded between 2018 and 2020 indicating that a breeding population was present at that time.

The GLM analysis did not indicate a correlation between the number of Northern Quolls, Feral Cats, fire and rainfall (Table 3.2). This is likely due to limited power of statistical analysis (low sample size). The effect of fire is considered a driver of the Northern Quoll population size on site, in particular when considering the long-lasting effects of these events over several months. An extensive fire in 2018 followed by dry conditions on site coincided with the decline of Northern Quoll records on site. Feral Cat numbers have been low with few individuals recorded over the monitoring period (Table 3.2).

3.3.2.2. Hamersley Line Rail

No Northern Quoll was trapped at the potential impact sites in 2023. A single image was recorded on a motion camera at site HL NQ I3. In 2022, a single male individual was trapped at that site. Prior to this, five individuals were recorded in 2014, followed by only secondary evidence recorded in 2015 and 2016, a single scat recorded in 2019, and a single motion camera image in 2020 (Table 3.1, Table 3.2).

The monitoring results at the Hamersley Line Rail in 2023 is comparable with the baseline monitoring in 2012 (one male captured). This observation is also consistent with trends observed at Solomon Hub where 2022 trapping data indicates that the local population has returned to baseline monitoring (2012) levels after a breeding population had not been recorded in recent years.

The decline in Northern Quoll populations along the Hamersley Line Rail since the 2014 monitoring is thought to be in response to extensive fires impacting the monitoring sites in 2015 and 2018 with a concurrent increase in Feral Cats (Table 3.2). However, the GLM analysis did not detect a correlation between the number of Northern Quolls, fire, rainfall and Feral Cats (Table 3.2) likely due to limited power of statistical analysis (low sample number). The local area is likely to support low-density populations of Northern Quoll. Fortescue has implemented a targeted feral predator control program along the rail to reduce predation pressure on threatened fauna species (Terrestrial Ecosystems, 2022b, 2022a).

3.3.2.3. Eliwana Mine

Four Northern Quolls were recorded on motion cameras at two potential impact sites (EM NQ I3 and EM NQ I4) in 2023. Camera images indicate that at least one female was recorded from site EM NQ I3. The remaining records were likely males. The current monitoring data indicates an increase in population size in comparison to 2022 (two individuals) and 2021 (no individuals) at the impact sites.

During a comprehensive baseline survey in 2012 and 2017, a single individual was recorded from two locations indicating the presence of a low-density population (roaming males only) (Ecologia 2012; Ecoscape 2017b). A survey in 2021 (J6 Project) recorded 12 Northern Quoll individuals via trapping (four females and eight males), nine individuals on motion camera, and seven scats indicating that higher density populations occur in the region surrounding the Eliwana Mine (Ecologia 2021). The J6 Project area consists of future

Eliwana life of mine areas and adjacent exploration areas. It is located to the southwest of the current Eliwana project.

There have been four years of above median rainfall at Eliwana Mine (Figure 3.1) and no fires impacting the trapping sites since 2018 (Table 3.2). This combination of factors is likely to have driven an increase in Northern Quoll numbers at the site. The control site data indicates that there is a stable population with minor decrease in 2023.

3.3.2.4. Eliwana Line Rail

There were no Northern Quolls recorded from the potential impact sites at the Eliwana Line Rail in 2023. This is consistent with previous results; there have been no Northern Quolls recorded from the Eliwana Line Rail monitoring sites to date. A comprehensive baseline survey was completed in 2017 that did not record the species and identified limited foraging habitat. Based on the habitat mapping it is unlikely that a breeding population exists along the Eliwana Rail Line (Ecoscape 2017b). However additional cameras installed at site ER NQ I1 as part of a PhD study recorded a single image of a Northern Quoll in 2022 indicating a roaming male (pers. Comms, M. Cowan, 2022). The control site data indicates that there is a stable population with minor decrease in 2023.

3.3.2.5. Nullagine

Northern Quolls were recorded from 18 of the 20 camera locations at Nullagine in 2023: nine locations at Bonnie East and nine at Warrigal (Map 3.1). This is the highest count of cameras recording Northern Quolls to date (12 camera sites in 2020 and 2022, and 14 camera sites in 2021) (Table 5.5 in Appendix F). Records have been consistently higher than those recorded between 2010 and 2017 (Table 5.6 in Appendix F). The 2023 results included both single and multiple images of individuals over several nights (possibly indicating the presence of a resident female) indicating a stable, resident population is persisting at Nullagine. The methods do not allow a clear count of individual numbers or indication of sex.

3.3.2.6. North Star

Twenty-one Northern Quoll individuals (15 males and six females) were recorded from all four potential impact sites in 2023. Females were recorded from three of the four potential impact sites (NS NQ I1, I3 and I4; Map 3.2). Environmental conditions were considered average with below median rainfall recorded during the 2023 wet season, however rainfall was favourable during the previous six years (Figure 3.1, Table 5.2).

When considering a breeding population, females are typically regarded as the critical factor for the survival of the population, given that males undergo an annual die-off and roam long distances (Oakwood, 2000). Statistical analysis indicates that there was an impact to the population of quolls at the potential impact sites between 2015 and 2018, in particular female quolls (EWMA & CMR analysis; Appendix G). The population is recovering from this impact and slowly returning to baseline data (Figure 3.3). The increase happened at the potential impact sites at a higher rate than at the control sites (Figure 3.2). Fire has been suggested to be a driving factor (GAM analysis) with an increase in fire frequency and extent having a negative effect on quoll abundance (Table 3.2). In addition to this, there is a potential correlation between Feral Cats and Northern Quolls (normalised numbers) as indicated by the GLM analysis. No correlation was identified with rainfall or total annual fire extent. Based on long-term motion camera data, Feral Cats have been recorded more frequently in the areas adjacent to mining infrastructure in comparison to the control sites (Map 3.3). Feral Cat records increased in 2022 compared to 2021 but decreased in 2023 when no cats were recorded from the monitoring sites (Table 3.2).

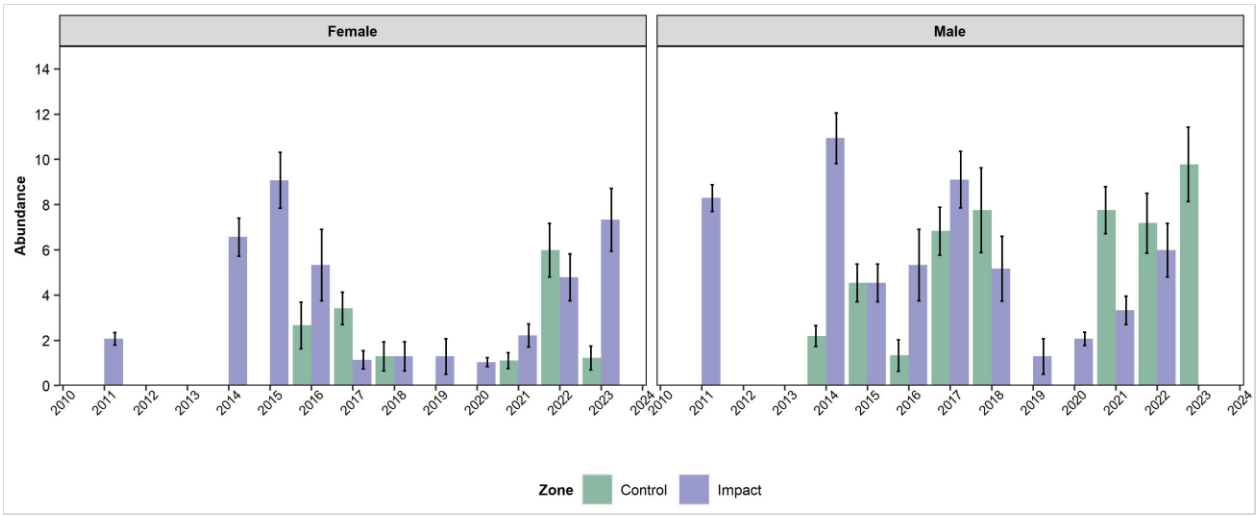
When comparing the last three years of monitoring with the first three years of monitoring (baseline), the female population of Northern Quoll has undergone a 19% decline across the potential impact sites (based on CMR analysis, Table 3.3). When considering normalised numbers, the decline is 20% across all impact sites, largely based on the low capture rates in 2021. As indicated by the EWMA analysis, the population is recovering and slowly returning to baseline data (Appendix G).

The trapping data and statistical analysis indicate that the female Northern Quolls have not been impacted negatively by the operation of the mine to date, but rather other factors such as frequent bush fires and possibly Feral Cats.

Table 3.3: Northern Quoll population at North Star potential impact sites

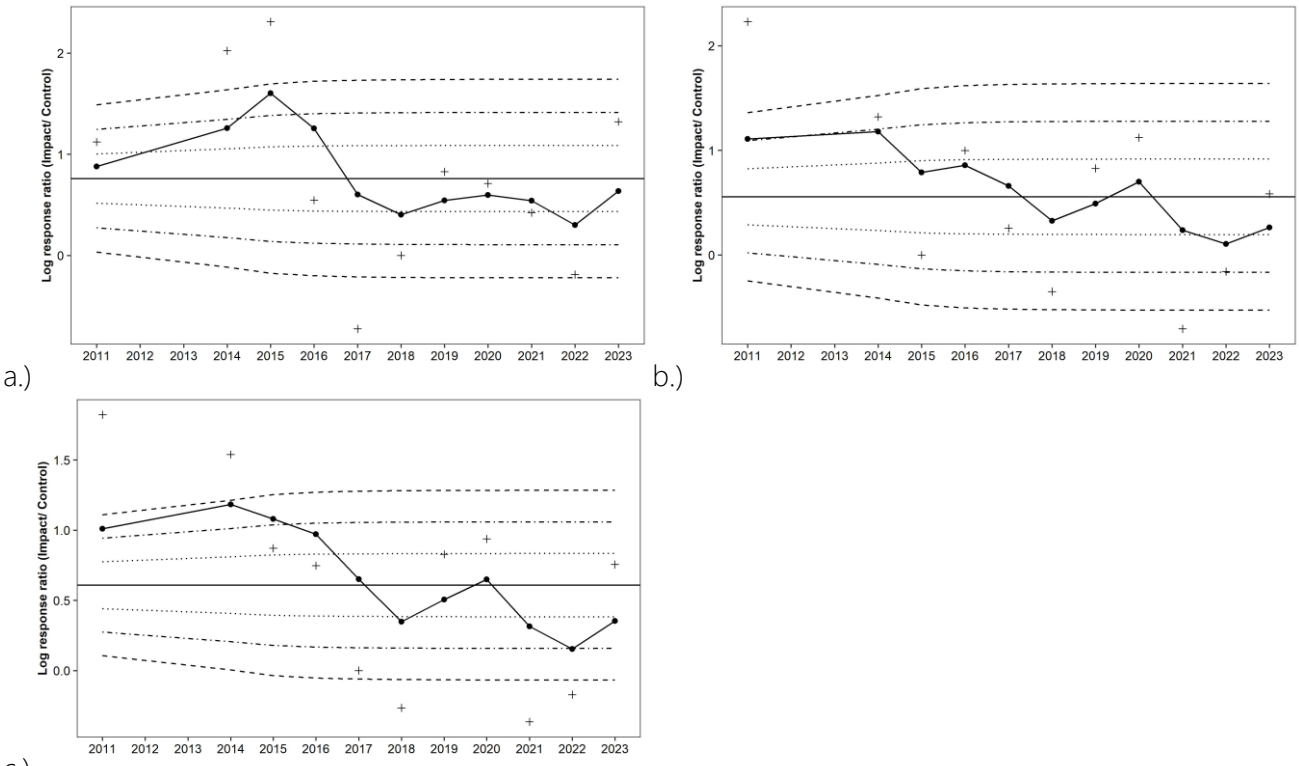
Values		2011	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
No. NQ Individuals captured impact sites)		6 (1)	16 (6)	12 (8)	8 (4)	10 (1)	6 (1)	2 (1)	3 (1)	5 (2)	10 (5)	21 (6)
Number of NQ/trap nights (cage traps only, excl. MCs)		0.030	0.015	0.011	0.008	0.010	0.006	0.003	0.004	0.006	0.013	0.026
Average NQ over 3 years/trap nights		0.0187			-					0.015		
Females	Estimated Abundance	2.07	6.56	9.07	5.33	1.14	1.29	1.29	1.04	2.22	4.79	7.33
	Averaged Abundance (over 3 years)	5.9			-					4.78		
Changes between baseline data (over 3 years)	NQ numbers – normalised	20.3% decrease										
	Female NQ Abundance - CMR	18.9% decrease										

Note: Number of females are noted in brackets; impact sites: Sites A-F in 2011; Sites NS NQ I1-4 & C1-C2 in 2014-2018; Sites NS NQ I1-4 for 2019 – 2022.



Error bars are Standard Error (SE).

Figure 3.2: Bar Plot displaying the estimated abundance of Northern Quolls at potential impact and control sites



The response variable is the log of the Impact/Control abundance ratio. + = log ratio of observed data. ● = smoothed standardised difference metric based on exponentially weighted three year moving average. Dotted curves represent ±1 SD, ±2 SD and ±3 SD.

Figure 3.3: EWMA control chart for a) female, b) male and c) female and male Northern Quolls abundance at monitored sites.

3.3.2.7. Radio-collaring

Two Northern Quolls were fitted with GPS radio collars in July 2023; one female and one male that were captured at monitoring site NS NQ I3. Both individuals were re-captured after four weeks, the radio collars retrieved, and the data downloaded. The collar attached to the female recorded 21 GPS locations while the GPS male's collar recorded 122 GPS points for the entirety of the tracking period. The home range estimate

of the female was 72 ha of which 23 ha comprised the core area (Map 3.4). The home range estimate of the male covered 307 ha of which 125 ha was the core area (Map 3.5).

The habitat at site NS NQ I3 comprised of a rocky ridge with multiple caves and rock crevices for shelter. The site was also indicated by the Species Distribution Modelling (SDM) as highly suitable for the species (Map 3.5). Areas close to disturbances were visited as well as areas outside the footprint. Mining activities within 200-300 m of the monitoring site consisted of landfill sites, magazine and tracks, and increased in size and activity since 2022. The vegetation at the monitoring site is still recovering from the fires that occurred in 2021 with little to no cover in previously burnt areas. Movements and recorded GPS locations of the female and male, as well as fire history (based on Fortescue data), and SDM completed as part of the Glacier Valley project (Spectrum 2021) are shown on Map 3.4, and Map 3.5.

Home ranges compared across previous monitoring events have varied between sexes and capture locations. Male home ranges varied between 307 ha (2023) and 3,887 ha (2014) while female home ranges were similar between 2015 and 2023 (50 – 80 ha) (Table 3.4). Data recorded from 2022 indicate a smaller female home range but this is based on a very small number of GPS recordings (collar malfunctioning) and should be omitted from the comparison. The home ranges recorded from site to date are similar to those recorded elsewhere for the species (Ecoscape, 2017e). The data to date does not indicate a change in Northern Quoll behaviour on site, however the low sample size of one to two individuals per year may limit the detectability of changes.

Table 3.4: Northern Quoll home range sizes based on radio-collar data

Sex	Home Range Area	Stage 1			Stage 2			
		2014	2015	2016	2020	2021	2022	2023
Female	Core Territory	-	13	-	-	37	2	23
	Home range	-	80	-	-	50	6	72
Male	Core Territory	525	1.7	-	*	294	163	125
	Home range	3,887	5.9	-	*	2,021	559	307

*male was not re-captured to download data

500000
600000
700000
800000
7700000
7600000
7500000

NL BE

MR CU 12

Map 3.2

MR CU 07

MR GB ASC16

NL BE

HL NQ C2

HL NQ I3

SM NQ I3

EMR NQ C2

EM NQ I4

EM NQ I3

Ripon Island
Legendre Island
Gidley Island
Dolphin Island
Rosemary Island
Dampier Archipelago
West Lewis Island
Burrup
Dampier
West Intercourse Island
Cleaverville
Antonymyre
Wickham
Point Samson
Mount Anketell
Karratha
Karratha Industrial Estate
Roebourne
Maitland
Depuch Island
Bella Bella
Mundabullangana
Whim Creek
Sherlock
Cooya Pooya
Indee
Marble Bar
Millstream
Millstream Chichester National Park
Fortescue
Mungaroona Range Nature Reserve
Chichester
Nullagine
Mulga Downs
Ex Mt Florence
Wittenoom
Hamersley Range
Mount Sheila
Karijini
Karijini National Park
Tom Price
Juna Downs

Legend

Northern Quoll records (excl. North Star)

- Eliwana Mine - Impact
- Eliwana Mine & Rail - Control Site
- Hamersley Line - Control
- Hamersley Line - Impact
- Main Line Rail - Control
- Main Line Rail - Culvert
- Nullagine
- Solomon - Impact
- Solomon
- Main and Hamersley Line Rail
- Eliwana Mine
- Eliwana Line Rail
- Nullagine
- North Star
- Not Applicable



N

0 10 20 30 km

Scale 1:1,100,000 @ A3

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Units: Meter

Spectrum ECOLOGY & SPATIAL

Author: MH Approved: AH Date: 10-11-2023

Locations of Northern Quoll records

Annual Fauna Monitoring Program 2023

Prepared for
Fortescue Metals Group

Map
3.1

705000
710000
715000
720000
7655000
7650000
7645000

NS NQ C3
NS NQ C2
NS NQ C4
NS MC I6
NS RE C3
NS NQ I1
NS MC I9
NS NQ I4
NS NQ I3
NS MC I4
NS MC I2
NS MC I8
NS NQ I2
NS MC I3
NS RE C2
NS RE 2
NS MC C9

Legend

North Star (MS993 Boundary)

Northern Quoll Captures

- Female
- Male
- Motion Camera Records



N

0 0.5 1 1.5 km

Scale 1:1,100,000 @ A3

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Units: Meter

Spectrum ECOLOGY & SPATIAL

Author: LR Approved: AH Date: 03-11-2023

Locations of Northern Quoll records at North Star

Annual Fauna Monitoring Program 2023

Map 3.2

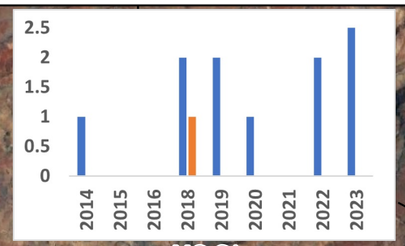
Prepared for
Fortescue Metals Group

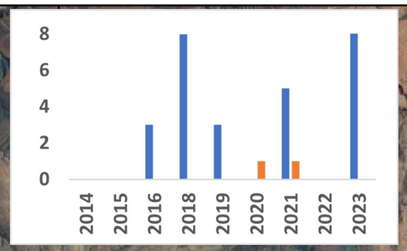
705000 710000 715000 720000

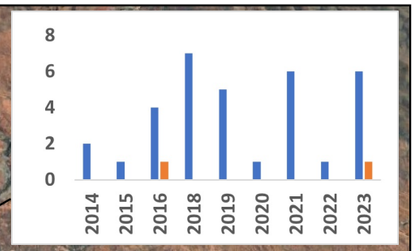
7655000 7650000 7645000

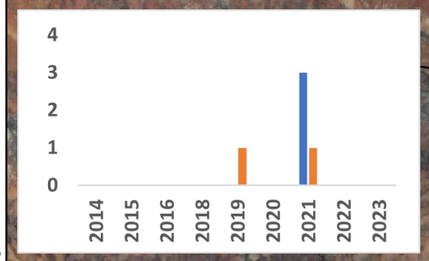
Northern Quoll (Number of triggered camera nights)

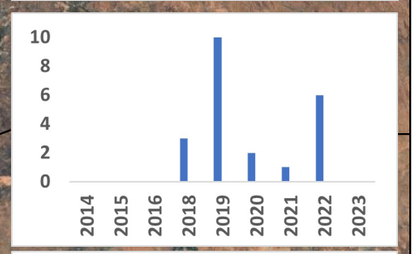
Feral Cat (Number of triggered camera nights)

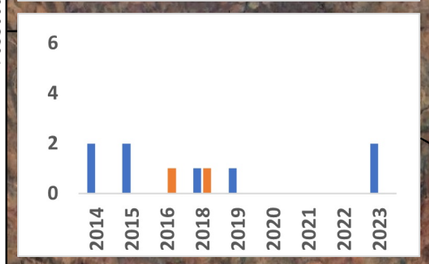


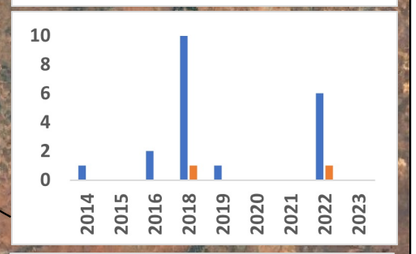


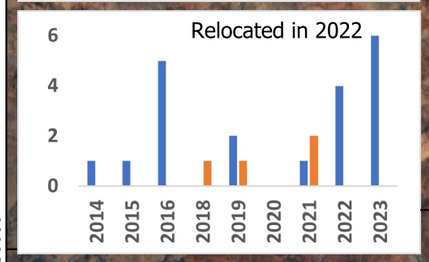


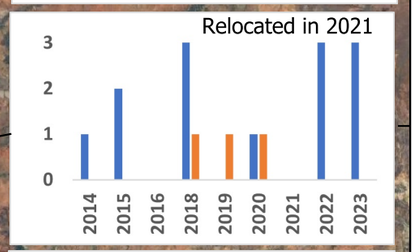


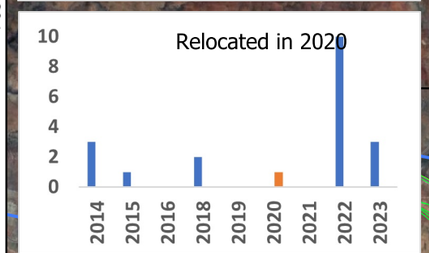


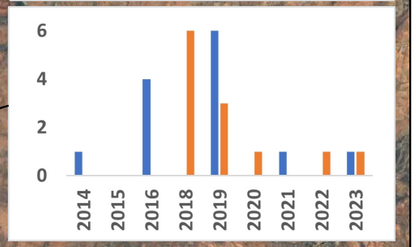


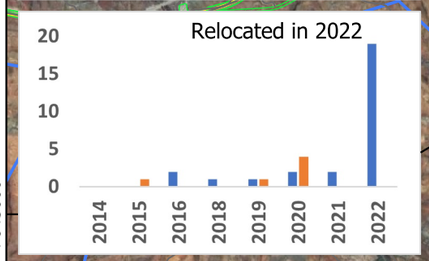


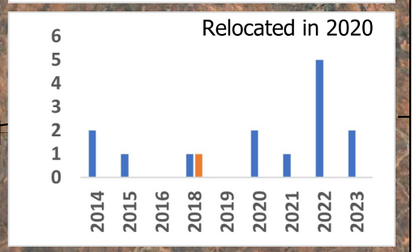


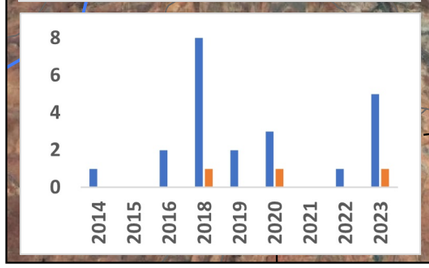


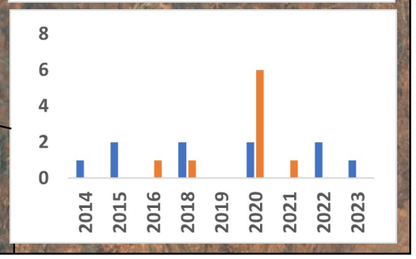












MC C1
MC C3
MC C2
MC C5
MC C6
MC C4
MC I5
MC I1
MC I6
MC I9
MC I7
MC I4
MC I2
MC I8
MC C8
MC I3
MC C7
MC C9

Legend

Northern Quoll Records (Number of years)

0 1 3 4 5 6 7 8 9

Feral Cat Records (Number of years)

0 1 2 3 4 5

North Star boundary

Proposed infrastructure (stage 2)

Existing infrastructure (stage 1)

Existing tracks



N

0 0.5 1 1.5 2 2.5 km

Scale 1:65,000 @ A3

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Units: Meter

Spectrum Ecology & Spatial

Author: AH Approved: DC Date: 10-11-2023

Northern Quoll and Feral Cat presence at LT MC sites

Annual Fauna Monitoring Program 2023

MAP 3.3

Prepared for Fortescue Metals Group

705000

710000

715000

7655000

7650000

7645000

Legend

North Star boundary

North Star Infrastructure (Stage 2)

Home Range

Core Territory (50%)

Home Range (95%)

Northern Quoll SDM

Band 1

1

0



N

0 0.5 1 km

Scale 1:40,000 @ A3

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Units: Meter

Spectrum Ecology & Spatial

Author: MH Approved: AH Date: 10-11-2023

GPS Radiocollar Results (Female)

Annual Fauna Monitoring 2023

MAP 3.4

Prepared for
Fortescue Metals Group

705000

710000

715000

7655000

7650000

7645000

Legend

North Star boundary

North Star Infrastructure (Stage 2)

Home Range

Core Territory (50%)

Home Range (95%)

Female Home Range

50

95

Northern Quoll SDM

Band 1

1

0



N

0 0.5 1 km

Scale 1:40,000 @ A3

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Units: Meter

Spectrum

Author: MH Approved: AH Date: 10-11-2023

GPS Radiocollar Results (Male)

Annual Fauna Monitoring 2023

MAP 3.5

Prepared for
Fortescue Metals Group

3.4. Greater Bilby

3.4.1. Control Sites

There was no evidence of the Greater Bilby recorded from the control occupancy sites during the wet or dry season monitoring. This was the second year of occupancy monitoring at the current control sites (previous sites were monitored until 2016 (Ecoscape (Australia), 2017a)). Results to date have been consistent.

Recent activity including active burrows, tracks, and diggings were recorded from the control abundance site MR GB AS C16 on Hillside station during the wet and dry season monitoring in 2023 (Map 3.6). Several images of at least one Greater Bilby using an active burrow were recorded from this site (Plate 3.1). The Greater Bilby was previously recorded from this site between 2014 and 2017, and in 2021 and 2022. The lack of activity recorded between 2017 and 2021 was attributed to repeated fires occurring in proximity to the site between 2017 and 2020 (NAFI 2023).



Plate 3.1: Greater Bilby recorded on motion camera at MR GB AS C16

3.4.2. Main Line Rail

Evidence of the Greater Bilby was recorded from three potential impact occupancy sites along the Main Line Rail during the wet season monitoring in 2023. Fresh diggings, scat and tracks were recorded from MR GB OS23 (Table 3.6). Evidence such as fresh digging was recorded from six potential impact occupancy monitoring sites during the dry season. Six scats were collected at site MR GB OS23, two of which yielded DNA from one individual Bilby (Table 3.5, Appendix I). No evidence was recorded from site MR GB AS I14 which is consistent with 2022 results. The Greater Bilby has an ongoing presence along the Main Line Rail (Table 3.6).

During a recent baseline survey along the Main Line Rail, a female bilby was recorded from a location near culvert MR CU 02 in May and October 2023. The record indicates that an additional resident population was present on site in 2023 (Spectrum, in prep).

Current data indicates that there is no significant impact to the Greater Bilby populations located along the Main Line Rail.

Table 3.5: Greater Bilby scats and individuals recorded from abundance monitoring sites

Year	MR GB OS23			MR GB AS I14			MR GB AS C16		
	Scats (total)	Scats (fresh)	No. Individuals	Scats (total)	Scats (fresh)	No. Individuals	Scats (total)	Scats (fresh)	No. Individuals
2014	-	-	-	50	19	2	49	16	4
2015	-	-	-	19	6	1	3	0	n/a
2016	-	-	-	40	5	2	1	0	n/a
2017	-	-	-	21	6	1	17	3	1
2018	-	-	-	23	9	2	0	0	0
2019	-	-	-	0	0	0	3	2	1
2020	-	-	-	0	0	0 (1 set of tracks)	0	0	1[MC]
2021	6	2	1	4	0	n/a	3	1	1 (DNA & MC)
2022	6	4	2	0	0	0	1	1	1 (DNA & MC)
2023	6	2	1	0	0	0	0	0	1[MC]

n/a=DNA analysis was not possible due to the lack of DNA yielding scats. [MC] = recorded on Motion Camera

Table 3.6: Greater Bilby records from potential impact occupancy sites

Site	2017		2018		2019		2020	2021		2022		2023	
	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry
MR GB OS1			✓			✓	O	O					
MR GB OS2						O		O					
MR GB OS3			O		O		O	O					✓
MR GB OS4					O	✓		O			O	O	✓
MR GB OS5						✓					O		
MR GB OS6	✓				O	O	✓	O	O				
MR GB OS7						✓		✓	O		O	O	✓
MR GB OS8	✓				✓	✓		✓	O		O		
MR GB OS9	✓		✓				✓	✓	O				
MR GB OS10			O										
MR GB OS12									O		O		
MR GB OS13					O	✓		✓			O		
MR GB OS14											O		
MR GB OS15						✓	✓	✓	✓				
MR GB OS16			O				✓				✓		
MR GB OS20											O		
MR GB OS22	✓							✓			O		✓
MR GB OS23						O		O	✓	✓	✓	✓	✓
MR GB OS24		R											
MR GB OS25													✓
MR GB OS32								✓					
MR GB OS33						O		✓					
MR GB OS39	✓												
Total	5	1	5	0	5	11	6	14	7	1	11	2	6

✓=Recorded; R – Greater Bilby skull found under Whistling Kite nest, O – Old or inconclusive records; Shaded sites – dry season monitoring only

500000
600000
700000
800000
7700000
7600000
7500000

MR_GB_ASC16-MC3
MR GB ASC16-MC4
MR_GB_ASC16-MC2
MR GB ASC16-MC1
MR GB OS 23
MR GB OS 23
MR GB OS 23
MR GB OS04
MR GB OS07
MR GB OS22
MR GB OS25
MR GB ASC16-MC43

Ripon Island
Port Hedland
Wedgefield
South Hedland
Boodarie
De Grey
Strelley
Rosemary Island
Dampier Archipelago
West Lewis Island
West Intercourse Island
Dampier
Maitland
Mundabullangana
Wallareenya
Indee
Coongan River
Marble Bar
Millstream
Millstream Chichester National Park
Fortescue
Chichester
Mungaroona Range Nature Reserve
Nullagine
Mulga Downs
Ex Mt Florence
Wittenoom
Hamersley Range
Mount Sheila
Karijini
Karijini National Park
Tom Price
Juna Downs

Legend
Main Line Rail
Not Applicable

N
0 10 20 30 km
Scale 1:1,100,000 @ A3

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Units: Meter

Spectrum ECOLOGY & SPATIAL

Author: LR Approved: AH Date: 10-11-2023

Locations of Bilby Records

Annual Fauna Monitoring Program 2023

Prepared for Fortescue Metals Group

Map 3.6

3.5. Pilbara Leaf-nosed Bat

A summary of all Pilbara Leaf-nosed Bat records from each location over the monitoring period is listed in Table 3.7. Detailed records for each site are provided in Table 5.10 of Appendix J, and the bat call analysis report for 2023 is provided in Appendix K. The results are discussed in the sections below.

Table 3.7: Pilbara Leaf-nosed Bat call detections at each location

Project	2013	2014	2015	2016	2017	2018	2019/ 2020	2021	2022	2023
Control Sites										
Solomon Hub	1	0	-	0	103 (5)	514 (9)	415 (4)	71 (4)	14 (5)	173 (6)
Main Line Rail	61 (1)	3 (1)	-	5 (3)	72 (7)	116 (6)	1,024 (7)	1 (1)	83 (3)	4 (3)
Eliwana Mine	-	-	-	-	-	-	36 (9)	37 (8)	19 (4)	67 (5)
Eliwana Rail Line*	-	-	-	-	-	-	284 (5)	71 (4)	29 (6)	185 (7)
Total Control#	**62 (2)**	**3 (1)**	**-**	**5 (3)**	**175 (12)**	**630 (15)**	**1,759 (25)**	**180 (17)**	**145 (18)**	**429 (21)**
Potential Impact Sites										
Solomon Hub	1 (1)	0	-	-	678 (1)	12 (2)	0	1 (1)	0	0
Main Line Rail	21 (2)	13 (2)	-	6 (3)	450 (7)	123 (7)	299 (9)	2 (1)	652 (8)	161 (5)
Eliwana Mine	-	-	-	-	-	-	49 (6)	440 (3)	20 (5)	6 (4)
Eliwana Rail Line	-	-	-	-	-	-	7 (4)	8 (1)	72 (3)	5 (2)
Total Potential Impact	**3 (3)**	**13 (2)**	**-**	**6 (3)**	**1,128 (8)**	**135 (9)**	**355 (19)**	**451 (17)**	**744 (16)**	**172 (11)**

Note: Number of sites detected at is given in brackets
The number of calls is not indicative of the number of individuals present on site; *shared sites with Solomon Hub control sites. #total includes a single count of passes and sites due to the use of shared sites between projects.

3.5.1. Control Sites

The Pilbara Leaf-nosed Bat was recorded from control sites associated with Solomon Hub, Main Line Rail, Eliwana Mine and Eliwana Line Rail in 2023 (Table 3.7; Map 3.7). Call numbers at each site between 2019/2020 and 2023 are listed in Table 3.7. Overall, call numbers were stable but are not suitable to indicate a trend (call numbers could indicate multiple individuals or one individual that calls repeatedly).

Call times at three control sites near Solomon Hub and Eliwana (EM Bat C8, SM Bat C3, SM Bat C9) were recorded within 1 hour of sunrise/sunset during a single night with recordings at site EM Bat C4 only shortly thereafter (1hr8min, Appendix K).

3.5.2. Potential Impact Sites

3.5.2.1. Solomon Hub

No Pilbara Leaf-nosed Bat calls were recorded from the Solomon Hub potential impact sites in 2023. This is consistent with previous monitoring events, where calls were recorded from between zero and two sites (Table 3.7). Pilbara Leaf-nosed Bats were recorded during the 2021 monitoring from potential impact site SM Bat I6, and in 2017 and 2018 monitoring from potential impact sites SM Bat I5 and SM Bat I7 which consisted of cave structures. The caves are no longer accessible due to heritage restrictions and the activity level of the species within the caves was not assessed, however monitoring was conducted nearby. No activity pattern indicative of a roost site has been recorded from the Solomon Hub site to date. The timing of all records indicates foraging individuals that are thought to be roosting at a site located 50 km west of Tom Price (south-west of Solomon Hub) (Bat Call WA, 2016).

3.5.2.2. Main Line Rail

The Pilbara Leaf-nosed Bat was recorded from five potential impact sites in 2023 (Table 3.7, Map 3.7). This is a slight decrease of Pilbara Leaf-nosed Bat activity since 2022, however the number of sites the species has been recorded from has been stable overall (two to eight sites). To date, only foraging individuals have been recorded and no roost habitat is present along the Main Line Rail (Ecoscape 2017a).

It is thought that monitoring timing and extreme weather events influenced the high numbers of Pilbara Leaf-nosed Bat calls recorded in 2022 – the monitoring was completed after heavy rainfall events which caused flash flooding and access limitations, including 101.8 mm recorded over a 24-hour period (Indee station – BoM 2023).

3.5.2.3. Eliwana Mine

The Pilbara Leaf-nosed Bat was recorded from six potential impact sites at the Eliwana Mine in 2023; a small increase from the 2022 monitoring (Table 3.7, Map 3.7). Activity patterns and call times from the monitoring data indicate that the potential impact sites were used as foraging habitat. Potential roost sites were recorded during the baseline survey from the area surrounding the Eliwana Mine (south, west and potentially north) with no known roost caves recorded from inside the mine footprint and the data indicating the species uses the mine area for foraging (Ecoscape 2017b). Records made during the monitoring in 2023 indicate the species is continuing to forage inside the mine.

3.5.2.4. Eliwana Line Rail

The Pilbara Leaf-nosed Bat was recorded from two potential impact sites (ER Bat I8 & I9) along the Eliwana Line Rail in 2023 (Table 3.7, Map 3.7, Table 5.10). Activity patterns and call times from the monitoring data indicate that the potential impact sites were used as foraging habitat. This is comparable to the baseline surveys in 2017 during which the Pilbara Leaf-nosed Bat was recorded from four sites within the Eliwana Line Rail (Ecoscape 2017b). Data collected to date indicate that there are roost caves in the vicinity, but outside the rail corridor, most likely 50 km west of Tom Price (Bat Call WA, 2016; Ecoscape 2017b). Pilbara Leaf-nosed Bat activity at the Eliwana Rail Line has been consistent but low.

500000
600000
700000
800000
7700000
7600000
7500000

SM BAT C6
Mount Sheila Summit
FMG BonnieDoon
SM BAT C2
ER Bat I9
SM BAT C4
SM BAT C3
SM BAT C9
ER BAT I8

MR BAT I3
MR BAT C4
MR BAT I4
MR BAT I7
MR BAT I8
GhB Opp 4
MR BAT C10
MR BAT I10
MR BAT C9

MR BAT I3
MR BAT C4
MR BAT I4
MR BAT I7
MR BAT I8
GhB Opp 4
MR BAT C10
MR BAT I10
GhB Opp 5

EM Bat C1
EM Bat C3
EM Bat I1
EM Bat I2
EM Bat I5
EM Bat I9
EM Bat C8
EM Bat C5
EM Bat C6

SM BAT C6
SM BAT C9
SM ER Bat I9
ER BAT I8
SM BAT C1

Port Hedland
Wedgefield
South Hedland
Boodarie
Mundabullangana
Wallareenya
Indee
Marble Bar
Hamersley Range
Mount Sheila
Mungaroona Range Nature Reserve
Mulga Downs
Ex Mt Florence
Wittenoom
Karijini
Karijini National Park
Tom Price
Juna Downs
Nullagine

Legend

Pilbara Leaf-nosed Bat Records

- Eliwana Mine (Control)
- Eliwana Mine (Impact)
- Main Line Rail (Control)
- Main Line Rail (Impact)
- Solomon (Control)

Ghost Bat Records

- Ghost Bat Opportunistic
- Eliwana
- Maine Line & Hamersley Rail
- Eliwana Line Rail
- Solomon Hub
- Not Applicable



N

0 10 20 30 km

Scale 1:1,100,000.001122 @ A3

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Units: Meter

Spectrum Ecology & Spatial

Author: LR Approved: AH Date: 18-01-2024

Locations of Pilbara Leaf-nosed Bat & Ghost Bat records

Annual Fauna Monitoring Program 2023

Prepared for Fortescue Metals Group

Map 3.7

3.6. Ghost Bat

A summary of all Ghost Bat records from each site is listed in Table 3.8. Detailed records for each monitoring site are provided in Table 5.11 of Appendix J, and the bat call analysis report for 2023 is provided in Appendix K. Ghost Bats can be difficult to detect in foraging habitat using acoustic recorders as the species relies on visual senses rather than echolocation to hunt (Tidemann *et al.*, 1985; Spectrum 2019). Social calls are typically only recorded when leaving roost caves (K. Armstrong, pers. Comms. 2017; (Ecoscape 2018a) making the detection of the species difficult when recorders are installed away from cave entrances (e.g., when roosting habitat is not present on site). For this reason, a lack of records does not necessarily indicate the absence of the species and call records should not be used to determine abundance of the species.

Table 3.8: Ghost Bat call detections at each site

Project	2013	2014	2015	2016	2017	2018	2019/2020	2021	2022	2023
Control Sites										
Solomon Hub	0	0	n/a	0	0	0	0	0	0	0
Main Line Rail	0	0	n/a	0	0	0	0	0	0	0
Eliwana Mine	-	-	-	-	-	-	0	0	0	0
Eliwana Line Rail	-	-	-	-	-	-	0	0	0	0
Total Control	**0**	**0**	**-**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Potential Impact Sites										
Solomon Hub	0	0	n/a	0	11 (1)	10 (1)	0	0	0	0
Main Line Rail	0	0	n/a	0	1	0	0	0	0	0#
Eliwana Mine	-	-	-	-	-	-	0	0	0	0#
Eliwana Line Rail	-	-	-	-	-	-	0	0	1 (1)	0
Total Impact	**0**	**0**	**-**	**0**	**11 (1)**	**10**	**0**	**0**	**1 (1)**	**2 (2)**

Note: Number of sites detected is given in brackets; n/a = site was not part of the monitoring program; * number of calls does not necessarily indicate a number of individuals recorded; # species was recorded opportunistically from a cave at Eliwana Mine (Spectrum 2023) or culverts along the Main Rail Line

3.6.1. Control Sites

The Ghost Bat was not recorded from the control sites associated with Solomon Hub, Main Line Rail, Eliwana Mine or Eliwana Line Rail in 2023. Changes in call numbers at each site and number of sites recorded as well as changes in the number of sites from which the species has been recorded in 2023 are listed in Table 5.11. The species has not been detected at any of the current control sites during the fauna monitoring.

3.6.2. Potential Impact Sites

3.6.2.1. Solomon Hub

The Ghost Bat was not recorded from the Solomon Hub during the 2023 monitoring. The species was previously recorded from two potential impact sites (SM Bat I5 and SM Bat I7, both caves) at the Solomon Hub during the 2017 and 2018 monitoring (Table 3.8). The data collected to date suggests that the two caves may have been used as a temporary roost cave at the time (call times at sunrise and sunset). The sites are no longer accessible due to heritage restrictions and mining infrastructure and the activity level of the species within the caves was not assessed, however monitoring was conducted nearby.

3.6.2.2. Main Line Rail

The Ghost Bat was recorded from two opportunistic sites (culverts) in the form of prey remains at the Main Line Rail during the 2023 monitoring. Evidence of the Ghost Bat was previously recorded from locations along the Main Line Rail during the dry season monitoring in 2017, 2018 and 2019 when scats and the remains of prey species (bird wings and rodent carcass) were recorded from three culverts (Map 3.7, Table 3.9). In 2017, a potential call was recorded from one potential impact site, no calls have been recorded since then (Table 3.8). The rail corridor does not contain any potential roost habitat and the area is only used for foraging and possibly temporary nocturnal roosts (culverts).

Table 3.9: Ghost Bats secondary evidence recorded during dry season monitoring

Site	2017	2018	2019	2020	2021	2022	2023	Co-ordinates	
	Dry Season	Dry Season	Dry Season	Dry Season	Dry Season	Dry Season	Dry Season	Easting	Northing
MR Cu 01	◆	◆	◆	-	-	-	-	692867	7634878
MR Cu 07	◆	◆	◆	-	-	-	-	695248	7626242
MR Cu 08	◆	◆	◆	-	-	-	-	696138	7622709
GhB Opp1	◆	-	-	-	-	-	-	694457	7628788
GhB Opp2	◆	-	-	-	-	-	-	695414	7625578
GhB Opp3	◆	-	-	-	-	-	-	696766	7606698
GhB Opp4	-	-	-	-	-	-	◆	697572	7617910
GhB Opp5	-	-	-	-	-	-	◆	727224	7557027

◆ Scats and prey remains recorded

3.6.2.3. Eliwana Mine

The Ghost Bat was not recorded from the Eliwana Mine during the 2023 monitoring (Table 3.8). This is consistent with previous monitoring. However, possible sightings were reported to Fortescue from a cave near the OPF in August 2023. Two bat recorders were installed at the cave entry (482975 mE, 7515050 mN; zone 50K) which detected 45 Ghost Bat calls over seven nights (15-22 August 2023). Call times were between 6pm and 6am, indicating that the cave was either used for roosting or is located in close proximity to a roost cave and is visited regularly. During the baseline survey in 2012 and 2017, the species was recorded from the vicinity of the Eliwana Mine through single calls (likely foraging individuals) and suitable foraging habitat was mapped as present (Ecoscape 2017b). Records made to date indicate that the Eliwana Mine site may be used for foraging, and occasional temporary roosting. No confirmed maternity caves have been recorded to date.

3.6.2.4. Eliwana Line Rail

The Ghost Bat was not recorded from the potential impact sites at the Eliwana Line Rail during the 2023 monitoring. In 2022, a Ghost Bat was recorded from one potential impact site (ER Bat I8) through a single call (Table 3.8, Map 3.7). The 2022 recorded was the first record of the species from a potential impact site during the monitoring since 2019/20. The species was recorded from the vicinity of the Eliwana Line Rail through single calls (likely foraging individuals) during the baseline survey in 2012 and 2017 (Ecoscape 2017b). Potential habitat for the species is very limited within the Eliwana Line Rail and limited to foraging habitat only (Ecoscape 2017b).

3.7. Pilbara Olive Python

A summary of all Pilbara Olive Python records made from each site is listed in Table 3.10. Details of the records are provided in Table 5.12 of Appendix L. Locations of the records are displayed on Map 3.8.

Table 3.10: Pilbara Olive Pythons records from across all sites

Project	2013	2014	2015#	2016	2017	2018	2019/2020	2021	2022	2023
Control sites										
Christmas Creek	0	0	0	0	0	0	1	0	0	1
Solomon Hub	2	0	0	0	1	1	eDNA	0	2	0
Eliwana Mine	-	-	-	-	-	-	0	0	0	0
Eliwana Line Rail	-	-	-	-	-	-	0	0	0	0
Total Control	**2**	**0**	**0**	**0**	**1**	**1**	**1**	**0**	**2**	**1**
Potential Impact sites										
Christmas Creek	0	0	0	0	0	0	0	1*	1*	0
Solomon Hub	1	3	1	2	1	0	1 + eDNA	0	0	0
Eliwana Mine	-	-	-	-	-	-	4	3	0	1
Eliwana Line Rail	-	-	-	-	-	-	0	0	0	0
Total Impact	**1**	**3**	**1**	**2**	**1**	**0**	**5**	**4**	**1**	**1**

Note: Records include site data and opportunistic records (road transects), orange cells = eDNA samples taken; * recorded by site personnel during the monitoring dates

3.7.1. Control Sites

One Pilbara Olive Python was recorded from the control sites associated with Christmas Creek in 2023. This is comparable with previous years' monitoring (zero to one individuals, Table 3.10).

No Pilbara Olive Pythons were recorded from the control sites associated with Solomon Hub, Eliwana Mine and Eliwana Line Rail in 2023. This is comparable with previous monitoring results where numbers of Pilbara Olive Pythons recorded from control sites have been very low, between zero and two individuals (Table 3.10).

Pilbara Olive Python eDNA was not detected in any of the water samples collected from the control sites in 2023 (Appendix M, Map 2.4, Map 3.7). The species was previously recorded from site SM POP C3 in 2019/2020 via eDNA analysis of water samples.

3.7.2. Potential Impact Sites

3.7.2.1. Christmas Creek

Pilbara Olive Pythons were not recorded from the Christmas Creek potential impact sites in 2023. One Pilbara Olive Python was recorded by site personnel after being found on site during the dry season in 2022. The lack of records during the monitoring is consistent with the previous eight years of monitoring (Table 3.10). Records of this species at Christmas Creek have mostly been limited to sightings made by site personnel. Six confirmed records were made between 2013 and 2022, one probable record exists from 2014 and one unconfirmed sighting was recorded in 2011 (Appendix E). Critical habitat for the species is not present at Christmas Creek and the sporadic records made to date indicate that the Pilbara Olive Python is not a permanent resident on site. Individuals recorded to date are thought to be moving through the site from suitable habitats found north of the mine area.

3.7.2.2. Solomon Hub

No Pilbara Olive Pythons were recorded from the Solomon Hub potential impact sites in 2023. This is comparable with previous years monitoring during which between zero and three individuals were recorded from the potential impact sites. The species was not detected in the eDNA samples collected in 2023 (Appendix M). Pilbara Olive Python DNA have previously been detected in water samples collected from one site (SM POP I1) during the 2020 monitoring.

There were three confirmed and two unconfirmed records of Pilbara Olive Pythons made by site personnel at the Solomon Hub between February and August 2023, confirming the species' continued presence at the site (Appendix E).

3.7.2.3. Eliwana Mine

One Pilbara Olive Python individual was recorded from one potential impact site (EM POP I4) at the Eliwana Mine during the 2023 monitoring (Table 3.10). Records peaked in 2019/2020 and 2021 with four and three individuals, respectively. The 2023 results are comparable to the results from the 2022 monitoring and the control sites.

Suitable habitat is present within the mine and has been mapped in the southern and western areas of the mine (Ecoscape 2017b) and the species is considered to be a resident based on ongoing records, including juveniles in 2020.

There was probable confirmed record of the Pilbara Olive Python made by site-based personnel at Eliwana Mine in January 2023, confirming the species' continued presence at the site (Appendix E).

3.7.2.4. Eliwana Line Rail

No Pilbara Olive Pythons were recorded from the Eliwana Line Rail during the 2023 monitoring. This is consistent with the baseline survey and previous monitoring during which no records of the species were made. This result is also consistent with the control sites where no Pilbara Olive Pythons were recorded. Critical habitat for the species is limited to the eastern section of the Eliwana Line Rail, near Solomon Hub (Ecoscape 2017b) although the absence of records made to date indicates that the Pilbara Olive Python is not likely a resident on site.

500000
600000
700000
800000
7700000
7600000
7500000

CC POP C3
EM POP I4

Ripon Island
Port Hedland
Wedgefield
South Hedland
Boodarie
De Grey
Strelley
Legendre Island
Gidley Island
Dolphin Island
Rosemary Island
Dampier Archipelago
West Lewis Island
Burrup
Dampier
West Intercourse Island
Cleaverville
Antonymyre
Point Samson
Wickham
Depuch Island
Kerratha
Mount Anketell
Karratha Industrial Estate
Roebourne
Bella Bella
Mundabullangana
Wallareenya
Maitland
Whim Creek
Sherlock
Cooya Pooya
Indee
Coongan River
Marble Bar
Millstream
Millstream Chichester National Park
Fortescue
Mungaroona Range Nature Reserve
Chichester
Nullagine
Mulga Downs
Ex Mt Florence
Wittenoom
Hamersley Range
Mount Sheila
Karijini
Karijini National Park
Tom Price
Juna Downs

Legend

Pilbara Olive Python Record

- Christmas Creek
- Eliwana Mine
- North Star

- Eliwana Mine
- Solomon_EPA_PartV_Licence
- Christmas Creek Boundary
- Not Applicable



N

0 10 20 30 km

Scale 1:1,100,000 @ A3

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Units: Meter

Spectrum ECOLOGY & SPATIAL

Author: LR Approved: AH Date: 10-11-2023

Locations of Pilbara Olive Python Records

Annual Fauna Monitoring Program 2023

Prepared for
Fortescue Metals Group

Map
3.8

3.8. Conservation Significant Birds

Records of conservation significant birds including opportunistic sightings from all sites over the annual monitoring periods are summarised in Table 3.11. Conservation significant bird species targeted in this monitoring program include the following species that have previously been recorded and/or occur within the region:

- Common Greenshank (*Tringa nebularia*);
- Wood Sandpiper (*Tringa glareola);*
- Oriental Plover (*Charadrius veredus);*
- Common Sandpiper (*Actitis hypoleucos*);
- Pacific Swift (*Apus pacificus*);
- Peregrine Falcon (*Falco peregrinus*); and
- Grey Falcon (*Falco hypoleucos*)

Monitoring for conservation significant birds at the Eliwana Mine and Eliwana Rail Line includes the aerial insectivores (Pacific Swift) and falcons (Peregrine Falcon). Other species of conservation significant birds that are recorded opportunistically or during monitoring events are included in Table 3.11.

Table 3.11: Conservation significant birds records

Project	Species	Records								
		Baseline*	2015	2016	2017	2018	2019/2020	2021	2022	2023
Marsh Control Sites										
Chichester Hub Control	Grey Falcon	-	1 (CC/CB MiB C3)	-	-	-	-	-	-	-
	Wood Sandpiper	✓	-	1 (CC/CB MiB C3)	-	-	-	-	-	-
	Common Greenshank	✓	3 (CC/CB MiB C1)	7 (CC/CB MiB C1)	-	1 (CC/CB MiB C1)	-	-	-	-
	Marsh Sandpiper	-	-	1 (CC/CB MiB C1)	-	-	-	-	-	-
	Oriental Plover	-	-	-	520 (CC/CB MiB C1)	-	-	-	-	-
	Gull-billed Tern	-	-	-	4 (CC/CB MiB C1) 1 (CC/CB MiB C3)	-	-	-	-	-
	Glossy Ibis	-	-	1 (CC/CB MiB C3)	1 (CC/CB MiB C2)	-	-	-	-	-
	Common Sandpiper	-	-	1 (CC/CB MiB C3)	-	1 (CC/CB MiB C3)	-	-	-	-
	Red-necked Stint	-	-	-	1 (CC/CB MiB C3)	-	-	-	-	-
	Peregrine Falcon	-	-	-	-	-	-	-	2 (CC/CB MiB C3)	-
Control Sites										
Chichester Hub Control	-	-	n/a	n/a	n/a	-	-	-	-	-
	Oriental Plover	-	-	-	1 SM C OPP	-	-	-	-	-

Project	Species	Records								
		Baseline*	2015	2016	2017	2018	2019/2020	2021	2022	2023
Solomon Hub Control	Peregrine Falcon	-	-	-	1 SM C OPP	-	-	-	-	-
Hamersley Rail Control	-	-	-	-	-	-	-	-	-	-
Main Line Rail Control	Grey Falcon	-	-	-	-	1 (MR MiB C1)	-	-	-	-
Eliwana Mine Control	-	-	n/a	n/a	n/a	n/a	-	-	-	-
Eliwana Line Rail Control	-	-	n/a	n/a	n/a	n/a	-	-	-	-
Potential Impact Sites										
Cloudbreak	Grey Falcon	✓	-	-	-	-	-	-	-	-
	Peregrine Falcon	✓	-	-	-	-	-	-	-	-
Christmas Creek	Wood Sandpiper	✓	-	-	-	-	-	-	-	-
	Common Greenshank	✓	-	-	-	-	-	-	-	-
	Peregrine Falcon	✓	-	-	-	-	-	-	-	-
	Grey Falcon	-	-	-	-	-	-	1 (CC OPP)	-	-
Solomon	Pacific Swift	✓	-	-	-	-	-	-	-	-
Hamersley Line Rail	Grey Falcon	-	-	-	-	1 (HL OPP)	1 (HL OPP)	-	-	-
Main Line Rail	Peregrine Falcon	✓	-	-	-	-	1 (MR OPP)	-	-	-
	Grey Falcon	✓	-	-	1 (MR MiB I2) 1 (MR OPP)	1 (MR OPP)**	-	-	-	1 (MR OPP)***

Project	Species	Records								
		Baseline*	2015	2016	2017	2018	2019/2020	2021	2022	2023
	Common Sandpiper	-	1 (MR MiB I2)	-	-	-	-	-	-	-
	Wood Sandpiper	-	1 (MR OPP)	-	-	-	1 (MR MiB I2)	-	-	-
	Oriental Plover	-	-	-	-	-	-	-	150 (MR OPP)	-
Eliwana Mine	Pacific Swift	✓	n/a	n/a	n/a	n/a	-	-	-	-
	Peregrine Falcon	✓					-	-	-	-
Eliwana Line Rail	Pacific Swift	✓	n/a	n/a	n/a	n/a	-	-	-	-
	Peregrine Falcon	✓					-	-	-	-
North Star	Grey Falcon	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	2 (Opp x 3 sites)

Note: number of records are listed for each year, site names of the records are presented in brackets; *Based on information provided in CSFMP (100-PL-EN-0022); **Carcass recorded; ***Record was made during a baseline survey for Fortescue in May 2023; n/a: Monitoring did not occur;

3.8.1. Control Sites

No conservation significant birds were recorded from the control sites associated with Solomon Hub, Main Line Rail, Hamersley Line Rail, Eliwana Mine and Eliwana Line Rail in 2022 (Table 3.11). In 2022, a pair of Peregrine Falcons were observed at one of the marsh control sites (CC/CB MiB C3). The level of conservation significant bird activity in 2023 was comparable to the previous monitoring across the control sites (Table 3.11).

3.8.2. Potential Impact Sites

3.8.2.1. Cloudbreak

There were no conservation significant birds recorded from potential impact sites at the Cloudbreak mine in 2023. This result is consistent with previous years' monitoring. This is primarily attributed to the absence of suitable habitat. Waterbirds are attracted to the Fortescue Marsh and may not utilise the potential impact sites at the Cloudbreak mine on a regular basis. The lack of records made from the potential impact sites is also consistent with the data from the Chichester Hub control sites CB/CC MiB C4-6 and all other control sites that are located in comparable habitats to the potential impact sites at Cloudbreak (Table 3.11).

The Grey Falcon, Peregrine Falcon and Common Sandpiper have previously been recorded from Cloudbreak (Bamford 2005a; Ecoscape 2018a). The occurrence of these species is sporadic, and typically limited to foraging habitat.

3.8.2.2. Christmas Creek

There were no conservation significant birds recorded from the Christmas Creek potential impact sites in 2023.

Conservation significant birds have rarely been recorded from the potential impact sites during previous monitoring events or baseline surveys (Table 3.11; ENV 2012). The data is mostly insufficient to determine a trend of the populations on site. In 2023, fewer birds of conservation significance were recorded in comparison to 2016, 2017 and 2018, most likely due to the scarcity of records and infrequent presence on site. Counts have been consistently low since the beginning of the monitoring in 2015. The habitats at the Christmas Creek mine site are not suitable for waterbirds and conservation significant falcon species are rarely recorded in the Pilbara region. This was the first year of monitoring at grassland and aerial bird sites.

The lack of records made from the potential impact sites is also consistent with the data from the Chichester Hub control sites CB/CC MiB C4-6 and all other control sites that are located in comparable habitats to the potential impact sites at Christmas Creek (Table 3.11).

3.8.2.3. Solomon Hub

Conservation significant birds were not recorded from the potential impact sites at the Solomon Hub in 2023, which was also reflected in the control site data and is consistent with previous years' monitoring. Previously, two conservation significant bird species – the Peregrine Falcon and the Pacific Swift – have been recorded opportunistically at the Solomon Hub control area (Table 3.11). Water pools and riparian vegetation are found along Kangeenarina Creek, however the migratory bird species known from the surrounding area (Common Sandpiper, Marsh Sandpiper, Common Greenshank, Oriental Plover) typically prefer open shallow water with muddy banks and minimal vegetation cover such as clay pans, billabongs, lakes and dams (DoEE 2018a, 2018b). This habitat type has not been recorded from the Solomon Hub and waterbirds (including migratory birds) are therefore unlikely to occur.

3.8.2.4. Hamersley Line Rail

No conservation significant birds were recorded from the potential impact sites along the Hamersley Line Rail in 2023. This is consistent with the results from previous monitoring events and from the control sites (Table 3.11). To date, only the Grey Falcon has been recorded from the Hamersley Line Rail, which was also recorded by site personnel in 2021 (Appendix E). Potential breeding habitat is present for the species in the form of repeater towers. Water pools and riparian vegetation were present at two of the potential impact sites in 2023; however, the vegetation cover is likely too dense for the migratory bird species known from the surrounding area.

3.8.2.5. Main Line Rail

No conservation significant birds were recorded from the Mail Line Rail potential impact sites in 2023, however a pair of Grey Falcons were observed opportunistically from two locations along the rail during a recent baseline survey in May 2023 (locations: 697862mE 7611973mN and 688312mE 7645742mN; zone50, Spectrum, in prep., Map 3.9). This result is comparable to previous monitoring along the Main Line Rail. Records to date have been sporadic and numbers of individuals low (Table 3.11). The Peregrine Falcon and the Grey Falcon were the only conservation significant birds recorded during the baseline survey (ATA Environmental, 2007). Both species are typically recorded infrequently due to the large distances they can travel when hunting and dispersing (Olson and Olson, 1986; Schoenjahn, 2011). Potential breeding habitat is only present for the Grey Falcon in the form of artificial structures such as repeater towers. Migratory birds recorded during subsequent monitoring events migrate to the Pilbara from November to March when conditions are suitable and surface water is present (Ecologia 2014a; Ecoscape 2017c, 2017d). This was the first year of monitoring at grassland and aerial bird sites.

3.8.2.6. Eliwana Mine

No conservation significant birds were recorded from the Eliwana Mine potential impact sites in 2023. Monitoring at the Eliwana Mine is focused on aerial insectivores (Pacific Swift) and falcons (Peregrine Falcon) which were recorded during the baseline surveys in 2012 and 2017 (Ecoscape 2017b). Both species are only likely to occur infrequently – Pacific Swifts when conditions are ideal, and Peregrine Falcons when overflying for foraging purposes. The lack of conservation significant birds recorded at the potential impact sites is consistent with the control sites, and previous monitoring (Table 3.11).

3.8.2.7. Eliwana Line Rail

No conservation significant birds were recorded from the Eliwana Line Rail potential impact sites during the wet season monitoring in 2023. Monitoring at the Eliwana Line Rail is focused on aerial insectivores (Pacific Swift) and falcons (Peregrine Falcon) which were recorded during the baseline survey in 2017 (Ecoscape 2017b). Both species are only likely to occur infrequently, and sightings are sporadic. The lack of conservation significant birds at the potential impact sites is consistent with the control sites, and previous monitoring.

3.8.2.8. North Star

No conservation significant birds were recorded from the Mail Line Rail potential impact sites in 2023, however a pair of Grey Falcons were observed opportunistically from three Northern Quoll monitoring sites (NS NQ I1-I3, Map 3.9). The species was recorded during the baseline survey in 2012 (Ecologia 2012). Potential breeding and foraging habitat exist on site in the form of infrastructure (repeater towers), large trees and minor drainage lines.

500000
600000
700000
800000
7700000
7600000
7500000

NS NQ I1
NS NQ I3
NS NQ I2
MR OPP1
Iron Bridge
Japal Village RMG Camp
Ripon Island
Port Hedland
Wedgefield
South Hedland
Boodarie
De Grey
Strelley
Mundabullangana
Wallareenya
Indee
Coongan River
Marble Bar
Maitland
Rosemary Island
Dampier Archipelago
West Lewis Island
Burrup
Dampier
West Intercourse Island
Karijini National Park
Fortescue
Mungaroona Range Nature Reserve
Chichester
Nullagine
Mulga Downs
Ex Mt Florence
Wittenoom
Hamersley Range
Mount Sheila
Karijini
Tom Price
Jung Downs

Legend

- Grey Falcon Records
- Christmas Creek
- Cloudbreak
- Eliwana Rail
- Eliwana Mine
- Solomon Hub
- Main Line Rail and Hamersley Line Rail
- North Star
- Not Applicable



N

0 10 20 30 km

Scale 1:1,100,000 @ A3

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Units: Meter

Spectrum ECOLOGY & SPATIAL

Author: LR Approved: AH Date: 10-11-2023

Locations of Significant Bird Records

Annual Fauna Monitoring Program 2023

Prepared for
Fortescue Metals Group

Map
3.9

3.9. Night Parrot

Potential calls were recorded during three call events on 21 February, 10 March and 26 March 2023, with call structure indicating three different individuals passing through.

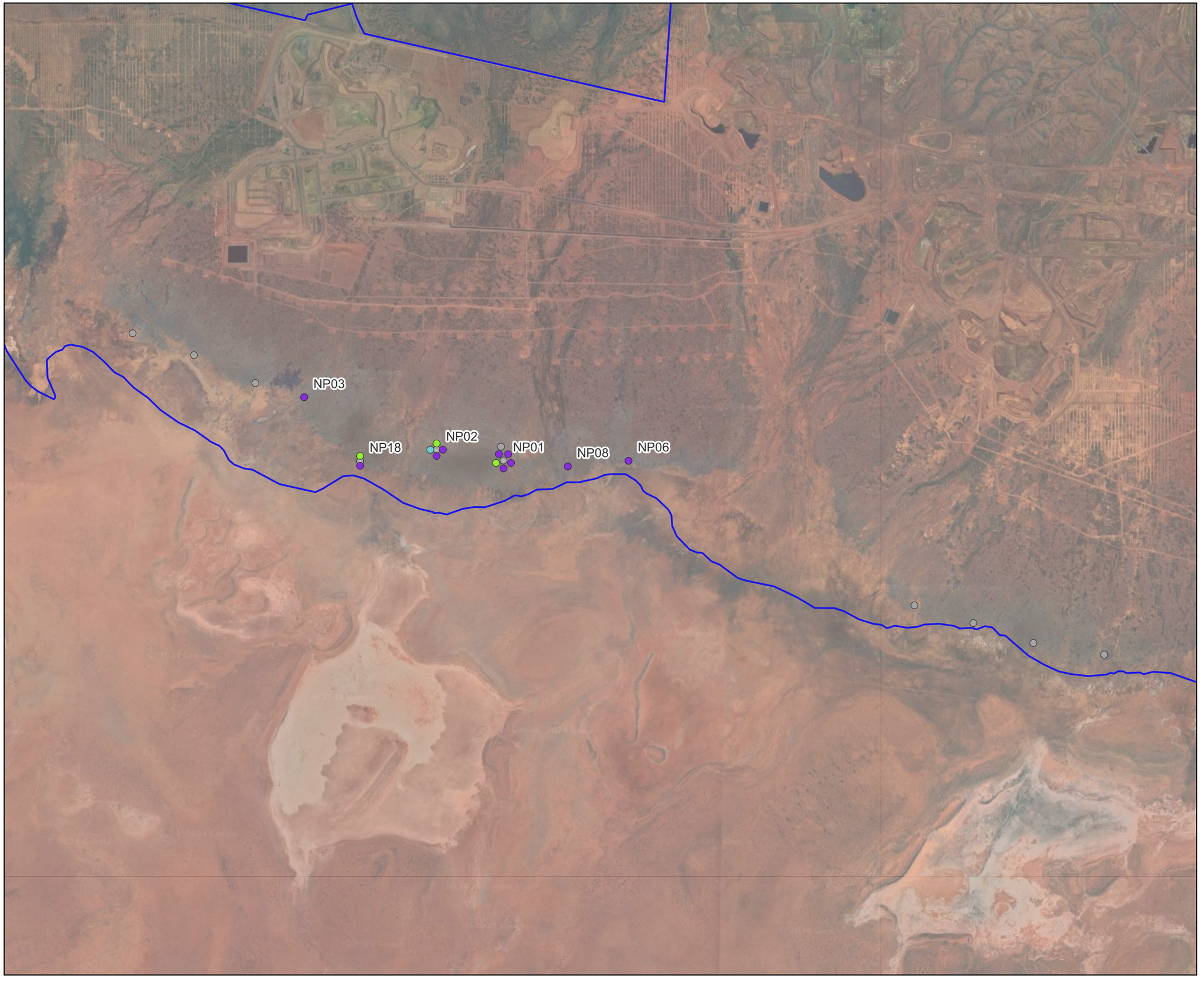
Calls recorded on 21 February 2023 indicated that one individual passed sites NP01, NP02, NP03, NP06, NP08 and NP18 over a 3 hr period (between 0043h and 0350h). In March, sites NP01, NP02 and NP18 were visited.

The six sites located in the middle of the monitoring sites (NP01, NP02, NP03, NP06, NP08 and NP18) were visited over the three call events in February and March 2023, indicating that conditions in this area may be favourable for temporary roosting (Map 3.10). The sites were located in moderate spinifex grassland in proximity to Samphire low shrubland which is described as suitable habitat (Department of the Environment, 2016a; Murphy *et al.*, 2017). Call details are listed in Table 3.12 with sites listed in geographical order (from east to west) and locations are displayed on Map 3.10. No permanent roost or breeding location was recorded (Appendix N).

Table 3.12: Night Parrot call details

Date of Recording	Site (unit)												
	NP 03-S03 (NP21)	NP07-S07 (NP05)	NP04-S11 (NP20)	NP20-S15 (NP03)	NP 09-S19 (NP18)	NP13-S23 (NP02)	NP08-S27 (NP01)	NP02-S31 (NP08)	NP12-S35 (NP06)	NP15-S44 (NP07)	NP18-S48 (NP04)	NP05-S52 (NP15)	NP06-S56 (NP13)
21 Feb 2023									0043h				
								0128h					
							0130h						
						0132h							
					0135h								
				0145h									
						0231h-0348h							
22 Feb 2023							1920h-1922h						
10 Mar 2023					0016h-0023h								
26 Mar 2023						0017h							

Note: order of columns indicates geographical location (east to west)



Legend

Event

- 1
- 2
- 3
- Night Parrot Monitoring Sites
- Cloudbreak



N

0 1 2 km

Scale 1:50,000 @ A3

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Units: Meter

Spectrum ECOLOGY & SPATIAL

Author: MH Approved: AH Date: 29-01-2024

Location of Night Parrot records

Annual Fauna Monitoring Program 2023

Prepared for
Fortescue Metals Group

Map 3.10

3.10. Rehabilitation Areas

Details and results of the fauna monitoring at rehabilitation sites are summarised in the below sections and detailed in Table 5.14 (including species recorded at each site to date). Number of introduced species recorded per camera trap night was compared to potential impact sites (where installed for other species) and rehabilitation control sites in 2023 (Figure 3.4).

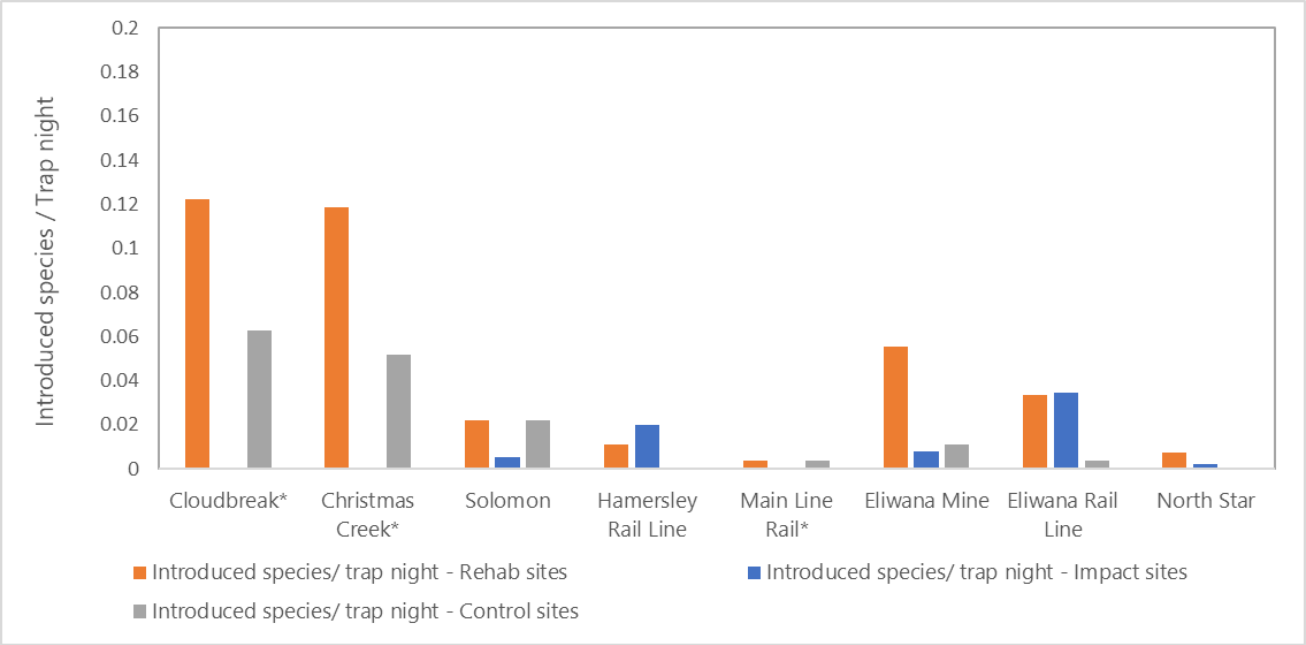
- Cloudbreak:
    - No conservation significant fauna species were recorded from the Cloudbreak rehabilitation sites in 2023;
    - No conservation significant fauna species have been recorded to date from the three rehabilitation sites located at the Cloudbreak mine site;
    - A very high level of activity by introduced species was recorded at the rehabilitation sites, largely driven by a large number of records of European Cattle and Rabbit. Both species were also recorded in large numbers in 2022. Activity levels were higher than those at the rehabilitation control sites. No potential impact sites were monitored in 2023 and therefore comparisons cannot be made.
- Christmas Creek:
    - No conservation significant fauna species were recorded from the Christmas Creek rehabilitation sites in 2023;
    - No conservation significant fauna species have been recorded to date from the three rehabilitation sites located at the Christmas Creek mine site.
    - A very high level of activity by introduced species was recorded at the rehabilitation sites, largely driven by a large number of records of European Cattle and Rabbit. Both species were also recorded in large numbers in 2022. Activity levels were higher than those at the rehabilitation control sites. No potential impact sites were monitored in 2023 and therefore comparison cannot be made.
- Solomon Hub:
    - No conservation significant fauna species were recorded from the Solomon Hub rehabilitation sites in 2023;
    - A Northern Quoll was recorded from rehabilitation site SM RE 06 in 2018 and 2019 when high population densities were recorded from monitoring sites;
    - Activity levels of introduced species at the rehabilitation sites were higher than those at potential impact sites and comparable to rehabilitation control sites in 2023 (Figure 3.4).
- Hamersley Line Rail:
    - No conservation significant fauna species were recorded from the Hamersley Line Rail rehabilitation sites in 2023;
    - No conservation significant fauna species have been recorded to date from the three rehabilitation sites located at the Hamersley Line Rail. Northern Quolls were recorded in 2013 and 2014 from previous rehabilitation sites with suitable habitat (large granite boulder piles);
    - Activity levels of introduced species at the rehabilitation sites were lower than at the potential impact sites and higher than at the rehabilitation control sites in 2023 (Figure 3.4).

- Main Line Rail:
    - No conservation significant fauna species were recorded in 2023 from the three rehabilitation sites located at the Main Line Rail;
    - In 2022, a Spectacled Hare-Wallaby (DBCA Priority 4) was recorded at Main Line Rail rehabilitation site MR RE 01;
    - A Red Fox was recorded from rehabilitation control site MR RE C37 in 2023 (Plate 3.2);
    - Activity levels of introduced species at the rehabilitation sites was comparable to rehabilitation control sites in 2023 (Figure 3.4). No potential impact sites were monitored in 2023 and therefore comparisons cannot be made.
- Eliwana Mine:
    - No conservation significant fauna species were recorded from the Eliwana Mine rehabilitation sites in 2023. Habitat is sub-optimal for Northern Quolls (lack of rocky boulders);
    - Feral Cats and European Cattle are the only introduced species recorded from the sites;
    - Activity levels of introduced species at the rehabilitation sites were higher than those at potential impact sites and rehabilitation control sites in 2023 (Figure 3.4). This is likely due to the recent age of the rehabilitation sites, and the fact that feral predators are attracted to open and disturbed areas.
- Eliwana Line Rail:
    - No conservation significant fauna species were recorded from the Eliwana Line Rail rehabilitation sites in 2023. Habitat is sub-optimal for Northern Quolls (lack of rocky boulders);
    - Activity levels of introduced species at the rehabilitation sites were comparable (slightly lower) to those at potential impact sites and higher than those at rehabilitation control sites in 2023 (Figure 3.4). This is likely due to the recent age of the rehabilitation sites, and the fact that feral predators are attracted to open and disturbed areas.
- North Star:
    - The Northern Quoll was recorded from one of the three rehabilitation sites (NS RE 02) located at the North Star mine site;
    - Habitat is optimal at one site (NS RE 02) for Northern Quolls (some rocky boulders);
    - Activity levels of introduced species recorded at the rehabilitation sites was greater than at the impact and control sites in 2023 (Figure 3.4).



Plate 3.2: Red Fox recorded from site MR RE C37

Details of each rehabilitation site are listed in Appendix O.



*no potential impact sites were installed in 2023 and comparison of activity level is not possible.

Figure 3.4: Introduced fauna recorded per trap night in 2023 in comparison to Northern Quoll sites

3.11. Culvert Sites

Records of conservation significant fauna and feral predators recorded from the culvert sites at Hamersley Line Rail, Main Line Rail and Eliwana Line Rail to date are presented in Table 3.13. Overall, the number of conservation significant species and feral predators recorded from the Main Line Rail (three and three) is higher than those recorded from the Hamersley Line Rail (one and two) and Eliwana Line Rail (zero and two). This is due to the number of culvert sites monitored (ten vs five vs three), the length of the rail and the range of habitats the infrastructure is located in.

Table 3.13: Conservation significant fauna and feral predators recorded from culvert sites

Project	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Hamersley Line Rail												
Northern Quoll	n/a	✓	✓	✓								
Feral Cat	n/a	✓	✓				✓	✓	✓	✓	✓	✓
Dingo/Dog	n/a	✓	✓								✓	✓
Main Line Rail												
Northern Quoll			✓				✓	✓	✓	✓		✓
Greater Bilby										✓		
Ghost Bat			✓			✓	✓					✓
Feral Cat	✓	✓	n/a	✓	✓	✓	✓	✓	✓	✓	✓	✓
Dingo/Dog	✓	✓	n/a	✓	✓	✓	✓	✓	✓	✓	✓	✓
Red Fox	n/a	n/a	n/a	n/a	n/a	n/a		✓				✓
Eliwana Line Rail												
Dingo/dog	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	✓	
Feral Cat	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a		✓

3.11.1. Hamersley Line Rail

No conservation significant fauna species were recorded from the culvert sites located along the Hamersley Line Rail in 2023. This is consistent with previous monitoring (2013-2022). In 2013 and 2014, a Northern Quoll was recorded using culverts along the Hamersley Line Rail (Ecologia 2014b). A Northern Quoll was also recorded on motion camera using a culvert in 2015 during monitoring of the Northern Quoll impact sites (Ecoscape 2016).

Three Feral Cats were recorded on motion cameras from culvert sites HL Cu 01 and HL Cu 03. This is consistent with recent years monitoring during which between one and five individuals were recorded.

3.11.2. Main Line Rail

The Northern Quoll was recorded from two Main Line Rail culvert sites in 2023 (MR CU 07 & MR CU 12). In 2021, two species of conservation significance were recorded: Greater Bilby tracks at MR CU 01 (adjacent to Greater Bilby abundance site MR GB AS I14), and Northern Quoll scats were recorded at MR CU 04. The Northern Quoll has also been recorded from site MR CU 04 in 2018 and 2019 (Spectrum 2019, 2020). The Ghost Bat has been recorded using culverts as nocturnal feeding roosts at three culvert sites during previous monitoring and in 2023 (Spectrum 2019, 2020) (Table 3.13).

A total of seven individual Feral Cats were recorded from five culvert sites (MR CU 04, MR CU 05, MR CU 06, MR CU 10 and MR CU 12) along the Main Line Rail in 2023. This is a slight decrease from 2022 (nine

individuals) and comparable to the results in 2021 during which seven individuals were recorded. Fortescue has implemented biannual trapping of feral predators including Feral Cats along the Main Line Rail to reduce the population near conservation significant fauna populations.

3.11.3. Eliwana Line Rail

No conservation significant fauna were recorded from the culvert sites located along the Eliwana Line Rail in 2023. There were five records of a Feral Cat (likely one individual) from one culvert site ER CU 01. In 2022, a Dingo/Dog was recorded from this site. This is the second year of monitoring and results cannot be compared nor trends determined.

3.12. Introduced Fauna

Eight introduced species were recorded from Cloudbreak, Christmas Creek, Hamersley Line Rail, Main Line Rail, Eliwana Mine, Eliwana Line Rail, Nullagine and North Star in 2023: Rabbit, House Mouse, Fox, Feral Cat, Dog/Dingo, Donkey, Horse, and European Cattle. All of the species have been recorded during previous monitoring events. Each record is presented in Table 5.15 of Appendix Q.

The focus of introduced species monitoring is Feral Cats and Red Foxes due to the known impact these species have on conservation significant fauna (Pavey, 2006; Woinarski *et al.*, 2008; Dunlop, Cook and Lees, 2013; Henderson, 2015; Hernandez-Santin, Goldizen and Fisher, 2016; DoE Department of the Environment, 2018; Ecoscape 2018b).

Feral Cats were recorded from all projects except Christmas Creek in 2023, which is consistent with 2022 (Figure 3.6). The number of cats recorded per trap nights has decreased at the majority of sites in comparison to 2023, apart from Hamersley Line, Eliwana Mine and Eliwana Line Rail (Table 3.14). Records from each site are summarised in Figure 3.6 and detailed in Appendix P.

The Red Fox was recorded from two sites along the Main Line Rail in 2023: culvert site MR CU 04 and rehabilitation control site MR RE C37. The sites are 40 km apart, with the records made in April and June 2023. Based on home ranges recorded for the species in WA (3,900-26,945 ha), the two records likely belonged to two individuals (Newsome, Spencer and Dickman, 2017). This is the first time that the Red Fox was recorded from two sites in one year (Figure 3.5). During previous monitoring, the species was recorded from one culvert site (MR CU 10) over five nights in 2019, and potential tracks were recorded from site MR GB OS 03 in 2020 (Table 3.15).

Dogs/Dingos were also recorded at all projects in 2023, however Dogs/Dingos are not typically considered a direct threat to conservation significant fauna, in particular to Northern Quoll in the Pilbara region (Hill and Ward, 2010; Hernandez Santin, Fisher and Goldizen, 2018; Northover *et al.*, 2023).

Trends of both species at each site are summarised in Table 3.14 and detailed in Appendix P.

Fortescue has implemented biannual feral predator control for Feral Cats, Dogs/Dingos and Red Foxes at Cloudbreak, Christmas Creek, Solomon Hub Main Line Rail, Hamersley Line Rail, Eliwana Mine and North Star in 2021 to reduce predation pressures on Northern Quoll and other conservation significant species.

Table 3.14: Population trends of key introduced predator species at each site in comparison to 2022

Species	Cloudbreak	Christmas Creek	Solomon Hub	Hamersley Line Rail	Main Line Rail	Eliwana Mine	Eliwana Line Rail	Nullagine	North Star
Feral Cat (*Felis catus*)	Decrease	Decrease	Decrease	Increase	Decrease	Increase	Increase	Decrease	Decrease
Red Fox (*Vulpes vulpes*)	Not detected	Not detected	Not detected	Not detected	Increase	Not detected	Not detected	Not detected	Not detected

Table 3.15: Details of Red Fox records

Site	Date	Easting	Northing	Details	2019	2020	2021	2022	2023
MR CU 10	15/7/2019; 21/7/2019; 22/7/19; 30/7/19; 31/7/19	666505	7708560	Motion Camera	✓	-	-	-	-
MR GB OS 03	10/07/20	665811	7728810	Potential tracks	-	✓	-	-	-
MR CU 04	13/06/23	675217	7682261	Motion Camera	-	-	-	-	✓
MR RE C37	21/04/23	665122	7722933	Motion Camera	-	-	-	-	✓



Figure 3.5: Records of Red Fox at Main Line Rail in 2023 (MR CU 04 and MR RE C37)

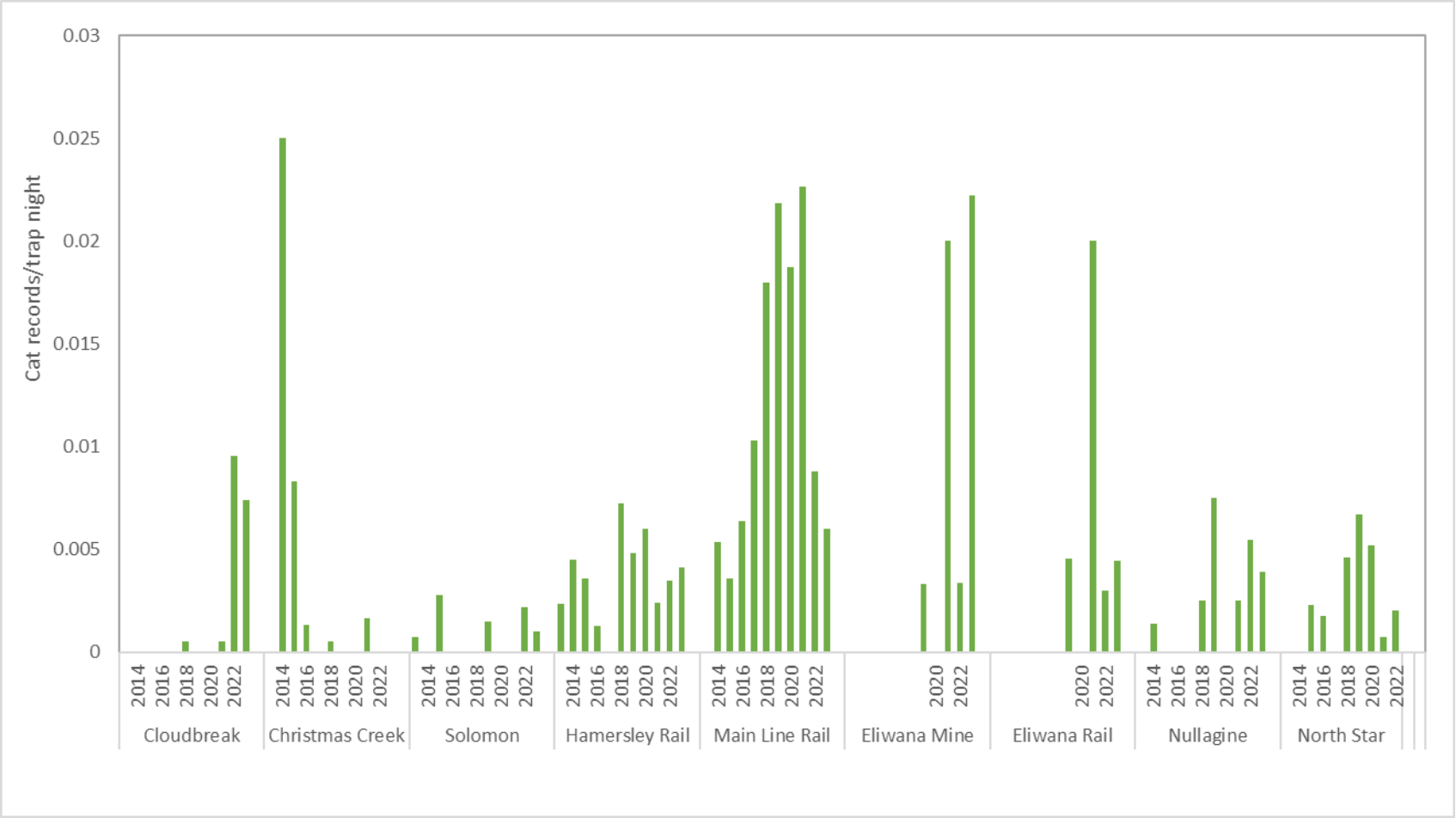


Figure 3.6: Number of Feral Cat records per trap/camera nights

3.13. Millipede *Antichiropus* '1021DNA02'

Sampling yielded a number of non-target invertebrate groups; however no millipedes (*Antichiropus* '1021DNA02') were recorded at Eliwana Mine in 2023. One specimen of the genus *Antichiropus* was collected opportunistically (site EM POP I5, on 07 February 2023) during the wet season monitoring and identified as belonging to *Antichiropus uvulus*, a widespread species. No disturbance was recorded to date at the original location of the species record at Eliwana Mine (Plate 3.3).



Plate 3.3: Photos of the original *Anthichiropus* Site. Clockwise from the top left: North, East, West, South.

3.14. Limitations

In 2023, some sites were not able to be accessed due to wet weather conditions, damaged tracks during the wet season monitoring and escort requirements (Table 3.16, Appendix C). None of the limitations impacted the monitoring outcomes or adequacy.

Table 3.16: Limitations and constraints

	Limitation/Constraint	Comments
Solomon		
SM POP I3	Access limitations due to issues with escort. There was no access to site for the first two nights.	Monitored for five nights (longer search times to equal seven person hours).
SM BAT I2		Site relocated to 580811mE 7550764mN in 2023.

SM BAT I8	Access restrictions with site - area had been cleared with bunds blocking access.	Site relocated to 587331mE 7549069mN in 2023.
SM BAT I4	Heritage restrictions.	Site relocated to to 583532mE 7550212mN in 2023.
Main Line Rail		**Comments**
MR BAT C5	Safety access issues.	Relocated to MR GB OS C10 within the LUC to 690938mE 7640103mN
Eliwana Mine		
EM POP I3	Safety access issues and reduced survey effort to six nights due to a cavity/large pothole formed within the survey area.	Site relocated within the LUC to 481071mE 7513409mN in 2023.
EM BAT I3		Site relocated within the LUC to 504423mE 7518461mN in 2023.
Eliwana Rail Line		
ER MiB I2	Access difficulties with the rail lines (bunting).	Survey completed from the MAR and site relocated within the LUC to 496574mE 7508262mN.
ER GAB I2		Survey completed from the MAR and site relocated within the LUC to 496092mE 7509079mN.

4. COMPLIANCE WITH FAUNA MANAGEMENT PLANS

4.1. Fortescue's Operational Sites

Compliance with targets of the CSFMP at the projects is summarised in Table 4.1.

Table 4.1: Compliance with objectives of CSFMP – Fortescue Operational Sites

Project/Species	T1: No statistically significant decline in relative abundance across impact sites vs control sites	T2: Conservation significant fauna species recorded inside the impact area continue to have an ongoing presence	Fauna usage of rehabilitation sites	Fauna usage of culvert sites
Cloudbreak (EPBC 2005/2205, 2010/5696 & MS 899)				
Northern Quoll (M45/1142)	Tenement M45/1142 is outside Cloudbreak MS899 boundary and species is not covered under CSFMP. Species not recorded during monitoring to date. Monitoring frequency reduced to three-yearly (2021, 2024, 2027)		Rehabilitation sites are used by common species. Sites outside mapped critical habitat	n/a
Conservation significant birds	Insufficient data due to low population densities, no records made during monitoring event.	Insufficient data due to low population densities, conservation significant birds not recorded from potential impact sites.	n/a	n/a
Night Parrot	Insufficient data, *results to be confirmed*	Insufficient data, *results to be confirmed*	n/a	n/a
Christmas Creek (EPBC 2013/7055 & MS1033)				
Northern Quoll	Species and habitat absent from site – target cannot be addressed. Monitoring suspended in 2022 and 2023.		Rehabilitation sites are used by common species. Sites outside mapped critical habitat	n/a
Pilbara Olive Python	Satisfied – population density very low. Sporadic records from site personnel consistent. Low-density population appears to not have undergone significant changes.	Satisfied – population density very low. Sporadic records from site personnel consistent. Low-density population appears to have ongoing presence.	n/a	n/a
Conservation significant birds	Insufficient data due to low population densities, no records made during monitoring events.	Insufficient data due to low population densities, conservation significant birds not recorded from potential impact sites.	n/a	

Project/Species	T1: No statistically significant decline in relative abundance across impact sites vs control sites	T2: Conservation significant fauna species recorded inside the impact area continue to have an ongoing presence	Fauna usage of rehabilitation sites	Fauna usage of culvert sites
Solomon Hub (EPBC 2010/5567, EPBC 2014/7275 & MS1062)				
Northern Quoll	Satisfied – Northern Quoll records are similar to baseline monitoring (2012). Motion camera record from one site.	Satisfied – species continues to be present.	Northern Quoll recorded from one rehabilitation sites in 2019. Remaining sites are outside mapped critical habitat.	n/a
Pilbara Olive Python	Satisfied – detection level very low although consistent abundance in areas of impact.	Satisfied – species continues to be present (site-based records).	Sites are outside mapped critical habitat	
Pilbara Leaf-nosed Bat	Satisfied – detection level very low although consistent abundance in areas of impact.	Satisfied – species continues to be present (foraging only).		
Ghost Bat	Insufficient data due to low population densities, no records made from monitoring sites.	Insufficient records – Detection historically low and limited to foraging. Lack of records is not unexpected and does not indicate absence of species, as species very difficult to detect.		
Conservation significant birds	Insufficient data due to low population densities, no records made from monitoring sites.	Insufficient records due to low population densities, no records made from monitoring sites.		

Project/Species	T1: No statistically significant decline in relative abundance across impact sites vs control sites	T2: Conservation significant fauna species recorded inside the impact area continue to have an ongoing presence	Fauna usage of rehabilitation sites	Fauna usage of culvert sites
Hamersley Line Rail (EPBC 2010/5567 & EPBC 2014/7275)				
Northern Quoll	Satisfied – monitoring results in 2023 (motion camera recording) are comparable with baseline monitoring (2012).	Satisfied – species continues to be present.	Rehabilitation sites are used by common species. Sites outside mapped critical habitat. Previous rehabilitation sites were shown to be occupied by Northern Quolls (2013 & 2014).	Species previously recorded from culvert sites.
Conservation significant birds	Insufficient data due to low population densities, no records made during monitoring events.	Insufficient data due to low population densities, no records made during monitoring events.	n/a	n/a
Main Line Rail (EPBC 2010/5513)				
Northern Quoll	Monitoring temporarily suspended due to the species not being impacted by the operation of the rail (previous years' data).	Monitoring temporarily suspended.	Rehabilitation sites are suitable for generalist species. Sites outside mapped critical habitat.	Species previously recorded from culvert sites.
Greater Bilby	Satisfied – no significant change in abundance at monitoring sites.	Satisfied – species continues to be present.		Species previously recorded from culvert sites.
Pilbara Leaf-nosed Bat	Satisfied – records peaked in 2022 and are stable in 2023.	Satisfied – species continues to be present (foraging only).	n/a	n/a
Ghost Bat	Satisfied – Secondary evidence has been consistent and comparable.	Satisfied – Secondary evidence has been consistent and comparable.	n/a	Ghost Bat shown to have used culverts as foraging ground during previous monitoring.
Conservation significant birds	Insufficient data due to low population densities – detection historically low.	Insufficient data due to low population densities – detection historically low.	n/a	n/a

Project/Species	T1: No statistically significant decline in relative abundance across impact sites vs control sites	T2: Conservation significant fauna species recorded inside the impact area continue to have an ongoing presence	Fauna usage of rehabilitation sites	Fauna usage of culvert sites
Eliwana Mine (MS 1109)				
Northern Quoll	Satisfied – Increase in abundance including presence of females.	Satisfied – species continues to be present.	Rehabilitation sites are suitable for generalist species. Sites outside mapped critical habitat.	n/a
Pilbara Olive Python	Satisfied – slight decline possible but no significant decline.	Satisfied – species continues to be present.		
Pilbara Leaf-nosed Bat	Satisfied – abundance consistent and comparable.	Satisfied – species continues to be present.		
Ghost Bat	Satisfied – opportunistic records made from a cave in 2023.	Satisfied – species continues to be present (opportunistic records)		
Conservation significant birds	Insufficient data due to low population densities, no records made during monitoring events.	Insufficient data due to low population densities, no records made during monitoring events.	n/a	n/a
Millipede *Antichiropus* '1021DNA02'	No direct impact to known locations at Eliwana Mine. Site of original record confirmed as undisturbed to date. No additional records made to date.			
Eliwana Line Rail (MS 1108)				
Northern Quoll	Satisfied – no decline is recorded as Northern Quoll populations have not been recorded along the Eliwana Rail Line. Monitoring indicates occasional use by roaming individuals (one opportunistic record in 2022).	Satisfied – no Northern Quoll populations have been recorded along the Eliwana Rail Line. Ongoing presence confirmed in 2022 (one roaming male).	Rehabilitation sites are suitable for generalist species. Sites outside mapped critical habitat.	ER CU 01 is within mapped critical habitat for all species. ER CU 02 and ER CU 03 are outside mapped critical habitat. No conservation significant species recorded.
Pilbara Olive Python	Insufficient data – species not known to occur; no records made from monitoring sites.	Insufficient data – species not known to occur; no records made from monitoring sites.		
Pilbara Leaf-nosed Bat	Satisfied – abundance consistent and comparable.	Satisfied – species continues to be present.		

Project/Species	T1: No statistically significant decline in relative abundance across impact sites vs control sites	T2: Conservation significant fauna species recorded inside the impact area continue to have an ongoing presence	Fauna usage of rehabilitation sites	Fauna usage of culvert sites
Ghost Bat	Likely satisfied – insufficient data, 2022 record indicates that no change has occurred.	Satisfied – species continues to be present (2022 record).		
Conservation significant birds	Insufficient data due to low population densities, no records made during monitoring events.	Insufficient data due to low population densities, no records made during monitoring events.	n/a	n/a

Table 4.2: Compliance with Objectives of NQMMP – Nullagine

Project/Species	T1: Monitor Northern Quoll and potential impacts	T2: Add to regional ecological knowledge of NQ	T3: Assess how the species responds to rehabilitation measures
Northern Quoll	No impacts have been detected. Northern Quoll population increased in comparison to the baseline survey.	Northern Quoll population detected as part of this monitoring that would otherwise not be known. Data suggests that resident quolls are present.	N/A

4.2. Iron Bridge's North Star

Details regarding trigger levels associated with the NQMP are addressed in Table 4.3.

Table 4.3: Performance indicators as per NQMP – North Star

Performance indicators	25% decline in Northern Quoll trap captures and estimated density over three monitoring events that is attributable to the Project and is independent of climate trend and DBCA regional Northern Quoll control site population trend.	50% decline in Northern Quoll trap captures and estimated density over three monitoring events that is attributable to the Project and is independent of climate trend and DBCA regional Northern Quoll control site population trend.
Assessment	Based on statistical analysis of the data, the abundance of females has undergone a decline of 18-20% for all impact sites (based on normalised numbers and CMR analysis). GAM analysis suggests that fire played a role in the decline of quolls, CMR and EMWA analysis indicate that the population has recovered in recent years and is slowly retuning to the baseline data. There appears to be no direct relationship between the decrease in Northern Quoll and the level of mining activity in the form of habitat clearance to date.	

5. REFERENCES

ATA Environmental (2007) *Assessment of Conservation Significant Vertebrate Fauna for the Proposed Rail Corridor and Associated Borrow Pits. Volume 1. Fortescue Metals Group (FMG) Pty Ltd*.

Bamford Consulting Ecologists (2005a) *Fauna survey of proposed Iron Ore Mine, Cloud Break. Fortescue Metals Group*.

Bamford Consulting Ecologists (2005b) *Survey for the Night Parrot Pezoporus occidentalis in the Cloud Break Project Area, Fortescue Metals Group.*

Bamford Consulting Ecologists (2006) *Survey for the Night Parrot Pezoporus occidentalis in the Cloud Break Project Area, Fortescue Metals Group.*

Bamford Consulting Ecologists (2007) *Survey for the Night Parrot Pezoporus occidentalis in the Cloud Break Project Area, Fortescue Metals Goup.*

Bamford Consulting Ecologists (2008) *Fauna Assesment of BC Iron Nullagine Iron Ore Project. Prepared for BC Iron by Bamford Consulting Ecologists, Kingsley.*

Bamford Consulting Ecologists (2009) *Report on September 2008 search for the Night parrot. A Fortescue Metals Group Project.*

Bamford Consulting Ecologists (2010a) *BC Iron Nullagine Iron Ore Project. Northern Quoll (Dasyurus hallucatus) Monitoring Programme Stage 1 September 2010.*

Bamford Consulting Ecologists (2010b) *Report on December 2009 search for the Night Parrot. A Fortescue Metals Group Project.*

Bamford Consulting Ecologists (2011) *BC Iron Nullagine Iron ore Project. Northern Quoll (Dasyurus hallucatus) Monitoring Programme Stage 2 June 2011.*

Bamford Consulting Ecologists (2012a) *2011/2012 Night Parrot Survey Summary Report. A Fortescue Metals Group Project.*

Bamford Consulting Ecologists (2012b) *BC Iron Nullagine Iron Ore Project. Northern Quoll (Dasyurus hallucatus) Monitoring Programme Stage 3 May 2012.*

Bamford Consulting Ecologists (2013) *BC Iron Nullagine Iron Ore Project. Northern Quoll (Dasyurus hallucatus) Monitoring Programme 2010-2013*.

Bamford Consulting Ecologists (2014) *BC iron Nullagine Iron ore Expansion Project - M46/522 and M46/523 Northern Quoll (Dasyurus hallucatus) April 2014 Survey*.

Bat Call WA (2016) *Brockman Syncline 4 Marra Mambas, Pilbara WA. Location of Upper Beasley River Pilbara leaf-nosed bat diurnal roost. Unpublished report for Rio Tinto Iron Ore*.

BC Iron Nullagine (2016a) *Northern Quoll Management Plan. Nullagine Iron Ore Joint Venture. NU-PL-EN-0001*.

BC Iron Nullagine (2016b) *Nullagine Iron Ore Project EPBC 2009/4930 & EPBC 2013/6887 Northern Quoll Survey Report 31 July 2015 to 1 October 2016*.

Bureau of Meteorology (2023) *Climate Data Online*. Available at: http://www.bom.gov.au/climate/data/.

Burnham, K.P.; and Anderson, D.R.; (2002) *Model selection and multimodel inference: A practical information-theoretic approach*. 2nd ed. New York, NY: Springer.

Charles Darwin University (2023) *North Australia and Rangelands Fire Information*. Available at: https://www.firenorth.org.au/nafi3/.

Davis, R.A. and Craig, M.D. (2021) *Review of FMG Annual Fauna Monitoring Program incluing Conservation Significant Species. Unpublished report for Fortescue Metals Group*.

Department of Agriculture Water and The Environment (2021) *Species Profile and Threats Database*. Available at: http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl.

Department of Sustainability Environment Water Population and Communities (2011a) 'Survey guidelines for Australia's threatened mammals. Guidelines for detecting mammals listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999'.

Department of Sustainability Environment Water Population and Communities (2011b) 'Survey guidelines for Australia's threatened reptiles. Guidelines for detecting reptiles listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999'.

Department of the Environment (2016a) *Conservation Advice Pezoporus occidentalis Night Parrot*.

Department of the Environment (2016b) *EPBC Act referral guideline for endangered northern quoll Dasyurus hallucatus. EPBC Act Policy Statement*.

Department of the Environment (2018) *Species Profile and Threats Database. Macrotis lagotis - Greater Bilby*. Available at: http://www.environment.gov.au/sprat (Accessed: 19 September 2018).

Department of the Environment and Energy (2018a) *Species Profile and Threats Database. Actitis hypoleucos — Common Sandpiper*. Available at: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=59309.

Department of the Environment and Energy (2018b) *Species Profile and Threats Database. Tringa glareola - Wood Sandpiper*. Available at: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=829.

Department of the Environment Water Heritage and the Arts (2010a) *Survey guidelines for Australia's threatened bats. Guidelines for detecting bats listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999*.

Department of the Environment Water Heritage and the Arts (2010b) 'Survey guidelines for Australia's threatened birds. Guidelines for detecting birds listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999'.

Dunlop, J. (2017) *Pilbara Northern Quoll Research Program. Annual Report 2016. Department of Parks and Wildlife, Perth.*

Dunlop, J., Cook, A. and Lees, J. (2013) *Ecology and management of the northern quoll Dasyurus hallucatus in the Pilbara. Progress Report.*

Dunlop, J., Cook, A. and Morris, K. (2014) *Pilbara northern quoll project. Surveying and monitoring Dasyurus hallucatus in the Pilbara, Western Australia. Department of Parks and Wildlife, Perth.*

Dziminski, M.A. and Carpenter, F. (2017) *The conservation and management of the bilby (Macrotis lagotis) in the Pilbara*.

Ecologia Environment (2012) *North Star Project. Level 2 Terrestrial Vertebrate Fauna Assessment. Fortescue Metals Group Ltd*.

ecologia Environment (2012) *Western Hub Project - Eliwana and Flying Fish. Terrestrial Vertebrate Fauna Assessment. Unpublished Report for Fortescue Metals Group*.

ecologia Environment (2014a) *Additional Rail Infrastructure Project. Conservation Significant Fauna Monitoring Program. Fortescue Metals Group Limited.*

ecologia Environment (2014b) *Hamersley Line Project Conservation Significant Fauna report 2014. Unpublished report for Fortescue Metals Group.*

ecologia Environment (2021) *J6 Terrestrial Vertebrate Fauna Assessment. Unpublished report for Fortescue Metals Group Limited*.

Ecoscape (Australia) (2016) *Conservation Significant Fauna Monitoring 2015/2016 - Operations. Unpublished report for Fortescue Metals Group.*

Ecoscape (Australia) (2017a) *Conservation Significant Fauna Monitoring 2016/2017. Unpublished report for Fortescue Metals Group.*

Ecoscape (Australia) (2017b) *Eliwana Project: Consolidated Vertebrate Fauna. Fortescue Metals Group.*

Ecoscape (Australia) (2017c) *Impact of Linear Infrastructure on Migratory Birds. Unpublished Report for Fortescue Metals Group.*

Ecoscape (Australia) (2017d) *Impact to Migratory Birds at Fortescue Marsh from Prolonged Inundation. Unpublished Report for Fortescue Metals Group.*

Ecoscape (Australia) (2017e) *Northern Quoll Artificial Denning Habitat Creation, Literature Review and Scoping Study. Unpublished report for FMG Iron Bridge.* Perth, WA.

Ecoscape (Australia) (2018a) *Conservation Significant Fauna Monitoring 2017/2018. Unpublished report for Fortescue Metals Group*.

Ecoscape (Australia) (2018b) *Fox Dispersal along the Mainline Rail Line. Fox Dispersal Assessment. Unpublished report for Fortescue Metals Group.*

ENV Australia (2012) *Christmas Creek Terrestrial Vertebrate Fauna and Fauna Habitat Assessment. Unpublished report for Fortescue Metals Group.*

Environmental Protection Authority (2016) 'Environmental Factor Guideline: Terrestrial Fauna'. Western Australia: EPA.

Environmental Protection Authority (2018) 'Statement of Environmental Principles, Factors and Objectives'. Western Australia: EPA.

Environmental Protection Authority (2020) 'Technical Guidance: Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment'. Western Australia: EPA.

Equinox (2016) *State of the Environment Report Rail Operations. Unpublished report for Fortescue Metals Group*.

Fortescue Metals Group (2020) 'Conservation Significant Fauna Management Plan 100-PL-EN-0022_Rev7'.

Henderson, M. (2015) *The Effects of Mining Infrastructure on Northern Quoll Movement and Habitat.* Edith Cowan University.

Hernandez Santin, L., Fisher, D. and Goldizen, A. (2018) 'Ecology and predator associations of the northern quoll in the Pilbara 2018', *Report of the National Environmental Science Program Threatened Species Recovery Hub* [Preprint].

Hernandez-Santin, L., Goldizen, A.W. and Fisher, D.O. (2016) 'Introduced predators and habitat structure influence range contraction of an endangered native predator, the northern quoll', *Biological Conservation*, 203, pp. 160–167.

Hill, B.M. and Ward, S.J. (2010) 'National Recovery Plan for the Northern Quoll Dasyurus hallucatus', pp. 1–31.

Iron Bridge (2016) *Northern Quoll Management Plan, North Star Project (662MI-5500-PL-EN-0001)*.

Johnson, B. and Anderson, H. (2014) *Northern Quoll (Dasyurus hallucatus) Remote Camera and Trapping Survey in the Central and Eastern Chichester Ranges, Pilbara Region of Western Australia*.

Laake, J.L. (2013) *Rmark: An interface for analysis of capture-recapture data with MARK. NOAA Alaska Fisheries Science Center Processed Report 2013-01*. Seattle, Washington, USA.

Leseberg, N.P. *et al.* (2021) *Fortescue Night Parrot Monitoring Procedure and Program 2018-2021. Final report. Report to Fortescue Metals Group*.

Moore, H.A. (2021) *Quantifying the habitat requirements of an endangered marsupial predator, the northern quoll (Dasyurus hallucatus)*. Charles Sturt University.

Murphy, S.A. *et al.* (2017) 'Observations on breeding Night Parrots (Pezoporus occidentalis) in western Queensland.', *The Emu - Austral Ornithology*, pp. 1–7. Available at: 10.1080/01584197.2017.1292404.

Newsome, T.M., Spencer, E.E. and Dickman, C.R. (2017) 'Short-term tracking of three red foxes in the Simpson Desert reveals large home-range sizes', *Australian Mammalogy*, 39(2), pp. 238–242. Available at: https://doi.org/10.1071/AM16037.

Northover, A. *et al.* (2023) *Summary of knowledge for six faunal species that are Matters of National Environmental Significance in the Pilbara, Western Australia. Department of Biodiversity, Conservation and Attractions, Perth.* Available at: www.dbca.wa.gov.au.

Oakwood, M. (2000) 'Reproduction and demography of the northern quoll, Dasyurus hallucatus, in the lowland savanna of northern Australia.', *Australian Journal of Zoology*, 48, pp. 519–539.

Olson, P.D. and Olson, J. (1986) 'Distribution, status, movements and breeding of the Grey Falcon Falco hypoleucos', *Emu*, 86, pp. 47–51.

Pavey, C. (2006) *National Recovery Plan for the Greater Bilby Macrotis lagotis*.

Queensland Government (2023) *SILO Climate Database*. Available at: https://www.longpaddock.qld.gov.au/silo/ (Accessed: 6 April 2023).

Roberts S. D. (1959) 'Properties of Control Chart Zone Tests.', *The Bell System Technical Journal*, 37, pp. 83–114.

Schoenjahn, J. (2011) 'How scarce is the Grey Falcon?', *Boobook*, 29(1), pp. 24–25.

Southgate, R. *et al.* (2018) 'Verifying bilby presence and the systematic sampling of wild populations using sign-based protocols - with notes on aerial and ground survey techniques and asserting absence', *Australian Mammalogy* [Preprint].

Spectrum Ecology (2019) *Operational Areas, Nullagine and North Star. Fauna Monitoring 2018. Prepared for Fortescue Metals Group.*

Spectrum Ecology (2020) *Fortescue Metals Group Annual Fauna Monitoring Program 2019. Prepared for Fortescue Metals Group.* Perth, WA.

Spectrum Ecology & Spatial (2021) *Glacier Valley Terrestrial Vertebrate Fauna Assessment. Unpublished report for IB Operations*.

Spectrum Spatial & Ecology (2023) *Eliwana Bat Echolocation Call Analysis. Unpublished Memo Letter Report for Fortescue Metals Group.*

Terrestrial Ecosystems (2022a) *Feral cat and wild dog management - Rail Camp 145 and Hamersley Rail. Unpublished report for Fortescue Metals Group*.

Terrestrial Ecosystems (2022b) *Feral cat management - Rail Camp 145 and Hamersley rail. Unpublished report for Fortescue Metals Group*.

Tidemann, C.R.R. *et al.* (1985) 'Foraging Behaviour of the Australian Ghost Bat, Macroderma gigas (Microchiroptera: Megadermatidae)', *Australian Journal of Zoology*, 33(5), pp. 705–713.

Woinarski, J.C.Z. *et al.* (2008) *Surviving the toads: patterns of persistence of the northern quoll Dasyurus hallucatus in Queensland. Report to The Australian Government's Natural Heritage Trust.*

Appendix A: Site-Specific Monitoring Requirements

Chichester Hub

Cloudbreak

Condition 1 of EPBC 2005/2205 (Cloudbreak Life of Mine) and Condition 13 of EPBC 2010/5696 sets out monitoring requirements for Night Parrot (*Pezoporus occidentalis*) at the Cloudbreak mine site. Condition 10 of Ministerial Statement 899 (Cloudbreak Life of Mine) sets out the monitoring requirements for EPBC and BC Act listed species at the Cloudbreak mine site. These conditions are addressed through the implementation of the CSFMP.

Christmas Creek

Condition 8 of Ministerial Statement 1033 (Pilbara Iron Ore and Infrastructure Project: Christmas Creek Mine, East-West Railway and Mindy Mindy Mine – Revised Proposal) sets out requirements for the monitoring and management requirements for conservation significant fauna and requires Fortescue to implement the CSFMP (prepared to satisfy the now superseded MS 871 and MS 707. Condition 9(d) of EPBC 2013/7055 (Christmas Creek Iron Ore Mine Expansion Project) requires the implementation of Condition 8.1, 8.2 and 8.3 of MS 1033; which is also achieved through implementation of the CSFMP.

Solomon Hub

Condition 4 of EPBC 2010/5567 (Solomon Iron Ore Project) and Condition 3(h) of EPBC 2014/7275 (Solomon Iron Ore Project Expansion) sets out the requirements for fauna monitoring and management of EPBC Act listed species (and specific conditions for Pilbara Leaf-nosed Bat, *Rhinonicteris aurantia*, and Northern Quoll, *Dasyurus hallucatus*). Condition 12 of Ministerial Statement 1062 (Solomon Iron Ore Project) sets out the requirements for fauna monitoring and management of Pilbara Olive Python (*Liasis olivaceus barroni*), Northern Quoll and Pilbara Leaf-nosed Bat. The above conditions are achieved through implementation of the CSFMP.

Main Line Rail, East-West Rail and Hamersley Line Rail

Condition 7 of Ministerial Statement 690 (Pilbara Iron Ore and Infrastructure Project Port and North-South railway (Stage A)) sets out requirements for fauna monitoring and management of EPBC listed species on Main Line Rail and Port. Condition 2 of EPBC 2010/5513 (Additional Rail Infrastructure between Herb Elliott Port Facility and Cloudbreak Mine Site, Pilbara, WA) sets out requirements for fauna monitoring and management of EPBC listed species on Main Line Rail. Condition 3 of EPBC 2010/5567 (Solomon Iron Ore Project) and Condition 3(h) of EPBC 2014/7275 (Solomon Iron Ore Project Expansion) sets out requirements for fauna monitoring and management of EPBC listed species (and specific conditions for Pilbara Leaf-nosed Bat and Northern Quoll) on the Hamersley Line Rail. The above conditions are achieved through implementation of the CSFMP.

Eliwana Mine and Eliwana Rail Line

Condition 10 of Ministerial Statement 1108 (MS 1108); Eliwana Railway Project and Condition 10 of MS 1109; Eliwana Iron Ore Mine Project set out requirements for monitoring and management of Northern Quoll, Pilbara Leaf-nosed Bat, Ghost Bat, Pilbara Olive Python, Peregrine Falcon and Pacific Swift (*Apus pacificus*). The above conditions are achieved through implementation of the CSFMP.

Nullagine

Condition 4 of EPBC 2009/6887 (Nullagine Iron Ore Project) sets out requirements for Northern Quoll monitoring and management. Condition 5, 6 and 7 of EPBC 2013/6887 (Nullagine Iron Ore Project) also

sets out requirements for Northern Quoll monitoring and management. The above conditions are achieved through implementation of the NQMMP.

North Star (Iron Bridge)

Iron Bridge Operation (IBO) is required to implement the NQMP, required under Condition 2(b) of EPBC 2012/6689 and Condition 11(4) of MS 993.

Appendix B: Species-Specific Monitoring Methods

Northern Quoll

Northern Quolls were monitored using a combination of live trapping and motion cameras. Each trapping site used a combination of medium and small Sheffield wire cage traps. All traps were baited using universal bait (peanut butter, oats and sardines) and were marked using flagging tape. Motion cameras were installed on star pickets facing downwards and included a fish oil-soaked cotton rope lure. All captured Northern Quolls were marked using Passive Integrated Transponder (PIT) tags (Model ISO 11784/11785 FDX-B), weighed (Pesola 1000 g) and morphometric measurements taken (short pes & caudal width) (Appendix F). Spectrum's zoologists have been endorsed to complete the implantation of PIT tags by an experienced veterinarian (Ausvet Animal Hospital; Unusual Pet Vets). DNA samples of each Northern Quoll individual were taken via an ear notch and stored in 100% ethanol (in a 1.5 ml vial) for submission to the WA Museum/DBCA.

The years of Northern Quoll monitoring completed at each site is shown in the table below.

Site/Year		2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	No. Years
Cloudbreak		X	X	X	X	X	X	✓	✓	✓	X	✓	X	X	5
Christmas Creek		X	X	✓	✓	✓	✓	✓	✓	✓	X	✓	X	X	8
Solomon Hub	Impact	X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	12
	Control	X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Hamersley Rail Line	Impact	X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	12
	Control	X	✓	✓	✓	✓	#	#	#	#	#	✓	✓	✓	
Main Line Rail	Impact	X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	X	X	10
	Control	X	✓	✓	✓	✓	#	#	#	#	#	#	X	X	
Eliwana	Mine Impact	X	X	X	X	X	X	X	X	✓	X	✓	✓	✓	4
	Rail Impact	X	X	X	X	X	X	X	X	✓	X	✓	✓	✓	4
	Control	X	X	X	X	X	X	X	X	X	X	✓	✓	✓	3
North Star	Impact	X	X	X	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	109
	Control	X	X	X	✓	✓	✓	✓	✓	X	X	✓	✓	✓	6
Nullagine	Impact	✓	✓	✓	✓	✓	✓	✓	✓	✓	X	✓	✓	✓	8

✓ = monitoring completed; X = no monitoring required/suspended; # = combined control sites used; grey cells indicate no trapping/use of MCs

Control Sites

At Solomon and Hamersley Line Rail, three control sites were installed. Methods included trapping over four consecutive nights using 50 cage traps set in two rows of 25 traps spaced 50 m apart, five downwards-facing motion cameras (attached to star pickets and equipped with fish oil-soaked cotton rope lures) deployed for over three months, and searches for secondary evidence (10-person hours) completed. One

of the control sites at Hamersley Line Rail could not be accessed on a daily basis and methods consisted of motion cameras and searches only.

At Eliwana low-density camera trapping was conducted at three control sites consisting of five downward-facing camera traps at each site for three months. Searches for secondary evidence (10-person hours) were completed.

At North Star, three control sites were trapped over four consecutive nights using 50 cage traps set in two rows of 25 traps spaced 50 m apart. Ten motion cameras were deployed at each site for a minimum of 12 consecutive nights. Of the 10 cameras, five were left in place for three months to be consistent with other mine sites. Searches for secondary evidence (10-person hours) was completed.

DBCA monitoring at Indee Station, Karijini National Park, Millstream National Park and Euro Springs (Mount Florance) is conducted with motion cameras using non-reward bait (tuna or burley oil). The number of cameras has varied between the sites.

Cloudbreak Tenement M45/1142 and Christmas Creek

Monitoring for Northern Quolls at Cloudbreak (tenement M45/1142) was suspended and will be conducted every five years, recommencing in 2025. Monitoring at Christmas Creek was ceased after 2021 due to the lack of records during previous years indicating the species to be absent from site.

Main Line Rail

Monitoring at the Main Line Rail was suspended after 2021 because the populations were shown to be stable with no changes in abundance or spatial distribution attributed to the operation of the rail. Monitoring will be conducted every three years and will recommence in 2024.

Solomon Hub and Hamersley Line Rail

Monitoring of Northern Quoll populations was completed at the Solomon Hub, Hamersley Line Rail, (12th year of monitoring for each project). Across each project area three potential impact sites were trapped over four consecutive nights using 50 cage traps set in two rows of 25 traps spaced 50 m apart. Five motion cameras were deployed at each site for three months. Searches for secondary evidence (10-person hours) were completed at all sites.

Eliwana Mine and Eliwana Line Rail

Monitoring of Northern Quoll populations was completed at Eliwana Mine and Eliwana Line Rail (4th year of monitoring). Monitoring consisted of low-density camera trapping at four (Eliwana Mine) or three (Eliwana Line Rail) potential impact sites. Five camera traps were deployed at each site for three months.

Nullagine

Monitoring of Northern Quoll populations was completed at Nullagine (9th year of monitoring). Motion cameras were deployed at 20 locations across two mining areas: Bonnie East and Warrigal. The cameras were left in situ for 30 nights resulting in a total of 600 camera nights. All sites were also searched for secondary evidence for 10-person hours.

North Star

Monitoring of Northern Quoll populations was completed at North Star (10th year of monitoring) with methods following the NQMP. Four potential impact sites were trapped over four consecutive nights using 50 cage traps set in a row spaced 50 m apart. Ten motion cameras were deployed at each site over a minimum of 12 consecutive nights. Five of these cameras at each site were left in place for three months to

be consistent with monitoring methods at the operational sites (Solomon Hub, Eliwana Mine and Rail, and Hamersley Line Rail). Searches for secondary evidence (10-person hours) were also completed.

North Star Statistical Analysis

A Capture-Mark-Recapture (CMR) was completed using the North Star data. Population estimates were calculated in the R package RMark (Laake, 2013) for females, males and overall (all individuals). The tested models were open robust design models with the Huggins estimator, including a closed component (across consecutive nights) and an open component (across consecutive years) (Laake, 2013). The Huggins robust model considers non-successive recaptures of marked individuals between years. Several different models were tested, and the best model was selected using Akaike Information Criteria. Abundance and survival rates were estimated for the potential impact and control sites. Both variables are estimated by RMark from the capture histories.

The Exponentially Weighted Moving Average (EWMA) control chart introduced by Roberts (1959) is designed to quickly detect either small or large shifts in the mean population and is a quantitative technique used as a forecasting model for time series analysis. EWMA weights the abundance geometrically decreasing order so that the most recent observations contribute highly while older observations contribute less. The weight declines exponentially as the data points get older.

A Generalised Additive Model (GAM) was applied to Northern Quoll abundance data to reveal the influence of habitat type (control vs impact), across time (years) effect of time since the last fire and burnt area (% burnt). Comparison of impact and control sites and their changes across time (years) were examined using time series control charts of the log ratio of the impact and control values. Fire data included Fortescue's data for 2015-2023 and Northern Australian Fire Information (NAFI) for 2006-2014 (Charles Darwin University, 2023).

GLM Analysis (Solomon, Hamersley Line Rail and North Star)

To identify a potential correlation between environmental variables (rainfall, number of cats recorded, and bush fires in the area) and the number of Northern Quolls captured, GLMs with a Gaussian distribution were used. The most plausible models (based on Akaike's weights (wAICc) and the ΔAICc, corrected for small sample sizes) were selected. Three models, one per variable (rainfall, cats, fire, and fire frequency), were used as competing models to identify any patterns. In addition, a null mode was included which represents the absence of effect on the list of competing models. The model with ΔAICc < 2.0 and wAICc > 0.1 were considered as equally plausible to determine observed patterns (Burnham and Anderson, 2002). A normalised number of Northern Quolls was used (number of Northern Quolls/trapping effort) to allow for better comparison between years.

GPS Radio-collaring

One male and one female individual of suitable size (minimum of 400g) and suitable health condition (health score of >4) were selected during the trapping program from potential impact sites NS NQ I3 and were equipped with a GPS radio-collar (Sirtracks LiteTrack 20). Details of the individuals are listed in Appendix F. The collars were programmed to record five GPS fixes per night, one fix at 6pm, 10pm, 12pm, 2am and 5am each night. Both individuals were re-captured on 21 August 2023 from site NS NQ I3. The work was completed under Wildlife Animal Ethics Committee (WAEC) WAEC 22-04-45 (DPIRD approval).

Home Range Analysis (North Star)

Statistical analysis of location data collected from the collared Northern Quolls was completed using the Kernel Density tool in ArcGIS Pro v3.0.1 in coordinate system GDA 1994 MGA Zone 50. Collar point data was

converted to feature classes using "XY to point" tool. The points were then connected using the "Generate points along line" tool at 25 m intervals, and the output entered into the Kernel Density tool. The cut-off values needed for the core home range were found using the "Extract Multi Values to Points" tool at 25 m intervals. Extracted fields were sorted into descending order to find the values corresponding with 50% and 95% of the records. This provides an estimate of an individual's home range (intensity of use of an individual's home range). Kernel Density Estimate (intensity of use of an individual's home range) was estimated to 95% with a core range estimate of 50%; e.g., the individual spends up to 50% of their time within the core area. Location data including trapping and motion camera records were collated based on date time.

Greater Bilby

Methods for Greater Bilbies utilise both occupancy and abundance monitoring techniques.

Abundance monitoring:

- 2-hectare active searches for secondary evidence (scats, diggings, burrows, tracks)
  - Even spread of transects across the abundance site using two or more zoologists
  - Recording of all fauna activity (by-catch) at each site
- Scat transects to allow statistical analysis following DBCA's methods
- Opportunistic scat collections for genetic analysis following DBCA's instruction for scat analysis
- Three food plots per site (recording of plant species with bilby diggings)
- Four long-term motion cameras (three months wet season and three months dry season)

Occupancy monitoring:

- 2-hectare active searches for secondary evidence (scats, diggings, burrows, tracks)
  - Even spread of transects across the occupancy site using two or more zoologists
  - Recording of all fauna activity (by-catch) at each site
- Occupancy site locations to be spread evenly across the project area based on previous records and habitat mapping
- Two phases of monitoring (half the sites monitored in the wet season and all sites monitored in the wet season after three months)

Occupancy site locations were kept consistent with the 2017 to 2019/20 monitoring sites, abundance site locations were based on sites that were occupied by Greater Bilby during previous monitoring events.

Control Sites

Monitoring of Greater Bilby populations was completed at control sites associated with the Main Line Rail using abundance and occupancy monitoring methods as described above.

Occupancy monitoring above was conducted at nine sites during the wet and dry season (first year of monitoring). Abundance monitoring was completed at one control site (MR GB ASC16) (Map 2.2) during the dry season monitoring (11th year of monitoring).

Christmas Creek

Monitoring of Greater Bilbies at Christmas Creek was suspended in 2022 and 2023 due to very sporadic records during previous years indicating individuals infrequently traversing through the site. Monitoring will be conducted every three years and will recommence in 2024.

Main Line Rail and East-West Rail

Monitoring of Greater Bilby populations was completed along the Main Line Rail (11th year of monitoring) using abundance and occupancy monitoring methods as described above.

Occupancy monitoring was completed at 20 potential impact sites during the wet season and 40 potential impact sites during the dry season. Abundance monitoring methods were not suitable for the potential impact abundance site (MR GB ASI14) 2022 and 2023 due to the absence of Greater Bilbies at that site.

Statistical Analysis

Statistical analysis of the genotyped scat data could not be undertaken in 2023 due to the low number of collected Greater Bilby scats yielding DNA at the Abundance sites.

Pilbara Leaf-nosed Bat and Ghost Bat

Christmas Creek

Monitoring of conservation significant bats at Christmas Creek was suspended in 2023 due to the lack of records during previous years indicating the species to be absent from site. Monitoring will be conducted every five years and will recommence in 2026.

Solomon Hub, Main Line Rail, Eliwana Mine and Rail

Monitoring of conservation significant bat populations was completed at the Solomon Hub (9th year of monitoring for PLNB, 6th year for Ghost Bat), along the Main Line Rail (9th year of monitoring for PLNB, 6th year for Ghost Bat), Eliwana Mine (4th year of monitoring) and Eliwana Line Rail (4th year of monitoring). Acoustic recordings were collected from 24 monitoring sites (12 potential impact sites and 12 control sites) over seven consecutive nights during the wet season monitoring for each location. Monitoring sites associated with the Eliwana Mine and Solomon Hub were used to supplement sites along the Eliwana Line Rail due to the proximity of the sites to each other.

The focus of the monitoring at Solomon Hub and Main Line Rail since 2018 is on Ghost Bat populations; however, surveillance level monitoring of Pilbara Leaf-nosed Bat populations was completed as part of the Ghost Bat monitoring with acoustic recordings analysed for the presence of both conservation significant bat species. The focus of the monitoring at the Eliwana Mine and Rail is on both conservation significant fauna species.

Conservation significant bat monitoring was completed using ultrasonic Song Meter recorders (Wildlife Acoustics SM4Bat FS and Wildlife Acoustics Song Meter Mini Bat). The acoustic recordings were analysed by Kyle Armstrong (Specialised Zoological) using a published data processing pipeline consisting of several filtering and statistical steps to detect target signals from bats of conservation significance (Appendix K). The identifications from automated processes were checked visually in a spectrogram (Adobe Audition CS6 version 5.0.2; for echolocation calls of the Ghost Bat and the Pilbara Leaf-nosed Bat) or by aural playback (BatSound Pro version 3.31a; for Ghost Bat social calls).

Pilbara Olive Python

Monitoring of Pilbara Olive Python populations was completed at the Christmas Creek mine site (11th year of monitoring), Solomon Hub (11th year of monitoring), Eliwana Mine (4th year of monitoring) and Eliwana Line Rail (4th year of monitoring). Monitoring was conducted at four potential impact and four control sites at Christmas Creek, three potential impact and three control sites at Solomon, five potential impact sites at Eliwana Mine, and two potential impact sites at Eliwana Line Rail. An additional three control sites were associated with both the Eliwana Mine and Eliwana Line Rail.

Methods were consistent at each site and consisted of active searches of potential impact and control sites over seven consecutive nights. Microhabitats suitable for Pilbara Olive Pythons (water edge, low branches, cliffs and overhangs) were searched each night by two zoologists for one-person hour. Two 200 m transects were also established at each site and searched on foot twice over the seven-night monitoring period. Start locations were alternated between potential impact sites and control sites every night so that temporal variation is consistent for impact and control areas.

All Pilbara Olive Python individuals captured were marked using PIT tags to enable accurate identification when re-captured. In addition, each individual was weighed, and a scale clipping taken. The scale clipping was stored in 100% ethanol and submitted to the WA Museum for future DNA analysis. Field team leaders were endorsed by a veterinarian (Ausvet Animal Hospital and Unusual Pet Vet) for the implantation of microchips (PITs).

eDNA Analysis

eDNA sampling was used to confirm the absence or presence of Pilbara Olive Pythons at Solomon Hub, Eliwana Mine, Eliwana Line Rail and North Star. Sample kits from EnviroDNA were used to sample sites with suitable surface water present (smaller pools or slow flowing streams). The sample kits consisted of a disposable syringe with which approx. 600 ml was sampled and flushed through a Sterivex Millipore filter (1.2µm Filter Unit without Filling Bell), followed by preservative (0.5 ml 10xTris-EDTA). At each sample site, three samples were collected per water body. The samples were couriered and submitted to EnviroDNA for analysis (Appendix M).

In 2023, sampling was conducted at Solomon, North Star and Eliwana during the wet season, and Solomon and North Star during the dry season.

Conservation Significant Birds

Monitoring of conservation significant bird populations was completed at Cloudbreak, Christmas Creek, Solomon Hub, Hamersley Line Rail, Main Line Rail, Eliwana Mine, Eliwana Line Rail and North Star during the wet season of early 2023. Methods for monitoring migratory birds were consistent with previous years of monitoring and follow the CSFMP. In 2022 and 2023, additional monitoring sites were established for grassland and aerial birds that may not be detected at the existing migratory bird sites.

To ensure data is relevant to each site, the control sites were located in habitat similar to that found within the potential impact sites associated with the project areas such as major creeklines and rivers. The sites are predominantly vegetated by larger trees and shrubs. Surface water can be present at the sites after heavy rainfall associated with significant rainfall events. Conditions may be sub-optimal during dry periods and the lack of conservation significant bird records at these sites may not be unusual during these times.

Conservation significant bird species included in this monitoring program include the following species that have previously been recorded and are known to occur within the region:

- Water birds:
  - Common Greenshank (*Tringa nebularia*, EPBC/ BC Act Migratory);
  - Wood Sandpiper (*Tringa Glareola*, EPBC/ BC Act Migratory);
  - Gull-billed Tern (*Gelochelidon nilotica*, EPBC/ BC Act Migratory);
  - Osprey (*Pandion haliaetus*, EPBC/ BC Act Migratory);
  - Common Sandpiper (*Actitis hypoleucos*, EPBC/ BC Act Migratory);
- Grassland birds:
  - Oriental Plover (*Charadrius veredus*, EPBC/ BC Act Migratory); and
- Aerial Insectivores:

  - Pacific Swift (*Apus pacificus*, EPBC/ BC Act Migratory);
- Falcons:
  - Peregrine Falcon (*Falco peregrinus*, DBCA OS);
  - Grey Falcon (*Falco hypoleucos*, EPBC/ BC Act Vulnerable).

Bird surveys focused on the water edges (Water birds), grassland transects (Grassland birds), elevated structures (radio towers, power lines etc; falcon nests) and free aerial space (falcons and Aerial Insectivores). To ensure data was relevant to each site, the control sites were established in comparable habitat to the potential impact sites associated with the project area such as major creeklines, the edge of the Fortescue Marsh and rivers. Surface water can be present at some of the sites but is reliant on significant rainfall events. Conditions may be sub-optimal during dry periods and the lack of conservation significant bird records at these sites may not be unusual during these times.

Cloudbreak and Christmas Creek

Monitoring of conservation significant bird populations using the current monitoring methods was completed at Cloudbreak and Christmas Creek mine sites (8th year of monitoring). Monitoring for the Night Parrot was completed at the Cloudbreak mine site over the prior eight years (2005-2012) and included sightings of other conservation significant bird species (Bamford 2005b, 2006, 2007, 2008, 2009, 2010b, 2012a).

Monitoring of conservation significant bird populations was completed at three potential impact sites at Cloudbreak and three potential impact sites at Christmas Creek. Six control migratory bird, aerial and grassland bird sites are monitored in association with the two projects. Three control migratory bird sites are located north of the Christmas Creek mine site, in habitat similar to that present at the potential impact sites and have been monitored since 2017. These sites are considered suitable for comparison of conservation significant bird population data with the potential impact sites.

An additional three control migratory bird sites are associated with yintas located on the eastern side of the Fortescue Marsh. The yinta control sites are monitored to provide regional control data from the closest known migratory bird source population (only during migration periods) which may influence migratory bird occurrence at the mine site. The proximity to the Fortescue Marsh and the permanent water source at these sites attracts bird species not likely to occur at the potential impact sites. Conservation significant bird activity at these sites has been recorded at relatively high levels (2015-2018) in comparison to other control and potential impact sites.

Solomon Hub, Hamersley Line Rail and Main Line Rail

Monitoring of conservation significant bird populations was completed at the Solomon Hub, along the Hamersley Line Rail and Main Line Rail (8th year of monitoring). Monitoring of conservation significant bird populations was completed at three potential impact sites and three control sites associated with each project.

Eliwana Mine and Rail Line

Monitoring of conservation significant birds at Eliwana Mine and Rail consisted of the monitoring of falcons (Peregrine Falcon) and aerial insectivores (Pacific Swift, 4th year of monitoring) as these were the only two conservation significant birds recorded during the baseline survey. Monitoring was completed at three potential impact and three control sites at Eliwana Mine and Rail Line.

Statistical Analysis of Data

Conservation significant bird species are generally rarely recorded and typically in low numbers which limits the suitability of the data set for statistical analysis. Sample sizes and record numbers have been too small and sporadic to detect any statistically significant changes.

Night Parrot

Monitoring of the Night Parrot was completed at Cloudbreak (2nd year of monitoring following completing of the Fortescue Night Parrot Monitoring Procedure and Program). Acoustic recordings were collected from 13 sites over 109 consecutive nights in the wet season. Sites are based on the Fortescue Night Parrot Monitoring Procedure and Program (Leseberg et al., 2021). Monitoring is completed using passive acoustic recorders (PAR; Wildlife Acoustics SM4). Raw acoustic data is suppled to ANRM in '.wav' format as 30-minute files and scanned using a signal detection algorithm based on the R package 'monitoR'. This package has been set up to detect known Night Parrot calls from Western Australia and Queensland. Potential recordings identified from the algorithm are manually checked by experts including visual inspection of the spectrogram and listening to a clip of the detection (Leseberg *et al.*, 2021).

Rehabilitation Areas

Monitoring of fauna usage of rehabilitation areas was completed at Cloudbreak and Christmas Creek (7th year of monitoring), Solomon Hub, Hamersley Line Rail, Main Line Rail and North Star (8th year of monitoring), Eliwana Mine and Eliwana Line Rail (2nd year of monitoring). Three rehabilitation sites were monitored at all projects.

Each site was monitored for the usage of fauna with particular focus on conservation significant fauna species. Sites were searched by two zoologists for one-person hour and one motion camera was installed for three months during the dry season. The searches targeted secondary evidence of conservation significant fauna and introduced fauna, but also recorded any other fauna sighted. Site locations were consistent since 2016. Where possible, locations align with the Fortescue rehabilitation monitoring program.

Culvert Sites

Monitoring of fauna usage of culverts was completed along the Hamersley Line Rail and Main Line Rail (11th year of monitoring). Fauna usage at the two rails was monitored at five culverts located along the Hamersley Line Rail and ten culverts located along the Main Line Rail. One motion camera was installed in each culvert (using L-shaped brackets) and left in situ for 3 months during the dry season. Each site was also searched for secondary evidence such as scats, tracks and food debris (prey items). To date, the Northern Quoll has been shown to use culverts to cross the rail infrastructure and therefore ongoing monitoring is focused on detecting the use of culverts by other conservation significant fauna species such as the Greater Bilby. Monitored culvert sites were located in proximity to habitats considered suitable for Greater Bilby. Monitoring site locations were consistent since 2016 with some overlaps since 2013.

Introduced Fauna

Introduced fauna can be a threat to native fauna and monitoring of the presence and abundance of introduced predators can assist when identifying causes of decline of threatened fauna. All sightings, signs, and motion camera recordings of introduced fauna was recorded during monitoring events at all project locations. In particular, the presence of introduced fauna was targeted at waste rock dumps, rehabilitation sites and across the Hamersley Rail, Main Line Rail and North Star due to a suspected increase of Feral Cats.

Red Fox

The occurrence and distribution of the Red Fox is monitored along the Mail Line Rail (5th year of monitoring) as the species was identified as a key risk to Greater Bilby populations in that area (Ecoscape 2018b). Surveillance techniques to detect the presence of the Red Fox along the Main Line Rail (including water points) consisted of:

- Baiting of motion cameras in culverts (10 locations for 3 months)
- On-ground searches for secondary evidence.
- Opportunistic observations.

Motion cameras used as part of the culvert monitoring were utilised for the surveillance of Red Fox along the Main Line Rail. Cameras included a fish oil-soaked rope lure and were left in place for 3 months. All sites were also searched for secondary signs of Red Fox (e.g., tracks).

Climatic Conditions

Climatic data was collected from each site, including long-term monthly total rainfall from nearby government weather stations (Bureau of Meteorology, BoM), and SILO which averages rainfall data based on the selected location (Queensland Government, 2023). The table below lists the weather stations relevant to each project / mine area.

Project area	Station used for current data	Station used for duration of monitoring (2012-2023)	BoM station used for local median rainfall
Cloudbreak	Cloudbreak	Cloudbreak, Fortescue Dave Forrest (BoM #505056),	Newman (BoM #7176) & Marillana (BoM #5009)
Christmas Creek	Christmas Creek	Christmas Creek (BoM #505049)	Newman (BoM #7176) & Marillana (BoM #5009)
Solomon Hub	SILO	Solomon Hub	Hamersley (BoM #5005), Mt Florance (BoM #5014)
Hamersley Line Rail*	Karijini North	Hamersley Line Rail (chainage 241 km and 271 km), Solomon Hub, Karjini North	Mt Florence (BoM #5014)
Main Line Rail	Indee Station (BoM #4016) & SILO	Main Line Rail (Port, chainage 68 km and 273 km, Fortescue Dave Forrest (BoM #505056))	Wallareenya (BoM #4038); Bonney Downs (BoM #4006)
Eliwana Mine	SILO	Eliwana Mine	Mt Stuart (BoM #5034), Red Hill (BoM #5022)
Eliwana Line Rail			
North Star	SILO	North Star, Marble Bar (BoM #4106)	Marble Bar (BoM #4106)

Millipede *Antichiropus* '1021DNA02'

Targeted searches for the millipede *Antichiropus* '1021DNA02' were completed at Eliwana Mine as part of the Fauna Monitoring in 2023. Leaf litter samples were collected from ten monitoring sites during the wet season monitoring (8-9 February 2023). Samples were initially processed using a leaf litter reducer, with the smaller leaf litter components placed into plastic zip-lock bags and transported back to Perth where they were placed under Tullgren funnels to extract the invertebrates.

One specimen of the genus *Antichiropus* encountered during monitoring was collected in a 30 ml vial and preserved in 100% ethanol. The specimen was then submitted to Harry Butler Institute (HBI) for DNA sequencing.

Monitoring of the initial collection site of this species was completed in 2022 and 2023. The site was visually assessed and photographed to confirm that no disturbance of this site had occurred. Reference photo of the site from 2022 is displayed in Plate 5.1.



Plate 5.1: Photos of the type locality in 2022

Appendix C: Site Locations

Table 5.1: Monitoring site locations

Site Name	Site Type	Easting	Northing	Details
Northern Quoll Control Sites				
DBCA				
Red Rock (Indee station)	Northern Quoll Control Site	664996	7690585	cameras only
Euro Springs (Mt Florance)	Northern Quoll Control Site	594422	7591931	cameras only
Ngirribungynha (Dales Gorge, Karijini NP)	Northern Quoll Control Site	660747	7513634	cameras only
Baranggunjiyarra / Black Hill Pool (Millstream, Chichester NP)	Northern Quoll Control Site	525331	7640370	cameras only
Solomon Hub				
SM NQ C1	Northern Quoll Control Site	588370	7560407	50 cages over 4 nights, 5 MCs over 3 months
SM NQ C2	Northern Quoll Control Site	590495	7559891	50 cages over 4 nights, 5 MCs over 3 months
SM NQ C3	Northern Quoll Control Site	583627	7556307	50 cages over 4 nights, 5 MCs over 3 months
Hamersley Line Rail				
HL NQ C1	Northern Quoll Control Site	697861	7577247	50 cages over 4 nights, 5 MCs over 3 months
HL NQ C2	Northern Quoll Control Site	666606	7564484	5 MCs over 3 months
HL NQ C3	Northern Quoll Control Site	687037	7578671	50 cages over 4 nights, 5 MCs over 3 months
Eliwana Mine and Rail Line				
EMR NQ C1	Northern Quoll Control Site	459899	7519600	5 MCs over 3 months
EMR NQ C2	Northern Quoll Control Site	467511	7509331	5 MCs over 3 months
EMR NQ C3	Northern Quoll Control Site	525023	7514594	5 MCs over 3 months
North Star				
NS NQ C2	Northern Quoll Control Site	713265	7657127	50 cages over 4 nights, 10 MCs over 12 nights, 5 MCs over 3 months
NS NQ C3	Northern Quoll Control Site	713265	7657127	50 cages over 4 nights, 10 MCs over 12 nights, 5 MCs over 3 months
NS NQ C4	Northern Quoll Control Site	718547	7655513	50 cages over 4 nights, 10 MCs over 12 nights, 5 MCs over 3 months
NS MC LT C1	Long-term Motion camera	710152	7656613	1 MC for 48 days
NS MC LT C2	Long-term Motion camera	714542	7655510	1 MC for 48 days
NS MC LT C3	Long-term Motion camera	713270	7657127	1 MC for 48 days
NS MC LT C4	Long-term Motion camera	717005	7654078	1 MC for 48 days
NS MC LT C5	Long-term Motion camera	718293	7655617	1 MC for 48 days
NS MC LT C6	Long-term Motion camera	715892	7654718	1 MC for 48 days
NS MC LT C7	Long-term Motion camera	713287	7643836	1 MC for 48 days
NS MC LT C8	Long-term Motion camera	713264	7645637	1 MC for 48 days
NS MC LT C9	Long-term Motion camera	713454	7643344	1 MC for 48 days
Northern Quoll Potential Impact Sites				
Solomon Hub				
SM NQ I1	Northern Quoll monitoring	590555	7555578	50 cages, 5 MCs over 3 months
SM NQ I2	Northern Quoll monitoring	589673	7554272	50 cages, 5 MCs over 3 months

Site Name	Site Type	Easting	Northing	Details
SM NQ I3	Northern Quoll monitoring	585636	7546981	50 cages, 5 MCs over 3 months
Hamersley Line Rail				
HL NQ I1	Northern Quoll monitoring	694647	7577143	50 cages, 5 MCs over 3 months
HL NQ I2	Northern Quoll monitoring	686430	7566458	50 cages, 5 MCs over 3 months
HL NQ I3	Northern Quoll monitoring	681031	7561782	50 cages, 5 MCs over 3 months
Eliwana Mine				
EM NQ I1	Northern Quoll monitoring	474313	7517590	5 MCs for 3 months
EM NQ I2	Northern Quoll monitoring	481955	7514417	5 MCs for 3 months
EM NQ I3	Northern Quoll monitoring	496694	7508417	5 MCs for 3 months
EM NQ I4	Northern Quoll monitoring	509341	7509594	5 MCs for 3 months
Eliwana Line Rail				
ER NQ I1	Northern Quoll monitoring	502439	7518899	5 MCs for 3 months
ER NQ I2	Northern Quoll monitoring	527234	7526911	5 MCs for 3 months
ER NQ I3	Northern Quoll monitoring	565707	7537087	5 MCs for 3 months
Nullagine				
NL NQ BE MC 01	Northern Quoll Monitoring Site BCI-11	799381	7558310	1 MC for 30 days
NL NQ BE MC 02	Northern Quoll Monitoring Site BCI-07	799548	7558173	1 MC for 30 days
NL NQ BE MC 03	Northern Quoll Monitoring Site BCI-08 south	800323	7558732	1 MC for 30 days
NL NQ BE MC 04	Northern Quoll Monitoring Site AUD-08	800279	7559322	1 MC for 30 days
NL NQ BE MC 05	Northern Quoll Monitoring Site BCI-03	800253	7559532	1 MC for 30 days
NL NQ BE MC 06	Northern Quoll Monitoring Site AUD-4	799785	7559398	1 MC for 30 days
NL NQ BE MC 07	Northern Quoll Monitoring Site Spypoint	799936	7560051	1 MC for 30 days
NL NQ BE MC 08	Northern Quoll Monitoring Site AUD-05	799927	7560148	1 MC for 30 days
NL NQ BE MC 09	Northern Quoll Monitoring Site AUD-02	800582	7560516	1 MC for 30 days
NL NQ BE MC 10	Northern Quoll Monitoring Site HRC-02	800480	7560254	1 MC for 30 days
NL NQ W MC 01	Northern Quoll Monitoring Site BCI-04	807543	7563826	1 MC for 30 days
NL NQ W MC 02	Northern Quoll Monitoring Site BCI-05	808045	7564649	1 MC for 30 days
NL NQ W MC 03	Northern Quoll Monitoring Site BCI-13	808227	7565028	1 MC for 30 days
NL NQ W MC 04	Northern Quoll Monitoring Site BCI-10	808805	7565840	1 MC for 30 days
NL NQ W MC 05	Northern Quoll Monitoring Site BCI-14	808722	7566065	1 MC for 30 days
NL NQ W MC 06	Northern Quoll Monitoring Site BCI-06	808839	7566397	1 MC for 30 days
NL NQ W MC 07	Northern Quoll Monitoring Site BCI-12 north	809249	7566879	1 MC for 30 days
NL NQ W MC 08	Northern Quoll Monitoring Site BCI-09	809615	7567062	1 MC for 30 days
NL NQ W MC 09	Northern Quoll Monitoring Site BCI-11 north	810506	7566512	1 MC for 30 days
NL NQ W MC 10	Northern Quoll Monitoring Site BCI-12	810449	7565913	1 MC for 30 days
North Star				
NS NQ I1	Northern Quoll Monitoring Site	712464	7650155	50 cages over 4 nights, 10 MCs for 12 nights, 5 MCs for 3 months

Site Name	Site Type	Easting	Northing	Details
NS NQ I2	Northern Quoll Monitoring Site	712928	7648666	50 cages over 4 nights, 10 MCs for 12 nights, 5 MCs for 3 months
NS NQ I3	Northern Quoll Monitoring Site	710525	7648763	50 cages over 4 nights, 10 MCs for 12 nights, 5 MCs for 3 months
NS NQ I4	Northern Quoll Monitoring Site	715886	7649262	50 cages over 4 nights, 10 MCs for 12 nights, 5 MCs for 3 months
NS MC LT I1	Long-term Motion camera	711967	7653971	1 MC for 48 days
NS MC LT I2	Long-term Motion camera	710856	7647824	1 MC for 48 days
NS MC LT I3	Long-term Motion camera	713605	7644609	1 MC for 48 days
NS MC LT I4	Long-term Motion camera	711076	7648577	1 MC for 48 days
NS MC LT I5	Long-term Motion camera	710066	7654724	1 MC for 48 days
NS MC LT I6	Long-term Motion camera	711769	7651013	1 MC for 48 days
NS MC LT I7	Long-term Motion camera	715860	7649265	1 MC for 48 days
NS MC LT I8	Long-term Motion camera	710088	7647244	1 MC for 48 days
NS MC LT I9	Long-term Motion camera	710529	7650094	1 MC for 48 days
Main Line Rail				
MR GB AS C16	Greater Bilby Abundance Site	744994	7606827	Scat Searches, DNA collections, Food plots
MR GB AS C16.MC1	Greater Bilby Abundance Site – MC1	745076	7607851	1 MC for 3 months
MR GB AS C16.MC2	Greater Bilby Abundance Site – MC2	744422	7607566	1 MC for 3 months
MR GB AS C16.MC3	Greater Bilby Abundance Site – MC3	745270	7607016	1 MC for 3 months
MR GB AS C16.MC4	Greater Bilby Abundance Site – MC4	744749	7605899	1 MC for 3 months
MR GB OS C04	Greater Bilby Occupancy site (dry & wet season)	689747	7650081	Searches
MR GB OS C05	Greater Bilby Occupancy site (dry & wet season)	689082	7589586	Searches
MR GB OS C07	Greater Bilby Occupancy site (dry & wet season)	671341	7701477	Searches
MR GB OS C08	Greater Bilby Occupancy site (dry & wet season)	689636	7599172	Searches
MR GB OS C10	Greater Bilby Occupancy site (dry & wet season)	691436	7640318	Searches
MR GB OS C11	Greater Bilby Occupancy site (dry & wet season)	667996	7701113	Searches
Greater Bilby Potential Impact Sites				
Main Line Rail				
MR GB AS I14	Greater Bilby Abundance Site	693132	7635001	Scat Searches, DNA collections, Food plots
MR GB AS I14.MC1	Greater Bilby Abundance Site – MC1	693364	7635487	1 MC for 3 months
MR GB AS I14.MC2	Greater Bilby Abundance Site – MC2	692955	7635026	1 MC for 3 months
MR GB AS I14.MC3	Greater Bilby Abundance Site – MC3	693129	7634797	1 MC for 3 months
MR GB AS I14.MC4	Greater Bilby Abundance Site – MC4	693594	7635025	1 MC for 3 months
MR GB OS 01	Greater Bilby Occupancy site (dry & wet season)	664978	7738793	Searches
MR GB OS 02	Greater Bilby Occupancy site (dry & wet season)	666011	7734412	Searches
MR GB OS 03	Greater Bilby Occupancy site (dry & wet season)	665811	7728810	Searches

Site Name	Site Type	Easting	Northing	Details
MR GB OS 04	Greater Bilby Occupancy site (dry & wet season)	665346	7724914	Searches
MR GB OS 05	Greater Bilby Occupancy site (dry & wet season)	665308	7723235	Searches
MR GB OS 06	Greater Bilby Occupancy site (dry & wet season)	665355	7717547	Searches
MR GB OS 07	Greater Bilby Occupancy site (dry & wet season)	666984	7707994	Searches
MR GB OS 08	Greater Bilby Occupancy site (dry & wet season)	668345	7703461	Searches
MR GB OS 09	Greater Bilby Occupancy site (dry & wet season)	671469	7701023	Searches
MR GB OS 10	Greater Bilby Occupancy site (dry & wet season)	677239	7675108	Searches
MR GB OS 11	Greater Bilby Occupancy site (dry season)	677789	7670399	Searches
MR GB OS 12	Greater Bilby Occupancy site (dry & wet season)	681423	7662812	Searches
MR GB OS 13	Greater Bilby Occupancy site (dry & wet season)	682349	7659703	Searches
MR GB OS 14	Greater Bilby Occupancy site (dry season)	683010	7657601	Searches
MR GB OS 15	Greater Bilby Occupancy site (dry & wet season)	686904	7648294	Searches
MR GB OS 16	Greater Bilby Occupancy site (dry season)	690321	7641579	Searches
MR GB OS 17	Greater Bilby Occupancy site (dry season)	693652	7632357	Searches
MR GB OS 18	Greater Bilby Occupancy site (dry season)	695581	7625885	Searches
MR GB OS 19	Greater Bilby Occupancy site (dry season)	697245	7618985	Searches
MR GB OS 20	Greater Bilby Occupancy site (dry season)	697388	7617800	Searches
MR GB OS 21	Greater Bilby Occupancy site (dry season)	697517	7611155	Searches
MR GB OS 22	Greater Bilby Occupancy site (dry & wet season)	697210	7609650	Searches
MR GB OS 23	Greater Bilby Occupancy site (dry & wet season)	696765	7607938	Searches
MR GB OS 24	Greater Bilby Occupancy site (dry & wet season)	696400	7605206	Searches
MR GB OS 25	Greater Bilby Occupancy site (dry season)	695689	7601843	Searches
MR GB OS 26	Greater Bilby Occupancy site (dry & wet season)	694129	7599083	Searches
MR GB OS 27	Greater Bilby Occupancy site (dry season)	694083	7595222	Searches
MR GB OS 28	Greater Bilby Occupancy site (dry season)	698556	7587334	Searches

Site Name	Site Type	Easting	Northing	Details
MR GB OS 29	Greater Bilby Occupancy site (dry season)	699884	7584979	Searches
MR GB OS 30	Greater Bilby Occupancy site (dry & wet season)	701192	7582678	Searches
MR GB OS 31	Greater Bilby Occupancy site (dry season)	702409	7578415	Searches
MR GB OS 32	Greater Bilby Occupancy site (dry & wet season)	704879	7576178	Searches
MR GB OS 33	Greater Bilby Occupancy site (dry & wet season)	708396	7573020	Searches
MR GB OS 34	Greater Bilby Occupancy site (dry season)	713331	7571520	Searches
MR GB OS 35	Greater Bilby Occupancy site (dry season)	725667	7559469	Searches
MR GB OS 36	Greater Bilby Occupancy site (dry season)	727225	7557025	Searches
MR GB OS 37	Greater Bilby Occupancy site (dry season)	730136	7553728	Searches
MR GB OS 38	Greater Bilby Occupancy site (dry season)	731775	7551253	Searches
MR GB OS 39	Greater Bilby Occupancy site (dry season)	734031	7548185	Searches
MR GB OS 40	Greater Bilby Occupancy site (dry season)	736327	7540651	Searches
Conservation Significant Bat Control Sites				
Solomon Hub				
SM/ER Bat C1	Conservation Significant Bats (PLNB & GB)	601547	7538247	1 x ARU for seven nights
SM/ER Bat C2	Conservation Significant Bats (PLNB & GB)	571541	7539027	1 x ARU for seven nights
SM/ER Bat C3	Conservation Significant Bats (PLNB & GB)	547166	7536913	1 x ARU for seven nights
SM/ER Bat C4	Conservation Significant Bats (PLNB & GB)	547214	7537420	1 x ARU for seven nights
SM/ER Bat C5	Conservation Significant Bats (PLNB & GB)	571799	7544634	1 x ARU for seven nights
SM/ER Bat C6	Conservation Significant Bats (PLNB & GB)	572692	7546865	1 x ARU for seven nights
SM/ER Bat C7	Conservation Significant Bats (PLNB & GB)	563809	7531641	1 x ARU for seven nights
SM/ER Bat C8	Conservation Significant Bats (PLNB & GB)	588929	7556482	1 x ARU for seven nights
SM/ER Bat C9	Conservation Significant Bats (PLNB & GB)	574977	7538119	1 x ARU for seven nights
SM/ER Bat C10	Conservation Significant Bats (PLNB & GB)	599880	7540825	1 x ARU for seven nights
SM/ER Bat C11	Conservation Significant Bats (PLNB & GB)	600908	7537687	1 x ARU for seven nights
SM/ER Bat C12	Conservation Significant Bats (PLNB & GB)	601796	7544314	Not accessed in 2022

Site Name	Site Type	Easting	Northing	Details
SM/ER Bat C12 2022	Conservation Significant Bats (PLNB & GB)	467474	7509295	1 x ARU for seven nights
Main Line Rail				
MR Bat C1	Conservation Significant Bats (PLNB & GB)	795870	7519181	1 x ARU for seven nights
MR Bat C2	Conservation Significant Bats (PLNB & GB)	776353	7525491	1 x ARU for seven nights
MR Bat C3	Conservation Significant Bats (PLNB & GB)	762541	7525641	1 x ARU for seven nights
MR Bat C4	Conservation Significant Bats (PLNB & GB)	800663	7517005	1 x ARU for seven nights
MR Bat C5	Conservation Significant Bats (PLNB & GB)	798497	7517639	1 x ARU for seven nights
MR Bat C6	Conservation Significant Bats (PLNB & GB)	791951	7517007	1 x ARU for seven nights
MR Bat C7	Conservation Significant Bats (PLNB & GB)	787819	7516252	1 x ARU for seven nights
MR Bat C8	Conservation Significant Bats (PLNB & GB)	790208	7517532	1 x ARU for seven nights
MR Bat C9	Conservation Significant Bats (PLNB & GB)	785302	7517861	1 x ARU for seven nights
MR Bat C10	Conservation Significant Bats (PLNB & GB)	774817	7523238	1 x ARU for seven nights
MR Bat C11	Conservation Significant Bats (PLNB & GB)	767083	7524495	1 x ARU for seven nights
MR Bat C12	Conservation Significant Bats (PLNB & GB)	764015	7525175	1 x ARU for seven nights
Eliwana Mine				
EM Bat C1	Conservation Significant Bats (PLNB & GB)	458475	7524252	1 x ARU for seven nights
EM Bat C2	Conservation Significant Bats (PLNB & GB)	458797	7520701	1 x ARU for seven nights
EM Bat C3	Conservation Significant Bats (PLNB & GB)	460472	7518710	1 x ARU for seven nights
EM Bat C4	Conservation Significant Bats (PLNB & GB)	462751	7514517	1 x ARU for seven nights
EM Bat C5	Conservation Significant Bats (PLNB & GB)	474224	7500764	1 x ARU for seven nights
EM Bat C6	Conservation Significant Bats (PLNB & GB)	477911	7498027	1 x ARU for seven nights
EM Bat C7	Conservation Significant Bats (PLNB & GB)	478760	7502052	1 x ARU for seven nights
EM Bat C8	Conservation Significant Bats (PLNB & GB)	484774	7505667	1 x ARU for seven nights
EM Bat C9	Conservation Significant Bats (PLNB & GB)	499203	7525929	1 x ARU for seven nights
EM Bat C10	Conservation Significant Bats (PLNB & GB)	502067	7527891	1 x ARU for seven nights
EM Bat C11	Conservation Significant Bats (PLNB & GB)	505842	7528544	1 x ARU for seven nights

Site Name	Site Type	Easting	Northing	Details
EM Bat C12 / ER BAT C8	Conservation Significant Bats (PLNB & GB)	511210	7529919	1 x ARU for seven nights
Eliwana Line Rail				
ER/SM Bat C1	Conservation Significant Bats (PLNB & GB)	458475	7524252	1 x ARU for seven nights
ER/SM Bat C2	Conservation Significant Bats (PLNB & GB)	458797	7520701	1 x ARU for seven nights
ER/SM Bat C3	Conservation Significant Bats (PLNB & GB)	460472	7518710	1 x ARU for seven nights
ER/SM Bat C4	Conservation Significant Bats (PLNB & GB)	462751	7514517	1 x ARU for seven nights
ER/SM Bat C5	Conservation Significant Bats (PLNB & GB)	474224	7500764	1 x ARU for seven nights
ER/SM Bat C6	Conservation Significant Bats (PLNB & GB)	477911	7498027	1 x ARU for seven nights
ER/SM Bat C7	Conservation Significant Bats (PLNB & GB)	478760	7502052	1 x ARU for seven nights
EM BAT C12 / ER Bat C8	Conservation Significant Bats (PLNB & GB)	511210	7529919	1 x ARU for seven nights
ER/SM Bat C9	Conservation Significant Bats (PLNB & GB)	499203	7525929	1 x ARU for seven nights
ER/SM Bat C10	Conservation Significant Bats (PLNB & GB)	502067	7527891	1 x ARU for seven nights
ER/SM Bat C11	Conservation Significant Bats (PLNB & GB)	505842	7528544	1 x ARU for seven nights
EM/ER Bat C12	Conservation Significant Bats (PLNB & GB)	511210	7529919	1 x ARU for seven nights
Conservation Significant Bat Potential Impact Sites				
Solomon Hub				
SM Bat I1	Conservation significant bat site	586863	7550251	1 x ARU for seven nights
SM Bat I2	Conservation significant bat site	580680	7551311	Not accessed in 2022
SM Bat I2 2022	Conservation significant bat site	582046	7550285	1 x ARU for seven nights
SM Bat I3	Conservation significant bat site	590379	7556082	1 x ARU for seven nights
SM Bat I4	Conservation significant bat site	580599	7552811	Not accessed in 2022
SM Bat I4 2022	Conservation significant bat site	583134	7550487	1 x ARU for seven nights
SM Bat I5	Conservation significant bat site	592138	7543529	1 x ARU for seven nights
SM Bat I6	Conservation significant bat site	586148	7548516	1 x ARU for seven nights
SM Bat I7	Conservation significant bat site	582503	7541580	Not accessed in 2022
SM Bat I7 2022	Conservation significant bat site	583171	7541053	1 x ARU for seven nights
SM Bat I8 2022	Conservation significant bat site	587025	7548856	1 x ARU for seven nights
SM Bat I9	Conservation significant bat site	587903	7548878	1 x ARU for seven nights
SM Bat I10	Conservation significant bat site	590831	7555243	1 x ARU for seven nights
SM Bat I11	Conservation significant bat site	596157	7546582	1 x ARU for seven nights
SM Bat I12	Conservation significant bat site	595823	7546955	1 x ARU for seven nights
Main Line Rail				
MR Bat I1	Conservation significant bat site	677136	7675074	1 x ARU for seven nights
MR Bat I2	Conservation significant bat site	677439	7670246	1 x ARU for seven nights

Site Name	Site Type	Easting	Northing	Details
MR Bat I3	Conservation significant bat site	686046	7650043	1 x ARU for seven nights
MR Bat I4	Conservation significant bat site	692843	7634865	1 x ARU for seven nights
MR Bat I5	Conservation significant bat site	695426	7625692	1 x ARU for seven nights
MR Bat I6	Conservation significant bat site	696139	7622889	1 x ARU for seven nights
MR Bat I7	Conservation significant bat site	694452	7628789	1 x ARU for seven nights
MR Bat I9	Conservation significant bat site	695515	7625511	1 x ARU for seven nights
MR Bat I10	Conservation significant bat site	696784	7606739	1 x ARU for seven nights
MR Bat I11	Conservation significant bat site	696717	7605210	1 x ARU for seven nights
MR Bat I12	Conservation significant bat site	695630	7601880	1 x ARU for seven nights
Eliwana Mine				
EM Bat I1	Conservation significant bat site	470655	7515923	1 x ARU for seven nights
EM Bat I2	Conservation significant bat site	479786	7514109	1 x ARU for seven nights
EM Bat I3	Conservation significant bat site	481611	7513530	1 x ARU for seven nights
EM Bat I4	Conservation significant bat site	488900	7511217	1 x ARU for seven nights
EM Bat I5	Conservation significant bat site	495276	7511453	1 x ARU for seven nights
EM Bat I6	Conservation significant bat site	496591	7508168	1 x ARU for seven nights
EM Bat I7	Conservation significant bat site	510024	7508805	1 x ARU for seven nights
EM Bat I9	Conservation significant bat site	512399	7508761	1 x ARU for seven nights
EM Bat I10	Conservation significant bat site	489839	7518081	1 x ARU for seven nights
EM Bat I11	Conservation significant bat site	493661	7518945	1 x ARU for seven nights
EM Bat I12	Conservation significant bat site	504139	7518206	1 x ARU for seven nights
Eliwana Line Rail				
ER Bat I2	Conservation significant bat site	493661	7518945	1 x ARU for seven nights
ER Bat I3	Conservation significant bat site	504139	7518206	1 x ARU for seven nights
ER Bat I4	Conservation significant bat site	513219	7521708	1 x ARU for seven nights
ER Bat I5	Conservation significant bat site	522096	7525321	1 x ARU for seven nights
ER Bat I6	Conservation significant bat site	527241	7526809	1 x ARU for seven nights
ER Bat I7	Conservation significant bat site	531791	7526923	1 x ARU for seven nights
ER Bat I9	Conservation significant bat site	563829	7532126	1 x ARU for seven nights
ER Bat I10	Conservation significant bat site	593314	7544964	1 x ARU for seven nights
ER Bat I11	Conservation significant bat site	596125	7546955	1 x ARU for seven nights
ER Bat I12	Conservation significant bat site	602016	7544148	1 x ARU for seven nights
Pilbara Olive Python Control Sites				
Christmas Creek				
CC POP C1	Pilbara Olive Python monitoring site	775880	7556395	Nocturnal searches for seven nights
CC POP C2	Pilbara Olive Python monitoring site	785545	7553911	Nocturnal searches for seven nights
CC POP C3	Pilbara Olive Python monitoring site	789497	7555277	Nocturnal searches for seven nights
CC POP C4	Pilbara Olive Python monitoring site	793650	7553058	Nocturnal searches for seven nights
Solomon Hub				
SM POP C1	Pilbara Olive Python monitoring site	601607	7538288	Nocturnal searches for seven nights
SM POP C2	Pilbara Olive Python monitoring site	568435	7537007	Nocturnal searches for seven nights
SM POP C3	Pilbara Olive Python monitoring site	547051	7537533	Nocturnal searches for seven nights
Eliwana Mine & Eliwana Line Rail				
EM/ER POP C1	Pilbara Olive Python monitoring site	478949	7507631	Nocturnal searches for seven nights

Site Name	Site Type	Easting	Northing	Details
EM/ER POP C2	Pilbara Olive Python monitoring site	534998	7534243	Nocturnal searches for seven nights
EM/ER POP C3	Pilbara Olive Python monitoring site	507306	7539516	Nocturnal searches for seven nights
ER POP C4/SM POP C3	Pilbara Olive Python monitoring site	547052	7537533	Nocturnal searches for seven nights
Pilbara Olive Python Potential Impact Sites				
Christmas Creek				
CC POP I1	Pilbara Olive Python site	760101	7525314	Nocturnal searches for seven nights
CC POP I2	Pilbara Olive Python site	773786	7523248	Nocturnal searches for seven nights
CC POP I3	Pilbara Olive Python site	781779	7519004	Nocturnal searches for seven nights
CC POP I4	Pilbara Olive Python site	795860	7519042	Nocturnal searches for seven nights
Solomon Hub				
SM POP I1	Pilbara Olive Python monitoring site	590509	7555052	Nocturnal searches for seven nights
SM POP I2	Pilbara Olive Python monitoring site	589100	7553518	Nocturnal searches for seven nights
SM POP I3	Pilbara Olive Python monitoring site	596668	7546469	Nocturnal searches for six nights
Eliwana Mine				
EM POP I1	Pilbara Olive Python site	470670	7515835	Nocturnal searches for seven nights
EM POP I2	Pilbara Olive Python site	479045	7513124	Nocturnal searches for seven nights
EM POP I3	Pilbara Olive Python site	481597	7513535	Nocturnal searches for seven nights
EM POP I4	Pilbara Olive Python site	496752	7508474	Nocturnal searches for seven nights
Eliwana Line Rail				
ER POP I1	Pilbara Olive Python site	481628	7513533	Nocturnal searches for seven nights
ER POP I2	Pilbara Olive Python site	527233	7526773	Nocturnal searches for seven nights
Conservation Significant Bird Control Sites				
Chichester Hub				
CB/CC MiB C1	Conservation Significant Birds	784372	7507872	20 minutes bird survey
CB/CC MiB C2	Conservation Significant Birds	804850	7492836	20 minutes bird survey
CB/CC MiB C3	Conservation Significant Birds	794452	7503100	20 minutes bird survey
CB/CC MiB C4	Conservation Significant Birds	793650	7553058	20 minutes bird survey
CB/CC MiB C5	Conservation Significant Birds	791592	7553224	20 minutes bird survey
CB/CC MiB C6	Conservation Significant Birds	775767	7556499	20 minutes bird survey
CB/CC GAB C1	Conservation Significant Birds	793427	7553196	20 minutes bird survey
CB/CC GAB C2	Conservation Significant Birds	791668	7553316	20 minutes bird survey
CB/CC GAB C3	Conservation Significant Birds	775646	7556373	20 minutes bird survey
CB/CC GAB C4	Conservation Significant Birds	804562	7493009	20 minutes bird survey
CB/CC GAB C5	Conservation Significant Birds	794633	7503388	20 minutes bird survey
CB/CC GAB C6	Conservation Significant Birds	785011	7508470	20 minutes bird survey
Solomon Hub				
SM MiB C1	Conservation Significant Birds	590610	7559785	20 minutes bird survey
SM MiB C2	Conservation Significant Birds	589665	7558887	20 minutes bird survey
SM MiB C3	Conservation Significant Birds	572512	7546766	20 minutes bird survey
SM GAB C1	Conservation Significant Birds	571634	7538827	20 minutes bird survey
SM GAB C2	Conservation Significant Birds	571933	7544498	20 minutes bird survey
SM GAB C3	Conservation Significant Birds	572602	7546661	20 minutes bird survey
Hamersley Rail				
HL MiB C1	Conservation Significant Birds	646178	7569894	20 minutes bird survey

Site Name	Site Type	Easting	Northing	Details
HL MiB C2	Conservation Significant Birds	688763	7589596	20 minutes bird survey
HL MiB C3	Conservation Significant Birds	689343	7598875	20 minutes bird survey
HL GAB C1	Conservation Significant Birds	689139	7575484	20 minutes bird survey
HL GAB C2	Conservation Significant Birds	688825	7598699	20 minutes bird survey
HL GAB C3	Conservation Significant Birds	688921	7589210	20 minutes bird survey
Main Line Rail				
MR MiB C1	Conservation Significant Birds	654404	7730055	20 minutes bird survey
MR MiB C2	Conservation Significant Birds	677450	7651200	20 minutes bird survey
MR MiB C3	Conservation Significant Birds	658031	7704864	20 minutes bird survey
MR GAB C1	Conservation Significant Birds	689747	7650081	20 minutes bird survey
MR GAB C2	Conservation Significant Birds	674541	7643539	20 minutes bird survey
MR GAB C3	Conservation Significant Birds	672347	7644648	20 minutes bird survey
Eliwana Mine				
EM MiB C1	Conservation Significant Birds	458454	7524201	20 minutes bird survey
EM MiB C2	Conservation Significant Birds	460731	7518500	20 minutes bird survey
EM MiB C3	Conservation Significant Birds	477908	7498025	20 minutes bird survey
EM GAB C1	Conservation Significant Birds	502133	7528065	20 minutes bird survey
EM GAB C2	Conservation Significant Birds	460467	7518750	20 minutes bird survey
EM GAB C3	Conservation Significant Birds	476924	7498673	20 minutes bird survey
Eliwana Line Rail				
ER MiB C1	Conservation Significant Birds	502128	7528150	20 minutes bird survey
ER MiB C2	Conservation Significant Birds	503882	7537523	20 minutes bird survey
ER MiB C3	Conservation Significant Birds	535204	7534416	20 minutes bird survey
ER GAB C1	Conservation Significant Birds	501980	7527830	20 minutes bird survey
ER GAB C2	Conservation Significant Birds	507434	7539562	20 minutes bird survey
ER GAB C3	Conservation Significant Birds	535226	7534583	20 minutes bird survey
Conservation Significant Bird Potential Impact Sites				
Cloudbreak				
CB MiB I1	Conservation Significant Birds	752146	7520886	20 minutes bird survey
CB MiB I2	Conservation Significant Birds	740165	7525365	20 minutes bird survey
CB MiB I3	Conservation Significant Birds	733727	7529757	20 minutes bird survey
CB GAB I1	Conservation Significant Birds – Grassland and Aerial birds	752116	7520933	20 minutes bird survey
CB GAB I2	Conservation Significant Birds – Grassland and Aerial birds	740132	7525391	20 minutes bird survey
CB GAB I3	Conservation Significant Birds – Grassland and Aerial birds	733799	7529755	20 minutes bird survey
NP02-S31	Night Parrot monitoring site	730645	7528703	1 x PAR for 3 months
NP03-S03	Night Parrot monitoring site	724474	7530624	1 x PAR for 3 months
NP04-S11	Night Parrot monitoring site	726203	7529894	1 x PAR for 3 months
NP05-S52	Night Parrot monitoring site	737282	7526122	1 x PAR for 3 months
NP06-S56	Night Parrot monitoring site	738262	7525968	1 x PAR for 3 months
NP07-S07	Night Parrot monitoring site	725319	7530276	1 x PAR for 3 months
NP08-S27	Night Parrot monitoring site	729729	7528788	1 x PAR for 3 months

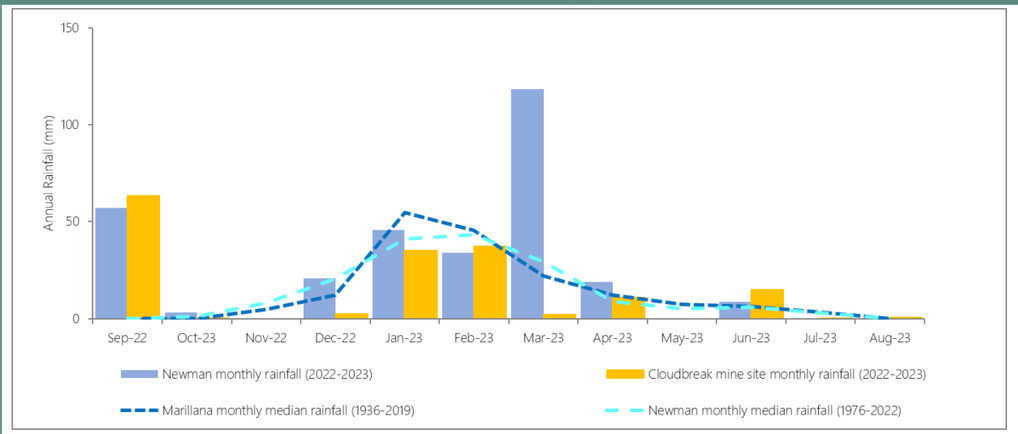
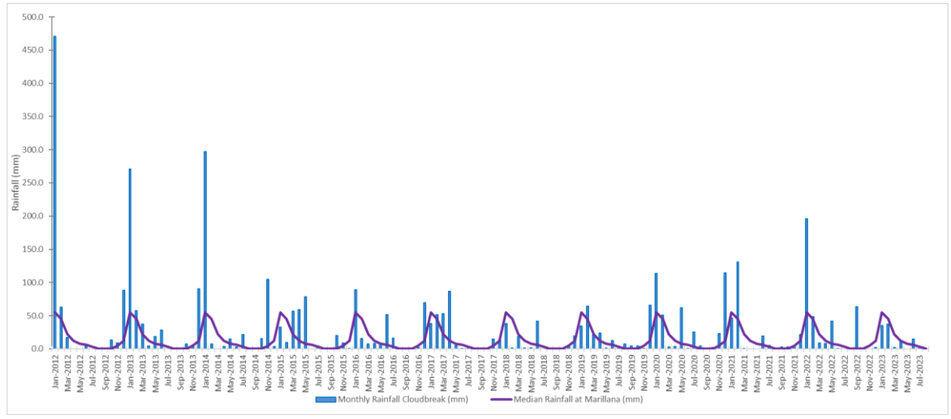
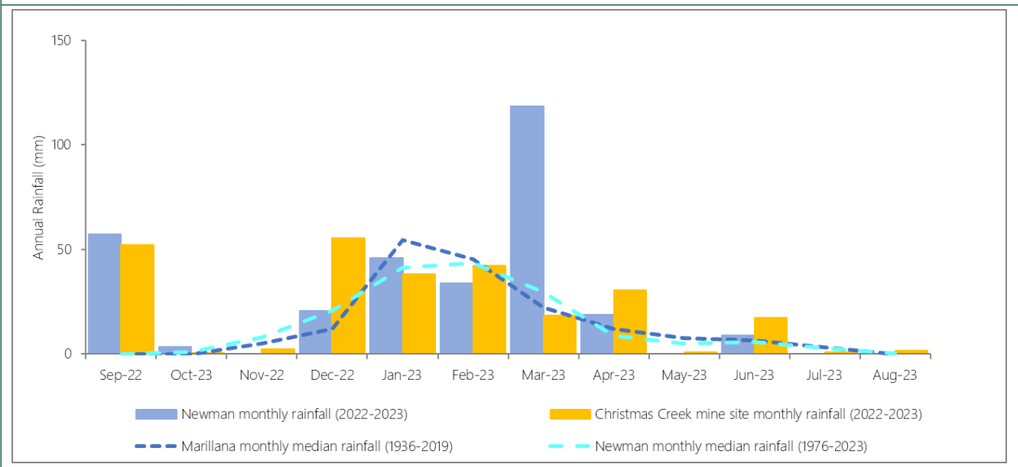
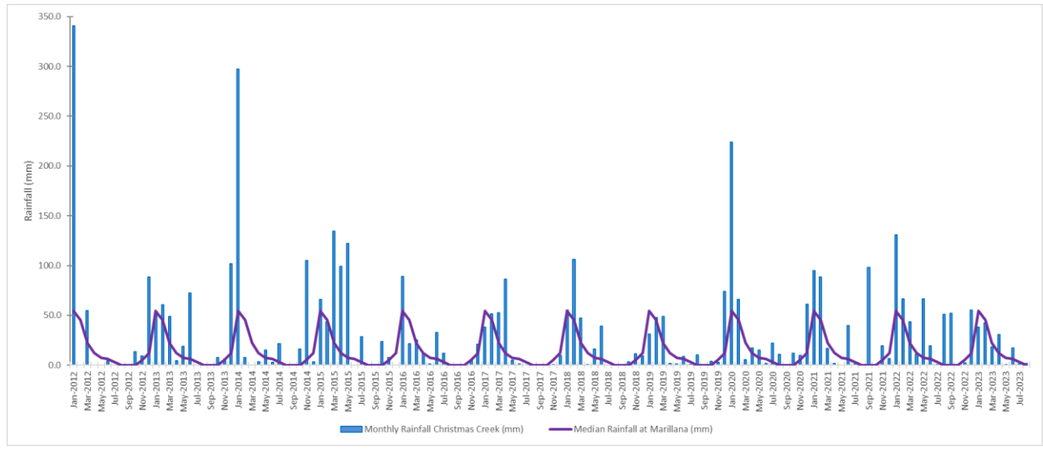
Site Name	Site Type	Easting	Northing	Details
NP09-S19	Night Parrot monitoring site	727685	7528782	1 x PAR for 3 months
NP12-S35	Night Parrot monitoring site	731511	7528784	1 x PAR for 3 months
NP13-S23	Night Parrot monitoring site	728775	7528941	1 x PAR for 3 months
NP15-S44	Night Parrot monitoring site	735587	7526725	1 x PAR for 3 months
NP18-S48	Night Parrot monitoring site	736427	7526471	1 x PAR for 3 months
NP20-S15	Night Parrot monitoring site	726887	7529690	1 x PAR for 3 months
Christmas Creek				
CC MiB I1	Conservation Significant Birds – Migratory birds	777755	7521913	20 minutes bird survey
CC MiB I2	Conservation Significant Birds – Migratory birds	795751	7518944	20 minutes bird survey
CC MiB I3	Conservation Significant Birds – Migratory birds	782143	7515952	20 minutes bird survey
CC GAB I1	Conservation Significant Birds – Grassland and Aerial birds	781618	7516309	20 minutes bird survey
CC GAB I2	Conservation Significant Birds – Grassland and Aerial birds	795836	7519099	20 minutes bird survey
CC GAB I3	Conservation Significant Birds – Grassland and Aerial birds	775364	7526410	20 minutes bird survey
Solomon Hub				
SM MiB I1	Conservation significant bird site	590526	7555667	20 minutes searches
SM MiB I2	Conservation significant bird site	589396	7553859	20 minutes searches
SM MiB I3	Conservation significant bird site	596184	7546647	Not accessed in 2022
SM MiB I3 2022	Conservation significant bird site	590162	7554805	20 minutes searches
SM GAB I1	Conservation significant bird site	583441	7540916	20 minutes searches
SM GAB I2	Conservation significant bird site	582046	7550285	20 minutes searches
SM GAB I3	Conservation significant bird site	586145	7548529	20 minutes searches
Hamersley Line Rail				
HL MiB I1	Conservation significant bird site	680568	7561821	20 minutes searches
HL MiB I2	Conservation significant bird site	686560	7566910	20 minutes searches
HL MiB I3	Conservation significant bird site	694972	7576498	Not completed in 2022
HL GAB I1	Conservation significant bird site	694998	7576740	20 minutes searches
HL GAB I2	Conservation significant bird site	686702	7567125	20 minutes searches
HL GAB I3	Conservation significant bird site	680643	7561788	Not completed in 2022
Main Line Rail				
MR MiB I1	Conservation significant bird site	677370	7673848	20 minutes searches
MR MiB I2	Conservation significant bird site	677234	7674941	20 minutes searches
MR MiB I3	Conservation significant bird site	666803	7707622	20 minutes searches
MR GAB I1	Conservation significant bird site	664978	7738793	20 minutes searches
MR GAB I2	Conservation significant bird site	668345	7703461	20 minutes searches
MR GAB I3	Conservation significant bird site	696765	7607938	20 minutes searches
Eliwana Mine				
EM MiB I1	Conservation significant bird site	481628	7513533	20 minutes searches
EM MiB I2	Conservation significant bird site	496354	7508647	20 minutes searches
EM MiB I3	Conservation significant bird site	480012	7510070	Not accessed in 2022

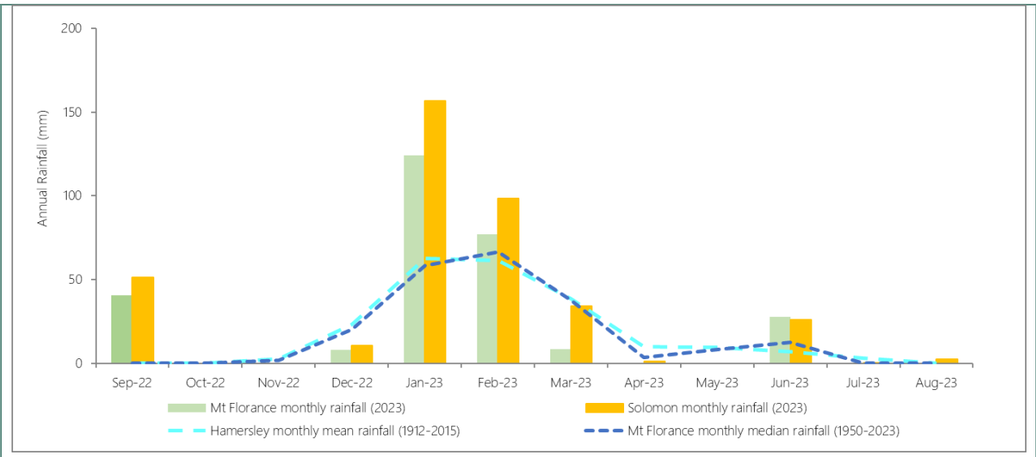
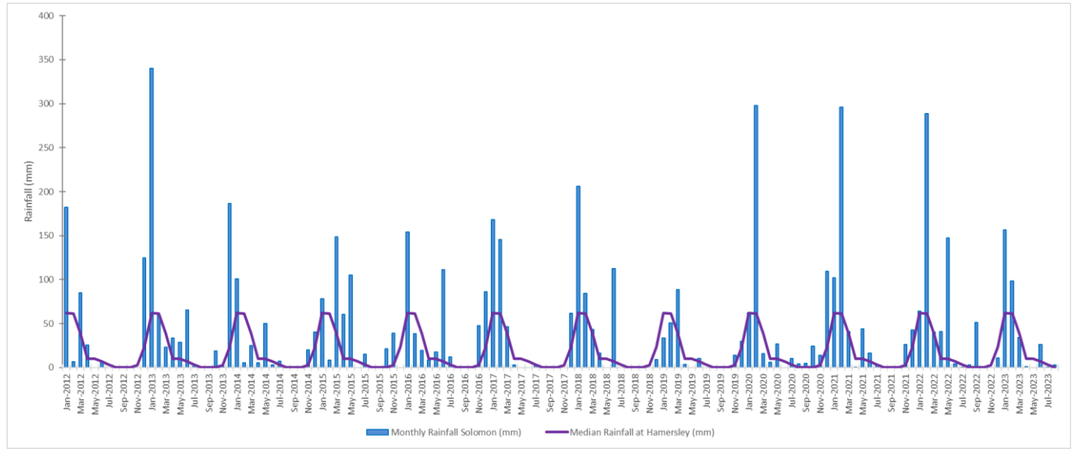
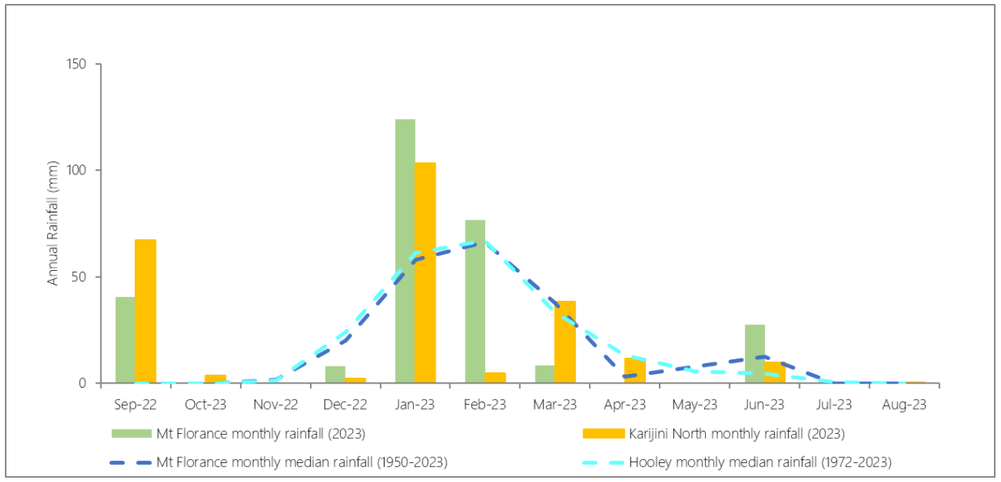
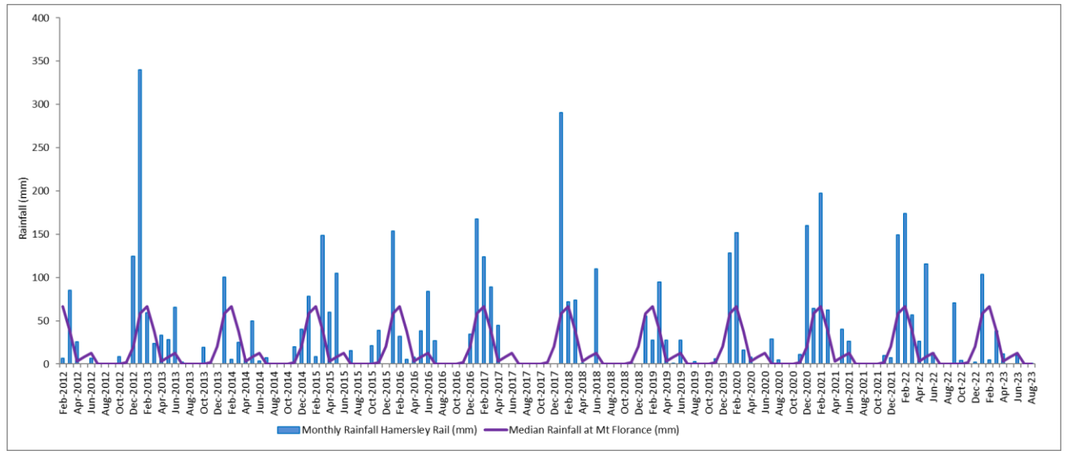
Site Name	Site Type	Easting	Northing	Details
EM GAB I1	Conservation significant bird site	481238	7513536	20 minutes searches
EM GAB I2	Conservation significant bird site	496092	7509079	20 minutes searches
EM GAB I3	Conservation significant bird site	479167	7513414	20 minutes searches
Eliwana Line Rail				
ER MiB I1	Conservation significant bird site	527232	7526781	20 minutes searches
ER MiB I2	Conservation significant bird site	535849	7527267	20 minutes searches
ER MiB I3	Conservation significant bird site	563850	7532161	20 minutes searches
ER GAB I1	Conservation significant bird site	527297	7526851	20 minutes searches
ER GAB I2	Conservation significant bird site	535642	7527275	20 minutes searches
ER GAB I3	Conservation significant bird site	563819	7532606	20 minutes searches
Rehabilitation Areas				
Rehabilitation Control				
CB/CC RE C01	Rehabilitation Site Control	774767	7525506	1 MC for three months and searches
CB/CC RE VAS01 C1	Rehabilitation Site Control	781027	7526578	1 MC for three months and searches
CB/CC RE C05	Rehabilitation Site Control	735586	7526813	1 MC for three months and searches
ER RE C02	Rehabilitation Site Control	514305	7511985	1 MC for three months and searches
HL RE C63	Rehabilitation Site Control	612954	7548078	1 MC for three months and searches
HL RE C87	Rehabilitation Site Control	673236	7560244	1 MC for three months and searches
HL RE C74	Rehabilitation Site Control	649456	7563705	1 MC for three months and searches
MR RE C37	Rehabilitation Site Control	694149	7594919	1 MC for three months and searches
MR RE C92	Rehabilitation Site Control	700786	7584357	1 MC for three months and searches
NS RE C2 (NS MC I3)	Rehabilitation Site Control	713605	7644609	1 MC for three months and searches
NS RE C3 (NS NQ I1 MC 6)	Rehabilitation Site Control	712239	7650467	1 MC for three months and searches
NS RE C6 (NS MC I1)	Rehabilitation Site Control	711967	7653971	1 MC for three months and searches
SM RE C11	Rehabilitation Site Control	602275	7549340	1 MC for three months and searches
SM RE C10	Rehabilitation Site Control	600088	7552156	1 MC for three months and searches
Cloudbreak				
CB Re 05	Rehabilitation Site	748902	7528856	1 MC for three months and searches
CB Re Cocos WD1	Rehabilitation Site	758142	7527251	1 MC for three months and searches
CB Re Cocos WD2	Rehabilitation Site	758165	7527259	1 MC for three months and searches
Christmas Creek				
CC Re 01	Rehabilitation Site	774789	7525354	1 MC for three months and searches
CC Re 02	Rehabilitation Site	772741	7524428	1 MC for three months and searches
CC Re VAS 01	Rehabilitation Site	781293	7526436	1 MC for three months and searches
Solomon Hub				
SM Re 06	Rehabilitation Site	589783	7554092	1 MC for three months and searches
SM Re 10	Rehabilitation Site	599259	7552177	1 MC for three months and searches
SM Re 11	Rehabilitation Site	598377	7551853	1 MC for three months and searches
Hamersley Line Rail				
HL Re 63	Rehabilitation Site	606745	7546194	1 MC for three months and searches
HL Re 74	Rehabilitation Site	642821	7561263	1 MC for three months and searches
HL Re 87	Rehabilitation Site	686970	7566681	1 MC for three months and searches
Main Line Rail				
MR Re 01	Rehabilitation Site	684792	7654808	1 MC for three months and searches

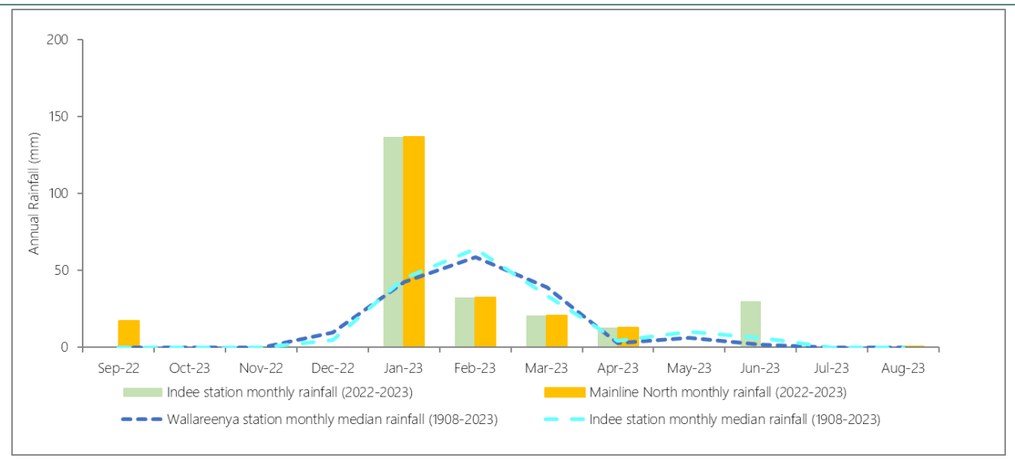
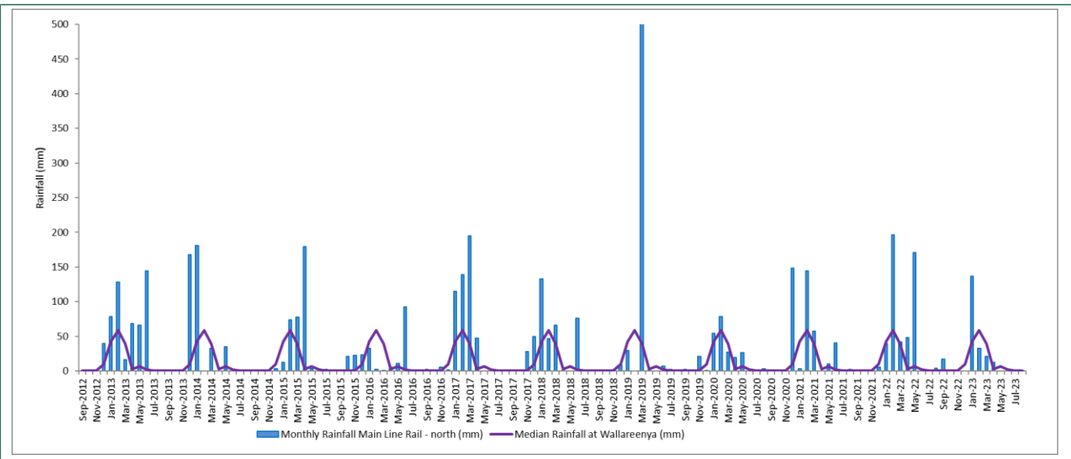
Site Name	Site Type	Easting	Northing	Details
MR Re 37	Rehabilitation Site	694150	7594920	1 MC for three months and searches
MR Re 92	Rehabilitation Site	703012	7577854	1 MC for three months and searches
Eliwana Mine				
EM RE 01	Rehabilitation Site	489241	7519093	1 MC for three months and searches
Eliwana Line Rail				
ER RE 01	Rehabilitation Site	603837	7545668	1 MC for three months and searches
ER RE 02	Rehabilitation Site	503264	7518052	1 MC for three months and searches
ER RE 03	Rehabilitation Site	527998	7526508	1 MC for three months and searches
North Star				
NS RE 02	Rehabilitation Site	713584	7644561	1 MC for three months and searches
NS RE 03	Rehabilitation Site	712501	7650606	1 MC for three months and searches
NS RE 06	Rehabilitation Site	711392	7653577	1 MC for three months and searches
Culvert Monitoring				
Hamersley Line Rail				
HL Cu 01	Culvert Monitoring	700703	7583200	1 MC for three months and searches
HL Cu 02	Culvert Monitoring	700703	7583170	1 MC for three months and searches
HL Cu 03	Culvert Monitoring	700561	7582773	1 MC for three months and searches
HL Cu 04	Culvert Monitoring	700562	7582778	1 MC for three months and searches
HL Cu 05	Culvert Monitoring	681042	7561816	1 MC for three months and searches
Main Line Rail				
MR Cu 01	Culvert / Red Fox	692867	7634878	1 MC for three months and searches
MR Cu 02	Culvert / Red Fox	685705	7650710	1 MC for three months and searches
MR Cu 04	Culvert / Red Fox	675256	7682298	1 MC for three months and searches
MR Cu 05	Culvert / Red Fox	694480	7628790	1 MC for three months and searches
MR Cu 06	Culvert / Red Fox	709501	7572421	1 MC for three months and searches
MR Cu 07	Culvert / Red Fox	695248	7626242	1 MC for three months and searches
MR Cu 08	Culvert / Red Fox	696138	7622709	1 MC for three months and searches
MR Cu 10	Culvert / Red Fox	666505	7708560	1 MC for three months and searches
MR CU 11	Culvert / Red Fox	704479	7576096	1 MC for three months and searches
MR CU 12	Culvert / Red Fox	686832	7648120	1 MC for three months and searches
Eliwana Mine				
ER CU 01	Culvert / Red Fox	504520	7518428	1 MC for three months and searches
ER CU 02	Culvert / Red Fox	527273	7526519	1 MC for three months and searches
ER CU 03	Culvert / Red Fox	513088	7521974	1 MC for three months and searches

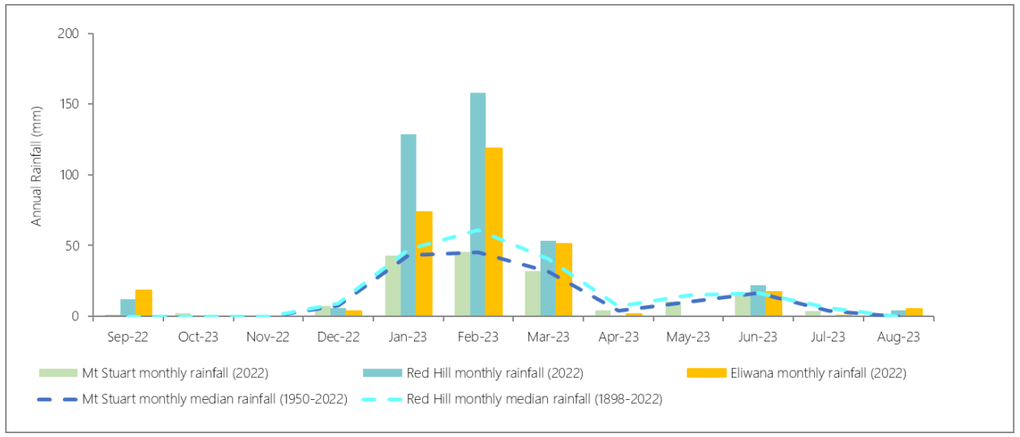
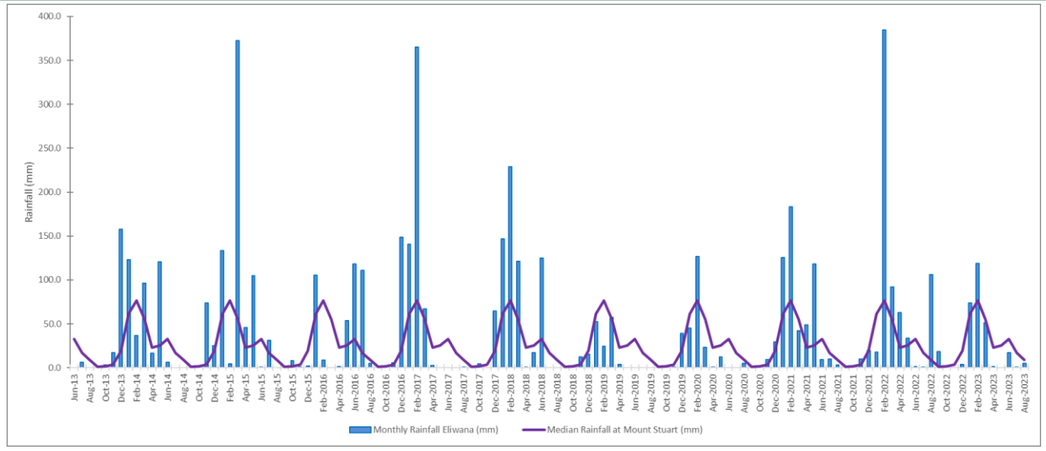
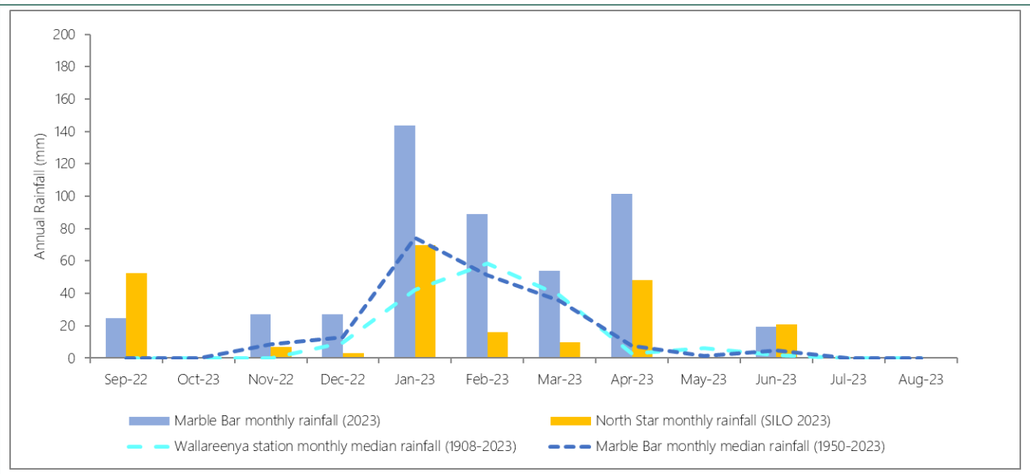
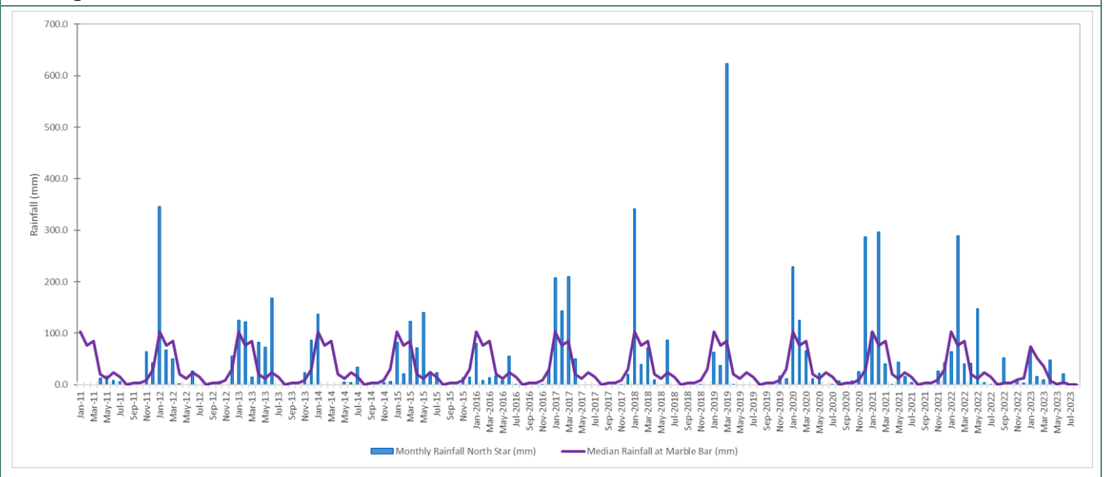
Appendix D: Climate Data

Table 5.2: Rainfall recorded at each site since the start of monitoring

Site	Current monitoring period	Long-term rainfall (median and actual)
Cloudbreak	 • Sep 2022 unusually wet conditions • Dec 2022 - Feb 2023: average rainfall for this region – typical wet season conditions • Mar 2023: very patchy above average rainfall recorded from Newman, but not Cloudbreak • Dry season typical conditions	 • Below average rainfall 2015 - 2020 and 2023 • Large rainfall events during the wet season in 2012-2014, 2021 and 2022
Christmas Creek & Nullagine	 • Sep 2022 unusually wet conditions • Slightly above average rainfall in Dec 2022: but typical rainfall for remainder of wet season and dry season • Mar 2023: very patchy above average rainfall recorded from Newman, but not Christmas Creek	 • High wet season rainfall totals in Jan 2012, Jan 2014, Jan 2020 and Jan 2022

Solomon Hub	 • Sep 2022 unusually wet conditions • Jan - Feb 2023: 130.5 mm above average rainfall • Wet conditions in June 2023 (untypical for dry season)	 • Most years received above average rainfall during wet season, apart from 2019 • 2019 driest year since 2012
Hamersley Rail Line	 • Sep 2022 unusually wet conditions • Jan 2023: above average rainfall with patchy rainfall in Feb 2023, remainder of wet season relatively dry • Above average conditions recorded in Jun 2023 (untypical for dry season)	 • Concentrated and above average rainfall in Jan 2013 and Jan 2018 • Above average rainfall in wet seasons 2020-2021 and 2021-2022, below average in wet season 2022/2023

Main Line Rail (north)	 • Sep 2022 some unusual rainfall • Jan 2023: High rainfall event; 92 mm above median rainfall for the region, but below average rainfall for remainder of wet season	 • Dry conditions in 2016 and 2020 • Above average rainfall in wet seasons 2021 and 2022
Main Line Rail (south)	 • Sep 2022 some unusual rainfall • Jan 2023: High rainfall event; 39 mm above median rainfall for the region, but below average rainfall for remainder of wet season • Jun 2023 unusual rainfall for dry season	 • Low rainfall/dry conditions in 2015, 2016, 2019 and 2020 • Very high rainfall in January and September 2022

Eliwana	 • Above average wet season in 2023 • Typical dry season	 • Above average wet season rainfall in 2020, 2021 and 2022 • High rainfall months in Mar 2015, and Feb 2017 and Feb 2022
North Star	 • Sep 2022 some unusual rainfall • Below average wet season, in particular Feb and Mar 2023 • Large rainfall events in Apr 2023 and some untypical dry season rainfall in Jun 2023	 • Wetter than average wet seasons 2017 - 2022

Appendix E: Site-Based Records (BMS)

Table 5.3: Site-based records of conservation significant fauna

Species recorded	Incidence number	Location	Date	Easting	Northing	Details	Verified
Cloudbreak							
Greater Bilby							
Bilby	PAR-4406	Haul Road	16/04/22	119.45	-22.34	Sighting	Unconfirmed
Grey Falcon							
Grey Falcon	PAR-1758	Pit/Norfolk	22/11/16	736574	7530562	Sighting	Probable confirmed
Christmas Creek							
Pilbara Olive Python							
Pilbara Olive Python	PAR-258	Roads	4/8/11	-	-	1 individual	Unconfirmed
Pilbara Olive Python	PAR-702	Mokare Pit	8/10/13	768158	7519769	1 individual	Confirmed
Pilbara Olive Python	PAR-770	Karntama Camp	5/3/14	-	-	1 individual	Probable confirmed
Pilbara Olive Python	PAR-1629	-	5/5/16	792409	7521611	Individual relocated	Confirmed
Pilbara Olive Python	PAR-1887	-	14/4/17	786269	7525412	Sighting	Confirmed
Pilbara Olive Python	PAR-2114	CCY2 Workshop	20/4/18	789662*	7517430*	Relocation	Confirmed
Pilbara Olive Python	INC-69479	Mokare Haul Road	15/01/19	-	-	Roadkill	Confirmed
Pilbara Olive Python	INC-100437	-	02/09/22	801227	7516709	Individual found in an excavator, relocated to Newman Vet for further care and release	Confirmed
Greater Bilby							
Greater Bilby	PAR-1905	Christmas Creek	17/5/17	790140	7519160	Sighting	Confirmed
Greater Bilby	PAR-2439	U Road, 100m west of YC2 monitoring point.	10/03/19	787651	7516336	Sighting	Probable confirmed
	PAR-2595	Christmas Creek	25/07/19	776822	7521622	Sighting	Confirmed
Grey Falcon							
Grey Falcon	PAR-1643	Christmas Creek	28/5/16	790081	7517741	Sighting	Probable confirmed
Solomon Hub							
Northern Quoll							
Northern Quoll	PAR-1608	Between Trinity Fuel Farm and Trinity Overpass	31/3/16	588919	7552971	1 individual	Unconfirmed

Species recorded	Incidence number	Location	Date	Easting	Northing	Details	Verified
	INC-52451	Kings OPF	5/5/16	590928*	7554466*	1 individual died in hydrocarbon bin	Confirmed
	PAR-1760	Kings OPF, Crib	29/11/16	590350*	7554616*	Sighting	Unconfirmed
	PAR-1763	Kings OPF, compound 2	2/12/16	590350*	7554616*	Sighting	Unconfirmed
Northern Quoll	INC-61299	Trinity Mine Area	6/10/17	588624*	7553134*	Fauna Death (Female)	Confirmed
	PAR-2142	Kings OPF	26/5/17	590520	7554631	Sighting	Confirmed
	INC-58966	Firetail South	27/05/17	593289	7553166	Fauna Death (Male)	Confirmed
	PAR-1958	Castle Road	2/8/17	588646	7552714	Sighting	Unconfirmed
	PAR-1946	Trinity Drive	18/7/17	588930	7552980	Sighting	Unconfirmed
	INC-60700	Firetail South	1/9/17	592422	7552599	Fauna Death (Male)	Confirmed
	INC-61299	Trinity/Apostle LV Access Road	6/10/17	-	-	Fauna Death	Confirmed
Northern Quoll	INC-63547	Trinity Tunnel	11/2/18	588968	7552919	Fauna Death	Confirmed
	PAR-2090	Kings OPF	26/3/18	590413	7554711	Sighting	Probable confirmed
	PAR-21110	Trinity Mine	15/4/18	588753	7552892	Sighting	Confirmed
	INC-64731	Firetail South	18/4/18	592420	7552828	Fauna Death (Male)	Confirmed
	PAR-2228	Overland Conveyor	18/9/18	-	-	Sighting	Probable confirmed
Northern Quoll	INC-73302	Joffre	01/08/19	593084	7555511	Roadkill	Confirmed
	INC-76237	Simpson Drive	13/12/19	592311	7554141	Dead on road	Confirmed
Northern Quoll	PAR-3457	-	19/02/21	589452	7550660	Sighting	Confirmed
	PAR-3588	-	29/03/21	591061	7554334	Sighting	Confirmed
	PAR-3599	Kings OPF	1/04/21	591564	7554017	Sighting	Confirmed
	PAR-3835	Trinity Drive	19/07/21	590285	7554667	Sighting	Confirmed
Northern Quoll	PAR-4245	Kings ROM	18/01/22	-	-	Sighting	Unconfirmed
	PAR-4366	Kings OPF	27/03/22	590851	7554568	Sighting	Confirmed
	PAR-4410	Kings OPF	16/04/22	590715	7554621	Sighting	Confirmed
	PAR-4517	Kings mining area	25/06/22	590593	7549476	Sighting	Confirmed
	INC-99636, PAR-4852	Queens mining area	2/08/22	579113	7553275	Fauna death – struck by vehicle on haul road	Confirmed

Species recorded	Incidence number	Location	Date	Easting	Northing	Details	Verified
	PAR-4827	Behind Bioremediation	14/12/22	585333	7551756	Sighting	Confirmed
Northern Quoll	INC-109766	Valley of the Queens	24/08/23	579441	7552997	Fauna death	Confirmed
	PAR-5044	Kings Valley Road	05/04/23	588344	7549114	A single adult quoll	Confirmed
	PAR-5067	Fredericks Road	15/04/23	592546	7543175	Sighting	Unconfirmed
Pilbara Olive Python							
Pilbara Olive Python	INC-44892, PAR-1178	Trinity Drive	2/3/15	587358	7551848	1 individual	Unconfirmed, fauna death
	PAR-1237	Craigies gorge	14/4/15	597153	7553206	1 individual	Probable confirmed, relocated
Pilbara Olive Python	PAR-1432	Kangi Village (Ring Road adjacent Wet Mess)	14/10/15	583803*	7542706*	1 individual	Probable confirmed, relocated
Pilbara Olive Python	PAR-1432	Kangi Village (Ring Road adjacent Wet Mess)	14/10/15	583803*	7542706*	1 individual	Probable confirmed, relocated
	PAR-1483	Firetail	19/11/15	597450	7551552	2 individuals	Probable confirmed, relocated
Pilbara Olive Python	PAR-1556	Explosives Storage Facility	7/2/2016	585490	7552283	1 individual	Probable confirmed, relocated
	PAR-1752	Kings Mining	11/11/16	590642	7549015	1 individual	Confirmed
Pilbara Olive Python	PAR-1804	Kangi Camp	20/1/17	583560	7542359	1 individual	Confirmed
	PAR-1819	Kings OPF	6/2/17	582003	7551289	Relocation	Confirmed
	PAR-1844	Kangi Camp	6/3/17	583749	7542526	Relocation	Confirmed
	PAR-1858	Dally Camp	18/3/17	585408	7543632	Relocation	Confirmed
	PAR-1891	Kings OPF	26/4/17	590375	7554652	Sighting	Confirmed
	PAR-2008	Simpson Drive	2/12/17	-	-	Sighting	Unconfirmed
	PAR-2017	Solomon	24/12/17	588290	7559174	-	-
Pilbara Olive Python	PAR-2086	Firetail south	25/3/18	-	-	Sighting	Probable confirmed
	PAR-2131	Kangeenarina Creek, near OPF	14/5/18	590311	7554774	Relocation	Confirmed
	PAR-2168	Kings	3/7/18	589693	7550233	Relocation	Confirmed
Pilbara Olive Python	PAR-2346	Trinity	12/01/19	-	-	Relocation	Confirmed
	PAR-2463	Kings	30/3/19	589077*	7552680*	Relocation	Confirmed
	PAR-2447	Kangi Camp	19/03/19	-	-	Relocation	Confirmed

Species recorded	Incidence number	Location	Date	Easting	Northing	Details	Verified
	PAR-2514	Solomon – Kings/Zalamea	18/05/19	595407	7545791	Relocation	Confirmed
Pilbara Olive Python	PAR-2761	Solomon	05/01/20	-	-	Relocation	Confirmed
	PAR-2836	Kangi Camp	13/02/20	-	-	Relocation	Probable confirmed
	PAR-2839	Kings OPF	15/02/20	-	-	Relocation	Confirmed
	INC-77832	Trinity Drive	23/2/20	-	-	Fauna death	Confirmed
	PAR-2910	Dally Camp	23/03/20	-	-	Relocation	Probable confirmed
	PAR-2925	LV Workshop	28/03/20	-	-	Relocation	Confirmed
Pilbara Olive Python	INC-87722/ PAR-3612	Solomon – Valley of the Kings	01/04/21	594656	7648637	Fauna death	Confirmed
Pilbara Olive Python	PAR-4250	Queens mining area	24/01/22	579081	7553299	Sighting	Probable confirmed
	PAR-4289	Firetail OPF	14/02/22	594879	7552497	Relocation to Kangi Creek	Confirmed
	PAR-4354	Kangi Camp	20/03/22	583922	7542451	Relocation to Kangi Creek	Confirmed
Pilbara Olive Python	PAR-4936	Kangi ESO medical carpark	12/02/23	583960	7542415	Relocation	Confirmed
	PAR-5096	Sol - Laboratory	28/04/23	117.87810	-22.10814	Relocation	Unconfirmed
	PAR-5109	Kangi Camp - Old WWTP	02/05/23	590387.3	7556067	Relocation	Confirmed
	PAR-5166	Solomon	22/05/23	558862	7564259	Sighting	Unconfirmed
	PAR-5312	Firetail OPF	19/08/23	596670	7551870	Relocation	Confirmed
Pilbara Leaf-nosed Bat							
Pilbara Leaf-nosed Bat	PAR-1598	Solomon	15/3/16	573663	7541495	Sighting	Unconfirmed
Peregrine Falcon							
Peregrine Falcon	INC-49550	Firetail OPF	25/11/15	-	-	-	Probable confirmed, fauna death
Hamersley Line Rail							
Northern Quoll							
Northern Quoll	-	Rail/culvert	01/04/2019	654288	7563640	Scats	Confirmed
Grey Falcon							
Grey Falcon	PAR-4177	Rail/Comms Tower	21/11/2021	685820	7566241	two adults and one juvenile	Confirmed
Main Line Rail							
Northern Quoll							
Northern Quoll	INC-80847	Rail – Mainline (CB/CC)	04/07/20	673777	7696607	Fauna death	Confirmed

Species recorded	Incidence number	Location	Date	Easting	Northing	Details	Verified
Northern Quoll	INC-89989	Rail – Mainline (CB/CC)	12/05/21	671577	7701118	Fauna death	Confirmed
	PAR-3850	Under bridge	01/08/21	677097	7674953	Fauna death	Confirmed
Northern Quoll	PAR-4360	Thomas Yard locomotive workshop	23/03/22			Sighting	Unconfirmed
	INC-98290 / PAR-4483	Rail (51km; CB/CC)	07/06/22	672913	7699686	Fauna death	Confirmed
Spectacled Hare-wallaby							
Spectacled Hare-wallaby	INC-92452	Thomas Yard	11/10/2021	665694	7731444	Fauna death	Confirmed
Nullagine							
Care and Maintenance – no traffic							
Eliwana Mine and Rail							
Northern Quoll							
Northern Quoll	PAR-4394	Access Roads	14/05/22	482825	7515739	Sighting	
Northern Quoll	TBA	Mine Area	25/09/23	485862	7513745	Sighting	
Pilbara Olive Python							
Pilbara Olive Python	PAR-2514	Solomon – Kings/Zalamea	18/05/19	595407	7545791	Relocation	Confirmed
	PAR-2642	Eliwana	22/8/19	482990	7512294	Sighting	Confirmed
Pilbara Olive Python	PAR-2902	Fly Camp	14/03/20	492665	7512418	Sighting	Unconfirmed
	PAR-2921	Eliwana Line Rail spur	26/03/20	565805	7539097	Relocation	Confirmed
	INC-78727	Eliwana Construction	18/3/20	483187	7520566	Fauna death	Confirmed
	PAR-3011	Eliwana	7/5/20	-	-	Sighting	Confirmed
	PAR-3206	Eliwana Line Rail spur	19/09/20	557784	7533047	Sighting	Confirmed
	PAR-3238	Eliwana Spur	18/10/20	563509	7532292	Relocation	Confirmed
	PAR-4782	Kangaroo Gorge	06/11/22	481660	7513977	Sighting	Probable confirmed
	PAR-4814	Flying Fish Area	30/11/22	503323	7511664	Relocation	Confirmed
Pilbara Olive Python	INC-94628	Eliwana access roads	10/01/22	482914	7520839	Fauna death	Confirmed
	PAR-4346	OPF	16/03/22	482444	7515310	Sighting	Probable confirmed
	PAR-4782	Eliwana	06/11/22	481660	7513977	Sighting	Confirmed
	PAR-4814	EW – Flying Fish	30/11/22	503323	7511664	Relocation	Confirmed

Species recorded	Incidence number	Location	Date	Easting	Northing	Details	Verified
	PAR-4859	EW – Flying Fish	23/11/22	503340	7511601	Sighting	Confirmed
Pilbara Olive Python	PAR-4867	Kangaroo Gorge	16/01/23	481657	7512853	Sighting	Probable confirmed
Ghost Bat							
Ghost Bat	PAR-939	Eliwana	27/08/2014	503413	7511623	Sighting	Confirmed
North Star							
Northern Quoll							
Northern Quoll	PAR-1197	-	21/3/15	7647791	712555	1 individual	Probable confirmed
	INC-44740	-	24/2/15	712542	7647772	Female road kill (PIT 941000016595479)	Confirmed, microchip scanned
	INC-48890	-	19/10/15	712221	7649994	Male road kill (PIT 941 000017452061)	Confirmed, microchip scanned
Northern Quoll	INC-51653	-	15/3/16	712469	7648013	Female road kill, no microchip	Confirmed, submitted to DpaW
Northern Quoll	PAR-2296	West of southern control area	14/12/18	709597	7645073	Sighting	Probably confirmed
Northern Quoll	INC-82565	Near Pad NS0784	10/09/20	713661	7648904	Fauna death	Confirmed
Northern Quoll	INC-91111	North ramp road	20/08/21	712855	7649038	Male road kill, no microchip	Confirmed
	PAR-3790	-	09/07/21	713263	7643859	Sighting	Confirmed
Northern Quoll	PAR-4399	Chateau Cave	4/04/22	713158	7648110	Sighting	Confirmed
	PAR-4508	MPK laydown	9/05/22	695531	7649829	Fauna death	Confirmed
	PAR-4449	IB - pipeline	19/6/22	665861	7731600	Sighting	Confirmed
	PAR-4586	North Star mine pit	6/08/22	712850	7647800	Sighting	Confirmed
	PAR-4743	Falls Pound Area	6/10/22	712924	7658578	Sighting	Confirmed
	PAR-5013	Dalton Creek Roost	07/12/2022	731122	7624956	Camera Recording	Confirmed
Northern Quoll	INC-104383	Concentrate Pipeline	26/01/23	696641	7649653	Female, fauna death	Confirmed
	PAR-5041	Primary crusher A	04/04/23	712678	7648093	Sighting/Photo ID	Confirmed
	INC-106901 / PAR-5102	Mine Access Road	30/04/23	708642	7647072	Fauna death	Confirmed
	PAR-5197	Drill pattern	05/06/23	713024	7649134	Sighting	Probable confirmed
	INC-108275	Airport Access Road	25/06/23	-	-	Fauna death	Confirmed

Species recorded	Incidence number	Location	Date	Easting	Northing	Details	Verified
	INC-108529	Drill and Blast Laydown	05/07/23	707705	7648814	Male, fauna death	Confirmed
	PAR-5264	Chateau Cave	11/07/23	713158	7648110	Sighting	Probable confirmed
	INC-109015	Mine Access Road	26/07/23	710761	7647488	Male, fauna death	Confirmed
	INC-109650	Mine	20/08/23	712049	7648646	Male, fauna death	Confirmed
Pilbara Olive Python							
Pilbara Olive Python	INC-43357	-	26/12/14	-	-	1 individual (2m TL), road kill on haul road	Confirmed
Pilbara Olive Python	PAR-1128	-	25/1/15	7648451	708829	1 individual	Confirmed
	PAR-1133	-	26/1/15	7650318	713354	1 individual	Confirmed
	PAR-1180	-	10/2/15	708186	7648219	3 individuals, relocated to 711068mE, 7647951mN	Probable confirmed
	PAR-1179	-	24/2/15	708152	7648236	1 individual, relocated to 711046mE, 7647980mN	Confirmed
	PAR-1254	-	24/4/15	7647975	706327	1 individual	Confirmed
Pilbara Olive Python	PAR-1712	-	16/9/16	713241	7643861	Sighting	Confirmed
Pilbara Olive Python	PAR-1814	-	2/2/17	708110#	7646951#	Relocation	Confirmed
	INC-60631	-	25/8/17	-	-	-	Confirmed?
Pilbara Olive Python	PAR-3103	-	20/07/20	-	-	Sighting	Confirmed
Pilbara Olive Python	PAR-4059	Bore 19	20/10/21	290840 715644#	7647124 7649319#	Relocation	Confirmed
Pilbara Olive Python	PAR-4115	Camp pool	10/11/21	712623	7655538	Sighting	Confirmed
Pilbara Olive Python	PAR 4257	Ops OPF Office	30/01/22	713474	7650278	Relocated to Site 12 entrance	Confirmed
	PAR 4279	-	10/02/22	715759#	7649294#	Relocated to Site 12 Pool	Confirmed
	PAR 4313	Japal Village	28/02/22	711728#	7650683#	Relocated to Fig Pool	Confirmed
	PAR-4401	Primary Crusher B Rom	15/04/22	712779	7647271	Relocated to Cockatoo Creek (704124mE, 7647023mN)	Confirmed
	PAR-4442	Primary and Secondary Crushing A	28/04/22	118°58'5.29"E	21°16'5.294"S	Relocated	Confirmed
	PAR 4734	Japal Camp	8/10/22	707256#	7648941#	Relocated	Confirmed
	PAR-4832	Dirty Water Pool	20/12/22	718265	7655596	Sighting	Confirmed

Species recorded	Incidence number	Location	Date	Easting	Northing	Details	Verified
Pilbara Olive Python	PAR-5010	MESA Ramp	15/03/23	711967	7648601	Sighting	Unconfirmed
Pilbara Leaf-nosed Bat							
Pilbara Leaf-nosed Bat	INC-61532	-	14/6/17	-	-	Death of animal during Environmental Survey (Radio-tracking)	Confirmed
Ghost Bat							
Ghost Bat	PAR-1937	-	29/6/17	n/a	n/a	Sighting	Unconfirmed
Ghost Bat	PAR-1862	-	21/3/17	n/a	n/a	Sighting	Unconfirmed
Ghost Bat	PAR-4096	Cave NW-088	05/11/21	703166	7650129	Sighting	Probable confirmed
Ghost Bat	PAR-4288	Cav rha5a	14/02/22	724484	7619030	Sighting	Confirmed
Western Pebble-mound Mouse							
Western Pebble-mound Mouse	PAR-2764	Ironbridge	07/01/20	-	-	Sighting	Confirmed

Datum GDA94, Zone 50K, *estimated co-ordinates, #relocation co-ordinates (original site unknown)

[1] individual was previously recorded during monitoring (PIT 991 0030 0017 4907) and relocated to Kangeenarina Creek

Appendix F: Northern Quoll Details

Table 5.4: Total number of Northern Quoll captures recorded from each site

Project/Site	Individuals recorded											
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Control Sites												
Solomon control sites												
SM NQ C1	N/A	N/A	N/A	P	1	P	P	0	0	0	1*	0
SM NQ C2	N/A	N/A	N/A	P	1	P	2	2[MC]	0	0	1*	0
SM NQ C3	N/A	N/A	N/A	N/A	0	0	0	2[R]	0	0	1*	0
Total Solomon control	N/A	N/A	N/A	2	2	2	3	3	0	0	3	0
Hamersley Line Rail												
HL NQ C1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	0	0
HL NQ C2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	2[MC]	5[MC]
HL NQ C3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	0	0
Total Hamersley Line Rail	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0*	2	5
Eliwana Mine and Rail												
EMR NQ C1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-	N/A	0	1[MC]	0
EMR NQ C2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-	N/A	7[MC]	6[MC]	6[MC]
EMR NQ C3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-	N/A	0	0	0
Total Eliwana Mine and Rail	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-	N/A	7	7	6
North Star control sites												
NS NQ C2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1	6	4
NS NQ C3	N/A	N/A	1	0	0	4	2	N/A	N/A	1	5	4
NS NQ C4	N/A	N/A	1	4	3	5	5	N/A	N/A	6	0	1
Total North Star control	N/A	N/A	2	4	3	9	7	-	-	8	11	9
Total control sites	**-**	**-**	**2**	**6**	**5**	**11**	**10**	**3**	**0**	**15**	**23**	**20**
Potential Impact Sites												
Solomon Hub												
SM NQ I1	0	3	3	P	4	2	6	2	2	1	1[MC]	0
SM NQ I2	0	0	1	0	0	2	1[MC]	2	0	0	0	0
SM NQ I3	0	0	0	-	1	0	3[R]	2	0	0	1[MC]	1
Total Solomon Hub	0	3	4	1*	4[R]	4	9	6	2	1	2	1
Hamersley Line Rail												
HL NQ I1	0	P	1	P	0	0	0	0	0	0	0	0
HL NQ I2	1	1	2	P	P	0	0	0	0	0	0	0
HL NQ I3	0	4	2	P	P	0	0	0	0	0	1 + 2[MC]	1[MC]
Total Hamersley Line Rail	1	6	5	3*	2	0	0	0	0	0	3	1
Main Line Rail												
MR NQ I1	0	P	0	P	0	0	1	0	7	4	N/A	N/A
MR NQ I2	P	2	1	0	0	2	4	4	3	3	N/A	N/A
MR NQ I3	P	0	1	P	1	3	P	1	0	0	N/A	N/A
Total Main Line Rail	2	3	2	2*	1	5	6	5	10	7	N/A	N/A

Project/Site	Individuals recorded											
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Eliwana Mine												
EM NQ I1	0	N/A	N/A	N/A	N/A	N/A	N/A	0	N/A	0*	0*	0
EM NQ I2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	N/A	0*	0*	0
EM NQ I3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	N/A	0*	2[MC]	2[MC]
EM NQ I4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	2[MC]
Total Eliwana Mine	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	N/A	0*	2	4
Eliwana Line Rail												
ER NQ I1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	N/A	0*	0*	0
ER NQ I2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	N/A	0*	0*	0
ER NQ I3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	N/A	0*	0*	0
Total Eliwana Line Rail	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	N/A	0*	0*	0
North Star												
NS NQ I1	N/A	N/A	2	3	4	0	0	0	0	1	1	4
NS NQ I2 (former NS NQ C1)	N/A	N/A	2	2	2	4	1	1	2	0	5	3
NS NQ I3 (2019-2020)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	1	3	3	7
NS NQ I4	N/A	N/A	2	3	0	2	1	2	2[MC]	1	1	7
Total North Star			9	9	5	3	2	3	5	5	10	21
Total impact sites#	**3**	**12**	**20**	**15**	**11**	**12**	**17**	**14**	**17**	**13**	**17**	**27**

P= Presence of species recorded through secondary evidence only, for count purposes the record has been counted as one individual; * no trapping conducted, use of motion cameras and searches did not allow for individual count; [MC] Recorded on motion camera only; [R] individual was previously trapped at another site, # not all previous monitoring sites shown as some sites were discontinued.

Table 5.5: Northern Quolls recorded at Nullagine

Site name	2017	2018	2019	2021	2022	2023	Estimated number of NQ recorded 2023	Estimated number of resident NQ	Dates of recordings 2023
Bonnie East									
NU BE MC1	-	✓	-	✓	✓	✓	1	1 (male)	23/06/23, 25/06/23, 13/07/23, 15/07/23
NU BE MC2	-	✓	✓	✓	✓	✓	4-5	3 (1x female)	24/06/23, 26/06/23, 28-29/06/23, 01-04/07/23, 05/07/2023, 09/07/2023, 11/07/2023, 13/07/23, 16/07/23, 18-21/07/23
NU BE MC3	-	✓	✓	✓	✓	✓	4-5	3	23/06/23, 25-26/06/23, 28/06/23, 30/06/23, 03/07/23, 08/07/23, 19/07/23
NU BE MC4	-	✓	✓	✓	✓	✓	1	0	25/06/23, 27/06/23
NU BE MC5	-	✓	✓	✓	✓	✓	3-4	2 (1x female)	25-27/06/23, 29/06/23, 01-02/07/23, 04 & 06/07/23, 09/07/23, 16/07/2023, 18-19/07/2023,
NU BE MC6	-	✓	✓	✓	✓	-	0	0	-
NU BE MC7	-	✓	-	✓	-	✓	2-3	2	23-25/06/2023, 27-30/06/23, 01-02/07/23, 16/07/23
NU BE MC8	-	✓	✓	✓	✓	✓	1	1	23-24/06/23, 27/06/23
NU BE MC9	✓	✓	✓	✓	✓	✓	2-3	2 (1x female)	24-26/06/23, 28/06/23, 03/07/23
NU BE MC10	-	✓	✓	✓	✓	✓	2	1 (female)	23, 24, 26, 27, 29, 30/06/23, 01 & 04/07/2023
Warrigal									
NU W MC1	-	-	-	-	✓	✓	1	1 (male)	28/06/23, 8/07/23, 10/07/23, 21/07/23
NU W MC2	-	-	-	-	-	✓	1	0	26/6/23
NU W MC3	-	✓	✓	✓	✓	✓	1	0	30/6/23, 11/7/23
NU W MC4	-	✓	-	-	-	✓	2	1 (female)	30/06/23, 1/07/23, 3-4/07/2023, 13/07/23, 15/07/23
NU W MC5	-	-	-	-	-	-	-	-	-
NU W MC6	-	✓	-	✓	✓	✓	1	0	30/6/23
NU W MC7	-	✓	✓	-	-	✓	1	0	28/6/23, 29/6/23

NU W MC8	-	✓	-	✓	-	✓	1	0	01/07/23, 17/7/23
NU W MC9	-	✓	✓	-	-	✓	3	1 (female)	24/06/23, 25/06/23, 26/06/23, 28/6/23, 3/7/23
NU W MC10	-	✓	-	✓	-	✓	2	1 (female)	23-24/06/23, 26-27/06/23, 29/06/23, 30/06/23, 1/07/23

Table 5.6: Historic Northern Quoll records at Nullagine

Management	Survey/Monitoring event	Date	Individuals recorded	Area
BC Iron	Baseline survey (Bamford 2008)	Jun & Oct 2008	12 individuals	Warrigal
	Monitoring Stage 1 (Bamford 2010a)	Sep 2010	0	-
	Monitoring Stage 2 (Bamford 2011)	Jun 2011	0 (scats only)	South of Nullagine, near Bonnie East
	Monitoring Stage 3 (Bamford 2012b)	May 2012	0 (scats only)	West of Nullagine (control)
	Targeted Survey (Bamford 2012b)	Dec 2011	0 (scats from 10 locations)	Coongan, Bonnie East
	Monitoring Stage 4 (Bamford 2013)	May 2013	0	-
	Targeted Survey (Expansion) (Bamford 2014)	Mar – Apr 2014	1 individual	Warrigal
	Monitoring (BC Iron 2016b)	Apr-May 2014	1 individual on 1 MC	Warrigal
		Jun-Oct 2014	2 individuals on 4 MCs	Warrigal
		Mar-Oct 2015	2 individuals on 5 MCs	Warrigal
		Aug-Oct 2015	2 individuals on 4 MCs	Warrigal & Bonnie East
		Jul-Oct 2016	1 individual on 1 MC	Bonnie East
Fortescue	2017 Monitoring (Ecoscape 2018a)	June 2017	1 individual on MC, 1 scat	Bonnie East
	2018 Monitoring	June 2018	13 individuals, 1 scat	Bonnie East
			7 individuals	Warrigal
	2019 Monitoring	Jun 2019	11 individuals, 1 scat	Bonnie East
			3 individuals	Warrigal
	2021 Monitoring	June 2021	10 camera locations	Bonnie East
			4 camera locations	Warrigal
	2022 Monitoring	June 2022	9 camera locations	Bonnie East
			2 camera locations	Warrigal
	2023 Monitoring	June 2023	9 camera locations	Bonnie East
			9 camera locations	Warrigal

Table 5.7: Details of Northern Quoll records at each site to date

ID (Microchip)	Sex	Date	Capture	Site	Trap	Co-ordinates		Weight	Short Pes (mm)	Caudal (mm)	Health Rating (1-5)	Reproductive Status	Comments
						Easting	Northing						
Control Sites													
Control Sites - Solomon Hub													
2012													
NQ 1	-	22/08/12	Motion camera	MC C	-	578019	7546548						
2013													
No records													
2014													
No records													
2015													
Secondary evidence	-	29/07/15	Motion Camera	FC NQ C1	C01	588532	7560316						
Secondary evidence	-	8/08/15	Motion Camera	FC NQ C1	C02	588566	7560202						
Secondary evidence	-	29/07/15	Motion Camera	FC NQ C1	C05	588511	7560348						
Secondary evidence	-	1/08/15	Motion Camera	FC NQ C1	C06	588447	7560404						
Secondary evidence	-	4/08/15	Motion Camera	FC NQ C1	C07	588463	7560432						
Secondary evidence	-	3/08/15	Motion Camera	FC NQ C1	C09	588474	7560455						
Secondary evidence	-	5/08/15	Motion Camera	FC NQ C1	C10	588588	7560161						
Secondary evidence	-	5/08/15	Motion Camera	FC NQ C1	C03	590076	7559696						
Secondary evidence	-	6/08/15	Motion Camera	FC NQ C2	C09	590087	7559677						
2016													
Secondary evidence	-	3/07/16	Motion Camera	FC NQ C1	MC68	588499	7560338						
Secondary evidence	-	4/08/16	Scats	FC NQ C1	C31	588404	7560380						
941000017452037	Male	5/08/16	Capture	FC NQ C1	C19	588484	7560548	420	36.5	14.5	4	Small male, a bit skinny, no signs of fighting	
941000017452041	Male	1/08/16	Capture	FC NQ C2	C12	590501	7559882	400	36.8	19.5	5	Small male, no signs of fighting	
		2/08/16	Recapture		C12	590501	7559882						
Secondary evidence	-	31/07/16	Motion Camera	FC NQ C2	MC63	590467	7559908						
Secondary evidence	-	2/08/16	Motion Camera	FC NQ C2	MC64	590496	7559884						
941000017452046	Female	3/9/16	Capture	FC CR1.3	C04	589726	7556898						
		14/9/16	Recapture		C08	589731	7556981						
941000017452051	Male	2/9/16	Capture	FC CR1.3	C05	589717	7556919						
2017													
Secondary evidence		6/08/17	-	FC NQ C1	opp	588462	7560438						
Secondary evidence		4/08/17	-	FC NQ C2	opp	590433	7559916						
2018													
991 0030 0017 4873	Male	17/07/18	Capture	FC NQ C2	C47	589967	7559653	920	36.5	22	5	No signs of fighting, really big male with lots of body fat	-
		18/07/18	Recapture		C29	590055	7559646						
		19/07/18	Recapture		C25	590021	7559590						
		20/07/18	Recapture		C36	590132	7559753						
No ID	-	19/07/18	Motion Camera	FC NQ C2	MC54	590432	7559933	-	-	-	-	-	Individual not previously captured (no ear notch)
No ID	-	19/07/18	Motion Camera	FC NQ C2	MC55	590478	7559899	-	-	-	-	-	
No ID	-	17/07/18	Skull	FC NQ C1	opp	588454	7560429	-	-	-	-	-	

ID (Microchip)	Sex	Date	Capture	Site	Trap	Co-ordinates		Weight	Short Pes (mm)	Caudal (mm)	Health Rating (1-5)	Reproductive Status	Comments
						Easting	Northing						
2019													
991 0030 0017 4900	Male	11/07/19	Recapture	FC NQ C3	T1	589136	7559637	720	38.0	21.0	5	Previously trapped at impact site SM NQ I3	New site location in 2019
		12/07/19	Recapture		T2	589134	7559675						
991 0030 0017 4905	Male	11/07/19	Capture		T8	589245	7559684	500	38.0	19.0	5	No signs of fighting	-
		12/07/19	Recapture		T14	589375	7559615						
2020													
No records													
2021													
No records													
2022													
-	-	17/07/2022	Motion camera capture	SM NQ C1	MC5	588459	7560447	-	-	-	-	-	-
-	-	18/07/2022	Motion camera capture	SM NQ C2	MC5	590518	7559873	-	-	-	-	-	-
-	-	25/06/2022	Motion camera capture	SM NQ C3	MC5	589788	7559694	-	-	-	-	-	-
Control Sites – Hamersley Line Rail													
2021													
No records													
2022													
-	-	10/07/2022	Motion camera capture	HL NQ C2	MC1	666407	7564093	-	-	-	-	-	-
-	-	11/07/2022	Motion camera capture	HL NQ C2	MC1	666407	7564093	-	-	-	-	-	-
-	-	13/07/2022	Motion camera capture	HL NQ C2	MC1	666407	7564093	-	-	-	-	-	-
-	-	15/07/2022	Motion camera capture	HL NQ C2	MC1	666407	7564093	-	-	-	-	-	-
-	-	18/07/2022	Motion camera capture	HL NQ C2	MC1	666407	7564093	-	-	-	-	-	-
-	-	10/07/2022	Motion camera capture	HL NQ C2	MC2	666414	7564191	-	-	-	-	-	-
-	-	11/07/2022	Motion camera capture	HL NQ C2	MC2	666489	7564267	-	-	-	-	-	-
-	-	12/07/2022	Motion camera capture	HL NQ C2	MC2	666572	7564319	-	-	-	-	-	-
-	-	16/07/2022	Motion camera capture	HL NQ C2	MC2	666594	7564412	-	-	-	-	-	-
-	-	10/07/2022	Motion camera capture	HL NQ C2	MC3	666489	7564267	-	-	-	-	-	-
-	-	11/07/2022	Motion camera capture	HL NQ C2	MC3	666489	7564267	-	-	-	-	-	-
-	-	12/07/2022	Motion camera capture	HL NQ C2	MC3	666489	7564267	-	-	-	-	-	-
-	-	12/07/2022	Motion camera capture	HL NQ C2	MC3	666489	7564267	-	-	-	-	-	-
-	-	13/07/2022	Motion camera capture	HL NQ C2	MC3	666489	7564267	-	-	-	-	-	-
-	-	14/07/2022	Motion camera capture	HL NQ C2	MC3	666489	7564267	-	-	-	-	-	-
-	-	15/07/2022	Motion camera capture	HL NQ C2	MC3	666489	7564267	-	-	-	-	-	-
-	-	16/07/2022	Motion camera capture	HL NQ C2	MC3	666489	7564267	-	-	-	-	-	-
-	-	18/07/2022	Motion camera capture	HL NQ C2	MC3	666489	7564267	-	-	-	-	-	-
-	-	19/07/2022	Motion camera capture	HL NQ C2.	MC3	666489	7564267	-	-	-	-	-	-
-	-	4/09/2022	Motion camera capture	HL NQ C2.	MC3	666489	7564267	-	-	-	-	-	-
-	-	10/07/2022	Motion camera capture	HL NQ C2.	MC4	666572	7564319	-	-	-	-	-	-
-	-	11/07/2022	Motion camera capture	HL NQ C2.	MC4	666572	7564319	-	-	-	-	-	-
-	-	12/07/2022	Motion camera capture	HL NQ C2.	MC4	666572	7564319	-	-	-	-	-	-
-	-	13/07/2022	Motion camera capture	HL NQ C2.	MC4	666572	7564319	-	-	-	-	-	-
-	-	14/07/2022	Motion camera capture	HL NQ C2.	MC4	666572	7564319	-	-	-	-	-	-

ID (Microchip)	Sex	Date	Capture	Site	Trap	Co-ordinates		Weight	Short Pes (mm)	Caudal (mm)	Health Rating (1-5)	Reproductive Status	Comments
						Easting	Northing						
-	-	18/07/2022	Motion camera capture	HL NQ C2.	MC4	666572	7564319	-	-	-	-	-	-
-	-	27/07/2022	Motion camera capture	HL NQ C2.	MC4	666572	7564319	-	-	-	-	-	-
-	-	10/07/2022	Motion camera capture	HL NQ C2.	MC5	666594	7564412	-	-	-	-	-	-
-	-	2/09/2022	Motion camera capture	HL NQ C2.	MC5	666594	7564412	-	-	-	-	-	-
Control Sites – Eliwana Mine and Eliwana Line Rail													
2022													
-	-	30/05/2022	Motion camera capture	EMR NQ C1	MC1	496691	7508420	-	-	-	-	-	-
-	-	26/06/2022	Motion camera capture	EMR NQ C2	MC1	496691	7508420	-	-	-	-	-	-
-	-	15/07/2022	Motion camera capture	EMR NQ C2	MC1	496691	7508420	-	-	-	-	-	-
-	-	22/09/2022	Motion camera capture	EMR NQ C2	MC2	459811	7519517	-	-	-	-	-	-
-	-	6/07/2022	Motion camera capture	EMR NQ C2	MC4	467455	7509263	-	-	-	-	-	-
-	-	21/09/2022	Motion camera capture	EMR NQ C2	MC4	467455	7509263	-	-	-	-	-	-
-	-	26/05/2022	Motion camera capture	EMR NQ C2	MC5	467485	7509288	-	-	-	-	-	-
-	-	9/07/2022	Motion camera capture	EMR NQ C2	MC5	467525	7509358	-	-	-	-	-	-
-	-	29/09/2022	Motion camera capture	EMR NQ C2	MC5	467525	7509358	-	-	-	-	-	-
Control Sites – North Star													
2014													
941000016595482	Male	26/08/14	Capture	NS NQ C1	C4	713392	7646226	860	40.0	16.5	-	adult male, reproductive	-
		28/08/14	Recapture		C17	713099	7646318						
		27/08/14	Recapture		C18	713087	7646363						
941000016595486	Female	24/08/14	Capture	NS NQ C1	C9	713247	7646030	340	17.4	17.4	4	-	-
		25/08/14	Recapture		C5	713371	7646193						
		28/08/14	Recapture		C9	713247	7646030						
941000016595485	Male	26/08/14	Capture	NS NQ C2	C19	713106	7644714	580	38.0	12.0	3.5	-	-
941000016595495	Male	28/08/14	Capture	NS NQ C2	C10	713236	7644684	635	34.0	16.5	3.5	Average, missing fur on tail	-
		30/08/14	Recapture		C21	713223	7644656						
941000016595497	Female	28/08/14	Capture	NS NQ C2	C4	713509	7644697	385	26.0	11.5	4	No pouched young	-
		29/08/14	Recapture		C8	713322	7644657						
		30/08/14	Recapture		C8	713322	7644657						
941000016595498	Female	28/08/14	Capture	NS NQ C2	C18	713101	7644777	365	28.0	14.0	3.5	-	-
941000016202871	Male	24/08/14	Capture	NS NQ C2	C19	713106	7644714	725	27.5	16.5	5	-	-
		25/08/14	Recapture		C8	713322	7644657						
		28/08/14	Recapture	NS NQ C1	C18	713087	7646363						
941000016595535	Male	25/08/14	Capture	NS NQ C3	C1	713202	7657203	560	23.5	14.0	3	-	-
941000016595534	Male	25/08/14	Capture	NS NQ C4	C3	718449	7655567	480	21.0	9.2	3.5	Young male, missing fur on tail but no sign of fighting	-
		26/08/14	Recapture		C4	718429	7655572						
		27/08/14	Recapture		C4	718429	7655572						
		28/08/14	Recapture		C5	718387	7655606						
2015													
941000016595486	Female	23/08/15	Recapture – second year	NS NQ C1	C25	713219	7646475	426	32.0	17.0	4	recapture from previous year, pouched, good condition	-
		24/08/15	Recapture		C17	713099	7646318						
		25/08/15	Recapture		C18	713087	7646363						

ID (Microchip)	Sex	Date	Capture	Site	Trap	Co-ordinates		Weight	Short Pes (mm)	Caudal (mm)	Health Rating (1-5)	Reproductive Status	Comments
						Easting	Northing						
941000016595533	Female	23/08/15	Capture	NS NQ C1	C11	713191	7646070	337	27.0	13.0	4	none	-
		26/08/15	Recapture		C11	713191	7646070						
941000016595497^	Female	24/08/15	Recapture – second year	NS NQ C2	C6	713503	7644693	446	35.0	15.0	4	none	-
		25/08/15	Recapture		C14	713283	7644663						
941000017452062	Male	23/08/15	Capture	NS NQ C4	C7	718404	7655595	406	36.0	16.0	3	fur missing	-
		24/08/15	Recapture		C17	718182	7655616						
		26/08/15	Recapture		C21	718110	7655604						
		27/08/15	Recapture		C25	718062	7655604						
941000017452068	Male	22/08/15	Capture	NS NQ C4	C9	718359	7655616	622	37.2	17.5	3.5	fur missing	-
		26/08/15	Recapture		C7	718404	7655595						
985170002967064	Male	21/08/15	Capture: MWH Recapture	NS NQ C4	C1	718547	7655513	489	37.0	13.0	2.5	few fight wounds	-
		25/08/15	Recapture		C6	718424	7655577						
		26/08/15	Recapture		C12	718289	7655612						
985170002971079	Male	21/08/15	Capture: MWH Recapture	NS NQ C4	C8	718381	7655612	522	35.0	12.0	3	few fight wounds	-
		22/08/15	Recapture		C4	718458	7655554						
		23/08/15	Recapture		C12	718289	7655612						
		24/08/15	Recapture		C13	718272	7655599						
		25/08/15	Recapture		C10	718338	7655602						
		26/08/15	Recapture		C5	718445	7655570						
		27/08/15	Recapture		C13	718272	7655599						
2016													
94100016595533	Female	13/08/16	Recapture – second year	NS NQ C1	C11	713191	7646070	418	27.0	13.0	5	Developed pouch, no young. Good condition, re-captured for 2nd year	-
		15/08/16	Recapture		C10	713226	7646073						
94100016595486	Female	14/08/16	Recapture – third year	NS NQ C1	C18	713087	7646363	540	30.8	17.0	5	No missing fur, developed pouch but no young, re-captured foo 3rd year	-
		15/08/16	Recapture		C11	713191	7646070						
941000017452048	Male	17/08/16	Capture	NS NQ C2	C16	713204	7644642	650	37.3	16.0	4	Some missing fur from fighting	-
		19/08/16	Recapture		C17	713173	7644646						
941000016202843	Female	17/08/16	Capture	NS NQ C4	C24	718079	7655593	460	23.2	14.0	5	Developed pouch, no young, healthy	-
941000017452057	Male	18/08/16	Capture	NS NQ C4	C24	718079	7655593	550	36.0	16.0	5	Very good health, no signs of fighting	-
		19/08/16	Recapture		C21	718110	7655604						
941000017452047	Female	19/08/16	Capture	NS NQ C4	C24	718079	7655593	370	32.3	16.0	5	Developed pouch, no young, healthy	-
2017													
941000017452025	Female	22/08/17	Capture	NS NQ C1	C12	713140	7646110	405	34.0	12.0	4	Good condition, small amount of hair loss on flanks, immature, no pouch developed	-
		24/08/17	Recapture		C17	713099	7646318						
		25/08/17	Recapture		C13	713118	7646163						
941000019576554	Male	24/08/17	Capture	NS NQ C1	C12	713140	7646110	590	36.7	14.8	3	Patches of fur missing	-
941000019576555	Male	23/08/17	Capture	NS NQ C1	C21	713116	7646422	620	38.3	15.4	3	Patches of missing fur	-
941000019576557	Male	23/08/17	Capture	NS NQ C1	C15	713111	7646234	595	38.4	13.1	3	Missing fur over bottom half of body	-
		24/08/17	Recapture		C19	713096	7646405						
		25/08/17	Recapture		C11	713191	7646070						

ID (Microchip)	Sex	Date	Capture	Site	Trap	Co-ordinates		Weight	Short Pes (mm)	Caudal (mm)	Health Rating (1-5)	Reproductive Status	Comments
						Easting	Northing						
		27/08/17	Recapture	NS NQ C2	C12	713340	7644651						
		28/08/17	Recapture		C13	713310	7644655						
941000017452028	Male	23/08/17	Capture	NS NQ C2	C13	713310	7644655	720	38.8	12.8	3	Some signs of fighting	-
941000017452058	Male	23/08/17	Capture	NS NQ C2	C12	713340	7644651	665	38.6	15.6	3	Patches of fur missing	-
		24/08/17	Recapture		C8	713449	7644674						
		24/08/17	Recapture		C14	713283	7644663						
941000019576556	Male	24/08/17	Capture	NS NQ C2	C15	713255	7644672	810	39.3	15.0	3	Missing patches of fur	-
941000017452032	Female	24/08/17	Capture	NS NQ C3	C3	713265	7657127	625	32.0	9.0	4	Developed pouch and pouch young present	-
		29/08/17	Recapture		C5	713320	7657089						
941000017452033	Male	24/08/17	Capture	NS NQ C3	C16	713667	7656755	830	40.0	18.0	2	Significant fur loss, signs of fighting	-
		25/08/17	Recapture		C22	713414	7656999						
		26/08/17	Recapture		C22	713414	7656999						
941000019576553	Male	25/08/17	Capture	NS NQ C3	C1	713219	7657189	670	38.5	13.0	3	Loss of fur along shoulder and flanks	-
941000019576551	Male	27/08/17	Capture	NS NQ C3	C3	713265	7657127	570	36.7	13.3	3	Missing patches of fur	-
941000017452031	Male	23/08/17	Capture	NS NQ C4	C24	718079	7655593	670	41.0	18.0	3	Missing fur along flanks, mature male	-
		24/08/17	Recapture		C25	718062	7655604						
		25/08/17	Recapture		C25	718062	7655604						
		28/08/17	Recapture		C4	718464	7655559						
		29/08/17	Recapture		C3	718492	7655536						
941000017452026	Male	24/08/17	Capture	NS NQ C4	C9	718359	7655616	755	36.0	15.0	3	Small areas of fur loss on back and flanks	-
		25/08/17	Recapture		C12	718289	7655612						
		26/08/17	Recapture		C12	718289	7655612						
943094322007681	Female	25/08/17	Capture: MWH recapture	NS NQ C4	C15	718226	7655613	345	33.4	11.4	4	Six small pouch young, <10mm each	-
941000017452029	Female	28/08/17	Capture	NS NQ C4	C1	718547	7655513	580	34.0	15.0	4	Six small pouch young, <10mm each	-
943094322007659	Male	28/08/17	Capture: MWH recapture	NS NQ C4	C5	718445	7655570	625	36.0	17.0	2	Significant loss of fur	-
2018													
991 0030 0017 4886	Male	17/08/18	Capture	NS NQ C1	C14	713095	7646197	480	36	17	3	Some evidence of fighting. Some missing fur and small bite marks	Very quiet animal
		18/08/18	Recapture	NS NQ C1	C12	713140	7646110	510					
		19/08/18	Recapture	NS NQ C1	C15	713111	7646234	530					
		21/08/18	Recapture	NS NQ C1	C18	713087	7646363						
991 0030 0017 4890	Male	19/08/18	Capture	NS NQ C2	C3	713560	7644656	545	32	15.2	4	-	-
941 0000 1957 6577	Female	21/08/18	Capture	NS NQ C2	C12	713340	7644651	385	29.2	15.2	2	Pouch undeveloped	Fur patchy, 50% missing. Not in good condition
991 0030 0017 4875	Male	20/08/18	Capture	NS NQ C2	C18	713159	7644676	555	33	16	3	Some signs of fighting	Substantial bite wounds to front right dorsal surface just behind neck.
941 0000 1745 2032	Female	21/08/18	Recapture – second year	NS NQ C3	C1	713219	7657189	390	30.8	11.3	4	Pouch developed however still furry and no young. Hips missing patches of fur indicates recent mating behaviour	Recapture from previous monitoring

ID (Microchip)	Sex	Date	Capture	Site	Trap	Co-ordinates		Weight	Short Pes (mm)	Caudal (mm)	Health Rating (1-5)	Reproductive Status	Comments
						Easting	Northing						
991 0030 0017 4895	Male	20/08/18	Capture	NS NQ C3	C2	718547	7655513	650	34.8	13.1	4	Several patches of fur missing indicating recent fighting	-
991 0030 0017 4896	Male	17/08/18	Capture	NS NQ C4	C10	718338	7655602	770	34.1	14.2	4	Some evidence of fighting. Missing fur patches and bite marks on neck	-
		18/08/18	Recapture		C25	718062	7655604						
		19/08/18	Recapture		C14	718254	7655603						
991 0030 0017 4894	Male	17/08/18	Capture	NS NQ C4	C24	718079	7655593	800	36.2	19.9	5	Really healthy. Little indication of fighting but might just be very successful.	Animal slightly stressed on 17/8 so chipped and released. Measurements taken on 19/8
		19/08/18	Recapture	NS NQ C4	C24	718079	7655593						
991 0030 0017 4882	Male	18/08/18	Capture	NS NQ C4	C22	718094	7655603	590	35.6	14.1	4	Little evidence of fighting.	-
		19/08/18	Recapture		C18	718160	7655607						
991 0030 0017 4906	Male	18/08/18	Capture	NS NQ C4	C24	718079	7655593	690	15.6	37.4	4	Few patches of fur missing. Some evidence of fighting.	-
991 0030 0017 4904	Male	19/08/18	Capture	NS NQ C4	C23	718090	7655592	770	34.3	19.1	4	Signs of fighting	Some fur patches missing
2019													
Temporarily suspended													
2020													
Temporarily suspended													
2021													
991 0030 0077 8681	Female	20/08/2021	Capture	NS NQ C2	C37	714611	7655537	370	32	15	3	-	Fur loss and old grazes on rump and head
		21/08/2021	Recapture		C33	714583	7655531						
		22/08/2021	Recapture		C37	714611	7655537						
		23/08/2021	Recapture		C27	714556	7655520						
991 0030 0077 8663	Male	24/08/2021	Capture	NS NQ C3	C16	713574	7656851	680	36	15	3	-	Patchy fur loss throughout body
991 0030 0077 8670	Male	19/08/2021	Capture	NS NQ C4	C20	718121	7655604	685	35	-	4	-	-
991 0030 0077 8662	Male	20/08/2021	Capture		C19	718116	7655591	710	37	12	4	-	-
		21/08/2021	Recapture		C24	718065	7655606						
		22/08/2021	Recapture		C23.2	718082	7655591						
900 1130 0171 5462	Male	20/08/2021	Capture		C20	718121	7655604	580	32	17	-	-	-
		21/08/2021	Recapture		C22	718092	7655600						
900 1130 0171 5469	Male	21/08/2021	Capture		C9	718347	7655612	680	33	14	4	-	-
		22/08/2021	Recapture		C13	718274	7655605						
991 0030 0077 8664	Male	21/08/2021	Capture		C23	718093	7655602	640	38	17	5	-	-
		22/08/2021	Recapture		C22	718092	7655600						
991 0030 0077 8677	Male	22/08/2021	Capture		C23	718093	7655602	580	36	18	4	-	-
2022													
991 0030 0171 6375	Male	20/07/2022	Capture	NS NQ C2	C32	714576	7655535	405	35	19	5	-	Hair and ear taken
991 0030 0171 6374	Female	20/07/2022	Capture	NS NQ C2	C39	714524	7655512	415	32	17	5	-	-
991 0030 0171 6372	Female	21/07/2022	Capture	NS NQ C2	C26	714548	7655532	400	33	16	5	Undeveloped pouch	Ear notch and hair sample collected
		22/07/2022	Recapture		C40	714519	7655512						
		23/07/2022	Recapture		C20	714531	7655517						
991 0030 0171 6359	Male	21/07/2022	Capture	NS NQ C2	C33	714576	7655535	710	36	20	5	-	Ear notch and hair sample collected
		22/07/2022	Recapture		C32	714576	7655535						

ID (Microchip)	Sex	Date	Capture	Site	Trap	Co-ordinates		Weight	Short Pes (mm)	Caudal (mm)	Health Rating (1-5)	Reproductive Status	Comments
						Easting	Northing						
		23/07/2022	Recapture		C32	714576	7655535						
991 0030 0171 6358	Male	21/07/2022	Capture	NS NQ C2	C47	714457	7655514	525	31	16	5	-	Hair sample and scat collected
991 0030 0171 6360	Male	22/07/2022	Capture	NS NQ C3	C14	713321	7657100	635	34	16	5	-	Hair sample and scat collected
991 0030 0171 6365	Female	22/07/2022	Capture	NS NQ C3	C18	713411	7657069	365	30	14.5	5	Undeveloped	Hair sample and scat collected
991 0030 0171 6377	Female	22/07/2022	Capture	NS NQ C3	C3	713246	7657077	385	33.2	14	5	Developed pouch	Old trap no 3, new trap no 11. Hair sample and scat collected
		24/07/2022	Recapture		C8	713233	7657174						
991 0030 0077 8676	Male	23/07/2022	Capture	NS NQ C2	C36	714607	7655538	535	34.5	13	5	-	Hair sample and scat collected
991 0030 0171 6373	Male	23/07/2022	Capture	NS NQ C3	C2	713243	7657073	1.08	38	18	5	-	Trap 2b (new no 10). Ear sample, scat and hair sample collected
		24/07/2022	Recapture		C24	713565	7656874						
991 0030 0171 6376	Female	24/07/2022	Capture	NS NQ C3	C24	713565	7656874	380	30	16	5	Undeveloped	Hair and scat collected. Caught in 24B-2 new site
2023													
991 0030 0171 6362	Male	27/07/2023	Capture	NS NQ C2	T31	714567	7655530	480	37.5	21.5	5	-	-
		28/07/2023	Recapture										
		29/07/2023			T36	714607	7655538						
		30/07/2023			T26	714548	7655532						
991 0030 0195 1370	Male	29/07/2023	Capture		T48	714448	7655514	560	34.5	15	4	-	-
		30/07/2023	Recapture		T48	714448	7655514						
991 0030 0077 8692	Male	30/07/2023	Capture		T36	714607	7655538	730	37.5	20	5	-	-
991 0030 0171 6372	Female	28/07/2023	Recapture		T36	714607	7655538	330	30.3	15	3	Previous young, pouch not developed yet	Recapture from 2022
991 0030 0077 8680	Male	30/07/2023	Capture	NS NQ C3	T13	713298	7657101	580	34	14	5	-	-
991 0030 0171 6363	Male	30/07/2023	Capture		T25	713579	7656853	630	37	18	5	-	-
		31/07/2023	Recapture		T30	713667	7656755						
2023-M1	Male	31/07/2023	Capture		T10	713253	7657142	-	34.3	17	5	-	-
2023-M2	Male	31/07/2023	Capture		T15	713365	7657100	800	35	17	5	-	-
991 0030 0077 8672	Male	28/07/2023	Capture	NS NQ C4	T29	718226	7655613	430	335	14	4	Big Balls	-
		29/07/2023	Recapture		T30	713667	7656755						
Potential Impact Sites													
Solomon Hub													
2012													
No records	-	-	-	-	-	-	-	-	-	-	-	-	-
2013													
M1	Male	4/09/13	Capture	SM NQ I2	T6	590498	7555850	790	34	-	1	Obvious signs of fighting, large areas of fur missing, poor condition	-
		6/09/13	Recapture	SM NQ I2	T3	590419	7555993						
M2	Male	6/09/13	Capture	SM NQ I2	T43	589600	7554102	720	38	-	1	Obvious signs of fighting, large areas of fur missing	-
M3	Male	8/09/13	Capture	SM NQ I2	T4	590447	7555941	650	65	-	1	Obvious signs of fighting, large areas of fur missing, scar between shoulder blades	-
		9/09/13	Recapture	SM NQ I2	T3	590419	7555993						

ID (Microchip)	Sex	Date	Capture	Site	Trap	Co-ordinates		Weight	Short Pes (mm)	Caudal (mm)	Health Rating (1-5)	Reproductive Status	Comments
						Easting	Northing						
2014													
941000016202857	Male	24/07/14	Capture	SM NQ I2	T5	590472	7555902	860	36.0	74.0	4	Good health, no signs of fighting	-
		28/07/14	Recapture		T4	590447	7555941						
94100001659557	Male	24/07/14	Capture	SM NQ I2	T22	590457	7554931	840	40.0	72.0	4.5	Good health, no signs of fighting	-
		25/07/14	Recapture		T21	590490	7554989						
941000016595572	Male	25/07/14	Capture	SM NQ I2	T43	589600	7554102	870	38.0	60.0	4.5	Good health, right ear torn	-
		30/07/14	Recapture		T47	589458	7553905						
941000016595536	Male	29/07/14	Capture	SM NQ I1	T20	592575	7554667	600	36.0	64.0	4	Small, young male in good condition. No signs of fighting	-
2015													
Secondary evidence	-	3/08/15	Secondary evidence	SM NQ I2	Opp	590623	7555921	-	-	-	-	Skull	-
2016													
941000017452043	M	28/07/16	Capture	SM NQI1	C10	590546	7555580	610	34.1	21.8	5	Some early signs of fighting, good condition	Equipped with radio-collar 1
		2/09/16	Recapture	SM CR1.3	C06	589717	7556949	490					Dropped collar VHF150.099
		5/09/16	Recapture		C03	589732	7556875						
		14/09/16	Recapture	SM CR2.2	C01	589735	7556816						
941000017452036	M	28/07/16	Capture	SM NQI1	C40	590574	7555562	640	38.2	20.0	5	Healthy and angry, no signs of fighting	-
		31/07/16	Recapture		C42	590565	7555653						
		31/08/16	Recapture	SM CR1.1	C06	590534	7555127						
		14/09/16	Recapture	SM CR2.1	C04	590537	7555151						
941000017452042	M	28/07/16	Capture	SM NQI1	C26	590489	7555001	510	32.1	16.0	5	Some early signs of fighting, good condition	Equipped with radio-collar 2 (VHF 150.119)
		2/09/16	Recapture	SM CR1.5	C01	590491	7555019						Collar retrieved
941000017452039	M	30/07/16	Capture	SM NQI1	C45	590523	7555813	740	40.5	21.1	5	Healthy, no signs of fighting. Equipped with radio-collar 3 (VHF 150.139)	-
		4/08/16	Recapture	SM NQI3	C32	592724	7554820						
941000017452027	M	15/09/16	Capture	SM CR2.4	C05	591021	7555454	450	35.2	13.4	4	Missing fur	-
		16/09/16	Recapture		C10	590876	7555743						
941000017452024	M	15/09/16	Capture	SM CR2.4	C01	590903	7555362	524	33.9	17.6	5	Healthy, no signs of fighting	
2017													
941000019576548	Female	2/08/17	Capture	SM NQ I1	C33	590551	7555212	400	34.0	14.0	4	No pouch young	Equipped with radio-collar (150.240), fur loss
		30/08/17	Recapture	SM CR 1	C20	590481	7555204					Pouch young developed in pouch	
941000019576547	Female	5/08/17	Capture	SM NQ I2	C19	589604	7554182	420	34.0	12.5	4	Developed pouch but no young	Attached collar 150.200
		7/08/17	Recapture	SM NQ I2	C17	589581	7554132						
		02/09/17	Recapture	SM CR 2	C33	589558	7554222	430	-	-	4	Developed pouch with pouch young	Had lost collar.
N/A (Not chipped)	Male	5/8/17	Capture	SM NQ I2	C27	589744	7554208	570	36.0	11.0	4	-	Mature male, very aggressive, could not take tissue sample or insert microchip
		7/08/17	Recapture	SM NQ I2	C44	589364	7553751						
941000017452044	Male	6/08/17	Capture	SM NQ I2	C33	589622	7554042	545	36.0	12.2	4	-	Loss of fur and scratches, signs of fighting
		8/08/17	Recapture	SM NQ I2	C9	589457	7553931						

ID (Microchip)	Sex	Date	Capture	Site	Trap	Co-ordinates		Weight	Short Pes (mm)	Caudal (mm)	Health Rating (1-5)	Reproductive Status	Comments
						Easting	Northing						
941000019576558	Male	31/08/17	Capture	SM CR 1	C1	590423	7555026	610	30.0	18.0	2	-	Lots of missing fur, very poor condition due to advanced breeding season
941000019576543	Female	02/09/17	Capture	SM CR 2	C35	589541	7554191	400	-	-	5	Pouch young	Regrown fur
2018													
941 0000 1957 6578	Male	11/07/18	Motion Camera	SM NQ I1	MC61	590465	7555186	870	37.1	18.2	5	-	Really healthy and good conditions, lots of body fat, no signs of fighting
		12/07/18	Capture		T24	590399	7555060						
		13/07/18	Recapture		T21	590463	7555180						
		14/07/18	Recapture		T20	590481	7555204						
		15/07/18	Recapture		T18	590530	7555290						
941 0000 1957 6548	Female	12/07/18	Recapture – second year	SM NQ I1	T19	590515	7555254	580	34.0	14.0	4	Developed pouch, no pouch young	Female caught in 2017. Re-captured in 2018 at same trap site
		13/07/18	Motion Camera		MC61 & MC62	590504	7555271						
		14/07/18	Recapture		T17	590551	7555325						
		15/07/18	Recapture		T20	590481	7555204						
941 0000 1957 6544	Female	14/07/18	Capture	SM NQ I1	T21	590463	7555180	440	35.0	17.0	5	Early stages of pouch development, fur inside. No pouch young or signs of mating (missing fur)	-
941 0000 1957 6572	Female	12/07/18	Capture	SM NQ I1	T15	590561	7555403	465	27.1	14.0	5	Developed pouch but no pouch young	-
		13/07/18	Recapture		T17	590551	7555325						
		14/07/18	Recapture		T18	590530	7555290						
941 0000 1957 6573	Male	12/07/18	Capture	SM NQ I1	T49	590410	7556000	830	39.0	17.5	5	-	Some signs of fighting, localised fur loss. Otherwise healthy and good condition
		15/07/18	Recapture	SM NQ I3	T30	590532	7555121						
941 0000 1957 6574	Male	14/07/18	Capture	SM NQ I3	T16b	592572	7554678	850	35.0	15.0	5	-	Heavy individual but could have some more body fat, fairly lean.
941 0000 1957 6550	Male	12/07/18	Capture	SM NQ I1	T27	590504	7555029	870	34.5	19.0	5	-	Good body condition
		13/07/18	Motion Camera		MC62 & MC63	590510	7555311						
		14/07/18	Motion Camera		MC61	590465	7555186						
		15/07/18	Recapture		T21	590463	7555180						
941 0000 1957 6549	Male	15/07/18	Capture	SM NQ I3	T14b	592533	7554656	660	36.0	15.5	5	-	No signs of fighting, healthy. Could have some more body fat
		16/07/18	Recapture		T13b	592551	7554644						
No ID	unknown	13/07/18	Motion Camera	SM NQ I2	MC54, MC55 & MC57	592578	7554696	-	-	-	-	-	-
2019													
941 0000 1957 6539	Female	04/07/19	Capture	SM NQ I1	T23	590418	7555105	380	34.0	14.0	5	No pouch developed as yet	-
991 0030 0017 4910	Female	04/07/19	Capture	SM NQ I1	T8	590512	7555667	310	31.0	14.0	5	No pouch developed as yet, very small	-
		05/07/19	Recapture		T11	590541	7555540						
		06/07/19	Recapture		T12	590550	7555503						
991 0030 0017 4880	Male	03/07/19	Capture	SM NQ I2	T28	590519	7555059	620	35.0	17.0	5	No signs of fighting	Site was burnt 6 months prior, remaining ash on top

ID (Microchip)	Sex	Date	Capture	Site	Trap	Co-ordinates		Weight	Short Pes (mm)	Caudal (mm)	Health Rating (1-5)	Reproductive Status	Comments
						Easting	Northing						
													of soil, no leaf litter or living vegetation
991 0030 0017 4893	Male	05/07/19	Capture		T41	590563	7555608	600	39.0	15.0	5	No signs of fighting	Site was burnt 6 months prior, remaining ash on top of soil, no leaf litter or living vegetation
		06/07/19	Recapture		T3	590389	7555951						
991 0030 0017 4877	Female	05/07/19	Capture	SM NQ I3	T10	590546	7555580	290	-	-	-	-	Very active, could not take measurements or tissue sample
		06/07/19	Recapture		T12	590550	7555503						
		08/07/19	Recapture		T13	590562	7555472						
991 0030 0017 4900	Male	07/07/19	Capture		T37	590596	7555377	720	38.0	21.0	5	-	Good condition, no signs of fighting. Travelled to Control sites
2020													
991 0030 0017 5463	Female	19/08/20	Capture	SM NQ I1	T20	590481	7555204	500	35	16.3	5	Developed pouch, no young	-
			Motion Camera		MC 21	590504	7555255	-	-	-	-		-
941 0000 1957 6539	Female	19/08/20	Capture	SM NQ I1	T17	590551	7555325	550	34.0	16.0	5	Developed pouch, no young	-
		20/08/20	Recapture		T11	590541	7555540						
		19/08/20	Motion Camera		MC 106	590565	7555434	-	-	-	-	-	-
2021													
991 0030 0077 8693	Male	21/07/2021	Capture	SM NQ I1	T17	590552	7555325	930	37	19	5	-	-
2022													
-	-	3/07/2022	Motion camera capture	SM NQ I1	MC2	590528	7555654	-	-	-	-	-	-
-	-	1/07/2022	Motion camera capture	SM NQ I1	MC3	590563	7555399	-	-	-	-	-	-
-	-	29/06/2022	Motion camera capture	SM NQ I1	MC4	590476	7555196	-	-	-	-	-	-
-	-	4/07/2022	Motion camera capture	SM NQ I1	MC4	590476	7555196	-	-	-	-	-	-
-	-	19/07/2022	Motion camera capture	SM NQ I1	MC4	590476	7555196	-	-	-	-	-	-
-	-	21/06/2022	Motion camera capture	SM NQ I1	MC5	590513	7555099	-	-	-	-	-	-
-	-	20/07/2022	Motion camera capture	SM NQ I1	MC5	590513	7555099	-	-	-	-	-	-
-	-	29/06/2022	Motion camera capture	SM NQ I1	MC2	585360	7546993	-	-	-	-	-	-
Hamersley Line Rail													
2012													
M1	Male	30/08/12	Capture	HL NQ I2	C13	688138	7567662	400	37.2	14.2	2	-	Signs of fighting, missing fur
Secondary evidence	-	01/09/12	Tracks	HL NQ I3	Opp	689742	7569490	-	-	-	-	-	Tracks
2013													
M1a	Male	22/08/13	Capture	HL NQ I3	C17	680393	7561494	650	36.0	-	3	-	Patches of hair loss on tail and body from fighting
		23/08/13	Recapture		C12	680581	7561745						
		25/08/13	Recapture		C20	680256	7561498						
M2	Male	22/0/13	Capture	HL NQ I3	C20	680286	7561493	550	36.0	-	3	-	Minimal tail fat, obvious scars from sighting and fur loss
		23/08/13	Recapture		C15	680519	7561596						
M3	Male	23/08/13	Capture	HL NQ I3	C13	680555	7561695	570	39.0	-	3	Reproductive male	Signs of fighting, limited body fat
		25/08/13	Recapture		C18	680333	7561485						
		26/08/13	Recapture		C21	680256	7561498						
		27/08/13	Recapture		C22	680224	7561504						

ID (Microchip)	Sex	Date	Capture	Site	Trap	Co-ordinates		Weight	Short Pes (mm)	Caudal (mm)	Health Rating (1-5)	Reproductive Status	Comments
						Easting	Northing						
M4	Female	23/08/13	Capture	HL NQ I3	C19	680286	7561493	320	32.0	-	3	Pouch empty	Some scars from mating behaviour, limited body fat
		25/08/13	Recapture		C21	680256	7561498						
		27/08/13	Recapture		C6	680555	7561827						
M5	Male	23/08/13	Capture	HL NQ I2	C2	688422	7567168	695	37.0	-	3	-	Some body fat
2014													
941000016595546	Male	23/06/14	Capture	HL NQ I1	C12	694647	7577189	635	40	-	4	-	Good condition. No signs of fighting
		24/06/14	Recapture		C8	694471	7577471						
		25/06/14	Recapture		C20	694436	7577540						
941000016595490	Male	25/06/14	Capture	HL NQ I2	C49	686230	7566417	765	38.0	-	5	-	Young male, good condition
941000016202856	Female	25/06/14	Capture	HL NQ I2	C47	686410	7566459	455	36.0	-	5	-	Good condition
941000016202859	Female	21/06/14	Capture	HL NQ I3	C2	680761	7561840	380	32.0	-	4	-	Small individual, but healthy
		24/06/14	Recapture		C3	680706	7561821						
941000016202858	Female	25/06/14	Capture	HL NQ I3	C3	680709	7561843	415	32.0	-	4	-	Good conditions but small
2015													
Secondary evidence	-	16/08/15	Tracks	HL NQ I1	-	694389	7577564	-	-	-	-	-	-
Secondary evidence	-	20/08/15	Scats, Motion Camera	HL NQ I2	-	686237	7566416	-	-	-	-	-	-
Secondary evidence	-	13/08/15	Scats, Motion Camera	HL NQ I3	-	680987	7561766	-	-	-	-	-	-
2016													
Secondary evidence	-	02/08/16	Scats	HL NQ I2	-	687258	7567193	-	-	-	-	-	-
Secondary evidence	-	21/12/16	Motion Camera	HL NQ I3	-	590583	755584	-	-	-	-	-	-
2017													
No records	-												
2018													
No records	-												
2019													
No records	-												
2020													
N/A	unknown	10/09/2020	Motion Camera	HL NQ MC LT4	MC04 (MC75)	667754	7562742	-	-	-	-	-	Tail only on camera
2021													
No records	-												
2022													
991 0030 0077 8688	Male	08/07/2022	Capture	HL NQ I3	34	680350	7561493	640	37.5	-	-	Breeding	-
-	-	17/07/2022	Motion camera capture	HL NQ I3	MC3	680130	7561571	-	-	-	-	-	-
-	-	10/07/2022	Motion camera capture	HL NQ I3	MC4	680293	7561497	-	-	-	-	-	-
-	-	10/07/2022	Motion camera capture	HL NQ LT1	-	666763	7562413	-	-	-	-	-	-
-	-	12/07/2022	Motion camera capture	HL NQ LT1	-	666763	7562413	-	-	-	-	-	-
-	-	16/07/2022	Motion camera capture	HL NQ LT1	-	666763	7562413	-	-	-	-	-	-
-	-	22/07/2022	Motion camera capture	HL NQ LT1	-	666763	7562413	-	-	-	-	-	-
-	-	24/07/2022	Motion camera capture	HL NQ LT1	-	666763	7562413	-	-	-	-	-	-
-	-	12/07/2022	Motion camera capture	HL NQ LT2	-	666133	7563829	-	-	-	-	-	-
-	-	17/09/2022	Motion camera capture	HL NQ LT2	-	666133	7563829	-	-	-	-	-	-

ID (Microchip)	Sex	Date	Capture	Site	Trap	Co-ordinates		Weight	Short Pes (mm)	Caudal (mm)	Health Rating (1-5)	Reproductive Status	Comments
						Easting	Northing						
Main Line Rail													
2012													
MR M1	Male	17/08/12	Capture	5B	E4	696624	7605329	865	40	21.0	2	Sternal gland present indicating male territorial marking	-
MR M2	Male	20/08/12	Capture	5B	E8	696610	7605140	755	41	24.5	4	-	Evidence of fighting
MC 1	-	Aug 2012	Motion Camera	-		677268	7674893	-	-	-	-	-	-
MC 2	-	Aug 2012	Motion Camera	-		677140	7674954	-	-	-	-	-	-
MC 3	-	Aug 2012	Motion Camera	-		675916	7680865	-	-	-	-	-	-
MC 4	-	Aug 2012	Motion Camera	-		677554	7674763	-	-	-	-	-	-
MC 5	-	Aug 2012	Motion Camera	-		677149	7675051	-	-	-	-	-	-
MC 6	-	Aug 2012	Motion Camera	-		675951	7680739	-	-	-	-	-	-
MC 7	-	Aug 2012	Motion Camera	-		674098	7697778	-	-	-	-	-	-
MC 8	-	Aug 2012	Motion Camera	-		692952	7634867	-	-	-	-	-	-
MC 9	-	Aug 2012	Motion Camera	-		671697	7700806	-	-	-	-	-	-
2013													
MR F3	Female	02/09/18	Capture	MR NQ I2	C16	675893	7680929	395	32.0	13.5	3.5	5 x pouch young (10mm)	Patches of fur loss regrowing. Looks healthy
		03/09/18	Recapture		C15	675909	7680957						
		07/09/18	Recapture		C18	675907	7680863						
MR M4	Male	07/09/18	Capture	MR NQ I2	C14	675921	7680973	405	34.6	13.1	3	-	-
2014													
941000016202838	Male	23/08/14	Capture	MR NQ I3	C15	677035	7675062	750	38.0	-	3.5	-	Reasonably healthy, missing some fur and some body fat
941000016202839	Male	23/08/14	Capture	MR NQ I2	C7	676022	7680857	720	41.0	-	3.5	-	Reasonably healthy, missing some fur and some body fat
		24/08/14	Recapture		C20	675916	7680805						
		25/08/14	Recapture		C19	675899	7680840						
		26/08/14	Recapture		C18	675907	7680863						
2015													
Secondary evidence	-	30/08/15	Scats	MR NQ I1	Opp	674504	7686726	-	-	-	-	-	-
Secondary evidence	-	30/08/15	MC	MR NQ I3	MC05	677403	7674826	-	-	-	-	-	-
Secondary evidence	-	30/08/15	MC	MR NQ I3	MC07	677496	7674802	-	-	-	-	-	-
2016													
941000017452	Male	31/07/16	Capture	MR NQ I3		677757	7674743	538	34.0	16.0	3	-	Skinny but no fur loss
Secondary evidence	-	31/07/16	Scat	MR NQ I3	Opp	677136	7674729	-	-	-	-	-	-
Secondary evidence	-	31/07/16	Scat	MR NQ I3	Opp	677440	7674623	-	-	-	-	-	-
2017													
941000019576564	Male	12/08/17	Capture	MR NQ I2	C24	675999	7680856	800	39.0	17.0	4	-	Some fur loss but good condition
941000019576563	Male	13/08/17	Capture	MR NQ I2	C28	676024	7680788	840	37.0	17.0	4	-	Some fur loss but good condition
941000019576561	Female	11/08/17	Capture	MR NQ I3	C46	677139	7675050	490	34.0	17.0	5	Pouch slightly developed	-
		12/08/17	Recapture	MR NQ I3	C2	677152	7674930						
		13/08/17	Recapture	MR NQ I3	C48	677076	7675059						
941000019576559	Male	11/08/17	Capture	MR NQ I3	C35	677644	7674888	730	37.0	15.0	4	-	

ID (Microchip)	Sex	Date	Capture	Site	Trap	Co-ordinates		Weight	Short Pes (mm)	Caudal (mm)	Health Rating (1-5)	Reproductive Status	Comments
						Easting	Northing						
		12/08/17	Recapture	MR NQ I3	C3	677202	7674934						Tail tip missing, some signs of fighting
941000017452030	Male	11/08/17	Capture	MR NQ I3	C46	677139	7675050	800	37.0	15.0	4	-	Outside of cage, female trapped in cage. Entered the cage once the females was released and was processed.
		12/08/17	Recapture	MR NQ I3	C3	677152	7674930						
2018													
941 0000 1957 6546	Male	02/08/18	Capture	ML NQ I1	C22	674464	7686687	790	15	32	4	-	Some signs of fighting, small patches of fur missing
		03/08/18	Recapture		C24	674483	7686618						
991 0030 0017 4885	Male	30/07/18	Capture	ML NQ I2	C10	675910	7680832	720	15.4	36	4	-	very healthy. No evidence of fighting
		31/07/18	Recapture		C17	675976	7681022						
		01/08/18	Recapture		C18	675980	7681016						
991 0030 0017 4888	Male	31/07/18	Capture	ML NQ I2	C33	676040	7680700	780	15.2	35.8	4	-	no signs of fighting
		02/08/18	Recapture		C31	676035	7680743						
991 0030 0017 4889	Female	31/07/18	Capture	ML NQ I2	C10	675910	7680832	430	15.9	29.6	5	pouch development minimal	-
		01/08/18	Recapture		C15	675925	7680971						
991 0030 0017 4876	Male	02/08/18	Capture	ML NQ I2	C12	675895	7680890	720	15.3	33.9	4	-	two small patches missing, some signs of fighting
Secondary evidence	Scats	29/07/18	Secondary evidence	ML NQ I3	opp	677310	7674849	-	-	-	-	-	-
Secondary evidence	Scats	29/07/18	Secondary evidence	ML NQ I3	opp	677278	7674900	-	-	-	-	-	-
Secondary evidence	MC	04/10/18	Motion Camera	MR GB AS I14	opp	692955	7635026	-	-	-	-	-	-
2019													
991 0030 0017 4892	Male	05/08/18	Capture	MR NQ I2	C5	675953	7680711	640	18.0	34.0	5	-	Left ear is deformed, notched the right ear
		06/08/18	Recapture		C29	676036	7680782						
991 0030 0017 4908	Male	05/08/18	Capture		C10	675910	7680832	740	2.0	39.0	5	-	-
991 0030 0017 4902	Male	07/08/18	Capture		C20	675993	7680962	690	16.5	39.0	5	-	-
991 0030 0017 4874	Male	08/08/18	Capture		C20	675993	7680962	770	-	-	5	-	-
Secondary evidence	Tracks	05/08/18	Tracks	MR NQ I3	opp	677781	7674927	-	-	-	-	-	-
Secondary evidence	MC	02/08/18	Motion Camera		MC28	677084	7675055	-	-	-	-	-	-
2020													
991 0030 0017 5464	Female	4/08/20	Capture	MR NQ I1	T22	674464	7686687	465	33.5	18.5	5	No pouch young	-
991 0030 0017 5466	Male	4/08/20	Capture	MR NQ I1	T21	674457	7686711	730	38	21	4	-	injury to tail, exposed bone
991 0030 0017 5472	Male	5/08/20	Capture	MR NQ I1	T6	674532	7686609	675	37	25	5	-	-
		6/08/20	Recapture		T5	674532	7686577					-	-
		7/08/20	Recapture		T24	674483	7686618					-	-
Unknown	unknown	5/08/2020	Motion Camera	MR NQ I1	MC25	674490	7686611	-	-	-	-	-	-
		6/08/2020	Motion Camera		MC25	674490	7686611	-	-	-	-	-	-
		5/08/2020	Motion Camera		MC40	674473	7686746	-	-	-	-	-	-
991 0030 0017 5441	Male	7/08/20	Capture	MR NQ I1	T22	674464	7686687	820	36	21.5	4	-	ticks, some fur loss
991 0030 0017 5467	Male	5/08/20	Capture	MR NQ I1	T10	674568	7686741	660	38	21	5	-	-
		6/08/20	Recapture		T7	674554	7686653						

ID (Microchip)	Sex	Date	Capture	Site	Trap	Co-ordinates		Weight	Short Pes (mm)	Caudal (mm)	Health Rating (1-5)	Reproductive Status	Comments
						Easting	Northing						
		7/08/20	Recapture		T6	674532	7686609						
991 0030 0017 5455	Male	6/08/20	Capture	MR NQ I1	T22	674464	7686687	730	36	21	4	-	ticks
991 0030 0017 5450	Female	7/08/20	Capture	MR NQ I1	T46	674201	7686503	440	32	23	5	No pouch young	-
991 0030 0017 5445	Male	8/08/20	Capture	MR NQ I2	T12	675895	7680890	610	36	18	5	-	-
991 0030 0017 5444	Male	6/08/20	Capture	MR NQ I2	T20	675985	7680956	600	37	21	4	-	-
991 0030 0017 5454	Female	6/08/20	Capture	MR NQ I2	T12	675895	7680890	465	33	-	5	No pouch young	-
2021													
991 0030 0017 8682	Female	1/08/2021	Capture	MR NQ I2	T8	675924	7680774	460	32	14.3	-	Developed pouch	Good condition
991 0030 0017 8683	Male	2/08/2021	Capture	MR NQ I1	T25	674489	7686591	770	39.9	19.9	-	-	Good condition
		3/08/2021	Recapture		T26	674492	7686560				-	-	
		4/08/2021	Recapture		T6	674532	7686609				-	-	
991 0030 0017 8696	Male	2/08/2021	Capture	MR NQ I1	T5	674532	7686577	1000+	41.3	19.3	-	-	Weight maxed out scale
991 0030 0017 8697	Female	3/08/2021	Capture	MR NQ I2	T1	675989	7680654	440	34.5	15.7	-	Undeveloped pouch	Good condition
		4/08/2021	Recapture		T6	675944	7680730				-	-	
991 0030 0017 8685	Male	3/08/2021	Capture	MR NQ I2	T14	675911	7680952	680	37	19.8	-	-	Good condition
		4/08/2021	Recapture		T33	676040	7680700				-	-	
991 0030 0017 8684	Male	3/08/2021	Capture	MR NQ I1	T10	674568	7686741	740	38.8	18.7	-	-	Good condition
		5/08/2021	Recapture		T8	674570	7686676				-	-	
991 0030 0017 8666	Female	4/08/2021	Capture	MR NQ I1	T10	674568	7686741	360	32.2	14.6	-	Undeveloped pouch	Good condition
-	Male	2/08/2021	Remains	MR NQ I3	Opp	677096	7675047	-	-	-	-	-	Remains found underneath railway
2022													
No monitoring													
Eliwana Mine													
2022													
-	-	30/05/2022	Motion camera capture	EM NQ I3	MC4	496691	7508420	-	-	-	-	-	Individual 1
-	-	26/06/2022	Motion camera capture	EM NQ I3	MC4	496691	7508420	-	-	-	-	-	Individual 2
-	-	15/07/2022	Motion camera capture	EM NQ I3	MC4	496691	7508420	-	-	-	-	-	
Eliwana Line Rail													
2022													
No records													
North Star													
2011													
M1	Male	8/07/11	Capture	A / -	C4	-	-	705	33.2	17.5	5	-	No signs of fighting
		9/07/11	Recapture	B / NS NQ I1	C13	-	-						
		10/07/11	Recapture		C11	-	-						
		11/07/11	Recapture		C11	-	-						
		12/07/11	Recapture		C13	-	-						
		13/07/11	Recapture		C11	-	-						
		14/07/11	Recapture		C11	-	-						
M2	Male	8/07/11	Capture	A / -	C6	-	-	615	32.7	13.5	3	-	Thin fur, few signs of fighting
		10/7/11	Recapture		C6	-	-						
		12/07/11	Recapture		C2	-	-						

ID (Microchip)	Sex	Date	Capture	Site	Trap	Co-ordinates		Weight	Short Pes (mm)	Caudal (mm)	Health Rating (1-5)	Reproductive Status	Comments
						Easting	Northing						
M3	Male	9/07/11	Capture	D / -	C28	-	-	590	35.6	15.5	5	-	No signs of fighting
		10/07/11	Recapture		C28	-	-						
		11/07/11	Recapture		C31	-	-						
		12/07/11	Recapture		C29	-	-						
		13/07/11	Recapture		C32	-	-						
		14/07/11	Recapture		C30	-	-						
M4	Male	10/07/11	Capture	E / -	C36	-	-	727	36.1	15.6	5	--	No signs of fighting
		11/07/11	Recapture		C37	-	-						
		12/07/11	Recapture		C39	-	-						
		13/07/11	Recapture		C36	-	-						
		14/07/11	Capture		C37	-	-	715	36.9				
M5	Male	10/08/11	Capture	C / NS NQ I2	C23	712918	7648805	595	34.6	16.4	5	-	No signs of fighting
		11/08/11	Recapture		C24	713028	7648914						
		12/08/11	Recapture		C23	712918	7648805						
		13/08/11	Recapture		C22	712893	7648932						
F6	Female	10/08/11	Capture	C / NS NQ I1	C10	711957	7650706	330	30.8	15	5	-	No signs of fighting
		12/08/11	Recapture		C11	712029	7650678						
		14/08/11	Recapture		C13	712167	7650597						
M7	Male	11/08/11	Capture	A / -	C3	711476	7651205	630	35.4	17.1	5	-	No signs of fighting
		12/08/11	Recapture		C3	711476	7651205						
		14/08/11	Recapture		C2	711578	7651211						
M8	Male	11/07/11	Capture	F / NS NQ I2 (2019-2020) (NS NQ C1- (2014-2018)	C47	713117	7646259	605	34.5	13.4	5	-	No signs of fighting
		12/07/11	Recapture		C47	713117	7646259						
		13/07/11	Recapture		C48	713098	7646325						
F9	Female	11/07/11	Capture	E / -	C36	713311	764466	320	32.1	14.8	5	Pouch not developed	
M10	Male	13/08/11	Capture	B / NS NQ I1	C14	712257	7650549	778	40	18.5	5	-	No signs of fighting
		14/08/11	Recapture		C14	712257	7650549						
2014													
941000016595571	Female	27/08/14	Capture	NS NQ I1	C21	712261	7650571	395	27.5	11.0	2.5	-	-
		29/08/14	Recapture		C17	712230	7650449						
		30/08/14	Recapture		C5	712303	7650321						
941000016595479	Female	29/08/14	Capture	NS NQ I2	C18	712924	7648751	360	3.77	17.0	3.5	appears to have been mated, no young in pouch, large scars on both thighs, small patch of hair missing on back	-
941000016202872	Male	25/08/14	Capture	NS NQ I1	C21	712261	7650571	275	36.5	11.5	4	-	Slender and small
		26/08/14	Recapture	NS NQ I2	C18	712924	7648751						
		27/08/14	Recapture		C17	712924	7648726						
		28/08/14	Recapture		C16	712928	7648696						
		29/08/14	Recapture		C14	712934	7648633						
		30/08/14	Recapture		C14	712934	7648633						
941000016595484	Male	31/08/14	Capture	NS NQ I2	C18	712924	7648751	640	32.0	20.0	4	-	
941000016595499	Male	29/08/14	Capture	Site office	Additional	712658	7650700	530	37.3	15.0	3.5	-	

ID (Microchip)	Sex	Date	Capture	Site	Trap	Co-ordinates		Weight	Short Pes (mm)	Caudal (mm)	Health Rating (1-5)	Reproductive Status	Comments
						Easting	Northing						
		30/08/14	Recapture	NS NQ I2	C18	712924	7648751						Signs of combat suggesting reproductive
941000016595477^	Male	26/08/14	Capture	NS NQ I2	C6	713065	7648513	800	38.5	15.5	4	-	Equipped with radio-collar
		28/08/14	Recapture	NS NQ I3	C4	713383	7647871						
		30/08/14	Recapture		C6	713319	7647876						
		31/08/14	Recapture		C6	713319	7647876						
941000016595575	Female	25/08/14	Capture	NS NQ I3	C5	713352	7647875	375	27.0	15.5	3.5	-	Healing wound
		27/08/14	Recapture		C4	713383	7647871						
		29/08/14	Recapture		C12	713192	7647903						
		30/08/14	Recapture		C5	713352	7647875						
941000016595478	Male	25/08/14	Capture	NS NQ I4	C17	715813	7649275	560	21.3	17.0	3.5	reproductive male	Signs of combat, missing fur on head and tail
		29/08/14	Recapture		C15	715837	7649277						
941000016595496	Male	26/08/14	Capture	NS NQ I4	C19	715772	7649294	370	34.5	11.0	4.5	-	
		27/08/14	Recapture		C19	715772	7649294						
		28/08/14	Recapture		C15	715837	7649277						
		29/08/14	Recapture		C15	715837	7649277						
2015													
941 000016595571	Female	22/08/15	Recapture – second year	NS NQ I1	C12	712296	7650382	410	30.0	15.0	4	-	mated and has missing fur on sides, developed pouch, very grumpy mood
941 000017452055^	Female	25/08/15	Capture	NS NQ I1	C24	712443	7650130	403	32.0	15.0	4	-	developed pouch with small embryos in it, some sores and signs of fighting
941 000017452056^	Male	26/08/15	Capture	NS NQ I1	C18	712350	7650282	524	36.0	14.0	3	-	some fighting and mating some fighting and fur missing, not much fat
941 000016202842	Female	24/08/15	Capture	NS NQ I2	C1	712924	7648751	345	33.0	13.0	4	-	developed pouch, missing fur on both sides indicating signs of mating
		25/08/15	Recapture		C5	712934	7648633						
941 000017452061	Male	22/08/15	Capture	NS NQ I3	C7	713295	7647886	613	36.0	15.0	3	-	wounds
941 000017452064	Female	24/08/15	Capture	NS NQ I3	C9	713264	7647912	445	40.9	15.0	4	developed pouch, no pouch young, good condition	-
941 000017452060	Male	23/08/15	Capture	NS NQ I4	C6	716171	7649355	565	36.0	12.0	3.5	-	skinny
		24/08/15	Recapture		C6	716171	7649355						
		25/08/15	Recapture		C5	716198	7649334						
941 000017452063	Female	25/08/15	Capture	NS NQ I4	C8	716106	7649354	347	31.0	10.0	4	good, developed pouch	-
941 000017452071	Male	22/08/15	Capture	NS NQ I4	C13	715935	7649279	547	48.9	15.5	3.5	-	fleas, mating and fighting, some hair loss
		23/08/15	Recapture		C13	715935	7649279						
		25/08/15	Recapture		C19	715813	7649275						
		26/08/15	Recapture		C18	715815	7649288						
		27/08/15	Recapture		C21	715772	7649294						
2016													
941000017452045	Male	14/08/16	Capture	NS NQ I1	C9	712242	7650438	550	33.7	13.3	4	-	No bite marks or signs of fighting
		15/08/16	Recapture		C10	712251	7650421						
941000017452052	Male	15/08/16	Capture	NS NQ I1	C9	712242	7650438	710	39.0	17.0	4	-	No bite marks

ID (Microchip)	Sex	Date	Capture	Site	Trap	Co-ordinates		Weight	Short Pes (mm)	Caudal (mm)	Health Rating (1-5)	Reproductive Status	Comments
						Easting	Northing						
		18/08/16	Recapture		C23	712415	7650185						
941000017452049	Male	15/08/16	Capture	NS NQ I1	C3	712202	7650547	616	32.9	15.8	4	-	Some fur missing
		16/08/16	Recapture		C9	712242	7650438						
94100016595571	Female	16/08/16	Recapture – third year	NS NQ I1	C12	712296	7650382	475	30.0	15.0	4	Developed pouch, no young. Captured for 3rd year	-
941 000017452064	Female	12/08/16	Recapture – second year	NS NQ I2	C3	712202	7650547	500	44.5	15.0	5	Captured for 2nd year, Pouch developed but no young, no hair loss	-
2017													
941000016595532	Male	23/08/17	Capture	NS NQ I2	C25	713115	7648237	540	37.0	13.0	4	-	Signs of fighting
		24/08/17	Recapture		C25	713115	7648237						
943094322007308	Male	23/08/17	Capture	NS NQ I4	C4	716221	7649311	575	38.3	16.0	4	-	Skinny, missing patches of fur
		24/08/17	Recapture		C9	716064	7649328						
		25/08/17	Recapture		C9	716064	7649328						
		26/08/17	Recapture		C13	715935	7649279						
		29/08/17	Recapture		C6	716171	7649355						
941000017452028	Male	26/08/17	Recapture	NS NQ I4	C24	715706	7649304	720	38.8	12.8	3	-	Sign of fighting
		27/08/17	Recapture		C25	715690	7649309						
2018													
991 0030 0017 4871	Male	17/08/18	Capture	NS NQ I4	C17	713035	7647984	545	13.8	32	4	-	Signs of fighting
		18/08/18	Recapture	NS NQ I4	C19	712958	7648002						
		19/08/18	Recapture	NS NQ I4	C18	712998	7648002						
991 0030 0017 4886	Male	20/08/18	Recapture	NS NQ I2	C24	713109	7648262	-	-	-	-	-	Individual captured at control site NS NQ C1 prior and post this record
2019													
991 0030 0017 4872	Female	29/08/19	Capture	NS NQ I2	C32	713123	7646281	315	32.3	11.4	3	Signs of mating, raw thighs, bit marks on neck. Pouch developed, no young	Too small for collar
		30/08/19	Recapture	NS NQ I2	C26	713378	7646293						
991 0030 0017 4879	Male	03/09/19	Capture	NS NQ I4	C1	716275	7649246	555	35.0	13.8	4	Some mild signs of fighting	Was equipped with radio-collar
2020													
900 1130 0171 5477	Male	26/7/20	Capture	NS NQ I2	C28	713115	7646213	840	-	-	5	-	Healthy
		27/7/20	Recapture		C37	713102	7646407						
		28/7/20	Recapture		C35	713106	7646349						
		29/7/20	Recapture		C31	713123	7646268						
900 1130 0171 4878	Male	28/7/20	Capture	NS NQ I2	C39	713145	7646413	740	-	-	5	-	Healthy
		29/7/20	Recapture		C23	713159	7646095						
900 1130 0171 5465	Female	28/7/20	Capture	NS NQ I3	C19	713238	7646088	310	33.0	14.5	4	No pouch developed, very small	-
		30/7/20	Recapture		C26	713116	7646164						

ID (Microchip)	Sex	Date	Capture	Site	Trap	Co-ordinates		Weight	Short Pes (mm)	Caudal (mm)	Health Rating (1-5)	Reproductive Status	Comments
						Easting	Northing						
2021													
900 1130 0171 5465^	Female	18/08/2021	Recapture – second year	NS NQ I3	C31	712340	7650401	410	-	-	5	Developed pouch	-
991 0030 0077 8673^	Male	19/08/2021	Capture	NS NQ I3	C1	710658	7648651	690	39.5	15	4	Mating	Bit skinny, some fur missing from fighting
		20/08/2021	Recapture		C2	708181	7647777	700					
		21/08/2021	Recapture		C36	710311	7648620						
991 0030 0077 8701	Male	19/08/2021	Capture	NS NQ I1	C40	713574	7656851	1100	39.5	19	5	-	Very big, good health
991 0030 0077 8699	Male	19/08/2021	Capture	NS NQ I3	C31	712340	7650401	1040	39.5	14	5	Mating	A few signs of fighting, too big to collar
		20/08/2021	Recapture		C34	710355	7648672	850			3		Weird behaviour of falling over in cage
991 0030 0077 8667	Female	23/08/2021	Capture	NS NQ I4	C21	715857	7649265	390	33	12	3	Developed pouch	-
		24/08/2021	Recapture		C20	715740	7649298						
		25/08/2021	Recapture		C10	715772	7649294						
		26/08/2021	Recapture		C10	715772	7649294						
2022													
991 0030 0171 6369	Female	20/07/2022	Capture	NS NQ I1	C09	710517	7648722	390	3.1	1.31	5	Small pouch	Good condition
991 0030 0077 8674	Female	23/07/2022	Capture	NS NQ I2	C15	713328	7646133	390	2.9	1.45	4	None	Very small
		24/07/2022	Recapture		C18	713258	7646109						
		26/07/2022	Recapture		C22	713179	7646088						
991 0030 0077 8675	Male	23/07/2022	Capture	NS NQ I2	C18	713258	7646109	1000	3.35	1.75	4	-	Laid upside down in cage
		24/07/2022	Recapture		C15	713328	7646133						
		25/07/2022	Recapture		C27	713117	7646187						
		26/07/2022	Recapture		C43	713153	7646476						
991 0030 0171 6367	Male	23/07/2022	Capture	NS NQ I2	C20	713226	7646066	1000	3.4	1.6	4	-	-
		24/07/2022	Recapture		C24	713146	7646119						
		25/07/2022	Recapture		C37	713102	7646407						
		26/07/2022	Recapture		C31	713123	7646268						
991 0030 0077 8665	Male	24/07/2022	Capture	NS NQ I2	C31	713123	7646268	870	3.6	1.7	5	Solid built	-
		25/07/2022	Recapture		C29	713121	7646232						
		26/07/2022	Recapture		C36	713095	7646362						
991 0030 0171 6370^	Male	19/07/2022	Capture	NS NQ I3	C36	710388	7648682	710	3.5	2.15	5	Solid, few scratches on back	Radio-collar ch 400, antenna on RHS
		20/07/2022	Recapture		C16	710358	7648633						
		22/07/2022	Recapture		C16	710358	7648633						
900 1130 0171 5465	Female	20/07/2022	Capture	NS NQ I3	C1	710695	7648583	490	-	-	4	Pouch just developing	Captured in 2020
991 0030 0077 8700	Male	22/07/2022	Capture	NS NQ I3	C15	710388	7648644	1000	3.49	2.8	5	-	Good condition some fur loss
991 0030 0077 8687^	Female	26/07/2022	Capture	NS NQ I4	C45	713153	7646476	450	-	-	5	Small pouch, no young	Collar 520.200
		19/08/2022	Recapture		A10B	715931	7649289						Collar removed
991 0030 0077 8667	Female	27/07/2022	Capture	NS NQ I4	C14	715803	7649274	520	-	-	5	Pouch well developed	Recapture from 2021

ID (Microchip)	Sex	Date	Capture	Site	Trap	Co-ordinates		Weight	Short Pes (mm)	Caudal (mm)	Health Rating (1-5)	Reproductive Status	Comments
						Easting	Northing						
2023													
900 1130 0171 5443	Male	28/07/2023	Capture	NS NQ I1	T36	712389	7650226	800	3.2	1.9	4	-	Some fur missing
		29/07/2023	Recapture		T50	712452	7650101						
991 0030 0195 1368	Male	29/07/2023	Capture		T4	712094	7650655	580	3.6	1.6	5	-	-
		30/07/2023	Recapture		T10	712191	7650569						
991 0030 0195 1377	Female	30/07/2023	Capture		T22	712247	7650458	350	3.1	1.1	4	-	Small
991 0030 0171 6369	Female	30/07/2023	Recapture		T10	712191	7650569	-	-	-	-	-	Recapture from 2022
900 1130 0171 6366	Male	30/07/2023	Capture	NS NQ I2	T42	713128	7646456	850	3.6	-	5	-	-
		31/07/2023	Recapture		T29	713121	7646232						
900 1130 0171 5451	Male	30/07/2023	Capture		T46	713166	7646490	540	-	-	4	-	Little guy
991 0030 0171 6368	Male	1/08/2023	Capture		T39	713145	7646413	820	-	-	5	-	Unsettled, not all measurements taken
		2/08/2023	Recapture		T32	713122	7646283						
991 0030 0195 1376^	Female	26/07/2023	Capture	NS NQ I3	T18	710313	7648614	500	3.2	1.6	5	Teats, pouch fairly open, no discoloration	Collar 150.500
		28/07/2023	Recapture		T26	710194	7648533						
991 0030 0195 1372	Male	26/07/2023	Capture		T15	710388	7648644	520	3.1	1.6	4	Small balls	-
991 0030 0171 6361	Male	26/07/2023	Capture		T13	710414	7648678	-	3.5	2.4	5	Large ball, some scratches	-
		27/07/2023	Recapture		T4	710401	7648658						
991 0030 0195 1363^	Male	26/07/2023	Capture		T14	710401	7648658	660	3.5	1.7	5	Middle size	Collar 150.700
		28/07/2023	Recapture		T3	710658	7648653						
991 0030 0171 6370	Male	28/07/2023	Recapture		T26	710194	7648533	-	-	-	-		From 2022
		29/07/2023	Recapture		T41	710484	7648751						
991 0030 0195 1360	Female	27/07/2023	Capture		T1	710695	7648583	350	3.1	1.1	4	Early pouch	Just little
991 0030 0195 1369	Male	29/07/2023	Capture		T1	710695	7648583	650	3.6	1.6	5	-	-
		27/07/2023	Recapture		T26	710194	7648533						
900 1130 0171 5448	Male	31/07/2023	Capture	NS NQ I4	T27	715940	7649288	490	3	1.7	4	-	-
		1/08/2023	Recapture		T26	715922	7649280						
		2/08/2023			T23	715891	7649269						
		3/08/2023			T15	715813	7649271						
900 1130 0171 5471	Male	2/08/2023	Capture		T4	715730	7649323	650	3.5	1.5	5	Big balls	-
		3/08/2023			T5	715742	7649316						
991 0030 0077 8667	Female	31/07/2023	Capture		T9	715767	7649299	490	-	-	5	Discolorations and pouch	Recapture from 2021 & 2022
		1/08/2023	Recapture		T10	715775	7649297						
		2/08/2023			T10	715775	7649297						
		3/08/2023			T18	715827	7649273						
900 1130 0711 5456	Male	2/08/2023	Capture		T17	715834	7649260	-	3.8	2	5	Big balls	-
		3/08/2023	Recapture		T19	715836	7649274						
900 1130 0171 5453	Male	3/08/2023	Capture		T16	715826	7649265	750	3.6	2	5	-	Some fur missing

ID (Microchip)	Sex	Date	Capture	Site	Trap	Co-ordinates		Weight	Short Pes (mm)	Caudal (mm)	Health Rating (1-5)	Reproductive Status	Comments
						Easting	Northing						
991 0030 0077 8687	Female	1/08/2023	Recapture		T46	716228	7649299	-	-	-	-	Discolorations and pouch	Recapture from 2022 (collared individual)
		2/08/2023	Recapture		T20	715848	7649272						
900 1130 0017 5443	Male	3/08/2023	Capture		T25	715914	7649272	-	-	-	-	-	-
Collar Retrieval													
991 0030 0195 1374	Male	22/08/2023	Capture	NS NQ I3	G7	711003	7648679	850	4.1	2.1	5	-	
991 0030 0195 1363^	Male	22/08/2023	Recapture		M16	710391	7648652					-	Collar retrieved
991 0030 0195 1376^	Female	22/08/2023	Recapture		G3	711058	7648615					Discolorations and pouch	
991 0030 0195 1369	Male	22/08/2023	Recapture		G4	711044	7648624					-	

^ Individual was equipped with GPS radio-collar

Appendix G: Statistical Analysis of Northern Quoll Data

Table 5.8: Abundance estimates of Northern Quoll at North Star monitoring sites using CMR

Session (Year)	Sex	Abundance						Survival (± SE)		Sex	Abundance						Survival (± SE)	
		Impact Sites			Control Sites			Impact Sites	Control Sites		Impact Sites			Control Sites			Impact Sites	Control Sites
		Estimate	LCI	UCI	Estimate	LCI	UCI				Estimate	LCI	UCI	Estimate	LCI	UCI		
2011	Females	2.07	2	3.89	-	-	-	-	-	Males	8.29	8.02	11.55	-	-	-	-	-
2014		6.56	6.07	10.66	0	0	0	0.001 ± 1.126	0 ± 0.108		10.94	10.15	15.93	2.19	2.01	4.92	0 ± 0.017	0 ± 0.002
2015		9.07	8.18	14.52	0	0	0	0.521 ± 0.217	0.094 ± 0.179		4.54	4.06	8.68	4.54	4.06	8.68	0.016 ± 0.029	0 ± 0.001
2016		5.33	4.21	12.32	2.66	2.08	7.81	0.32 ± 0.205	0.043 ± 0.092		5.33	4.21	12.32	1.33	1.03	5.24	0.007 ± 0.014	0 ± 0.001
2017		1.14	1.01	3.61	3.41	3.04	7.16	0 ± 0	0 ± 0		9.11	8.19	14.55	6.83	6.12	11.68	0 ± 0	0 ± 0
2018		1.29	1.02	4.94	1.29	1.02	4.94	0.695 ± 0.499	0.179 ± 0.221		5.17	4.18	11.64	7.75	6.32	15.66	0.034 ± 0.057	0 ± 0
2019		1.29	1.02	6	-	-	-	0 ± 0	0 ± 0		1.29	1.02	6	-	-	-	0 ± 0	0 ± 0
2020		1.04	1	2.38	-	-	-	0 ± 0	0 ± 0		2.07	2	3.98	-	-	-	0 ± 0	0 ± 0
2021		2.22	2.01	5.17	1.11	1.01	3.33	0.851 ± 0.271	0.354 ± 0.572		3.32	3.03	6.79	7.76	7.1	12.66	0.082 ± 0.161	0 ± 0.004
2022		4.79	4.11	9.67	5.98	5.15	11.31	0.804 ± 0.24	0.283 ± 0.365		5.98	5.15	11.31	7.18	6.2	12.91	0.061 ± 0.093	0 ± 0.001
2023		7.33	6.25	13.17	1.22	1.01	4.31	0.837 ± 0.283	0.33 ± 0.232		18.33	15.92	27.07	9.78	8.38	16.32	0.075 ± 0.102	0 ± 0.002

- = no data collected

Appendix H: Greater Bilby records

Table 5.9: Greater Bilby records

Record ID	Type of recording	Date	Easting	Northing
Control Sites				
MR GB AS C16				
2013/2014				
MR GB2	Motion Camera	Jun'14	744761	7606937
2014/2015				
BB C3	Active Burrow	Jun'2015	744845	7607229
BB C4	Active Burrow	Jun'2015	744848	7607299
BB C5	Active Burrow	Jun'2015	744890	7606942
BB C6	Active Burrow	Jun'2015	744892	7606932
2015/2016				
BB C7	Active Burrow	Jun'2015	744777	7607302
BB C8	Active Burrow	Jun'2015	744780	7607298
BB C9	Active Burrow	Jun'2015	744975	7606777
BB C10	Active Burrow	Jun'2015	745080	7606861
BB C11	Active Burrow	Jun'2015	745171	7606915
2016/2017				
BB C12	Active Burrow	Jun'2016	701065	7614184
BB C13	Active Burrow	Jun'2016	744892	7606942
BB C14	Active Burrow	Jun'2016	744892	7606941
BB C15	Active Burrow	Jun'2016	744899	7606839
BB C16	Active Burrow	Jun'2016	744956	7606774
BB C17	Active Burrow	Jun'2016	745080	7605863
2017/2018				
BB C18	Active Burrow	Jun'2017	744850	7607231
2018/2019				
Nil				
2019				
BB C19	Active Burrow	Jun-Aug 2019	745096	7606800
BB C20	Active Burrow	Jun-Aug 2019	745248	7606668
2020				
BB C19 (2019)	Active Burrow	June 2020	745096	7606800
BB C20 (2019)	Active Burrow	June 2020	745248	7606668
2021				
MR GB AS C16 (2021)	Motion Camera	March 2021	744994	7606827
MR GB AS C16.MC2 (2021)	Active Burrow	March 2021	745097	7606802
MR GB AS C16 MC1	Motion Camera	June-Aug 2021	745477	7606503
MR GB AS C16 MC2	Motion Camera	25/08/2021	745476	7606504
MR GB AS C16 MC3	Motion Camera	June – July 2021	745247	7606666
2022				
MR GB AS C16	Active burrow, tracks, diggings	Feb'22	745111	7606838

MR GB AS C16 MC2	Motion camera	April-July 2023	745476	7606504
MR GB AS C16 MC4	Motion camera	May 2022	745416	7606506
MR GB AS C16	Tracks, diggings scat	Jun'22	745059	7606841
Potential Impact Sites				
MR GB AS I14				
2013/2014				
F2	Female captured	4/6/14	692889	7634869
BB I5	Active Burrow	3/6/14	693126	7634935
	Active Burrow		693166	7634939
	Active Burrow		693352	7634971
2014/2015				
BB I6-8	Active Burrow	Jun'15	693097	7634937
2015/2016				
BB I9-14	Active Burrow	Jun'16	693009	7634972
2016/2017				
BB I15-25	Active Burrow	Jun'16	692964	7634950
2017/2018				
BB I26-30	Active Burrow	Jun'17	693325	7635186
2018/2019				
BB I31	Active Burrow	Jun'18	693168	7634939
2019				
Nil	-	-	-	-
2020				
-	Potential tracks	Jun'20	693132	7635001
2021				
-	Scats (recent)	Jun'21	693087	7635052
2022				
Nil	-	-	-	-
MR GB AS I14				
2022				
MR GB OS 23	Tracks, diggings, and scats	Feb'22	696702	7608099
MR GB OS 23	Scats and diggings	June'22	696720	7607818

Appendix I: Greater Bilby DNA Analysis Report

Helix
Molecular
Solutions

Ground Floor, Unit F2, 661 Newcastle St, Leederville WA 6007 | PO Box 155, Leederville WA 6903

t: 0439 845 456 | w: www.helixsolutions.com.au

13 September 2023

Astrid Heidrich
Principal Zoologist
Spectrum Ecology & Spatial
661C Newcastle St
Leederville WA 6007

Genotyping Bilby (*Macrotis lagotis*) Individuals from Scat Samples

Dear Astrid,

Please find below the results of our investigation into Bilby (*Macrotis lagotis*) scat samples to identify the number of individuals represented in your 'Occupancy', 'Abundance' and 'Impact' sites.

Methodology

Six scat samples collected in March – June 2023 from one site (MR GB OS 23, Table 1) were analysed to determine the potential number of individuals present, based on their genotypic variation. Site MR GB OS 23 and an additional site (MR GB ASC 16) were previously sampled in June 2021 and June 2022 (see Table 2 and Table 3) and the data from those samples were included in the current analysis to determine if the same individuals were detected during 2023.

Bilby scat samples submitted to Helix Molecular Solutions were stored in silica-based desiccant to preserve DNA. All samples collected were completely dry upon arrival and medium-large in size. One to three scats from each sample were selected for analysis.

Table 1. Bilby scat sample collection sites and sample details from March – June 2023. Shaded cells represent specimens that did not produce useable genotypes.

Site	Easting	Northing	Specimen ID	Helix ID	Scat size	Scat moisture
MR GB OS 23	696704	7608025	MR GB OS 23 SO1	**SM01**	Medium	Dry
	696704	7608025	MR GB OS 23 SO2	**SM02**	Large	Dry
	696704	7608025	MR GB OS 23 SO3	**SM03**	Large	Dry
	665350	7717540	MR GB OS 23 SO4	**SM04**	Medium	Dry
	696790	7607969	2300 GB OS 23	**SM05**	Large	Dry
	696736	7608005	2300 GB OS 23	**SM06**	Med – Large	Dry

Table 2. **Previously genotyped Bilby scat sample collection sites and sample details from June 2022. Shaded cells represent specimens that did not produce useable genotypes.**

Site	Easting	Northing	Specimen ID	Helix ID	Scat size	Scat moisture
MR GB OS 23	696772	7607974	GBS01	**RP01**	Med - Large	Dry
	696775	7607972	GBS02	**RP02**	Med - Large	Dry
	696771	7607972	GBS03	**RP03**	Med - Large	Dry
	696793	7607985	GBS04	**RP04**	Med - Large	Dry
	696853	7608012	GBS05	**RP05**	Med - Large	Dry
	696844	7608034	GBS06	**RP06**	Med - Large	Dry
MR GB ASC 16	745448	7606559	C16 Scat 01	**RP07**	Med - Large	Dry

Table 3. **Previously genotyped Bilby scat sample collection sites and sample details from June 2021. Shaded cells represent specimens that did not produce useable genotypes.**

Site	Easting	Northing	Specimen ID	Helix ID	Scat size	Scat moisture
MR GB OS 23	696686	7608071	OS23 SCAT01NP	**QT1**	Medium	Dry
	696689	7608074	OS23 SCAT02NP	**QT4**	Small - Med	Wet
	696689	7608075	OS23 SCAT03NP	**QT15**	Medium	Wet
	696682	7608055	OS23 SCAT04NP	**QT9**	Medium	Dry
	696689	7608032	OS23 SCAT05NP	**QT8**	Med - Large	Dry
	696761	7608120	OS23 SCAT06NP	**QT10**	Med - Large	Dry
MR GB ASC 16	744890	7606952	ASC16 SCAT01NP	**QT14**	Medium	Wet
	-	-	ASC16 SCAT02NP	**QT6**	Small - Med	Dry
	745257	7606709	ASC16 SCAT03NP	**QT7**	Medium	Mid

The QIAGEN QIAamp Fast DNA Stool mini kit (Qiagen, Hilden, Germany) was used to extract the six scat samples. Specimens were washed in buffer as per Carpenter *et al.* (2017) and eluted as per manufacturer's protocols.

The seven microsatellite loci used for the 2021 and 2022 Bilby scat collections (Appendix 1 and 2) were again amplified for the 2023 samples using the QIAGEN Multiplex PCR kit in triplicate. PCR products were analysed on an ABI3730XL Sequencer using Genescan-500 LIZ internal standard and scored using the software GeneMarker v1.91.

Results

Two of the six scat samples from 2023 were successfully amplified at all seven loci tested (Appendix 3).

Based on these seven loci, both samples represented the same distinct genotype (Table 4). This genotype has been previously detected at site MR GB OS 23 in one sample from 2022 (RP02; Table 4), indicating that all three scats were deposited by the same individual bilby.

A partial genotype was obtained for the remaining four samples (one or less loci worked), but individual identifications could not be determined from these partial genotypes due to low confidence in the assignment (Table 4).

Table 4. Bilby scat sample collections from 2021 – 2023 and individual assignment based on genotyping.

Collection Year	Helix ID	Field ID	Individual Identity
2023	**SM01**	MR GB OS 23 SO1	Failed
2023	**SM02**	MR GB OS 23 SO2	Failed
2023	**SM03**	MR GB OS 23 SO3	1
2023	**SM04**	MR GB OS 23 SO4	Failed
2023	**SM05**	2300 GB OS 23	Failed
2023	**SM06**	2300 GB OS 23	1
2022	**RP01**	MR GB OS 23	2
2022	**RP02**	MR GB OS 23	1
2022	**RP03**	MR GB OS 23	2
2022	**RP05**	MR GB OS 23	2
2022	**RP07**	MR GB AS C16	3
2021	**QT4**	OS23 SCAT02NP	2
2021	**QT9**	OS23 SCAT04NP	2
2021	**QT7**	ASC16 SCAT03NP	3

Summary

Two of the six scat samples from 2023 were successfully genotyped and both represented the same individual. Comparisons with the 2021 and 2022 data revealed that this bilby, Individual '1', has now been detected three times at site MR GB OS 23: twice in 2023 (SM03 and SM06) and once in 2022 (RP02).

Individuals '2' and '3', which were previously recorded in 2021 and 2022, were not detected from the 2023 samples.

Thank you for the opportunity to assist with this project. Please contact us should you have any queries regarding the above.

Yours sincerely,

Serina McConnell
Molecular Biologist

Dr Zoë Hamilton
Principal Geneticist / Zoologist

Yvette Hitchen
Senior Molecular Biologist

Helix Molecular Solutions Pty Ltd

References

Carpenter FM, Dziminski MA. 2017. Breaking down scats: degradation of DNA from Greater Bilby (*Macrotis lagotis*) faecal pellets. *Australian Mammalogy*. **39**: 197-204

Moritz C, Heideman A, Geffen E, McRae P. 1997. Genetic population structure of the Greater Bilby *Macrotis lagotis*, a marsupial in decline. *Molecular Ecology.* **6**: 925–936.

Smith S, McRae P, Hughes J. 2009. Faecal DNA analysis enables genetic monitoring of the species recovery program for an arid-dwelling marsupial. *Australian Journal of Zoology*. **57**:139–148.

Appendix J: Pilbara Leaf-Nosed Bat and Ghost Bat Records

Table 5.10: Pilbara Leaf-nosed Bat records

Site	2013	2014	2015	2016	2017	2018	2019/ 2020	2021	2022	2023	2023 Record Details	
											Date	Detection time
Control Sites												
Christmas Creek												
CC Bat C1	n/a	n/a	n/a	n/a	0	0	0	0	n/a	n/a	Monitoring suspended in 2022	
CC Bat C2	n/a	n/a	n/a	n/a	0	0	0	0	n/a	n/a		
CC Bat C3	n/a	n/a	n/a	n/a	0	0	0	0	n/a	n/a		
CC Bat C4	n/a	n/a	n/a	n/a	1	0	0	0	n/a	n/a		
CC Bat C5	n/a	n/a	n/a	n/a	0	0	0	0	n/a	n/a		
CC Bat C6	n/a	n/a	n/a	n/a	0	0	0	0	n/a	n/a		
CC Bat C7	n/a	n/a	n/a	n/a	0	0	0	0	n/a	n/a		
CC Bat C8	n/a	n/a	n/a	n/a	0	0	0	0	n/a	n/a		
CC Bat C9	n/a	n/a	n/a	n/a	0	0	0	0	n/a	n/a		
CC Bat C10	n/a	n/a	n/a	n/a	0	0	0	0	n/a	n/a		
CC Bat C11	n/a	n/a	n/a	n/a	0	0	0	0	n/a	n/a		
CC Bat C12	n/a	n/a	n/a	n/a	0	0	0	0	n/a	n/a		
CC Bat C4	n/a	n/a	n/a	n/a	0	0	0	0	n/a	n/a		
Total	n/a	n/a	n/a	n/a	1	0	0	0	n/a	n/a	n/a	n/a
Solomon Hub												
SM Bat C1	0	0	n/a	0	0	1	0	0	0	1	19/01/23	22:53
SM Bat C2	0	0	n/a	0	2	0	0	0	1	1	19/01/23	21:27
SM Bat C3	0	0	n/a	0	5	35	277	7	6	44	19/01/23	19:46 – 4:12
SM Bat C4	n/a	n/a	n/a	n/a	0	1	0	2	1	37	19/01/23	20:07-4:17
SM Bat C5	1	0	n/a	0	0	6	0	0	0	0	-	-

Site	2013	2014	2015	2016	2017	2018	2019/ 2020	2021	2022	2023	2023 Record Details	
											Date	Detection time
SM Bat C6	n/a	n/a	n/a	n/a	0	11	1	0	1	1	19/01/23	23:57
SM Bat C7	n/a	n/a	n/a	n/a	7	454	0	0	0	0	-	-
SM Bat C8	n/a	n/a	n/a	n/a	0	1	0	0	0	0	-	-
SM Bat C9	n/a	n/a	n/a	n/a	15	4	133	59	5	89	11-17/01/23	20:02-4:33
SM Bat C10	n/a	n/a	n/a	n/a	74	1	0	0	0	0	-	-
SM Bat C11	n/a	n/a	n/a	n/a	0	0	0	0	0	0	-	-
SM Bat C12	0	0	n/a	0	n/a	n/a	4	3	0	0	-	-
Total	1	0	n/a	0	103	514	415	71	14	173	-	-
Main Line Rail												
MR Bat C1	61	3	n/a	1	2	1	4	1	0	0	-	-
MR Bat C2	0	0	n/a	3	0	0	0	0	0	0	-	-
MR Bat C3	0	0	n/a	1	0	0	4	0	0	0	-	-
MR Bat C4	n/a	n/a	n/a	n/a	13	1	0	0	2	1	05-06/01/23	2:55
MR Bat C5	n/a	n/a	n/a	n/a	2	1	0	0	63	0	-	-
MR Bat C6	n/a	n/a	n/a	n/a	9	1	3	0#	0	0	-	-
MR Bat C7	n/a	n/a	n/a	n/a	0	0	0	0#	0	0	-	-
MR Bat C8	n/a	n/a	n/a	n/a	0	0	0	0	0	0	-	-
MR Bat C9	n/a	n/a	n/a	n/a	0	2	25	0#	0	2	01-02/03/23	-
MR Bat C10	n/a	n/a	n/a	n/a	11	0	975	0	18	1	03/03/23	3:23
MR Bat C11	n/a	n/a	n/a	n/a	3	0	7	n/a	0	0	-	-
MR Bat C11 2021	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0	-	-
MR Bat C12	n/a	n/a	n/a	n/a	32	110	10	0#	0	0	-	-
Total	61	3	n/a	5	72	116	1,024	1	83	4	-	-

Site	2013	2014	2015	2016	2017	2018	2019/ 2020	2021	2022	2023	2023 Record Details	
											Date	Detection time
EM Bat C11	n/a	n/a	n/a	n/a	n/a	n/a	1	n/a	0	0	-	-
EM Bat C12	n/a	n/a	n/a	n/a	n/a	n/a	0	n/a	15	0	-	-
EM Bat C10 2021	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
EM Bat C11 2021	n/a	n/a	n/a	n/a	n/a	n/a	n/a	7	n/a	n/a	n/a	n/a
EM Bat C12 2021	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a
Total	n/a	n/a	n/a	n/a	n/a	n/a	36	37	19	67	-	-
Eliwana Line Rail												
SM/ER Bat C1	0	0	n/a	0	0	0	0	0	0	1	19/01/23	22:53
SM/ER Bat C2	0	0	n/a	0	0	0	0	0	1	1	19/01/23	21:27
SM/ER Bat C3	0	0	n/a	0	5	35	277	7	6	44	19/01/23	19:46 – 4:12
SM/ER Bat C4	n/a	n/a	n/a	n/a	0	0	0	2	1	37	19/01/23	20:07-4:17
SM/ER Bat C5	1	0	n/a	0	0	0	0	0	0	0	-	-
SM/ER Bat C6	n/a	n/a	n/a	n/a	0	11	1	0	1	1	19/01/23	23:57
SM/ER Bat C7	n/a	n/a	n/a	n/a	0	0	0	0	0	0	-	-
EM/ER Bat C8	n/a	n/a	n/a	n/a	n/a	n/a	3	4	1	12	01-04/02/23	21:40-4:57
SM/ER Bat C9	n/a	n/a	n/a	n/a	0	0	0	59	5	89	11-17/01/23	20:02-4:33
SM/ER Bat C10	n/a	n/a	n/a	n/a	n/a	n/a	1	0	0	0	-	-
SM/ER Bat C11	n/a	n/a	n/a	n/a	n/a	n/a	1	0	0	0	-	-
EM/ER Bat C12	n/a	n/a	n/a	n/a	n/a	n/a	4	3	7	0	-	-
Total	1	0	n/a	0	5	46	284	71	29	185	-	-
Potential Impact Sites												
SM Bat I8	n/a	n/a	n/a	n/a	0	0	0	0	0	0	-	-
SM Bat I9	n/a	n/a	n/a	n/a	0	0	0	0	0	0	-	-

Site	2013	2014	2015	2016	2017	2018	2019/ 2020	2021	2022	2023	2023 Record Details	
											Date	Detection time
SM Bat I10	n/a	n/a	n/a	n/a	0	0	0	0	0	0	-	-
SM Bat I11	0	0	n/a	0	0	0	0	0	0	0	-	-
SM Bat I12	0	0	n/a	0	0	0	0	0	0	0	-	-
Total	1	0		0	678	12	0	1	0	0	-	-
Main Line Rail												
MR Bat I1	3	2	n/a	4	2	37	14	0	0	0	-	-
MR Bat I2	18	11	n/a	1	2	0	9	2	0	0	-	-
MR Bat I3	0	0	n/a	1	0	0	4	0	0	1	01/03/23	0:33
MR Bat I4	n/a	n/a	n/a	n/a	60	42	62	0	154	139	28/02-7/03/23	21:07-4:24
MR Bat I5	n/a	n/a	n/a	n/a	24	0	1	0	106	0	-	-
MR Bat I6	n/a	n/a	n/a	n/a	15	3	7	0	15	0	-	-
MR Bat I7	n/a	n/a	n/a	n/a	335	1	18	0	342	1	06/03/23	0:04
MR Bat I8	n/a	n/a	n/a	n/a	12	32	0	0	17	2	02/03/23	21:50-1:53
MR Bat I9	n/a	n/a	n/a	n/a	0	0	16	0#	6	0	-	-
MR Bat I10	n/a	n/a	n/a	n/a	0	0	168	0#	11	18	01-07/03/23	22:31-2:04
MR Bat I11	n/a	n/a	n/a	n/a	0	7	0	0#	0	0	-	-
MR Bat I12	n/a	n/a	n/a	n/a	0	1	0	0#	0	0	-	-
Total	21	13	n/a	6	450	123	299	2	652	161	-	-
Eliwana Mine												
ER/EM Bat I1	n/a	n/a	n/a	n/a	n/a	n/a	2	0	2	3	08/02/23	21:48-3:55
EM Bat I2	n/a	n/a	n/a	n/a	n/a	n/a	7	0	0	1	03/02/23	0:30
EM Bat I3	n/a	n/a	n/a	n/a	n/a	n/a	1	0	0	0	-	-
EM Bat I4	n/a	n/a	n/a	n/a	n/a	n/a	2	0	0	0	-	-

Site	2013	2014	2015	2016	2017	2018	2019/ 2020	2021	2022	2023	2023 Record Details	
											Date	Detection time
EM Bat I5	n/a	n/a	n/a	n/a	n/a	n/a	2	4	2	1	07/02/23	2:09
EM Bat I6	n/a	n/a	n/a	n/a	n/a	n/a	35	2	2	0	-	-
EM Bat I7	n/a	n/a	n/a	n/a	n/a	n/a	0	0	13	0	-	-
EM Bat I8	n/a	n/a	n/a	n/a	n/a	n/a	0	434	0	0	-	-
EM Bat I9	n/a	n/a	n/a	n/a	n/a	n/a	0	0#	0	1	31/01/23	23:54
EM Bat I10	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0	0	-	-
EM Bat I11	n/a	n/a	n/a	n/a	n/a	n/a	0	0	1	0	-	-
EM Bat I12	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0	0	-	-
Total	n/a	n/a	n/a	n/a	n/a	n/a	49	440	20	6	-	-
Eliwana Line Rail												
ER Bat I1	n/a	n/a	n/a	n/a	n/a	n/a	2	0	2	3	08/02/23	21:48-3:55
ER Bat I2/ EM Bat I11	n/a	n/a	n/a	n/a	n/a	n/a	0	0	1	0	21/02/2022	22:34
ER Bat I3/ EM Bat I12	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0	0	-	-
ER Bat I4	n/a	n/a	n/a	n/a	n/a	n/a	2	0	1	0	18/02/2022	21:28
ER Bat I5	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0	0	-	-
ER Bat I6	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0	0	-	-
ER Bat I7	n/a	n/a	n/a	n/a	n/a	n/a	0	0#	0	0	-	-
ER Bat I8	n/a	n/a	n/a	n/a	n/a	n/a	2	8	70	4	12&14/01/23	20:24-4:01
ER Bat I9	n/a	n/a	n/a	n/a	n/a	n/a	1	0	0	1	12/01/23	23:50
ER Bat I10	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0	0	-	-
ER Bat I11	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0	0	-	-
ER Bat I12	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0	0	-	-

Site	2013	2014	2015	2016	2017	2018	2019/ 2020	2021	2022	2023	2023 Record Details	
											Date	Detection time
Total	n/a	n/a	n/a	n/a	n/a	n/a	7	8	72	5	-	-

n/a = site was not part of the monitoring program; # = unit malfunction; * number of calls does not necessarily indicate the number of individuals recorded.

Table 5.11: Ghost Bat records

Site	2013	2014	2015	2016	2017	2018	2019/ 2020	2021	2022	2022 Record Details		2022	
										Date	Detection time	Call numbers trend*	Spatial distribution trend
Control Sites													
Christmas Creek													
CC Bat C1	n/a	n/a	n/a	1	0	0	0	0	n/a	Monitoring suspended in 2022			
CC Bat C2	n/a	n/a	n/a	0	0	0	0	0	n/a				
CC Bat C3	n/a	n/a	n/a	0	1	0	0	0	n/a				
CC Bat C4	n/a	n/a	n/a	n/a	0	0	0	0	n/a				
CC Bat C5	n/a	n/a	n/a	n/a	0	0	0	0	n/a				
CC Bat C6	n/a	n/a	n/a	n/a	0	0	0	0	n/a				
CC Bat C7	n/a	n/a	n/a	n/a	0	0	0	0	n/a				
CC Bat C8	n/a	n/a	n/a	n/a	0	0	0	0	n/a				
CC Bat C9	n/a	n/a	n/a	n/a	0	0	0	0	n/a				
CC Bat C10	n/a	n/a	n/a	n/a	0	0	0	0	n/a				
CC Bat C11	n/a	n/a	n/a	n/a	0	0	0	0	n/a				
CC Bat C12	n/a	n/a	n/a	n/a	0	0	0	0	n/a				
Total	n/a	n/a	n/a	1	1	0	0	0	n/a				
Solomon Hub													
SM Bat C1	0	0	n/a	0	0	0	0	0	0	-	-	Insufficient data – very low detection levels	Insufficient data – very low detection levels
SM Bat C2	0	0	n/a	0	0	0	0	0	0	-	-		
SM Bat C3	0	0	n/a	0	0	0	0	0	0	-	-		
SM Bat C4	n/a	n/a	n/a	n/a	0	0	0	0	0	-	-		
SM Bat C5	0	0	n/a	0	0	0	0	0	0	-	-		
SM Bat C6	n/a	n/a	n/a	n/a	0	0	0	0	0	-	-		

Site	2013	2014	2015	2016	2017	2018	2019/ 2020	2021	2022	2022 Record Details		2022	
										Date	Detection time	Call numbers trend*	Spatial distribution trend
SM Bat C7	n/a	n/a	n/a	n/a	0	0	0	0	0	-	-		
SM Bat C8	n/a	n/a	n/a	n/a	0	0	0	0	0	-	-		
SM Bat C9	n/a	n/a	n/a	n/a	0	0	0	0	0	-	-		
SM Bat C10	n/a	n/a	n/a	n/a	0	0	0	0	0	-	-		
SM Bat C11	n/a	n/a	n/a	n/a	0	0	0	0	0	-	-		
SM Bat C12	0	0	n/a	0	0	0	0	0	0	-	-		
Total	0	0	n/a	0	0	0	0	0	0	-	-		
Main Line Rail													
MR Bat C1	0	0	n/a	0	0	0	0	0	0	-	-		
MR Bat C2	0	0	n/a	0	0	0	0	0	0	-	-		
MR Bat C3	0	0	n/a	0	0	0	0	0	0	-	-		
MR Bat C4	n/a	n/a	n/a	n/a	0	0	0	0	0	-	-		
MR Bat C5	n/a	n/a	n/a	n/a	0	0	0	0	0	-	-		
MR Bat C6	n/a	n/a	n/a	n/a	0	0	0	0	0#	-	-		
MR Bat C7	n/a	n/a	n/a	n/a	0	0	0	0	0#	-	-	Insufficient data – very low detection levels	Insufficient data – very low detection levels
MR Bat C8	n/a	n/a	n/a	n/a	0	0	0	0	0	-	-		
MR Bat C9	n/a	n/a	n/a	n/a	0	0	0	0	0	-	-		
MR Bat C10	n/a	n/a	n/a	n/a	0	0	0	0	0	-	-		
MR Bat C11	n/a	n/a	n/a	n/a	0	0	0	0	0	-	-		
MR Bat C12	n/a	n/a	n/a	n/a	0	0	0	0	0#	-	-		
Total	0	0	n/a	0	0	0	0	0	0	-	-		
Eliwana Mine													
EM Bat C1	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0	-	-		

Site	2013	2014	2015	2016	2017	2018	2019/ 2020	2021	2022	2022 Record Details		2022	
										Date	Detection time	Call numbers trend*	Spatial distribution trend
EM Bat C2	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0	-	-	Insufficient data – requires further monitoring	Insufficient data – requires further monitoring
EM Bat C3	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0	-	-		
EM Bat C4	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0	-	-		
EM Bat C5	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0	-	-		
EM Bat C6	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0	-	-		
EM Bat C7	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0	-	-		
EM Bat C8	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0	-	-		
EM Bat C9	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0	-	-		
EM Bat C10	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0	-	-		
EM Bat C11	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0	-	-		
EM Bat C12	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0	-	-		
Total	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0	-	-		
Eliwana Line Rail													
SM/ER Bat C1	0	0	n/a	0	0	0	0	0	0	-	-	Insufficient data – requires further monitoring	Insufficient data – requires further monitoring
SM/ER Bat C2	0	0	n/a	0	0	0	0	0	0	-	-		
SM/ER Bat C3	0	0	n/a	0	0	0	0	0	0	-	-		
SM/ER Bat C4	n/a	n/a	n/a	n/a	0	0	0	0	0	-	-		
SM/ER Bat C5	1	0	n/a	0	0	0	0	0	0	-	-		
SM/ER Bat C6	n/a	n/a	n/a	n/a	0	0	0	0	0	-	-		
SM/ER Bat C7	n/a	n/a	n/a	n/a	0	0	0	0	0	-	-		
ER Bat C8	n/a	n/a	n/a	n/a	0	0	0	0	0	-	-		
SM/ER Bat C9	n/a	n/a	n/a	n/a	0	0	0	0	0	-	-		
SM/ER Bat C10	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0	-	-		

Site	2013	2014	2015	2016	2017	2018	2019/ 2020	2021	2022	2022 Record Details		2022	
										Date	Detection time	Call numbers trend*	Spatial distribution trend
SM/ER Bat C11	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0	-	-		
SM/ER Bat C12	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0	-	-		
Total	n/a	n/a	n/a	0	0	0	0	0	0	-	-		
Potential Impact Sites													
Solomon Hub													
SM Bat I1	0	0	n/a	0	0	0	0	0	0	-	-	Insufficient data – very low detection rate	Insufficient data – very low detection rate
SM Bat I2	0	0	n/a	0	0	0	0	0	0	-	-		
SM Bat I3	0	0	n/a	0	0	0	0	0	0	-	-		
SM Bat I4	n/a	n/a	n/a	n/a	0	0	0	0	0	-	-		
SM Bat I5	n/a	n/a	n/a	n/a	n/a	0	0	0	0	-	-		
SM Bat I6	n/a	n/a	n/a	n/a	0	0	0	0	0	-	-		
SM Bat I7	n/a	n/a	n/a	n/a	11	10	0	0	0	-	-		
SM Bat I8	n/a	n/a	n/a	n/a	0	0	0	0	0	-	-		
SM Bat I9	n/a	n/a	n/a	n/a	0	0	0	0	0	-	-		
SM Bat I10	n/a	n/a	n/a	n/a	0	0	0	0	0	-	-		
SM Bat I11	n/a	n/a	n/a	0	0	0	0	0	0	-	-		
SM Bat I12	n/a	n/a	n/a	0	0	0	0	0	0	-	-		
Total	0	0		0	11	10	0	0	0	-	-	-	
Main Line Rail													
MR Bat I1	n/a	n/a	n/a	4	0	0	0	0	0	-	-	Insufficient data – very low detection rate	Insufficient data – very low detection rate
MR Bat I2	n/a	n/a	n/a	1	0	0	0	0	0	-	-		
MR Bat I3	n/a	n/a	n/a	1	0	0	0	0	0	-	-		
MR Bat I4	n/a	n/a	n/a	n/a	0	0	0	0	0	-	-		

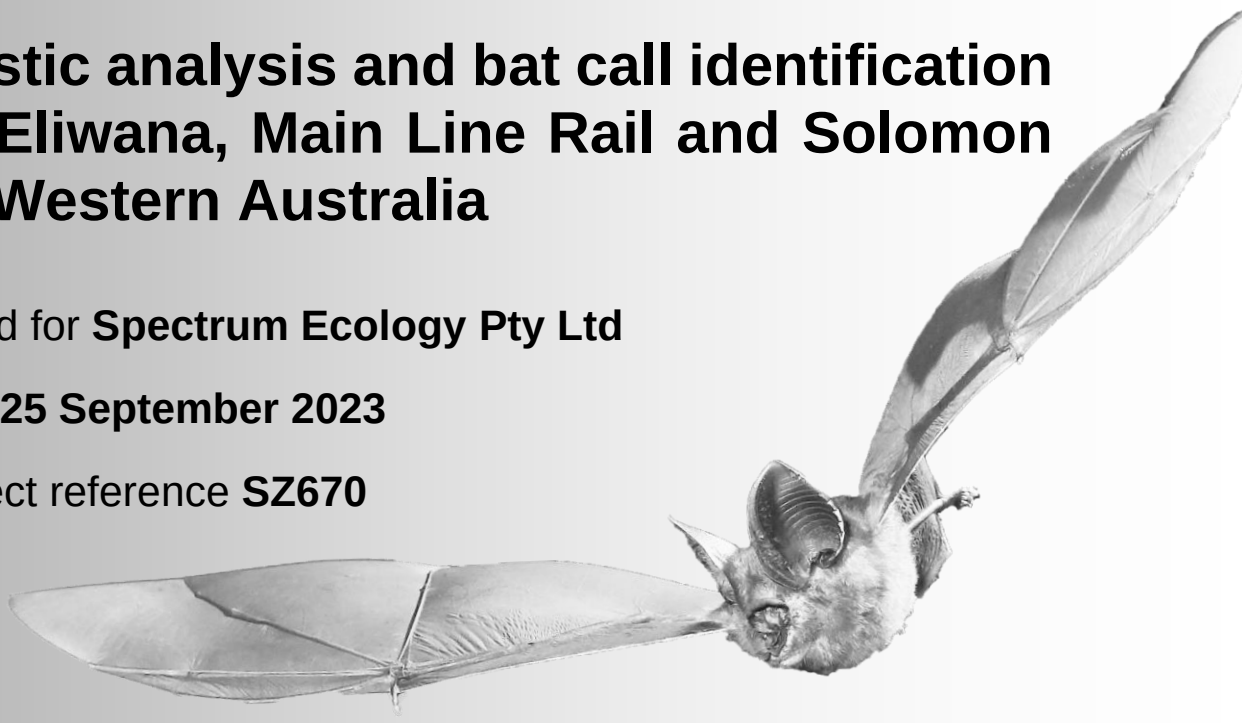
Site	2013	2014	2015	2016	2017	2018	2019/ 2020	2021	2022	2022 Record Details		2022	
										Date	Detection time	Call numbers trend*	Spatial distribution trend
MR Bat l5	n/a	n/a	n/a	n/a	0	0	0	0	0	-	-		
MR Bat l6	n/a	n/a	n/a	n/a	0	0	0	0	0	-	-		
MR Bat l7	n/a	n/a	n/a	n/a	0	0	0	0	0	-	-		
MR Bat l8	n/a	n/a	n/a	n/a	1	0	0	0	0	-	-		
MR Bat l9	n/a	n/a	n/a	n/a	0	0	0	0#	0	-	-		
MR Bat l10	n/a	n/a	n/a	n/a	0	0	0	0#	0	-	-		
MR Bat l11	n/a	n/a	n/a	n/a	0	0	0	0#	0	-	-		
MR Bat l12	n/a	n/a	n/a	n/a	0	0	0	0	0	-	-		
Total	n/a	n/a	n/a	6	1	0	0	0	0	-	-	-	-
Eliwana Mine													
ER/EM Bat l1	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0	-	-	Insufficient data – very low detection rate	Insufficient data – very low detection rate
EM Bat l2	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0	-	-		
EM Bat l3	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0	-	-		
EM Bat l4	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0	-	-		
EM Bat l5	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0	-	-		
EM Bat l6	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0	-	-		
EM Bat l7	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0	-	-		
EM Bat l8	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0	-	-		
EM Bat l9	n/a	n/a	n/a	n/a	n/a	n/a	0	0#	0	-	-		
EM Bat l10	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0	-	-		
EM Bat l11	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0	-	-		
EM Bat l12	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0	-	-		
Total	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0	-	-	-	-

Site	2013	2014	2015	2016	2017	2018	2019/ 2020	2021	2022	2022 Record Details		2022	
										Date	Detection time	Call numbers trend*	Spatial distribution trend
Eliwana Line Rail													
ER Bat I1	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0	-	-	Insufficient data – very low detection rate	Insufficient data – very low detection rate
ER Bat I2	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0	-	-		
ER Bat I3	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0	-	-		
ER Bat I4	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0	-	-		
ER Bat I5	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0	-	-		
ER Bat I6	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0	-	-		
ER Bat I7	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0	-	-		
ER Bat I8	n/a	n/a	n/a	n/a	n/a	n/a	0	0	1	23/01/2022	20:44		
ER Bat I9	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0	-	-		
ER Bat I10	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0	-	-		
ER Bat I11	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0	-	-		
ER Bat I12	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0	-	-		
Total	n/a	n/a	n/a	n/a	n/a	n/a	0	0	1	-	-	-	-

n/a = site was not part of the monitoring program; # = unit malfunction; * number of calls does not necessarily indicate a number of individuals recorded.

Appendix K: Bat Identifications

Acoustic analysis and bat call identification from Eliwana, Main Line Rail and Solomon Hub, Western Australia



Prepared for **Spectrum Ecology Pty Ltd**

Version **25 September 2023**

SZ project reference **SZ670**

Prepared by **Dr Kyle Armstrong and Yuki Konishi**

Specialised Zoological ABN 92 265 437 422
Tel +61 (0)404 423 264
kyle.n.armstrong@gmail.com

© Copyright - Specialised Zoological, ABN 92 265 437 422. This document and its content are copyright and may not be copied, reproduced or distributed (in whole or part) without the prior written permission of Specialised Zoological other than by the Client for the purposes authorised by Specialised Zoological ("Intended Purpose"). The Client acknowledges that the Final Report is intended for the sole use of the Client, and only to be used for the Intended Purpose. Any representation or recommendation contained in the Final Report is made only to the Client. Specialised Zoological will not be liable for any loss or damage whatsoever arising from the use and/or reliance on the Final Report by any third party. To the extent that the Intended Purpose requires the disclosure of this document and/or its content to a third party, the Client must procure such agreements, acknowledgements and undertakings as may be necessary to ensure that the third party does not copy, reproduce, or distribute this document and its content other than for the Intended Purpose. This disclaimer does not limit any rights Specialised Zoological may have under the *Copyright Act 1968 (Cth)*.

This report should be included as an appendix in any larger submission to Government, and cited as:

Specialised Zoological (2023). Acoustic analysis and bat call identification from Eliwana, Main Line Rail and Solomon Hub, Western Australia. Unpublished report by Specialised Zoological for Spectrum Ecology Pty Ltd, 25 September 2023, project reference SZ670.

Summary

Bat identifications from acoustic recordings are provided from the Eliwana, Main Line Rail (Christmas Creek), and Solomon Hub project areas in the Pilbara region of Western Australia. The analysis was limited to the detection of two bat species of conservation significance: Ghost Bat *Macroderma gigas* (Megadermatidae) and Pilbara Leaf-nosed Bat *Rhinonicteris aurantia* (Rhinonycteridae). A total of 2,657,052 WAV format files from 79 recording sites (691 recording nights) was analysed (**Table 1**).

Table 1. Summary of recording dataset, and detections of the two target bat species (Mg: Ghost Bat; Ra: Pilbara Leaf-nosed Bat; one WAV file is equivalent to approximately one pass of an individual bat in front of the bat detector microphone).

	Sites	WAVs	Nights	Mg	Ra sites	Ra nights	Ra WAVs
Main Line Rail	24	768,092	188	0	8	17	165
Eliwana	31	1,041,170	322	0	9	20	73
Solomon Hub	24	847,790	181	0	8	23	178
Totals	**79**	**2,657,052**	**691**	**0**	**25**	**60**	**416**

The Pilbara Leaf-nosed Bat was recorded in all three project areas from a total of 25 sites (**Table 1**). Most detections of the Pilbara Leaf-nosed Bat were well after sunset, and well before sunrise (more than an hour in the case of almost all recording nights; **Tables 2–4**).

Analysis to detect the presence of the Ghost Bat was focussed predominantly on recordings made at cave entrances—five sites in the Solomon project area: SM BAT C9, SM BAT I1, SM BAT I4, SM BAT I5, SM BAT I7. Further targeted analysis for the Ghost Bat analysis was conducted on recordings from ER BAT I8 (at Eliwana), given that the species was detected at this site in 2022 (Specialised Zoological 2022). Calls of the Ghost Bat were not detected in any of the recordings analysed.

Methods

The data provided were recorded in full spectrum WAV and W4V format with Wildlife Acoustics Song Meter SM4BAT bat detectors (sampling rate 384 kHz, set to turn on automatically at sunset and off at sunrise). All W4V format files were converted to WAV format and limited to a maximum of five seconds in duration. All WAV files exceeding five seconds were split into separate WAVs with a maximum of five seconds. Conversions were undertaken in Kaleidoscope version 5.1.9g.

A multi-step acoustic analysis procedure developed to process large full spectrum echolocation recording datasets from insectivorous bats (Armstrong et al. 2021a,b) was applied to the recordings made on the survey. Firstly, the WAV files were scanned in the software SCAN'R version 1.8.3 (Binary Acoustic Technology) for bat echolocation calls using a parameter set optimised for the detection of each of the two target species (for the Ghost Bat at selected sites only). This process provides measurements (SCAN'R parameters) from each putative pulse of the target species. The outputs were then used to determine if putative bat pulses measured in SCAN'R could be attributed to the two target species. This was done in two ways.

First, all WAV files containing putative calls of the Pilbara Leaf-nosed Bat were inspected in Adobe Audition version 23.1 software, and listings of files containing false positive identifications were discarded. Custom R language scripts assisted with summarisation of the remaining data, and the calculation of times of first detection after sunset and last detection before sunrise.

Second, a custom [R] language 'shiny' app was used to aid recognition of the calls of the Ghost Bat in recordings from cave sites. The app assisted with three tasks:

1. Performed a Discriminant Function Analysis on training data from representative calls from cave-roosting bats in the Pilbara;
2. From the measurements of each putative Ghost Bat echolocation pulse from SCAN'R, calculated values for the first two Discriminant Functions that could separate the signal types derived from the analysis of training data, and plotted these resulting coordinates over confidence regions for the defined signal types; and
3. Facilitated an inspection in a spectrogram of chosen examples of interest (within the confidence region for Ghost Bat calls) for each recording night by opening the original WAV files in Adobe Audition version 23.1.

Identifications were made and confirmed based on the authors' own unpublished and published data.

References

Armstrong K.N., Broken-Brow J., Hoye G., Ford G., Thomas M. and Corben C. (2021a). Effective detection and identification of sheath-tailed bats of Australian forests and woodlands. *Australian Journal of Zoology* 68:346–363. https://doi.org/10.1071/ZO20044

Armstrong K.N., Clarke S., Linke A., Scanlon A., Roetman P., Hitch, A.T. and Donnellan S.C. (2021b). Citizen science implements the first intensive acoustics-based survey of insectivorous bat species across the Murray-Darling Basin of South Australia. *Australian Journal of Zoology* 68: 364–381. https://doi.org/10.1071/ZO20051

DEWHA (2010). Survey guidelines for Australia's threatened bats. Guidelines for detecting bats listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999. Department of the Environment, Water, Heritage and the Arts, Canberra.

Ruykys, L., Hanrahan, N. and Stokeld, D. (2023 in press). Novel acoustic lure methodology facilitates detection of the cryptic ghost bat at a landscape scale. *Wildlife Research*. URL: https://www.publish.csiro.au/WR/justaccepted/WR22189

Specialised Zoological (2022). Acoustic analysis and bat call identification from Christmas Creek, Eliwana, North Star and Solomon, Western Australia. Unpublished report by Specialised Zoological for Spectrum Ecology Pty Ltd, 4 October 2022, project reference SZ611.

Limitations

The identifications presented in this report have been made within the following context:

1. The identifications made herein were based on the ultrasonic acoustic data recorded and provided by a 'third party' (the client named on the front of this report).
2. The scope of this report extended to providing information on the identification of the Ghost Bat and Pilbara Leaf-nosed Bat in bulk ultrasonic recordings. Further comment on these species and the possible impacts of a planned project on bat species were not part of the scope.
3. In the case of the present report, the recording equipment was not set up and supplied by Specialised Zoological. The equipment was operated by the third party during the survey.
4. Other than the general location of the study area, Specialised Zoological has not been provided with detailed information of the survey area, has not made a visit to observe the habitats available for bats, nor have we visited the specific project areas on a previous occasion.
5. Specialised Zoological has had no input into the overall design and timing of this bat survey, recording site placement, nor the degree of recording site replication.
6. While Specialised Zoological has made identifications to the best of our ability given the available materials, and reserves the right to re-examine the data and revise any identification following a query, it is the client's and / or proponent's responsibility to provide supporting evidence for any identification, which might require follow-up trapping effort or non-invasive methods such as video recordings. Specialised Zoological bears no liability for any follow-up work that may be required to support an identification based initially on the analysis of acoustic recordings undertaken and reported on here.
7. There are a variety of factors that affect the 'detectability' of each bat species, given the frequency, power and shape characteristics of their calls. Further information on the analysis and the various factors that can impinge on the reliability of identifications can be provided upon request.
8. The most reliable way of detecting the Ghost Bat with bat detectors is to place the equipment with the microphone facing into a potential cave roosting site. The echolocation calls of this species are of low amplitude, and therefore most detectable when a Ghost Bat flies close to the bat detector as it exits the underground structure. If there is uncertainty about whether Ghost Bats are present in a cave, then video recordings can be a useful addition to the survey. The detection of Ghost Bats with bat detectors away from cave entrances is less reliable, unless an approach based on an acoustic lure is used (Ruykys et al. 2023 in press).
9. Predictions about whether the Pilbara Leaf-nosed Bat roosts within a particular surveyed cave (where a bat detector was placed at the entrance), or somewhere nearby, based on the time of first detection should be considered indicative only. If unambiguous confirmation of diurnal roosting of this species is required, this should be undertaken using the entrance sheeting method that is described in DEWHA (2010).
10. This version of the document supersedes any previous version. Previous drafts are not authorised by us for submission to the regulator or the public domain.

Table 2. Summary of detections of the Pilbara Leaf-nosed Bat from Eliwana (blue highlight aids inspection of tables, with the highlighting alternating to distinguish different sites; continued across successive pages; orange highlight indicates a detection within an hour of sunset or sunrise time).

Site	Serial	Night of	Passes	Sunset	Dusk	Dawn	Sunrise	Time first detection	Time last detection	Time since sunset	Time until dawn
EM Bat C1	SMU01238	31/01/2023	9	31/01/2023 18:59	31/01/2023 19:23	1/02/2023 5:28	1/02/2023 5:52	20:54:36	23:48:30	1H 54M 41S	6H 4M 5S
EM Bat C1	SMU01238	1/02/2023	3	1/02/2023 18:59	1/02/2023 19:23	2/02/2023 5:29	2/02/2023 5:53	20:17:53	4:44:59	1H 18M 20S	1H 8M 17S
EM Bat C1	SMU01238	2/02/2023	4	2/02/2023 18:59	2/02/2023 19:23	3/02/2023 5:30	3/02/2023 5:53	22:24:22	3:31:41	3H 25M 11S	2H 22M 15S
EM Bat C1	SMU01238	4/02/2023	5	4/02/2023 18:58	4/02/2023 19:22	5/02/2023 5:31	5/02/2023 5:55	1:04:40	4:31:26	6H 6M 18S	1H 23M 50S
EM Bat C1	SMU01238	5/02/2023	4	5/02/2023 18:57	5/02/2023 19:21	6/02/2023 5:32	6/02/2023 5:55	20:03:19	3:17:21	1H 5M 23S	2H 38M 34S
EM Bat C1	SMU01238	7/02/2023	6	7/02/2023 18:57	7/02/2023 19:20	8/02/2023 5:33	8/02/2023 5:57	21:49:33	0:48:15	2H 52M 33S	5H 8M 56S
EM Bat C1	SMU01238	8/02/2023	6	8/02/2023 18:56	8/02/2023 19:20	9/02/2023 5:34	9/02/2023 5:57	20:02:07	1:48:51	1H 5M 37S	4H 8M 58S
EM Bat C3	S4U06266	3/02/2023	1	3/02/2023 18:58	3/02/2023 19:22	4/02/2023 5:30	4/02/2023 5:54	2:59:51	2:59:51	8H 1M 4S	2H 54M 45S
EM Bat C5	S4U06260	1/02/2023	2	1/02/2023 18:59	1/02/2023 19:23	2/02/2023 5:29	2/02/2023 5:53	1:47:00	1:47:05	6H 47M 27S	4H 6M 11S
EM Bat C5	S4U06260	5/02/2023	3	5/02/2023 18:57	5/02/2023 19:21	6/02/2023 5:32	6/02/2023 5:55	22:31:06	1:23:14	3H 33M 10S	4H 32M 41S
EM Bat C6	S4U06273	3/02/2023	11	3/02/2023 18:58	3/02/2023 19:22	4/02/2023 5:30	4/02/2023 5:54	21:55:31	4:02:23	2H 56M 44S	1H 52M 13S
EM Bat C6	S4U06273	8/02/2023	1	8/02/2023 18:56	8/02/2023 19:20	9/02/2023 5:34	9/02/2023 5:57	21:47:39	21:47:39	2H 51M 9S	8H 10M 10S
EM Bat C8	SMU01230	1/02/2023	4	1/02/2023 18:59	1/02/2023 19:23	2/02/2023 5:29	2/02/2023 5:53	0:22:57	0:23:53	5H 23M 24S	5H 29M 23S
EM Bat C8	SMU01230	2/02/2023	2	2/02/2023 18:59	2/02/2023 19:23	3/02/2023 5:30	3/02/2023 5:53	4:36:50	4:39:19	9H 37M 39S	1H 14M 37S
EM Bat C8	SMU01230	3/02/2023	1	3/02/2023 18:58	3/02/2023 19:22	4/02/2023 5:30	4/02/2023 5:54	2:04:40	2:04:40	7H 5M 53S	3H 49M 56S
EM Bat C8	SMU01230	4/02/2023	5	4/02/2023 18:58	4/02/2023 19:22	5/02/2023 5:31	5/02/2023 5:55	21:40:56	4:57:06	2H 42M 34S	58M 10S

Site	Serial	Night of	Passes	Sunset	Dusk	Dawn	Sunrise	Time first detection	Time last detection	Time since sunset	Time until dawn
EM Bat I1	S4U06269	8/02/2023	3	8/02/2023 18:56	8/02/2023 19:20	9/02/2023 5:34	9/02/2023 5:57	21:48:02	3:55:25	2H 51M 32S	2H 2M 24S
EM Bat I2	SMU01275	3/02/2023	1	3/02/2023 18:58	3/02/2023 19:22	4/02/2023 5:30	4/02/2023 5:54	0:30:27	0:30:27	5H 31M 40S	5H 24M 9S
EM Bat I5	SMU01273	7/02/2023	1	7/02/2023 18:57	7/02/2023 19:20	8/02/2023 5:33	8/02/2023 5:57	2:09:20	2:09:20	7H 12M 20S	3H 47M 51S
EM Bat I9	S4U06174	31/01/2023	1	31/01/2023 18:59	31/01/2023 19:23	1/02/2023 5:28	1/02/2023 5:52	23:54:41	23:54:41	4H 54M 46S	5H 57M 54S

Table 3. Summary of detections of the Pilbara Leaf-nosed Bat from Main Line Rail (Christmas Creek).

Site	Serial	Night of	Passes	Sunset	Dusk	Dawn	Sunrise	Time first detection	Time last detection	Time since sunset	Time until dawn
MR BAT C4	SMU01242	5/03/2023	1	5/03/2023 18:27	5/03/2023 18:50	6/03/2023 5:37	6/03/2023 5:59	2:55:07	2:55:07	8H 27M 26S	3H 4M 47S
MR BAT C9	S4U06081	1/03/2023	1	1/03/2023 18:31	1/03/2023 18:53	2/03/2023 5:35	2/03/2023 5:58	23:58:38	23:58:38	5H 27M 32S	5H 59M 33S
MR BAT C9	S4U06081	2/03/2023	1	2/03/2023 18:30	2/03/2023 18:52	3/03/2023 5:35	3/03/2023 5:58	22:30:21	22:30:21	4H 0M 6S	7H 28M 17S
MR BAT C10	SMU01004	3/03/2023	1	3/03/2023 18:29	3/03/2023 18:52	4/03/2023 5:36	4/03/2023 5:59	3:23:34	3:23:34	8H 54M 10S	2H 35M 29S
MR BAT I3	S4U06257	1/03/2023	1	1/03/2023 18:31	1/03/2023 18:53	2/03/2023 5:35	2/03/2023 5:58	0:33:44	0:33:44	6H 2M 38S	5H 24M 27S
MR BAT I7	SMU01230	6/03/2023	1	6/03/2023 18:26	6/03/2023 18:49	7/03/2023 5:37	7/03/2023 6:00	0:04:02	0:04:02	5H 37M 14S	5H 56M 16S
MR BAT I8	SMU01039	2/03/2023	2	2/03/2023 18:30	2/03/2023 18:52	3/03/2023 5:35	3/03/2023 5:58	21:50:37	1:53:05	3H 20M 22S	4H 5M 33S
MR BAT I10	S4U06252	1/03/2023	12	1/03/2023 18:31	1/03/2023 18:53	2/03/2023 5:35	2/03/2023 5:58	22:31:02	1:18:52	3H 59M 56S	4H 39M 19S
MR BAT I10	S4U06252	3/03/2023	3	3/03/2023 18:29	3/03/2023 18:52	4/03/2023 5:36	4/03/2023 5:59	0:13:56	1:17:23	5H 44M 32S	4H 41M 40S
MR BAT I10	S4U06252	6/03/2023	2	6/03/2023 18:26	6/03/2023 18:49	7/03/2023 5:37	7/03/2023 6:00	1:25:47	2:04:11	6H 58M 59S	3H 56M 7S
MR BAT I10	S4U06252	7/03/2023	1	7/03/2023 18:25	7/03/2023 18:48	8/03/2023 5:38	8/03/2023 6:00	23:51:02	23:51:02	5H 25M 7S	6H 9M 41S
MR BAT I4	S4U06269	28/02/2023	34	28/02/2023 18:31	28/02/2023 18:54	1/03/2023 5:35	1/03/2023 5:57	21:37:22	3:44:58	3H 5M 27S	2H 12M 47S
MR BAT I4	S4U06269	1/03/2023	17	1/03/2023 18:31	1/03/2023 18:53	2/03/2023 5:35	2/03/2023 5:58	21:45:10	2:48:53	3H 14M 4S	3H 9M 18S
MR BAT I4	S4U06269	2/03/2023	19	2/03/2023 18:30	2/03/2023 18:52	3/03/2023 5:35	3/03/2023 5:58	22:02:12	3:48:50	3H 31M 57S	2H 9M 48S
MR BAT I4	S4U06269	4/03/2023	2	4/03/2023 18:28	4/03/2023 18:51	5/03/2023 5:36	5/03/2023 5:59	1:24:45	3:31:35	6H 56M 12S	2H 27M 54S
MR BAT I4	S4U06269	5/03/2023	27	5/03/2023 18:27	5/03/2023 18:50	6/03/2023 5:37	6/03/2023 5:59	22:07:32	3:57:52	3H 39M 51S	2H 2M 2S
MR BAT I4	S4U06269	7/03/2023	40	7/03/2023 18:25	7/03/2023 18:48	8/03/2023 5:38	8/03/2023 6:00	21:36:27	4:24:36	3H 10M 32S	1H 36M 7S

Table 4. Summary of detections of the Pilbara Leaf-nosed Bat from Solomon Hub.

Serial	Serial	Night of	Passes	Sunset	Dusk	Dawn	Sunrise	Time first detection	Time last detection	Time since sunset	Time until dawn
SM BAT C1	S4U06253	19/01/2023	1	19/01/2023 18:58	19/01/2023 19:23	20/01/2023 5:17	20/01/2023 5:41	22:53:29	22:53:29	3H 54M 31S	6H 48M 28S
SM BAT C2	S4U06285	10/01/2023	1	10/01/2023 18:58	10/01/2023 19:23	11/01/2023 5:10	11/01/2023 5:35	21:27:53	21:27:53	2H 29M 10S	8H 7M 42S
SM BAT C3	S4U06256	11/01/2023	6	11/01/2023 18:58	11/01/2023 19:23	12/01/2023 5:11	12/01/2023 5:36	21:33:07	2:06:23	2H 34M 17S	3H 29M 54S
SM BAT C3	S4U06256	12/01/2023	9	12/01/2023 18:58	12/01/2023 19:23	13/01/2023 5:12	13/01/2023 5:36	20:24:56	3:19:14	1H 26M 0S	2H 17M 45S
SM BAT C3	S4U06256	13/01/2023	13	13/01/2023 18:59	13/01/2023 19:23	14/01/2023 5:13	14/01/2023 5:37	20:07:01	4:30:07	1H 8M 1S	1H 7M 34S
SM BAT C3	S4U06256	14/01/2023	7	14/01/2023 18:59	14/01/2023 19:23	15/01/2023 5:13	15/01/2023 5:38	20:43:33	3:43:43	1H 44M 30S	1H 54M 40S
SM BAT C3	S4U06256	15/01/2023	9	15/01/2023 18:59	15/01/2023 19:23	16/01/2023 5:14	16/01/2023 5:39	19:46:18	4:12:49	47M 13S	1H 26M 17S
SM BAT C4	S4U06259	11/01/2023	2	11/01/2023 18:58	11/01/2023 19:23	12/01/2023 5:11	12/01/2023 5:36	20:07:26	0:38:57	1H 8M 36S	4H 57M 20S
SM BAT C4	S4U06259	12/01/2023	4	12/01/2023 18:58	12/01/2023 19:23	13/01/2023 5:12	13/01/2023 5:36	20:19:01	1:39:07	1H 20M 5S	3H 57M 52S
SM BAT C4	S4U06259	13/01/2023	15	13/01/2023 18:59	13/01/2023 19:23	14/01/2023 5:13	14/01/2023 5:37	20:29:04	4:12:20	1H 30M 4S	1H 25M 21S
SM BAT C4	S4U06259	14/01/2023	7	14/01/2023 18:59	14/01/2023 19:23	15/01/2023 5:13	15/01/2023 5:38	20:26:02	3:54:14	1H 26M 59S	1H 44M 9S
SM BAT C4	S4U06259	15/01/2023	3	15/01/2023 18:59	15/01/2023 19:23	16/01/2023 5:14	16/01/2023 5:39	23:36:08	3:35:23	4H 37M 3S	2H 3M 43S
SM BAT C4	S4U06259	16/01/2023	6	16/01/2023 18:59	16/01/2023 19:23	17/01/2023 5:15	17/01/2023 5:39	20:10:05	4:17:24	1H 11M 0S	1H 22M 24S
SM BAT C6	S4U06252	11/01/2023	1	11/01/2023 18:58	11/01/2023 19:23	12/01/2023 5:11	12/01/2023 5:36	23:57:03	23:57:03	4H 58M 13S	5H 39M 14S
SM BAT C9	SMU01238	11/01/2023	20	11/01/2023 18:58	11/01/2023 19:23	12/01/2023 5:11	12/01/2023 5:36	20:16:10	4:29:18	1H 17M 20S	1H 6M 59S
SM BAT C9	SMU01238	12/01/2023	14	12/01/2023 18:58	12/01/2023 19:23	13/01/2023 5:12	13/01/2023 5:36	20:02:17	3:40:03	1H 3M 21S	1H 56M 56S
SM BAT C9	SMU01238	13/01/2023	8	13/01/2023 18:59	13/01/2023 19:23	14/01/2023 5:13	14/01/2023 5:37	20:07:05	3:21:46	1H 8M 5S	2H 15M 55S
SM BAT C9	SMU01238	15/01/2023	37	15/01/2023	15/01/2023	16/01/2023	16/01/2023	22:18:15	4:40:14	3H 19M 10S	58M 52S

Serial	Serial	Night of	Passes	Sunset	Dusk	Dawn	Sunrise	Time first detection	Time last detection	Time since sunset	Time until dawn
				18:59	19:23	5:14	5:39				
SM BAT C9	SMU01238	16/01/2023	4	16/01/2023 18:59	16/01/2023 19:23	17/01/2023 5:15	17/01/2023 5:39	21:38:30	3:56:38	2H 39M 25S	1H 43M 10S
SM BAT C9	SMU01238	17/01/2023	6	17/01/2023 18:59	17/01/2023 19:23	18/01/2023 5:16	18/01/2023 5:40	21:14:44	4:33:54	2H 15M 40S	1H 6M 37S
	SMU01227	12/01/2023	1	12/01/2023 18:58	12/01/2023 19:23	13/01/2023 5:12	13/01/2023 5:36	23:50:31	23:50:31	4H 51M 35S	5H 46M 28S
	S4U06269	12/01/2023	1	12/01/2023 18:58	12/01/2023 19:23	13/01/2023 5:12	13/01/2023 5:36	20:24:00	20:24:00	1H 25M 4S	9H 12M 59S
	S4U06269	14/01/2023	3	14/01/2023 18:59	14/01/2023 19:23	15/01/2023 5:13	15/01/2023 5:38	0:46:58	4:01:07	5H 47M 55S	1H 37M 16S

Appendix L: Pilbara Olive Python records

Table 5.12: Details of Pilbara Olive Python records at each site to date

ID (Microchip)	Capture	Sex	Site	Date	Co-ordinates		Weight	Length (cm)	Health rating (1-5)	Veg conditions	Comments
					Easting	Northing					
Control Sites											
Control Sites– Christmas Creek											
2019											
POP C1	Initial Capture	unknown	Opp	18/12/19	781373	7529290	-	290	4	-	Crossed road
2023											
POP C3	Initial Capture	unknown	Opp	17/02/2023	789390	7555127	130	200	4	-	3 ticks on tail
Control Sites– Solomon											
2012/2013											
POP SM C-1	Initial Capture	-	NS POP C2	20/01/13	636165	7536764	-	200	4	Excellent	-
POP SM C-2	Initial Capture	-	NS POP C1	18/01/13	601700	7538315	-	210	3.5	Very good	-
	Recapture			19/01/13	601650	7538317					
	Recapture			20/01/13	601691	7538320					
2013/2014											
Nil											
2014/2015											
Nil											
2015/2016											
Nil											
2016/2017											
941 000 1745 2050	Initial Capture	Juvenile	NS POP C1	11/01/17	601737	7538335	154	100	4	Very good	-
2017/2018											
941 0001957 6541	Initial Capture	Male (subadult)	NS POP C1	15/01/18	601673	7538321	280	120	4	Very good	
2019											
NIL											
2020											
NIL											
2021											
NIL											
2022											
991 0030 0077 8669	Initial Capture	Female	NS POP C1	19/02/2022	601607	7538288	140	65	-	-	-
2023											
NIL											
Impact Sites											
Impact Sites– Christmas Creek											
2021											
900 1130 0171 5473	Initial Capture	Unknown	Karntama Village	6/03/2021	773811	525485	900	1,660	5	-	Found by camp security. Released south of camp
2022											
Nil											

ID (Microchip)	Capture	Sex	Site	Date	Co-ordinates		Weight	Length (cm)	Health rating (1-5)	Veg conditions	Comments
					Easting	Northing					
2023											
Nil											
Impact Sites – Solomon Hub											
2012/2013											
POP I-1	Initial Capture	Juvenile	SM POP I4	20/01/13	596668	7546469	-	100	5	Excellent	-
2013/2014											
00066ACE53 (POP I-2)	Initial Capture	Female	SM POP I4	5/09/13	596166	7546564	-	310	2.5	Excellent	-
POP I-3	Motion Camera	-	Opportunistic	31/08/13	583408	7550201	-	-	-	Excellent	
2014/2015											
941000016595540 (POP I-4)	Initial Capture	Male	Opportunistic Road spotting	28/01/15	583745	7541556	-	-310	-	Degraded	-
2015/2016											
941 000017452067	Initial Capture	Female	SM POP I3	15/01/16	596668	7546469	4000	2.4	4	Good	-
	Recapture			16/01/16							
	Recapture			19/01/16							
941 000017452054	Initial Capture	Female	SM POP TI2	16/01/16	589904	7554325	879	1.6	4	Degraded	--
2016/2017											
941 000 1659 5529	Initial Capture	Female	SM POP I1	6/1/17	589100	7553518	684	150	5	Good	
2017/2018											
Nil											
2018/2019											
991 0030 0017 4907	Initial Capture	Juvenile	Opp (Kangi Camp)	17/3/19	583828	7542383	120	90	5	Completely Degraded	
2019/2020											
900 1130 0171 5458	Initial Capture	Male	Opp (Kangeenarina Creek north)	14/1/20	590377	7556092	2000	190	-	-	-
2021											
Nil											
2022											
Nil											
2023											
Nil											
Impact Sites – Eliwana Mine											
2019/2020											
900 1130 0171 5457 & 900 1130 0171 5449[1-1]	Initial Capture	Male	EM POP I2	28/11/19	479050	7513136	2500	2400	4	-	"Old Mate", In ambush at small pool
	Recapture			29/11/19							
	Recapture			4/12/19	479085	7513181	2500	2520	4	-	Male sitting next to female (below). Second microchip inserted in error.
900 1130 0171 5452[2-1]	Initial Capture	Female	EM Add S1	30/11/19	475911	7514566	2000	2200	5	-	"Sheila", Sitting next to small spring

ID (Microchip)	Capture	Sex	Site	Date	Co-ordinates		Weight	Length (cm)	Health rating (1-5)	Veg conditions	Comments
					Easting	Northing					
	Recapture			1/12/19	476188	7514896					
	Recapture			2/12/19	476196	7514898					
900 1130 0171 5459	Initial Capture	Juvenile	EM POP I2	2/12/19	479069	7513176	110	1050	4	-	-
900 1130 0171 5447	Initial Capture	Female	EM POP I2	4/12/19	479080	7513180	2500	2750	5	-	Female sitting next to male (below) on BIF rock
2021											
900 1130 0171 5457 & 900 1130 0171 5449[1-2]	Initial Capture	Male	EM POP I2	11/01/2021	479056	7513111	2500	2500	-	-	"Old Mate", Male hunting above overhang with water
	Recapture			13/01/2021					-	-	Moving through site
	Recapture			14/01/2021					-	-	Moving through site. Second microchip found, likely double chipped during 2019 monitoring.
900 1130 0171 5479	Initial Capture	Unknown	EM POP I2	11/01/2021	-	-	1750	2300	-	-	Moving through site
	Recapture			13/01/2021	479008	7512955			-	-	Moving through site
	Recapture			17/01/2021	479041	7513078			-	-	Hunting at edge of waterpool
900 1130 0171 5452[2-2]	Initial Capture	Unknown	EM POP Add S1	12/01/2021	475899	7515141	2250	1950	-	-	"Sheila", Moving through site, at small spring
	Recapture			13/01/2021					-	-	Hunting
	Recapture			15/01/2021					-	-	Moving through site, in big gorge approx. 800 m from small spring
2022											
Nil											
2023											
991003001716371	Initial Capture	Unknown	EM POP I4	7/02/2023	496752	7508474	1240	80	5	-	Hatchling

Table 5.13: MARK Parameters for Pilbara Olive Pythons

Parameter	2013	2014	2015	2015/2016	2016/2017	2017/2018	2018	2019	2021	2022
Impact Sites										
North Star										
ψA (SE)	-	0.10 ± 0.00	0.75 ± 0.22	0.25 ± 0.21	0.51 ± <0.01	0.55 ± 0.26	0.71 ± <0.15	Nil	Nil	Nil
Pi (SE)	-	>0.01 ± 0.00	1.00 ± <0.01	0.59 ± 0.01	0.55 ± 0.23	0.75 ± 0.22	0.49 ± 0.35	Nil	Nil	Nil
NED (overall)	-	0 (0)	0.75 (0.75)	0.25 (0.75)	0.25 (1.0)	0.5 (1.0)	0.5 (1.0)	Nil	Nil	Nil
Control Sites										
North Star										
ψA (SE)	-	0.39 ± 0.15	0.59 ± 0.22	0.50 ± 0.25	0.49 ± 0.38	0.63 ± <0.01	0.52 ± 0.10	Nil	Nil	Nil
Pi (SE)	-	0.52 ± 0.26	0.75 ± 0.54	0.98 ± <0.01	0.70 ± <0.01	0.50 ± 0.25	0.78 ± 0.18	Nil	Nil	Nil
NED (overall)	-	0.50 (0.50)	0.50 (0.75)	0.50 (0.75)	0.25 (0.75)	0.33 (1.0)	0.25 (1.0)	Nil	Nil	Nil

NED=Naïve estimator during the monitoring season (and across all years of monitoring)

Appendix M: Pilbara Olive Python eDNA Report

Pilbara olive python (*Liasis olivaceus barroni*) eDNA surveys, 2023 dry season

Wednesday, 11 October 2023	
Project number:	ED_2006CR8
Client:	Spectrum Ecology
Prepared for:	Astrid Heidrich
Lab analysis by:	Dr Rachael Impey
Report prepared by:	Will Webster
Report approved by:	Josh Griffiths
Assay(s):	*Liasis olivaceus barroni*
Filter used:	1.2 µm disc filter (manual syringe)

Highlights

- 11 sites sampled (3 replicates) during June and August 2023.
- All sites were analysed for Pilbara olive python *(Liasis olivaceus barroni)*.
- No Pilbara olive python DNA was detected at any of the 11 sites.
- Contamination was not detected in laboratory controls.

Background

Spectrum Ecology has extensive experience using eDNA to assess for the presence of Pilbara olive python (*Liasis olivaceus barroni*). For this project, they will use eDNA to assess for presence of Pilbara olive python throughout the Pilbara region during the wet and dry seasons of 2023. The current report presents the results for the 2023 dry season.

Methods

Sampling

During June and August 2023, 33 water samples were collected from 11 sites by Spectrum Ecology staff following sampling protocols developed by EnviroDNA. At each site, 3 replicate samples were collected by passing up to 700 mL of water (mean = 500 mL) through a 1.2 μm manual disc filter. Filtration was undertaken on-site to reduce DNA degradation during the transport of water samples. A preservative was added to the filters after filtering to minimise DNA degradation. Filters were stored out of sunlight and at ambient temperature before being transported to the laboratory for processing.

Analysis

DNA was extracted from filters using a commercially available DNA extraction kit (Qiagen Power Soil Pro Kit). Real-time quantitative Polymerase Chain Reaction (qPCR) assays were used to amplify the target DNA, using a species-specific probe targeting a small region of the mitochondrial DNA the target species (Pilbara olive python). Assays were performed in triplicate on each sample. Positive and negative controls were included for all assays, as was an Internal Positive Control (IPC) to detect inhibition.

Results

Data spreadsheet

Results of the eDNA analysis are summarised in the attached spreadsheet ED2006CR8_SpectrumEcology_Data_PoP_DrySeason. The 11 sites (33 samples) analysed for the presence of Pilbara olive python DNA returned negative results (0 out of 3 assays positive for all samples).

Quality assurance

Included in each assay plate were control reactions containing a range of Pilbara olive python DNA concentrations. The R^2 value from a regression of qPCR cycle number vs DNA concentration was 1.00. Negative controls were included at all stages (DNA extraction, n = 3 negatives; qPCR, n = 3 negatives) so that contamination from laboratory processes could be identified if present. No contamination was detected.

Disclaimer

The professional analysis and advice in this report has been prepared for the exclusive use of the party or parties to whom it is addressed (the addressee) and for the purposes specified in it. This report is supplied in good faith and reflects the knowledge, expertise and experience of the consultants involved. The report must not be published, quoted or disseminated to any other party without prior written consent from EnviroDNA pty ltd.

EnviroDNA pty ltd accepts no responsibility whatsoever for any loss occasioned by any person acting or refraining from action as a result of reliance on the report. In conducting the analysis in this report EnviroDNA pty ltd has endeavoured to use what it considers is the best information available at the date of publication including information supplied by the addressee. Unless stated otherwise EnviroDNA pty ltd does not warrant the accuracy of any forecast or prediction in this report.

Appendix N: Night Parrot Report (Adaptive NRM)

Results of acoustic surveys conducted for the Night Parrot (*Pezoporus occidentalis*) in the Cloudbreak area, Fortescue Marsh December 2022 – June 2023

Report to:

Fortescue Metals Group

Prepared by:

Nicholas Leseberg

Adaptive NRM

25th January 2024

DRAFT

1. Summary

From December 2022 until June 2023, automated recording units (ARUs) were deployed at 12 sites along the northern margin of Fortescue Marsh to survey for Night Parrots (*Pezoporus occidentalis*). Resulting acoustic data was analysed using a signal recognition algorithm trained to detect known Night Parrot calls. Several Night Parrot calls were detected during the surveys, and suggest several birds passed through the area during the survey period.

2. Background

Between 2018 and 2021 Fortescue Metals Group (Fortescue) conducted a comprehensive program of spatially explicit surveys to determine whether Night Parrots occur along the northern margin of Fortescue Marsh (Leseberg *et al*. 2021). Across the three-year survey period, several very likely Night Parrot calling events were detected. The nature of the calls detected suggested that Night Parrots were probably visiting the northern margin of the marsh occasionally. However, no permanent long-term stable roost sites were detected, indicating that Night Parrots may not be resident in the area.

A recommendation following on from these surveys, was that Fortescue continue to conduct monitoring for Night Parrots during the wet season (December – April), with the aim of detecting whether parrots are continuing to use the area, and whether any parrots occupy the area permanently (Leseberg *et al*. 2021).

Subsequent surveys on the northern margin of the marsh from December 2021 – April 2022 failed to detect any Night Parrot calls. However, surveys conducted on the southern margin of the marsh during 2022 did detect several calls of what was apparently an individual Night Parrot that was present for around two weeks in late May and early June. These results suggest that Night Parrots are still using the marsh, at least periodically.

3. Survey results

Between December 2022 and June 2023, ARUs were deployed at 12 sites in suitable habitat within the Cloudbreak area of operations, on the northern margin of Fortescue Marsh. The placement of ARUs was planned to give even coverage of the entire area of suitable habitat. All ARUs recorded every night for at least five months during that period.

A total of 30 Night Parrot calls were detected throughout the survey period, across six ARUs. These calls appear to represent three discrete calling events.

In the early morning of 21 Feb 23, multiple 2-note *didit* calls were detected on ARUs NP01, NP02, NP03, NP06, NP08 and NP18. All calls were detected between approximately 0043h and 0350h. The order of call detections indicate a bird arriving from the east; it was first detected on NP06 at 0043h. The bird was detected 1 km further west at 0128h, and over the course of the next 15 minutes was detected on multiple ARUs as it moved 6.5 km further west, where it was detected on NP03 at 0145h. The bird was next detected at 0231h, having returned 5.5 km to the east, and over the following 80 mins was detected multiple times on ARUs NP02 and NP01 which are in close proximity. The final call was detected on NP01 at 0348h, approximately 2 hours before sunset. The following evening, between 1920h and 1922h, approximately 40 mins after sunset, three calls were detected on NP01. This suggests the bird probably roosted somewhere in the vicinity of NP01 during the day of 21 Feb 23, before departing the area that night.

DRAFT

In the early morning of 10 Mar 23, several 2-note *dink* calls were detected across ARUs NP01, NP02 and NP18. These ARUs are all in relatively close proximity, and all calls were detected between 0016h and 0023h, suggesting a bird stopping briefly at the site before moving on.

In the early morning of 26 Mar 23, at 0017h, a single 2-note *didit* call was detected on NP02. No other calls were detected around this time, suggesting a bird passing through the site.

Differences in the structure and frequency of the calls detected for each calling event suggest that each involved a different individual Night Parrot.

4. Conclusion

The detection of Night Parrot calls in the data from the 2022-2023 surveys is consistent with previous detections on Fortescue Marsh. They suggest that Night Parrots occasionally visit the northern margin of the marsh, with one bird apparently roosting for one night in the area. However, it seems that no long-term stable roost sites have been established in the area during the survey period.

We recommend that these annual surveys continue. Although the information being obtained through this survey program is seemingly limited, as a long-term study of a single site, the data obtained is critical to informing our understanding of Night Parrot movements and habitat use at the landscape scale.

5. References

Leseberg, N.P., Murphy, S.A., Jackett, N.A., and Healy, A.H. (2021). Fortescue Night Parrot Monitoring Procedure and Program 2018-2021 – Final Report. Report to Fortescue Metals Group. Adaptive NRM, Malanda, QLD.

DRAFT

Appendix O: Fauna Monitoring at Rehabilitation Sites

Table 5.14: Fauna usage of rehabilitation sites

Site	Habitat	Year of Rehabilitation	Suitability of habitat to support fauna	Suitability of habitat to support conservation significant fauna	Fauna species recorded prior to 2023	Fauna species recorded 2023
Cloudbreak						
CB RE Cocos CB01.1	Waste Dump (Cocos), low shrubland over grassland.	2014	Advanced stages of regrowth, suitable for generalist fauna species.	Site is outside significant habitat, no significant fauna expected.	Bush Stone-Curlew (*Burhinus grallarius)* Ring-tailed Dragon (*Ctenophorus caudicinctus*) Sheep Frog (*Cyclorana maini*) *Cattle (*Bos taurus*) *Feral Cat (*Felis catus*) *Rabbit (*Oryctolagus cuniculus*)	Crested Bellbird *(Oreoica gutturalis*) Crested Pigeon (*Ocyphaps lophotes*) Spinifex Pigeon (*Geophaps plumifera*) *Cattle (*Bos taurus*) *Rabbit (*Oryctolagus cuniculus*)
CB RE Cocos CB01.2	Waste Dump (Cocos), low shrubland over grassland.	2014	Advanced stages of regrowth, suitable for generalist fauna species.	Site is outside significant habitat, no significant fauna expected.	Crested Bellbird (*Oreoica gutturalis)* Diamond Dove (*Geopelia cuneata*) Euro (*Osphranter robustus)* Red Kangaroo (*Osphranter rufus*) Spinifex Pigeon (*Geophaps plumifera*) *Cattle (*Bos taurus*) *Feral Cat (*Felis catus)* *Rabbit (*Oryctolagus cuniculus*)	Crested Bellbird (*Oreoica gutturalis*) Crested Pigeon (*Ocyphaps lophotes*) Diamond Dove (*Geopelia cuneata*) Euro (*Osphranter robustus)* Magpie-lark (*Grallina cyanoleuca*) Spinifex Pigeon (*Geophaps plumifera*) Yellow-spotted Monitor (*Varanus panoptes*) *Cattle (*Bos taurus*) *Dog/Dingo (*Canis familiaris*) *Rabbit (*Oryctolagus cuniculus*)
CB RE 05	Rocky plain with mixed shrubland over grasses.	2014	Advanced stages of regrowth, suitable for generalist fauna species.	Site is outside significant habitat, no significant fauna expected.	Common Bronzewing (*Phaps chalcoptera*) Crested Pigeon (Ocyphaps *lophotes*) Euro (*Osphranter robustus)* Little Buttonquail (*Turnix velox*) Red Kangaroo (*Osphranter rufus*) *Dog/Dingo (*Canis familiaris*) *Rabbit (*Oryctolagus cuniculus*)	Euro (*Osphranter robustus*) Galah (*Eolophus roseicapilla*) Perentie (*Varanus giganteus*) Spinifex Pigeon (*Geophaps plumifera*) Yellow-spotted Monitor (*Varanus panoptes*) *Feral Cat (*Felis catus)* *Rabbit (*Oryctolagus cuniculus*)
Christmas Creek						
CC RE VAS1	Rocky plain with advanced stages of mixed shrubland.	n/a	Early stages of regrowth, suitable for generalist fauna species.	Site is outside significant habitat, no significant fauna expected.	Fairy Martin (*Petrochelidon ariel*) Painted Finch (*Emblema pictum*) Ring-tailed Dragon (*Ctenophorus caudicinctus*) Rufous Whistler (*Pachycephala rufiventris*) Torresian Crow (*Corvus orru*) Zebra Finch (*Taeniopygia guttata*)	Common Bronzewing (*Phaps chalcoptera*) Sand Monitor (*Varanus gouldii*) Short-beaked Echidna (*Tachyglossus aculeatus*) Spinifex Pigeon (*Geophaps plumifera*) *Rabbit (*Oryctolagus cuniculus*)
CC RE 02	Rocky plain with advanced stages of mixed shrubland.	2014	Early stages of regrowth, suitable for generalist fauna species.	Site is outside significant habitat, no significant fauna expected.	Common Rock-rat (*Zyzomys argurus*) Perentie (*Varanus giganteus*) Red Kangaroo (*Osphranter rufus*) Western Quail-thrush (*Cinclosoma marginatum*) Willie Wagtail (*Rhipidura leucophrys)* *Cattle (*Bos taurus*) *Dog/Dingo (*Canis familiaris*) *Rabbit (*Oryctolagus cuniculus*)	Black-faced Woodswallow (*Artamus cinereus*) Crested Bellbird (*Oreoica gutturalis*) Magpie-lark (*Grallina cyanoleuca*) Spinifex Pigeon (*Geophaps plumifera*) Western Quail-thrush (*Cinclosoma marginatum*) Yellow-spotted Monitor (*Varanus panoptes*) *Rabbit (*Oryctolagus cuniculus*)
CC RE 01	Rocky plain with advanced stages of mixed shrubland.	2014	Early stages of regrowth, suitable for generalist fauna species.	Site is outside significant habitat, no significant fauna expected.	Common Rock-rat (*Zyzomys argurus*) *Dog/Dingo (*Canis familiaris*)	Crested Pigeon (*Ocyphaps lophotes*) Galah (*Eolophus roseicapilla*)

Site	Habitat	Year of Rehabilitation	Suitability of habitat to support fauna	Suitability of habitat to support conservation significant fauna	Fauna species recorded prior to 2023	Fauna species recorded 2023
						Ring-tailed Dragon (*Ctenophorus caudicinctus*) Spinifex Pigeon (*Geophaps plumifera*) Willie Wagtail (*Rhipidura leucophrys*) Zebra Finch (*Taeniopygia castanotis*) *Cattle (*Bos taurus*)
Solomon Hub						
SM RE 10	Lower slope with advanced stages of open shrubland over small patches of early stages of *Triodia* grassland.	2012	Habitat open but suitable for the suitable for generalist fauna species.	Site is outside significant habitat, no significant fauna expected.	Stripe-faced Dunnart (*Sminthopsis macroura*) *Dog/Dingo (*Canis familiaris*)	Common Bronzewing (*Phaps chalcoptera*) Euro (*Osphranter robustus)* Little Buttonquail (*Turnix velox*) Perentie (*Varanus giganteus*) Spinifex Pigeon (*Geophaps plumifera*) White-plumed Honey-eater (*Ptilotula penicillata*) Willie Wagtail (*Rhipidura leucophrys*)
SM RE 11	Rocky plain adjacent to major drainage, advanced stages of open shrubland.	2014	Habitat suitable for generalist fauna species.	Area in close proximity to significant habitat; Northern Quoll recorded, coarse rocks provide foraging habitat.	Common Rock-rat (*Zyzomys argurus*) Galah (*Eolophus roseicapilla*) Spinifex Pigeon (*Geophaps plumifera*) Torresian Crow (*Corvus orru*) *Dog/Dingo (*Canis familiaris*) *Feral Cat (*Felis catus*) *House Mouse (*Mus musculus*)	Spinifex Pigeon (Geophaps plumifera) Torresian Crow (Corvus orru) *Rabbit (Oryctolagus cuniculus)
SM RE 06	Rocky plain with *Triodia* grassland adjacent to road.	2014	Good spinifex grassland developing, suitable for generalist fauna species.	Site is outside significant habitat, no significant fauna expected.	Common Rock-rat (*Zyzomys argurus*) Euro (*Osphranter robustus*) Northern Quoll (*Dasyurus hallucatus*) *Feral Cat (*Felis catus)* *House Mouse (*Mus musculus*)	Long-nosed Dragon (*Gowidon longirostris*) Perentie (*Varanus giganteus*) Purple-backed Fairy-wren (*Malurus assimilis*) Ring-tailed Dragon (*Ctenophorus caudicinctus*) Spinifex Pigeon (*Geophaps plumifera*) Willie Wagtail (*Rhipidura leucophrys*) Yellow-spotted Monitor (*Varanus panoptes*) Zebra Finch (*Taeniopygia castanotis*) *Feral Cat (*Felis catus*)
Hamersley Line Rail						
HL RE 63	Rocky plain with advanced stage of mixed shrubland over small patches of early stages of *Triodia* grassland.	2012	Advanced stages of shrub regrowth, habitat suitable for generalist fauna species.	Area in proximity to mapped foraging habitat; no significant fauna expected.	Brown Honey-eater (*Lichmera indistincta*) Common Rock-rat (*Zyzomys argurus*) Euro (*Osphranter robustus*) Little Buttonquail (*Turnix velox*) Planigale (*Planigale* sp.) Zebra Finch (*Taeniopygia guttata*) *Cattle (*Bos taurus*) *House mouse (*Mus musculus*)	Common Rock-rat (*Zyzomys argurus*) Willie Wagtail (*Rhipidura leucophrys*) *Dog/Dingo (*Canis familiaris*) *Feral Cat (*Felis catus*)
HL RE 74	Rocky plain with advanced stage of mixed shrubland.	2012	Advanced stages of shrub regrowth, habitat suitable for generalist fauna species.	Area in proximity to mapped foraging habitat; no significant fauna expected.	Common Rock-rat (*Zyzomys argurus*) Euro (*Osphranter robustus*) Little Button Quail (*Turnix velox*)	Australian Magpie (*Gymnorhina tibicen*) Common Rock-rat (*Zyzomys argurus*) Euro (*Osphranter robustus*) Spinifex Pigeon (*Geophaps plumifera*)

Site	Habitat	Year of Rehabilitation	Suitability of habitat to support fauna	Suitability of habitat to support conservation significant fauna	Fauna species recorded prior to 2023	Fauna species recorded 2023
HL RE 87	Rocky plain with advanced stage of mixed shrubland over small patches of early stages of *Triodia* grassland.	2012	Advanced stages of vegetation regrowth, habitat suitable for generalist fauna species.	Site is adjacent to significant habitat, no significant fauna recorded.	Common Rock-rat (*Zyzomys argurus*) Euro (*Osphranter robustus*) Short-beaked Echidna (*Tachyglossus aculeatus*) Zebra Finch (*Taeniopygia guttata*) *Feral Cat (*Felis catus*)	Black-headed Monitor (*Varanus tristis*) *Feral Cat (*Felis catus*)
Main Line Rail						
MR RE 01	Moderate stages of *Triodia* regrowth and scattered shrubs on sandy/loamy soil.	2012	Moderate vegetation regrowth, habitat suitable for generalist fauna species.	Site is adjacent to significant foraging habitat, no significant fauna recorded.	Australian Bustard (*Ardeotis australis*) Pseudantechinus (*Pseudantechinus* sp.) Spectacled Hare-wallaby (*Lagorchestes conspicillatus*)	Nil
MR RE 37	Moderate stages of *Triodia* regrowth and scattered shrubs on loamy soil.	2011	Moderate vegetation regrowth, habitat suitable for generalist fauna species.	Site is adjacent to significant foraging habitat, no significant fauna recorded.	*Cattle (*Bos taurus*) *Dog/Dingo (*Canis familiaris*)	Torresian Crow (*Corvus orru*) *Red Fox (*Vulpes vulpes*)
MR RE 92	Advanced stages of *Triodia* regrowth and scattered shrubs on loamy soil, adjacent to creekline.	2008	Habitat suitable for generalist fauna species.	Site is adjacent to significant foraging habitat, no significant fauna recorded.	Common Rock-rat (*Zyzomys argurus*) Euro (*Osphranter robustus*) Spinifex Pigeon (*Geophaps plumifera*) Stripe-faced Dunnart (*Sminthopsis macroura*) Torresian Crow (*Corvus orru*) *Feral Cat (*Felis catus*)	Nil
North Star						
NS RE 02	Top of mesa, stony plain with scattered shrubs	2015	Early stage of regrowth, habitat suitable for generalist fauna species.	Site is adjacent to significant habitat. Northern Quolls previously recorded in surrounding area.	Australian Owlet Nightjar (*Aegotheles cristatus*) Common Bronzewing (*Phaps chalcoptera*) Common Rock-rat (Zyzomys argurus) Euro (*Osphranter robustus*) Grey-headed Honey-eater (*Ptilotula keartlandi*) Torresian Crow (Corvus orru) Spinifex Pigeon (*Geophaps plumifera*) *Feral Cat (*Felis catus*)	Euro (*Osphranter robustus*) Northern Quoll (*Dasyurus hallucatus*) *Feral Cat (*Felis catus)*
NS RE 03	Top of mesa, stony plain with scattered shrubs	2015	Early stage of regrowth, habitat suitable for generalist fauna species.	Site is adjacent to significant habitat. Northern Quolls previously recorded in surrounding area.	Black-faced Cuckoo-shrike (*Coracina novaehollandiae*) Common Rock-rat (*Zyzomys argurus*) Euro (*Osphranter robustus*) Ring-tailed Dragon (*Ctenotus caudicinctus*) Singing honey-eater (*Gavicalis virescens*)	Nil
NS RE 06	Rocky plain adjacent to creekline, open *Triodia* grassland	2015	Early stage of regrowth, habitat suitable for generalist fauna species.	Site is nearby to foraging habitat, no significant fauna recorded.	Singing Honey-eater (*Gavicalis virescens*) Spinifex Pigeon (*Geophaps plumifera*) White-winged Fairy-wren (*Malurus leucopterus*)	Common Rock-rat (*Zyzomys argurus*) *Cattle (*Bos taurus*)
Eliwana Mine						
EM RE 01	Rocky plain with moderate stage of mixed shrubland.	2021	Moderate vegetation regrowth, habitat suitable for generalist fauna species.	Site is nearby to potential foraging habitat, no significant fauna recorded.	Common Rock-rat (*Zyzomys argurus*) *Feral Cat (*Felis catus*)	Euro (*Osphranter robustus*) Common Rock-rat (*Zyzomys argurus*) Spinifex Pigeon (*Geophaps plumifera*) *Cattle (*Bos taurus*) *Feral Cat (*Felis catus*)
Eliwana Line Rail						

Site	Habitat	Year of Rehabilitation	Suitability of habitat to support fauna	Suitability of habitat to support conservation significant fauna	Fauna species recorded prior to 2023	Fauna species recorded 2023
ER RE 01	Rocky plain with mixed shrubland over small patches of early stages of *Triodia* grassland.	2021	Advanced stages of shrub regrowth, habitat suitable for generalist fauna species.	Area in proximity to mapped foraging habitat; no significant fauna recorded.	Galah (*Eolophus roseicapilla)* Grey Butcherbird (*Cracticus torquatus*) Spinifex Pigeon (*Geophaps plumifera*) *Dog/Dingo (*Canis familiaris*) *Feral Cat (*Felis catus*)	Red Kangaroo (*Osphranter rufus*) Spinifex Pigeon (*Geophaps plumifera*) *Cattle (*Bos taurus*) *Feral Cat (*Felis catus*)
ER RE 02	Rocky plain with early regrowth adjacent to road.	2021	Very early stage of regrowth, habitat suitable for generalist fauna species.	Site is nearby to foraging habitat, no significant fauna recorded.	Little Crow (*Corvus bennetti*) *Dog/Dingo (*Canis familiaris*) *Donkey (*Equus africanus*)	Galah (*Eolophus roseicapilla*) Spinifex Pigeon (*Geophaps plumifera*) *Donkey (*Equus africanus*)
ER RE 03	Rocky plain with early regrowth adjacent to road.	2021	Very early stage of regrowth, habitat suitable for generalist fauna species.	Site is nearby to foraging habitat, no significant fauna recorded.	*Cattle (*Bos taurus*)	Spinifex Pigeon (*Geophaps plumifera*) Stripe-faced Dunnart (*Sminthopsis macroura*) *Cattle (*Bos taurus*) *Donkey (*Equus africanus*)

* Introduced species.

Appendix P: Introduced Fauna Recorded

Table 5.15: Introduced fauna recorded

Species	Site	Date	Co-ordinates		Comments
			Easting	Northing	
Cloudbreak					
European Cattle	CB RE Cocos CB01.2	5/03/2023	758223	7527072	Motion camera recording
European Cattle	CB RE Cocos CB01.2	7/03/2023	758223	7527072	Motion camera recording
European Cattle	CB RE Cocos CB01.2	10/03/2023	758223	7527072	Motion camera recording
European Cattle	CB RE Cocos CB01.2	11/03/2023	758223	7527072	Motion camera recording
European Cattle	CB RE Cocos CB01.2	22/03/2023	758223	7527072	Motion camera recording
Dog/Dingo	CB RE Cocos CB01.2	8/04/2023	758223	7527072	Motion camera recording
Rabbit	CB RE Cocos CB01.2	9/04/2023	758223	7527072	Motion camera recording
Rabbit	CB RE Cocos CB01.2	11/04/2023	758223	7527072	Motion camera recording
Rabbit	CB RE Cocos CB01.2	12/04/2023	758223	7527072	Motion camera recording
Dog/Dingo	CB RE Cocos CB01.2	5/05/2023	758223	7527072	Motion camera recording
European Cattle	CB RE Cocos CB01.2	12/05/2023	758223	7527072	Motion camera recording
Rabbit	CB RE Cocos CB01.2	20/05/2023	758223	7527072	Motion camera recording
European Cattle	CB RE Cocos CB01.2	21/05/2023	758223	7527072	Motion camera recording
European Cattle	CB RE Cocos CB01.2	25/05/2023	758223	7527072	Motion camera recording
European Cattle	CB RE Cocos CB01.2	1/06/2023	758223	7527072	Motion camera recording
European Cattle	CB RE Cocos CB01.1	11/03/2023	758170	7527074	Motion camera recording
European Cattle	CB RE Cocos CB01.1	12/03/2023	758170	7527074	Motion camera recording
European Cattle	CB RE Cocos CB01.1	22/03/2023	758170	7527074	Motion camera recording
Rabbit	CB RE Cocos CB01.1	31/03/2023	758170	7527074	Motion camera recording
European Cattle	CB RE Cocos CB01.1	10/05/2023	758170	7527074	Motion camera recording
Rabbit	CB RE Cocos CB01.1	22/05/2023	758170	7527074	Motion camera recording
European Cattle	CB RE Cocos CB01.1	24/05/2023	758170	7527074	Motion camera recording
European Cattle	CB RE Cocos CB01.1	31/05/2023	758170	7527074	Motion camera recording
Rabbit	CB RE 05	3/03/2023	748899	7528856	Motion camera recording
Feral Cat	CB RE 05	4/03/2023	748899	7528856	Motion camera recording
Rabbit	CB RE 05	19/03/2023	748899	7528856	Motion camera recording
Rabbit	CB RE 05	20/03/2023	748899	7528856	Motion camera recording
Feral Cat	CB RE 05	27/03/2023	748899	7528856	Motion camera recording
Feral Cat	CB RE 05	28/03/2023	748899	7528856	Motion camera recording
Rabbit	CB RE 05	10/04/2023	748899	7528856	Motion camera recording
Feral Cat	CB RE 05	17/04/2023	748899	7528856	Motion camera recording
Feral Cat	CB RE 05	21/05/2023	748899	7528856	Motion camera recording
Rabbit	CB RE 05	11/06/2023	748899	7528856	Motion camera recording
Christmas Creek					
European Cattle	CC RE 01	12/05/2023	774786	7525393	Motion camera recording
European Cattle	CC RE 01	11/05/2023	774786	7525393	Motion camera recording
European Cattle	CC RE 01	3/05/2023	774786	7525393	Motion camera recording
European Cattle	CC RE 01	1/05/2023	774786	7525393	Motion camera recording
European Cattle	CC RE 01	15/04/2023	774786	7525393	Motion camera recording
European Cattle	CC RE 01	10/04/2023	774786	7525393	Motion camera recording
European Cattle	CC RE 01	9/04/2023	774786	7525393	Motion camera recording

Species	Site	Date	Co-ordinates		Comments
			Easting	Northing	
European Cattle	CC RE 01	5/04/2023	774786	7525393	Motion camera recording
European Cattle	CC RE 01	16/03/2023	774786	7525393	Motion camera recording
European Cattle	CC RE 01	8/03/2023	774786	7525393	Motion camera recording
European Cattle	CC RE 01	6/03/2023	774786	7525393	Motion camera recording
European Cattle	CC RE 01	28/04/2023	774786	7525393	Motion camera recording
European Cattle	CC RE 01	21/04/2023	774786	7525393	Motion camera recording
Rabbit	CC RE 02	4/06/2023	772742	7524424	Motion camera recording
Rabbit	CC RE 02	3/06/2023	772742	7524424	Motion camera recording
Rabbit	CC RE 02	30/05/2023	772742	7524424	Motion camera recording
Rabbit	CC RE 02	21/05/2023	772742	7524424	Motion camera recording
Rabbit	CC RE 02	19/05/2023	772742	7524424	Motion camera recording
Rabbit	CC RE 02	15/05/2023	772742	7524424	Motion camera recording
Rabbit	CC RE 02	11/05/2023	772742	7524424	Motion camera recording
Rabbit	CC RE 02	10/05/2023	772742	7524424	Motion camera recording
Rabbit	CC RE 02	9/05/2023	772742	7524424	Motion camera recording
Rabbit	CC RE 02	8/05/2023	772742	7524424	Motion camera recording
Rabbit	CC RE 02	26/04/2023	772742	7524424	Motion camera recording
Rabbit	CC RE 02	17/04/2023	772742	7524424	Motion camera recording
Rabbit	CC RE 02	20/03/2023	772742	7524424	Motion camera recording
Rabbit	CC RE 02	11/03/2023	772742	7524424	Motion camera recording
Rabbit	CC RE 02	10/03/2023	772742	7524424	Motion camera recording
European Cattle	CB/CC RE C1	8/03/2023	774766	7525524	Motion camera recording
Rabbit	CC RE C1	6/06/2023	774767	7525506	Motion camera recording
Rabbit	CC RE C1	15/04/2023	774767	7525506	Motion camera recording
Rabbit	CC RE C1	10/04/2023	774767	7525506	Motion camera recording
Rabbit	CC RE C1	2/04/2023	774767	7525506	Motion camera recording
Rabbit	CC RE VAS01	6/06/2023	781293	7526430	Motion camera recording
Rabbit	CC RE VAS01	15/04/2023	781293	7526430	Motion camera recording
Rabbit	CC RE VAS01	10/04/2023	781293	7526430	Motion camera recording
Rabbit	CC RE VAS01	2/04/2023	781293	7526430	Motion camera recording
Rabbit	CB/CC RE VAS01 C1	1/06/2023	781249	7526449	Motion camera recording
Rabbit	CB/CC RE VAS01 C1	16/05/2023	781249	7526449	Motion camera recording
Rabbit	CB/CC RE VAS01 C1	15/05/2023	781249	7526449	Motion camera recording
Rabbit	CB/CC RE VAS01 C1	14/05/2023	781249	7526449	Motion camera recording
Rabbit	CB/CC RE VAS01 C1	13/05/2023	781249	7526449	Motion camera recording
Rabbit	CB/CC RE VAS01 C1	2/05/2023	781249	7526449	Motion camera recording
Rabbit	CB/CC RE VAS01 C1	17/04/2023	781249	7526449	Motion camera recording
Rabbit	CB/CC RE VAS01 C1	3/04/2023	781249	7526449	Motion camera recording
Rabbit	CB/CC RE VAS01 C1	17/03/2023	781249	7526449	Motion camera recording
Rabbit	CB/CC RE VAS01 C1	7/03/2023	781249	7526449	Motion camera recording
Rabbit	CB/CC RE VAS01 C1	5/03/2023	781249	7526449	Motion camera recording
Rabbit	CB/CC RE VAS01 C1	4/03/2023	781249	7526449	Motion camera recording
Rabbit	CB/CC RE VAS01 C1	28/02/2023	781249	7526449	Motion camera recording

Species	Site	Date	Co-ordinates		Comments
			Easting	Northing	
Solomon Hub					
Rabbit	SM RE 11	6/04/2023	598078	7551440	Motion camera recording
Feral Cat	SM NQ I1 MC1	19/05/2023	590433	7555960	Motion camera recording
Feral Cat	SM NQ I1 MC3	9/05/2023	590567	7555397	Motion camera recording
Feral Cat	SM NQ I2 MC5	7/04/2023	589304	7553672	Motion camera recording
European Cattle	SM NQ I3 MC1	14/05/2023	585540	7547006	Motion camera recording
Feral Cat	SM RE C10	9/04/2023	600088	7552156	Motion camera recording
Dog/Dingo	SM RE C10	8/05/2023	600088	7552156	Motion camera recording
European Cattle	SM RE C11	17/05/2023	602275	7549340	Motion camera recording
European Cattle	SM RE C11	14/05/2023	602275	7549340	Motion camera recording
European Cattle	SM RE C11	14/04/2023	602275	7549340	Motion camera recording
European Cattle	SM RE C11	11/04/2023	602275	7549340	Motion camera recording
Feral Cat	SM RE C11	23/03/2023	602275	7549340	Motion camera recording
Dog/Dingo	SM RE C11	18/05/2023	602275	7549340	Motion camera recording
Hamersley Line Rail					
European Cattle	HL NQ C3 MC3	2/04/2023	687056	7578648	Motion camera recording
European Cattle	HL NQ C3 MC4	26/10/2023	686945	7578581	Motion camera recording
European Cattle	HL NQ C3.MC5	25/04/2023	686761	7578493	Motion camera recording
European Cattle	HL NQ C3.MC5	3/04/2023	686761	7578493	Motion camera recording
European Cattle	HL NQ C3.MC5	29/03/2023	686761	7578493	Motion camera recording
European Cattle	HL NQ C3.MC5	27/03/2023	686761	7578493	Motion camera recording
European Cattle	HL NQ C3.MC5	21/03/2023	686761	7578493	Motion camera recording
European Cattle	HL NQ C3.MC5	24/03/2023	686761	7578493	Motion camera recording
Feral Cat	HL NQ I1 MC4	30/12/2023	694743	7576913	Motion camera recording
Feral Cat	HL NQ I1 MC4	25/12/2023	694743	7576913	Motion camera recording
Feral Cat	HL NQ I1 MC4	24/12/2023	694743	7576913	Motion camera recording
Feral Cat	HL NQ I1 MC4	7/12/2023	694743	7576913	Motion camera recording
Feral Cat	HL NQ I1 MC4	7/12/2023	694743	7576913	Motion camera recording
Feral Cat	HL NQ I1 MC4	2/12/2023	694743	7576913	Motion camera recording
Feral Cat	HL NQ I1 MC4	23/12/2023	694743	7576913	Two individuals; motion camera recording
Dog/Dingo	HL NQ I1 MC4	19/01/2023	694743	7576913	Motion camera recording
Feral Cat	HL NQ I1.MC5	5/04/2023	694836	7576748	Motion camera recording
Feral Cat	HL NQ I1MC2	27/06/2023	687180	7578773	Motion camera recording
Feral Cat	HL NQ I1MC2	17/05/2023	687180	7578773	Motion camera recording
Feral Cat	HL NQ I1MC2	23/03/2023	687180	7578773	Motion camera recording
Feral Cat	HL NQ I2 MC5	15/06/2023	686901	7567238	Motion camera recording
Feral Cat	HL NQ I2 MC5	11/05/2023	686901	7567238	Motion camera recording
European Cattle	HL NQ I3 MC1	13/05/2023	680556	7561855	Motion camera recording
European Cattle	HL NQ I3 MC1	1/05/2023	680556	7561855	Motion camera recording
Dog/Dingo	HL NQ I3 MC1	27/04/2023	680556	7561855	Motion camera recording
European Cattle	HL NQ I3 MC2	10/06/2023	680690	7561842	Motion camera recording
European Cattle	HL NQ I3 MC2	3/06/2023	680690	7561842	Motion camera recording

Species	Site	Date	Co-ordinates		Comments
			Easting	Northing	
European Cattle	HL NQ I3 MC2	27/05/2023	680690	7561842	Motion camera recording
European Cattle	HL NQ I3 MC2	7/05/2023	680690	7561842	Motion camera recording
European Cattle	HL NQ I3 MC2	30/04/2023	680690	7561842	Motion camera recording
European Cattle	HL NQ I3 MC2	21/04/2023	680690	7561842	Motion camera recording
European Cattle	HL NQ I3 MC2	23/03/2023	680690	7561842	Motion camera recording
European Cattle	HL NQ I3 MC2	19/03/2023	680690	7561842	Motion camera recording
European Cattle	HL NQ I3 MC3	2/05/2023	680523	7561590	Motion camera recording
European Cattle	HL NQ I3 MC4	15/04/2023	680290	7561492	Motion camera recording
European Cattle	HL NQ I3 MC5	15/05/2023	680130	7561564	Motion camera recording
Feral Cat	HL RE 87	21/05/2023	686792	7566549	Motion camera recording
Main Line Rail					
Dog/Dingo	MR CU 01	6/05/2023	692844	7634857	Motion camera recording
Feral Cat	MR CU 04	28/06/2023	675217	7682261	Motion camera recording
Feral Cat	MR CU 04	18/06/2023	675217	7682261	Motion camera recording
Feral Cat	MR CU 04	21/04/2023	675217	7682261	Motion camera recording
Feral Cat	MR CU 04	18/04/2023	675217	7682261	Motion camera recording
Feral Cat	MR CU 05	9/05/2023	694449	7628788	Motion camera recording
Dog/Dingo	MR CU 05	1/05/2023	694449	7628788	Motion camera recording
Dog/Dingo	MR CU 05	11/05/2023	694449	7628788	Motion camera recording
Dog/Dingo	MR CU 05	23/05/2023	694449	7628788	Motion camera recording
Dog/Dingo	MR CU 05	9/06/2023	694449	7628788	Motion camera recording
Dog/Dingo	MR CU 05	14/06/2023	694449	7628788	Motion camera recording
Dog/Dingo	MR CU 05	25/06/2023	694449	7628788	Motion camera recording
Feral Cat	MR CU 06	8/06/2023	709503	7572430	Motion camera recording
Feral Cat	MR CU 06	15/05/2023	709503	7572430	Motion camera recording
Feral Cat	MR CU 06	9/05/2023	709503	7572430	Motion camera recording
Feral Cat	MR CU 06	26/04/2023	709503	7572430	Motion camera recording
Dog/Dingo	MR CU 08	10/05/2023	696137	7622710	Motion camera recording
Dog/Dingo	MR CU 08	11/05/2023	696137	7622710	Motion camera recording
Dog/Dingo	MR CU 08	20/05/2023	696137	7622710	Motion camera recording
Dog/Dingo	MR CU 08	24/05/2023	696137	7622710	Motion camera recording
Dog/Dingo	MR CU 08	3/06/2023	696137	7622710	Motion camera recording
Dog/Dingo	MR CU 08	7/06/2023	696137	7622710	Motion camera recording
Feral Cat	MR CU 10	24/06/2023	666488	7708573	Motion camera recording
Feral Cat	MR CU 10	23/06/2023	666488	7708573	Motion camera recording
Feral Cat	MR CU 10	2/06/2023	666488	7708573	Motion camera recording
Feral Cat	MR CU 10	26/05/2023	666488	7708573	Motion camera recording
Feral Cat	MR CU 10	25/05/2023	666488	7708573	Motion camera recording
Feral Cat	MR CU 10	16/05/2023	666488	7708573	Motion camera recording
Feral Cat	MR CU 12	18/06/2023	686832	7648120	Motion camera recording
Feral Cat	MR CU 12	7/06/2023	686832	7648120	Motion camera recording
Feral Cat	MR CU 12	5/06/2023	686832	7648120	Motion camera recording
Feral Cat	MR CU 12	2/06/2023	686832	7648120	Motion camera recording

Species	Site	Date	Co-ordinates		Comments
			Easting	Northing	
Feral Cat	MR CU 12	1/06/2023	686832	7648120	Motion camera recording
Feral Cat	MR CU 12	30/05/2023	686832	7648120	Motion camera recording
European Cattle	MR GB ASC16 MC1	23/03/2023	745483	7606491	Motion camera recording
European Cattle	MR GB ASC16 MC1	31/03/2023	745483	7606491	Motion camera recording
European Cattle	MR GB ASC16 MC1	22/04/2023	745483	7606491	Motion camera recording
European Cattle	MR GB ASC16 MC1	28/04/2023	745483	7606491	Motion camera recording
European Cattle	MR GB ASC16 MC1	24/05/2023	745483	7606491	Motion camera recording
European Cattle	MR GB ASC16 MC1	15/06/2023	745483	7606491	Motion camera recording
European Cattle	MR GB ASC16 MC1	18/06/2023	745483	7606491	Motion camera recording
European Cattle	MR GB ASC16 MC4	18/03/2023	745295	7606616	Motion camera recording
European Cattle	MR GB ASC16 MC4	19/03/2023	745295	7606616	Motion camera recording
European Cattle	MR GB ASC16 MC4	22/03/2023	745295	7606616	Motion camera recording
European Cattle	MR GB ASC16 MC4	25/03/2023	745295	7606616	Motion camera recording
European Cattle	MR GB ASC16 MC4	26/03/2023	745295	7606616	Motion camera recording
European Cattle	MR GB ASC16 MC4	29/03/2023	745295	7606616	Motion camera recording
European Cattle	MR GB ASC16 MC4	31/03/2023	745295	7606616	Motion camera recording
European Cattle	MR GB ASC16 MC4	3/04/2023	745295	7606616	Motion camera recording
European Cattle	MR GB ASC16 MC4	4/04/2023	745295	7606616	Motion camera recording
European Cattle	MR GB ASC16 MC4	11/04/2023	745295	7606616	Motion camera recording
European Cattle	MR GB ASC16 MC4	20/04/2023	745295	7606616	Motion camera recording
European Cattle	MR GB ASC16 MC4	19/05/2023	745295	7606616	Motion camera recording
European Cattle	MR GB ASC16 MC4	27/05/2023	745295	7606616	Motion camera recording
European Cattle	MR GB ASC16 MC4	13/06/2023	745295	7606616	Motion camera recording
European Cattle	MR GB ASC16 MC4	14/06/2023	745295	7606616	Motion camera recording
European Cattle	MR GB ASC16 MC4	16/06/2023	745295	7606616	Motion camera recording
European Cattle	MR GB ASC16 MC4	23/06/2023	745295	7606616	Motion camera recording
European Cattle	MR GB ASC16 MC4	24/06/2023	745295	7606616	Motion camera recording
European Cattle	MR GB OS 23	23/04/2023	696718	7607863	Motion camera recording
European Cattle	MR GB OS 23	16/05/2023	696718	7607863	Motion camera recording
European Cattle	MR GB OS 23	27/05/2023	696718	7607863	Motion camera recording
European Cattle	MR GB OS 23	31/05/2023	696718	7607863	Motion camera recording
European Cattle	MR GB OS 23	7/06/2023	696718	7607863	Motion camera recording
European Cattle	MR GB OS 23	12/06/2023	696718	7607863	Motion camera recording
European Cattle	MR GB OS 23	14/06/2023	696718	7607863	Motion camera recording
Feral Cat	MR GB OS 23	14/06/2023	696718	7607863	Motion camera recording
Feral Cat	MR GB OS 23	14/06/2023	696718	7607863	Motion camera recording
Feral Cat	MR GB OS 23	17/06/2023	696718	7607863	Motion camera recording
Feral Cat	MR GB OS 23	18/06/2023	696718	7607863	Motion camera recording
Rabbit	MR GB OS 23	9/05/2023	696718	7607863	Motion camera recording
Dog/Dingo	MR GB OS 23	20/04/2023	696718	7607863	Motion camera recording
Dog/Dingo	MR GB OS 23	30/04/2023	696718	7607863	Motion camera recording
Dog/Dingo	MR RE C37	25/04/2023	694149	7594919	Motion camera recording
European Cattle	MR GB ASC16 MC2	19/03/2023	745421	7606505	Motion camera recording

Species	Site	Date	Co-ordinates		Comments
			Easting	Northing	
European Cattle	MR GB ASC16 MC2	13/06/2023	745421	7606505	Motion camera recording
European Cattle	MR GB ASC16 MC2	19/06/2023	745421	7606505	Motion camera recording
Eliwana Mine					
European Cattle	EM RE 01	6/08/2023	489241	7519093	Motion camera recording
Feral Cat	EM NQ I2 MC5	7/05/2023	481906	7514361	Motion camera recording
Feral Cat	EM NQ I2 MC2	10/08/2023	481968	7514507	Motion camera recording
Feral Cat	EM NQ I2 MC2	2/08/2023	481968	7514507	Motion camera recording
Feral Cat	EM NQ I2 MC3	10/08/2023	481970	7514455	Motion camera recording
Feral Cat	EM NQ I2 MC1	3/05/2023	482020	7514538	Motion camera recording
Feral Cat	EM RE C01	24/07/2023	482251	7522172	Motion camera recording
Feral Cat	EM RE 01	12/08/2023	489241	7519093	Motion camera recording
Feral Cat	EM RE 01	6/08/2023	489241	7519093	Motion camera recording
Feral Cat	EM RE 01	21/07/2023	489241	7519093	Motion camera recording
Feral Cat	EM RE 01	8/07/2023	489241	7519093	Motion camera recording
Feral Cat	EM NQ I3 MC1	4/07/2023	496652	7508277	Motion camera recording
Feral Cat	EM NQ I3 MC1	4/05/2023	496652	7508277	Motion camera recording
Feral Cat	EM NQ I3 MC3	19/08/2023	496667	7508371	Motion camera recording
Feral Cat	EM NQ I3 MC3	12/06/2023	496667	7508371	Motion camera recording
Feral Cat	EM NQ I3 MC3	11/05/2023	496667	7508371	Motion camera recording
Feral Cat	EM NQ I3 MC5	17/05/2023	496734	7508446	Motion camera recording
Feral Cat	EM NQ I4 MC01	16/05/2023	509340	7509584	Motion camera recording
Dog/Dingo	EM POP I1	4/02/2023	470265	7516119	Motion camera recording
Dog/Dingo	EM NQ I2 MC4	21/05/2023	481961	7514420	Motion camera recording
Dog/Dingo	EM NQ I2 MC4	15/06/2023	481961	7514420	Motion camera recording
Dog/Dingo	EM POP I5	2/02/2023	482837	7520727	Motion camera recording
Dog/Dingo	EM Opp	6/02/2023	495807	7509664	Motion camera recording
Eliwana Line Rail					
European Cattle	ER NQ I1 MC01	7/05/2023	502249	7518795	Motion camera recording
European Cattle	ER NQ I1 MC01	16/05/2023	502249	7518795	Motion camera recording
European Cattle	ER NQ I1 MC01	20/06/2023	502249	7518795	Motion camera recording
European Cattle	ER NQ I1 MC03	15/05/2023	502336	7518865	Motion camera recording
European Cattle	ER NQ I2 MC1	14/05/2023	527240	7526874	Motion camera recording
European Cattle	ER NQ I2 MC1	23/05/2023	527240	7526874	Motion camera recording
European Cattle	ER NQ I2 MC1	29/05/2023	527240	7526874	Motion camera recording
European Cattle	ER NQ I2 MC1	17/07/2023	527240	7526874	Motion camera recording
European Cattle	ER NQ I2 MC1	28/07/2023	527240	7526874	Motion camera recording
European Cattle	ER NQ I2 MC1	8/08/2023	527240	7526874	Motion camera recording
European Cattle	ER NQ I2 MC2	5/05/2023	527254	7526921	Motion camera recording
European Cattle	ER NQ I2 MC2	14/05/2023	527254	7526921	Motion camera recording
European Cattle	ER NQ I2 MC2	19/06/2023	527254	7526921	Motion camera recording
European Cattle	ER NQ I2 MC2	29/08/2023	527254	7526921	Motion camera recording
European Cattle	ER NQ I2 MC3	29/05/2023	527312	7526928	Motion camera recording
European Cattle	ER NQ I2 MC3	5/07/2023	527312	7526928	Motion camera recording

Species	Site	Date	Co-ordinates		Comments
			Easting	Northing	
European Cattle	ER NQ I2 MC3	21/08/2023	527312	7526928	Motion camera recording
European Cattle	ER NQ I2 MC5	31/05/2023	527322	7526776	Motion camera recording
European Cattle	ER NQ I2 MC4	6/07/2023	527372	7526842	Motion camera recording
European Cattle	ER RE 03	15/06/2023	527999	7526508	Motion camera recording
European Cattle	ER RE 03	18/06/2023	527999	7526508	Motion camera recording
European Cattle	ER RE 01	5/04/2023	603871	7545727	Motion camera recording
Feral Cat	ER RE C01	24/07/2023	482251	7522172	Motion camera recording
Feral Cat	ER NQ I1 MC01	5/05/2023	502249	7518795	Motion camera recording
Feral Cat	ER NQ I1 MC01	12/06/2023	502249	7518795	Motion camera recording
Feral Cat	ER NQ I1 MC02	23/05/2023	502301	7518815	Motion camera recording
Feral Cat	ER NQ I3 MC1	20/03/2023	502301	7518815	Motion camera recording
Feral Cat	ER NQ I3 MC1	27/04/2023	502301	7518815	Motion camera recording
Feral Cat	ER NQ I3 MC1	18/05/2023	502301	7518815	Motion camera recording
Feral Cat	ER NQ I3 MC1	2/06/2023	502301	7518815	Motion camera recording
Feral Cat	ER NQ I1 MC03	8/05/2023	502336	7518865	Motion camera recording
Feral Cat	ER NQ I1 MC03	11/08/2023	502336	7518865	Motion camera recording
Feral Cat	ER NQ I1 MC04	13/06/2023	502379	7518872	Motion camera recording
Feral Cat	ER CU 01	19/05/2023	504525	7518427	Motion camera recording
Feral Cat	ER CU 01	26/05/2023	504525	7518427	Motion camera recording
Feral Cat	ER CU 01	4/06/2023	504525	7518427	Motion camera recording
Feral Cat	ER CU 01	5/08/2023	504525	7518427	Motion camera recording
Feral Cat	ER CU 01	9/08/2023	504525	7518427	Motion camera recording
Feral Cat	ER NQ I2 MC3	5/05/2023	527312	7526928	Motion camera recording
Feral Cat	ER NQ I2 MC3	26/05/2023	527312	7526928	Motion camera recording
Feral Cat	ER NQ I2 MC3	27/05/2023	527312	7526928	Motion camera recording
Feral Cat	ER NQ I3 MC3	12/07/2023	565664	7537176	Motion camera recording
Feral Cat	ER RE 01	5/04/2023	603871	7545727	Motion camera recording
Feral Cat	ER RE 01	24/04/2023	603871	7545727	Motion camera recording
Feral Cat	ER RE 01	28/05/2023	603871	7545727	Motion camera recording
Dog/Dingo	ER NQ I1 MC01	9/05/2023	502249	7518795	Motion camera recording
Dog/Dingo	ER NQ I1 MC01	9/05/2023	502249	7518795	Motion camera recording
Dog/Dingo	ER NQ I1 MC01	13/05/2023	502249	7518795	Motion camera recording
Dog/Dingo	ER NQ I1 MC01	14/05/2023	502249	7518795	Motion camera recording
Dog/Dingo	ER NQ I1 MC01	17/05/2023	502249	7518795	Motion camera recording
Dog/Dingo	ER NQ I1 MC01	24/05/2023	502249	7518795	Motion camera recording
Dog/Dingo	ER NQ I1 MC01	24/05/2023	502249	7518795	Motion camera recording
Dog/Dingo	ER NQ I1 MC04	29/07/2023	502379	7518872	Motion camera recording
Dog/Dingo	ER NQ I1 MC05	29/07/2023	502440	7518898	Motion camera recording
Dog/Dingo	ER NQ I2 MC1	19/05/2023	527240	7526874	Motion camera recording
Dog/Dingo	ER NQ I2 MC1	31/07/2023	527240	7526874	Motion camera recording
Dog/Dingo	ER NQ I2 MC1	1/08/2023	527240	7526874	Motion camera recording
Dog/Dingo	ER NQ I2 MC2	12/05/2023	527254	7526921	Motion camera recording
Dog/Dingo	ER NQ I2 MC2	19/05/2023	527254	7526921	Motion camera recording

Species	Site	Date	Co-ordinates		Comments
			Easting	Northing	
Dog/Dingo	ER NQ I2 MC2	2/06/2023	527254	7526921	Motion camera recording
Dog/Dingo	ER NQ I2 MC2	5/05/2023	527254	7526921	Two individuals; motion camera recording
Dog/Dingo	ER NQ I2 MC3	8/05/2023	527312	7526928	Motion camera recording
Dog/Dingo	ER NQ I3 MC3	21/05/2023	527312	7526928	Motion camera recording
Eliwana Mine and Rail Line Controls					
European Cattle	EMR NQ C1 MC1	24/06/2023	459816	7519519	Motion camera recording
European Cattle	EMR NQ C1 MC1	5/06/2023	459816	7519519	Motion camera recording
European Cattle	EMR NQ C1 MC1	18/05/2023	459816	7519519	Motion camera recording
European Cattle	EMR NQ C1 MC2	29/05/2023	459862	7519552	Motion camera recording
European Cattle	EMR NQ C1 MC2	18/05/2023	459862	7519552	Motion camera recording
European Cattle	EMR NQ C1 MC3	18/05/2023	459918	7519634	Motion camera recording
European Cattle	EMR NQ C1 MC4	9/05/2023	459936	7519630	Motion camera recording
European Cattle	EMR NQ C1 MC5	23/06/2023	459981	7519686	Motion camera recording
Feral Cat	EMR NQ C1 MC1	19/05/2023	459816	7519519	Motion camera recording
Feral Cat	EMR NQ C1 MC2	8/05/2023	459862	7519552	Motion camera recording
Feral Cat	EMR NQ C2 MC1	3/08/2023	467456	7509264	Motion camera recording
Feral Cat	EMR NQ C2 MC1	29/07/2023	467456	7509264	Motion camera recording
Feral Cat	EMR NQ C2 MC1	6/07/2023	467456	7509264	Motion camera recording
Feral Cat	EMR NQ C2 MC1	4/07/2023	467456	7509264	Motion camera recording
Feral Cat	EMR NQ C2 MC1	27/06/2023	467456	7509264	Motion camera recording
Feral Cat	EMR NQ C2 MC1	23/06/2023	467456	7509264	Motion camera recording
Feral Cat	EMR NQ C2 MC1	15/06/2023	467456	7509264	Motion camera recording
Feral Cat	EMR NQ C2 MC1	9/05/2023	467456	7509264	Motion camera recording
Feral Cat	EMR NQ C3 MC3	29/06/2023	525039	7514565	Motion camera recording
Feral Cat	EMR NQ C3 MC3	20/05/2023	525039	7514565	Motion camera recording
Feral Cat	EMR NQ C3 MC4	3/05/2023	525049	7514610	Motion camera recording
Feral Cat	EMR NQ C3 MC1	9/05/2023	525054	7514425	Motion camera recording
Feral Cat	EMR NQ C3 MC2	26/05/2023	525058	7514507	Motion camera recording
Feral Cat	EMR NQ C3 MC2	17/05/2023	525058	7514507	Motion camera recording
Feral Cat	EMR NQ C3 MC2	3/05/2023	525058	7514507	Motion camera recording
Dog/Dingo	EMR NQ C1 MC2	27/05/2023	459862	7519552	Motion camera recording
Dog/Dingo	EMR NQ C1 MC4	27/05/2023	459936	7519630	Motion camera recording
Dog/Dingo	EMR NQ C1 MC4	28/05/2023	459936	7519630	Motion camera recording
Nullagine					
European Cattle	NL BE MC 04	24/06/2023	800274	7559322	Motion camera recording
European Cattle	NL BE MC 04	13/07/2023	800274	7559322	Motion camera recording
European Cattle	NL BE MC 03	25/06/2023	800321	7558729	Motion camera recording
European Cattle	NL BE MC 03	7/08/2023	800321	7558729	Motion camera recording
European Cattle	NL BE MC 09	5/07/2023	800589	7560528	Motion camera recording
European Cattle	NL W MC1	29/06/2023	807669	7563784	Motion camera recording
European Cattle	NL W MC 02	24/08/2023	808038	7564650	Motion camera recording
European Cattle	NL W MC3	16/08/2023	808238	7564990	Motion camera recording

Species	Site	Date	Co-ordinates		Comments
			Easting	Northing	
European Cattle	NL W MC 05	23/09/2023	808778	7566061	Motion camera recording
European Cattle	NL W MC 09	2/07/2023	810506	7566512	Motion camera recording
Feral Cat	NL BE MC 06	4/09/2023	799786	7559397	Motion camera recording
Feral Cat	NL BE MC 05	24/06/2023	800255	7559534	Motion camera recording
Feral Cat	NL BE MC 05	10/07/2023	800255	7559534	Motion camera recording
Feral Cat	NL BE MC 05	12/07/2023	800255	7559534	Motion camera recording
Feral Cat	NL BE MC 04	7/07/2023	800274	7559322	Motion camera recording
Feral Cat	NL BE MC 03	25/06/2023	800321	7558729	Motion camera recording
Feral Cat	NL BE MC 03	23/07/2023	800321	7558729	Motion camera recording
Feral Cat	NL BE MC 03	31/08/2023	800321	7558729	Motion camera recording
Feral Cat	NL W MC1	19/09/2023	807669	7563784	Motion camera recording
Feral Cat	NL W MC 10	1/08/2023	810449	7565913	Motion camera recording
Feral Cat	NL W MC 10	12/08/2023	810449	7565913	Motion camera recording
Feral Cat	NL W MC 09	27/06/2023	810506	7566512	Motion camera recording
Dog/Dingo	NL BE MC 06	11/08/2023	799786	7559397	Motion camera recording
Dog/Dingo	NL BE MC 06	9/09/2023	799786	7559397	Motion camera recording
Dog/Dingo	NL BE MC 03	17/07/2023	800321	7558729	Motion camera recording
Dog/Dingo	NL BE MC 03	26/07/2023	800321	7558729	Motion camera recording
Dog/Dingo	NL BE MC 09	9/07/2023	800589	7560528	Motion camera recording
Dog/Dingo	NL BE MC 09	11/07/2023	800589	7560528	Motion camera recording
Dog/Dingo	NL BE MC 09	11/08/2023	800589	7560528	Motion camera recording
Dog/Dingo	NL BE MC 09	9/09/2023	800589	7560528	Motion camera recording
Dog/Dingo	NL W MC3	12/07/2023	808238	7564990	Motion camera recording
North Star					
European Cattle	NS MC I5	5/08/2023	710066	7654724	Motion camera recording
European Cattle	NS RE6	3/08/2023	711392	7653580	Motion camera recording
European Cattle	NS NQ C2MC1	2/08/2023	714464	7655235	Motion camera recording
European Cattle	NS NQ C2MC2	17/08/2023	714467	7655360	Motion camera recording
European Cattle	NS NQ C2MC2	19/08/2023	714467	7655360	Motion camera recording
European Cattle	NS NQ C2MC2	21/08/2023	714467	7655360	Motion camera recording
European Cattle	NS NQ C2MC3	2/08/2023	714506	7655417	Motion camera recording
European Cattle	NS NQ C2MC3	2/08/2023	714506	7655417	Motion camera recording
European Cattle	NS NQ C2MC3	4/08/2023	714506	7655417	Motion camera recording
European Cattle	NS NQ C2MC3	6/08/2023	714506	7655417	Motion camera recording
European Cattle	NS NQ C2MC3	11/08/2023	714506	7655417	Motion camera recording
European Cattle	NS NQ C2MC3	17/08/2023	714506	7655417	Motion camera recording
European Cattle	NS NQ C2MC3	19/08/2023	714506	7655417	Motion camera recording
European Cattle	NS NQ C2MC3	21/08/2023	714506	7655417	Motion camera recording
European Cattle	NS NQ C2MC4	30/07/2023	714508	7655481	Motion camera recording
European Cattle	NS NQ C2MC4	1/08/2023	714508	7655481	Motion camera recording
European Cattle	NS NQ C2MC4	2/08/2023	714508	7655481	Motion camera recording
European Cattle	NS NQ C2MC4	4/08/2023	714508	7655481	Motion camera recording
European Cattle	NS NQ C2MC4	11/08/2023	714508	7655481	Motion camera recording

Species	Site	Date	Co-ordinates		Comments
			Easting	Northing	
European Cattle	NS NQ C2MC4	17/08/2023	714508	7655481	Motion camera recording
European Cattle	NS NQ C2MC4	19/08/2023	714508	7655481	Motion camera recording
European Cattle	NS NQ C2MC4	21/08/2023	714508	7655481	Motion camera recording
European Cattle	NS NQ C2MC4	6/08/2023	714508	7655481	Motion camera recording
European Cattle	NS MC C2/NS NQ C2 MC5	13/05/2023	714534	7655507	Motion camera recording
European Cattle	NS MC C2/NS NQ C2 MC5	13/05/2023	714534	7655507	Motion camera recording
European Cattle	NS MC C2/NS NQ C2 MC5	22/05/2023	714534	7655507	Motion camera recording
European Cattle	NS MC C2/NS NQ C2 MC5	22/05/2023	714534	7655507	Motion camera recording
European Cattle	NS MC C2/NS NQ C2 MC5	2/08/2023	714534	7655507	Motion camera recording
European Cattle	NS MC C2/NS NQ C2 MC5	2/08/2023	714534	7655507	Motion camera recording
European Cattle	NS NQ I4 MC8	26/05/2023	715993	7649306	Motion camera recording
Feral Cat	NS MC C8	11/08/2023	713264	713264	Motion camera recording
Feral Cat	NS NQ C3MC3	1/05/2023	713282	7657112	Motion camera recording
Feral Cat	NS NQ C3MC5	15/07/2023	713386	7657120	Motion camera recording
Feral Cat	NS MC C9	3/08/2023	713454	7643344	Motion camera recording
Feral Cat	NS RE 2	17/08/2023	713584	7644568	Motion camera recording
Feral Cat	NS NQ C4 MC04	16/08/2023	718175	7655615	Motion camera recording
Feral Cat	NS MC C5/ NS_F_P_NS NQ C4 MC04	16/08/2023	718293	7655617	Motion camera recording
Dog/Dingo	NS MC I8	6/08/2023	710088	7647244	Motion camera recording
Dog/Dingo	NS NQ I3 MC8	12/08/2023	710394	7648657	Motion camera recording
Dog/Dingo	NS NQ I3 MC9	20/08/2023	710607	7648716	Motion camera recording
Dog/Dingo	NS NQ I4 MC9	28/04/2023	716039	7649350	Motion camera recording

Appendix 3: Bonney Downs: Terrestrial Vertebrate Fauna Survey Consolidation (ecologia, 2025b)

FEBRUARY 2025



Providing sustainable environmental strategies,
management and monitoring solutions
to industry and government.

ecologia
ENVIRONMENT

FORTESCUE METALS GROUP LIMITED

BONNEY DOWNS:

TERRESTRIAL VERTEBRATE FAUNA SURVEY CONSOLIDATION

Document Status						
***ecologia* project number: 2021**						
Rev.	**Author(s)**	**Reviewer**	**Date**	**Approved for Issue**		
				Name	**Distributed To**	**Date**
0	C. Elliott, T. McCabe, S. Plant, D. Scrimshaw	S. Grein	12/12/2024	S. Grein	J. Harper	16/12/2024
1	C. Elliott, T. McCabe, S. Plant	S. Grein	31/01/2025	S. Grein	J. Harper	31/01/2025

***ecologia* Environment (2025)**. Reproduction of this report in whole or in part by electronic, mechanical or chemical means, including photocopying, recording or by any information storage and retrieval system, in any language, is strictly prohibited without the express approval of *ecologia* Environmental Consultants and Fortescue Limited.

ecologia Environment

463 Scarborough Beach Rd

OSBORNE PARK WA 6017

Phone: 08 6168 7200

Email: *admin@ecologia.com.au*

EXECUTIVE SUMMARY

Fortescue Ltd (Fortescue) is proposing to develop a wind generation hub at Bonney Downs Station, located approximately 140 km north of Newman in the Pilbara region of Western Australia, along with an associated transmission line (PEC 8) to Fortescue's Cloudbreak and Christmas Creek mines. Fortescue commissioned Ecologia Environment (*ecologia*) to consolidate the results of detailed and targeted terrestrial vertebrate fauna surveys and the first year of a two year Bird and Bat Site Utilisation Survey (BBSUS) study undertaken within the Bonney Downs study area (hereafter referred to as the 'study area').

Fauna Habitat

Ten broad fauna habitat types were identified within the study area: Rocky Escarpments (Ridges/Mesa/Cliffs/Outcrops/Breakaways), Plain (stony/gibber), Plain (cracking clays), Woodland (open), Woodland (closed), Drainage Line/River/Creek (major), Drainage Line/River/Creek (minor), Hill/Ranges/Plateaux, Granite Outcrops (flat dome) and Gorges/Gullies. Although the extent of the Woodland (open) and Woodland (closed) habitats is restricted within the study area, these habitat types are not confined to the study area and is generally well represented at a local and regional level. Granite Outcrops are of restricted extent within the study area and broader region and may provide microhabitats for significant fauna at both a local and regional scale. All other habitat types identified within the study area are generally considered common and widespread in the Pilbara.

Fauna Assemblage

A total of 237 species have been recorded within the study area including 31 mammals (20 non-volant species and eleven bats), 82 reptiles, 118 birds, two fish and four amphibians. Three introduced species were recorded during the surveys including European cattle, cat and house mouse.

Significant Fauna

Nine significant fauna species were recorded within the study area, including:

- Northern quoll (*Dasyurus hallucatus*) – Endangered EPBC Act and BC Act.
- Grey falcon (*Falco hypoleucos*) – Vulnerable EPBC Act and BC Act.
- Pilbara leaf-nosed bat (*Rhinonicteris aurantia* [Pilbara form]) - Vulnerable EPBC Act and BC Act.
- Ghost bat (*Macroderma gigas*) - Vulnerable EPBC Act and BC Act.
- Pilbara olive python (*Liasis olivaceus barroni*) - Vulnerable EPBC Act and BC Act.
- Gane's blind snake (*Anilios ganei*) – Priority 1.
- Brush-tailed mulgara (*Dasycercus blythi)* – Priority 4.
- Western pebble mound mouse (*Pseudomys chapmani)* – Priority 4.
- Northern short-tailed mouse (*Leggadina lakedownensis)* – Priority 4.

The greater bilby (*Macrotis lagotis* [Vulnerable]) has historically been recorded within the study area; however, both records are associated with vague localities and unknown accuracy. No primary or secondary evidence of the species was recorded during the current surveys and limited suitable habitat occurs within the study area. Based on the general absence of suitable habitat, absence of evidence and questionable accuracy of the record locations, this species is considered unlikely to occur within the study area.

The grey falcon (*Falco hypoleucos* [VU]) was recorded on 10 occasions during the Bonney Downs North fauna surveys and BBSUS, with an additional record obtained during the Bonney Downs South surveys. A maximum of two individuals have been recorded at any given time, suggesting

that at least one pair of birds are regularly utilising habitat within the study area. The species may overfly and forage within all habitat types and Drainage Line/River/Creek (major) habitat within the study area may provide critical breeding and foraging habitat for the grey falcon.

The northern quoll (*Dasyurus hallucatus* [EN]) was recorded at 13 sites at Bonney Downs North, with spot pattern analysis identifying at least eight individuals. A total of nine northern quoll individuals (seven males, two females) were trapped across four systematic sites at Bonney Downs North. One additional individual was recorded on a motion camera trap deployed at Bonney Downs South, with utilisation of the southern half of the study area appearing to represent transient presence rather than permanent occupancy. A high-density population occurs within the northern half of the study area, with a low-density population recorded in the south. Critical habitat for the northern quoll occurs in the northern half of the study area, encompassing the Rocky Escarpment, Gorges/Gullies, Drainage Line/River/Creek and Hills/Ranges/Plateaux habitat types. Additionally, rocky habitats (Rocky Escarpments and Granite Outcrops) and Drainage Line/River/Creek (major and minor) habitat in the southern half of the study area may be utilised by the species during dispersal and foraging activities.

Echolocation calls belonging to the Pilbara leaf-nosed bat (*Rhinonicteris aurantia* (Pilbara form) [VU]) were recorded at 19 sites throughout the study area, with low activity rates recorded across the site. Utilisation of habitat within the study area appears to be restricted to foraging and transit during the dry season and very low activity was detected in the post-wet season. No suitable roosting habitat was recorded during the current surveys; however, rocky habitats within the study area may provide nocturnal refugia and foraging opportunities. No low-time calls indicative of a nearby roost site have been recorded to date.

The ghost bat (*Macroderma gigas* [VU]) was recorded at a single acoustic lure site (BDGB03) within the Bonney Downs North study area in March 2024. The species was not recorded at Bonney Downs South. The ghost bat has the potential to use all habitat types while foraging and Rocky Escarpments, Hills/Ranges/Plateaux and Gorges/Gullies within the study area may provide roosting habitat and nocturnal shelter. No suitable roost caves or secondary evidence of the species were recorded in rocky habitat types.

The Pilbara olive python (*Liasis olivaceus barroni* [VU]) was recorded on two occasions at Bonney Downs North, with a single individual observed during nocturnal spotlighting activities and a second individual captured in a cage trap. Both animals were recorded in the Drainage Line/River/Creek (major) habitat type. No Pilbara olive pythons were recorded during the Bonney Downs South surveys, a previous record of the species within this area was identified during the database assessment. Permanent and semi-permanent pools associated with Bonney Creek, Bonney Pools, the Nullagine River and the Coongan River provide suitable aquatic habitat for the Pilbara olive python.

A total of 12 mounds belonging to the western pebble-mound mouse (*Pseudomys chapmani* [P4]) were recorded across the study area in Plain (stony/gibber), Hills/Ranges/Plateaux and Rocky Escarpments habitat types. The brush-tailed mulgara (*Dasycercus blythi* [P4]) was recorded on a single occasion within the Plain (stony/gibber) habitat type which provides suitable substrates for burrowing. The Gane's blind snake (*Anilios ganei* [P1]) was recorded on a single occasion within the Plain (stony/gibber) habitat type at Bonney Downs North and was not recorded at Bonney Downs South. The short-tailed mouse was recorded on eight occasions within the Plain (cracking clay) and Drainage Line/River/Creek (minor) habitat types across the study area.

The long-tailed dunnart (*Sminthopsis longicaudata* [P4]) and peregrine falcon (*Falco peregrinus* [OS]) are considered highly likely to occur within the study area, despite neither species being recorded in the surveys.

Ten Migratory birds and two Threatened birds (common greenshank [EN/MI] and Australian painted snipe [EN]) were classified as moderately likely to occur within (or overfly) the study area and may temporarily utilise waterbodies within the survey area. Critical habitat required by these species does not occur within the study area.

The night parrot (*Pezoporus occidentalis* [CR/EN]) was not recorded during the current surveys; however, small patches of long unburnt spinifex within the Plain (stony/gibber) habitat type may provide roosting habitat and Plain (cracking clays) habitat may provide foraging habitat (seasonal grasses and herbs) for the night parrot.

TABLE OF CONTENTS

EXECUTIVE SUMMARY ..... **III**

1 INTRODUCTION **1**
1.1 PROJECT BACKGROUND 1
1.2 SURVEY OBJECTIVES 1
1.3 LEGISLATIVE AND REGULATORY FRAMEWORK 1

2 REGIONAL AND BIOLOGICAL CONTEXT **3**
2.1 CLIMATE 3
2.2 IBRA 7 BIOREGIONS 3
2.3 LAND SYSTEMS 4
2.4 SURFACE GEOLOGY OF AUSTRALIA 4
2.5 ATLAS OF AUSTRALIAN SOILS 4
2.6 VEGETATION 5
2.7 LAND USE, LAND TENURE, CONSERVATION RESERVES, ENVIRONMENTALLY SENSITIVE AREAS AND NATIONALLY IMPORTANT WETLANDS 11
2.8 DESKTOP ASSESSMENT 17

3 METHODOLOGY **27**
3.1 SURVEY TIMING 27
3.2 SITE SELECTION 29
3.3 SAMPLING METHODS 29
3.4 SURVEY EFFORT 35
3.5 TAXONOMY AND NOMENCLATURE 42
3.6 STUDY TEAM AND LICENCES 42
3.7 LIMITATIONS AND CONSTRAINTS 43

4 RESULTS AND DISCUSSION **45**
4.1 FAUNA HABITAT 45
4.2 FAUNA ASSEMBLAGE 51
4.3 SIGNIFICANT FAUNA 53

5 CONCLUSIONS **77**

6 REFERENCES **79**

7 APPENDICES **85**

TABLES

Table 1: IBRA subregions within the study area. 4
Table 2: Land systems within the study area. 6
Table 3: Surface geology associated with the study area (Geoscience Australia 2012). 7
Table 4: Atlas of Australian Soil units associated with the study area (Northcote *et al*. 1960-1968). 9
Table 5: Vegetation associations of the study area. 10
Table 6: Databases queried for the desktop study. 17
Table 7: Criteria used to assess the likelihood of occurrence of significant species and communities. 17
Table 8: Summary of fauna database search results within the study area (Appendix B). 18
Table 9: Summary of literature reviewed. Green shading indicates reports included in the current consolidation. 22
Table 10: Timing of detailed and targeted fauna surveys undertaken within the study area between 2019-2024. Green shading indicates detailed fauna surveys included in the current consolidation. 28
Table 11: Survey methodologies utilised at Bonney Downs. 30
Table 12: Cumulative survey effort undertaken within the study area between 2021-2024. 36
Table 13: References used for identification. 42
Table 14: Study team and licences. 42
Table 15: Fauna survey limitations. 43
Table 16: Fauna habitats identified within the study area. 46

FIGURES

Figure 1: Climate data from Bonney Downs (rainfall) and Marble Bar (temperature). 3

MAPS

Map 1: Location of the study area and IBRA subregions. 2
Map 2: Land systems of the study area (DPIRD 2016). 12
Map 3: Surface geology (1:1,000,000) of the study area (Geoscience Australia, 2012). 13
Map 4: Atlas of Australian Soils map units associated with the study area (Northcote et al., 1960-1968). 14
Map 5: Pre-European vegetation associations (Shepherd et al., 2002). 15
Map 6: DBCA Legislated Lands and Nationally Important Wetlands near the study area. 16
Map 7: Significant fauna records within 100 km of the study area. 19
Map 8: Fortescue fauna surveys within 100 km of the study area. 26
Map 9: Location of all survey sites (consolidated survey effort). 37

Map 10: Locations of systematic trapping sites (consolidated survey effort). 38
Map 11: Locations of camera traps, cage traps and Elliott traps (consolidated survey effort).... 39
Map 12: Locations of Autonomous Recording Units (ARUs) and ghost bat lures (consolidated survey effort)..... 40
Map 13: Locations of targeted grey falcon searches (consolidated survey effort)..... 41
Map 14: Fauna habitat types identified within the study area..... 50
Map 15: Grey falcon records and critical habitat within the study area..... 56
Map 16: Northern quoll records and critical habitat within the study area..... 59
Map 17: Pilbara leaf-nosed bat and ghost bat records and roosting/foraging habitats within the study area. 62
Map 18: Priority fauna recorded within the study area. 67
Map 19: Pilbara olive python records and critical habitat within the study area. 69
Map 20: Greater bilby records and potential habitat within the study area. 72
Map 21: Potential night parrot roosting and foraging habitat within the study area..... 76

APPENDICES

Appendix A Definitions.
Appendix B Fauna database search results.
Appendix C Regional fauna records from detailed surveys within 100 km of study area.
Appendix D Bat echolocation call analysis.
Appendix E Fauna habitat assessments
Appendix F Night parrot call analysis.
Appendix G Post-survey likelihood of occurrence.

1 INTRODUCTION

1.1 PROJECT BACKGROUND

Fortescue Limited (Fortescue) is investigating decarbonisation options to achieve carbon neutrality across existing and future operations by 2030. One of the sites being considered for renewable energy generation is the Bonney Downs Wind Generation Project, which will comprise a proposed wind generation hub, along with associated transmission lines (PEC 8) running from the project area to Fortescue's Cloudbreak and Christmas Creek mines.

Detailed and targeted terrestrial vertebrate fauna surveys were completed at Bonney Downs North (three-phase detailed and two-phase targeted survey) and Bonney Downs South (two-phase detailed and targeted survey). Following the completion of the surveys, Fortescue commissioned Ecologia Environment (*ecologia*) to consolidate the results of these assessments into a single report covering the entire Bonney Downs Wind Generation Project (hereafter referred to as the "study area"). The study area comprises approximately 102,802.56 ha and is located approximately 140 km north of Newman, in the Pilbara region of Western Australia (WA) (Map 1).

1.2 SURVEY OBJECTIVES

This report consolidates results from the Bonney Downs North Terrestrial Vertebrate Fauna Assessment (ecologia, 2024a) and Bonney Downs South Terrestrial Vertebrate Fauna Assessment (Spectrum Ecology, 2024). Additional results from the first year of Bird and Bat Site Utilisation Surveys (BBSUS) were incorporated as relevant, as these surveys overlap the current study area. Consolidation of terrestrial fauna and fauna habitat mapping data associated with these reports was also undertaken as part of the current consolidation report.

1.3 LEGISLATIVE AND REGULATORY FRAMEWORK

The survey was designed and undertaken to comply with the following statutory legislation and policies (definitions can be seen in Appendix A):

- *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act);
- *Biodiversity Conservation Act* 2016 (BC Act); and
- *Environmental Protection Act* 1986 (EP Act).

The assessments complied with all necessary Environmental Protection Authority (EPA), Commonwealth and client-specific guidelines, including but not limited to:

- Technical Guidance – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (EPA, 2020);
- Environmental Protection Authority (EPA) Environmental Factor Guideline: Terrestrial Fauna (EPA, 2016);
- Survey Guidelines for Australia's Threatened Mammals (DSEWPaC, 2011a), Bats (DSEWPaC, 2010), Birds (DEWHA, 2010a), Frogs (DEWHA, 2010b) and Reptiles (DSEWPaC, 2011b);
- Guidelines for surveys to detect the presence of bilbies, and assess the importance of habitat in Western Australia (DBCA, 2017a);
- EPBC Act Referral Guideline for the Endangered Northern Quoll (Commonwealth of Australia 2016); and
- Interim Guideline for Preliminary Surveys of Night Parrot (*Pezoporus occidentalis*) in Western Australia (DBCA, 2017b).

119.3667°E
119.6°E
119.8333°E
120.0667°E
120.3°E
120.5333°E
21.1667°S
21.4°S
21.6333°S
21.8667°S
22.1°S
22.3333°S
MARBLE BAR
PIL01
PIL02
PIL02
PIL01

Study area
Ecologia - Vertebrate Fauna Assessment (2024) survey area
Stantec - Vertebrate Fauna Assessment (2024) survey area
Ecologia - Bird and Bat Utilisation Assessment (2024) survey area

IBRA 7 subregion

PIL01: Chichester
PIL02: Fortescue
State roads
Towns



ecologia ENVIRONMENT

Project No.: 2021
Author: SP
Created Date: 17 January 2025
Coordinate System: GCS GDA 1994
Scale: 1:550,000 @A3

Earthstar Geographics

Map 1: Location of the study area and IBRA subregions.

0 7 10 20 40
Kilometers

2 REGIONAL AND BIOLOGICAL CONTEXT

A review of background environmental information for the study area was conducted, including, but not limited to, climate (Bureau of Meteorology, BOM), biogeography (IBRA 7) (DSEWPaC, 2012), soil-landscape systems (land systems) (DPIRD, 2016), the Surface Geology of Australia 1:1M spatial dataset (Geoscience Australia, 2012), the Atlas of Australian Soils (Northcote et al., 1960-1968), and pre-European native vegetation of Western Australia (Shepherd, Beeston, & Hopkins, 2002).

2.1 CLIMATE

The study area is located in the Pilbara region of Western Australia (WA) and experiences an arid-tropical climate with two distinct seasons: a hot summer from October to April and a mild winter from May to September. Temperatures are generally high, with summer temperatures frequently approaching 40°C. Light frosts occasionally occur inland during the winter months of July and August. Maximum daytime temperatures frequently exceed 40°C between November and January, and minimum temperatures can drop below 14°C between June and August.

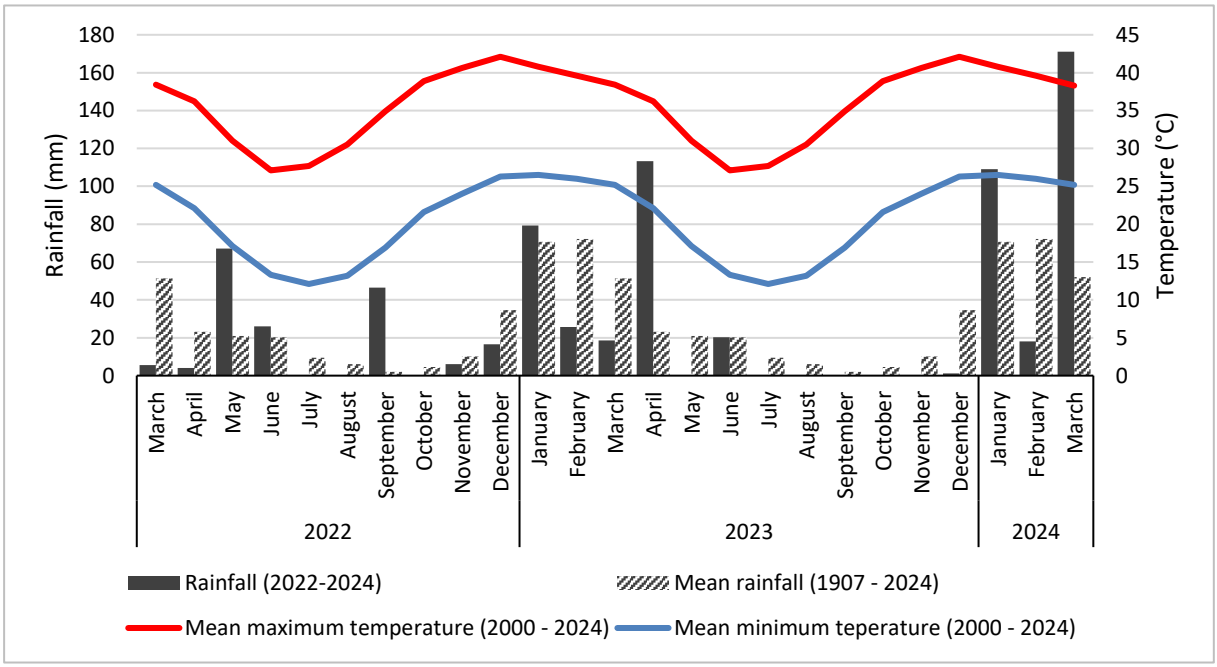


Figure 1: Climate data from Bonney Downs (rainfall) and Marble Bar (temperature).

2.2 IBRA 7 BIOREGIONS

The Interim Biogeographic Regionalisation for Australia (IBRA) classifies the Australian continent into regions or bioregions on the basis of similar geology, landform, vegetation, fauna and climate characteristics (DSEWPC, 2012). The study area is situated entirely within the Pilbara bioregion according to IBRA 7 (DSEWPC, 2012). The Pilbara region is further divided into four subregions: Hamersley (PIL03), Fortescue Plains (PIL02), Chichester (PIL01) and Roebourne (PIL04). The majority of the study area (97.83%) intersects the Chichester subregion, with a small portion (2.17%) intersecting the Fortescue Plains subregion (Map 1, Table 1).

The Chichester subregion (PIL01) comprises the northern section of the Pilbara Cration. Undulating Archaean granite and basalt plains include significant areas of basaltic ranges. Plains support a shrub steppe characterised by *Acacia inaequilatera* over *Triodia wiseana* (formerly *Triodia pungens*) hummock grasslands, while *Eucalyptus leucophloia* tree steppes occur on ranges. The climate is semi-desert-tropical and receives 300mm of rainfall annually. Drainage

occurs to the north via numerous rivers (e.g. De Grey, Oakover, Nullagine, Shaw, Yule, Sherlock). Subregional area is 9,044,560 ha (Kendrick and McKenzie 2001).

The Fortescue subregion is characterised by alluvial plains and river frontage. Extensive salt marsh, mulga-bunch grass, and short grass communities on alluvial plains in the east. Deeply incised gorge systems in the western (lower) part of the drainage. River gum woodlands fringe the drainage lines. Northern limit of mulga (*Acacia aneura*). An extensive calcrete aquifer (originating within a palaeo-drainage valley) feeds numerous permanent springs in the central Fortescue, supporting large permanent wetlands with extensive stands of river gum and cadjeput *Melaleuca* woodlands. Climatic conditions are semi desert tropical, with average rainfall of 300mm, falling mainly in summer cyclonic events. Drainage occurs to the north-west. Subregional area is 2,041,914 ha.

Table 1: IBRA subregions within the study area.

IBRA subregion	Extent within the study area (ha)	Extent within study area (%)
Chichester	100,571.08	97.83
Fortescue	2,231.47	2.17

2.3 LAND SYSTEMS

In 2016 the Department of Primary Industries and Regional Development (DPIRD) consolidated soil-landscape mapping of Western Australia from two technical reports created by the Department of Agriculture and Food (Department of Agriculture Resource Management Technical Reports RMTR No. 280 (Purdie, Tille, & Schoknecht, 2016) and RMTR No. 313 (Tille, 2006). The resulting spatial dataset, *Soil-landscape mapping covering Western Australia at the best available scale (Version 05.01)* (DPIRD, 2016), is a compilation of various surveys at different scales varying between 1:20,000 and 1:3,000,000. Mapping conforms to a nested hierarchy established to deal with the varying levels of information resulting from the variety of scales in mapping to provide soil-landscape data for all Western Australia.

Sixteen land systems are associated with the study area, with the majority (55.67%) comprised of the Rocklea Land System (Map 2, Table 2). The Rocklea Land System is characterised by basalt hills, plateaux, lower slopes and stony plains, supporting hard spinifex and scattered shrubs.

2.4 SURFACE GEOLOGY OF AUSTRALIA

The Surface Geology of Australia 1:1,000,000 scale spatial dataset is a seamless national coverage of outcrop and surficial geology (Geoscience Australia, 2012). Seventeen surface geological units are associated with the study area (Table 3, Map 3).

The Kylena Formation, a geological unit consisting of sediments derived from basalt, andesite, dacite, rhyolite and dolerite accounts for 43.21% of the study area.

2.5 ATLAS OF AUSTRALIAN SOILS

The Atlas of Australian Soils (Northcote et al., 1960-1968) was compiled by the CSIRO in the 1960's to provide a consistent national description of Australia's soils. The original maps used scales from 1:250,000 to 1:500,000. In 1991 the National Resource Information Centre used these maps to create the Digital Atlas of Australian Soils which describes over 14,000 soil units and their distribution across Australia.

Five soil types of the Atlas of Australian Soils are associated with the study area (Table 4, Map 4). The majority of the study area (71.9%) is comprised of Oa11, which is characterised by stony pediments and hills.

2.6 VEGETATION

The Western Australian Land Use and Vegetation Data Project (Shepherd et al., 2002) produced a 1:250,000 scale digital spatial dataset of the pre-European native vegetation of Western Australia, compiled from previous vegetation mapping exercises, primarily by J.S. Beard from 1964 to 1981, with updates reflecting the National Vegetation Information System (NVIS) standards. Six vegetation associations (18, 29, 82, 93, 173 and 562) are mapped within the study area (Table 5, Map 5). Most of the study area (96.86%) is comprised of vegetation association 173, characterised by *Triodia wiseana* hummock grassland and low *Eucalyptus* steppe.

The pre-European and current extent of each vegetation association is available from the Statewide Vegetation Statistics dataset (Government of Western Australia, 2018). The National Objectives and Targets for Biodiversity Conservation 2001-2005 (DEH, 2001) recognise that the retention of 30% or more of the pre-clearing extent of an ecological community is necessary if Australia's biological diversity is to be protected, as this is the threshold below which species loss appears to accelerate exponentially (EPA, 2000). Vegetation associations at less than 30% of their pre-European extent are classified as either 'Vulnerable' (10-30%) or 'Endangered' (< 10 %) (DER, 2014). The current extent of vegetation associations within the study area are all well above this 30% threshold (Table 5) and are classified as 'Least concern' (DER, 2014).

Table 2: Land systems within the study area.

Land system	Description	Extent within the survey area (ha)	Extent within survey area (%)
Bonney Land System	Low rounded hills and undulating stony plains supporting soft spinifex grasslands.	17,775.6	17.29
Capricorn Land System	Rugged sandstone hills, ridges, stony footslopes and interfluves supporting low acacia shrublands or hard spinifex grasslands with scattered shrubs.	6,299.16	6.13
Elimunna Land System	Stony plains on basalt supporting sparse acacia and cassia shrublands and patchy tussock grasslands.	292.56	0.28
Granitic Land System	Rugged granitic hills supporting shrubby hard and soft spinifex grasslands.	77.65	0.08
Jamindie Land System	Stony hardpan plains and rises supporting groved mulga shrublands, occasionally with spinifex understorey.	629.53	0.61
Laterite Land System	Low lateritic plateaux, mesas, buttes and gravelly rises and plains supporting sparse mulga shrublands.	878.33	0.85
Macroy Land System	Stony plains and occasional tor fields based on granite supporting hard and soft spinifex shrubby grasslands.	28.02	0.03
McKay Land System	Hills, ridges, plateaux remnants and breakaways of meta sedimentary and sedimentary rocks supporting hard spinifex grasslands with acacias and occasional eucalypts.	5,726.3	5.57
Newman Land System	Rugged jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands.	305.14	0.3
River Land System	Narrow, seasonally active flood plains and major river channels supporting moderately close, tall shrublands or woodlands of acacias and fringing communities of eucalypts sometimes with tussock grasses or spinifex.	498.98	0.49
Robe Land System	Low plateaux, mesas and buttes of limonite supporting soft spinifex and occasionally hard spinifex grasslands.	4,313.96	4.2
Rocklea Land System	Basalt hills, plateaux, lower slopes and minor stony plains supporting hard spinifex and occasionally soft spinifex grasslands with scattered shrubs.	57,234.89	55.67
Spearhole Land System	Gently undulating gravelly hardpan plains and dissected slopes supporting groved mulga shrublands and hard spinifex.	273.99	0.27
Talga Land System	Hills and ridges of greenstone and chert and stony plains supporting hard and soft spinifex grasslands.	557.07	0.54
Turee Land System	Stony alluvial plains with gilgaied and non-gilgaied surfaces supporting tussock grasslands and grassy shrublands of mulga and snakewood.	35.39	0.03
Wona Land System	Basalt upland gilgai plains supporting Roebourne Plains grass and Mitchell grass tussock grasslands, minor hard spinifex grasslands or annual grasslands/herbfields.	7,876.02	7.66

Table 3: Surface geology associated with the study area (Geoscience Australia 2012).

Map symbol	Surface geological unit	Description	Extent within study area (ha)	Extent within study area (%)
Abfk	Kylena Formation	Basalt, andesite, dacite, high-Mg basalt, rhyolite; basaltic agglomerate; dolerite; grey carbonate rock with microbial laminations and stromatolites; sandstone; pillow breccia; tuff, limestone, conglomerate	17,111.22	16.64
Abfm	Maddina Formation	Massive, vesicular and amygdaloidal basalt, basaltic andesite, and andesite, minor dacite, dolerite sills; bedded lapilli, vitric, crystal and lithic tuff, volcaniclastic siltstone, shale, chert, sandstone, dolomite.	44,418.97	43.21
Abfr	Mount Roe Basalt	Massive, porphyritic, vesicular, amygdaloidal and doleritic basalt; some high-Mg basalt, agglomerate, volcanic breccia, tuff, mafic wacke, shale, polymictic conglomerate and sandstone, siliceous limestone and dolomite.	3,231.11	3.14
Abke	Euro Basalt	Basalt, chert, dolerite, komatiitic basalt, komatiite, amphibolite, basaltic fragmental rock, gabbro, ultramafic to mafic schist, carbonate rock, felsic tuff, shale, sandstone, quartzite, metapyroxenite, serpentinite	1,356.79	1.32
Acg	Gorge Creek Group	Chert, ferruginous chert, banded iron formation, jaspilite; minor siltstone, shale, sandstone, pebbly sandstone, quartzite, polymictic conglomerate, felsic volcaniclastic rock, basalt, ultramafic schist, mafic schist	663.88	0.65
Agnb	Bamboo Springs Monzogranite	Coarsely K-feldspar porphyritic monzogranite with a strong synmagmatic foliation defined by aligned K-feldspar phenocrysts.	73.53	0.07
Agro	Bonney Downs Monzogranite	Monzogranite and leucomonzongranite, sparsely porphyritic and muscovite-bearing, locally abundant xenoliths of granitic gneiss and greenstone.	83.09	0.08
Anbig	Golden Eagle Orthogneiss	Layered orthogneiss derived from tonalite, granodiorite, monzogranite and pegmatite; layers and lenses of amphibolite and ultramafic schist; foliated granite, granitic gneiss, mingled metasedimentary and metavolcanic xenoliths and granite.	10.38	0.01
Awfh	Hardey Formation	Sandstone, siltstone, shale, lithic wacke, mudstone, arkose, calcareous beds, conglomerate; porphyry, porphyry breccia; quartzite; dacitic to rhyolitic lavas; quartz-feldspar-mica schist; boulder breccia; basalt; felsic pyroclastics, ultramafic lava.	5,116.60	4.98
Awfj	Jeerinah Formation	Shale, sandstone, siltstone, mudstone, dolomite, local microbanded chert, jaspilite, conglomerate; fine-grained massive rhyolite; mafic tuff with local accretionary lapilli and agglomerate; thin basalt/dolerite and andesitic basalt flows.	1,646.27	1.60
Awft	Tumbiana Formation	Pisolitic tuff, siliceous limestone and dolomite, mudstone, tuffaceous shale, siltstone, sandstone, volcaniclastic sandstone and siltstone, calcareous sandstone, local basalt and basaltic breccia, chert, local conglomerate, shale, jasper.	10,089.79	9.81

Map symbol	Surface geological unit	Description	Extent within study area (ha)	Extent within study area (%)
Awk	Kelly Group	Felsic tuffaceous sandstone, quartz sandstone, siltstone, shale, chert, banded iron formation, schist, tuff, conglomerate, rhyolite, basalt, serpentinised peridotite; local dolerite sills; intrusive porphyry and microgranite; metamorphosed.	214.80	0.21
Awu	Sulphur Springs Group	Felsic to mafic volcanics and volcaniclastic rocks, chert, volcaniclastic sandstone, greywacke, shale, basalt, komatiitic basalt, amphibolite, mafic and ultramafic schist, banded iron formation, quartz-carbonate rock, siltstone.	823.14	0.80
Czl	ferruginous duricrust 38498	Ferruginous duricrust, laterite; pisolitic, nodular, vuggy; may include massive to pisolitic ferruginous subsoil, mottled clays, magnesite, reworked products of ferruginous and siliceous duricrusts, calcrete, gossan; residual ferruginous saprolite.	279.47	0.27
Czlr	Robe Pisolite	Pisolitic, oolitic and massive limonite, minor terrigenous siliciclastic material, goethite and hematite deposits; developed along palaeodrainage lines; dissected by present day drainage.	9,649.05	9.39
Qa	alluvium 38485	Channel and flood plain alluvium; gravel, sand, silt, clay; may be locally calcreted.	306.31	0.30
Qrc	colluvium 38491	Colluvium and/or residual deposits, sheetwash, talus, scree; boulder, gravel, sand; may include minor alluvial or sand plain deposits, local calcrete and reworked laterite.	7,728.17	7.52

Table 4: Atlas of Australian Soil units associated with the study area (Northcote *et al*. 1960-1968).

Map symbol	Description	Extent within study area (ha)	Extent within study area (%)
Gf1	Steep ranges on basic lavas along with dolomites, tuff, banded iron formations, and dolerite dykes, with some narrow valley plains and high-level gently undulating areas of limited extent. The soils are generally shallow and stony and there are large areas without soil cover: chief soils are brown loams (Um6.23) along with significant areas of earthy loams (Um5.51). (Dr2.33) soils occur on lower slopes, with (Uf6.71) and (Ug5.37) on valley floors.	1,634.60	1.59
Oa11	Dissected stony pediments and hills occurring at the foot of unit Gf1; some residuals of more resistant rocks occur as mesas. On deeply dissected areas lime is released from weathering of more basic rocks: chief soils are hard alkaline red soils (Dr2.13) and other (Dr) soils. There are also shallow (Um5.51) and (Uc) soils associated with rock outcrop; some cracking clays (Ug5.37) on pediments associated with basic rocks; and some shallow calcareous loam soils (Um1.2).	73,915.56	71.90
Gf1	Steep ranges on basic lavas along with dolomites, tuff, banded iron formations, and dolerite dykes, with some narrow valley plains and high-level gently undulating areas of limited extent. The soils are generally shallow and stony and there are large areas without soil cover: chief soils are brown loams (Um6.23) along with significant areas of earthy loams (Um5.51). (Dr2.33) soils occur on lower slopes, with (Uf6.71) and (Ug5.37) on valley floors.	13,425.31	13.06
Oc70	Dissected pediments and low stony hills associated with cherts, jaspilites, and iron ore formations; much coarse surface gravel: the chief soils are hard alkaline red soils (Dr2.33) along with some (Dr2.32) and (Um5.52) soils.	11,614.81	11.30
Fb8	Plains: chief soils are deep earthy loams (Um5.52) together with some areas of clay soils (Uf6.71) and (Ug5.37)	1,663.97	1.62
Mz25	Plains associated with the Fortescue valley; there is a surface cover of stony gravels close to the ranges and hills: chief soils are acid red earths (Gn2.11) with some neutral red earths (Gn2.12); red-brown hardpan is absent. Associated are areas of calcareous earths (Gc) and loams (Um1) on calcrete (kunkar) and some hard red (Dr) soils around creek lines.	548.31	0.53

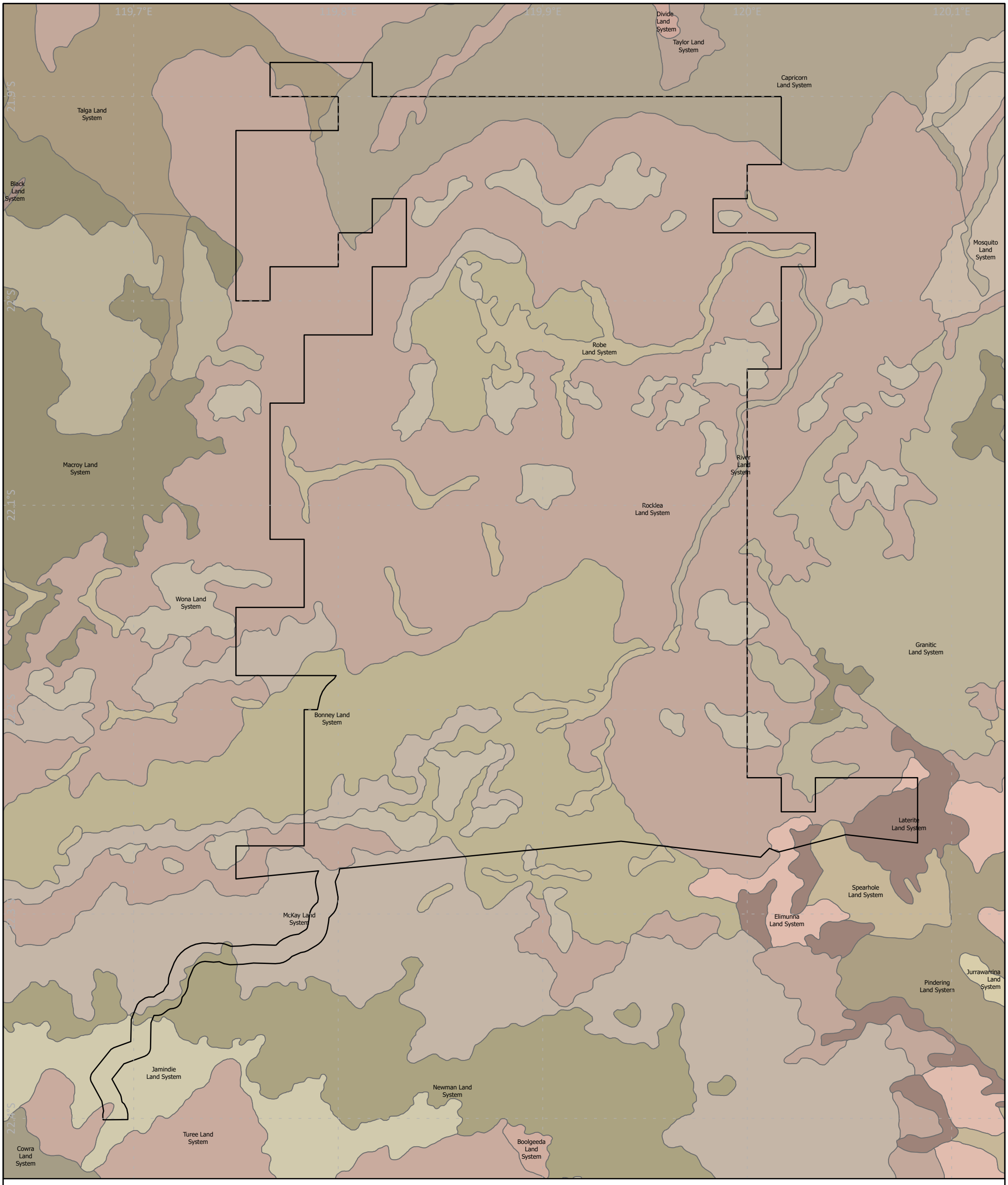
Table 5: Vegetation associations of the study area.

Shepherd et al. (2002) vegetation association	Description	Pre-European extent within Pilbara IBRA region (ha)	Percentage remaining within Pilbara IBRA region	Current percentage protected for conservation within Pilbara IBRA region	Extent within study area (ha)	Extent within study area (%)
18	Low woodland; mulga (Acacia aneura)	676,556.72	99.30	16.76	616.50	0.60
29	Sparse low woodland; mulga, discontinuous in scattered groups	1,133,219.76	99.87	1.91	736.86	0.72
82	Hummock grasslands, low tree steppe; snappy gum over *Triodia wiseana*	2,563,583.23	99.50	10.26	884.52	0.86
93	Hummock grasslands, shrub steppe; kanji over soft spinifex	3,042,114.27	99.88	0.44	17.46	0.02
173	Hummock grasslands, shrub steppe; kanji over soft spinifex & *Triodia wiseana* on basalt	1,752,520.89	99.72	7.49	99,576.62	96.86
562	Mosaic: Low woodland; mulga in valleys / Hummock grasslands, open low tree-steppe; snappy gum over Triodia wiseana	103,606.82	100.00	16.76	970.59	0.94

2.7 LAND USE, LAND TENURE, CONSERVATION RESERVES, ENVIRONMENTALLY SENSITIVE AREAS AND NATIONALLY IMPORTANT WETLANDS

The Department of Climate Change, Energy, the Environment and Water (DCCEEW) and the DBCA's legislated lands and waters database were queried for Ramsar Wetlands, Nationally Important Wetlands, and DBCA managed lands and waters occurring within the study area. The Fortescue Marsh Nationally Important Wetland occurs within a 50 km radius of the study area (Map 6).

Pastoral activities associated with Bonney Downs station along with mining tenements (numerous mines and exploration tenements) are the dominant land uses in the vicinity of the study area. Three major water courses intersect the study area including the Nullagine River, the Coongan River and Bonney Creek, with numerous permanent water bodies including Bonney Pools. Permanent and semi-permanent water sources within the study area provide important seasonal habitat for a wide range of vertebrate fauna taxa. The pastoral dam at Bonney Downs Station may be utilised for short periods of time by Migratory species as a temporary layover location; however, it does not provide long-term suitable foraging habitat for these species.



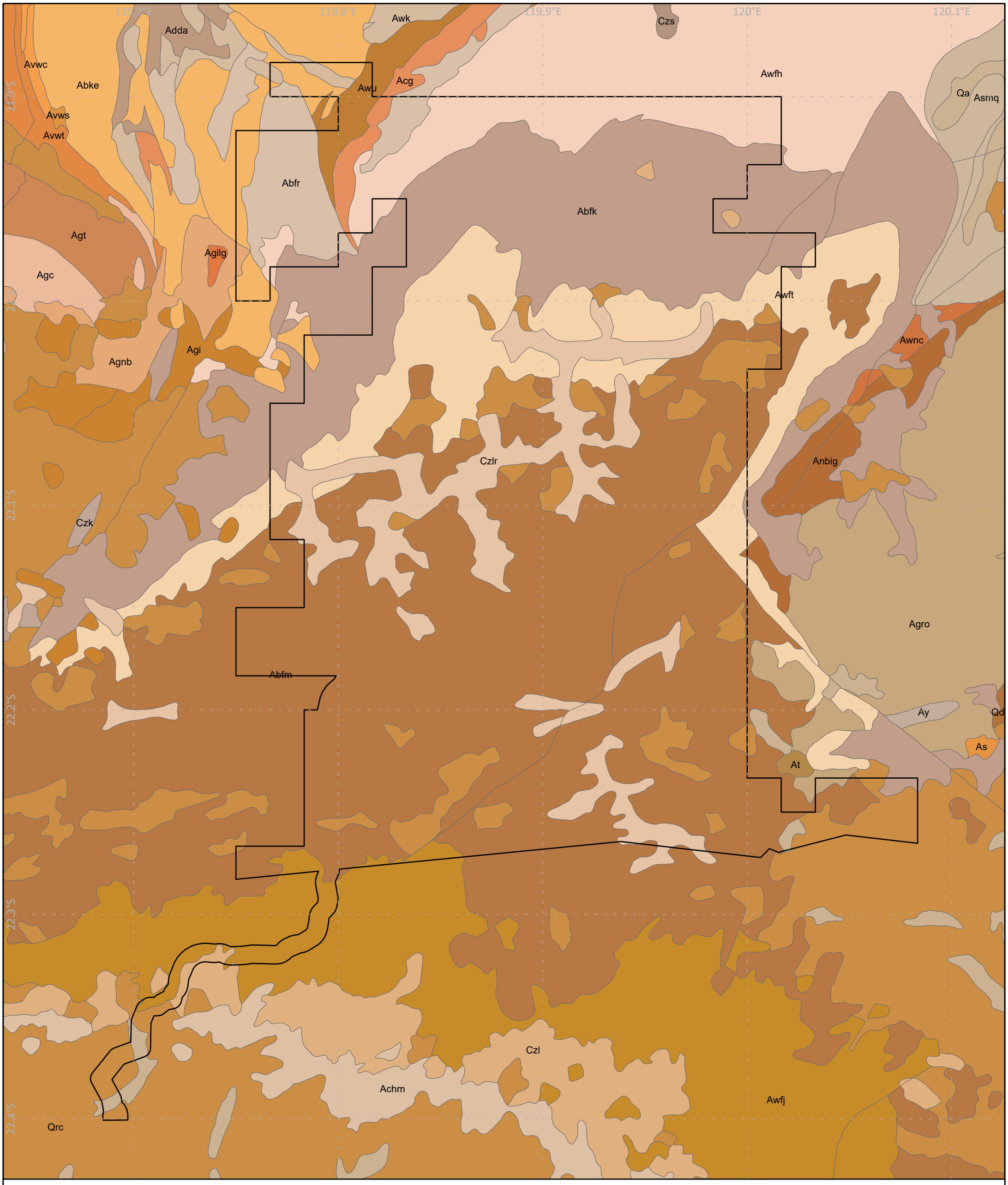
ecologia ENVIRONMENT

Project No.: 2021
Author: SP
Created Date: 2 December 2024
Coordinate System: GCS GDA 1994
Scale: 1:190,000 @A3

Map 2: Land systems of the study area (DPIRD 2016).

0 2 4 6 10 Kilometers

Earthstar Geographics



Study area

Surface geology unit

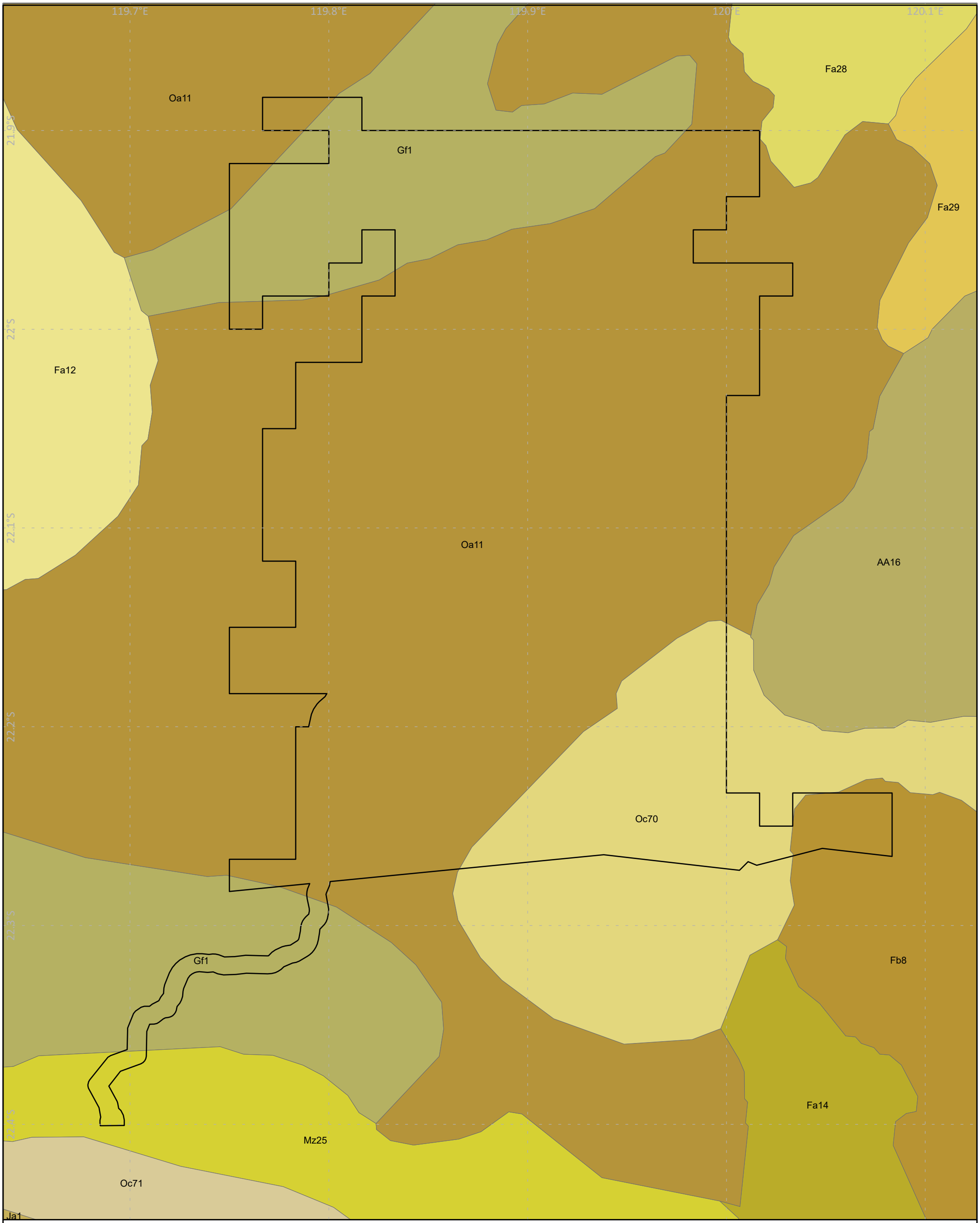
- Abfk: Kylena Formation
- Abfm: Maddina Formation
- Abfr: Mount Roe Basalt
- Abke: Euro Basalt
- Acg: Gorge Creek Group
- Achm: Marra Mamba Iron Formation
- Adda: Dalton Suite
- Agc: Callina Supersuite
- Agi: Sisters Supersuite
- Agilg: Mulgandinnah Monzogranite
- Agnb: Bamboo Springs Monzogranite
- Agro: Bonney Downs Monzogranite
- Agt: Tambina Supersuite
- Anbig: Golden Eagle Orthogneiss
- As: siliciclastic sedimentary rocks 74321
- Asmq: Mosquito Creek Formation
- At: amphibolite 74324
- Avwc: Coongan Subgroup
- Avws: Salgash Subgroup
- Avwt: Talga Talga Subgroup
- Awfh: Hardey Formation
- Awfj: Jeerinah Formation
- Awft: Tumbiana Formation
- Awk: Kelly Group
- Awnc: Coondamar Formation
- Awu: Sulphur Springs Group
- Ay: pelitic schist, quartzite 74460
- Czims: Millstream Formation
- Czk: calcrete 38497
- Czl: ferruginous duricrust 38498
- Czlr: Robe Pisolite
- Czs: sand plain 38499
- Qa: alluvium 38485
- Qd: dunes 38496
- Qrc: colluvium 38491

ecologia ENVIRONMENT

Project No.: 2021
Author: SP
Created Date: 2 December 2024
Coordinate System: GCS GDA 1994
Scale: 1:190,000 @A3

Map 2: Surface geology (1:1,000,000) of the study area (Geoscience Australia, 2012).

0 2 4 6 10 Kilometers



Study area

Soil map unit

- AA16
- Fa12
- Fa14
- Fa28
- Fa29
- Fb8
- Gf1
- Ja1
- Mz25
- Oa11
- Oc70
- Oc71

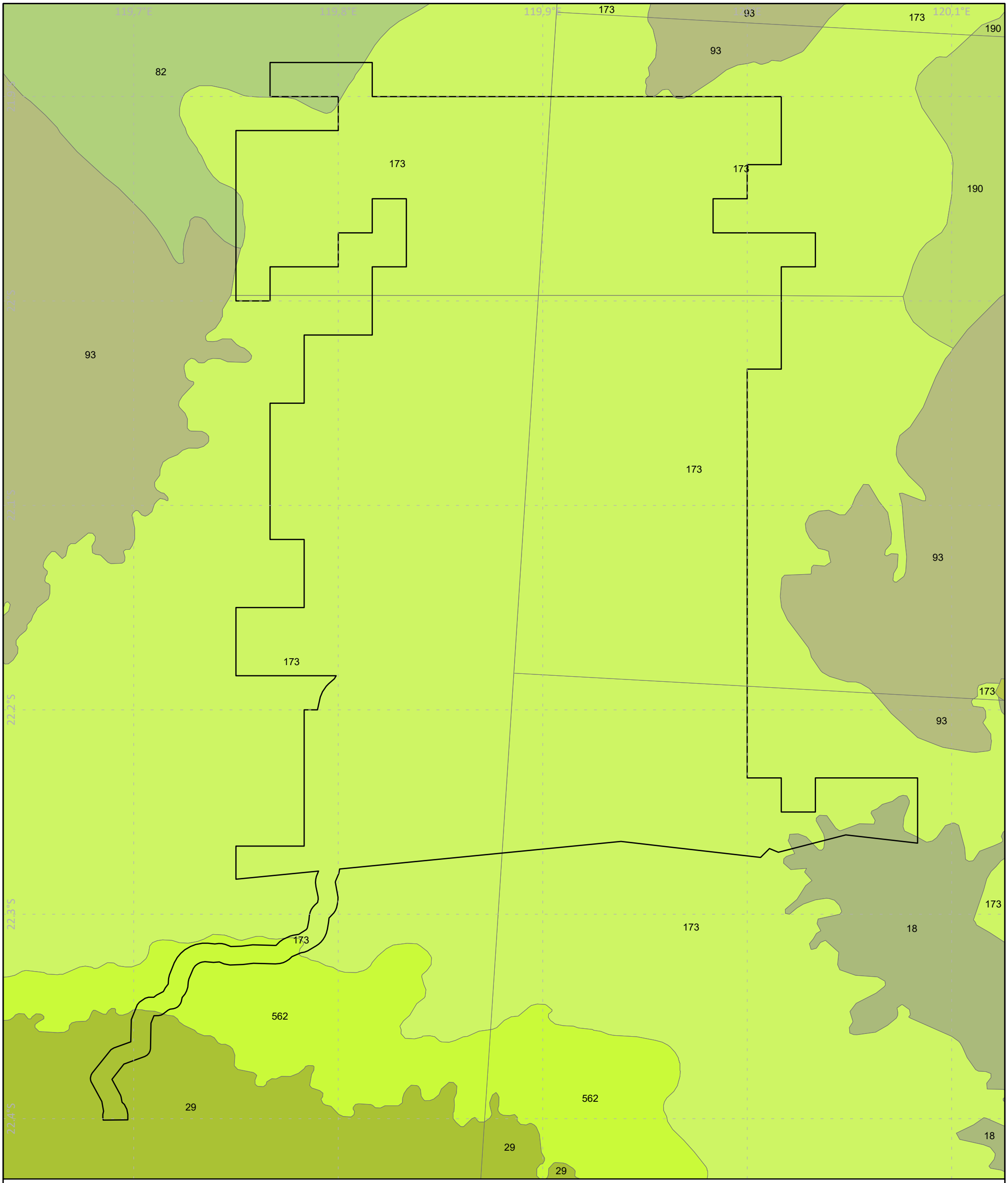
ecologia ENVIRONMENT

Project No.: 2021
Author: SP
Created Date: 2 December 2024
Coordinate System: GCS GDA 1994
Scale: 1:190,000 @A3

Map 4: Atlas of Australian Soils map units associated with the study area (Northcote et al., 1960-1968).

0 2 4 6 10 Kilometers

Earthstar Geographics



Study area

Vegetation association

- 18: Low woodland; mulga (Acacia aneura)
- 29: Sparse low woodland; mulga, discontinuous in scattered groups
- 82: Hummock grasslands, low tree steppe; snappy gum over Triodia wiseana
- 93: Hummock grasslands, shrub steppe; kanji over soft spinifex
- 111: Hummock grasslands, shrub steppe; Eucalyptus gamophylla over hard spinifex
- 173: Hummock grasslands, shrub steppe; kanji over soft spinifex & Triodia wiseana on basalt
- 190: Hummock grasslands, sparse shrub steppe; Acacia bivenosa & A. trachycarpa over hard spinifex, Triodia wiseana, Very poor rocky country on gneiss
- 562: Mosaic: Low woodland; mulga in valleys / Hummock grasslands, open low tree-steppe; snappy gum over Triodia wiseana

ecologia ENVIRONMENT

Project No.: 2021
Author: SP
Created Date: 2 December 2024
Coordinate System: GCS GDA 1994
Scale: 1:190,000 @A3

Map 5: Pre-European vegetation associations of the study area (Shepherd et al., 2002).

0 2 4 6 10 Kilometers

118.6667°E
119.25°E
119.8333°E
120.4167°E
21.1667°S
21.75°S
22.3333°S
22.9167°S
23.5°S
24.0833°S

Mungaroona Range Nature Reserve
Karijinni (Hamersley Range) Gorges
Fortescue Marshes
Mt Bruce Coolibah - Lignum Flats
Karijini National Park
Lake Disappointment (Savory Creek) System

Study area
40km buffer

Nationally Important Wetlands
- Fortescue Marshes
- Karijinni (Hamersley Range) Gorges
- Lake Disappointment (Savory Creek) System
- Mt Bruce Coolibah - Lignum Flats

DBCA managed lands and waters
- Un-named
- Karijini National Park
- Mungaroona Range Nature Reserve

Environmentally sensitive area
- Un-named ESA

ecologia ENVIRONMENT

Project No.: 2021
Author: SP
Created Date: 2 December 2024
Coordinate System: GCS GDA 1994
Scale: 1:1,130,000 @A3

Map 6: DBCA Legislated Lands and Waters, Nationally Important Wetlands and Environmentally Sensitive Areas near the study area.

Earthstar Geographics

0 10 30 40 80 Kilometers

N

2.8 DESKTOP ASSESSMENT

The methodology adopted for the desktop assessment was in accordance with the Technical Guidance – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (EPA, 2020). Searches of the databases listed in Table 6 along with a review of relevant survey data was undertaken to identify vertebrate fauna and significant species previously recorded within 40 kilometres (km) of the study area (the "study area"). As DBCA and Fortescue database search buffers are determined based on the availability of significant fauna records in the local area, the buffers utilised for these databases (100 km) differs to those applied for other databases. Habitat preferences were sourced, where available, from relevant taxonomic literature or Threatened Species Profiles (SPRATs). The presence of potentially suitable habitat within the study area was determined using broad landforms, soils, and vegetation associations in comparison to cited preferred habitat (if available) for each species.

Table 6: Databases queried for the desktop study.

Database	Search details
DCCEEW Protected Matters Database	Records of matters of national significance under the EPBC Act within 40 km of the study area.
DBCA Threatened and Priority Fauna Database	Fauna records within 100 km of the study area
BirdLife Australia's Birdata Database	All bird records within 40 km of the study area.
Atlas of Living Australia (ALA) Database	All fauna records within 40 km of the study area.
Index of Biodiversity Surveys for Assessments (IBSA) Database	All IBSA vertebrate fauna surveys within 100 km of the study area.
Fortescue Internal Fauna Databases	All fauna records within 40 km of the study area.

Results of database searches and the literature review were compiled, and significant species were identified. The criteria listed in Table 7 were then applied to determine the likelihood of occurrence of these species within the study area. Additional consideration was given to the age and locality of the record, recent taxonomic species revisions and modelled species distributions.

Table 7: Criteria used to assess the likelihood of occurrence of significant species and communities.

Rating	Criterion
Recorded	The species has been recorded within the study area previously or during the current survey.
High (likely to occur)	The species is likely to occur within the study area as suitable habitat is known to be present and there are existing records very close to the study area (within ca. 5-15 km, depending on species mobility).
Moderate (possibly occurs)	The species may occur within the study area as there are existing records in the vicinity of the study area, and suitable habitat is likely to be present; OR The species may occur within the study area as there is insufficient information available to exclude the possibility of occurrence.
Low (unlikely to occur)	The species is unlikely to occur within the study area as suitable habitat is not present or is not likely to be present; OR Suitable habitat is present within the study area, but the taxon has not been recorded despite reasonable survey effort.
Does not occur	The species is recognised as being locally extinct or extinct in the wild and does not occur within the study area; OR Records identified through database searches are associated with a listed subspecies which does not occur within the region.

2.8.1 Database Searches

According to database searches, 305 fauna species have the potential to occur within 40 km of the study area, comprising 30 mammals (three introduced), 178 birds, 89 reptiles and eight amphibians (Appendix B). A summary outlining the results of database searches within the study area can be seen in Table 8 and a regional species summary table outlining the faunal assemblages recorded during detailed fauna surveys in the vicinity of the study area is provided in Appendix C.

Table 8: Summary of fauna database search results within the study area (Appendix B).

Database	Mammals	Birds	Reptiles	Amphibians	Fish
Atlas of Living Australia (ALA)	25 (3)	161	86	8	0
DBCA Threatened and Priority Fauna Search	8	13	3	0	0
Fortescue Significant Fauna Databases	5	12	1	0	0
Birdlife Australia Birdata	0	149	0	0	0
DCCEEW Protected Matters Search	4	18	1	0	0

2.8.2 Significant Fauna

DBCA Threatened and Priority fauna and Fortescue internal database search results identified 34 significant species comprising 21 birds, 10 mammals and three reptiles occurring within 100 km of the study area (Map 7). To accord with DBCA's decision to redact night parrot records from Threatened and Priority database search extracts, both records of the night parrot have been excluded from spatial mapping associated with this report.

DBCA database search results identified records of two species which represent likely taxonomic misidentifications. Two records of the crest-tailed mulgara (*Dasycercus cristicauda,* Priority 4) and two historical records of the barking owl (southwest subpop.) (*Ninox connivens connivens*, Priority 3) are associated with species which do not occur within the region and are instead considered to represent records of the brush-tailed mulgara (*Dasycercus blythi*, Priority 4) and the barking owl (*Ninox connivens peninsularis*, unlisted) respectively.

The EPBC Act Protected Matters Report identified four additional species (great desert skink, red goshawk, curlew sandpiper and yellow wagtail) with the potential to occur within the study area (Appendix B). Species listed as Marine under the EPBC Act have been excluded from the significant fauna likelihood of occurrence assessment as the study area does not encompass marine habitats and these species are generally common and widespread.

119°E
119.5°E
120°E
120.5°E
121°E
21°S
21.5°S
22°S
22.5°S
23°S

Study area
Survey area

DBCA database

EPBC: Endangered
- Northern quoll
- Australian painted snipe

EPBC: Endangered & Migratory
- Southern giant petrel
- Common greenshank

EPBC: Vulnerable
- Greater bilby
- Ghost bat
- Pilbara olive python
- Pilbara leaf-nosed bat
- Grey falcon

EPBC: Vulnerable; Priority 4
- Princess parrot

EPBC: Vulnerable & Migratory
- Sharp-tailed sandpiper

Priority 1
- Gane's blind snake
- Pin-striped finesnout Ctenotus

Priority 3
- Barking owl (southwest subpopulation)

Priority 4
- Western pebble-mound mouse
- Brush-tailed mulgara
- Crest-tailed mulgara
- Mulgara
- Spectacled hare-wallaby (mainland)
- Northern short-tailed mouse
- Sminthopsis longicaudata

EPBC: Migratory
- Fork-tailed swift
- Common sandpiper
- Red-necked stint
- Oriental plover
- Gull-billed tern
- Caspian tern
- Grey wagtail
- Osprey
- Glossy ibis
- Wood sandpiper
- Marsh sandpiper

BC: Other Specially Protected
- Peregrine falcon

FMG database

EPBC: Endangered
- Northern quoll

EPBC: Vulnerable
- Grey falcon
- Ghost Bat
- Pilbara Olive Python
- Pilbara Leaf-nosed bat
- Greater Bilby

EPBC: Endangered & Migratory
- Common Greenshank

EPBC: Vulnerable & Migratory
- Sharp-tailed Sandpiper

Priority 1
- Gane's blind snake

Priority 4
- Western pebble-mound mouse
- Long-tailed Dunnart
- Brush-tailed mulgara
- Northern short-tailed mouse

EPBC: Migratory
- Caspian Tern
- Wood Sandpiper
- Common Sandpiper
- Oriental Plover
- Red-necked Stint
- Gull-billed Tern
- Fork-tailed Swift
- Glossy Ibis

BC: Other Specially Protected
- Peregrine falcon

ecologia ENVIRONMENT

Project No.: 2021
Author: DS
Created Date: 11 December 2024
Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Scale: 1:900,000 @A3

Earthstar Geographics

Map 7: Significant fauna records within 100 km of the study area.

0 8 20 30 50 Kilometers

2.8.3 Literature Review

The literature review identified nine multi-phase detailed vertebrate fauna assessments, nine single-phase detailed fauna surveys, 13 targeted fauna surveys, five significant fauna monitoring programs, one bat and bird site utilisation survey and three basic fauna surveys undertaken within 100 km of the study area (Table 9). Of the literature reviewed, two basic fauna and fauna habitat assessments, three significant fauna monitoring programs, one bat and bird site utilisation survey (BBSUS), three single-phase detailed and targeted surveys and two multi-phase detailed and targeted surveys were found to intersect the current study area. Both basic fauna surveys and all three single-phase detailed fauna assessments intersecting the study area were completed >10 years ago and are considered outdated for the purposes of environmental impact assessment (Table 9). These reports will not be discussed as part of the current consolidation. Locations of fauna surveys commissioned by Fortescue within 100 km of the study area are shown in Map 8.

Key findings associated with reports which were available at the time of the consolidation are outlined in Table 9, with a list of regional fauna records, including updated species names to align with the current Western Australian Museum (WAM) checklist of terrestrial vertebrates, provided in Appendix C. Asterixis indicate surveys for which the survey report and/or a comprehensive species list were unavailable at the time of the consolidation.

Multi-phase detailed fauna assessments:

- Bonney Downs North: Terrestrial Vertebrate Fauna Assessment (ecologia, 2024a);
- Bonney Downs South: Terrestrial Vertebrate Fauna Assessment (Spectrum Ecology, 2024);
- Corunna Downs Project: Terrestrial Vertebrate Fauna Survey (Stantec, 2016);
- East Hamersley Rail Terrestrial Vertebrate Fauna Assessment (*ecologia*, 2024c);
- McPhee Creek: Consolidated Terrestrial Fauna Report (Biologic, 2021);
- Mindy South: Detailed and Targeted Terrestrial Vertebrate Fauna Baseline Survey (Stantec, 2024);
- Nyidinghu Iron Ore Project Detailed Terrestrial Fauna Survey (360 Environmental, 2023);
- Nyidinghu Mine Terrestrial Vertebrate Fauna Assessment (*ecologia*, 2024d); and
- Roy Hill Iron Ore Project, Level 2 Terrestrial Vertebrate Fauna Survey (ecologia, 2009).

Single-phase detailed fauna assessments:

- Adele Flora, Fauna and SRE Survey (360 Environmental, 2021);
- Bonney Downs Rail Alignment Vertebrate Fauna Survey (Phoenix, 2011)*;
- Christmas Creek Terrestrial Vertebrate Fauna and Fauna Habitat Assessment (ENV Australia, 2012);
- Cloudbreak Level 2 Terrestrial Vertebrate Fauna Assessment (ecologia, 2011);
- Fauna Assessment - Nyidinghu Iron Ore Project (Bamford Consulting Ecologists, 2012a);
- Fauna Survey of the Proposed Iron Ore Mine, Cloud Break (Bamford Consulting Ecologists, 2005)*;
- FMG Stage A Rail Corridor Fauna Assemblage (Biota Environmental Sciences, 2004)*;
- FMG Stage B Rail (Biota Environmental Sciences, 2005)*; and
- Kutayi Project Vertebrate Fauna Survey (Spectrum Ecology, 2020)*.

Targeted significant fauna surveys:

- Adele West Targeted Flora and Fauna Survey (360 Environmental, 2022);
- Fortescue Marsh Migratory Shorebird and Waterbird Survey (Spectrum Ecology, 2022b);
- Fortescue Marsh Tenement E46/684 Level 1 Targeted Vertebrate Fauna Survey (Biologic Environmental, 2014);

- Fortescue Metals Group Cloudbreak Expansion Project - Pre Clearance Night Parrot Survey (Outback Ecology, 2013);
- Migratory Bird Habitat Survey of the Fortescue Marsh (Bennelongia Environmental Consultants, 2018);
- Night Parrot surveys at Fortescue Marsh, Western Australia: Habitat Analyses, Survey Review and Recommendations (Adaptive NRM, 2017);
- Nyidinghu Rail - Terrestrial Vertebrate Fauna and Fauna Habitat Assessment (Bamford Consulting Ecologists, 2012b);
- Roy Hill Mine and Southern Borefields Targeted Fauna Survey (Biologic, 2017a);
- Roy Hill Level 1 Targeted Vertebrate Fauna Assessment Updated (Biologic, 2018);
- Targeted Fauna Assessment of the Rail Duplication (Bamford Consulting Ecologists, 2010);
- Vegetation and Fauna Habitat Mapping of the Northern Tenement Area, Cloudbreak (Ecoscape Australia, 2016);
- Warrawoona Gold Project: VHF Bat Foraging Studies (Biologic, 2019b); and
- Warrawoona Gold Project: 2019 Significant Species Survey (Biologic, 2019a).

Significant fauna monitoring:

- Fortescue Metals Group: Annual Fauna Monitoring Program 2021 (Spectrum Ecology, 2021);
- Fortescue Metals Group: Annual Fauna Monitoring Program 2022 – Operational Sites, Nullagine and North Star (Spectrum Ecology, 2022a);
- Fortescue Metals Group: Annual Fauna Monitoring Program 2023 – Operational Sites, Nullagine and North Star (Spectrum Ecology, 2023a);
- Nyidinghu Project: Baseline Significant Fauna Monitoring (Spectrum Ecology, 2023b); and
- Fortescue Night Parrot Monitoring Procedure and Program (Adaptive NRM, 2021).

Bat and Bird Site Utilisation Surveys:

- Bonney Downs Wind Farm: Bird and Bat Site Utilisation Report -Year 1 (ecologia, 2024b).

Basic fauna and fauna habitat assessment:

- BC Iron Nullagine Project Extension Areas – Bonnie East, Warrigal North and Coongan: Assessment of Fauna Values (Bamford, 2013);
- Bonney Downs Alignment Level 1 Fauna Survey (Phoenix Environmental Sciences, 2011)*; and
- Ministers North to Yandi Corridor: Single Phase Level 2 Fauna and Detailed Flora/Vegetation Survey (Biologic, 2017b).

Table 9: Summary of literature reviewed. Green shading indicates reports included in the current consolidation.

Survey details	Proximity to study area	Mammals (introduced)	Birds	Reptiles	Amphibians	Fish	Significant fauna recorded
Single-phase detailed fauna survey							
Adele Flora, Fauna and SRE Survey (360 Environmental, 2021)	20 km	12 (2)	31	19	0	0	Western pebble-mound mouse.
Bonney Downs Rail Alignment Vertebrate Fauna Survey (Phoenix, 2011)	**Intersects**	17 (5)	62	46	4	0	Significant fauna assemblages not available.
Cloudbreak Level 2 Terrestrial Vertebrate Fauna Assessment (ecologia Environment, 2011)	<5 km	7	55	41	1	0	Western pebble-mound mouse.
Christmas Creek Terrestrial Vertebrate Fauna and Fauna Habitat Assessment (ENV Australia, 2012)	**Intersects**	12 (2)	61	45	3	0	Pilbara olive python.
Fauna Assessment - Nyidinghu Iron Ore Project (Bamford Consulting, 2012)	40 km	20 (3)	83	52	2	0	Fork-tailed swift, peregrine falcon, Pilbara olive python.
Fauna Survey of the Proposed Iron Ore Mine, Cloud Break (Bamford Consulting Ecologists, 2005)	<5 km	22 (5)	90	28	2	0	Significant fauna assemblages not available.
FMG Stage A Rail Corridor Fauna Assemblage (Biota Environmental Sciences, 2004)	<40 km	24 (5)	84	55	6	0	Significant fauna assemblages not available.
FMG Stage B Rail (Biota Environmental Sciences, 2005)	**Intersects**	22 (6)	103	42	6	0	Significant fauna assemblages not available.
Kutayi Project - Vertebrate Fauna Survey (Spectrum Ecology, 2020)	20 km	26 (5)	88	50	1	0	Significant fauna assemblages not available.
Multi-phase detailed fauna survey							
Bonney Downs North: Terrestrial Vertebrate Fauna Assessment (ecologia, in. prep.)	**Intersects**	**30 (3)**	**86**	**69**	**4**	**2**	**Northern quoll, Pilbara leaf-nosed bat, grey falcon, ghost bat, Pilbara olive python, western pebble-mound mouse, short-tailed mouse and Gane's blind snake.**
Bonney Downs South: Terrestrial Vertebrate Fauna Assessment (Spectrum Ecology, in. prep.)	**Intersects**	**25 (4)**	**96**	**58**	**2**	**0**	**Northern quoll, grey falcon, Pilbara leaf-nosed bat, brush-tailed mulgara, short-tailed mouse, western pebble-mound mouse.**

Survey details	Proximity to study area	Mammals (introduced)	Birds	Reptiles	Amphibians	Fish	Significant fauna recorded
Corunna Downs Project: Terrestrial Vertebrate Fauna Survey (Stantec, 2016)	Adjacent	32 (4)	72	66	4	0	Northern quoll, Pilbara leaf-nosed bat, ghost bat, Pilbara olive python, peregrine falcon, spectacled hare-wallaby, western pebble-mound mouse
East Hamersley Rail Terrestrial Vertebrate Fauna Assessment (ecologia, 2023)	40 km	29 (5)	36	54	1	0	Grey falcon, northern quoll, ghost bat, western pebble-mound mouse, greater bilby, brush-tailed mulgara, fork-tailed swift, Gane's blind snake, grey wagtail, gull-billed tern, eastern osprey
McPhee Creek: Consolidated Terrestrial Fauna Report (Biologic, 2021)	<50 km	31 (5)	70	60	3	0	Northern quoll, greater bilby, Pilbara leaf-nosed bat, ghost bat, long-tailed dunnart, western pebble-mound mouse, fork-tailed swift, Pilbara olive python
Mindy South: Detailed and Targeted Terrestrial Vertebrate Fauna Baseline Survey (Stantec, 2024)	50 km	33 (6)	89 (1)	70	2	0	Northern quoll, Pilbara leaf-nosed bat, ghost bat, Caspian tern and western pebble mound mouse.
Nyidinghu Iron Ore Project Detailed Terrestrial Fauna Survey (360 Environmental, 2023)	20 km	31 (6)	75	57	1	1	Gane's blind snake, ghost bat, Pilbara leaf-nosed bat, western pebble-mound mouse.
Nyidinghu Mine Terrestrial Vertebrate Fauna Assessment (ecologia, 2023)	<15 km	29 (5)	66	43	0	1	Grey falcon, western pebble-mound mouse, Pilbara leaf-nosed bat, Gane's blind snake, night parrot, fork-tailed swift, peregrine falcon, Caspian tern, Australian painted snipe, greater bilby and eastern osprey.
Roy Hill Iron Ore Project, Level 2 Terrestrial Vertebrate Fauna Survey (ecologia, 2009)	<20 km	22 (8)	75	48	3	0	Ghost bat, peregrine falcon, grey falcon, wood sandpiper and western pebble-mound mouse.
Targeted fauna survey							
Adele West Targeted Flora and Fauna Survey (360 Environmental, 2022)	20 km	11 (2)	31	8	0	0	Northern quoll, western pebble-mound mouse.
Fortescue Marsh Migratory Shorebird and Waterbird Survey (Spectrum, 2022)	<10 km	0	38	0	0	0	Gull-billed tern, Caspian tern, sharp-tailed sandpiper, common greenshank, glossy ibis.
Fortescue Marsh Tenement E46/684 Level 1 Targeted Vertebrate Fauna Survey (Biologic, 2014)	<10 km	15 (5)	18	3	0	0	No significant fauna recorded.
Fortescue Metals Group Cloudbreak Expansion Project – Pre-Clearance Night Parrot Survey (Outback Ecology, 2013)	10 km	5 (3)	72	3	3	0	No significant fauna recorded.

Survey details	Proximity to study area	Mammals (introduced)	Birds	Reptiles	Amphibians	Fish	Significant fauna recorded
Migratory Bird Habitat Survey of the Fortescue Marsh (Bennelongia Environmental Consultants, 2018)	<10 km	0	35	0	0	0	Gull-billed tern, Caspian tern, sharp-tailed sandpiper, common greenshank, marsh sandpiper, glossy ibis.
Night Parrot surveys at Fortescue Marsh, Western Australia: Habitat analyses, survey review and recommendations (Adaptive NRM, 2017)	<10 km	0	0	0	0	0	No significant fauna recorded.
Nyidinghu Rail - Terrestrial Vertebrate Fauna and Fauna Habitat Assessment (Bamford, 2012)	40 km	7 (4)	49	5	0	0	Western pebble-mound mouse.
Roy Hill Level 1 Targeted Vertebrate Fauna Assessment Updated (Biologic, 2018)	<20 km	6	2	0	0	0	Northern quoll, greater bilby, ghost bat, peregrine falcon, brush-tailed mulgara, western pebble-mound mouse, grey falcon.
Roy Hill Mine and Southern Borefields Targeted Fauna Survey (Biologic, 2020)	<20 km	1	0	0	0	0	Brush-tailed mulgara
Targeted Fauna Assessment of the Rail Duplication (Bamford Consulting, 2010)	<30 km	5	25	2	0	0	Greater bilby, brush-tailed mulgara, western pebble-mound mouse.
Warrawoona Gold Project: 2019 Significant Species Survey (Biologic, 2019)	> 50 km	2	20	1	0	0	Northern quoll, olive python, brush-tailed mulgara
Warrawoona Gold Project: VHF Bat Foraging Studies (Biologic, 2019)	>50 km	2	0	0	0	0	Pilbara leaf-nosed bat, ghost bat
Vegetation and Fauna Habitat Mapping of the Northern Tenement Area, Cloudbreak (Ecoscape, 2016)	<40 km	10 (2)	12	1	0	0	Ghost bat, northern quoll, Pilbara leaf-nosed bat, western pebble-mound mouse.
Basic fauna and fauna habitat assessment							
BC Iron Nullagine Project Extension Areas – Bonnie East, Warrigal North and Coongan: Assessment of Fauna Values (Bamford, 2013)	**Intersects**	2	8	1	1	0	Australian painted snipe, northern quoll, Pilbara leaf-nosed bat, grey falcon, western pebble-mound mouse, Pilbara olive python
Bonney Downs Alignment: Level 1 Fauna Survey (Phoenix Environmental Sciences, 2011)	**Intersects**	3 (2)	38	17	0	0	Significant fauna assemblages not available.
Ministers North to Yandi Corridor: Single Phase Level 2 Fauna and Detailed Flora/Vegetation Survey (Biologic, 2017)	>50 km	14 (1)	35	10	0	0	Western pebble-mound mouse.

Survey details	Proximity to study area	Mammals (introduced)	Birds	Reptiles	Amphibians	Fish	Significant fauna recorded
Fauna monitoring							
Fortescue Night Parrot Monitoring Procedure and Program (Adaptive NRM, 2021)	<10 km	0	1	0	0	0	Night parrot.
Nyidinghu Project: Baseline Significant Fauna Monitoring (Spectrum Ecology, 2023)	20 km	2 (1)	1	0	0	0	Night parrot, northern quoll.
Fortescue Metals Group: Annual Fauna Monitoring Program 2021 (Spectrum Ecology, 2021)	**Intersects**	**1**	**0**	**0**	**0**	**0**	**Northern quoll**
Fortescue Metals Group: Annual Fauna Monitoring Program 2022 – Operational Sites, Nullagine and North Star (Spectrum Ecology, 2022a)	**Intersects**	**1**	**0**	**0**	**0**	**0**	**Northern quoll**
Fortescue Metals Group: Annual Fauna Monitoring Program 2023 – Operational Sites, Nullagine and North Star (Spectrum Ecology, 2023a)	**Intersects**	**1**	**0**	**0**	**0**	**0**	**Northern quoll**
Bat and Bird Site Utilisation Surveys							
Bonney Downs Wind Farm: Bird and Bat Site Utilisation Report - Year 1 (ecologia, 2024b)	**Intersects**	**10**	**108**	**0**	**0**	**0**	**Grey falcon, Pilbara leaf-nosed bat.**

119°E 119,5°E 120°E 120,5°E 121°E

21°S 21,5°S 22°S 22,5°S 23°S

Study area
100km buffer

Level 1 Basic Assessment
- Christmas Creek Terrestrial Vertebrate Fauna Desktop Assessment
- Fauna Assessment, Cloud Break Airstrip, Camp and Access Road
- 11024 Christmas Creek Airstrip Flora, Vegetation & Fauna Assessment
- Solomon Project – Rail Camp Sites 1, 2 and 3, Fauna Assessment

Targeted Survey
- Fortescue Marsh Migratory Shorebird and Waterbird Survey
- Kutayi Project Targeted Night Parrot and Greater Bilby Survey
- Pilbara Transmission Project Targeted Flora and Fauna Survey
- Pre-clearance Greater Bilby and Mulgara Survey
- Targeted Surveys – Northern Quolls, Mulgara and Pilbara Olive Python
- Cloudbreak Expansion Project – Pre-clearance Night Parrot Survey
- Fauna Assessment of the Yandeyarra Area
- Vegetation and Fauna Habitat Mapping of the Northern Tenement Area, Cloudbreak
- Christmas Creek Exploration Drilling Program, Targeted Flora and Fauna Habitat Assessments Survey Report

Single-phase Detailed Survey
- Cloudbreak Level 2 Terrestrial Vertebrate Fauna Assessment
- Fauna Assessment Nyidinghu Iron Ore Project
- Christmas Creek Terrestrial Vertebrate Fauna and Fauna Habitat Assessment
- Fig Tree, Terrestrial Vertebrate Fauna Assessment

Multi-phase Detailed Survey
- Fauna Assessment of the BC Iron Nullagine Iron Ore Project
- Kutayi Project – Vertebrate Fauna Survey
- Fauna Habitats of the Proposed FMG Stage B Rail Corridor & Mindy Mindy, CC, Mt Lewin & Mt Nicholas
- Kutayi Level 2 Vertebrate Fauna Assessment
- Nyidinghu Iron Ore Project: Detailed Terrestrial Fauna Survey
- Nyidinghu Mine Terrestrial Vertebrate Fauna Assessment
- East Hamersley Rail Terrestrial Vertebrate Fauna Assessment
- Mindy South: Detailed and and Targeted Terrestrial Vertebrate Fauna Baseline Survey

ecologia ENVIRONMENT

Project No.: 2021
Author: SP
Created Date: 9 December 2024
Coordinate System: GCS GDA 1994
Scale: 1:1,001,978 @A3

Map 8: Fortescue fauna surveys within 100km of the study area.

0 10 20 30 70 Kilometers

Earthstar Geographics

3 METHODOLOGY

3.1 SURVEY TIMING

The timing of two detailed fauna assessments and four fauna monitoring surveys undertaken within the study area in the past five years (2019-2024) are summarised in Table 10. A discussion of methodologies, survey timing, sampling effort and limitations associated with these reports is provided below. The current consolidation only considers surveys completed since 2019, as work completed more than five years ago is not considered relevant for Environmental Impact Assessment purposes. Additionally, surveys which only partially intersect the current study area were not included if they included few or no sampling sites within the study area, or if it was unclear whether sampling was undertaken within the study area.

3.1.1 Detailed Vertebrate Fauna Assessment

Both detailed fauna surveys included at least one survey phase undertaken within the optimal survey window (March-May) as defined by *Technical Guidelines: Terrestrial Vertebrate Fauna* (EPA, 2016). Additionally, both detailed surveys also include at least one survey phase within the optimal survey window for reptiles (September-April) as specified in the *Technical Guidance – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (EPA, 2020).

Spectrum noted that higher-than-average rainfall was recorded in the 12-month period preceding both survey phases, with significant rainfall recorded between January and March 2024 (291 mm) (Spectrum Ecology, 2024). *ecologia* also noted higher-than-average rainfall prior to phase one survey commencement, with significant rainfall recorded in the three months prior to the phase 1 and phase 3 surveys (157.5 mm and 248.2 mm respectively). All surveys included in this consolidation had significant rainfall events immediately prior to (or during) at least one survey phase and are considered to have been undertaken during the optimal survey window for amphibian and bird surveys, as per EPA (2020).

The EPA guidelines do not stipulate an optimal timing for mammal surveys, therefore all surveys included in this consolidation are considered to be in compliance with the *Technical Guidance – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (EPA, 2020).

3.1.2 Targeted Surveys and Significant Fauna Monitoring

Targeted northern quoll surveys included in the current consolidation were completed between May – August, in accordance with the optimal timing outlined in the EPBC Act *Referral Guideline for the Endangered Northern Quoll Dasyurus hallucatus* (Commonwealth of Australia, 2016). Annual monitoring of the northern quoll was undertaken at Nullagine between 2016-2023 in accordance with the northern quoll referral guidelines (Commonwealth of Australia, 2016) and Fortescue's NQMMP.

Targeted night parrot surveys included in the current consolidation were undertaken prior to the publication of the recent *Guidelines for Determining the Likely Presence and Habitat Usage of Night Parrot (Pezoporus occidentalis) in Western Australia* (DBCA, 2024). Night parrot surveys were undertaken in the months following significant rainfall events for both surveys included in this consolidation, which accords with the interim survey guidelines for the night parrot (DBCA, 2017b).

The *Guidelines for Surveys to Detect the Presence of Bilbies and Assess the Importance of Habitat in Western Australia* (DBCA, 2017a) do not specify an optimal window for targeted surveys for the species but instead focus on the detection of secondary evidence which may be undertaken at any time of year. No survey guidelines currently exist for the Pilbara olive python, Pilbara leaf-nosed bat, ghost bat, brush-tailed mulgara, western pebble-mound mouse or Fortescue grunter.

Table 10: Timing of detailed and targeted fauna surveys undertaken within the study area between 2019-2024. Green shading indicates detailed fauna surveys included in the current consolidation.

Report	Survey timing
Significant fauna monitoring	
Annual Fauna Monitoring Program 2021 (Spectrum Ecology, 2022)	**Northern quoll:** 12 June – 12 July, 2021
Annual Fauna Monitoring Program 2022 – Operational Sites, Nullagine and North Star (Spectrum Ecology, 2023)	**Northern quoll:** 29 June – 1 September, 2022
Annual Fauna Monitoring Program 2023 – Operational Sites, Nullagine and North Star (Spectrum Ecology, 2024)	**Northern quoll:** 29 June – 29 August, 2023
Multi-phase detailed fauna survey	
Bonney Downs North: Terrestrial Fauna Assessment (ecologia, 2024a)	**Phase 1:** 22 May – 2 June 2023 **Phase 2:** 9 - 19 October 2023 **Phase 3:** 16 - 28 March 2024 **Targeted:** 24 July – 2 August 2023
Bonney Downs South: Terrestrial Fauna Assessment (Spectrum Ecology, 2024)	**Phase 1:** 13 -25 October 2023 **Phase 2:** 4-14 April 2024 **Targeted camera installation:** 26 – 28 April 2024 (retrieved 46 days later)
Bird and Bat Site Utilisation Survey	
Bonney Downs Wind Farm: Bird and Bat Site Utilisation Report -Year 1 (ecologia, 2024b)	**Southward migration:** 12-19 October 2023 **Wet season:** 5-12 February 2024 **Northward migration:** 21-28 March 2024 **Dry season:** 17-24 June 2024

3.2 SITE SELECTION

Site selection was undertaken based on the indicative habitat types identified within each survey area and was in accordance with the *Technical Guidance – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (EPA, 2020)*, which specifies that a minimum of two trapping sites should be installed within each habitat type. The abundance and significance of habitat types was taken into consideration in selecting fauna trapping sites within the survey area, with widespread and significant habitat types receiving greater systematic trapping effort. Apart from the Granite Outcrops (flat dome) and Gorges/Gullies and Woodland (open/closed) habitat types, at least two systematic sampling sites were installed within each of the remaining nine habitat types identified within the study area.

Given the limited extent of the Granite Outcrops, Gorges/Gullies, Woodland (open) and Woodland (closed) habitat types, which each represent <1.0% of the study area, the installation of a single trapping site within these habitat types is unlikely to represent a significant limitation as these habitat types are unlikely to support additional significant fauna taxa or fauna assemblages which were not recorded elsewhere. Additional targeted and active search methodologies were utilised in these habitat types to ensure a representative fauna assemblage was recorded.

Habitat types poorly represented by systematic trapping sites were sampled using additional sampling methods (motion cameras, ARUs, cage traps and spotlighting) and targeted searches, with specific focus on potentially sensitive habitats and habitat types with the potential to support significant species.

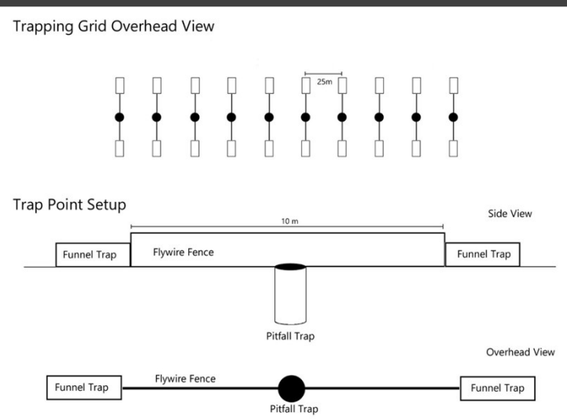
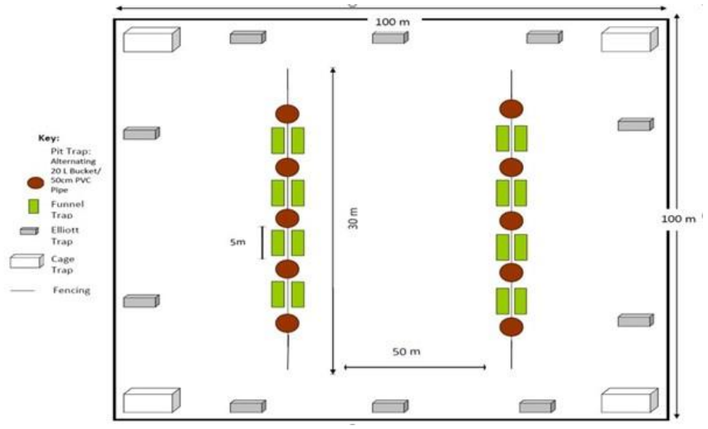
3.3 SAMPLING METHODS

All surveys were undertaken using a variety of sampling techniques, including systematic, targeted and opportunistic methodologies in accordance with *Technical Guidance – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (EPA, 2020). Broad methods utilised during vertebrate fauna surveys undertaken at Bonney Downs are summarised in Table 11 below, with detailed methodologies provided in each respective report.

The locations of sampling sites associated with the Bonney Downs North (ecologia, 2024a), Bonney Downs South (Spectrum Ecology, 2024) and Bonney Downs BBSUS (ecologia, 2024b) are shown in Map 9-Map 13.

Table 11: Survey methodologies utilised at Bonney Downs.

Technique	Spectrum Ecology methods (Bonney South)	*ecologia* methods (Bonney North and BBSUS)	Purpose and target groups	Sites	
				North	South
Habitat assessment	Fauna habitats were described by considering landforms, land systems, geology, and vegetation. These determine the fauna assemblage and the occurrence of significant fauna at a defined location. The assessment included photographs and descriptions.	Habitat assessments were undertaken within the study areas at sites considered representative of each habitat type. Habitat assessments were also undertaken at each systematic trapping site. The following parameters were recorded: • broad habitat type; • habitat condition • digital photographs; • landform type; • soil colour, type and characteristics; • type and extent of non-vegetative surface cover; • type of vegetation in lower, middle and upper strata; • observable fire history and evidence of any disturbance; • presence and extent of leaf litter and coarse woody debris; • presence of, or distance to, water sources; • presence of significant microhabitats such as tree hollows and rocky outcrops; and • notes on suitability for hosting significant fauna.	• Habitat assessment and habitat mapping • Significant fauna habitat identification and delineation	BHA01-BHA02, BDHA1, BDHA01-BDHA04, BBD02-BBD07, BPHA01, BDBAT01	BDS HAB01- BDS HAB19
Systematic pitfall trapping site	**Pitfall traps:** 5 x 20 L bucket and 5 x 50 cm PVC pipe pitfall traps, dug into the ground to act as pitfall traps. A 10 m long, 30 cm high fence was also installed, passing across the top of each pit to direct fauna into it. **Funnel traps:** placed at the ends of each fence to capture fauna that are not readily caught in pitfall traps (20 per trapping grid). All funnel traps were covered with shades to reduce the likelihood of animals suffering from overheating. Layout of a trap site and a single trap line is shown below. Ten trapping lines per site. Traps were left open for seven nights.	**Pitfall traps:** Alternating series of 20 L buckets and 50 cm PVC pipe pitfall traps (five pits per line, 10 per site), dug into the ground to act as pitfall traps. No pits installed at sites situated on ridgelines, mesas gullies or escarpments. A 30 m long, 30 cm high fence was also installed per line, passing across the top of each pit to direct fauna into it. Shades provided to provide thermal protection and shelter for trapped animals. **Funnel traps**: placed at the ends of each fence to capture fauna that are not readily caught in pitfall traps (eight per trapping line, 16 per trapping site). At sites established within rocky habitats, additional funnel traps were used in the place of pitfall traps (10 per line, 20 per site). All funnel traps were covered with shades to reduce the likelihood of animals suffering from overheating. **Elliott traps:** five aluminium Elliott traps per line (10 per trapping site) baited with balls of 'universal bait' (oats, peanut butter and sardines). All Elliott traps were covered by shades to reduce the likelihood of animals suffering from overheating. **Cage traps:** four large, wire-framed Sheffield traps (22 cm x 22 cm x 55 cm) per line (four per trapping site) baited with balls of 'universal bait'. All cage traps were covered by shades to reduce the likelihood of animals suffering from overheating. Layout of a trap site is shown below. Two trapping lines per site. Traps were left open for at least seven nights and checked twice daily (when temperatures exceeded 26°C) within three hours of dawn and post-peak reptile activity periods.	• Baseline fauna assemblage • Mammals (small-medium sized non-volant) • Reptiles • Amphibians • Significant fauna	BDDP01- BDDP23	BDS 02- BDS 12

Technique	Spectrum Ecology methods (Bonney South)	*ecologia* methods (Bonney North and BBSUS)	Purpose and target groups	Sites	
				North	South
Systematic trapping layout			• Baseline fauna assemblage • Mammals (small-medium sized non-volant) • Reptiles • Amphibians • Significant fauna	BDDP01-BDDP23	BDS 02- BDS 12
Targeted trapping site	**Elliott traps & cage traps**: aluminium box traps were installed in suitable habitat (rocky ridges or major creek line), baited with 'universal bait' to attract and capture smaller mammals, and re-baited as required (as a minimum every second day). All Elliott and cage traps were covered by shades to reduce the likelihood of animals suffering from overheating. Traps were left open for four nights.	N/A. This is encompassed in ecologia's systematic trapping methodology and other targeted methods detailed below.	• Mammals (small, non-volant)	N/A	BDS S1 (cages), BDS 11-E (Elliott)
Systematic bird surveys (detailed survey)	Area searches (30-minute set-time searches of 2 ha areas) were used to document the bird assemblage present at each of the systematic fauna trapping sites. During each area search an ornithologist recorded the number of individuals of each species observed while actively searching similar habitat within a 2ha area surrounding the trapping site. Survey effort was concentrated within three hours of dawn or dusk, as these times are considered optimal for recording most bird species.	Set-time surveys (20-minute set-time searches of 2 ha areas) were used to document the avifauna assemblage present at each of the systematic fauna trapping sites. During each survey the number of individuals of each species observed were recorded while actively searching similar habitat within a 2ha area surrounding the trapping site. Survey methods utilised were in accordance with systematic survey methods recommended by BirdLife Australia. All avifauna surveys are conducted within three hours of dawn and dusk, during the peak activity period for most bird species.	•Birds • Significant fauna	BDDP01-BDDP23	BDS S2-Bird, BDS 02-Bird1- BDS 12-Bird1, BDS Dam1, BDS Windmill 01, BDS Windmill 02, BDS Driving Bird1, BDS OPP Homestead, BDS OPP01, BDS OPP05, BDS OPP06, BDS OPP08- BDS OPP12, BDS OPP14, BDS OPP15, BDS OPP18- BDS OPP21
Bird and Bat Site Utilisation Surveys (BBSUS)	N/A	Bird and Bat site Utilisation Surveys (BBSUSs) were undertaken at 40 sites across the combined Bonney Downs study area concurrently with the October 2023 and March 2024 detailed fauna surveys. Thirty-minute fixed time surveys were undertaken at each site to record avifauna assemblages and behaviour and understand how each species is utilising the site. Each site was surveyed once within three hours of sunrise, once at mid-day and once within three hours of sunset (three surveys total) during each survey phase. Avifauna assemblages recorded at BBSUS sites have been incorporated into the species list for the current surveys.	• Birds • Significant fauna	BB001-BB040	
Active searches	N/A	Each systematic trapping site was actively searched for a period of 30 minutes to identify cryptic reptile and mammal species. Search methods utilised include but were not limited to sifting leaf litter, searching under and around old logs, stumps, and dead free-standing trees, investigating burrows and over-turning logs and stones.	• Mammals • Reptiles •Amphibians •Birds • Significant fauna	BDDP01-BDDP23	N/A

Technique	Spectrum Ecology methods (Bonney South)	*ecologia* methods (Bonney North and BBSUS)	Purpose and target groups	Sites	
				North	South
Opportunistic sampling/Opportunistic site/Basic site	Fauna species not recorded through other sampling methods were opportunistically sampled as encountered in the study area. Opportunistic sampling also included recording locations of significant and introduced species. Information collected at each site included some, or all of the following: • Site code, date, location, zoologist; • A photograph; • Vegetation condition and disturbances (including fire); • Landform including slope, soil, rock type, aspect; • Vegetation community type and density; and • Fauna present.	Fauna species not recorded through other sampling methods were opportunistically sampled as encountered in the study area. Opportunistic sampling also included recording locations of significant and introduced species. Opportunistic avifauna surveys were conducted at sites considered to potentially support a different avifauna assemblage to systematic trapping locations, focussing on water sources and habitats with flowering shrubs or other important foraging resources.	•Mammals •Reptiles •Amphibians •Birds •Fish • Significant fauna	Various fauna records (no set site codes)	BSD PMM01- BSD PMM03, BDS OPP02- BDS OPP04, BDS OPP17, BDS OPP 22- BDS OPP 36, BDS Camp 2, BDS Driving 1- BDS Driving 10 BDS PMM01-BDS PMM02
Targeted searches	Areas likely to support significant fauna were targeted during the survey. Areas were selected based on existing records from previous surveys, database searches, geology, aerial imagery, and vegetation mapping.	Areas likely to support significant fauna were targeted during the survey. Areas were selected based on existing records from previous surveys, database searches, geology, aerial imagery, and vegetation mapping. Supplementary search effort was undertaken in habitats likely to support significant fauna and habitats poorly represented by systematic trapping sites (due to accessibility and/or extent within the study area). Grey falcon search transects were undertaken on foot within the Drainage Line/River/Creek (major) habitat type to identify suitably sized nests or primary sightings of the species. Particular focus was given to identifying intact nests located in large eucalypts or telecommunication towers, of a suitable size and condition to be utilised by grey falcons (Schoenjahn *et al.* 2020). Targeted searches were undertaken during the grey falcon breeding season (June-November) when detectability of the species and confirmation of nest utilisation is likely to be higher (Schoenjahn *et al.* 2020). Suitable nests were recorded, and secondary evidence of recent use (if present) was documented during searches of feeding debris and mutes within the drop zone below the nest. Targeted survey effort for the grey falcon was primarily focused within Drainage Line/River/Creek (major) habitat associated with Bonnie Creek, as this habitat type represents suitable breeding and foraging habitat for the species. Cave floors were inspected for northern quoll scat, ghost bat scat/middens and olive python sloughs during targeted searches in rocky habitats. Permanent water bodies were investigated for evidence of Pilbara olive python occupancy.	• Significant fauna (grey falcon, northern quoll, ghost bat, Pilbara olive python)	134 person hours (Phase 1-3, targeted surveys)	BDS GF01-BDS GF13, BDS TAS01- BDS TAS10
Motion cameras	Motion sensitive cameras capable of recording both normal (day) and infra-red (night) images were deployed in areas of interest, such as near permanent water or in gorges, to record cryptic or targeted species not normally recorded by other survey methods. In addition, suitable habitat for significant fauna likely to occur were targeted to determine their presence or absence. Motion cameras were baited with non-food reward baits (cotton rope soaked in fish oil).	Motion sensitive cameras capable of recording both normal (day) and infra-red (night) images were deployed in areas of interest, such as near permanent water or in gorges, to record cryptic or targeted species not normally recorded by other survey methods. In addition, suitable habitat for significant fauna likely to occur were targeted to determine their presence or absence. Targeted surveys for the northern quoll were undertaken using Reconyx HC500 Hyperfire, Browning Patriot Trail and X-Trail 3CR motion cameras. Cameras were set in linear transects, spaced at intervals of 100-200m, to facilitate northern quoll population analysis and identify other cryptic nocturnal species that inhabit rocky habitats. Seven motion camera transects (BDQT01-BDT07) were deployed at Bonney Downs North during the phase one detailed survey and retrieved during the first targeted survey. An additional five transects (BDQT08-BDQT12) were deployed at Bonney Downs North on the 13th of February 2024 and retrieved during the phase three detailed fauna survey. Cameras were set specifically to target northern quolls using methods outlined in Hohnen et al.	•Mammals •Reptiles • Birds • Significant fauna	B01-B20, BDMC01- BDMC39, RC21, RC32, RC36, RC38, RC47	BSD MC1.1- BSD MC1.5, BDS MC2.1- BDS MC2.5, BDS MC3.1- BDS MC3.5, BDS MC4.1- BDS MC4.5, BCS MC5.1- BCS MC5.5, BDS MC6.1- BDS MC6.5, BDS MC7.1-BDS MC7.5, BDS MUL MC1, BDS PMM MC1

Technique	Spectrum Ecology methods (Bonney South)	*ecologia* methods (Bonney North and BBSUS)	Purpose and target groups	Sites	
				North	South
		(2013), enabling spot pattern analysis on captured individuals. Photographs were analysed post survey, and the entire suite of recorded fauna were identified. Each camera was set to record five images concurrently with no minimum time delay between triggers. Cameras were baited with a non-consumable sardine lure to encourage animals to occupy the camera's field of view and increase the number of camera trap photos available for identification purposes. All cameras were able to be triggered by movement using highly sensitive, passive infra-red motion sensors that function during the day and night.			
Ultrasonic Recording Units (ARUs)	Bat echolocation calls were recorded using Wildlife Acoustics SM4BAT ultrasonic recorders. The ARU devices record the full spectrum of calls allowing greater accuracy and sensitivity when identifying bat species. Each ARU device was programmed to record from 30 minutes pre-dusk to 30 minutes post-dawn for each night and deployed for a minimum of three nights.	Bat echolocation calls were recorded using Wildlife Acoustics SM4BAT and Titley Chorus ultrasonic recorders. The ARU devices record the full spectrum of calls allowing greater accuracy and sensitivity when identifying bat species. Each ARU device was programmed to record from 30 minutes pre-dusk to 30 minutes post-dawn for each night and deployed for a minimum of three nights. ARUs were deployed with microphones facing towards the sky at a height of at least 1m above the ground, to record bat echolocation calls in the vicinity of the device. ARUs were deployed at all systematic survey and BBSUS sites, prospective cave entrances and potential flightpaths within the study area to identify foraging and roosting habitat within the study area. Echolocation calls recorded were analysed by bat specialist Dr Kyle Armstrong. To provide an indication of site proximity to a potential roost location, the period between sunset and the first detection, and the period between the last detection and sunrise was calculated. The presence or absence of low time calls (within 20 minutes of sunset or sunrise) are used to indicate proximity of the detector to a potential roost location.	• Bats	BB001-BB040, BBD01, BDBD02-BDBD07, BDTBD01-BDTBD04, BDOPP1	BDS S2- Bat2, BDS 02- Bat1 - BDS12-Bat1, BDS Dam-Bat1, BDS Windmill 02-Bat1, BDS Homestead-Bat1, BDS TAS03-Bat1, BDS Dam-Bat2, BDS OPP1-Bat2- BDS OPP3-Bat2, BDS 06- Bat2, BDS 09- Bat2- BDS 12- Bat2, BDS OPP13-Bat1, BDS OPP16-Bat1
Ghost bat lures	N/A	Each lure consists of one portable speaker, two camera traps, two infrared spotlights and a bat detector. Portable speakers were loaded with a micro-SD card containing a sequence of sound files containing 'squabble' calls of the ghost bat (sensu Hanrahan et al. 2023), with sound files played for a 2-minute period, followed by a 2-minute period of silence. Each camera trap was programmed to record 3-minute black and white video files at high resolution continuously upon start up. Infrared spotlights were set to turn on when ambient illumination levels drop below the threshold required for quality colour video recordings. A bat detector was placed on the star picket, below the portable speaker to maximise the chance of echolocation call detection if a ghost bat approached the speaker. Each site was sampled for a single night, before the lure was relocated to a new location, ensuring that behavioural impacts associated with sampling over repeated nights are avoided. All sites sampled on the same night were located a minimum of 10km apart to avoid interference or movement of bats between sites. The distance at which ghost bats can hear the signals at night is unknown but assumed to be at least 100m (Kyle Armstrong, pers. comm.). Ghost bats can be distinguished in infrared and thermal video recordings from other bat species and insects based on the observation of any combination of the following morphological and behavioural features that provide an empirical basis for the identification: • flight pattern (four distinct behaviours classified as: 'circling' of the post containing the speaker; 'hover' in front of the speaker; 'long glide' towards the speaker; and 'drop in' whereby they would sometimes approach at c. 2 m above	• Ghost bat	BDGB01-BDGB07	N/A

Technique	Spectrum Ecology methods (Bonney South)	*ecologia* methods (Bonney North and BBSUS)	Purpose and target groups	Sites	
				North	South
		the speaker and then drop vertically towards it); • body size relative to other objects in the frame; • large ear size; • lack of a tail; • bright eyeshine of the reflected infrared light from their large eyes (infrared recordings only, though not always visible); and • corroboration with concurrently recorded diagnostic echolocation calls. All bats observed in videos are examined by single manual frame advancement to check for diagnostic features. The relatively high resolution and video frame rate provides a reasonable level of image quality.			
Ghost bat lure layout	N/A		• Ghost bat	BDGB01-BDGB07	N/A
Acoustic Recording Units (ARUs)	Wildlife Acoustics Song Meter SM4 recording units were deployed in suitable night parrot foraging habitat. Each recorder was programmed to record from 30 minutes pre-dusk to 30 minutes post-dawn for each night and deployed for six nights.	Targeted night parrot surveys were undertaken within suitable roosting (long-unburnt spinifex) and suitable foraging habitat. The surveys were undertaken in the months following significant rainfall events when breeding is more likely to occur and therefore, detectability of the species is expected to be higher. ARUs were deployed in areas supporting old, long unburnt spinifex (with particular focus on the species *Triodia longiceps*), as these areas represent prospective night parrot roosting habitat within the study area. Wildlife Acoustics Song Meter SM4 recording units were deployed in suitable foraging habitat. Each recorder was programmed to record from 30 minutes pre-dusk to 30 minutes post-dawn for each night and deployed for a minimum of six nights. As surveys were undertaken prior to the publication of the *Guidelines for determining the likely presence and habitat usage of night parrot (Pezoporus occidentalis) in Western Australia* (DBCA 2024), methodologies utilised may exhibit slight variations to those outlined in this document.	•Night parrot	BDNP01-BDNP09	BDS 01-PAR2, BDS 03-PAR2, BDS 04-PAR2, BDS 07-PAR2, BDS 10-PAR2, BDS 12-PAR2
Nocturnal spotlighting	Nocturnal spotlighting was conducted from vehicles and on foot to target the Pilbara olive-python and other cryptic, nocturnal fauna species.	Nocturnal spotlighting was conducted from vehicles and on foot to target the Pilbara olive-python and other cryptic, nocturnal fauna species.	• Reptiles • Nocturnal mammals • Nocturnal birds	76 person hours	BDS N1- BDS N7

3.4 SURVEY EFFORT

Extensive consolidated survey work has been undertaken within the study area, as shown in Table 12.

Table 12: Cumulative survey effort undertaken within the study area between 2021-2024.

Survey reference	Study area	Sampling year	Systematic trapping (pit, cage, Elliott and funnel)	Targeted cage/Elliott traps	Camera traps	Avifauna surveys	Active searches	ARU (acoustic)	ARU (ultrasonic)	Spotlighting	Ghost bat lure	Targeted searches
Ecologia Environment (ecologia, 2024a)	Bonney Downs North	2023-2024	9,260 trap nights (23 sites)	-	2,274 recording nights (64 cameras)	123 hours	94 hours	60 recording nights (nine sites)	119 recording nights (41 sites)	76 hours	7 nights (7 sites)	134 hours (falcons) + 64 hours (quolls and bats)
Spectrum Ecology (Spectrum Ecology, 2024)	Bonney Downs South	2023-2024	4,630 trap nights (11 sites)	790 trap nights (Elliott) + 224 trap nights (cage)	1,610 nights (37 cameras)	57 hours	34 hours	38 recording nights (six sites)	40 recording nights (17 sites)	23.2 hours	-	21 hours (grey falcon), 8 hours (Migratory birds), 20 hours (olive python- diurnal searches at waterbodies and gorges/gullies), 8 hours of bilby searches
Ecologia Environment (ecologia, 2024b)	Bonney Downs BBSUS	2023-2024	-	-	-	240 hours	-	-	320 recording nights (40 sites)	-	-	-
Spectrum Ecology (2024)	Nullagine	2023	-	-	600 recording nights (20 cameras)	-	-	-	-	-	-	10 hours (northern quolls)
Spectrum Ecology (2023)	Nullagine	2022	-	-	600 recording nights (20 cameras)	-	-	-	-	-	-	10 hours (northern quolls)
Spectrum Ecology (2022)	Nullagine	2021	-	-	800 recording nights (20 cameras)	-	-	-	-	-	-	10 hours (northern quolls)
Total			13,890 (34 sites)	790 trap nights (Elliott) + 224 trap nights (cage)	5,884 nights (161 cameras)	420 hours	128 hours	98 recording nights (15 sites)	479 recording nights (98 sites)	99.2 hours	7 nights (7 sites)	134 hours (falcons), 94 hours (northern quoll), 64 hours (bats), 8 hours (Migratory birds), 20 hours diurnal searches (olive python), 8 hours (bilby)

119.7°E
119.8°E
119.9°E
120°E
120.1°E
21.9°S
22°S
22.1°S
22.2°S
22.3°S
22.4°S

Survey area

Ecologia (2024) Bonney North
- Fauna: Trap Site
- Fauna: Habitat Assessment
- Fauna: Motion Camera
- Fauna: Sound Recorder
- Fauna: Ghost bat lure

Spectrum (2024) Bonney South
- Acoustic recording unit
- Bat recorder
- Habitat assessment
- Motion Camera
- Nocturnal search
- Opportunistic
- Systematic Survey
- Systematic trapping
- Targeted active search

Ecologia (2024) BBSUS
- BBSUS site

Habitat type
- Cleared
- Drainage Line/River/Creek (major)
- Drainage Line/River/Creek (minor)
- Gorges/Gullies
- Granite Outcrops (flat dome)
- Hills/Ranges/Plateaux
- Plain (Cracking clays)
- Plain (stony/gibber)
- Rocky Escarpments (Ridges/Mesa/Cliffs/Outcrops/Breakaways)
- Woodland (closed)
- Woodland (open)

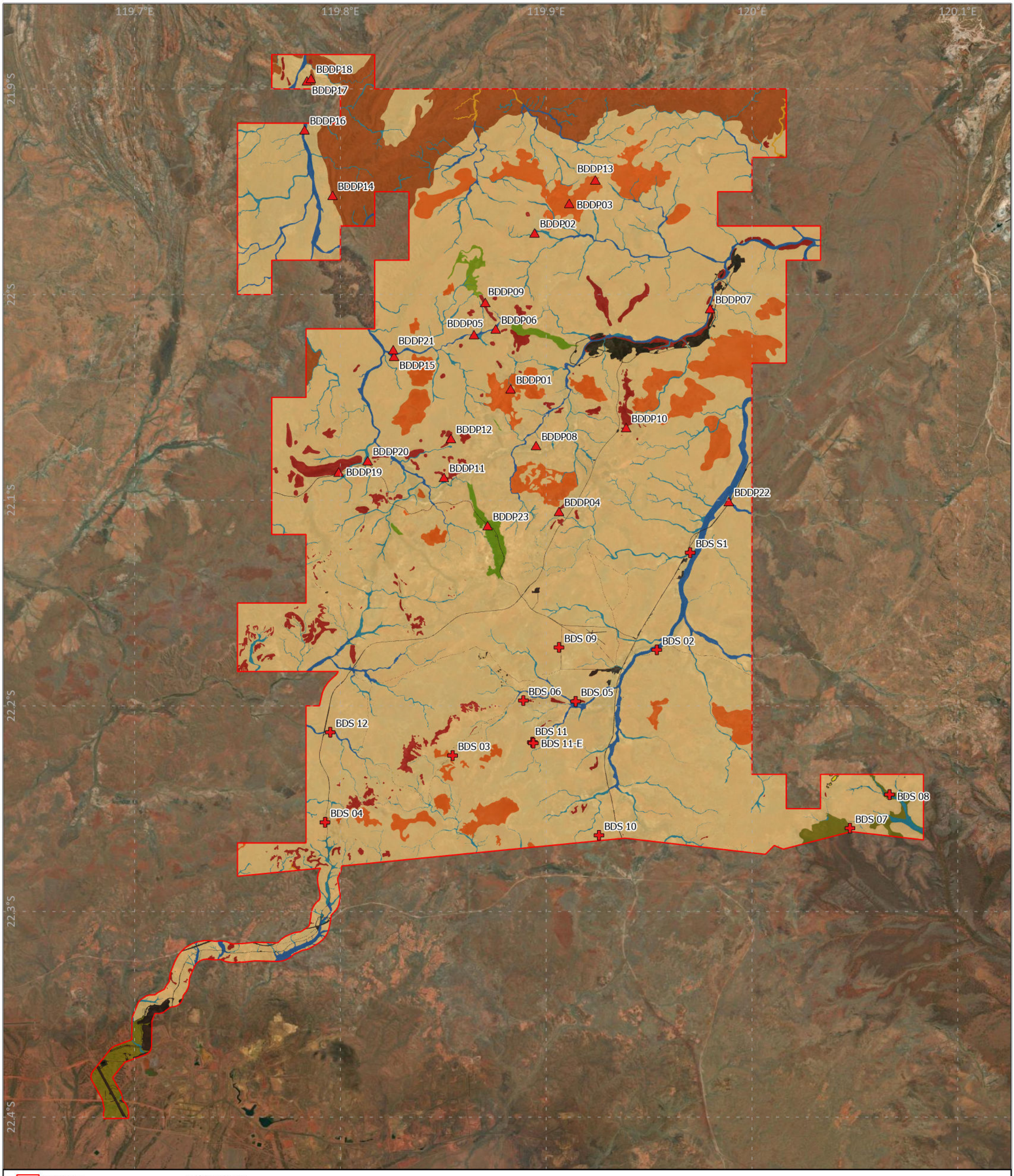
ecologia ENVIRONMENT

Project No.: 2021
Author: SP
Created Date: 4 October 2024
Coordinate System: GCS GDA 1994
Scale: 1:190,000 @A3

Map 9: Locations of all survey sites (consolidated survey effort).

0 2 4 6 10 Kilometers

Earthstar Geographics



Survey area

Spectrum (2024) Bonney South

Systematic trapping

Ecologia (2024) Bonney North

Fauna: Trap Site

Habitat type

- Cleared
- Drainage Line/River/Creek (major)
- Drainage Line/River/Creek (minor)
- Gorges/Gullies
- Granite Outcrops (flat dome)
- Hills/Ranges/Plateaux
- Plain (Cracking clays)
- Plain (stony/gibber)
- Rocky Escarpments (Ridges/Mesa/Cliffs/Outcrops/Breakaways)
- Woodland (closed)
- Woodland (open)

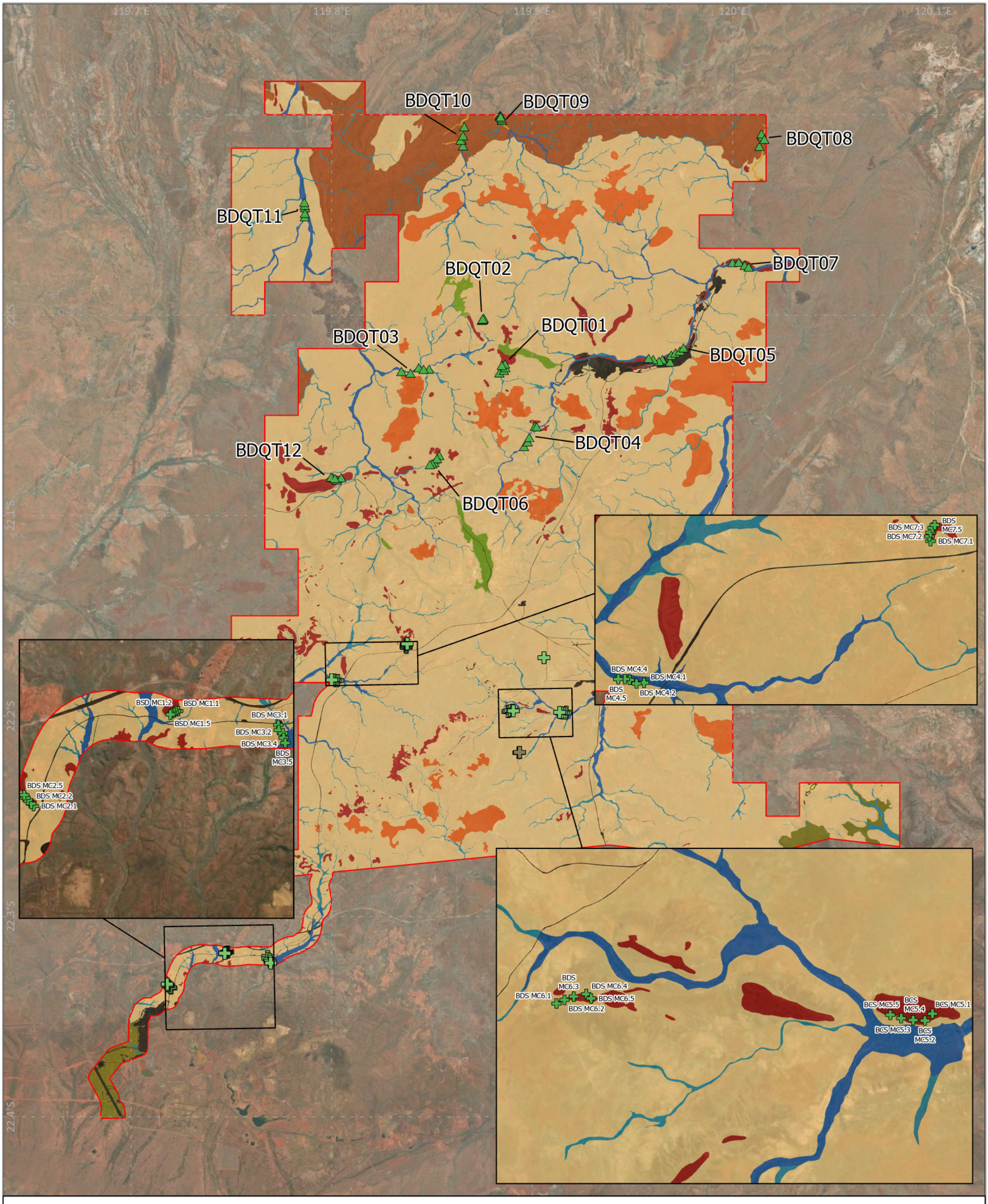
ecologia ENVIRONMENT

Project No.: 2021
Author: SP
Created Date: 4 October 2024
Coordinate System: GCS GDA 1994
Scale: 1:190,000 @A3

Earthstar Geographics

Map 10: Locations of systematic survey sites (consolidated survey effort).

0 2 4 6 10 Kilometers



Survey area

Ecologia (2024) Bonney North

Fauna: Motion Camera

Spectrum (2024) Bonney South

Fauna: Motion Camera

Fauna: Trap Site (Cage)

Habitat type

- Cleared
- Drainage Line/River/Creek (major)
- Drainage Line/River/Creek (minor)
- Gorges/Gullies
- Granite Outcrops (flat dome)
- Hills/Ranges/Plateaux
- Plain (Cracking clays)
- Plain (stony/gibber)
- Rocky Escarpments (Ridges/Mesa/Cliffs/Outcrops/Breakaways)
- Woodland (closed)
- Woodland (open)

ecologia ENVIRONMENT

Project No.: 2021
Author: SP
Created Date: 24 October 2024
Coordinate System: GCS GDA 1994
Scale: 1:190,000 @A3

Map 11: Locations of camera traps, cage traps and Elliott traps (consolidated survey effort).

0 2 4 6 10 Kilometers

Earthstar Geographics, Maxar

119.6667°E
119.75°E
119.8333°E
119.9167°E
120°E
120.0833°E
21.9167°S
22°S
22.0833°S
22.1667°S
22.25°S
22.3333°S

Survey area

Ecologia (2024) Bonney North
- Bat detector
- Night parrot detector
- Ghost bat lure

Spectrum (2024) Bonney South
- Bat detector
- Night parrot detector

Ecologia (2024) BBSUS
- Bat detector

Habitat type
- Cleared
- Drainage Line/River/Creek (major)
- Drainage Line/River/Creek (minor)
- Gorges/Gullies
- Granite Outcrops (flat dome)
- Hills/Ranges/Plateaux
- Plain (Cracking clays)
- Plain (stony/gibber)
- Rocky Escarpments (Ridges/Mesa/Cliffs/Outcrops/Breakaways)
- Woodland (closed)
- Woodland (open)

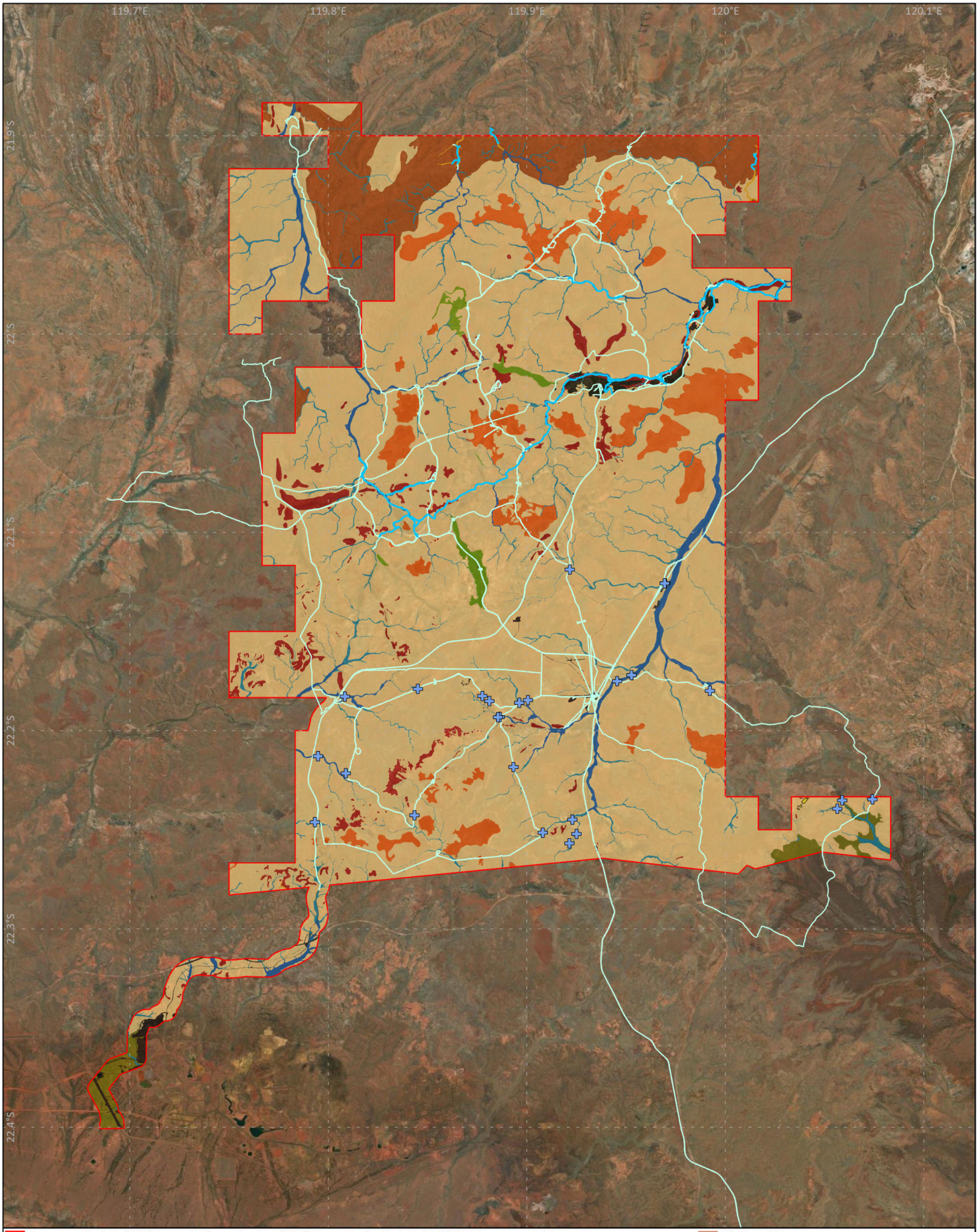
ecologia ENVIRONMENT

Project No.: 2021
Author: SP
Created Date: 24 October 2024
Coordinate System: GCS GDA 1994
Scale: 1:190,000 @A3

Map 12: Locations of Autonomous Recording Units (ARUs) and ghost bat lures (consolidated survey effort).

0 2 4 6 10 Kilometers

Earthstar Geographics



Survey area

Ecologia (2024) Bonney North
Grey falcon searches - walking

Spectrum (2024) Bonney South
Targeted active search

Ecologia (2024) BBSUS
Grey falcon searches - driving

Habitat type
- Cleared
- Drainage Line/River/Creek (major)
- Drainage Line/River/Creek (minor)
- Gorges/Gullies
- Granite Outcrops (flat dome)
- Hills/Ranges/Plateaux
- Plain (Cracking clays)
- Plain (stony/gibber)
- Rocky Escarpments (Ridges/Mesa/Cliffs/Outcrops/Breakaways)
- Woodland (closed)
- Woodland (open)

ecologia ENVIRONMENT

Project No.: 2021
Author: SP
Created Date: 4 October 2021
Coordinate System: GCS GDA 1994
Scale: 1:190,000 @A3

Map 13: Locations of targeted grey falcon searches (consolidated survey effort).

0 2 4 6 10 Kilometers

Earthstar Geographics

3.5 TAXONOMY AND NOMENCLATURE

Nomenclature for birds, mammals, reptiles and amphibians within this report is as per the WAM Checklist of the Vertebrates of Western Australia (November 2024). Key taxonomic references and field guides used for fauna identification are listed in Table 13.

Table 13: References used for identification.

Fauna group	Reference
Mammals	Menkhorst and Knight (2011), Van Dyck *et al.* (2013)
Bats	Churchill (2008), Menkhorst and Knight (2011)
Birds	Pizzey et al. (2013)
Reptiles	Cogger (2018), Wilson and Swan (2021)
Amphibians	Frog ID App (FrogID 2023)
Fish	Allen et al. (2002)

3.6 STUDY TEAM AND LICENCES

The consolidation was planned, coordinated, executed, and reported by those summarised below in Table 14

Table 14: Study team and licences.

Project staff				
Name	**Qualification**	**Experience**	**Position**	**Role**
Shaun Grein	B. Sc. Biol.; Grad. Dip. Nat. Resources; MBA	>30yrs	Managing Director/Senior Principal Scientist	Project management, QA
Tim McCabe	B.Sc. Env. Biol, Dip Proj Mngment, Cert III Vert Pest Mngment	>15 yrs	Principal Zoologist	Reporting, GIS
Claudia Elliott	B.Sc. Cons. Biol. & Zool.; MWildlifeHth	>8 yrs	Senior Zoologist	GIS, reporting
Sam Plant	B. Sc WildlifeBiol. EnvSc.; MWildlifeHth; Cert II ConsLandMngment.	>5 yrs	Zoologist	GIS, reporting

3.7 LIMITATIONS AND CONSTRAINTS

An assessment of survey-specific issues and limitations is detailed in Table 15.

Table 15: Fauna survey limitations.

Aspect	Comment	Limitation
Competency/experience of the consultant carrying out the survey.	The lead zoologists coordinating surveys included in the current consolidation have >15 years' experience and all other zoologists involved in the fauna surveys had between 1-12 years' experience working within the Pilbara region. Bat call analysis was undertaken by Dr Kyle Armstrong of Specialised Zoological (>20 yrs experience) for all projects Night parrot call analysis was undertaken by Dr Nick Leseberg of Adaptive NRM (>8 years' experience) for all projects	Nil
Scope (what faunal groups were sampled and were some sampling methods not able to be employed because of constraints such as weather conditions).	All survey scopes were well defined. Terrestrial vertebrate fauna and their habitats were mapped and described using standardised and well-established techniques and previous survey work in the vicinity of the study area were used to provide contextual information. All vertebrate fauna groups occurring within the study area were adequately sampled.	Nil
Proportion of fauna identified, recorded and/or collected.	The inventory of 237 vertebrate fauna taxa recorded within the study area represents 63.5% of the total faunal assemblage identified from database searches and surveys in the vicinity of the study area (n=373). All taxonomic groups were represented and species richness exceeded that recorded by the majority of single- and multi-phase detailed fauna surveys identified from the literature review. This is likely attributable to favourable seasonal conditions (increased rainfall) and high survey intensity.	Nil
Sources of information (previously available information as distinct from new data).	Extensive database records (public databases, DBCA Threatened and Priority fauna databases and Fortescue internal databases), were available for the area and provided adequate contextual information for the study. Spatial data and reports associated with three recent surveys and three significant fauna monitoring reports were available for the consolidation.	Nil
The proportion of the task achieved and further work which might be needed.	Planned survey works were conducted and completed. Additional survey work may be required to ensure compliance with the new night parrot guidelines published in 2024 (DBCA, 2024).	Minor
Timing/weather/season/cycle.	All surveys included at least one phase conducted during the optimal survey window (March-May) outlined in *Technical Guidelines: Terrestrial Vertebrate Fauna*. Additionally, all surveys included at least one survey phase within the optimal survey timing for reptiles (September-April) in accordance with *Technical Guidance – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment*. All surveys included in the current consolidation included at least one survey phase immediately after (or during) significant rainfall events, coinciding with optimal timing for amphibians and birds. Significant fauna surveys were undertaken during the appropriate seasons, as specified by relevant guidelines and guidance statements.	Nil
Disturbances which affected results of the survey (e.g. fire, flood, accidental human intervention).	Although a small portion (0.99%) of the study area encompasses areas associated with clearing for tracks or other infrastructure, these areas were generally able to be avoided when sampling habitat within the study area. As the study area encompasses a working cattle station, cattle grazing was widespread throughout portions of the study area and may have resulted in decreased species diversity in these areas. This is considered unlikely to have had a significant impact on survey outcomes.	Nil
Intensity (in retrospect was the intensity adequate).	No systematic sampling was undertaken with the Granite Outcrop (flat dome) or Gorges/Gullies; however, as both habitat types only represents 0.10% of the study area, this is not considered a	Negligible

Aspect	Comment	Limitation
	significant limitation. Similarly, only a single trapping site was established within the Woodland (open) habitat type, due to the small extent of this habitat type within the study area (<1%). All other habitat types were represented by two or more systematic trapping sites in accordance with the *Technical Guidance – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment*. Where pitfall traps were unable to be installed in rocky habitats, alternative systematic trapping methods and targeted searches were utilised to ensure the full species assemblage present was recorded.	
Completeness (e.g. was relevant area fully surveyed).	Each of the surveys included in the current consolidation were completed according to the scope of works provided by Fortescue. Relevant areas were fully surveyed.	Nil
Resources (e.g. degree of expertise available in animal identification to taxon level).	Resources were adequate to carry out the surveys and survey participants were competent in the identification of species. There were no resource issues encountered.	Nil
Remoteness and/or access problems.	Remoteness and/or access restrictions are not considered a limitation for the purposes of the current consolidation, as representative areas were able to be sampled elsewhere in the study area. A helicopter was utilised at Bonney Downs North to allow access to the northern portion of the survey area and ensure targeted sampling was undertaken in these parts of the study area. A helicopter was unable to be utilised at Bonney Downs South, due to conflicts with mustering being undertaken by pastoralists; however, representative habitat was able to be sampled, and this is only considered a minor limitation. All other areas of the study area were able to be accessed either via vehicle or on foot.	Negligible
Availability of contextual (e.g. biogeographic) information on the region.	Sufficient contextual information was available for the Pilbara region and the study area. An extensive literature review was undertaken utilising public databases and internal resources to ensure that relevant contextual information sources were identified and utilised.	Nil
Efficacy of sampling methods (i.e. any groups not sampled by survey methods).	Sampling methods are considered adequate for detailed and targeted vertebrate fauna surveys. Methods utilised were in accordance with those outlined in the *Technical Guidance – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* and relevant significant fauna survey guidelines. The fauna assemblage recorded within the study area included in the current consolidation includes all faunal groups likely to occur within the study area.	Nil

4 RESULTS AND DISCUSSION

4.1 FAUNA HABITAT

Fauna habitat assessments were undertaken to describe and map fauna habitat types with the potential to support significant fauna species within the study area. After assessing the fauna habitat types identified, based on vegetation types, soil units, and landforms present, 10 broad fauna habitat types were identified within the study area: Woodland (open), Woodland (closed), Plain (stony/gibber), Plain (cracking clays), Hills/Ranges/Plateaux, Gorges/Gullies, Granite Outcrops (flat dome), Drainage Line/River/Creek (major), Drainage Line/River/Creek (minor) and Rocky Escarpments (Ridges/Mesa/Cliffs/Outcrops/Breakaways) (Table 16, Map 14). An additional 0.99% of the study area was mapped as Cleared, lacking suitable habitat for terrestrial vertebrate fauna. Fauna habitat assessment data sheets are provided in Appendix E.

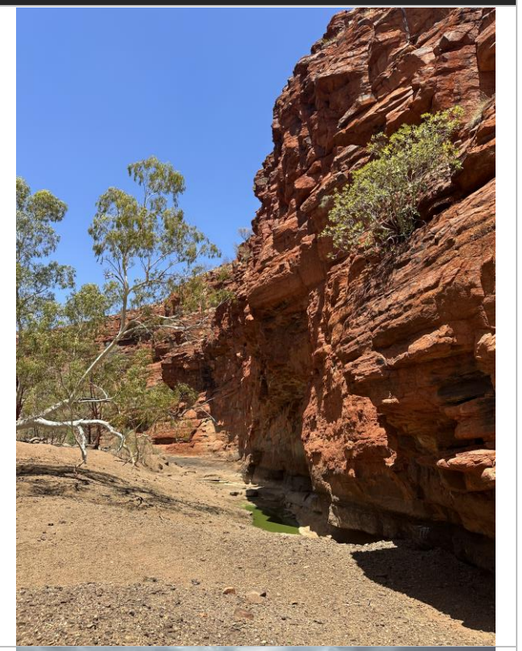
From a local perspective, habitat features that are disjunct and provide sources of shelter, food and mesic qualities required for restricted species may be considered important. The Plain (stony/gibber) (79.22%) habitat type was the dominant feature of the study area, with widespread grazing and trampling disturbances from European cattle documented throughout these areas.

Bonney Creek, Bonney Pools, the Nullagine River and the Coongan River provide seasonal habitat for amphibians and fish in addition to water sources for terrestrial fauna and aquatic birds. Ephemeral inundation of these habitats and the station dam may also provide refuge for Migratory birds travelling to the Fortescue Marsh.

Table 16: Fauna habitats identified within the study area.

Broad habitat type	Area (ha)	%	Sampling effort*	Vegetation description	Fauna suitability	Representative photos
Woodland (open)	571.80	0.56	**Habitat assessment**:** 1 site **Systematic trapping site:** 1 site **Ultrasonic ARU:** 3 devices **BBSUS:** 2 sites	Open *Acacia aptaneura* (mulga) woodland over scattered mixed shrubs over scattered tussock grassland and herblands on red soil, sandy loam plains and stony substrates.	Mulga woodlands are only found in small, isolated patches within the study area usually associated with alluvial deposits. Some areas of the mulga woodland habitat were burnt at the time of survey. Refuges for fauna include woody debris and substrates conduce for burrowing by monitor species and trap door spiders. Widespread habitat degradation associated with grazing and trampling by European cattle was recorded within this habitat type, particularly in areas of mulga woodland adjacent to water sources. The grey falcon (VU) was recorded within this habitat type and may utilise Woodland (open) habitat while foraging.	
Woodland (closed)	874.30	0.85	**Habitat assessment**:** 1 site **Systematic trapping site:** 2 sites **Ultrasonic ARU:** 2 devices **Acoustic ARU:** 1 device **Ornithological survey:** 1 site	Dense *Acacia aptaneura* (mulga) woodland over scattered mixed shrubs over scattered tussock grassland and herblands on red soil, sandy loam plains and stony substrates.	Mulga woodlands are only found in small, isolated patches within the study area usually associated with alluvial deposits. Some areas of the mulga woodland habitat were burnt at the time of survey. Refuges for fauna include woody debris and substrates conduce for burrowing by monitor species and trap door spiders. Widespread habitat degradation associated with grazing and trampling by European cattle was recorded within this habitat type, particularly in areas of mulga woodland adjacent to water sources. No significant fauna taxa were recorded within this habitat type.	
Granite Outcrops (flat dome)	12.46	0.01	**Incidental observations only**	Exposed boulder piles and domes, the vegetation is sparse and limited to scattered *Triodia* sp. hummocks and other soft grasses. Sandy substrate with no leaf or wood litter.	Cracks and crevices, overhangs and the underside of rocks may provide shelter and foraging opportunities for terrestrial fauna. The open nature and small extent of this habitat type makes it unlikely to provide critical habitat for significant fauna; however, the northern quoll, Pilbara olive python, significant bats and both falcons may intermittently utilise this habitat while foraging or dispersing. No significant fauna taxa were recorded within this habitat type.	

Broad habitat type	Area (ha)	%	Sampling effort*	Vegetation description	Fauna suitability	Representative photos
Plain (stony/gibber)	81,441.48	79.22	**Habitat assessment**:** 16 sites **Systematic trapping site:** 7 sites **Elliott transect**:1 site **Camera trap:** 10 devices **Ultrasonic ARU:** 26 devices **Acoustic ARU:** 6 devices **BBSUS:** 15 sites **Ornithological survey:** 6 sites	Low open *Eucalyptus leucophloia* woodland over *Acacia bivenosa* and *Acacia inaequilatera* scattered shrubs over *Triodia longiceps, Triodia* epactia, *Triodia brizoides, Triodia wiseana* mid-dense hummock grassland. Some areas supporting *Acacia xiphophylla* (snakewood) tall shrubland.	Stony or stony sand on undulating plains and low rises with spinifex hummock grasslands on loam-clay with a stony mantle. Mixed *Acacia* open shrubland may be present in isolated areas. Coarse stony red clay soils provide habitat for the western pebble-mound mouse (Priority 4). The northern quoll, Pilbara leaf-nosed bat and ghost bat are known to forage in these areas. This habitat type is well represented at a local and regional scale and is not restricted to the study area. The brush-tailed mulgara (P4), Gane's blind snake (P1), grey falcon (VU), Pilbara leaf-nosed bat (VU), Pilbara olive python (VU) and western pebble-mound mouse (P4) were recorded within this habitat type. Substrates within this habitat type are generally considered to be too stony for greater bilby occupancy.	
Plain (cracking clays)	5,756.19	5.60	**Habitat assessment**:** 2 sites **Trapping site:** 5 sites **Ultrasonic ARU:** 8 devices **Acoustic ARU:** 7 devices **BBSUS:** 3 sites **Ornithological survey:** 2 sites	Mid-sparse *Acacia synchronicia* and *Vachellia farnesiana* shrubland over low *Aristida latifolia*, *Cynodon convergens*, *Rhynchosia minima* tussock grassland/ herbland.	Basalt upland gilgai plains associated with the Wona Land System supporting scattered shrubs over grasses and herbs. Provides quality foraging for granivores including cockatoos and budgerigars with large flocks recorded foraging in this habitat type. Provides habitat for the Priority 4 (DBCA) northern short-tailed mouse (*Leggadina lakedownensis*). Habitat degradation associated with grazing and trampling by European cattle. The Pilbara leaf-nosed bat (VU) and short-tailed mouse (P4) were recorded within this habitat type.	
Hills/Ranges/Plateaux	6,446.92	6.27	**Trapping site:** 2 sites **Camera trap:** 1 device **Ultrasonic ARU:** 3 devices **BBSUS:** 1 site	Low open *Eucalyptus* woodland over mixed *Acacia* and *Senna* shrubland over mixed *Triodia* low hummock grassland.	Hills/Ranges/Plateaux consists of large ranges and hills associated with the Capricorn Land System with ridgelines and cliffs containing breakaways, boulders, crevices and caves may provide shelter, denning, foraging and roosting habitat for species such as the northern quoll, Pilbara leaf-nosed bat and ghost bat. No significant fauna taxa were recorded within this habitat type.	

Broad habitat type	Area (ha)	%	Sampling effort*	Vegetation description	Fauna suitability	Representative photos
Gorges/Gullies	82.56	0.08	**Camera traps:** 14 devices **Ultrasonic ARU:** 2 devices **Ghost bat lure:** 2 lures	Low open *Acacia cyperophylla* var. *omearana*, *Corymbia candida* woodland over tall sparse *Acacia tumida*, *Grevillea wickhamii*, *Santalum lanc eolatum* shrubland over mixed *Triodia* and *Eriachne* low sparse tussock/hummock grassland.	Gorges and Gullies are characterised by steep sided rocky habitats with breakaways, caves, crevices, and cracks with a number of semi-permanent and permanent water sources present at the time of survey. Moist areas, woody debris along with dense shrubbery and leaf litter provide shelter and habitat for ground dwelling species. Generally, these areas are of high conservation value providing denning and roosting habitat for species such as the northern quoll, Pilbara olive python, ghost bat and Pilbara leaf-nosed bat. Permanent and semi-permanent waterholes within this habitat type provide important habitat for numerous species (including the northern quoll, ghost bat, Pilbara olive python and Pilbara leaf-nosed bat). No significant fauna taxa were recorded within this habitat type.	
Rocky Escarpments (Ridges/Mesa/Cliffs/ Outcrops/Breakaways)	2,142.50	2.08	**Habitat assessment**:** 2 sites **Trapping site:** 8 sites **Ultrasonic ARU:** 10 sites **Camera trap:** 43 devices **BBSUS:** 2 sites **Nocturnal search:** 1 night **Ornithological survey:** 1 site	Mixed shrubland of *Acacia* sp., *Senna* sp., *Hakea* sp., *Eremophila*, *Ptilotus obovatus*, *Paspalidium clementii* and *Solanum lasiophyllum* over hummock grassland of *Triodia* sp.	Rocky features from small-scale rock face to large protruding rocks/boulders and mesas, usually associated with the tops or bases of ridgelines, stony hills and rises. Ridgelines, cliff, breakaways, boulders, crevices and caves within this habitat type may provide shelter, denning and roosting habitat for species such as the northern quoll, ghost bat and Pilbara leaf-nosed bat. This habitat type is well represented at a local and regional scale and is not restricted to the study area. The northern quoll (EN), Pilbara leaf-nosed bat (VU) and western pebble-mound mouse (P4) were recorded within this habitat type.	

Broad habitat type	Area (ha)	%	Sampling effort*	Vegetation description	Fauna suitability	Representative photos
Drainage Line/River/Creek (major)	2,029.04	1.97	**Habitat assessment**:** 3 sites **Trapping site:** 7 sites **Ultrasonic ARU:** 27 devices **Acoustic ARU:** 1 device **Camera trap:** 33 devices **BBSUS**: 8 sites **Ghost bat lure:** 4 lures **Nocturnal search:** 1 night **Ornithological survey:** 4 sites	Open woodland of *Eucalyptus camaldulensis* and *Eucalyptus victrix* over and *Acacia coriacea* subsp. *pendens* over mixed *Cenchrus* and *Triodia* low tussock and hummock grassland.	Generally encompassing major drainage lines and associated tributaries, this habitat type feature deeply incised drainage channels and a higher density of vegetation than surrounding areas. Substrates of gravelly, sand or rocks on clay/loam soils provide quality burrowing substrates. Scattered trees and shrub species provide habitat for birds and shelter for species using this habitat for dispersal (northern quoll, grey falcon, Pilbara leaf-nosed bat, ghost bat and Pilbara olive python). This habitat type is well represented at a local and regional scale and is not restricted to the study area. The ghost bat (VU), grey falcon (VU), northern quoll (EN), Pilbara leaf-nosed bat (VU) and Pilbara olive python (VU) were recorded in this habitat type.	
Drainage Line/River/Creek (minor)	2,424.40	2.36	**Habitat assessment**:** 7 sites **Trapping site:** 2 sites **Cages:** 1 site **Ultrasonic ARU:** 10 devices **BBSUS**: 4 sites	Scattered *Eucalyptus leucophloia* subsp. *leucophloia* over *Acacia pruinocarpa* over *Triodia epactia*, *Eriachne lanata* low hummock/tussock grassland.	This habitat type features shallow incised drainage channels and a higher density of vegetation than surrounding areas. Substrates of gravelly, sand or rocks on clay/loam soils supports scattered trees and shrubs. This habitat type is well represented at a local and regional scale and is not restricted to the study area. The grey falcon (VU), short-tailed mouse (P4) and Pilbara leaf-nosed bat (VU) were recorded in this habitat type.	
Cleared	1,020.92	0.99	**Habitat assessment**:** 2 sites **Bat detector**: 2 devices **BBSUS:** 5 sites **Ghost bat lure:** 1 lure **Nocturnal survey**: Four nights **Ornithological survey:** 2 sites	N/A	Anthropogenic clearing with little to no vegetation. The grey falcon and Pilbara leaf-nosed bat were both recorded in this habitat type; however, these records are associated with dispersal or utilisation of man-made waterbodies rather than permanent occupancy.	N/A
Total	102,802.56	100				

***Note: Sites which appear to be located in cleared areas were sampled in adjacent habitat or were associated with man-made structures and waterbodies (e.g. dams).**
****Number only includes habitat assessments not undertaken at systematic trap sites.**

119.7°E
119.8°E
119.9°E
120°E
120.1°E
21.9°S
22°S
22.1°S
22.2°S
22.3°S
22.4°S

Study area

Habitat type

- Cleared
- Drainage Line/River/Creek (major)
- Drainage Line/River/Creek (minor)
- Gorges/Gullies
- Granite Outcrops (flat dome)
- Hills/Ranges/Plateaux
- Plain (Cracking clays)
- Plain (stony/gibber)
- Rocky Escarpments (Ridges/Mesa/Cliffs/Outcrops/Breakaways)
- Woodland (closed)
- Woodland (open)

Water sources

- Bonney Downs Station Dam
- Bonnie Pools
- Non-permanent pool/waterhole
- Permanent pool/waterhole
- Date Palm

ecologia ENVIRONMENT

Project No.: 2021
Author: SP
Created Date: 23 January 2025
Coordinate System: GCS GDA 1994
Scale: 1:190,000 @A3

Map 14: 14: Fauna habitat types identified within the study area.

0 2 4 6 10 Kilometers

Earthstar Geographics, Maxar

4.2 FAUNA ASSEMBLAGE

Of the 305 vertebrate fauna species identified by database searches as potentially occurring within 40 km of the study area, 237 (63.5%) were recorded during the current surveys including 31 mammals (20 non-volant species and 11 bats), 82 reptiles, 118 birds, four amphibians and two fish. A regional fauna summary table, showing species recorded during each survey is provided in Appendix C. The fauna assemblage recorded is considered typical for the habitat types observed within the study area.

4.2.1 Mammals

A total of 31 mammal species from 13 families were recorded within the study area including 17 species of native ground dwelling mammals, 11 species of bat and three introduced species (Appendix C). Ground dwelling mammal species recorded include six carnivorous marsupials (Dasyuridae), six native rodents (Muridae), three macropods (Macropodidae), the dingo (Canidae) and three introduced mammals (European cattle, feral cat and house mouse). The number of non-volant mammal species recorded (20, three introduced) represents 66.7% of species identified as occurring the region based on database searches. The mammal assemblage recorded during the current surveys is greater than or equal to all bar one detailed survey assessed as part of the literature review (Appendix C).

Echolocation calls belonging to two species of sheath-tailed bat (Emballonuridae), three species of freetail bat (Molossidae), the Pilbara leaf-nosed bat, the ghost bat, the black flying fox and three species of evening bats (Vespertilionidae) were recorded during the current survey. A single ghost bat 'fly-by' was recorded on motion cameras at acoustic lure site BDGB03 within Drainage Line/River/Creek (major) at Bonney Downs North and the Pilbara leaf-nosed bat was recorded at 19 sites across the study area. A small colony of the black flying-fox was recorded roosting at site BB006 in a large date palm growing in a major drainage line.

The northern quoll (*Dasyurus hallucatus* [Endangered]), Pilbara leaf-nosed bat (*Rhinonicteris aurantia* [Vulnerable]), ghost bat (*Macroderma gigas* [Vulnerable]), short-tailed mouse (*Leggadina lakedownensis* [Priority 4], brush-tailed mulgara (*Dasycercus blythi* [Priority 4]) and western pebble-mound mouse (*Pseudomys chapmani* [Priority 4]) were recorded during the current survey. Four significant species, comprising the northern quoll, Pilbara leaf nosed bat, short-tailed mouse and western pebble-mound mouse were recorded at both Bonney North and Bonney South. The ghost bat was only recorded in Bonney North and the brush-tailed mulgara was only recorded at Bonney South. Further discussion regarding significant mammals recorded within the study area is provided in Section 4.3.

4.2.2 Avifauna

A total of 118 bird species from 49 families were recorded during the current surveys (Appendix C). The family Meliphagidae (honeyeaters) (12 species) was the most diverse family recorded during the surveys, followed by Accipitridae (raptors) (nine species), Anatidae (ducks) (seven species) and Artamidae (woodswallows, butcherbirds and magpies) (six species) (Appendix C). The number of avifauna taxa recorded within the study area (118 species) represents 66.3% of species potentially occurring according to database searches and the assemblage recorded is significantly more diverse than that recorded by all other detailed assessed as part of the literature review (Appendix C). No introduced avifauna taxa were recorded during the surveys.

The grey falcon (*Falco hypoleucos* [Vulnerable]) was recorded on 10 occasions during the Bonney Downs detailed, targeted and BBSUS surveys. One additional grey falcon observation was recorded at Bonney Downs South. Further discussion on the grey falcon is provided in Section 4.3.2.1. An additional 10 Migratory birds and three Threatened avifauna species (common greenshank [EN/MI], Australian painted snipe [EN] and night parrot [EN/CR]) considered

moderately likely to occur within the study area. These species are discussed further in Section 4.3.5.

4.2.3 Reptiles

A combined total of 82 species of reptile, represented by 11 families, were recorded during the current survey (Appendix C). Reptile species recorded included 21 geckos (12 Diplodactylidae, one Carphodactylidae and eight Gekkonidae), 23 skinks (Scincidae), 11 venomous snakes (Elapidae), three pythons (Pythonidae), nine monitor lizards (Varanidae), six legless lizards (Pygopodidae), five dragons (Agamidae), three blind snakes (Typhlopidae) and one turtle (Chelidae) (Appendix C). The reptile diversity recorded within the study area (82 species) represents 92.1% of reptile species potentially occurring within 40 km of the study area according to database searches and the assemblage recorded is significantly more diverse than that recorded by all other detailed assessed as part of the literature review (Appendix C). No introduced reptile taxa were recorded during the surveys.

The Pilbara olive python (*Liasis olivaceus barroni*) was recorded on two occasions during detailed and targeted surveys at Bonney Downs North, with one individual recorded during nocturnal spotlighting adjacent to Bonney Pools and one individual captured at a systematic trapping site (BDDP16). The Gane's blind snake was also recorded during the phase three detailed fauna survey undertaken at Bonney Downs North. Significant reptiles recorded in the study area are discussed in further detail in Section 4.3.2.

4.2.4 Amphibians

Four amphibian taxa were recorded during the surveys, represented by three families including Limnodynastidae (one species), Myobatrachidae (one species) and Pelodryadidae (two species) (Appendix C). The amphibian diversity recorded within the study area represents 50% of species potentially occurring within 40 km of the study area according to database searches. The number of amphibians recorded during the current surveys was equal to or greater than that recorded during all detailed fauna surveys assessed as part of the literature review (Appendix C). No introduced or significant amphibian taxa were recorded within the study area and no significant taxa are expected to occur based on database searches.

Significant rainfall was recorded in the months prior to the phase three detailed fauna survey resulting in favourable conditions for amphibians.

4.2.5 Fish

Two fish were recorded from aquatic habitat at Bonney Creek during the Bonney Downs North detailed survey. Both species are considered common throughout the Pilbara. Although database searches failed to identify any fish taxa within 40 km of the study area, this likely reflects the low levels of historical sampling effort undertaken within the local area rather than an actual absence of these species. The number of fish taxa recorded during the current surveys exceeds that recorded by all other detailed surveys assessed as part of the literature review (Appendix C). No significant or introduced fish taxa were recorded within the study area.

4.2.6 Introduced Species

Three introduced species were recorded during the surveys including European cattle, the cat and the house mouse. Canines were recorded during both detailed fauna surveys; however, genetic research suggests that feral dogs and feral dog/dingo hybrids are very rare across mainland Australia (Cairns, Crowther, Nesbitt, & Letnic, 2021). Therefore, these canines have been classified as dingoes for the purposes of this report and are not considered to represent an introduced species.

The study area intersects an operational pastoral lease and European cattle activity (trampling, grazing, primary sighting, scats and tracks) was widely recorded throughout the study area. The house mouse was recorded at three trapping sites at Bonney Downs North and a single individual was recorded at site BDS 2 at Bonney Downs South. Feral cats were recorded at 10 camera trapping sites within the Bonney Downs North survey area, with additional opportunistic records obtained at Bonney Downs South.

4.3 SIGNIFICANT FAUNA

A post-survey likelihood of occurrence assessment was undertaken for significant fauna species with the potential to occur within the study area, taking into consideration the field survey results, habitat types identified, and desktop survey (Appendix G). Further discussion surrounding significant species recorded within the study area and species considered highly or moderately likely to occur within the study area is provided in Sections 4.3.2 - 4.3.5.

Nine significant species were recorded during the current survey, included one bird, six mammals and two reptiles:

- Northern quoll (*Dasyurus hallucatus*) – Endangered EPBC Act and BC Act;
- Grey falcon (*Falco hypoleucos*) – Vulnerable EPBC Act and BC Act;
- Pilbara olive python (*Liasis olivaceus barroni*)- Vulnerable EPBC Act and BC Act;
- Pilbara leaf-nosed bat (*Rhinonicteris aurantia* [Pilbara form]) - Vulnerable EPBC Act and BC Act;
- Ghost bat (*Macroderma gigas*) – Vulnerable EPBC Act and BC Act
- Gane's blind snake (*Anilios ganei*) – Priority 1;
- Brush-tailed mulgara (*Dasycercus blythi*) – Priority 4;
- Western pebble-mound mouse (*Pseudomys chapmani*) – Priority 4; and
- Short-tailed mouse (*Leggadina lakedownensis*) – Priority 4.

Although the greater bilby (*Macrotis lagotis* [VU]) has been historically recorded on two occasions (1982 & 1984) within the study area, suitable burrowing substrates are generally absent from habitat types and no evidence of this species was recorded during the current survey.

The long-tailed dunnart (*Sminthopsis longicaudata* [Priority 4]) and peregrine falcon (*Falco peregrinus* [Other Specially Protected Fauna]) were allocated a high likelihood of occurrence rating due to proximity of recent records and presence of suitable habitat within the study area. Ten Migratory birds (common sandpiper, fork-tailed swift, sharp-tailed sandpiper, red-necked stint, oriental plover, gull-billed tern, Caspian tern, glossy ibis, wood sandpiper and marsh sandpiper) and two Threatened avifauna taxa (common greenshank and Australian painted snipe) were allocated a moderate likelihood of occurrence based on distance of records from the study area and ability of these species to overfly or intermittently utilise habitat within the study area. One additional Threatened avifauna species (night parrot [CR/EN]) was assessed as moderately likely to occur, based on the modelled distribution of the species and presence of suitable roosting and foraging habitat within the study area.

The likelihood of occurrence assessment identified 10 species (seven birds, one mammal and two reptiles) as having a low likelihood of occurrence within the study area due to absence of suitable habitat, age of records, distance of records from the study area or a combination of these factors. An additional two species (crest-tailed mulgara and barking owl) were classified as 'Does Not Occur' as these records were assessed to represent inaccurate taxonomic identifications and/or the species does not occur within the region. Species assigned a likelihood of occurrence of 'Low' or 'Does Not Occur' will not be discussed further.

4.3.1 Matters of National Significance (MNES)

Significant impacts to MNES are considered by DEWHA (2013) to be impacts which are important, notable or of consequence having regard to its context or intensity. DEWHA (2013) also outlines important populations necessary for a species' long-term survival and recovery, which may include:

- key source populations either for breeding or dispersal;
- populations necessary for maintaining genetic diversity; and/or
- populations near the limit of the species range.

Six MNES species listed as Threatened (EPBC Act) have been recorded in the survey area during current or previous surveys:

- Northern quoll (*Dasyurus hallucatus*) - Endangered EPBC and BC Act.
- Grey falcon (*Falco hypoleucos*) – Vulnerable EPBC and BC Act.
- Pilbara leaf-nosed bat (*Rhinonicteris aurantia*) - Vulnerable EPBC Act and BC Act.
- Ghost bat (*Macroderma gigas*) - Vulnerable EPBC Act and BC Act.
- Greater bilby (*Macrotis lagotis*) - Vulnerable EPBC Act and BC Act.
- Pilbara olive python (*Liasis olivaceus barroni*) - Vulnerable EPBC Act and BC Act.

Significant impacts to MNES are considered by DEWHA (2013) to be impacts which are important, notable or of consequence having regard to its context or intensity. Habitat critical to the survival of a species and important populations is considered important. According to DEWHA (2013), critical habitat to the survival of a species refers to areas that are necessary:

- for activities such as foraging, breeding, roosting or dispersal;
- for 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.

Further discussion regarding habitats within the study area considered critical for each MNES species recorded within the study area is provided in Sections 4.3.2 and 4.3.3.

4.3.2 Significant Fauna Recorded – Current Surveys

4.3.2.1 Grey falcon (*Falco hypoleucos*) – Vulnerable EPBC Act and BC Act

Ecology and Distribution

The grey falcon (*Falco hypoleucos)* is a stocky, elusive species endemic to mainland Australia and is the rarest of the Australian members of the *Falco* genus (Marchant & Higgins, 1993); (Schoenjahn, 2011b). The total population size is accepted to be <1,000 mature individuals (Schoenjahn, 2011a) and as a result, this species was listed as Vulnerable under the EPBC Act in September 2019. The grey falcon is also listed as Vulnerable under the BC Act.

The grey falcon is a medium-sized raptor, with average body mass for males around 390 grams and for females around 560 grams (Schoenjahn, 2011b). A sleek, grey plumaged falcon with a swift, direct flight pattern, patrolling low over groundcover below treetop level with shallow wing beats and brief glides (Morcombe, 2022). Soars with wings held close to level with dark tipped primaries slightly spread to give a blunt wingtip (Morcombe, 2022).

Grey falcons of all ages feed almost exclusively on birds including doves, pigeons, parrots, cockatoos and finches (Schoenjahn, Pavey, & Walter, 2020). Grey falcons hunt predominantly in open country, often over treeless grassland, which is also a key feeding habitat of prey species (Schoenjahn, 2013) and are well known for hunting over natural and artificial water sources (Schoenjahn, 2018).

The grey falcon is distributed sparsely over parts of Australia's arid and semi-arid zone with climate characteristics appearing to play a crucial role in the species' distribution (Schoenjahn *et al*., 2020). This species occurs in low densities across inland Australia and is considered to comprise a single, monotypic population (Marchant & Higgins, 1993). The species frequents timbered lowland plains, particularly Acacia shrublands that are crossed by tree-lined water courses (Garnett, Szabo, & Dutson, 2011); (Ehmann & Watson, 2008); (Schoenjahn, 2013). The species has been observed hunting in treeless areas and frequents tussock grassland and open woodland, especially in winter (Schoenjahn, 2018); (Olsen & Olsen, 1986).

Grey falcons do not build their own nests and use old stick-nests of other birds, mainly corvids and other raptors in trees or on artificial structures including telecommunication towers and powerline poles (Schoenjahn *et al*., 2020); (Johnstone & Storr, 1998). Nesting usually occurs high in the tallest trees in the area usually along watercourses or river pools (Morcombe, 2022) particularly in *Eucalyptus camaldulensis* and *Eucalyptus coolabah* (Threatened Species Scientific Committee, 2020). Breeding takes place between June and November with a clutch size of 2-4, a nestling number of 1-4 and a nestling period of >38 days (Schoenjahn, 2013).

Occurrence within the Study Area

DBCA and Fortescue database searches identified 38 records of the grey falcon within 100 km of the study area, with the closest record (historical) located within 70 m of the study area (Map 7).

The grey falcon was recorded on 10 occasions during the Bonney Downs North and BBSUS surveys (ecologia, 2024a, 2024b), with an additional record obtained during the Bonney Downs South surveys (Spectrum Ecology, 2024). A maximum of two individuals have been recorded at any given time, suggesting that at least one pair of birds are regularly utilising habitat within the study area. Behaviours recorded include soaring and active flight, feeding, perching and standing in an ephemeral waterbody (ecologia, 2024a).

Grey falcon records and critical habitat mapping are provided in Map 15.

Critical Habitat within the Study Area

Repeated sightings of grey falcons during the detailed, targeted and BBSUS surveys suggest regular utilisation of habitat in and around the study area. The species may overfly and forage within all habitat types and Drainage Line/River/Creek (major) (2,029.04 ha) habitat within the study area represents critical breeding and foraging habitat for the grey falcon.

At least 12 suitably sized stick nests were recorded within minor and major drainage lines within the Bonney Downs North portion of the study area (ecologia, 2024a). Breeding activity, presence of juvenile or sub-adult birds and nest utilisation has not been recorded to date despite extensive targeted searches. Although no evidence of nest utilisation by grey falcons was recorded during the current surveys, nests identified within the study area represent potential future breeding habitat for the species. Inspection of man-made structures (e.g. telecommunication towers) within the study area failed to identify any nests which may be utilised by grey falcons.

119.7°E
119.8°E
119.9°E
120°E
120.1°E
21.9°S
22°S
22.1°S
22.2°S
22.3°S
22.4°S

Study area

Ecologia (2024) BBSUS Year 1
Grey falcon (EPBC: VU)

Spectrum (2024) Bonney South
Grey falcon (EPBC: VU)

Ecologia (2024) Bonney North
Grey falcon (EPBC: VU)

Grey falcon breeding habitat
Drainage Line/River/Creek (major)

ecologia ENVIRONMENT

Project No.: 2021
Author: SP
Created Date: 2 December 2024
Coordinate System: GCS GDA 1994
Scale: 1:190,000 @A3

Map 15: Grey falcon records and critical habitat within the study area.

0 2 4 6 10 Kilometers

Earthstar Geographics

4.3.2.2 Northern quoll (*Dasyurus hallucatus*) - Endangered EPBC and BC Act

Ecology and Distribution

The northern quoll's range once extended contiguously across the north of Australia but is now restricted to six separate land units including the Pilbara (DoE, 2023a). The Pilbara is now regarded as the stronghold population for the species given that the cane toad is not expected to make its way across the desert into parts of the Pilbara (Woinarski, Burbidge, & Harrison, 2014). The preferred denning habitat for the northern quoll is rocky escarpments, but the species also utilises riverine habitat for dispersal (Woinarski *et al.,* 2014). Rocky habitats with rock crevices and caves support higher densities of northern quoll (S. van Dyck & R. Strahan, 2008; Woinarski *et al.*, 2014). Predominantly inhabiting dissected rocky escarpments, a male quoll can have a home range of more than 100 ha while a female occupies territories of up to 35 ha (Steve Van Dyck & Ronald Strahan, 2008).

While this species is predominantly nocturnal, it may be observed during the day particularly during the breeding season and on overcast days (Oakwood, 2008). Northern quolls are opportunistic omnivores, feeding primarily on small vertebrates (mammals, amphibians and reptiles), invertebrates and soft fruits (Oakwood, 2008). Breeding occurs once per year, with juveniles deposited in dens once they reach eight to nine weeks of age (Oakwood, 2008). Northern quolls are the smallest of the Australian quolls and are the largest mammal species in the world for males to undergo die-off events following the breeding season (Oakwood, 2008). Lifespan of females in the wild is typically less than three years, with most females only surviving a single breeding season (Oakwood, 2008).

Important Populations and Critical Habitat

Northern quoll populations considered important for the long-term survival of this species are outlined by the Commonwealth of Australia (2016) in the EPBC referral guidelines for the northern quoll. Populations important for the long-term survival of this species include:

- high density populations, which occur in refuge-rich habitat critical to the survival of the species, including where cane toads are present
- occurring in habitat that is free of cane toads and unlikely to support cane toads upon arrival i.e. granite habitats in WA, populations surrounded by desert and without permanent water
- subject to ongoing conservation or research actions i.e. populations being monitored by government agencies or universities or subject to reintroductions or translocation.

The EPBC referral guidelines define a high-density population as being characterised by numerous camera triggers by multiple individuals at multiple sites and or traps (Commonwealth of Australia, 2016). A low density population is defined as on which is characterised by infrequent captures of one or two individuals which are confined to one or two sites or where no individuals have been trapped but latrine evidence is present (Commonwealth of Australia, 2016).

The EPBC referral guidelines for the northern quoll also outline habitat critical to the survival of the species (Commonwealth of Australia, 2016). Critical habitat for this species is outlined below:

- offshore islands where the northern quoll is known to exist
- rocky habitats such as ranges, escarpments, mesas, gorges, breakaways, boulder fields, major drainage lines or treed creek lines

- structurally diverse woodland or forest areas containing large diameter trees, termite mounds or hollow logs.

Dispersal and foraging habitat which is associated with or connects populations important for long-term survival of the species are also considered critical habitat for the northern quoll (Commonwealth of Australia, 2016).

Occurrence within the Study Area

DBCA and Fortescue database searches indicate that a total of 934 northern quoll records have previously been documented within 100 km of the study area, with 85 Fortescue records occurring within the study area (Map 7).

The northern quoll was recorded at 13 sites across six camera transects and a single opportunistic camera trapping site within Bonney Downs North (ecologia, 2024a). A total of 219 independent motion camera visits were recorded during targeted northern quoll surveys at Bonney Downs North, with spot pattern analysis identifying at least eight individuals (ecologia, 2024a). An additional nine northern quoll individuals (seven males, two females) were trapped across four systematic sites (BDDP04, BDDP07, BDDP10 and BDDP19) at Bonney Downs North (ecologia, 2024a). A single visit by a northern quoll was recorded at Bonney Downs South, which is considered likely to have been a dispersing male rather than a permanent occupant (Spectrum Ecology, 2024).

Northern quoll records and critical habitat mapping are shown in Map 16.

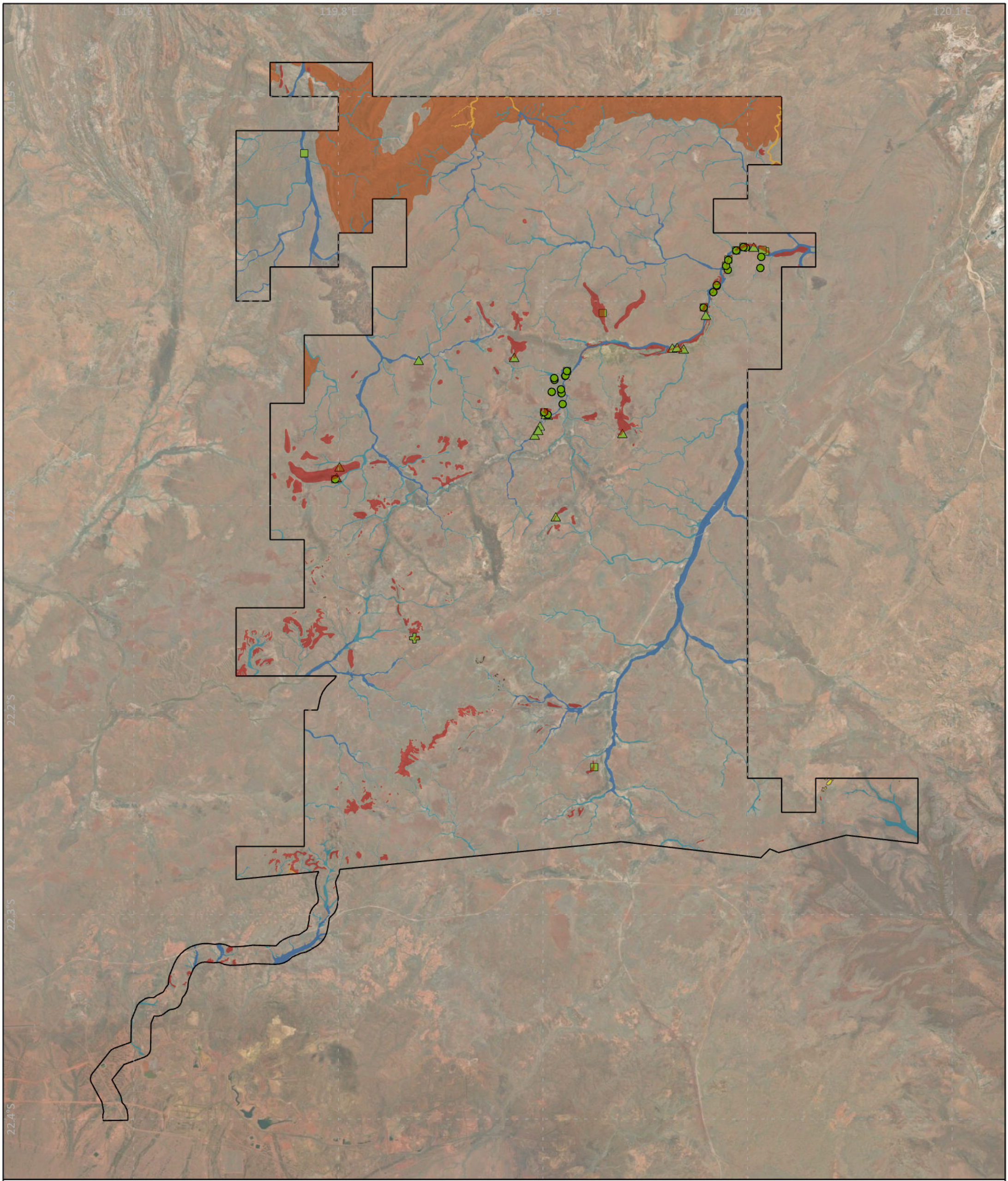
Critical Habitat and Important Populations within the Study Area

The EPBC referral guidelines define a high-density population as one characterised by numerous camera triggers or captures of two or more individuals across multiple traps or cameras on the site (Commonwealth of Australia, 2016). High density northern quoll populations are considered important for the long-term survival of the species when they occur in refuge-rich habitats, even when cane toads are present (Commonwealth of Australia, 2016).

Based on the number of individuals identified and frequency of detections, the northern half of the study area appears to support a high density, reproductive population of northern quolls. Conversely, the low number of records obtained in the southern half of the study area (Bonney Downs South), suggests that this portion of the study area only supports a low-density quoll population and is unlikely to represent critical habitat for the species.

Rocky habitats such as ranges, escarpments, mesas, gorges, breakaways, and major drainage lines which provide shelter for breeding, refuge from fire or predation are considered critical habitat for the northern quoll (Commonwealth of Australia, 2016). Additionally, populations which occur in habitats that are currently free of cane toads and are unlikely to support any future cane toad invasion are considered critical for the survival of the species (Commonwealth of Australia, 2016). Based on this, Rocky Escarpment (2,142.50 ha), Gorges/Gullies (82.56 ha), Drainage Line/River/Creek (major and minor) (4,453.44 ha) and Hills/Ranges/Plateaux (6,446.92 ha) habitat within the northern half of the study area is considered critical for the survival of the northern quoll.

Based on the results of the current surveys, habitat in the southern half of the study area does not appear to be critical for the survival of the northern quoll; however, Rocky Escarpments, Granite Outcrops and Drainage Line/River/Creek (major and minor) habitat types in the southern half of the study area may be utilised by the species during dispersal and foraging activities.



Study area

Ecologia (2024) Bonney North
- Northern quoll (EPBC: EN)

Spectrum (2024) Bonney South
- Northern quoll (EPBC: EN)

DBCA database
- Northern quoll (EPBC: EN)

FMG Database
- Northern Quoll (EPBC: EN)

Dispersal habitat
- Drainage Line/River/Creek (major)
- Drainage Line/River/Creek (minor)

Critical habitat
- Gorges/Gullies
- Granite Outcrops (flat dome)
- Hills/Ranges/Plateaux
- Rocky Escarpments (Ridges/Mesa/Cliffs/Outcrops/Breakaways)

ecologia ENVIRONMENT

Project No.: 2021
Author: SP
Created Date: 2 December 2024
Coordinate System: GCS GDA 1994
Scale: 1:190,000 @A3

Map 16: Northern quoll records and critical habitat within the study area.

0 2 4 6 10 Kilometers

Earthstar Geographics

4.3.2.3 Pilbara leaf-nosed bat (*Rhinonicteris aurantia* [Pilbara form]) – Vulnerable EPBC Act and BC Act

Ecology and Distribution

This small insectivorous bat occurs throughout the Pilbara and adjacent upper Gascoyne regions of Western Australia (Threatened Species Scientific Committee, 2016b). The species was listed under the EPBC Act as Vulnerable in April 2001 as it had undergone a substantial reduction in numbers, its geographic distribution is precarious for its survival (being limited to the Pilbara), the estimated total number of mature individuals is limited, and the number is likely to continue to decline.

The Pilbara leaf-nosed bat has very restrictive habitat requirements, including caves and disused mines with hot to very hot and humid roost sites with temperatures in the 28° to 32°C range and 96% to 100% relative humidity (K. N. Armstrong, 2001; S. Churchill, 2008). During the Pilbara dry, winter months, preceding the heavy summer rains, Pilbara leaf-nosed bat colonies are thought to contract to the deepest mines and caves that maintain microclimates suitable for roosting (K. N. Armstrong, 2001; Bullen & McKenzie, 2011; S. van Dyck & R. Strahan, 2008). During the hotter, wetter and more humid summer months, the species has a greater ability to disperse through the landscape. The Pilbara leaf-nosed bat has been observed foraging in a variety of habitats including *Triodia* hummock grasslands covering low rolling hills and shallow gullies, with scattered *Eucalyptus camaldulensis* along the creeks (DoE, 2023b). This species is most commonly encountered over small pools of water in rocky gullies and gorges (DoE, 2023b).

Critical Roosting and Foraging Habitat

Underground refuges used by the Pilbara leaf-nosed bat can be categorised into one of the following standard categories:

- **permanent diurnal roosts (Priority 1)**—occupied year-round and likely the focus for some part of the 9-month breeding cycle; considered as critical habitat that is essential for the daily survival of the PLNB.
- **non-permanent breeding roosts (Priority 2)**—evidence of usage during some part of the 9-month breeding cycle (July–March), but not occupied year-round; considered as critical habitat that is essential for both the daily and long-term survival of the PLNB.
- **transitory diurnal roosts (Priority 3)**—occupied for part of the year only, outside the breeding season (i.e. April–June), and which could facilitate long distance dispersal in the region; considered as critical habitat that is essential for both the daily and long-term survival of the PLNB.
- **nocturnal refuge (Priority 4)**—occupied or entered at night for resting, feeding or other purposes, with perching not a requirement. Excludes overhangs. Not considered critical habitat but are important for persistence in a local area.

Pilbara leaf-nosed bats have been observed foraging in a variety of habitats including spinifex hummock grasslands covering low rolling hills and shallow gullies, black soil grasslands, open savannah woodland, tall open forest and monsoon rainforest (S. K. Churchill, Jolly, Hand, & Milne, 2008). The Pilbara leaf-nosed bat is commonly encountered over small pools of water in rocky gullies and gorges (DEWHA, 2021). Foraging areas may range up to 20 km away from a diurnal roost (Bat Call, 2016). Given the lack of understanding around which habitats are required to sustain a roosting colony, it is difficult to define critical foraging habitat of the PLNB (Threatened Species Scientific Committee, 2016b). According to the Conservation Advice for the Pilbara leaf-nosed bat, foraging habitats are categorised as follows:

- **Gorges with pools (Priority 1)**—watercourses through upland areas bounded by sheer rock walls for parts of their length, often containing pools that remain for weeks or months, sites of relatively large biomass production, sometimes containing caves;
- **Gullies (Priority 2)**—primary drainage with limited riparian development in upland rocky habitats, sometimes containing small pools that may last for weeks, with less biomass production than Priority 1 gorge habitat;
- **Rocky outcrop (Priority 3)**—areas of exposed rock at the top of rocky outcrop and mesa hills that contain caves and overhangs, and boulder piles in the granite terrains;
- **Major watercourses (Priority 4)**—riparian vegetation on flat land plus the main gravelly or sandy channel of the riverbed, sometimes containing pools that persist for weeks or months, and generally supporting higher productivity of biomass than the surrounding habitats;
- **Open grassland and woodland (Priority 5**)—dominated by *Triodia,* on lowland plains, colluvial slopes and hilltops.

Occurrence within the Study Area

DBCA and Fortescue database search results indicate that the Pilbara leaf-nosed bat has been recorded on 1,838 occasions within 100 km of the study area, with the closest record located approximately 20 km from the study area (Map 7).

Echolocation calls belonging to the Pilbara leaf-nosed bat were recorded at seven sites (54 passes) during the phase one detailed surveys undertaken at Bonney Downs North, with a single detection recorded in phase two and no detections in phase three. Calls belonging to the Pilbara leaf nosed bat were also recorded at three sites (43 passes) during the October 2024 BBSUS and three sites (four passes) during the February 2024 BBSUS. No calls were recorded at BBSUS sites in March 2024. The Pilbara leaf-nosed bat was recorded at five sites within Bonney Downs South, with 70 passes recorded across four sites during the phase 1 survey and four passes recorded at two sites in phase two.

Call patterns recorded to date do not indicate the presence of a nearby roost, with no low time calls recorded at or near civil twilight. Calls patterns recorded to date indicate relatively low activity levels across the study area, with the majority of records collected at sites within Drainage Line/River/Creek (major) habitat and adjacent to water sources (most dams) during the wet season.

Pilbara leaf-nosed bat records and habitat mapping are shown in Map 17.

Roosting and Foraging Habitat within the Study Area

No suitable roost caves have been identified within the study area and no call times indicative of a nearby roost site have been recorded despite extensive survey effort over multiple seasons. Given the general lack of evidence to support the presence of a nearby roost, habitat within the study area is not currently considered to represent critical roosting habitat for the Pilbara leaf-nosed bat. Although the study area supports suitable foraging and dispersal habitat for the Pilbara leaf-nosed bat, echolocation calls recorded to date indicate that this species only infrequently utilises habitat within the study area for foraging and dispersal.

During the wet season, Gorges/Gullies, Drainage Line/River/Creek (major and minor) and other permanent and semi-permanent water bodies within the study area may provide foraging habitat for the species, with site utilisation appearing to decrease significantly in the post-wet season. The species may utilise all habitat types while foraging. As no suitable roosting caves or low-time calls have been recorded to date, habitat within the study area is not considered to be critical for the survival of the species.

119.7°E
119.8°E
119.9°E
120°E
120.1°E
21.9°S
22°S
22.1°S
22.2°S
22.3°S
22.4°S

Study area

Ecologia (2024) Bonney North
- Ghost bat (EPBC: VU)
- Pilbara leaf-nosed bat (EPBC: VU)

Stantec (2024) Bonney South
- Pilbara leaf-nosed bat (EPBC: VU)

Ecologia (2024) BBSUS Year 1
- Ghost bat (EPBC: VU)
- Pilbara leaf-nosed bat (EPBC: VU)

Ghost bat and PLnB potential roosting habitat
- Gorges/Gullies
- Hills/Ranges/Plateaux
- Rocky Escarpments (Ridges/Mesa/Cliffs/Outcrops/Breakaways)

Foraging habitat
- Drainage Line/River/Creek (major)
- Drainage Line/River/Creek (minor)
- Plain (Cracking clays)
- Plain (stony/gibber)
- Woodland (closed)
- Woodland (open)

ecologia ENVIRONMENT

Project No.: 2021
Author: SP
Created Date: 2 December 2024
Coordinate System: GCS GDA 1994
Scale: 1:190,000 @A3

Map 17: Pilbara leaf-nosed bat and ghost bat records and roosting/foraging habitat within the study area.

Earthstar Geographics

0 2 4 6 10 Kilometers

4.3.2.4 Ghost bat (*Macroderma gigas*) – Vulnerable EPBC Act and BC Act

Ecology and Distribution

The ghost bat is the largest microchiropteran bat in Australia, is strictly carnivorous and captures its prey mainly on the ground before returning to an established feeding site to devour its catch (Steve Van Dyck & Ronald Strahan, 2008). The diet of this species includes amphibians, reptiles, birds, small terrestrial mammals, insects and other bats (Steve Van Dyck & Ronald Strahan, 2008). Unlike other microchiropterans, the ghost bat does not continuously call when in flight and instead uses its eyes and ears to scan for prey (Steve Van Dyck & Ronald Strahan, 2008). Females reach reproductive maturity between two and three years of age (Hoyle, Pople, & Toop, 2001).

The ghost bat was historically distributed across much of Australia but now has a fragmented although widespread distribution restricted to northern Australia (Threatened Species Scientific Committee, 2016c). Following European settlement, the distribution of this species contracted northward with arid zone populations undergoing the greatest contractions (Threatened Species Scientific Committee, 2016c). Ghost bat populations are highly structured and are considered to be genetically distinct at both local and regional scales (Threatened Species Scientific Committee, 2016c).

Critical Roosting and Foraging Habitat

Preferred roosting habitat in the Pilbara includes caves beneath bluffs of low, rounded hills composed of Marra Mamba geology, and granite rock piles. Ghost bats have also been known to roost in large colonies within sandstone caves, under boulder piles and in abandoned mines (S. Churchill, 1998). Permanent roost sites are typically deep caves, rock crevices or old mine adits with a relatively stable temperature (23-28°C) and high humidity (50-100%) (Threatened Species Scientific Committee, 2016c). During daylight hours, ghost bats roost in large caves, mines or deep rock fissures (Steve Van Dyck & Ronald Strahan, 2008). In some parts of its range, the ghost bat shares roosts with the Pilbara leaf-nosed bat, Finlayson's cave bat, common heath-tailed bat, and possibly Hill's sheath-tailed bat.

Ghost bats are known to seasonally move between a number of caves or as dictated by weather conditions (Hutson, Mickleburgh, & Racey, 2001) and disperse widely when not breeding, but concentrate in a relatively few roost sites when breeding (Threatened Species Scientific Committee, 2016c). Maternity caves are relatively uncommon, with only 11 recorded in the Pilbara region (three natural caves and eight mines) (K. Armstrong & Anstee, 2000). Diurnal roost caves usually contain one or more large chambers with additional geological features, including fissures and chambers which are completely dark and have a minimum roof height of 2-3 m (Bat Call, 2016). Maternal roost sites exhibit the features outlined for diurnal roosts with the addition of an interior chamber that rises towards the rear of the cave creating a warm and humid environment for breeding females and pups (Bat Call, 2016). Nocturnal roosts or feeding caves (middens), which are only used at night, are usually present in rock overhangs and small caves which are well lit during the day and can be easily recognised based on the presence of discarded prey pieces and faeces on the floor (Richards, Hand, & Armstrong, 2008). K. Armstrong and Anstee (2000) suggested that ghost bats occur in small groups within the Hamersley Ranges and may move about in a local area, possibly in response to disturbance, microclimate or social factors.

Occurrence within the Study Area

DBCA and Fortescue database searches identified 170 ghost bat records within 100 km of the study area, with the closest record located within 10 km. Echolocation and social calls belonging to the ghost bat were not recorded by bat detectors deployed at Bonney Downs North or Bonney

Downs South during the detailed and targeted surveys; however, analysis undertaken by Specialised Zoological indicates the species was detected on motion cameras at acoustic ghost bat lure site BDGB03 in March 2024 (Specialised Zoological, 2024). The image in question and associated commentary by Dr Kyle Armstrong is provided in Appendix D. Confirmatory echolocation recordings were not available for this site; however, identification of the species was based on the presence of an "anteriorly-directed structure resembling long ears, the broad wings and lack of a distinct tail" (Specialised Zoological, 2024). No ghost bat calls were recorded at Bonney Downs South (Spectrum Ecology, 2024); however, acoustic lures which may increase detectability of this cryptic species were not utilised within this portion of the study area.

Ghost bat records and habitat mapping are shown in Map 17.

Roosting and Foraging Habitat within the Study Area

The ghost bat was recorded within Drainage Line/River/Creek (major) habitat within the study area (timestamp 18:52:22). Given the location of the site, this record is likely to be associated with foraging or dispersal activities. No suitable ghost bat roost caves or middens were identified during the current surveys.

Hills/Ranges/Plateaux, Gorges/Gullies and Rocky Escarpment habitat types may provide potential nocturnal shelter and diurnal roosting opportunities for the ghost bat, with all other habitat types providing potential foraging and dispersal habitat. As no suitable roosting caves or low-time calls have been recorded to date, habitat within the study area is not considered to be critical for the survival of the species.

4.3.2.5 Brush-tailed mulgara (*Dasycercus blythi*) – Priority 4

Ecology and Distribution

The brush-tailed mulgara has been reclassified and taxonomically separated from the crest-tailed mulgara (*Dasycercus cristicauda*). This species is more widespread than the crest-tailed mulgara and is not listed in the EPBC Act but is listed as Priority 4 (Rare, Near Threatened and other species in need of monitoring) under *the Biodiversity Conservation Act* (2016).

The brush-tailed mulgara occurs in spinifex grasslands throughout much of the arid zone and dig burrows in flats between low sand dunes (Woolley, 2008). This species is generally solitary outside of the breeding season and constructs single-entranced, multi-tunnelled burrows within their home range (Woolley, 2008). According to Koertner *et al.* (2007), home ranges and burrows encompass both mature spinifex and open regrowth areas and this species does not appear to exhibit a preference for one habitat type over the other. Utilisation of open habitats may be associated with an increased risk of predation, especially following fire.

The brush-tailed mulgara is typically a nocturnal hunter, feeding on arthropods and small vertebrates (Woolley, 2008). This species is not exclusively nocturnal and may be seen basking at burrow entrances on sunny days (Woolley, 2008). During periods of abundant resource availability, fat is stored in the tail to provide an energy reserve when food is scarce (Woolley, 2008). Breeding is thought to occur from late winter to spring (Woolley, 2008).

Occurrence within the Study Area

DCBA and Fortescue database searches indicate that the brush-tailed mulgara has been recorded on 325 occasions within 100 km of the study area. A single brush-tailed mulgara was recorded by a targeted motion camera deployed on a potential burrow in Bonney Downs South (Spectrum Ecology, 2024).

Brush-tailed mulgara records are shown in Map 18.

Habitat within the Study Area

Habitat for the brush-tailed mulgara occurs within the Plain (stony/gibber) habitat type which encompasses spinifex grasslands and substrates suitable for burrowing.

4.3.2.6 Western pebble-mound mouse (*Pseudomys chapmani*) – Priority 4

Ecology and Distribution

The western pebble-mound mouse constructs distinctive mounds of pebbles around their burrows (S. D. Anstee, Roberts, & O'Shea, 1997). The species has a fragmented distribution in the Pilbara, but is known to have a preference for hilly and/or rocky landscapes (S. Anstee & Armstrong, 2001; Ford & Johnson, 2007). When first described, it was considered that the range and abundance of this species had decreased dramatically. Since that time, it has been recorded on numerous occasions and is considered common and widespread in the bioregion.

Occurrence within the Study Area

DBCA and Fortescue database searches identified a total of 991 records of the western pebble-mound mouse within 100 km of the study area, with two previous Fortescue records occuring within the study area. Secondary evidence of the western pebble-mouse mounds was recorded at 10 sites within the Rocky Escarpment and Plain (stony/gibber) habitat types during the Bonney Downs North surveys (ecologia, 2024a), with two additional mounds recorded in Plain (stony/gibber) habitat during the Bonney Downs South surveys (Spectrum Ecology, 2024).

Western pebble-mound mouse records are shown in Map 18.

Habitat within the Study Area

Pebbles of a suitable size for mound construction are found across most of the study area, with suitable habitat occuring within the Rocky Escarpments, Plain (stony/gibber) and Hills/Ranges/Plateaux habitat types. The western pebble-mound mouse is considered relatively widespread throughout the Pilbara and suitable habitat for this species extends well beyond the confines of the study area.

4.3.2.7 Short-tailed mouse (*Leggadina lakedownensis*) – Priority 4

Ecology and Distribution

Populations of this small, elusive rodent are distributed across northern Australia, but records of this species have been sporadic since 1969 (Moro & Kutt, 2008). The short-tailed mouse occupies a diverse range of habitats from the monsoon tropical coast to semi-arid climates, including spinifex and tussock grasslands, samphire and sedgelands, *Acacia* shrublands, tropical eucalypt and *Melaleuca* woodlands and stony ranges. However, the species is usually found in habitats which are seasonally inundated with red or white sandy-clay soils (Moro & Kutt, 2008).

The diet of the short-tailed mouse consists primarily of invertebrates and water requirements are satisfied by consuming supplementary plant material (Moro & Kutt, 2008). Studies indicate that the short-tailed mouse is extremely well physiologically and ecologically adapted to substantial variation in tropical climatic conditions (Moro & Kutt, 2008). Numbers fluctuate greatly in response to rainfall on Thevenard and Serrurier Islands, with populations occasionally reaching plague proportions following heavy rainfall events. Conversely, a population in Kakadu which has been the subject of a long-term monitoring program has exhibited large scale population oscillations which are not correlated with environmental factors. The species is both nocturnal and solitary, spending the day in simple, single-chambered burrows (Moro & Kutt, 2008).

Occurrence within the Study Area

DBCA and Fortescue database searches identified 57 records of the short-tailed mouse within 100 km of the study area, with a single record from 2004 located within 300m of the study area. The short-tailed mouse was recorded on four occasions within the Plain (cracking clay) and Drainage Line/River/Creek (minor) habitat types during the Bonney Downs North surveys (ecologia, 2024a). Four additional short-tailed mouse captures were recorded at two Plain (cracking clay) sites at Bonney Downs South (Spectrum Ecology, 2024).

Short-tailed mouse records are shown in Map 18.

Habitat within the Study Area

Plain (cracking clay) and Drainage Line/River/Creek (minor) habitat types within the study area may encompass suitable substrates for the short-tailed mouse. Suitable habitat for the short-tailed mouse is not restricted within the study area and the known distribution of the species extends beyond the confines of the study area.

4.3.2.8 Gane's blind snake (*Anilios ganei*) – Priority 1

Ecology and Distribution

Very little is known about this elusive blind snake due to its fossorial lifestyle. Blind snakes are exclusively insectivorous and, like other members of their genus, the Gane's blind snake is believed to burrow into social insect colonies to feed on termites and ants, as well as their eggs and pupae (S. Wilson & Swan, 2021). The Gane's blind snake has been found within the Pilbara region between Newman and Pannawonica (S. Wilson & Swan, 2010; S. Wilson & Swan, 2021). It has been suggested that the species prefers to live in subterranean habitats near moist gullies and gorges (S. Wilson & Swan, 2010), although there are records from sandy soil vegetated with spinifex and mulga woodland.

Occurrence within the Study Area

According to DBCA Threatened and Priority database searches, the Gane's blind snake has been recorded on nine occasions within 100 km of the study area. This species was recorded on a single occasion within the Plain (stony/gibber) habitat type at Bonney Downs North (ecologia, 2024a). The species was not recorded at Bonney Downs South (Spectrum Ecology, 2024).

Gane's blind snake records are shown in Map 18.

Habitat within the Study Area

Hills/Ranges/Plateaux, Plain (stony/gibber), Gorges/Gullies and Drainage Line/River/Creek (major) habitat types within the study area may encompass suitable habitat for the Gane's blind snake. Suitable habitat for the Gane's blind snake is not restricted within the study area and the known distribution of the species extends beyond the confines of the study area.

119.7°E
119.8°E
119.9°E
120°E
120.1°E
21.9°S
22°S
22.1°S
22.2°S
22.3°S
22.4°S

Study area

Ecologia (2024) Bonney North
- Gane's blind snake (DBCA: P1)
- Northern short-tailed mouse (DBCA:P4)
- Western pebble-mound mouse (DBCA: P4)

Spectrum (2024) Bonney South
- Brush-tailed mulgara (DBCA: P4)
- Northern short-tailed mouse (DBCA: P4)
- Western pebble-mound mouse (DBCA: P4)

FMG Database
- Western Pebble-mound Mouse (DBCA: P4)

Habitat type
- Cleared
- Drainage Line/River/Creek (major)
- Drainage Line/River/Creek (minor)
- Gorges/Gullies
- Granite Outcrops (flat dome)
- Hills/Ranges/Plateaux
- Plain (Cracking clays)
- Plain (stony/gibber)
- Rocky Escarpments (Ridges/Mesa/Cliffs/Outcrops/Breakaways)
- Woodland (closed)
- Woodland (open)

ecologia ENVIRONMENT

Project No.: 2021
Author: SP
Created Date: 17 January 2025
Coordinate System: GCS GDA 1994
Scale: 1:190,000 @A3

Map 18: Priority fauna recorded within the study area.

0 2 4 6 10 Kilometers

Earthstar Geographics

4.3.2.9 Pilbara olive python (*Liasis olivaceus barroni*) - Vulnerable EPBC Act and BC Act

Ecology and Distribution

The Pilbara subspecies of the olive python only occurs in the ranges of the Pilbara region of Western Australia. It inhabits watercourses and areas of permanent water in rocky gorges and gullies (D. J. Pearson, 2006).This subspecies is an adept swimmer, often hunting in water, feeding on a variety of vertebrates such as rock wallabies, fruit bats, ducks and pigeons. Individuals spend the cooler winter months sheltering in caves and rock crevices. In the warmer months the pythons can move widely, usually in close proximity to water and rock outcrops (DEWHA, 2008). Radiotelemetry of individuals has found that they occupy a distinct home range, with males travelling long distances (up to 4 km) to locate and mate with females (D. Pearson, 2003).

Population size estimates are difficult due to the olive python's cryptic nature and lack of reliable trapping or census techniques (DEWHA, 2008). The main threats to this subspecies come from predation by feral cats and foxes, particularly of juveniles, competition with foxes for food, and destruction of habitat (D. J. Pearson, 2006).

Critical Habitat

Critical habitat for the Pilbara olive python includes areas which may contain escarpments, gorges, preferably with rock crevices and outcrops near water holes, which attract prey species (Threatened Species Scientific Committee, 2008). The species prefers deeps gorges and holes within ranges in the Pilbara and spends the cooler months sheltering in caves and rock crevices away from water sources (Threatened Species Scientific Committee, 2008).

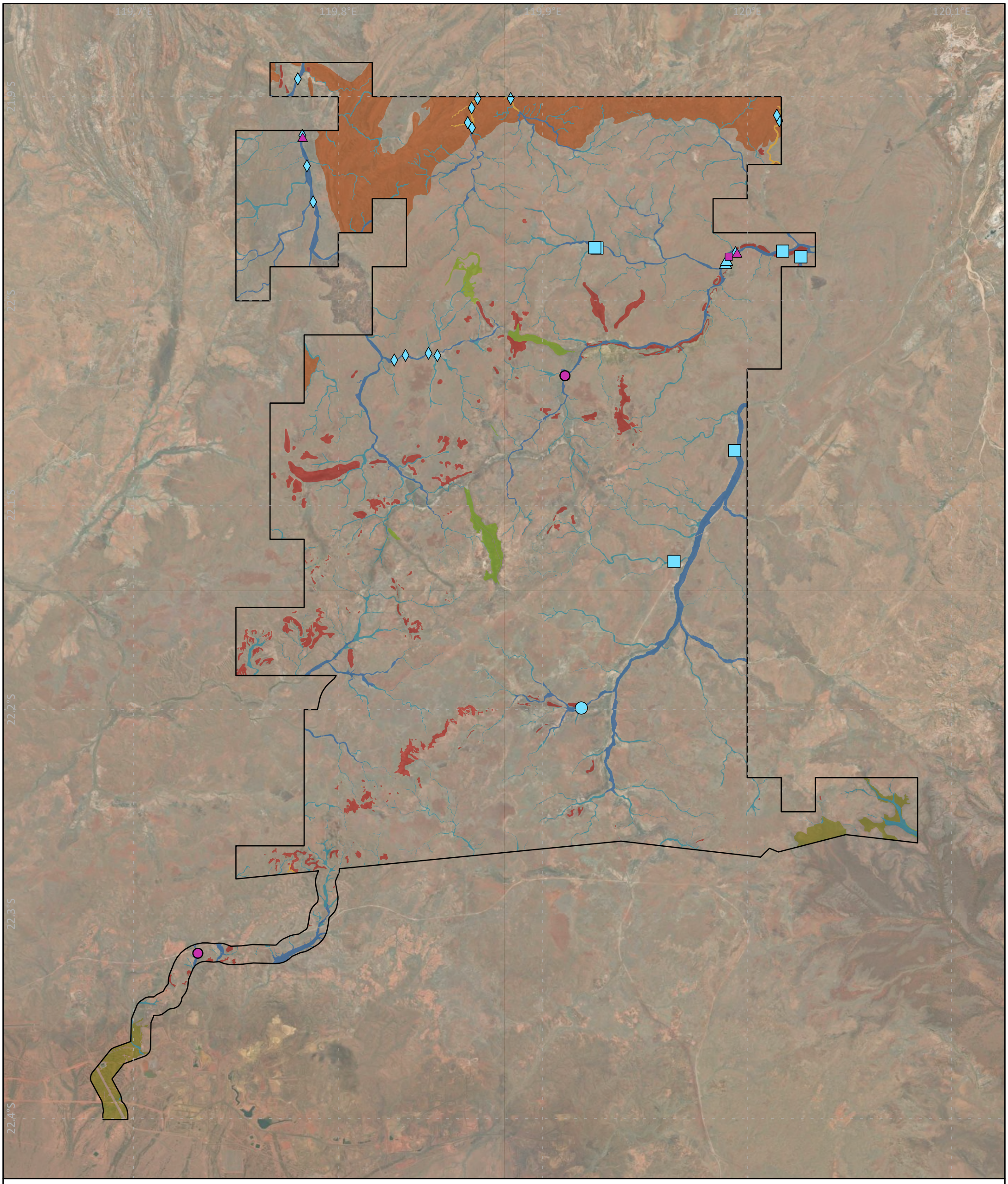
Occurrence within the Study Area

DBCA and Fortescue databases identified 64 records of the Pilbara olive python within 100 km of the study area, with the species recorded on three occasions during previous surveys. The Pilbara olive python was recorded on two occasions within the study area during detailed surveys at Bonney Downs North (ecologia, 2024a). One individual was recorded during nocturnal spotlighting activities near Bonney Pool and another individual was captured in a cage trap during the phase three detailed survey (ecologia, 2024a). No Pilbara olive pythons were recorded at Bonney Downs South (Spectrum Ecology, 2024).

Pilbara olive python records and critical habitat are shown in Map 19.

Critical Habitat within the Study Area

Hills/Ranges/Plateaux (6,446.92), Gorges/Gullies (82.56 ha), Drainage Line/River/Creek (major) (2,029.04 ha) and Rocky Escarpment (2,142.50 ha) habitat types within the study area provide critical habitat for the Pilbara olive python. Permanent and semi-permanent pools within the study area associated with Bonney Creek, Bonney Pools, the station dam, Nullagine River and the Coongan River provide suitable aquatic habitat for the species (Map 19).



Study area

Ecologia (2024) Bonney North
- Pilbara olive-python (EPBC: VU)

DBCA database
- Pilbara olive-python (EPBC: VU)

FMG Database
- Pilbara Olive Python (EPBC: VU)

Critical habitat
- Drainage Line/River/Creek (major)
- Drainage Line/River/Creek (minor)
- Gorges/Gullies
- Hills/Ranges/Plateaux
- Rocky Escarpments (Ridges/Mesa/Cliffs/Outcrops/Breakaways)
- Woodland (closed)
- Woodland (open)

Water sources
- Bonney Downs Station Dam
- Bonnie Pools
- Non-permanent pool/waterhole
- Permanent pool/waterhole

ecologia ENVIRONMENT

Project No.: 2021
Author: SP
Created Date: 2 December 2024
Coordinate System: GCS GDA 1994
Scale: 1:190,000 @A3

Map 19: Pilbara olive python records and critical habitat within the study area.

0 2 4 6 10 Kilometers

Earthstar Geographics

4.3.3 Significant Fauna Recorded – Previous Surveys

4.3.3.1 Greater bilby (*Macrotis lagotis*) – Vulnerable EPBC Act and BC Act

Ecology and Distribution

Once common over 70% of mainland Australia's arid and semiarid regions, the greater bilby is now patchily distributed through the Tanami, Great Sandy and Gibson Deserts (Maxwell, Burbidge, & Morris, 1996). Isolated populations also occur in south-west Queensland and to the north-east of Alice Springs. The species experienced a sudden and widespread population reduction in the early 1900s, and the distribution is believed to still be contracting northwards (Threatened Species Scientific Committee, 2016a). Since the 1800s, the greater bilby has experienced dramatic population reductions to the extent that it now occupies less than 20% of its former range (Threatened Species Scientific Committee, 2016a). The greater bilby occupies a variety of habitats, including open tussock grasslands, Acacia (mulga) shrubland and woodlands, hummock grasslands on plains and alluvial areas and cracking clays (Johnson, 2008; Maxwell et al., 1996; Threatened Species Scientific Committee, 2016a).

The greater bilby is a medium-sized nocturnal marsupial with soft, silky fur (Pavey, 2006). Bilbies are solitary animals which are predominantly nocturnal and shelter in burrows during the day (Threatened Species Scientific Committee, 2016a). This species has strong forelimbs and claws which are used to construct extensive tunnel systems up to 3 m long and 1.8 m deep. The diet of this species is highly specialised and it uses its long tongue to feed on seeds, insects, bulbs, fruit and fungi (Johnson, 2008). Reproduction is dependent on seasonal conditions and resource availability and litters consist of one to three offspring (Threatened Species Scientific Committee, 2016a). Females reach reproductive maturity at five months and males mature three months later (Threatened Species Scientific Committee, 2016a).

Reasons for historical decline included predation by feral predators on both young and adult bilbies, competition from rabbits and livestock, reduced food as a result of changed fire regimes, and drought (Johnson, 2008; Maxwell et al., 1996; O'Malley, 2006). Current threats impacting greater bilby population numbers are identical to historical threats, with the addition of habitat loss and fragmentation due to land clearing and development.

Critical Habitat

Remaining populations of the species are known to occupy three main habitat types: open tussock grassland on uplands and hills, mulga woodland/shrubland on ridges and rises and hummock grassland plains and alluvial areas (Threatened Species Scientific Committee, 2016a). The distribution of the species is limited by the availability of suitable substrates for burrowing, with the species considered more likely to occur in sandy areas where burrow excavation is easier (Commonwealth of Australia, 2019).

Critical habitat for the greater bilby is defined by the species recovery plan as any area which meets the criteria outlined below:

- Any area where the species is known or likely to occur as per the distribution map on the greater bilby SPRAT profile.
- Any location outside the modelled distribution where the bilby is found to occur.
- Any area between the areas noted above, that may be periodically occupied by bilbies.
- Any area which bilbies may naturally colonise or may feasibly be reintroduced.

Occurrence within the Study Area

DBCA and Fortescue database search results indicate that the greater bilby has previously been recorded on 285 occasions within 100 km of the study area, with two historical records (1982 & 1984) identified within the study area. The records identified within the study area have an unknown accuracy (0) and the locations provided are "Corunna 16kmN" (1984) and "Bonney Downs Station" (1982). Neither of the records were included in Dziminski, Carpenter, and Morris (2020) analysis of historical bilby records, which discarded records deemed to be uncertain due to low location accuracy. No evidence of this species was recorded during the current surveys, and limited suitable habitat was detected. Most of the study area encompasses rocky habitats and Plain (stony/gibber) habitat which lack suitable substrates and habitat for the greater bilby.

Historical greater bilby records and potential habitat are shown in Map 20.

Habitat within the Study Area

Potential greater bilby habitat in the study area primarily occurs within the Woodland (open/closed), with a small amount of potential habitat present in the Drainage Line/River/Creek (major) habitat type along the Nullagine River. Given the questionable accuracy of the historical records, general lack of suitable habitat and absence of evidence to suggest that the species is occupying the study area, habitat within the study area is not currently considered to represent critical habitat for the species.

119.7°E
119.8°E
119.9°E
120°E
120.1°E
21.9°S
22°S
22.1°S
22.2°S
22.3°S
22.4°S

Study area

DBCA database

- Greater bilby (EPBC: VU)

Potential habitat

- Drainage Line/River/Creek (major)
- Woodland (closed)
- Woodland (open)

ecologia ENVIRONMENT

Project No.: 2021
Author: SP
Created Date: 2 December 2024
Coordinate System: GCS GDA 1994
Scale: 1:190,000 @A3

Map 20: Greater bilby records and potential habitat within the study area.

Earthstar Geographics

0 2 4 6 10 Kilometers

4.3.4 Significant Fauna with a High Likelihood of Occurrence

4.3.4.1 Long-tailed dunnart (*Sminthopsis longicaudata*) – Priority 4

Ecology and Distribution

The long-tailed dunnart is a small, carnivorous marsupial, distinguished from other *Sminthopsis* species by the length of its brush-tipped tail which is more than twice the head-body length (Burbidge, McKenzie, & Fuller, 2008). The species feeds on arthropods including beetles, ants, spiders, cockroaches, centipedes, grasshoppers and larvae. It has a long tail with a muscular base that allows it to be held in a variety of positions and probably acts as a balancer. This, along with striated foot-pads and behavioural observations made in captivity indicate that this species is well adapted to climbing (Burbidge et al., 2008). Breeding occurs in spring and summer, and juveniles disperse in March/April (Burbidge et al., 2008).

Long-tailed dunnarts are mostly found in rocky country in the western arid zone and occasionally in open country with a gravel/stony mantle (Burbidge et al., 2008). Although rarely encountered, in Western Australia they occur in the Pilbara, Murchison, north-eastern Goldfields, Ashburton and Gibson Desert regions (Burbidge et al., 2008).

Potential Occurrence within the Study Area

Although the long-tailed dunnart was not recorded during the current surveys, the species has previously been recorded on 10 occasions within 100 km of the study area, with two records (2005) located within 2 km of the study area. Suitable habitat may occur within the Rocky Escarpments, Gorges/Gullies, Granite Outcrops and Hills/Ranges/Plateaux habitat types. This species is highly cryptic, and was assigned a high likelihood of occurrence within the study area due to the presence of suitable rocky habitats and proximity of records.

4.3.4.2 Peregrine falcon (*Falco peregrinus*) – Other Specially Protected Fauna BC Act

Ecology and Distribution

This species is widespread in Australia but requires specific nesting sites. It does not build a nest but requires cliffs, rocky outcrops, or large tree hollows (Johnstone & Storr, 1998). Suitable breeding habitat has the potential to occur in the study area in the form of tree hollows and breakaways; however, due to its widespread movements, the species may also overfly all habitats of the study area intermittently. Peregrine falcons feed almost entirely on birds, especially ducks, parrots, and pigeons.

Potential Occurrence within the Study Area

According to DBCA and Fortescue database searches, the peregrine falcon has been recorded on 45 occasions within 100 km of the study area, with a single record located 3 km south of the study area. Records of the species appear to be concentrated around the Fortescue Marsh, with only a single record located north of the study area; however, this may reflect sampling bias rather than a true species distribution pattern. Although no evidence of this species was recorded during the current surveys, the peregrine falcon has the potential to utilise all habitat types while foraging. Rocky Escarpment habitat within the study area supports cliffs and overhangs for breeding activities and Drainage Line/River/Creek (major) habitat provide foraging habitat and encompass large trees which potentially provide nesting opportunities for this species.

4.3.5 Significant Fauna with a Moderate Likelihood of Occurrence

4.3.5.1 Migratory birds

Occurrence within the Study Area

DBCA and Fortescue database searches identified 10 Migratory bird species (common sandpiper, fork-tailed swift, sharp-tailed sandpiper, red-necked stint, oriental plover, gull-billed tern, Caspian tern, glossy ibis, wood sandpiper and marsh sandpiper) and two Threatened species (Australian painted snipe and common greenshank) which area considered moderately likely to occur within the study area based on the proximity of records to the study area and ability of these species to fly significant distances during migration. Although these species may intermittently occur within the study area (overflying or temporary utilisation of aquatic habitat), presence within the study area is likely to be associated with migratory movement to the Fortescue Marsh and does not represent permanent occupancy. Critical habitat for Migratory birds does not occur within the study area.

4.3.5.2 Night parrot (*Pezoporus occidentalis*) – Endangered EPBC Act and Critically Endangered BC Act

Ecology and Distribution

The night parrot is a cryptic, nocturnal parrot that is endemic to Australia primarily feeding on the ground inhabiting remote arid and semi-arid areas of Australia (DBCA, 2017b). Historical evidence indicates that night parrots were distributed over much of semi-arid and arid Australia (Garnett, Szabo, & Dutson, 2011). This elusive parrot was thought to be extinct for a long period of time prior to purported sightings in 2005 in the vicinity of Fortescue Marsh and the discovery of night parrots in western Queensland by John Young in 2013. Since 2013, detailed studies at Pullen Pullen Reserve in western Queensland have provided critical information relating to the ecology, biology, breeding behaviour, physiology, roosting and foraging habitat, nocturnal movements, and calling behaviour (Stephen A. Murphy, 2017). This species has subsequently been recorded and sighted in the East Murchison by (Jackett, Greatwich, Swann, & Boyle, 2017).

The structure of the Triodia recorded by Jackett et al. (2017) was similar to that described by Murphy, Silcock, Murphy, Reid, and Austin (2017) at Pullen Pullen, being dense, and ring-shaped. Murphy et al. (2017) recording a nest located in *Triodia longiceps* while (Jackett et al., 2017) recorded the nest in *Triodia* aff. *plurinervata*. night parrot nest site selection may be more reliant on the structure of the spinifex and not necessarily the size of the spinifex expanse, or the substrate type (Jackett et al., 2017). It is also suggested that the proximity of dense ground layer vegetation (e.g., *Triodia*) to suitable foraging grounds is likely to play a role in nest (and roost) site selection, suggesting the samphire and herbfields adjacent to the *Triodia* expanse could be a food source (Jackett et al., 2017; Murphy et al., 2017).

Potential Occurrence within the Study Area

Night parrot calls were not recorded during the current survey and it is considered unlikely that a long-term stable night parrot roosts exist in the area immediately surrounding the points sampled or that night parrots were foraging in proximity to these surveyed points at the time of sampling (Adaptive NRM, 2023). Methods used were compliant with the *Interim Survey Guidelines for the Night Parrot* (DBCA, 2017b) and further long-term surveys may be required to fulfil the requirements of new *Guidelines for Determining the Likely Presence and Habitat Usage of Night Parrot (Pezoporus occidentalis) in Western Australia* (DBCA, 2024) .

Potential Habitat within the Study Area

Suitable foraging habitat occurs within the Plain (cracking clays) habitat type (5,756.19 ha) and long-unburnt spinifex within the Plain (stony/gibber) habitat type (54,756.01 ha) may represent potential roosting habitat for the species; however, no evidence of the species has been recorded within the study area to date. Potential foraging and roosting habitat for the night parrot is mapped in Map 21.

It is important to note that due to heavy grazing and trampling by European cattle within the Plain (cracking clay) habitat type, potential foraging resources identified within the study area are unlikely to sustain a permanent population of the species during the dry season and foraging resource availability during the wet season is likely to be restricted to periods following sustained rainfall and areas where cattle are excluded. If grazing pressure or stocking rates were to decrease in the future, foraging habitat suitability may increase accordingly.

Map 21: Potential night parrot roosting and foraging habitat within the study area.



Study area Burnt

(2007-2024)

Foraging habitat

Plain (Cracking clays) - wet season only

Roosting habitat

Plain (stony/gibber)

ecologia ENVIRONMENT

Project No.: 2021
Author: CB
Created Date: 17 January 2025
Coordinate System: GCS GDA 1994
Scale: 1:190,000 @A3

Map 21: Potential night parrot roosting and foraging habitat within the study area.

Earthstar Geographics

0 2 4 6 10 Kilometers

5 CONCLUSIONS

The key conclusions from the terrestrial vertebrate fauna assessment of the Bonney Downs North study area are as follows:

- Ten fauna habitat types have been identified within the study area: Plain (stony/gibber), Rocky Escarpments, Gorges/Gullies, Granite Outcrop (flat dome), Drainage Line/River/Creek (major), Drainage Line/River/Creek (minor), Plain (cracking clays), Woodland (open), Woodland (closed) and Hills/Ranges/Plateaux.
- Rocky Escarpments and Hills/Ranges/Plateaux within the study area provide suitable denning habitat for the northern quoll and potential nocturnal shelter and diurnal roosting habitat for the ghost bat and Pilbara leaf-nosed bat, though no suitable roosting caves were recorded.
- Gorges/Gullies within the study area provides foraging and dispersal habitat for the Pilbara olive python, both significant bat species, the northern quoll and the Gane's blind snake.
- Plain (stony/gibber) habitat encompasses suitable substrates for the Gane's blind snake, the western pebble-mound mouse and the brush-tailed mulgara while the Plain (cracking clays) habitat type contains suitable habitat for the short-tailed mouse.
- Drainage Line/River/Creek (major) habitat provides dispersal habitat for the northern quoll and Pilbara olive python, breeding and foraging habitat for significant falcons and foraging opportunities for the Pilbara leaf-nosed bat and ghost bat.
- A total of 237 terrestrial vertebrate fauna species including 31 mammals (17 native non-volant species, three introduced species and 11 bats), 82 reptiles, 118 birds, four amphibians and two fish have been recorded in the study area, representing 63.5% of the fauna assemblage potentially occurring based on database searches. The number of terrestrial vertebrate fauna taxa recorded during the current surveys (237 species) is significantly greater than that recorded by other detailed fauna surveys undertaken in the vicinity of the study area (min=32 species, max=194 species).
- Nine vertebrate species of significance were recorded during the current survey: the grey falcon, northern quoll, brush-tailed mulgara, western pebble-mound mouse, short-tailed mouse, Pilbara leaf-nosed bat, ghost bat, Pilbara olive python and Gane's blind snake. Although the greater bilby has historically been recorded within the study area, suitable habitat for this species is limited and no evidence of occupancy was recorded during the current surveys during targeted surveys for the species.
- The long-tailed dunnart and peregrine falcon are considered highly likely to occur within the study area based on proximity, abundance and recency of database records and a further 13 significant avifauna taxa (10 Migratory species and three Threatened species) are considered moderately likely to occur within the study area, though critical habitat for Migratory birds does not occur within the study area.
- No significant limitations were identified and survey methods were assessed as being in accordance with relevant Technical Guidance and significant fauna survey guidelines available at the time of survey. Both detailed and targeted fauna surveys included in the current consolidation included at least one survey phase within the optimal survey window for the region and were undertaken during optimal timing for birds, bats, mammals, amphibians and reptiles. BBSUS surveys included in the current consolidation were undertaken in accordance with timings outlined in the Draft Onshore Wind Farm Guidance Statement.

6 REFERENCES

360 Environmental. (2021). Adele Flora, Fauna and SRE Survey.

360 Environmental. (2022). Adele West Targeted Flora and Fauna Survey.

360 Environmental. (2023). Nyidinghu Iron Ore Project Detailed Terrestrial Fauna Survey.

Adaptive NRM. (2017). Night Parrot surveys at Fortescue Marsh, Western Australia: Habitat analyses, survey review and recommendations.

Adaptive NRM. (2021). Fortescue Night Parrot Monitoring Procedure and Program.

Adaptive NRM. (2023). Results of acoustic surveys conducted for Night Parrot (Pezoporus occidentalis) Nydinghu May-July 2023. Unpublished report for Ecologia Environment.

Armstrong, K., & Anstee, S. D. (2000). The Ghost Bat in the Pilbara: 100 years on. *Australian Mammalogy*(22), 93-101.

Armstrong, K. N. (2001). The distribution and roost habitat of the Orange Leaf-nosed Bat, *Rhinonicteris aurantius*, in the Pilbara region of Western Australia. *Wildlife Research, 28*, 95-104.

Bamford. (2013). *BC Iron Nullagine Project Extension Areas - Bonnie East, Warrigal North and Coongan.* Retrieved from

Bamford Consulting Ecologists. (2005). Fauna Survey of Proposed Iron Ore Mine, Cloud Break.

Bamford Consulting Ecologists. (2010). Targeted Fauna Assessment of the Rail Duplication.

Bamford Consulting Ecologists. (2012a). Fauna Assessment - Nyidinghu Iron Ore Project.

Bamford Consulting Ecologists. (2012b). Nyidinghu Rail - Terrestrial Vertebrate Fauna and Fauna Habitat Assessment.

Bat Call. (2016). Mesa B and C: Ghost Bat Roost Cave Assessment. Prepared for Rio Tinto by Bat Call WA Pty Ltd.

Bennelongia Environmental Consultants. (2018). Migratory Bird Habitat Survey of the Fortescue Marsh.

Biologic. (2017a). *Roy Hill Mine and Southern Borefields Targeted Fauna Survey. Report prepared for Roy Hill Iron Ore.* Retrieved from

Biologic. (2017b). *Warrawoona Gold Project: 2019 Significant Species Survey. Report prepared for BHP Pty Ltd.* Retrieved from

Biologic. (2018). *Roy Hill Level 1 Targeted Vertebrate Fauna Assessment Updated. Report prepared for Roy Hill Holdings Pty Ltd.* Retrieved from

Biologic. (2019a). *Warrawoona Gold Project: 2019 Significant Species Survey. Report prepared for Calidus Resources Limited.* Retrieved from

Biologic. (2019b). *Warrawoona Gold Project: VHF Bat Foraging Studies . Report prepared for Calidus Resources Limited.* Retrieved from

Biologic. (2021). *McPhee Creek: Consolidated Terrestrial Fauna Report. Report prepared for Roy Hill and Atlas Iron Limited.* Retrieved from

Biologic Environmental. (2014). Fortescue Marsh Tenement E46/684 Level 1 Targeted Vertebrate Fauna Survey.

Biota Environmental Sciences. (2004). FMG Stage A Rail Corridor Fauna Assemblage. .

Biota Environmental Sciences. (2005). FMG Stage B Rail Corridor.

Bullen, R. D., & McKenzie, N. L. (2011). Recent developments in studies of the community structure, foraging ecology and conservation of Western Australian bats. In B. Law, P. Eby, D. Lunney, & L. Lumsden (Eds.), *The Biology and Conservation of Australasian Bats* (pp. 31-43). Mosman, New South Wales: Royal Zoological Society of NSW.

Burbidge, A. A., McKenzie, N. L., & Fuller, P. J. (2008). Long-tailed Dunnart, *Sminthopsis longicaudata*. In S. Van Dyck & R. Strahan (Eds.), *The Mammals of Australia* (3rd edition ed., pp. 148-150). Sydney: Reed New Holland.

Cairns, K. M., Crowther, M. S., Nesbitt, B., & Letnic, M. (2021). The myth of wild dogs in Australia: are there any out there? *Australian Mammalogy*. doi:https://doi.org/10.1071/AM20055

Churchill, S. (1998). *Australian Bats*. Sydney: Reed New Holland.

Churchill, S. (2008). *Australian Bats* (Second ed.). Crows Nest NSW: Jacana Books.

Churchill, S. K., Jolly, S., Hand, S., & Milne, D. J. (2008). Orange Leaf-nosed Bat *Rhinonicteris aurantia*. In S. Van Dyck & R. Strahan (Eds.), *The Mammals of Australia* (3rd edition ed., pp. 470-471). Chatswood: Reed New Holland.

Commonwealth of Australia. (2016). EPBC Act referral guideline for the endangered northern quoll *Dasyurus hallucatus*. In. Department of the Environment http://www.environment.gov.au/system/files/resources/d7e011a7-bf59-40ed-9387-9afcb8d590f8/files/referral-guideline-northern-quoll.pdf.

Commonwealth of Australia. (2019). Recovery Plan for the Greater Bilby—DRAFT.

DBCA. (2017a). *Guidelines for surveys to detect the presence of bilbies, and assess the importance of habitat in Western Australia*. Retrieved from

DBCA. (2017b). Interim guideline for preliminary surveys of night parrot (Pezoporus occidentalis) in Western Australia. Perth, Western Australia.

DBCA. (2024). Guidelines for Determining the Likely Presence and Habitat Usage of Night Parrot (*Pezoporus occidentalis*) in Western Australia. In. Perth, Western Australia: Department of Biodiversity, Conservation and Attractions.

DEH. (2001). National Objectives and Targets for Biodiversity Conservation 2001–2005. In. Canberra.

DER. (2014). A guide to the assessment of applications to clear native vegetation Under Part V Division 2 of the Environmental Protection Act 1986 December 2014. Retrieved from http://maps.dec.wa.gov.au/idelve/nv/index.jsp

DEWHA. (2008). Approved Conservation Advice for *Liasis olivaceus barroni* (Olive Python-Pilbara subspecies). Environment Protection and Biodiversity Conservation Act 1999, Canberra.

DEWHA. (2010a). Survey Guidelines for Australia's Threatened Birds. Department of the Environment, Water, Heritage and the Arts.

DEWHA. (2010b). *Survey guidelines for Australia's threatened frogs*.

DEWHA. (2013). *Matters of National Environmental Significance. Significant Impact Guidelines 1.1. Environment Protection and Biodiversity Conservation Act 1999.* Retrieved from Canberra:

DEWHA. (2021). *Rhinonicteris aurantia* (Pilbara form) - Pilbara Leaf-nosed Bat in Species Profile and Threats Database. *Species Profile and Threats Database.* Retrieved from https://www.environment.gov.au/sprat

DoE. (2023a). Dasyurus hallucatus in Species Profile and Threats Database. Retrieved from https://www.environment.gov.au/sprat

DoE. (2023b). *Rhinonicteris aurantia* (Pilbara form) - Pilbara Leaf-nosed Bat in Species Profile and Threats Database. *Species Profile and Threats Database.* Retrieved from https://www.environment.gov.au/sprat

DPIRD. (2016). Soil Landscape Mapping - Best Available (DPIRD-027). Available at: https://catalogue.data.wa.gov.au/dataset/soil-landscape-mapping-best-available. In. Western Australia, Perth: Department of Primary Industries and Regional Development.

DSEWPaC. (2010). Survey Guidelines for Australia's Threatened Bats. Department of Sustainability, Environment, Water, Population and Communities.

DSEWPaC. (2011a). Survey guidelines for Australia's Threatened Mammals. Department of Sustainability, Environment, Water, Population and Communities.

DSEWPaC. (2011b). Survey Guidelines for Australia's Threatened Reptiles. Department of Sustainability, Environment, Water, Population and Communities.

DSEWPaC. (2012). Interim Biogeographic Regionalisation for Australia (IBRA), Version 7. In. Canberra: Australian Government.

DSEWPC. (2012). Interim Biogeographic Regionalisation for Australia (IBRA) Version 7. Department of Sustainability Environment Water Population and Communities, Canberra.

Dziminski, M. A., Carpenter, F. M., & Morris, F. (2020). Range of the greater bilby (Macrotis lagotis) in the Pilbara Region, Western Australia. *Journal of the Royal Society of Western Australia, 103*, 97–102.

ecologia. (2009). Roy Hill Iron Ore Project, Level 2 Terrestrial Vertebrate Fauna Survey. .

ecologia. (2011). Cloudbreak Level 2 Terrestrial Fauna Assessment. Unpublished report for Fortescue Metals Group Ltd.

ecologia. (2024a). Bonney Downs North Vertebrate Fauna Assessment. Draft report prepared for Fortescue.

ecologia. (2024b). Bonney Downs Wind Farm: Bat and Bird Site Utilisation Report- Year 1. Draft report prepared for Fortescue.

ecologia. (2024c). *East Hamersley Rail Terrestrial Vertebrate Fauna Assessment. Unpublished report prepared for Fortescue Metals Group Pty Ltd.* Retrieved from

ecologia. (2024d). *Nyidinghu Mine Terrestrial Vertebrate Fauna Assessment. Unpublished report prepared for Fortescue Metals Group Pty Ltd.* Retrieved from

Ecoscape Australia. (2016). Vegetation and Fauna Habitat Mapping of the Northern Tenement Area, Cloudbreak.

ENV Australia. (2012). *Christmas Creek Terrestrial Vertebrate Fauna and Fauna Habitat Assessment*. Retrieved from

EPA. (2000). Position Statement No. 2: Environmental protection of native vegetation in Western Australia: clearing of native vegetation, with particular reference to the agricultural area. . In. Western Australia: Environment Protection Authority.

EPA. (2016). *Environmental Factor Guideline: Terrestrial Fauna*. Perth, Western Australia: Environmental Protection Authority.

EPA. (2020). *Technical Guidance: Terrestrial vertebrate fauna surveys for environmental impact assessment*. Western Australia: Environmental Protection Authority.

Garnett, S. T., Szabo, J. K., & Dutson, G. (2011). *The Action Plan for Australian Birds 2010.* Collingwood, Victoria: CSIRO Publishing and Birds Australia.

Geoscience Australia. (2012). Surface Geology of Australia, 1:1 000 000 scale. In *2012 edition*: Bioregional Assessment Source Dataset.

Government of Western Australia. (2018). *2017 Statewide Vegetation Statistics incorporating the CAR Reserve Analysis (Full Report). Current as of December 2017. WA Department of Biodiversity Conservation and Attractions, Perth, https://catalogue.data.wa.gov.au/dataset/dbca-statewide-vegetation-statistics*

Hoyle, S. D., Pople, A. R., & Toop, G. J. (2001). Mark–recapture may reveal more about ecology than about population trends: Demography of a threatened ghost bat (*Macroderma gigas*) population. *Austral Ecology, 26*, 80-92.

Hutson, A. M., Mickleburgh, S. P., & Racey, P. A. (2001). Microchiropteran Bats: Global Status Survey and Action Plan. *Macroderma gigas*. *IUCN Red List of Threatened Species.* Retrieved from www.iucnredlist.org

International Union for Conservation of Nature. (2014). Guidelines for using the IUCN Red List Categories and Criteria, Version 11. Prepared by the IUCN Standards and Petitions Subcommittee. Downladable from http://www.iucnredlist.org/documents/RedListGuidelines.pdf. In.

Jackett, N. A., Greatwich, B. R., Swann, G., & Boyle, A. (2017). A nesting record and vocalisations of the Night Parrot *Pezoporus occidentalis* from the East Murchison, Western Australia. *Australian Field Ornithology, 34*, 144–150.

Johnson, K. A. (2008). Bilby, *Macrotis lagotis*. In S. van Dyck & R. Strahan (Eds.), *The Mammals of Australia* (pp. 191-193). Sydney: Reed New Holland.

Johnstone, R. E., & Storr, G. M. (1998). *Handbook of Western Australian Birds, Volume I - Non-Passerines (Emu to Dollarbird)* (Vol. 1). Perth: Western Australian Museum.

Koertner, G., Pavey, C. R., & Geiser, F. (2007). Spatial ecology of the mulgara in arid Australia: impact of fire history on home range size and burrow use. *Journal of Zoology, 273*, 350-357.

Maxwell, S., Burbidge, A. A., & Morris, K. D. (Eds.). (1996). *The 1996 Action Plan for Australian Marsupials and Monotremes*. Canberra: Wildlife Australia.

Moro, D., & Kutt, A. S. (2008). Northern Short-tailed Mouse, *Leggadina lakedownensis*. In S. van Dyck & R. Strahan (Eds.), *The Mammals of Australia* (pp. 583-584). Sydney: Reed New Holland.

Murphy, S. A., Silcock, J., Murphy, R., Reid, J., & Austin, J. J. (2017). Movements and habitat use of the night parrot *Pezoporus occidentalis* in south-western Queensland. *Austral Ecology, 42*(7), 858-868.

Northcote, K. H., Beckmann, G. G., Bettenay, E., Churchward, H. M., Van Dijk, D. C., Dimmock, G. M., . . . Wright, M. J. (1960-1968). Atlas of Australian Soils, Sheets 1 to 10. With explanatory data. In. Melbourne: CSIRO Australia and Melbourne University Press.

O'Malley, C. (2006). Australian Threatened Species, Greater Bilby, *Macrotis lagotis*.

Oakwood, M. (2008). Northern Quoll, *Dasyurus hallucatus*. In S. van Dyck & R. Strahan (Eds.), *The Mammals of Australia* (3rd edition ed., pp. 57-59). Sydney: Reed New Holland.

Outback Ecology. (2013). Fortescue Metals Group Cloudbreak Expansion Project - Pre Clearance Night Parrot Survey.

Pavey, C. (2006). *Threatened Species of the Northern Territory: Greater Bilby Macrotis lagotis*. Parks and Wildlife Commission - Northern Territory Government.

Pearson, D. (2003). Giant pythons of the Pilbara. *Landscope, 19*(1), 32-39.

Pearson, D. J. (2006). Giant pythons of the pilbara. *Landscope, 19*, 32-39.

Phoenix. (2011). Bonney Downs Rail Alignment Vertebrate Fauna Survey.

Phoenix Environmental Sciences. (2011). Bonney Downs Alignment: Level 1 Fauna Survey.

Purdie, B. R., Tille, P. J., & Schoknecht, N. R. (2016). Resource Management Technical Report 280 - Soil-landscape mapping in south-Western Australia: an overview of methodology and outputs. In. Western Australia, Perth: Department of Primary Industries and Regional Development.

Richards, G. C., Hand, S., & Armstrong, K. N. (2008). Ghost Bat, *Macroderma gigas*. In S. van Dyck & R. Strahan (Eds.), *The Mammals of Australia* (Vol. 3rd Volume, pp. 449-450). Sydney: Reed New Holland.

Shepherd, D. P., Beeston, G. R., & Hopkins, A. J. M. (2002). Native vegetation in Western Australia: Extent, type and status. In *Technical Report 249*. South Perth, Western Australia: Department of Agriculture.

Specialised Zoological. (2024). Identification of bat species from Bonney Downs, Western Australia. Unpublished report by Specialised Zoological for Ecologia Environment Pty Ltd, 22 August 2024, project reference SZ720.

Spectrum Ecology. (2020). Kutayi Project – Vertebrate Fauna Survey.

Spectrum Ecology. (2021). Fortescue Annual Monitoring Program – Operational Sites, Nullagine and North Star

Spectrum Ecology. (2022a). Fortescue Annual Monitoring Program – Operational Sites, Nullagine and North Star

Spectrum Ecology. (2022b). Fortescue Marsh Migratory Shorebird and Waterbird Survey.

Spectrum Ecology. (2023a). Fortescue Annual Monitoring Program – Operational Sites, Nullagine and North Star

Spectrum Ecology. (2023b). Nyidinghu Project: Baseline Conservation Significant Fauna Monitoring.

Spectrum Ecology. (2024). Bonney Downs South Vertebrate Fauna Assessment. Draft report prepared for Fortescue.

Stantec. (2016). *Corunna Downs Project: Terrestrial Vertebrate Fauna Survey. Report prepared for Atlas Iron Limited.* Retrieved from

Stantec. (2024). Mindy South: Detailed and Targeted Terrestrial Vertebrate Fauna Baseline Survey. Unpublished report prepared for Fortescue Metals Group Limited.

Stephen A. Murphy, J. J. A., Rachel K. Murphy, Jennifer Silcock, Leo Joseph, Stephen T. Garnett, Nicholas P. Leseberg, James E. M. Watson & Allan H. Burbidge. (2017). Observations on breeding Night Parrots (Pezoporus occidentalis) in western Queensland. *Emu - Austral Ornithology*.

Threatened Species Scientific Committee. (2008). *Commonwealth conservation advice on Liasis olivaceus barroni (Olive Python - Pilbara subspecies)*. Retrieved from Canberra: http://www.environment.gov.au/biodiversity/threatened/species/pubs/66699-conservation-advice.pdf

Threatened Species Scientific Committee. (2016a). Conservation advice for *Macrotis lagotis* (greater bilby).

Threatened Species Scientific Committee. (2016b). Conservation Advice for *Rhinonicteris aurantius* (Pilbara form) (Pilbara Leaf-nosed Bat).

Threatened Species Scientific Committee. (2016c). *Macroderma gigas* (ghost bat) Conservation Advice,.

Tille, P. J. (2006). Soil-landscapes of Western Australia's rangelands and arid interior. In *Report 313*. Western Australia, Perth: Department of Agriculture and Food.

Van Dyck, S., & Strahan, R. (2008). *The Mammals of Australia*. In (3rd edition ed.). Sydney: Reed New Holland.

van Dyck, S., & Strahan, R. (2008). *The Mammals of Australia* (Third ed.). Sydney, New South Wales: Australian Museum Trust and Queensland Museum.

Wilson, S., & Swan, G. (2010). *A Complete Guide to Reptiles of Australia* (3rd edition ed.). Sydney: New Holland Publishers.

Wilson, S., & Swan, G. (2021). *A Complete Guide to Reptiles of Australia*. Sydney: New Holland Publishers.

Woinarski, J. C. Z., Burbidge, A. A., & Harrison, P. L. (2014). *The Action Plan for Australian Mammals 2012*. Collingwood, Victoria: CSIRO Publishing.

Woolley, P. A. (2008). Brush-tailed Mulgara, *Dasycercus blythi*. In S. van Dyck & R. Strahan (Eds.), *The Mammals of Australia* (pp. 47-48). Sydney: Reed New Holland.

7 APPENDICES

Appendix A Definitions.

SIGNIFICANT FAUNA

According to the *EPA Factor Guideline: Terrestrial* Fauna (EPA, 2016) animal taxa (or records) may be considered significant for a number of reasons including, but not restricted to, the following:

A taxon listed as 'Threatened' under the Biodiversity Conservation Act 2016 (WA) or the Environment Protection and Biodiversity Conservation Act 1999 (Cwlth);

- A taxon on the Department of Biodiversity, Conservation and Attractions (DBCA) Priority Fauna List;
- Species with restricted distributions;
- Degree of historical impact from threatening processes;
- Providing an important function required to maintain the ecological integrity of a significant ecosystem.

Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) (Cwlth)

At a Commonwealth level, Threatened species are protected under the EPBC Act, which lists species in accordance with the criteria of the International Union for Conservation of Nature (International Union for Conservation of Nature, 2014), that is, 'Critically Endangered', 'Endangered', 'Vulnerable', 'Conservation Dependant', 'Extinct', or 'Extinct in the Wild' (see http://www.environment.gov.au/cgi-bin/sprat/public/publicthreatenedlist.pl?wanted=flora and http://www.environment.gov.au/cgi-bin/sprat/public/publicthreatenedlist.pl?wanted=fauna).

Biodiversity Conservation Act 2016 (Western Australia)

At a State level, Threatened species are protected under the BC Act. These are taxa which have been adequately surveyed and are deemed to be either rare, in danger of extinction, or otherwise in need of special protection in the wild and are gazetted as Threatened (Declared Rare) Flora. Threatened species are further categorised by the Department of Biodiversity, Conservation and Attractions (DBCA) according to their level of threat using the International Union for Conservation of Nature (IUCN) red list criteria ((International Union for Conservation of Nature, 2014) (see https://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities for definitions).

Priority Fauna (DBCA)

The DBCA maintains a list of Priority species, which are considered poorly known, uncommon or under threat but for which there is insufficient justification to be listed as Threatened, based on known distribution and population sizes. Priority species are assigned to one of four categories, described below. DBCA listed Priority species do not have any statutory protection (see https://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/threatened-plants for definitions.)

Appendix B Fauna database search results.

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 28-Nov-2024

Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat
Acknowledgements

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance (Ramsar	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	13
Listed Migratory Species:	9

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at https://www.dcceew.gov.au/parks-heritage/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	2
Commonwealth Heritage Places:	None
Listed Marine Species:	14
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	None
Regional Forest Agreements:	None
Nationally Important Wetlands:	1
EPBC Act Referrals:	24
Key Ecological Features (Marine):	None
Biologically Important Areas:	None
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

Listed Threatened Species		[Resource Information]
Status of Conservation Dependent and Extinct are not MNES under the EPBC Act. Number is the current name ID.		
Scientific Name	Threatened Category	Presence Text
BIRD		
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Endangered	Species or species habitat may occur within area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat known to occur within area
Pezoporus occidentalis Night Parrot [59350]	Endangered	Species or species habitat likely to occur within area
Polytelis alexandrae Princess Parrot, Alexandra's Parrot [758]	Vulnerable	Species or species habitat likely to occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
MAMMAL		
Dasyurus hallucatus Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Macroderma gigas		
Ghost Bat [174]	Vulnerable	Species or species habitat known to occur within area
Macrotis lagotis		
Greater Bilby [282]	Vulnerable	Species or species habitat known to occur within area
Rhinonicteris aurantia (Pilbara form)		
Pilbara Leaf-nosed Bat [82790]	Vulnerable	Roosting known to occur within area
REPTILE		
Liasis olivaceus barroni		
Pilbara Olive Python [66699]	Vulnerable	Species or species habitat likely to occur within area
Liopholis kintorei		
Great Desert Skink, Tjakura, Warrarna, Mulyamiji, Tjalapa, Nampu [83160]	Vulnerable	Species or species habitat may occur within area

Listed Migratory Species [Resource Information]

Scientific Name	Threatened Category	Presence Text
Migratory Marine Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Hirundo rustica		
Barn Swallow [662]		Species or species habitat may occur within area
Motacilla cinerea		
Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava		
Yellow Wagtail [644]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Calidris acuminata		
Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat known to occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat may occur within area
Charadrius veredus		
Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Commonwealth Lands [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Commonwealth Land Name	State
Unknown	
Commonwealth Land - [51745]	WA
Commonwealth Land - [51746]	WA

Listed Marine Species [Resource Information]

Scientific Name	Threatened Category	Presence Text
Bird		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area
Bubulcus ibis as Ardea ibis		
Cattle Egret [66521]		Species or species habitat may occur within area overfly marine area

Scientific Name	Threatened Category	Presence Text
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area overfly marine area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area overfly marine area
Chalcites osculans as Chrysococcyx osculans Black-eared Cuckoo [83425]		Species or species habitat known to occur within area overfly marine area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area overfly marine area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area overfly marine area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area overfly marine area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area overfly marine area

Scientific Name	Threatened Category	Presence Text
Rostratula australis as Rostratula benghalensis (sensu lato)		
Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area overfly marine area

Extra Information

Nationally Important Wetlands	[Resource Information]
Wetland Name	State
Fortescue Marshes	WA

EPBC Act Referrals			[Resource Information]
Title of referral	Reference	Referral Outcome	Assessment Status
East Hamersley Railway	2023/09542		Assessment
Nyidinghu Iron Ore Mine	2023/09543		Assessment
Roy Hill Iron Ore Mine expansion, Pilbara Region, WA	2018/8330		Post-Approval
Controlled action			
Additional Rail Infrastructure between Herb Elliott Port Facility and Cloudbreak Mine Site	2010/5513	Controlled Action	Post-Approval
Bonney Downs Rail Alignment	2011/5867	Controlled Action	Post-Approval
Christmas Creek Iron Ore Mine Expansion Project, East Pilbara, WA	2013/7055	Controlled Action	Post-Approval
Christmas Creek Water Management Scheme	2010/5706	Controlled Action	Post-Approval
Cloud Break Open Pit Iron Ore Mine	2005/2205	Controlled Action	Post-Approval
construction of iron ore mine & associated infrastructure	2013/6945	Controlled Action	Completed
Expansion of Cloudbreak iron ore mine	2010/5696	Controlled Action	Post-Approval
FerrAus Pilbara Project - mine & Rail Pilbara Region WA	2011/6036	Controlled Action	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Controlled action			
Golden Eagle Satellite Deposits Development	2011/5855	Controlled Action	Post-Approval
McPhee Iron Ore Project	2021/8897	Controlled Action	Assessment Approach
Nullagine Iron Ore Extension Project, Pilbara region, WA	2013/6887	Controlled Action	Post-Approval
Nullagine Iron Ore Project	2009/4930	Controlled Action	Post-Approval
Roy Hill to Port Hedland Rail Line and Associated Infrastructure	2010/5424	Controlled Action	Post-Approval
Not controlled action			
Development of iron ore resources in eastern Pilbara region, including port at P	2004/1562	Not Controlled Action	Completed
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed
Pilbara Transmission Project, Pilbara, WA	2018/8349	Not Controlled Action	Completed
Roy Hill Iron Ore Project	2008/4624	Not Controlled Action	Completed
Stage B of Pilbara Iron Ore and Infrastructure Project	2004/1897	Not Controlled Action	Completed
Not controlled action (particular manner)			
Additional Rail Infrastructure	2012/6314	Not Controlled Action (Particular Manner)	Post-Approval
Northwest Resources Blue Spec Shear Gold-Antimony Project	2012/6672	Not Controlled Action (Particular Manner)	Post-Approval
Referral decision			
Mining at the Blue Spec and Gold Spec deposits	2012/6234	Referral Decision	Completed

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data is available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance on the contents of this report.

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions when time permits.

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded breeding sites; and
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact us page.

© Commonwealth of Australia
Department of Climate Change, Energy, the Environment and Water
GPO Box 3090
Canberra ACT 2601 Australia
+61 2 6274 1111

Birdata Species List

Emu
Dromaius novaehollandiae
4 (1.17%)

Plumed Whistling-Duck
Dendrocygna eytoni
12 (3.52%)

Pink-eared Duck
Malacorhynchus membranaceus
11 (3.23%)

Black Swan
Cygnus atratus
15 (4.40%)

Australian Shelduck
Tadorna tadornoides
9 (2.64%)

Hardhead
Aythya australis
16 (4.69%)

Pacific Black Duck
Anas superciliosa
38 (11.14%)

Grey Teal
Anas gracilis
25 (7.33%)

Freckled Duck
Stictonetta naevosa
2 (0.59%)

Australian Wood Duck
Chenonetta jubata
9 (2.64%)

Brown Quail
Synoicus ypsilophorus
4 (1.17%)

Australasian Grebe
Tachybaptus novaehollandiae
9 (2.64%)

Hoary-headed Grebe
Poliocephalus poliocephalus
16 (4.69%)

Spinifex Pigeon
Geophaps plumifera
46 (13.49%)

Common Bronzewing
Phaps chalcoptera
13 (3.81%)

Crested Pigeon
Ocyphaps lophotes
81 (23.75%)

Diamond Dove
Geopelia cuneata
97 (28.45%)

Peaceful Dove
Geopelia placida
30 (8.80%)

Pheasant Coucal
Centropus phasianinus
1 (0.29%)

Horsfield's Bronze-Cuckoo
Chalcites basalis
16 (4.69%)

Pallid Cuckoo
Heteroscenes pallidus
17 (4.99%)

Australian Bustard
Ardeotis australis
17 (4.99%)

Tawny Frogmouth
Podargus strigoides
4 (1.17%)

Spotted Nightjar
Eurostopodus argus
8 (2.35%)

Australian Owlet-nightjar
Aegotheles cristatus
13 (3.81%)

Buff-banded Rail
Hypotaenidia philippensis
1 (0.29%)

Black-tailed Native-hen
Tribonyx ventralis
3 (0.88%)

Eurasian Coot
Fulica atra
7 (2.05%)

Bush Stone-curlew
Burhinus grallarius
2 (0.59%)

Pied Stilt
Himantopus leucocephalus
10 (2.93%)

Red-capped Plover
Charadrius ruficapillus
3 (0.88%)

Oriental Plover
Charadrius veredus
1 (0.29%)

Black-fronted Dotterel
Elseyornis melanops
45 (13.20%)

Red-kneed Dotterel
Erythrogonys cinctus
4 (1.17%)

Australian Painted-Snipe
Rostratula australis
1 (0.29%)

Sharp-tailed Sandpiper
Calidris acuminata
1 (0.29%)

Wood Sandpiper
Tringa glareola
3 (0.88%)

Little Button-quail
Turnix velox
24 (7.04%)

Silver Gull
Larus novaehollandiae
2 (0.59%)

Australian Gull-billed Tern
Gelochelidon macrotarsa
2 (0.59%)

Caspian Tern
Hydroprogne caspia
2 (0.59%)

Whiskered Tern
Chlidonias hybrida
7 (2.05%)

Black-necked Stork
Ephippiorhynchus asiaticus
8 (2.35%)

Australian Pelican
Pelecanus conspicillatus
23 (6.74%)

Nankeen Night-Heron
Nycticorax caledonicus
1 (0.29%)

Cattle Egret
Bubulcus ibis
1 (0.29%)

White-necked Heron
Ardea pacifica
23 (6.74%)

Great Egret
Ardea alba
24 (7.04%)

White-faced Heron
Egretta novaehollandiae
35 (10.26%)

Little Egret
Egretta garzetta
7 (2.05%)

Australian White Ibis
Threskiornis moluccus
3 (0.88%)

Straw-necked Ibis
Threskiornis spinicollis
22 (6.45%)

Yellow-billed Spoonbill
Platalea flavipes
12 (3.52%)

Royal Spoonbill
Platalea regia
8 (2.35%)

Glossy Ibis
Plegadis falcinellus
1 (0.29%)

Little Pied Cormorant
Microcarbo melanoleucos
28 (8.21%)

Great Cormorant
Phalacrocorax carbo
1 (0.29%)

Little Black Cormorant
Phalacrocorax sulcirostris
29 (8.50%)

Great Pied Cormorant
Phalacrocorax varius
1 (0.29%)

Australasian Darter
Anhinga novaehollandiae
30 (8.80%)

Black-shouldered Kite
Elanus axillaris
4 (1.17%)

Black-breasted Buzzard
Hamirostra melanosternon
3 (0.88%)

Wedge-tailed Eagle
Aquila audax
32 (9.38%)

Little Eagle
Hieraaetus morphnoides
10 (2.93%)

Swamp Harrier
Circus approximans
6 (1.76%)

Spotted Harrier
Circus assimilis
12 (3.52%)

Brown Goshawk
Accipiter fasciatus
13 (3.81%)

Collared Sparrowhawk
Accipiter cirrocephalus
8 (2.35%)

White-bellied Sea-Eagle
Haliaeetus leucogaster
1 (0.29%)

Whistling Kite
Haliastur sphenurus
106 (31.09%)

Black Kite
Milvus migrans
9 (2.64%)

Barn Owl
Tyto alba
1 (0.29%)

Southern Boobook
Ninox boobook
13 (3.81%)

Rainbow Bee-eater
Merops ornatus
71 (20.82%)

Sacred Kingfisher
Todiramphus sanctus
26 (7.62%)

Red-backed Kingfisher
Todiramphus pyrrhopygius
38 (11.14%)

Blue-winged Kookaburra
Dacelo leachii
46 (13.49%)

Nankeen Kestrel
Falco cenchroides
56 (16.42%)

Australian Hobby
Falco longipennis
18 (5.28%)

Brown Falcon
Falco berigora
45 (13.20%)

Peregrine Falcon
Falco peregrinus
2 (0.59%)

Cockatiel
Nymphicus hollandicus
83 (24.34%)

Galah
Eolophus roseicapilla
79 (23.17%)

Little Corella
Cacatua sanguinea
70 (20.53%)

Australian Ringneck
Barnardius zonarius
65 (19.06%)

Bourke's Parrot
Neopsephotus bourkii
6 (1.76%)

Budgerigar
Melopsittacus undulatus
64 (18.77%)

Western Bowerbird
Chlamydera guttata
2 (0.59%)

Black-tailed Treecreeper
Climacteris melanurus
2 (0.59%)

Variegated Fairy-wren
Malurus lamberti
44 (12.90%)

White-winged Fairy-wren
Malurus leucopterus
37 (10.85%)

Striated Grasswren
Amytornis striatus
4 (1.17%)

Black Honeyeater
Sugomel nigrum
6 (1.76%)

Brown Honeyeater
Lichmera indistincta
57 (16.72%)

Black-chinned Honeyeater
Melithreptus gularis
5 (1.47%)

Pied Honeyeater
Certhionyx variegatus
2 (0.59%)

Crimson Chat
Epthianura tricolor
21 (6.16%)

Orange Chat
Epthianura aurifrons
3 (0.88%)

White-gaped Honeyeater
Stomiopera unicolor
1 (0.29%)

Spiny-cheeked Honeyeater
Acanthagenys rufogularis
33 (9.68%)

Singing Honeyeater
Gavicalis virescens
68 (19.94%)

Grey-headed Honeyeater
Ptilotula keartlandi
15 (4.40%)

Grey-fronted Honeyeater
Ptilotula plumula
1 (0.29%)

White-plumed Honeyeater
Ptilotula penicillata
144 (42.23%)

White-fronted Honeyeater
Purnella albifrons
1 (0.29%)

Yellow-throated Miner
Manorina flavigula
128 (37.54%)

Red-browed Pardalote
Pardalotus rubricatus
45 (13.20%)

Striated Pardalote
Pardalotus striatus
12 (3.52%)

Western Gerygone
Gerygone fusca
5 (1.47%)

Weebill
Smicrornis brevirostris
59 (17.30%)

Redthroat
Pyrrholaemus brunneus
1 (0.29%)

Rufous Fieldwren
Calamanthus campestris
1 (0.29%)

Inland Thornbill
Acanthiza apicalis
1 (0.29%)

Slaty-backed Thornbill
Acanthiza robustirostris
3 (0.88%)

Chestnut-rumped Thornbill
Acanthiza uropygialis
16 (4.69%)

Grey-crowned Babbler
Pomatostomus temporalis
47 (13.78%)

White-browed Babbler
Pomatostomus superciliosus
4 (1.17%)

Ground Cuckoo-shrike
Coracina maxima
1 (0.29%)

Black-faced Cuckoo-shrike
Coracina novaehollandiae
98 (28.74%)

White-winged Triller
Lalage tricolor
25 (7.33%)

Chestnut-breasted Quail-thrush
Cinclosoma castaneothorax
1 (0.29%)

Rufous Whistler
Pachycephala rufiventris
52 (15.25%)

Grey Shrike-thrush
Colluricincla harmonica
16 (4.69%)

Crested Bellbird
Oreoica gutturalis
28 (8.21%)

Chiming Wedgebill
Psophodes occidentalis
1 (0.29%)

Australian Magpie
Gymnorhina tibicen
31 (9.09%)

Pied Butcherbird
Cracticus nigrogularis
73 (21.41%)

Grey Butcherbird
Cracticus torquatus
7 (2.05%)

Masked Woodswallow
Artamus personatus
5 (1.47%)

Black-faced Woodswallow
Artamus cinereus
69 (20.23%)

Little Woodswallow
Artamus minor
10 (2.93%)

Willie Wagtail
Rhipidura leucophrys
124 (36.36%)

Torresian Crow
Corvus orru
95 (27.86%)

Little Crow
Corvus bennetti
13 (3.81%)

Magpie-lark
Grallina cyanoleuca
139 (40.76%)

Red-capped Robin
Petroica goodenovii
35 (10.26%)

Hooded Robin
Melanodryas cucullata
13 (3.81%)

Mistletoebird
Dicaeum hirundinaceum
12 (3.52%)

Painted Finch
Emblema pictum
32 (9.38%)

Star Finch
Neochmia ruficauda
2 (0.59%)

Zebra Finch
Taeniopygia castanotis
152 (44.57%)

Australasian Pipit
Anthus novaeseelandiae
37 (10.85%)

Horsfield's Bushlark
Mirafra javanica
6 (1.76%)

Brown Songlark
Cincloramphus cruralis
31 (9.09%)

Rufous Songlark
Cincloramphus mathewsi
33 (9.68%)

Spinifexbird
Poodytes carteri
9 (2.64%)

Australian Reed-Warbler
Acrocephalus australis
8 (2.35%)

Fairy Martin
Petrochelidon ariel
20 (5.87%)

Tree Martin
Petrochelidon nigricans
17 (4.99%)

Welcome Swallow
Hirundo neoxena
3 (0.88%)

Corella spp
1 (0.29%)

Crow & Raven spp
6 (1.76%)

Atlas of Living Australia

Species Name	Vernacular Name	Class	Order	Family	Genus	Number of records
Litoria rubella	Little Red Tree Frog	Amphibia	Anura	Pelodryadidae	Litoria	23
Uperoleia saxatilis	Pilbara Toadlet	Amphibia	Anura	Myobatrachidae	Uperoleia	5
Platyplectrum spenceri	Spencer's Burrowing Frog	Amphibia	Anura	Limnodynastidae	Platyplectrum	3
Neobatrachus sutor	Shoemaker Frog	Amphibia	Anura	Limnodynastidae	Neobatrachus	2
Cyclorana maini	Main's Frog	Amphibia	Anura	Pelodryadidae	Cyclorana	2
Cyclorana occidentalis		Amphibia	Anura	Pelodryadidae	Cyclorana	1
Rhinella marina	Cane Toad	Amphibia	Anura	Bufonidae	Rhinella	1
Notaden nichollsi	Desert Spadefoot	Amphibia	Anura	Limnodynastidae	Notaden	1
Ctenotus saxatilis	Stony-soil Ctenotus	Reptilia	Squamata	Scincidae	Ctenotus	34
Anilios ammodytes	Sand-diving Blind Snake	Reptilia	Squamata	Typhlopidae	Anilios	31
Lerista timida	Timid Slider	Reptilia	Squamata	Scincidae	Lerista	30
Ctenophorus caudicinctus	Ring-tailed Dragon	Reptilia	Squamata	Agamidae	Ctenophorus	29
Tympanocryptis fortescuensis	Fortescue Pebble-mimic Dragon	Reptilia	Squamata	Agamidae	Tympanocryptis	25
Gehyra montium	Centralian Dtella	Reptilia	Squamata	Gekkonidae	Gehyra	22
Cyclodomorphus melanops	Spinifex Slender Blue-tongue	Reptilia	Squamata	Scincidae	Cyclodomorphus	21
Heteronotia binoei	Bynoe's Gecko	Reptilia	Squamata	Gekkonidae	Heteronotia	20
Ctenotus duricola	Pilbara Ctenotus	Reptilia	Squamata	Scincidae	Ctenotus	19
Lucasium woodwardi		Reptilia	Squamata	Diplodactylidae	Lucasium	18
Ctenotus helenae	Clay-soil Ctenotus	Reptilia	Squamata	Scincidae	Ctenotus	17
Delma pax	Peace Delma	Reptilia	Squamata	Pygopodidae	Delma	16
Lucasium wombeyi	Pilbara Ground Gecko	Reptilia	Squamata	Diplodactylidae	Lucasium	15
Menetia greyii	Grey's Menetia	Reptilia	Squamata	Scincidae	Menetia	15
Menetia surda	Western Dwarf Skink	Reptilia	Squamata	Scincidae	Menetia	14
Lerista amicorum		Reptilia	Squamata	Scincidae	Lerista	13
Gehyra variegata	Tree Dtella	Reptilia	Squamata	Gekkonidae	Gehyra	12
Carlia munda	Shaded-litter Rainbow-skink	Reptilia	Squamata	Scincidae	Carlia	12
Morethia ruficauda	Lined Firetail Skink	Reptilia	Squamata	Scincidae	Morethia	12
Gowidon longirostris	Long-nosed Dragon	Reptilia	Squamata	Agamidae	Gowidon	11
Lerista muelleri	Wood Mulch-slider	Reptilia	Squamata	Scincidae	Lerista	11
Strophurus wellingtonae	Western Shield Spiny-tailed Gecko	Reptilia	Squamata	Diplodactylidae	Strophurus	10
Gehyra punctata	Spotted Dtella	Reptilia	Squamata	Gekkonidae	Gehyra	9
Eremiascincus richardsonii	Broad-banded Sand-swimmer	Reptilia	Squamata	Scincidae	Eremiascincus	9
Strophurus elderi	Jewelled Gecko	Reptilia	Squamata	Diplodactylidae	Strophurus	9
Ctenotus nigrilineatus	Pin-striped Finesnout Ctenotus	Reptilia	Squamata	Scincidae	Ctenotus	8
Ctenophorus reticulatus	Western Netted Dragon	Reptilia	Squamata	Agamidae	Ctenophorus	8
Varanus acanthurus	Ridge-tailed Monitor	Reptilia	Squamata	Varanidae	Varanus	7

Ctenophorus isolepis	Central Military Dragon	Reptilia	Squamata	Agamidae	Ctenophorus	7
Anilios grypus	Long-beaked Blind Snake	Reptilia	Squamata	Typhlopidae	Anilios	7
Ctenotus pantherinus	Leopard Ctenotus	Reptilia	Squamata	Scincidae	Ctenotus	6
Delma nasuta	Sharp-snouted Delma	Reptilia	Squamata	Pygopodidae	Delma	6
Varanus giganteus	Perentie	Reptilia	Squamata	Varanidae	Varanus	6
Anilios waitii	Beaked Blind Snake	Reptilia	Squamata	Typhlopidae	Anilios	5
Pseudonaja mengdeni	Western Brown Snake	Reptilia	Squamata	Elapidae	Pseudonaja	5
Varanus bushi		Reptilia	Squamata	Varanidae	Varanus	4
Ctenophorus nuchalis	Central Netted Dragon	Reptilia	Squamata	Agamidae	Ctenophorus	4
Pseudonaja modesta	Ringed Brown Snake	Reptilia	Squamata	Elapidae	Pseudonaja	4
Cryptoblepharus plagiocephalus	PÃ©ron's Snake-eyed Skink	Reptilia	Squamata	Scincidae	Cryptoblepharus	4
Heteronotia spelea	Desert Cave Gecko	Reptilia	Squamata	Gekkonidae	Heteronotia	4
Furina ornata	Moon Snake	Reptilia	Squamata	Elapidae	Furina	4
Demansia reticulata	Yellow-faced Whipsnake	Reptilia	Squamata	Elapidae	Demansia	4
Varanus panoptes	Yellow-spotted Monitor	Reptilia	Squamata	Varanidae	Varanus	4
Diplodactylus savagei	Southern Pilbara Beak-faced Gecko	Reptilia	Squamata	Diplodactylidae	Diplodactylus	3
Gehyra micra	Small Pilbara Spotted Rock Gehyra	Reptilia	Squamata	Gekkonidae	Gehyra	3
Lerista jacksoni		Reptilia	Squamata	Scincidae	Lerista	3
Proablepharus reginae	Spinifex Snake-eyed Skink	Reptilia	Squamata	Scincidae	Proablepharus	3
Rhynchoedura ornata	Western Beaked Gecko	Reptilia	Squamata	Diplodactylidae	Rhynchoedura	3
Notoscincus ornatus	Ornate Soil-crevice Skink	Reptilia	Squamata	Scincidae	Notoscincus	3
Nephrurus cinctus		Reptilia	Squamata	Carphodactylidae	Nephrurus	3
Ctenotus uber	Spotted Ctenotus	Reptilia	Squamata	Scincidae	Ctenotus	3
Carlia triacantha	Desert Rainbow-skink	Reptilia	Squamata	Scincidae	Carlia	3
Lerista verhmens	Powerful Lerista	Reptilia	Squamata	Scincidae	Lerista	3
Antaresia childreni	Children's Python	Reptilia	Squamata	Pythonidae	Antaresia	3
Pseudechis australis	Mulga Snake	Reptilia	Squamata	Elapidae	Pseudechis	3
Varanus brevicauda	Short-tailed Pygmy Monitor	Reptilia	Squamata	Varanidae	Varanus	2
Ctenotus grandis	Grand Ctenotus	Reptilia	Squamata	Scincidae	Ctenotus	2
Lerista bipes	Two-toed Lerista	Reptilia	Squamata	Scincidae	Lerista	2
Delma tincta	Excitable Delma	Reptilia	Squamata	Pygopodidae	Delma	2
Varanus caudolineatus	Stripe-tailed Monitor	Reptilia	Squamata	Varanidae	Varanus	2
Anilios hamatus	Pale-headed Blind Snake	Reptilia	Squamata	Typhlopidae	Anilios	2
Varanus tristis	Black-headed Monitor	Reptilia	Squamata	Varanidae	Varanus	2
Delma elegans	Pilbara Delma	Reptilia	Squamata	Pygopodidae	Delma	2
Aspidites melanocephalus	Black-headed Python	Reptilia	Squamata	Pythonidae	Aspidites	2
Suta punctata	Little Spotted Snake	Reptilia	Squamata	Elapidae	Suta	2
Lerista flammicauda	Pilbara Flame-tailed Slider	Reptilia	Squamata	Scincidae	Lerista	2

Anilios pilbarensis	Pilbara Blind Snake	Reptilia	Squamata	Typhlopidae	Anilios	2
Acanthophis wellsi	Pilbara Death Adder	Reptilia	Squamata	Elapidae	Acanthophis	2
Varanus eremius	Pygmy Desert Monitor	Reptilia	Squamata	Varanidae	Varanus	1
Egernia formosa	Goldfields Crevice-skink	Reptilia	Squamata	Scincidae	Egernia	1
Lialis burtonis	Burton's Snake-lizard	Reptilia	Squamata	Pygopodidae	Lialis	1
Pygopus nigriceps	Western Hooded Scaly-foot	Reptilia	Squamata	Pygopodidae	Pygopus	1
Pogona minor	Dwarf Bearded Dragon	Reptilia	Squamata	Agamidae	Pogona	1
Diporiphora amphiboluroides	Mulga Dragon	Reptilia	Squamata	Agamidae	Diporiphora	1
Egernia cygnitos	Western Pilbara Spiny-tailed Skink	Reptilia	Squamata	Scincidae	Egernia	1
Varanus pilbarensis	Pilbara Rock Monitor	Reptilia	Squamata	Varanidae	Varanus	1
Gehyra media	Medium Pilbara Spotted Rock Gehyra	Reptilia	Squamata	Gekkonidae	Gehyra	1
Diplodactylus laevis	Desert Fat-tailed Gecko	Reptilia	Squamata	Diplodactylidae	Diplodactylus	1
Lerista labialis	Southern Sandslider	Reptilia	Squamata	Scincidae	Lerista	1
Suta fasciata	Rosen's Snake	Reptilia	Squamata	Elapidae	Suta	1
Egernia pilbarensis	Pilbara Crevice-skink	Reptilia	Squamata	Scincidae	Egernia	1
Diplodactylus pulcher	Fine-faced Gecko	Reptilia	Squamata	Diplodactylidae	Diplodactylus	1
Varanus gouldii	Gould's Goanna	Reptilia	Squamata	Varanidae	Varanus	1
Delma butleri	Unbanded Delma	Reptilia	Squamata	Pygopodidae	Delma	1
Egernia epsisolus	Eastern Pilbara Spiny-tailed Skink	Reptilia	Squamata	Scincidae	Egernia	1
Chelodina (Chelodina) steindachneri	Steindachner's Turtle	Reptilia	Testudines	Chelidae	Chelodina	1
Taeniopygia guttata	Zebra Finch	Aves	Passeriformes	Estrildidae	Taeniopygia	207
Ptilotula penicillata	White-plumed Honeyeater	Aves	Passeriformes	Meliphagidae	Ptilotula	191
Grallina cyanoleuca	Magpie-lark	Aves	Passeriformes	Monarchidae	Grallina	190
Manorina (Myzantha) flavigula	Yellow-throated Miner	Aves	Passeriformes	Meliphagidae	Manorina	166
Rhipidura (Sauloprocta) leucophrys	Willie Wagtail	Aves	Passeriformes	Rhipiduridae	Rhipidura	147
Coracina (Coracina) novaehollandiae	Black-faced Cuckoo-shrike	Aves	Passeriformes	Campephagidae	Coracina	135
Haliastur sphenurus	Whistling Kite	Aves	Accipitriformes	Accipitridae	Haliastur	131
Geopelia cuneata	Diamond Dove	Aves	Columbiformes	Columbidae	Geopelia	130
Eolophus roseicapilla	Galah	Aves	Psittaciformes	Cacatuidae	Eolophus	124
Corvus orru	Torresian Crow	Aves	Passeriformes	Corvidae	Corvus	121
Ocyphaps lophotes	Crested Pigeon	Aves	Columbiformes	Columbidae	Ocyphaps	110
Artamus (Angroyan) cinereus	Black-faced Woodswallow	Aves	Passeriformes	Artamidae	Artamus	108
Nymphicus hollandicus	Cockatiel	Aves	Psittaciformes	Cacatuidae	Nymphicus	107
Melopsittacus undulatus	Budgerigar	Aves	Psittaciformes	Psittacidae	Melopsittacus	103
Cracticus nigrogularis	Pied Butcherbird	Aves	Passeriformes	Artamidae	Cracticus	100
Cacatua (Licmetis) sanguinea	Little Corella	Aves	Psittaciformes	Cacatuidae	Cacatua	100
Merops (Merops) ornatus	Rainbow Bee-eater	Aves	Coraciiformes	Meropidae	Merops	92
Gavicalis virescens	Singing Honeyeater	Aves	Passeriformes	Meliphagidae	Gavicalis	91

Smicrornis brevirostris	Weebill	Aves	Passeriformes	Acanthizidae	Smicrornis	88
Geophaps (Lophophaps) plumifera	Spinifex Pigeon	Aves	Columbiformes	Columbidae	Geophaps	87
Barnardius zonarius	Australian Ringneck	Aves	Psittaciformes	Psittacidae	Barnardius	85
Falco (Tinnunculus) cenchroides	Nankeen Kestrel	Aves	Falconiformes	Falconidae	Falco	76
Pomatostomus (Pomatostomus) temporalis	Grey-crowned Babbler	Aves	Passeriformes	Pomatostomidae	Pomatostomus	75
Elseyornis melanops	Black-fronted Dotterel	Aves	Charadriiformes	Charadriidae	Elseyornis	72
Pachycephala (Alisterornis) rufiventris	Rufous Whistler	Aves	Passeriformes	Pachycephalidae	Pachycephala	70
Pardalotus (Pardalotinus) rubricatus	Red-browed Pardalote	Aves	Passeriformes	Pardalotidae	Pardalotus	70
Dacelo (Dacelo) leachii	Blue-winged Kookaburra	Aves	Coraciiformes	Alcedinidae	Dacelo	69
Lichmera (Lichmera) indistincta	Brown Honeyeater	Aves	Passeriformes	Meliphagidae	Lichmera	66
Emblema pictum	Painted Finch	Aves	Passeriformes	Estrildidae	Emblema	59
Falco (Ieracidea) berigora	Brown Falcon	Aves	Falconiformes	Falconidae	Falco	56
Malurus (Musciparus) leucopterus	White-winged Fairy-wren	Aves	Passeriformes	Maluridae	Malurus	56
Anthus (Anthus) novaeseelandiae	Australian Pipit	Aves	Passeriformes	Motacillidae	Anthus	55
Todiramphus (Cyanalcyon) pyrrhopygius	Red-backed Kingfisher	Aves	Coraciiformes	Alcedinidae	Todiramphus	53
Oreoica gutturalis	Crested Bellbird	Aves	Passeriformes	Oreoicidae	Oreoica	53
Cincloramphus (Maclennania) mathewsi	Rufous Songlark	Aves	Passeriformes	Locustellidae	Cincloramphus	51
Aquila (Uroaetus) audax	Wedge-tailed Eagle	Aves	Accipitriformes	Accipitridae	Aquila	50
Egretta novaehollandiae	White-faced Heron	Aves	Ciconiiformes	Ardeidae	Egretta	48
Anas (Anas) superciliosa	Pacific Black Duck	Aves	Anseriformes	Anatidae	Anas	46
Acanthagenys rufogularis	Spiny-cheeked Honeyeater	Aves	Passeriformes	Meliphagidae	Acanthagenys	43
Malurus (Leggeornis) lamberti	Variegated Fairy-wren	Aves	Passeriformes	Maluridae	Malurus	42
Ardea pacifica	White-necked Heron	Aves	Ciconiiformes	Ardeidae	Ardea	41
Ptilotula keartlandi	Grey-headed Honeyeater	Aves	Passeriformes	Meliphagidae	Ptilotula	39
Petroica (Petroica) goodenovii	Red-capped Robin	Aves	Passeriformes	Petroicidae	Petroica	39
Gymnorhina tibicen	Australian Magpie	Aves	Passeriformes	Artamidae	Gymnorhina	39
Epthianura (Parepthianura) tricolor	Crimson Chat	Aves	Passeriformes	Meliphagidae	Epthianura	38
Todiramphus (Todiramphus) sanctus	Sacred Kingfisher	Aves	Coraciiformes	Alcedinidae	Todiramphus	37
Ardeotis australis	Australian Bustard	Aves	Gruiformes	Otididae	Ardeotis	36
Cincloramphus (Cincloramphus) cruralis	Brown Songlark	Aves	Passeriformes	Locustellidae	Cincloramphus	36
Phalacrocorax (Phalacrocorax) sulcirostris	Little Black Cormorant	Aves	Pelecaniformes	Phalacrocoracidae	Phalacrocorax	32
Petrochelidon (Petrochelidon) ariel	Fairy Martin	Aves	Passeriformes	Hirundinidae	Petrochelidon	32
Microcarbo melanoleucos	Little Pied Cormorant	Aves	Pelecaniformes	Phalacrocoracidae	Microcarbo	30
Colluricincla (Colluricincla) harmonica	Grey Shrike-thrush	Aves	Passeriformes	Pachycephalidae	Colluricincla	30
Anhinga novaehollandiae	Australasian Darter	Aves	Pelecaniformes	Anhingidae	Anhinga	29
Pelecanus conspicillatus	Australian Pelican	Aves	Pelecaniformes	Pelecanidae	Pelecanus	28
Turnix (Alphaturnia) velox	Little Button-quail	Aves	Turniciformes	Turnicidae	Turnix	28
Poodytes carteri	Spinifexbird	Aves	Passeriformes	Locustellidae	Poodytes	27

Ardea alba	Great Egret	Aves	Ciconiiformes	Ardeidae	Ardea	26
Anas gracilis	Grey Teal	Aves	Anseriformes	Anatidae	Anas	25
Malurus (Leggeornis) assimilis	Purple-backed Fairy-wren	Aves	Passeriformes	Maluridae	Malurus	24
Heteroscenes pallidus	Pallid Cuckoo	Aves	Cuculiformes	Cuculidae	Heteroscenes	24
Aegotheles (Aegotheles) cristatus	Australian Owlet-nightjar	Aves	Apodiformes	Aegothelidae	Aegotheles	24
Petrochelidon (Hylochelidon) nigricans	Tree Martin	Aves	Passeriformes	Hirundinidae	Petrochelidon	23
Phaps (Phaps) chalcoptera	Common Bronzewing	Aves	Columbiformes	Columbidae	Phaps	23
Threskiornis spinicollis	Straw-necked Ibis	Aves	Ciconiiformes	Threskiornithidae	Threskiornis	23
Accipiter (Leucospiza) fasciatus	Brown Goshawk	Aves	Accipitriformes	Accipitridae	Accipiter	22
Corvus bennetti	Little Crow	Aves	Passeriformes	Corvidae	Corvus	21
Circus assimilis	Spotted Harrier	Aves	Accipitriformes	Accipitridae	Circus	21
Acanthiza (Geobasileus) uropygialis	Chestnut-rumped Thornbill	Aves	Passeriformes	Acanthizidae	Acanthiza	20
Pardalotus (Pardalotinus) striatus	Striated Pardalote	Aves	Passeriformes	Pardalotidae	Pardalotus	19
Dromaius novaehollandiae	Emu	Aves	Struthioniformes	Casuariidae	Dromaius	18
Milvus migrans	Black Kite	Aves	Accipitriformes	Accipitridae	Milvus	18
Melanodryas (Melanodryas) cucullata	Hooded Robin	Aves	Passeriformes	Petroicidae	Melanodryas	18
Ninox (Ninox) novaeseelandiae	Southern Boobook	Aves	Strigiformes	Strigidae	Ninox	18
Chenonetta jubata	Australian Wood Duck	Aves	Anseriformes	Anatidae	Chenonetta	17
Geopelia placida	Peaceful Dove	Aves	Columbiformes	Columbidae	Geopelia	17
Falco (Falco) longipennis	Australian Hobby	Aves	Falconiformes	Falconidae	Falco	17
Artamus (Angroyan) minor	Little Woodswallow	Aves	Passeriformes	Artamidae	Artamus	17
Dicaeum (Dicaeum) hirundinaceum	Mistletoebird	Aves	Passeriformes	Dicaeidae	Dicaeum	17
Platalea (Platibis) flavipes	Yellow-billed Spoonbill	Aves	Ciconiiformes	Threskiornithidae	Platalea	15
Cracticus torquatus	Grey Butcherbird	Aves	Passeriformes	Artamidae	Cracticus	14
Chalcites basalis	Horsfield's Bronze-cuckoo	Aves	Cuculiformes	Cuculidae	Chalcites	14
Ephippiorhynchus (Ephippiorhynchus) asiaticus	Black-necked Stork	Aves	Ciconiiformes	Ciconiidae	Ephippiorhynchus	13
Eurostopodus (Eurostopodus) argus	Spotted Nightjar	Aves	Caprimulgiformes	Caprimulgidae	Eurostopodus	13
Lalage (Lalage) tricolor	White-winged Triller	Aves	Passeriformes	Campephagidae	Lalage	13
Aythya (Nyroca) australis	Hardhead	Aves	Anseriformes	Anatidae	Aythya	13
Tadorna (Casarca) tadornoides	Australian Shelduck	Aves	Anseriformes	Anatidae	Tadorna	12
Poliocephalus poliocephalus	Hoary-headed Grebe	Aves	Podicipediformes	Podicipedidae	Poliocephalus	12
Himantopus himantopus	Black-winged Stilt	Aves	Charadriiformes	Recurvirostridae	Himantopus	12
Melithreptus (Eidopsarus) gularis	Black-chinned Honeyeater	Aves	Passeriformes	Meliphagidae	Melithreptus	11
Acrocephalus (Acrocephalus) australis	Australian Reed Warbler	Aves	Passeriformes	Acrocephalidae	Acrocephalus	11
Chlamydera guttata	Western Bowerbird	Aves	Passeriformes	Ptilonorhynchidae	Chlamydera	11
Amytornis (Magnamytis) whitei		Aves	Passeriformes	Maluridae	Amytornis	11
Artamus (Campbellornis) personatus	Masked Woodswallow	Aves	Passeriformes	Artamidae	Artamus	11
Sugomel niger	Black Honeyeater	Aves	Passeriformes	Meliphagidae	Sugomel	11

Hieraaetus (Hieraaetus) morphnoides	Little Eagle	Aves	Accipitriformes	Accipitridae	Hieraaetus	11
Dendrocygna eytoni	Plumed Whistling-duck	Aves	Anseriformes	Anatidae	Dendrocygna	11
Tachybaptus novaehollandiae	Australasian Grebe	Aves	Podicipediformes	Podicipedidae	Tachybaptus	11
Cygnus atratus	Black Swan	Aves	Anseriformes	Anatidae	Cygnus	11
Ninox (Ninox) boobook	Southern Boobook	Aves	Strigiformes	Strigidae	Ninox	10
Climacteris (Climacteris) melanurus	Black-tailed Treecreeper	Aves	Passeriformes	Climacteridae	Climacteris	10
Mirafra (Mirafra) javanica	Horsfield's Bushlark	Aves	Passeriformes	Alaudidae	Mirafra	10
Erythrogonys cinctus	Red-kneed Dotterel	Aves	Charadriiformes	Charadriidae	Erythrogonys	9
Platalea (Platalea) regia	Royal Spoonbill	Aves	Ciconiiformes	Threskiornithidae	Platalea	9
Stiltia isabella	Australian Pratincole	Aves	Charadriiformes	Glareolidae	Stiltia	8
Chlidonias (Pelodes) hybrida	Whiskered Tern	Aves	Charadriiformes	Laridae	Chlidonias	8
Podargus strigoides	Tawny Frogmouth	Aves	Caprimulgiformes	Podargidae	Podargus	8
Burhinus (Burhinus) grallarius	Bush Stone-curlew	Aves	Charadriiformes	Burhinidae	Burhinus	8
Neopsephotus bourkii	Bourke's Parrot	Aves	Psittaciformes	Psittacidae	Neopsephotus	7
Egretta garzetta	Little Egret	Aves	Ciconiiformes	Ardeidae	Egretta	7
Circus approximans	Swamp Harrier	Aves	Accipitriformes	Accipitridae	Circus	7
Acanthiza (Milligania) robustirostris	Slaty-backed Thornbill	Aves	Passeriformes	Acanthizidae	Acanthiza	7
Malacorhynchus membranaceus	Pink-eared Duck	Aves	Anseriformes	Anatidae	Malacorhynchus	7
Accipiter (Paraspizias) cirrocephalus	Collared Sparrowhawk	Aves	Accipitriformes	Accipitridae	Accipiter	6
Pomatostomus (Morganornis) superciliosus	White-browed Babbler	Aves	Passeriformes	Pomatostomidae	Pomatostomus	6
Gerygone fusca	Western Gerygone	Aves	Passeriformes	Acanthizidae	Gerygone	6
Ninox (Hieracoglaux) connivens	Barking Owl	Aves	Strigiformes	Strigidae	Ninox	6
Tribonyx ventralis	Black-tailed Native-hen	Aves	Gruiformes	Rallidae	Tribonyx	5
Cinclosoma (Samuela) castaneothorax	Chestnut-breasted Quail-thrush	Aves	Passeriformes	Cinclosomatidae	Cinclosoma	5
Hamirostra melanosternon	Black-breasted Buzzard	Aves	Accipitriformes	Accipitridae	Hamirostra	5
Coturnix ypsilophora		Aves	Galliformes	Phasianidae	Coturnix	4
Purnella albifrons	White-fronted Honeyeater	Aves	Passeriformes	Meliphagidae	Purnella	4
Falco (Hierofalco) hypoleucos	Grey Falcon	Aves	Falconiformes	Falconidae	Falco	4
Synoicus ypsilophora	Brown Quail	Aves	Galliformes	Phasianidae	Synoicus	4
Tyto javanica	Eastern Barn Owl	Aves	Strigiformes	Tytonidae	Tyto	4
Certhionyx (Certhionyx) variegatus	Pied Honeyeater	Aves	Passeriformes	Meliphagidae	Certhionyx	4
Elanus axillaris	Black-shouldered Kite	Aves	Accipitriformes	Accipitridae	Elanus	4
Threskiornis moluccus	Australian White Ibis	Aves	Ciconiiformes	Threskiornithidae	Threskiornis	4
Epthianura (Aurepthianura) aurifrons	Orange Chat	Aves	Passeriformes	Meliphagidae	Epthianura	3
Tringa (Rhyacophilus) glareola	Wood Sandpiper	Aves	Charadriiformes	Scolopacidae	Tringa	3
Cheramoeca leucosterna	White-backed Swallow	Aves	Passeriformes	Hirundinidae	Cheramoeca	3
Amytornis (Magnamytis) striatus	Striated Grasswren	Aves	Passeriformes	Maluridae	Amytornis	3
Daphoenositta (Neositta) chrysoptera	Varied Sittella	Aves	Passeriformes	Neosittidae	Daphoenositta	3

Fulica atra	Eurasian Coot	Aves	Gruiformes	Rallidae	Fulica	3
Neochmia (Neochmia) ruficauda	Star Finch	Aves	Passeriformes	Estrildidae	Neochmia	3
Falco (Hierofalco) peregrinus	Peregrine Falcon	Aves	Falconiformes	Falconidae	Falco	2
Cinclosoma (Samuela) marginatum	Western Quail-thrush	Aves	Passeriformes	Cinclosomatidae	Cinclosoma	2
Stictonetta naevosa	Freckled Duck	Aves	Anseriformes	Anatidae	Stictonetta	2
Acanthiza (Acanthiza) apicalis	Red-rumped Tit	Aves	Passeriformes	Acanthizidae	Acanthiza	2
Phalacrocorax (Phalacrocorax) varius	Pied Cormorant	Aves	Pelecaniformes	Phalacrocoracidae	Phalacrocorax	2
Gelochelidon nilotica	Gull-billed Tern	Aves	Charadriiformes	Laridae	Gelochelidon	2
Psophodes (Sphenostoma) occidentalis	Chiming Wedgebill	Aves	Passeriformes	Psophodidae	Psophodes	2
Charadrius (Charadrius) ruficapillus	Red-capped Plover	Aves	Charadriiformes	Charadriidae	Charadrius	2
Plegadis falcinellus	Glossy Ibis	Aves	Ciconiiformes	Threskiornithidae	Plegadis	2
Glareola (Glareola) maldivarum	Oriental Pratincole	Aves	Charadriiformes	Glareolidae	Glareola	1
Hypotaenidia philippensis	Buff-banded Rail	Aves	Gruiformes	Rallidae	Hypotaenidia	1
Phalacrocorax (Phalacrocorax) carbo	Great Cormorant	Aves	Pelecaniformes	Phalacrocoracidae	Phalacrocorax	1
Ptilotula plumula	Grey-fronted Honeyeater	Aves	Passeriformes	Meliphagidae	Ptilotula	1
Conopophila (Lacustroica) whitei	Grey Honeyeater	Aves	Passeriformes	Meliphagidae	Conopophila	1
Columba (Janthoenas) leucomela	White-headed Pigeon	Aves	Columbiformes	Columbidae	Columba	1
Hirundo (Hirundo) neoxena	Welcome Swallow	Aves	Passeriformes	Hirundinidae	Hirundo	1
Lophochroa leadbeateri	Major Mitchell's Cockatoo	Aves	Psittaciformes	Cacatuidae	Lophochroa	1
Chalcites osculans	Black-eared Cuckoo	Aves	Cuculiformes	Cuculidae	Chalcites	1
Psephotellus varius	Mulga Parrot	Aves	Psittaciformes	Psittacidae	Psephotellus	1
Stipiturus ruficeps	Rufous-crowned Emu-wren	Aves	Passeriformes	Maluridae	Stipiturus	1
Pyrrholaemus brunneus	Redthroat	Aves	Passeriformes	Acanthizidae	Pyrrholaemus	1
Charadrius (Eupoda) veredus	Oriental Plover	Aves	Charadriiformes	Charadriidae	Charadrius	1
Bubulcus ibis	Cattle Egret	Aves	Ciconiiformes	Ardeidae	Bubulcus	1
Falco (Hierofalco) subniger	Black Falcon	Aves	Falconiformes	Falconidae	Falco	1
Hydroprogne caspia	Caspian Tern	Aves	Charadriiformes	Laridae	Hydroprogne	1
Haliaeetus (Pontoaetus) leucogaster	White-bellied Sea-eagle	Aves	Accipitriformes	Accipitridae	Haliaeetus	1
Coracina (Pteropodocys) maxima	Ground Cuckoo-shrike	Aves	Passeriformes	Campephagidae	Coracina	1
Nycticorax caledonicus	Nankeen Night-heron	Aves	Ciconiiformes	Ardeidae	Nycticorax	1
Chroicocephalus novaehollandiae	Silver Gull	Aves	Charadriiformes	Laridae	Chroicocephalus	1
Calidris (Erolia) ferruginea	Curlew Sandpiper	Aves	Charadriiformes	Scolopacidae	Calidris	1
Calidris (Erolia) acuminata	Sharp-tailed Sandpiper	Aves	Charadriiformes	Scolopacidae	Calidris	1
Vespadelus finlaysoni	Finlayson's Cave Bat	Mammalia	Chiroptera	Vespertilionidae	Vespadelus	149
Taphozous georgianus	Common Sheathtail-bat	Mammalia	Chiroptera	Emballonuridae	Taphozous	31
Ningaui timealeyi	Pilbara Ningaui	Mammalia	Dasyuromorphia	Dasyuridae	Ningaui	26
Pseudomys hermannsburgensis	Sandy Inland Mouse	Mammalia	Rodentia	Muridae	Pseudomys	25
Macroderma gigas	Ghost Bat	Mammalia	Chiroptera	Megadermatidae	Macroderma	23

Sminthopsis macroura	Stripe-faced Dunnart	Mammalia	Dasyuromorphia	Dasyuridae	Sminthopsis	20
Pseudomys desertor	Desert Mouse	Mammalia	Rodentia	Muridae	Pseudomys	18
Mus musculus	House Mouse	Mammalia	Rodentia	Muridae	Mus	10
Pseudomys chapmani	Pebble-mound Mouse	Mammalia	Rodentia	Muridae	Pseudomys	6
Dasykaluta rosamondae	Little Red Antechinus	Mammalia	Dasyuromorphia	Dasyuridae	Dasykaluta	5
Leggadina lakedownensis	Lakeland Downs Mouse	Mammalia	Rodentia	Muridae	Leggadina	4
Oryctolagus cuniculus	Rabbit	Mammalia	Lagomorpha	Leporidae	Oryctolagus	3
Pseudomys delicatulus	Delicate Mouse	Mammalia	Rodentia	Muridae	Pseudomys	3
Dasyurus hallucatus	Digul	Mammalia	Dasyuromorphia	Dasyuridae	Dasyurus	2
Osphranter rufus	Red Kangaroo	Mammalia	Diprotodontia	Macropodidae	Osphranter	2
Camelus dromedarius	One-humped Camel	Mammalia	Artiodactyla	Camelidae	Camelus	2
Zyzomys argurus	Common Rock-rat	Mammalia	Rodentia	Muridae	Zyzomys	2
Pseudantechinus woolleyae	Woolley's Pseudantechinus	Mammalia	Dasyuromorphia	Dasyuridae	Pseudantechinus	2
Petrogale rothschildi	Rothschild's Rock-wallaby	Mammalia	Diprotodontia	Macropodidae	Petrogale	2
Canis familiaris	Common Dog	Mammalia	Carnivora	Canidae	Canis	2
Tachyglossus aculeatus	Short-beaked Echidna	Mammalia	Monotremata	Tachyglossidae	Tachyglossus	1
Rhinonicteris aurantia	Orange Leaf-nosed Bat	Mammalia	Chiroptera	Rhinonycteridae	Rhinonicteris	1
Sminthopsis youngsoni	Lesser Hairy-footed Dunnart	Mammalia	Dasyuromorphia	Dasyuridae	Sminthopsis	1
Chalinolobus nigrogriseus	Hoary Wattled Bat	Mammalia	Chiroptera	Vespertilionidae	Chalinolobus	1
Trichosurus vulpecula	Common Brushtail Possum	Mammalia	Diprotodontia	Phalangeridae	Trichosurus	1

Appendix C Regional fauna records from detailed surveys within 100 km of study area.

Letter	Survey
Previous surveys	
A	Adele Flora, Fauna and SRE Survey (360 Environmental, 2021)
B	Cloudbreak Level 2 Terrestrial Vertebrate Fauna Assessment (ecologia Environment, 2011)
C	Fauna Assessment - Nyidinghu Iron Ore Project (Bamford Consulting, 2012)
D	Targeted Fauna Assessment of the Rail Duplication (Bamford Consulting, 2010)
E	Nyidinghu Iron Ore Project Detailed Terrestrial Fauna Survey (360 Environmental, 2023)
F	Corunna Downs Project: Terrestrial Vertebrate Fauna Survey (Stantec, 2016)
G	Nyidinghu Mine Terrestrial Vertebrate Fauna Assessment (Ecologia Environment, 2023)
H	East Hamersley Rail Terrestrial Vertebrate Fauna Assessment (Ecologia Environment, 2023)
I	Mindy South: Detailed and Targeted Terrestrial Vertebrate Fauna Baseline Survey
J	McPhee Creek: Consolidated Terrestrial Fauna Report (Biologic, 2021)
K	Roy Hill Iron Ore Project, Level 2 Terrestrial Vertebrate Fauna Survey (ecologia, 2009)
L	Christmas Creek Terrestrial Vertebrate Fauna and Fauna Habitat Assessment (ENV Australia, 2012)
Current consolidation	
M	Bonney Downs North: Terrestrial Vertebrate Fauna Assessment (ecologia, 2024a)
N	Bonney Downs South: Terrestrial Vertebrate Fauna Assessment (Spectrum Ecology, 2024)
O	Bonney Downs Wind Farm: Bird and Bat Site Utilisation Report -Year 1 (ecologia, 2024b)

Family	Scientific Name	Common Name	Conservation Status		Database					Literature												Current consolidation		
			WA	EPBC	ALA	Birdata	PMST	DBCA	Fortescue	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
Amphibians																								
Limnodynastidae	*Neobatrachus sutor*	Shoemaker frog			x																			
	Notaden nichollsi	Desert spadefoot			x																			
	Platyplectrum spenceri	Centralian burrowing frog			x										x							x		
Myobatrachidae	*Pseudophryne douglasi*	Gorge toadlet																			x			
	Uperoleia saxatilis	Pilbara toadlet			x										x			x				x		
Pelodryadidae	*Cyclorana maini*	Sheep frog			x							x		x	x						x	x	x	
	Cyclorana occidentalis	Western water holding frog			x																			
	Litoria rubella	Little red tree frog			x						x	x			x		x	x	x	x	x	x	x	
Bufonidae	*Rhinella marina**	Cane toad			x																			
Total					**8**	**0**	**0**	**0**	**0**	**0**	**1**	**2**	**0**	**1**	**4**	**0**	**1**	**2**	**1**	**1**	**3**	**4**	**2**	**0**
Birds																								
Acanthizidae	*Acanthiza apicalis*	Inland thornbill			x	x												x						
	Acanthiza chrysorrhoa	Yellow-rumped thornbill								x								x						
	Acanthiza robustirostris	Slaty-backed thornbill			x	x					x									x			x	x
	Acanthiza uropygialis	Chestnut-rumped thornbill			x	x					x	x		x			x	x		x			x	x
	Gerygone fusca	Western gerygone			x	x						x		x		x	x			x	x			x
	Pyrrholaemus brunneus	Redthroat			x	x					x							x						x
	Smicrornis brevirostris	Weebill			x	x					x	x		x	x	x	x	x	x	x	x	x	x	x
	Calamanthus campestris	Rufous fieldwren				x																		
Accipitridae	*Tachyspiza cirrocephala*	Collared sparrowhawk			x	x						x			x			x		x		x	x	x
	Tachyspiza fasciata	Brown goshawk			x	x						x		x	x		x	x		x		x	x	x
	Aquila audax	Wedge-tailed eagle			x	x				x		x	x	x	x	x	x	x			x	x	x	x
	Circus approximans	Swamp harrier			x	x																		
	Circus assimilis	Spotted harrier			x	x						x			x	x	x			x		x	x	x
	Elanus axillaris	Black-shouldered kite			x	x							x		x					x			x	x
	Erythrotriorchis radiatus	Red goshawk	VU	EN			x																	
	Haliaeetus leucogaster	White-bellied sea-eagle			x	x	x																	
	Haliastur sphenurus	Whistling kite			x	x					x	x	x	x	x	x	x	x		x	x	x	x	x
	Hamirostra melanosternon	Black-breasted buzzard			x	x						x				x	x	x						
	Hieraaetus morphnoides	Little eagle			x	x											x	x		x			x	
	Milvus migrans	Black kite			x	x				x		x		x	x			x			x			x
	Lophoictinia isura	Square-tailed kite															x							x
Acrocephalidae	*Acrocephalus australis*	Australian reed warbler			x	x				x				x		x								
Aegothelidae	*Aegotheles cristatus*	Australian owlet-nightjar			x	x				x		x			x	x	x	x	x	x		x	x	x
Alaudidae	*Mirafra javanica*	Horsfield's bush lark			x	x					x	x								x	x	x	x	x
Alcedinidae	*Dacelo leachii*	Blue-winged kookaburra			x	x					x			x	x			x	x	x	x	x	x	x
	Todiramphus pyrrhopygius	Red-backed kingfisher			x	x				x	x	x		x	x	x		x		x	x	x	x	
	Todiramphus sanctus	Sacred kingfisher			x	x					x					x		x			x	x	x	x
Anatidae	*Anas gracilis*	Grey teal			x	x					x	x										x	x	x
	Anas superciliosa	Pacific black duck			x	x					x			x				x			x	x	x	x
	Aythya australis	Hardhead			x	x								x						x				x
	Chenonetta jubata	Australian wood duck			x	x								x										x

Family	Scientific Name	Common Name	Conservation Status		Database					Literature												Current consolidation		
			WA	EPBC	ALA	Birdata	PMST	DBCA	Fortescue	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
	Cygnus atratus	Black swan			x	x						x										x		
	Dendrocygna eytoni	Plumed whistling duck			x	x					x			x							x		x	x
	Malacorhynchus membranaceus	Pink-eared duck			x	x								x									x	x
	Stictonetta naevosa	Freckled duck			x	x																		
	Tadorna tadornoides	Australian shelduck			x	x						x												
Anhingidae	*Anhinga novaehollandiae*	Australasian darter			x	x																x	x	x
Apodidae	*Apus pacificus*	Fork-tailed swift	MI	MI			x	x	x			x												
Ardeidae	*Ardea alba*	Great egret			x	x						x									x	x	x	x
	Ardea pacifica	White-necked heron			x	x								x							x	x	x	x
	Bubulcus ibis	Cattle egret			x	x	x																	
	Egretta garzetta	Little egret			x	x																		
	Egretta novaehollandiae	White-faced heron			x	x						x		x								x	x	x
	Nycticorax caledonicus	Nankeen night-heron			x	x													x			x		x
Artamidae	*Artamus cinereus*	Black-faced woodswallow			x	x				x	x	x	x	x	x	x	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	x	x	x		x	x	x
	Artamus leucorynchus	White-breasted woodswallow																x						
	Cracticus nigrogularis	Pied butcherbird			x	x					x	x	x	x	x	x	x	x	x	x	x	x	x	x
	Cracticus torquatus	Grey butcherbird			x	x					x	x		x		x	x	x		x	x	x	x	x
	Gymnorhina tibicen	Australian magpie			x	x						x			x	x			x	x		x	x	x
Burhinidae	*Burhinus grallarius*	Bush stone-curlew			x	x					x				x				x	x		x	x	x
Cacatuidae	*Cacatua sanguinea*	Little corella			x	x					x	x	x	x	x	x		x		x	x	x	x	x
	Eolophus roseicapilla	Galah			x	x				x		x	x	x	x	x	x	x	x	x	x	x	x	x
	Nymphicus hollandicus	Cockatiel			x	x						x		x	x	x	x	x	x	x	x	x	x	x
	Lophochroa leadbeateri	Major Mitchell's cockatoo			x																			
Campephagidae	*Coracina maxima*	Ground cuckoo-shrike			x														x		x		x	x
	Coracina novaehollandiae	Black-faced cuckoo-shrike			x	x				x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	Lalage tricolor	White-winged triller			x	x						x			x	x		x		x	x	x	x	x
Caprimulgidae	*Eurostopodus argus*	Spotted nightjar			x	x					x	x		x	x	x		x	x	x		x	x	x
Casuariidae	*Dromaius novaehollandiae*	Emu			x	x					x	x	x	x		x	x			x		x		
Charadriidae	*Charadrius ruficapillus*	Red-capped plover				x																		
	Charadrius veredus	Oriental plover	MI	MI	x	x	x	x	x															
	Elseyornis melanops	Black-fronted dotterel			x	x					x	x		x	x			x			x	x	x	x
	Erythrogonys cinctus	Red-kneed dotterel			x	x														x				x
	Vanellus miles	Masked plover			x																x			
Ciconiidae	*Ephippiorhynchus asiaticus*	Black-necked stork			x	x																		x
Cinclosomatidae	*Cinclosoma marginatum*	Western quail-thrush			x															x				
	Cinclosoma castaneothorax	Chestnut-breasted quail-thrush			x	x																		
Climacteridae	*Climacteris melanurus*	Black-tailed treecreeper			x	x									x			x						
Columbidae	*Columba livia**	Rock pigeon																x						
	Geopelia cuneata	Diamond dove			x	x				x	x	x	x	x	x	x	x	x		x	x	x	x	x
	Geopelia placida	Peaceful dove			x	x				x	x			x	x			x		x		x	x	x
	Geophaps plumifera	Spinifex pigeon			x	x				x	x	x	x	x	x	x	x	x		x	x	x	x	x

Family	Scientific Name	Common Name	Conservation Status		Database					Literature												Current consolidation		
			WA	EPBC	ALA	Birdata	PMST	DBCA	Fortescue	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
	Ocyphaps lophotes	Crested pigeon			x	x				x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	Phaps chalcoptera	Common bronzewing			x	x					x			x	x	x	x	x		x	x	x	x	x
Corvidae	*Corvus bennetti*	Little crow			x	x					x	x			x					x	x			
	Corvus orru	Torresian crow			x	x				x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Cuculidae	*Centropus phasianinus*	Pheasant coucal				x								x								x	x	x
	Chalcites basalis	Horsfield's bronze cuckoo			x	x						x		x	x	x	x	x		x		x	x	x
	Chalcites osculans	Black-eared cuckoo			x		x											x		x	x			
	Heteroscenes pallidus	Pallid cuckoo			x	x					x	x			x	x		x		x	x	x	x	x
Dicaeidae	*Dicaeum hirundinaceum*	Mistletoebird			x	x						x			x	x				x			x	x
Estrildidae	*Emblema pictum*	Painted finch			x	x					x	x		x	x	x	x	x	x	x	x	x	x	x
	Neochmia ruficauda	Star finch			x	x								x						x	x			
	Taeniopygia guttata castanotis	Zebra finch			x	x				x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Falconidae	*Falco berigora*	Brown falcon			x	x					x	x	x	x	x	x	x	x	x	x	x	x	x	x
	Falco cenchroides	Nankeen kestrel			x	x				x	x	x	x	x	x	x	x	x		x	x	x	x	x
	Falco hypoleucos	Grey falcon	VU	VU	x		x	x	x							x	x			x		x	x	x
	Falco longipennis	Australian hobby			x	x						x						x		x			x	x
	Falco peregrinus	Peregrine falcon	OS	-	x	x		x	x			x			x					x				
	Falco subniger	Black falcon			x																			
Glareolidae	*Stiltia isabella*	Australian pratincole			x																		x	
	Glareola maldivarum	Oriental pratincole	MI	MI	x																			
Hirundinidae	*Cheramoeca leucosterna*	White-backed swallow			x											x								
	Hirundo neoxena	Welcome swallow			x	x																		
	Hirundo rustica	Barn swallow	MI	MI			x																	
	Petrochelidon ariel	Fairy martin			x	x						x			x	x	x					x	x	x
	Petrochelidon nigricans	Tree martin			x	x				x		x			x	x				x	x	x	x	x
Laridae	*Chlidonias hybrida*	Whiskered tern			x	x						x												
	Gelochelidon nilotica	Gull-billed tern	MI	MI	x	x		x	x			x												
	Hydroprogne caspia	Caspian tern	MI	MI	x	x		x	x										x					
	Chroicocephalus novaehollandiae	Silver gull			x	x																		
Locustellidae	*Cincloramphus cruralis*	Brown songlark			x	x								x									x	x
	Cincloramphus mathewsi	Rufous songlark			x	x									x		x			x	x	x	x	x
	Poodytes carteri	Spinifexbird			x	x				x		x	x	x	x	x	x	x	x	x		x	x	x
Maluridae	*Amytornis whitei*	Pilbara grasswren (striated grasswren)			x	x								x	x	x		x		x		x	x	x
	Malurus assimilis	Purple-backed fairywren			x	x				x	x	x		x	x	x	x	x		x	x	x	x	x
	Malurus leucopterus	White-winged fairywren			x	x				x	x	x	x			x	x	x		x	x	x	x	x
	Stipiturus ruficeps	Rufous-crowned emu-wren			x																			
Meliphagidae	*Acanthagenys rufogularis*	Spiny-cheeked honeyeater			x	x					x	x		x		x		x		x	x	x	x	x
	Certhionyx variegatus	Pied honeyeater			x	x										x		x		x	x		x	
	Epthianura aurifrons	Orange chat			x	x																		
	Epthianura tricolor	Crimson chat			x	x						x			x					x	x	x	x	x
	Gavicalis virescens	Singing honeyeater			x	x				x		x	x	x	x	x	x	x	x	x	x	x	x	x
	Conopophila whitei	Grey honeyeater			x									x				x					x	
	Lichmera indistincta	Brown honeyeater			x	x				x	x	x		x	x	x	x	x		x	x	x	x	x

Family	Scientific Name	Common Name	Conservation Status		Database					Literature												Current consolidation		
			WA	EPBC	ALA	Birdata	PMST	DBCA	Fortescue	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
	Manorina flavigula	Yellow-throated miner			x	x					x	x	x	x	x	x	x	x	x	x	x	x	x	x
	Melithreptus gularis	Black-chinned honeyeater			x	x					x				x		x	x	x					
	Ptilotula keartlandi	Grey-headed honeyeater			x	x				x		x		x	x	x	x	x	x	x		x	x	x
	Ptilotula penicillata	White-plumed honeyeater			x	x				x		x		x	x	x	x	x		x	x	x	x	x
	Ptilotula plumula	Grey-fronted honeyeater			x	x									x									x
	Purnella albifrons	White-fronted honeyeater			x	x																	x	x
	Sugomel nigrum	Black honeyeater			x	x						x						x		x				x
	Stomiopera unicolor	White-gaped honeyeater				x																		
Meropidae	*Merops ornatus*	Rainbow bee-eater			x	x	x			x	x	x	x	x	x	x		x	x	x	x	x	x	x
Monarchidae	*Grallina cyanoleuca*	Magpie-lark			x	x					x	x	x	x	x	x	x	x	x	x	x	x	x	x
Motacillidae	*Anthus australis*	Australian pipit			x	x					x	x	x		x			x		x	x	x	x	x
	Motacilla cinerea	Grey wagtail	MI	MI			x	x																
	Motacilla flava	Yellow wagtail	MI	MI			x																	
Neosittidae	*Daphoenositta chrysoptera*	Varied sittella			x						x													
Oreoicidae	*Oreoica gutturalis*	Crested bellbird			x	x					x	x		x	x	x	x	x	x	x	x	x	x	x
Otididae	*Ardeotis australis*	Australian bustard			x	x				x	x	x	x	x	x	x	x	x		x	x	x	x	x
Pachycephalidae	*Colluricincla harmonica*	Grey shrikethrush			x	x				x	x	x		x	x	x	x	x	x	x	x	x	x	x
	Pachycephala rufiventris	Rufous whistler			x	x				x	x	x		x	x	x	x	x		x	x	x	x	x
Pandionidae	*Pandion haliaetus*	Osprey	MI	MI				x																
Pardalotidae	*Pardalotus rubricatus*	Red-browed pardalote			x	x					x	x		x	x	x			x	x	x	x	x	x
	Pardalotus striatus	Striated pardalote			x	x										x	x	x				x	x	x
Pelecanidae	*Pelecanus conspicillatus*	Australian pelican			x	x						x				x						x	x	x
Petroicidae	*Melanodryas cucullata*	Hooded robin			x	x					x	x		x	x	x		x		x		x	x	x
	Petroica goodenovii	Red-capped robin			x	x					x	x				x	x			x			x	x
Phalacrocoracidae	*Microcarbo melanoleucos*	Little pied cormorant			x	x																x	x	x
	Phalacrocorax sulcirostris	Little black cormorant			x	x													x		x	x	x	x
	Phalacrocorax carbo	Great cormorant			x	x																		
	Phalacrocorax varius	Pied cormorant			x	x													x					
Phasianidae	*Synoicus ypsilophorus*	Brown quail			x	x								x				x			x	x	x	x
Podargidae	*Podargus strigoides*	Tawny frogmouth			x	x											x	x		x		x	x	x
Podicipediformes	*Poliocephalus poliocephalus*	Hoary-headed grebe			x	x																	x	x
	Tachybaptus novaehollandiae	Australasian grebe			x	x								x										x
Pomatostomidae	*Pomatostomus superciliosus*	White-browed babbler			x	x					x			x				x		x		x		
	Pomatostomus temporalis	Grey-crowned babbler			x	x					x	x		x	x	x	x	x	x	x	x	x	x	x
Procellariidae	*Macronectes giganteus*	Southern giant petrel	MI	EN				x																
Psittaculidae	*Barnardius zonarius*	Australian ringneck			x	x				x		x		x	x	x	x	x	x	x	x	x	x	x
	Melopsittacus undulatus	Budgerigar			x	x						x		x	x	x	x	x	x	x	x	x	x	x
	Neopsephotus bourkii	Bourke's parrot			x	x								x										
	Pezoporus occidentalis	Night parrot	CR	EN			x	x																
	Polytelis alexandrae	Princess parrot	P4	VU			x	x																
	Psephotellus varius	Mulga parrot			x														x					
Psophodidae	*Psophodes occidentalis*	Chiming wedgebill			x	x																		
Ptilonorhynchidae	*Chlamydera guttata*	Western bowerbird			x	x						x			x	x	x	x				x	x	x

Family	Scientific Name	Common Name	Conservation Status		Database					Literature												Current consolidation		
			WA	EPBC	ALA	Birdata	PMST	DBCA	Fortescue	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
Rallidae	*Fulica atra*	Eurasian coot			x	x					x										x			
	Gallirallus philippensis	Buff-banded rail			x	x																		
	Porphyrio porphyrio	Australasian swamphen									x			x										
	Tribonyx ventralis	Black-tailed native hen			x	x																		
Recurvirostridae	*Himantopus leucocephalus*	Black-winged stilt			x							x		x				x					x	x
	Recurvirostra novaehollandiae	Red-necked avocet										x												
	Cladorhychus leucocephalus	Banded stilt				x																		
Rhipiduridae	*Rhipidura albiscapa*	Grey fantail													x					x		x		
	Rhipidura leucophrys	Willie wagtail			x	x				x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Rostratulidae	*Rostratula australis*	Australian painted snipe	EN	EN		x	x	x																
Scolopacidae	*Actitis hypoleucos*	Common sandpiper	MI	MI			x	x	x															
	Calidris acuminata	Sharp-tailed sandpiper	MI	MI	x	x	x	x	x															
	Calidris ferruginea	Curlew sandpiper	CR	CR	x		x																	
	Calidris ruficollis	Red-necked stint	MI	MI				x	x															
	Calidris melanotos	Pectoral sandpiper	MI	MI			x																	
	Tringa glareola	Wood sandpiper	MI	MI	x	x		x	x											x				
	Tringa nebularia	Common greenshank	MI	MI				x	x															
	Tringa stagnatilis	Marsh sandpiper	MI	MI				x	x															
Strigidae	*Ninox boobook boobook*	Southern boobook			x	x						x		x	x	x		x	x	x		x	x	x
	Ninox connivens	Barking owl			x			x (P3)																x
Threskiornithidae	*Platalea flavipes*	Yellow-billed spoonbill			x	x								x										
	Platalea regia	Royal spoonbill			x	x								x						x				x
	Plegadis falcinellus	Glossy ibis	MI	MI	x	x		x	x															
	Threskiornis moluccus	Australian white ibis				x																		
	Threskiornis spinicollis	Straw-necked ibis			x	x						x		x								x	x	x
Turnicidae	*Turnix velox*	Little buttonquail			x	x						x		x	x	x	x	x		x	x	x	x	x
Tytonidae	*Tyto javanica*	Eastern barn owl			x	x						x			x			x		x		x	x	
Total					**161**	**149**	**18**	**20**	**13**	**31**	**55**	**83**	**25**	**75**	**71**	**66**	**55**	**89**	**32**	**91**	**60**	**87**	**99**	**108**
Mammals																								
Bovidae	*Bos primigenius taurus**	European cattle								x		x		x	x	x	x	x	x	x	x	x	x	
Camelidae	*Camelus dromedarius**	Camel			x									x	x	x		x						
Canidae	*Canis familiaris*	Dingo			x							x		x	x	x	x	x	x	x		x	x	
Dasyuridae	*Dasycercus blythi*	Brush-tailed mulgara	P4	-				x					x										x	
	Dasycercus cristicauda	Crest-tailed mulgara	P4	-				x																
	Dasykaluta rosamondae	Kaluta			x						x	x		x	x	x	x	x				x		
	Dasyurus hallucatus	Northern quoll	EN	EN	x		x	x	x						x		x	x				x	x	
	Ningaui timealeyi	Pilbara ningaui			x					x	x	x		x	x		x	x				x	x	
	Planigale ingrami	Long-tailed planigale												x	x									
	Planigale kendricki (formerly Planigale 1)															x		x						
	Planigale tealei																					x		
	Planigale sp.																			x	x			
	Pseudantechinus woolleyae	Woolley's pseudantechinus			x							x			x	x		x						
	Sminthopsis hirtipes	Hairy-footed dunnart										x												
	Sminthopsis longicaudata	Long-tailed dunnart	P4	-				x																

Family	Scientific Name	Common Name	Conservation Status		Database					Literature												Current consolidation		
			WA	EPBC	ALA	Birdata	PMST	DBCA	Fortescue	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
	Sminthopsis macroura	Stripe-faced dunnart			x									x		x	x	x		x		x	x	
	Sminthopsis ooldea	Ooldea dunnart																x						
	Sminthopsis youngsoni	Lesser hairy-footed dunnart			x									x		x		x						
Emballonuridae	*Saccolaimus flaviventris*	Yellow-bellied sheath-tailed bat								x	x	x		x	x	x	x	x			x	x	x	x
	Taphozous georgianus	Common sheath-tailed bat			x					x		x		x	x	x	x	x	x		x	x	x	x
	Taphozous hilli	Hill's sheath-tailed bat												x										
Equidae	*Equus africanus asinus**	Donkey															x			x				
	*Equus ferus caballus**	Horse																		x				
Felidae	*Felis catus**	Cat								x		x		x	x	x	x	x	x	x		x	x	
Leporidae	*Oryctolagus cuniculus**	Rabbit			x									x		x	x	x						
Macropodidae	*Osphranter robustus erubescens*	Euro								x		x	x	x	x			x	x	x		x	x	
	Osphranter rufus	Red kangaroo			x							x	x	x	x	x	x	x		x		x	x	
	Petrogale rothschildi	Rothschild's rock-wallaby			x									x	x	x		x				x	x	
	Lagorchestes conspicillatus	Spectacled hare-wallaby	P4	-				x							x									
Megadermatidae	*Macroderma gigas*	Ghost bat	VU	VU	x		x	x	x					x	x				x			x		x
Molossidae	*Austronomus australis*	White-striped free-tailed bat												x		x	x	x				x		x
	Chaerephon jobensis	Greater northern free-tailed bat								x		x		x	x	x	x	x		x	x	x	x	x
	Ozimops lumsdenae	Northern free-tailed bat												x		x		x				x	x	x
	Mormopterus beccarii	Beccari's freetail-bat													x									
Muridae	*Leggadina lakedownensis*	Short-tailed mouse	P4	-	x			x	x													x	x	
	*Mus musculus**	House mouse			x									x	x	x	x	x		x	x	x	x	
	Notomys alexis alexis	Spinifex hopping-mouse												x		x	x	x						
	Pseudomys chapmani	Western pebble-mound mouse	P4	-	x			x	x	x	x	x	x	x	x	x		x		x		x	x	
	Pseudomys pilbarensis	Pilbara delicate mouse			x										x	x	x					x		
	Pseudomys desertor	Desert mouse			x							x		x	x	x	x	x		x		x		
	Pseudomys hermannsburgensis	Sandy inland mouse			x							x		x	x	x	x	x		x		x	x	
	Zyzomys argurus	Common rock-rat			x							x		x	x	x	x	x				x	x	
Pteropodidae	*Pteropus alecto*	Black flying-fox																				x	x	
Phalangeridae	*Trichosurus vulpecula*	Common brushtail possum			x										x									
Rhinonycteridae	*Rhinonicteris aurantia* (Pilbara form)	Pilbara leaf-nosed bat	VU	VU	x		x	x						x	x			x	x			x	x	x
Tachyglossidae	*Tachyglossus aculeatus acanthion*	Short-beaked echidna			x					x					x	x		x				x		
Thylacomyidae	*Macrotis lagotis*	Greater bilby	VU	VU			x	x	x				x											
Vespertilionidae	*Chalinolobus gouldii*	Gould's wattled bat								x	x	x		x	x	x	x	x		x	x	x	x	x
	Chalinolobus nigrogriseus	Hoary wattled bat			x																			
	Nyctophilus geoffroyi geoffroyi	Lesser long-eared bat										x		x	x					x	x			
	Nyctophilus daedalus	Pallid long-eared bat																		x	x			
	Nyctophilus sp.															x	x							
	Scotorepens greyii	Little broad-nosed bat								x	x	x		x	x	x	x	x		x	x	x	x	x
	Vespadelus finlaysoni	Finlayson's cave bat			x					x	x	x		x	x	x	x	x	x	x	x	x	x	x
Total					25	0	4	10	5	12	7	2	5	31	31	29	24	33	8	19	11	30 (3)	24 (3)	10
Reptiles																								
Agamidae	*Ctenophorus caudicinctus*	Western ring-tailed dragon			x					x	x	x		x	x	x	x	x		x	x	x	x	
	Ctenophorus isolepis	Central military dragon			x							x		x	x	x	x	x				x	x	

Family	Scientific Name	Common Name	Conservation Status		Database					Literature												Current consolidation		
			WA	EPBC	ALA	Birdata	PMST	DBCA	Fortescue	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
	Ctenophorus nuchalis	Central netted dragon			x							x		x	x									
	Ctenophorus reticulatus	Western netted dragon			x																			
	Diporiphora amphiboluroides	Mulga dragon			x											x	x			x	x			
	Diporiphora valens	Southern Pilbara tree-dragon																x						
	Gowidon longirostris	Long-nosed dragon			x							x		x	x		x	x		x	x	x	x	
	Pogona minor mitchelli	Bearded dragon			x							x		x		x	x	x		x	x	x	x	
	Tympanocryptis cephalus	Coastal pebble-mimic dragon									x										x			
	Tympanocryptis fortescuensis	Fortescue pebble-mimic dragon			x																		x	
Carphodactylidae	*Nephrurus cinctus*	Southern banded knob-tailed gecko			x						x					x	x	x		x		x		
Chelidae	*Chelodina steindachneri*	Flat-shelled turtle			x						x			x	x							x	x	
Diplodactylidae	*Crenadactylus pilbarensis*	Pilbara clawless gecko																				x		
	Diplodactylus bilybara	Western fat-tailed gecko																	x					
	Diplodactylus conspicillatus	Variable fat-tailed gecko									x	x			x			x			x			
	Diplodactylus galaxias	Northern Pilbara beak-faced gecko								x													x	
	Diplodactylus laevis	Desert fat-tailed gecko			x									x		x	x					x	x	
	Diplodactylus mitchelli																						x	
	Diplodactylus pulcher				x						x			x							x		x	
	Diplodactylus savagei	Southern Pilbara beak-faced gecko			x						x				x			x			x	x		
	Lucasium squarrosum									x														
	Lucasium stenodactylus	Sand-plain gecko													x					x			x	
	Lucasium wombeyi				x						x	x		x	x			x		x	x	x		
	Lucasium woodwardi				x						x	x		x			x	x			x	x	x	
	Oedura fimbria	Western marbled velvet gecko													x			x				x		
	Rhynchoedura ornata	Western beaked gecko			x						x	x		x	x	x					x		x	
	Strophurus elderi				x					x	x	x			x							x	x	
	Strophurus jeanae											x		x										
	Strophurus strophurus	Western spiny-tailed gecko																x						
	Strophurus wellingtonae				x						x	x				x	x	x		x	x			
Elapidae	*Acanthophis wellsi*	Pilbara death adder			x										x							x		
	Acanthophis pyrrhus	Desert death adder													x									
	Brachyurophis approximans									x	x	x			x			x		x	x	x	x	
	Demansia reticulata	Reticulated whipsnake			x							x		x	x	x	x	x		x	x	x		
	Demansia rufescens	Rufous whipsnake												x	x	x	x	x			x	x	x	
	Furina ornata	Moon snake			x					x	x			x	x					x	x	x	x	
	Parasuta monachus	Inland hooded snake										x		x	x									
	Pseudechis australis	Mulga snake			x						x	x		x	x	x		x		x		x	x	
	Pseudonaja mengdeni	Western brown snake			x						x	x		x		x		x				x		
	Pseudonaja modesta	Ringed brown snake			x										x		x	x						
	Pseudonaja nuchalis	Northern brown snake																x		x	x		x	
	Simoselaps bertholdi	Jan's banded snake																x						
	Suta fasciata	Rosen's snake			x										x			x				x	x	
	Suta gaikhorstorum	Pilbara hooded snake																x						
	Suta punctata	Spotted snake			x										x	x		x			x		x	

Family	Scientific Name	Common Name	Conservation Status		Database					Literature												Current consolidation		
			WA	EPBC	ALA	Birdata	PMST	DBCA	Fortescue	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
	Vermicella snelli														x							x		
Gekkonidae	*Gehyra crypta*	Western cryptic gehyra														x	x	x				x	x	
	Gehyra fenestrula	Hamersley Range spotted gehyra														x								
	Gehyra media	Medium Pilbara spotted rock gehyra			x																	x		
	Gehyra micra	Small Pilbara spotted rock gehyra			x													x				x	x	
	Gehyra montium	Centralian dtella			x											x	x	x				x		
	Gehyra pilbara																	x						
	Gehyra punctata	Spotted dtella			x					x	x			x	x			x		x	x	x	x	
	Gehyra purpurascens	Purplish dtella										x												
	Gehyra variegata	Variegated gehyra			x						x	x		x	x	x	x	x		x	x	x	x	
	Heteronotia binoei	Bynoe's gecko			x					x	x	x		x	x	x	x	x		x	x	x	x	
	Heteronotia spelea	Pilbara cave gecko			x						x				x			x			x	x	x	
Pygopodidae	*Delma butleri*				x							x		x	x			x			x	x		
	Delma desmosa																x	x				x		
	Delma elegans				x										x						x			
	Delma nasuta				x					x				x	x			x		x	x	x	x	
	Delma pax				x						x	x		x	x	x	x	x		x	x	x	x	
	Delma tincta				x										x			x		x				
	Lialis burtonis				x						x	x		x	x	x	x	x		x		x	x	
	Pygopus nigriceps				x						x	x			x	x				x		x		
Pythonidae	*Antaresia childreni*	Children's python			x							x												
	Antaresia perthensis	Pygmy python									x	x			x	x		x			x	x	x	
	Aspidites melanocephalus	Black-headed python			x							x										x	x	
	Liasis olivaceus barroni	Pilbara olive python	VU	VU			x	x	x			x			x				x		x	x		
Scincidae	*Carlia munda*				x					x	x	x		x	x	x	x	x		x	x	x	x	
	Carlia triacantha				x						x			x	x	x	x							
	Cryptoblepharus buchananii																						x	
	Cryptoblepharus plagiocephalus				x																			
	Cryptoblepharus ustulatus														x			x					x	
	Ctenotus ariadnae											x		x										
	Ctenotus duricola	Eastern Pilbara lined ctenotus			x					x		x			x	x	x	x		x	x	x	x	
	Ctenotus grandis				x							x		x	x							x		
	Ctenotus hanloni											x		x		x	x	x						
	Ctenotus helenae				x					x	x			x		x		x				x	x	
	Ctenotus inornatus														x									
	Ctenotus nigrilineatus		P1	-	x			x																
	Ctenotus leonhardii											x		x	x			x				x		
	Ctenotus pallasotus	Western Pilbara lined ctenotus															x	x						
	Ctenotus pantherinus				x					x	x	x		x	x	x	x	x		x	x	x	x	
	Ctenotus piankai	Coarse sands ctenotus															x							
	Ctenotus quattuordecimlineatus													x		x								
	Ctenotus robustus																	x					x	
	Ctenotus rubicundus														x			x		x		x	x	

Family	Scientific Name	Common Name	Conservation Status		Database					Literature												Current consolidation		
			WA	EPBC	ALA	Birdata	PMST	DBCA	Fortescue	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
	Ctenotus rutilans											x		x	x			x		x				
	Ctenotus saxatilis	Rock ctenotus			x					x	x	x		x		x	x			x	x	x	x	
	Ctenotus serventyi													x										
	Ctenotus uber uber				x									x		x	x				x			
	Cyclodomorphus melanops				x							x			x	x				x	x	x	x	
	Egernia cygnitos	Western Pilbara spiny-tailed skink			x													x						
	Egernia epsisolus				x										x							x	x	
	Egernia formosa				x						x				x		x	x				x		
	Egernia pilbarensis				x																			
	Eremiascincus richardsonii	Broad-banded sand swimmer			x						x	x						x		x	x	x		
	Lerista amicorum				x							x		x								x		
	Lerista bipes				x							x		x	x	x		x						
	Lerista flammicauda	Pilbara flame-tailed slider			x															x				
	Lerista jacksoni				x							x			x									
	Lerista labialis				x							x						x						
	Lerista muelleri				x						x	x			x	x	x	x		x	x	x		
	Lerista neander																	x						
	Lerista timida				x							x				x	x	x			x			
	Lerista verhmens				x																		x	
	Lerista vermicularis													x										
	Lerista zietzi (Lerista chalybura)																	x						
	Liopholis kintorei	Great desert skink	VU	VU			x																	
	Menetia greyii				x					x	x	x		x	x	x	x	x		x		x	x	
	Menetia surda				x																			
	Morethia ruficauda				x									x	x	x		x		x	x	x	x	
	Notoscincus ornatus				x									x	x	x	x					x		
	Proablepharus reginae				x									x								x	x	
	Tiliqua multifasciata	Central blue-tongue								x	x			x	x	x	x	x			x		x	
Typhlopidae	*Anilios ammodytes*				x					x				x	x	x	x	x		x	x	x	x	
	Anilios ganei	Gane's blind snake	P1	-				x						x								x		
	Anilios grypus				x									x	x			x		x	x	x	x	
	Anilios hamatus	Pale-headed blind snake			x										x					x				
	Anilios waitii	Beaked blind snake			x																			
	Anilios pilbarensis				x									x								x	x	
Varanidae	*Varanus acanthurus*	Spiny-tailed goanna			x					x	x	x			x	x		x		x	x	x	x	
	Varanus brevicauda	Short-tailed pygmy goanna			x						x			x	x	x						x	x	
	Varanus bushi	Pilbara mulga goanna			x						x			x										
	Varanus caudolineatus				x						x									x				
	Varanus eremius	Pygmy desert goanna			x							x		x	x			x				x	x	
	Varanus giganteus	Perentie			x					x	x			x	x			x				x	x	
	Varanus gouldii	Bungarra			x						x	x	x	x				x			x	x		
	Varanus hamersleyensis															x		x						
	Varanus panoptes				x							x	x	x	x	x				x	x	x	x	

Family	Scientific Name	Common Name	Conservation Status		Database					Literature												Current consolidation		
			WA	EPBC	ALA	Birdata	PMST	DBCA	Fortescue	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
	Varanus pilbarensis	Northern Pilbara rock goanna			x							x			x							X	X	
	Varanus tristis	Racehorse goanna			x						x	x		x	x		x	x		x	x	X	X	
Total					**86**	**0**	**2**	**3**	**1**	**19**	**41**	**52**	**2**	**57**	**67**	**43**	**36**	**70**	**1**	**40**	**45**	**69**	**58**	**0**
Fish																								
Terapontidae	*Leiopotherapon unicolor*	Spangled perch												x		x						X		
Atherinidae	*Craterocephalus cuneiceps*	Murchison River hardyhead																				X		
Total					**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**

Appendix D Bat echolocation call analysis.

Specialised Zoological

Identification of bat species from Bonney Downs, Western Australia

Prepared for **Ecologia Environment Pty Ltd**

Version **22 August 2024**

SZ project reference **SZ720**

Specialised Zoological ABN 92 265 437 422
Dr Kyle Armstrong and Yuki Konishi
Tel +61 (0)404 423 264
kyle.n.armstrong@gmail.com

This report should be included as an appendix in any larger submission to Government, and cited as:

Specialised Zoological (2024). Identification of bat species from Bonney Downs, Western Australia. Unpublished report by Specialised Zoological for Ecologia Environment Pty Ltd, 22 August 2024, project reference SZ720.

Version history

Date	Version	Note
2024-06-20	2024-06-20	Interim results from partial analysis of the datasets
2024-08-19	2024-08-19	Final report with outcomes from full analysis
2024-08-22	2024-08-22	Final report with addition of 2023 data

© Copyright - Specialised Zoological, ABN 92 265 437 422. This document and its content are copyright and may not be copied, reproduced or distributed (in whole or part) without the prior written permission of Specialised Zoological other than by the Client for the purposes authorised by Specialised Zoological ("Intended Purpose"). The Client acknowledges that the Final Report is intended for the sole use of the Client, and only to be used for the Intended Purpose. Any representation or recommendation contained in the Final Report is made only to the Client. Specialised Zoological will not be liable for any loss or damage whatsoever arising from the use and/or reliance on the Final Report by any third party. To the extent that the Intended Purpose requires the disclosure of this document and/or its content to a third party, the Client must procure such agreements, acknowledgements and undertakings as may be necessary to ensure that the third party does not copy, reproduce, or distribute this document and its content other than for the Intended Purpose. This disclaimer does not limit any rights Specialised Zoological may have under the *Copyright Act 1968 (Cth)*.

Contents

1.0 Summary 4
1.1 Scope and data 4
1.2 Species richness 4
1.3 Ghost Bat 5
1.4 Pilbara Diamond-faced Bat 5
1.5 Bat species not detectable with the methods used 5
2.0 Methods 6
2.1 Ultrasonic recordings 6
2.2 Acoustic lure sites with infrared video recordings 6
3.0 Limitations 9
4.0 References 10
Appendix 1. Summarising collision risk—a possible starting point 28
Appendix 2. Use of acoustic lures 31

1.0 Summary

1.1 Scope and data

Bat identifications from acoustic recordings are provided from the Bonney Downs project area, in the Pilbara region of Western Australia. The datasets reported on here comprise a total of 144 sites, 320 recording nights and 475,151 WAV files:

- May 2023 'BBD' and 'BDDP' series—18 sites, 53 recording nights (119,133 sound files)
- July 2023 'BDTBD' series—4 sites, 18 recording nights (9,912 sound files)
- October 2023 'BB' and 'BDDP' series—42 sites, 80 recording nights (121,987 sound files)
- February 2024 'BB' series—39 sites, 78 recording nights (104,101 WAV sound files)
- March 2024 'BB' series—31 sites, 63 recording nights (65,952 WAV sound files)
- March 2024 'BDDP'—10 sites, 28 recording nights (54,066 WAV sound files)

Particular attention was given to the detection of two bat species of conservation significance: Ghost Bat *Macroderma gigas* (Megadermatidae) and Pilbara Diamond-faced Bat *Rhinonicteris aurantia* (Rhinonycteridae).

Two methods were used on the field survey:

1. Ultrasonic recordings with bat detectors to provide species identifications from echolocation calls;
2. Acoustic lure (portable speaker broadcasting Ghost Bat social calls; **Figure 1**) with detections and identification of the Ghost Bat from both infrared video and ultrasonic recordings; this is a targeted survey method to detect the species away from roost sites.

1.2 Species richness

Ten species of bat were detected (**Table 1**; **Figure 2**); which includes both the Ghost Bat and Pilbara Diamond-faced Bat. Each bat species was assigned to one of three categories representing the likelihood that they would be encountered above an altitude of 50 metres. This is an authoritative estimate based on my own accumulated casual field observations.

To give a further indication of the relative risk of collision of each species, the frequency of detection was calculated across sites for each species on each survey, and across all sites (**Table 2**). A risk matrix was devised based on the likelihood of detection at height categories and the frequency of detection values, which might be useful as a 'starting point' (conjecture) for considering the relative risk of collision with a turbine for each species (**Appendix 1**).

Details of detections at each site (collated across recording nights per site) are summarised in **Tables 3 – 8**.

One interesting observation was made for a high-flying species: the White-striped Free-tailed Bat *Austronomus australis* (Molossidae) is only seasonally present in the region from April to September according to an analysis presented by Bullen and McKenzie (2005). Observations

from the surveys were consistent with this analysis, with *A. australis* being detected only on the May and July 2023 surveys.

1.3 Ghost Bat

The Ghost Bat was detected at one acoustic lure site: BDGB03. One 'fly-by' was observed in in video recordings on both infrared camera traps at 18:52:22 and 18:52:54 (**Table 9**). The identification was based on the observation of an anteriorly-directed structure resembling long ears, the broad wings, and lack of a distinct tail (**Figure 3**; see comparison with images of birds and insects in **Figure 4**). It was not detected in echolocation recordings at the acoustic lure sites. However, the bat detector recording failed at site BDGB03. No other detections of the Ghost Bat were made on the surveys.

1.4 Pilbara Diamond-faced Bat

The Pilbara Diamond-faced Bat was detected from one echolocation sequence from acoustic lure site BDGB01 (unit 641036) on the night of 2024-03-22 at 23:21:09 (**Figure 5**). I have observed this species approaching a Ghost Bat social call broadcast on previous occasions. The Pilbara Diamond-faced Bat was also detected well after sunset and well before sunrise at 14 other sites in 2023 and 2024 (**Table 10**):

- 7 sites in May 2023
- 4 sites October 2023
- 3 sites in February 2024

1.5 Bat species not detectable with the methods used

Given that this survey was conducted to understand the possible effects of the construction and operation of wind turbines on bats, it is worth noting six species that were not detected in the analysis. Three of these are known to forage or commute above the tree canopy height and might range within the blade swept area of a wind turbine in this study area. These species cannot be detected using the methods described in the present report. Three other species not detected are either not found in this part of the Pilbara, or else have low detectability with bat detectors.

- **Black Flying-fox *Pteropus alecto* and Little Red Flying-fox *Pteropus scapulatus*** (Pteropodidae)—do not echolocate and are therefore not detected by acoustic recorders (bat detectors).
- **Hill's Sheath-tailed Bat *Taphozous hilli*** (Emballonuridae)—could be present in addition to *T. georgianus*, given its distribution in the region (Milne et al. 2023), but its calls cannot be distinguished reliably from those of *T. georgianus*.
- **Pallid Long-eared Bat *Nyctophilus daedalus* and Lesser Long-eared Bat *Nyctophilus geoffroyi*** (Vespertilionidae)—might be present but their echolocation calls are usually low in amplitude, and can be difficult to distinguish from clutter calls of the Little Broad-nosed Bat *Scotorepens greyii*.
- **Northern Coastal Free-tailed Bat *Ozimops cobourgianus*** (Molossidae)—found only along the Pilbara coast, usually in mangal habitat.

2.0 Methods

2.1 Ultrasonic recordings

The ultrasonic recordings provided were recorded in WAV format with Titley Scientific Anabat Chorus bat detectors (sampling rate 500 kHz, set to turn on automatically at sunset and off at sunrise), and Wildlife Acoustics SM4BAT-FS bat detectors (sampling rate 384 kHz).

A multi-step acoustic analysis procedure developed to process large full spectrum echolocation recording datasets from insectivorous bats (Armstrong et al. 2021a,b) was applied to the recordings made on the survey. Firstly, the WAV files were scanned for bat echolocation calls using several parameter sets in the software SCAN'R version 1.8.3 (Binary Acoustic Technology), which also provides measurements (SCAN'R parameters) from each putative bat pulse. The outputs were then used to determine if putative bat pulses measured in SCAN'R could be identified to species. This was done using a custom [R] language application that performed three tasks:

1. undertook a Discriminant Function Analysis on training data from representative calls from the Pilbara;
2. from the measurements of each putative bat pulse from SCAN'R, calculated values for the first two Discriminant Functions that could separate the echolocation call types derived from the analysis of training data, and plotted these resulting coordinates over data ellipses representing one standard deviation of the variation for the defined call types; and
3. facilitated an inspection in a spectrogram of multiple examples of each call type for each recording night by opening the original WAV files containing pulses of interest in ADOBE AUDITION version 23.1.

Species were identified based on information in the author's unpublished material and Churchill (2008). Nomenclature follows Jackson and Groves (2015). Identifications were supported by distribution information in a curated source of distribution records maintained by the Australasian Bat Society, Inc. (https://www.ausbats.org.au/batmap.html) (Milne et al. 2023). Custom [R] language scripts were used to summarise the analysis outcomes.

2.2 Acoustic lure sites with infrared video recordings

An acoustic lure system was set at seven sites for one night each. This method is based on recent demonstrations of its utility by Hanrahan et al. (2023) and Ruykys et al. (2023), and is broadly consistent with guidelines on the approach released in the Northern Territory (Ruykys et al. 2024). The system comprised a portable speaker (generic brand from Amazon), an Anabat Chorus bat detector, two infrared-capable camera traps (Jaycar model QC8051), and two 'long range infrared spotlights' (Jaycar model QC3654).

The portable speakers were loaded with a micro-SD card containing a sequence of sound files comprising 'squabble' calls; *sensu* Hanrahan et al. 2023; see **Appendix 2**) of the Ghost Bat. Sound files consisted of a 2-minute period with various examples of squabble calls, followed by a 2-minute period of silence. The speakers played sound files on a memory card

sequentially upon startup, for the entire night. The speaker volume was maximised. The distance at which Ghost Bats can hear the signals at night is unknown but assumed to be at least 100 m.

The camera trap was set to record back-to-back 3-minute black and white video files at high resolution (4K 3840 x 2160) continuously upon start up. Recordings were started after covering the camera lens so that the unit switched from colour to night (black and white) mode. The settings were adjusted so that built-in infrared LEDs were non-functional, and infrared light was instead provided by the long-range infrared spotlight, which was powered by 10 AA batteries that lasted c. 5 hours. Each camera trap contained a blank 256 GB Sandisk SD card, which had the capacity to save the recording from a full night.

The Chorus bat detector was placed on the central star picket underneath the portable speaker to maximise the chance of detection via echolocation calls if a Ghost Bat approached the speaker. Detection of echolocation calls provides a way to independently validate any detection made from the video recordings (**Appendix 2**).



Figure 1. Representation of the acoustic lure system deployment. There are two camera traps for redundancy and corroboration of images of bats, and a bat detector for validation of an identification made from videos based on echolocation calls only.

All videos were processed with an expeditious and robust analysis method. A custom Python (https://www.python.org/) script (Dr R. C. Morgans, Supersensory Technologies Pty Ltd unpublished) applied a background subtraction algorithm from the *opencv* framework (https://opencv.org/) to the recordings and constructed a concatenated short video containing only portions of the recording with moving objects above a certain size. These concatenated videos are watched at <50% speed in the MPV MEDIA PLAYER (https://mpv.io/), which allows fine control of frame advancement. Objects of interest were located and re-examined in the original 4K recording using the embedded timestamp information.

Smaller species of bat can be seen often in the infrared videos. Without careful consideration, these species can sometimes be confused for the Ghost Bat when they fly near the speaker—a behaviour that might intuitively be expected only from the Ghost Bat. Ghost Bats can be distinguished in infrared and thermal video recordings from other bat species and insects based on the observation of any combination of the following morphological and behavioural features that provide an empirical basis for the identification:

- flight pattern (four distinct behaviours classified as: ‘circling’ of the post containing the speaker; ‘hover’ in front of the speaker; ‘long glide’ towards the speaker; and ‘drop in’ whereby they would sometimes approach at c. 2 m above the speaker and then drop vertically towards it);
- body size relative to other objects in the frame;
- large ear size;
- lack of a tail;
- bright eyeshine of the reflected infrared light from their large eyes (infrared recordings only, though not always visible); and
- corroboration with concurrently-recorded diagnostic echolocation calls (**Appendix 2**).

All bats observed in videos are examined by single manual frame advancement to check for diagnostic features. The relatively high resolution and video frame rate provides a reasonable level of image quality.

3.0 Limitations

The identifications presented in this report have been made within the following context:

1. The identifications made herein were based on the ultrasonic sound recordings made and provided by a 'third party' (the client named on the front of this report).
2. In the case of the present report, the recording equipment was set up and supplied by Specialised Zoological. The equipment was operated by the third party during the survey.
3. Other than the general location of the study area, Specialised Zoological has not been provided with detailed information of the survey area, has not made a visit to observe the habitats available for bats, nor have we visited the specific project areas on a previous occasion.
4. Specialised Zoological has had no input into the overall design and timing of this bat survey, recording site placement, nor the degree of recording site replication.
5. This version of the document supersedes any previous version, including the interim report (Specialised Zoological 2024). Previous drafts are not authorised by us for submission to the regulator or the public domain.
6. Please see **Appendix 2** for more information about the application of the acoustic lure.

4.0 References

Armstrong K.N., Broken-Brow J., Hoye G., Ford G., Thomas M. and Corben C. (2021a). Effective detection and identification of sheath-tailed bats of Australian forests and woodlands. *Australian Journal of Zoology* 68:346–363. https://doi.org/10.1071/ZO20044

Armstrong K.N., Clarke S., Linke A., Scanlon A., Roetman P., Hitch, A.T. and Donnellan S.C. (2021b). Citizen science implements the first intensive acoustics-based survey of insectivorous bat species across the Murray-Darling Basin of South Australia. *Australian Journal of Zoology* 68: 364–381. https://doi.org/10.1071/ZO20051

Bullen, R.D. and McKenzie, N.L. (2005). Seasonal range variation of *Tadarida australis* (Chiroptera: Molossidae) in Western Australia: the impact of enthalpy. *Australian Journal of Zoology* 53: 145–156.

Churchill, S.K. (2008). *Australian bats.* 2nd ed. Allen and Unwin, Crows Nest, NSW.

Hanrahan, N., Turbill C., Armstrong K.N., Dalziell A.H. and Welbergen J.A. (2023). Calling up ghosts: acoustic playback of social vocalisations reveals complex communication in a cryptic bat and provides a promising tool for monitoring disturbance-sensitive species. *Mammal Research*. https://doi.org/10.1007/s13364-023-00727-w

Jackson, S.M. and Groves, C.P. (2015). *Taxonomy of Australian mammals*. CSIRO Publishing, Victoria.

Milne D.J., Reardon T.B. and Ford G. (2023) BatMap – authoritative distribution maps for Australian bats. *Australian Mammalogy*. 45: 350–355. https://doi.org/10.1071/AM23005

Ruykys, L., Hanrahan, N. and Stokeld, D. (2023). Novel acoustic lure methodology facilitates detection of the cryptic ghost bat at a landscape scale. *Wildlife Research* 51. https://doi.org/10.1071/WR22189

Ruykys L., Hanrahan N. and Stokeld D. (2024) Northern Territory guidelines for surveying for the ghost bat at the landscape scale. Technical Report 05/2024, Department of Environment, Parks and Water Security, Palmerston, Northern Territory and Charles Darwin University, Brinkin, Northern Territory.

Specialised Zoological (2024). Acoustic analysis and bat call identification from Bonney Downs, Western Australia: interim results. Unpublished report by Specialised Zoological for Ecologia Environment Pty Ltd, 20 June 2024, project reference SZ720.

Table 1. Species identified in the present survey from all sites combined. The predicted presence above 50 metres in altitude is an authoritative estimate based on my own accumulated casual field observations ('predicted to be encountered commonly above 50 m').

Predicted presence above 50 m altitude		
	MEGADERMATIDAE	
Medium	Ghost Bat	*Macroderma gigas*
	RHINONYCTERIDAE	
Low	Pilbara Diamond-faced Bat (Pilbara Leaf-nosed Bat)	*Rhinonicteris aurantia*
	EMBALLONURIDAE	
Medium	Yellow-bellied Sheath-tailed Bat	*Saccolaimus flaviventris*
High	Common Sheath-tailed Bat	*Taphozous georgianus*
	VESPERTILIONIDAE	
Low	Gould's Wattled Bat	*Chalinolobus gouldii*
Low	Little Broad-nosed Bat	*Scotorepens greyii*
Low	Finlayson's Cave Bat	*Vespadelus finlaysoni*
	MOLOSSIDAE	
High	White-striped Free-tailed Bat	*Austronomus australis*
Medium	Greater Northern Free-tailed Bat	*Chaerephon jobensis*
Medium	Northern Free-tailed Bat	*Ozimops lumsdenae*

Table 2. Frequency of detection across sites for each species on each survey (higher intensity of colour for higher values).

Species	May 2024	July 2024	October 2024	February 2024 (BB series)	March 2024 (BB series)	March 2024 (BDDP series)	Over all surveys
A. australis	0.00	0.00	0.00	0.44	0.50	0.00	0.07
C. gouldii	0.87	0.77	0.80	0.94	1.00	0.74	0.85
C. jobensis	0.54	0.39	0.50	0.83	1.00	0.45	0.55
O. lumsdenae	0.18	0.26	0.00	0.11	0.50	0.14	0.18
R. aurantia	0.08	0.00	0.00	0.39	0.00	0.10	0.10
S. flaviventris	0.87	0.84	0.90	0.50	0.25	0.48	0.71
S. greyii	0.87	0.74	0.80	0.89	1.00	0.79	0.85
T. georgianus	0.77	0.61	0.80	0.83	1.00	0.50	0.70
V. finlaysoni	0.49	0.42	0.60	0.50	1.00	0.55	0.53

Table 3. Species detected at each site in May 2023 ('BBD' and 'BDDP' sites).

						A. australis	*C. gouldii*	*C. jobensis*	*O. lumsdenae*	*R. aurantia*	*S. flaviventris*	*S. greyii*	*T. georgianus*	*V. finlaysoni*
Site	**Detector serial**	**Coordinates**	**First night**	**Last night**	**Nights**									
BBD01	S4U06484-MDSM4-02	-22.579550, 117.011240	2023-05-27	2023-05-30	4	X	X	X	.	X	.	X	X	X
BBD02	S4U11723-MDSM4-03	-22.579550, 117.011240	2023-05-28	2023-05-29	2	X	X	X	.	X	.	X	X	X
BBD03	S4U11658-MDSM4-05	-22.579330, 117.011580	2023-05-30	2023-05-31	2	.	X	X	.	.	.	X	.	.
BBD04	S4U11723-MDSM4-03	-22.579550, 117.011240	2023-05-30	2023-05-31	2	.	X	X	.	.	X	.	.	.
BBD05	S4U06478-MDSM4-01	-22.579550, 117.011240	2023-05-30	2023-05-31	2	.	X	X	.	.	X	X	X	.
BBD06	S4U11657-MDSM4-07	-22.140550, 118.563240	2023-05-30	2023-05-31	2	X	X	X	.	X	X	X	X	X
BBD07	S4U11659-MDSM4-04	-22.579330, 117.011240	2023-05-30	2023-05-31	2	.	X	X	.	.	X	X	X	X
BBDDP02	S4U11723-MDSM4-03	-22.579550, 117.011240	2023-05-25	2023-05-27	3	.	X	X	.	.	X	X	X	X
BDBAT01	S4U11651-MDSM4-06	-22.579330, 117.011580	2023-05-28	2023-05-30	3	X	X	X	X	X	.	.	X	X
BDDP01	S4U11651-MDSM4-06	-22.579330, 117.011580	2023-05-24	2023-05-26	3	X	X	.	.	.	X	X	X	.
BDDP03	S4U06478-MDSM4-01	-22.579550, 117.011240	2023-05-23	2023-05-26	4	X	X	X	.	X	.	X	X	.
BDDP04	S4U11657-MDSM4-07	-22.140550, 118.563240	2023-05-24	2023-05-26	3	X	X	X	.	.	X	X	X	X
BDDP05	S4U11658-MDSM4-05	-22.579330, 117.011580	2023-05-23	2023-05-25	3	.	X	X	X	.	X	X	X	X
BDDP06	S4U11658-MDSM4-05	-22.579330, 117.011580	2023-05-26	2023-05-29	4	.	X	X	.	X	.	X	X	X
BDDP07	S4U11659-MDSM4-04	-22.579330, 117.011240	2023-05-26	2023-05-29	4	.	X	X	.	X	.	X	X	.
BDDP08	S4U06484-MDSM4-02	-22.579550, 117.011240	2023-05-23	2023-05-26	4	.	X	.	.	.	.	X	X	.
BDDP09	S4U06478-MDSM4-01	-22.579550, 117.011240	2023-05-27	2023-05-29	3	.	X	.	.	.	.	X	.	.
BDDP10	S4U11657-MDSM4-07	-22.140550, 118.563240	2023-05-27	2023-05-29	3	X	.	X	.	.	X	X	X	.

Table 4. Species detected at each site in July 2023 ('BDTBD' sites).

						A. australis	*C. gouldii*	*C. jobensis*	*O. lumsdenae*	*R. aurantia*	*S. flaviventris*	*S. greyii*	*T. georgianus*	*V. finlaysoni*
Site	**Detector serial**	**Coordinates**	**First night**	**Last night**	**Nights**									
BDTBD01	636494	-22.018644, 119.971222	2023-07-25	2023-07-28	4	.	X	X	X	.	.	X	X	X
BDTBD02	644439	-22.021631, 119.964485	2023-07-25	2023-07-28	4	.	X	X	X	.	.	X	X	X
BDTBD03	644439	-21.973442, 119.999969	2023-07-26	2023-07-31	6	X	X	X	.	.	.	X	X	X
BDTBD04	636494	-21.978964, 119.990219	2023-07-29	2023-08-01	4	X	X	X	.	.	X	X	X	X

Table 5. Species detected at each site in October 2023 ('BB' and 'BDDP' sites; continued next page).

						A. australis	*C. gouldii*	*C. jobensis*	*O. lumsdenae*	*R. aurantia*	*S. flaviventris*	*S. greyii*	*T. georgianus*	*V. finlaysoni*
Site	**Detector serial**	**Coordinates**	**First night**	**Last night**	**Nights**									
BDDP13	S4U06484-MDSM4-02	.	2023-10-12	2023-10-14	3	.	.	.	.	X	.	X	X	X
BB017	S4U06484-MDSM4-02	.	2023-10-15	2023-10-16	2	.	X	X	.	.	X	X	.	X
BB012	S4U06484-MDSM4-02	.	2023-10-17	2023-10-18	2	.	X	.	.	.	X	X	.	X
BB040	S4U11723-MDSM4-03	.	2023-10-09	2023-10-10	2	.	X	.	.	.	.	X	.	.
BDDP11	S4U11723-MDSM4-03	.	2023-10-11	2023-10-13	3	.	X	X	.	.	X	X	X	X
BB039	S4U11723-MDSM4-03	.	2023-10-14	2023-10-15	2	.	X	X	.	.	X	X	X	.
BB011	S4U11723-MDSM4-03	.	2023-10-16	2023-10-18	3	.	X	X	.	X	X	X	X	X
BB028	S4U11659-MDSM4-04	.	2023-10-11	2023-10-12	2	.	.	.	.	.	.	X	X	.
BB026	S4U11659-MDSM4-04	.	2023-10-13	2023-10-14	2	.	X	X	.	.	.	.	X	X
BB018	S4U11659-MDSM4-04	.	2023-10-15	2023-10-16	2	.	X	.	.	.	.	X	.	X
BB015	S4U11659-MDSM4-04	.	2023-10-17	2023-10-18	2	.	X	X	X	.	X	X	X	X
BB033	S4U11658-MDSM4-05	.	2023-10-11	2023-10-12	2	.	X	X	X	.	.	X	.	.
BB030	S4U11658-MDSM4-05	.	2023-10-13	2023-10-14	2	.	X	X	.	.	.	X	X	.
BB002	S4U11658-MDSM4-05	.	2023-10-15	2023-10-16	2	.	.	.	.	.	.	.	.	.
BB029	MDSM4-06	no data	2023-10-11	2023-10-12	2	.	.	.	.	.	.	.	.	.
BB023	MDSM4-06	no data	2023-10-13	2023-10-14	2	.	.	.	.	.	.	.	.	.
BB001	MDSM4-06	no data	2023-10-15	2023-10-16	2	.	.	.	.	.	.	.	.	.
BB007	MDSM4-06	no data	2023-10-17	2023-10-18	2	.	.	.	.	.	.	.	.	.
BB032	S4U11659-MDSM4-07	-22.045100, 119.944370	2023-10-09	2023-10-10	2	.	X	X	.	.	.	X	X	.
BB025	S4U11659-MDSM4-07	-22.045100, 119.944370	2023-10-11	2023-10-12	2	.	X	X	.	.	X	X	X	X
BB036	S4U11659-MDSM4-07	-22.045100, 119.944370	2023-10-13	2023-10-14	2	.	X	X	X	X	X	X	X	X
BB005	S4U11659-MDSM4-07	-22.045100, 119.944370	2023-10-15	2023-10-16	2	.	X	X	.	.	.	X	X	X
BB010	S4U11659-MDSM4-07	-22.045100, 119.944370	2023-10-17	2023-10-18	2	.	X	.	.	.	X	X	.	X
BB020	TC36-644436	-22.107889, 119.867348	2023-10-11	2023-10-13	2	.	X	.	.	.	X	X	.	X

						A. australis	*C. gouldii*	*C. jobensis*	*O. lumsdenae*	*R. aurantia*	*S. flaviventris*	*S. greyii*	*T. georgianus*	*V. finlaysoni*
Site	**Detector serial**	**Coordinates**	**First night**	**Last night**	**Nights**									
BB016	TC36-644436	-22.198734, 119.918373	2023-10-13	2023-10-15	2	.	X	X	X	.	X	X	.	X
BB004	TC36-644436	-21.951029, 119.794090	2023-10-15	2023-10-17	2	.	X	.	.	.	X	X	.	X
BB021	TC36-644436	-22.196741, 120.013084	2023-10-17	2023-10-19	2	.	X	.	.	.	X	X	.	.
BB037	TC39-644439	-22.045776, 119.883430	2023-10-11	2023-10-13	2	.	.	.	.	.	.	X	X	.
BB022	TC39-644439	-22.114225, 119.975815	2023-10-13	2023-10-15	2	.	X	X	.	.	X	X	X	X
BB003	TC39-644439	-21.919384, 119.782402	2023-10-15	2023-10-17	2	.	X	X	.	X	X	X	X	X
BB008	TC39-644439	no data	.	.	.	.	.	.	.	.	.	.	.	.
BB035	TC40-644440	-22.076000, 119.895966	2023-10-11	2023-10-13	2	.	X	.	.	.	X	X	X	.
BB024	TC40-644440	-21.999393, 119.954002	2023-10-13	2023-10-15	2	.	X	X	X	.	.	.	X	X
BB038	TC40-644440	-22.225801, 119.852524	2023-10-15	2023-10-17	2	.	X	X	.	.	X	X	X	X
BB013	TC40-644440	-22.256664, 119.987633	2023-10-17	2023-10-19	2	.	X	.	.	.	X	X	.	X
BB031	TC88-636488	-22.015324, 119.875801	2023-10-11	2023-10-13	2	.	X	X	X	.	X	X	X	X
BB027	TC88-636488	-21.933846, 119.972397	2023-10-13	2023-10-15	2	.	X	.	.	.	.	.	X	.
BB014	TC88-636488	-22.209757, 119.814163	2023-10-15	2023-10-17	2	.	.	.	.	.	.	X	.	.
BB019	TC88-636488	-22.174740, 119.855011	2023-10-17	2023-10-19	2	.	X	X	.	.	.	X	.	.
BDDP12	TC94-636494	-22.070423, 119.854462	2023-10-11	2023-10-14	3	.	.	.	.	.	X	X	.	X
BB034	TC94-636494	-22.092993, 119.863396	2023-10-14	2023-10-16	2	.	X	.	.	.	.	X	X	X
BB009	TC94-636494	.	2023-10-17	2023-10-17	1	.	X	.	.	.	.	X	.	.

Table 6. Species detected at each site in February 2024 ('BB' sites; continued next page).

						C. gouldii	*C. jobensis*	*O. lumsdenae*	*R. aurantia*	*S. flaviventris*	*S. greyii*	*T. georgianus*	*V. finlaysoni*
Site	**Detector serial**	**Coordinates**	**First night**	**Last night**	**Nights**								
BB001	S4U11723	-32.911090,116.475810	2024-02-09	2024-02-10	2	X	X	.	.	X	X	X	X
BB002	S4U11657	-32.816600,116.379770	2024-02-09	2024-02-10	2	X	X	.	.	X	X	.	.
BB003	S4U11659	-32.781330,116.495450	2024-02-09	2024-02-10	2	X	X	X	X	X	X	X	X
BB004	644439	-21.949577,119.793472	2024-02-09	2024-02-10	2	X	X	.	.	X	.	X	X
BB005	636494	-22.003422,119.817451	2024-02-09	2024-02-10	2	X	.	.	.	X	X	X	X
BB006	644436	-22.025839,119.844109	2024-02-09	2024-02-10	2	X	.	.	.	X	X	.	.
BB007	636494	-22.053459,119.824661	2024-02-11	2024-02-12	2	X	X	.	.	.	X	.	.
BB008	S4U11657	-32.816600,116.379770	2024-02-11	2024-02-12	2	X	X	.	.	X	X	X	X
BB009	S4U11723	-32.911090,116.475810	2024-02-11	2024-02-12	2	.	X	.	.	X	X	X	.
BB010	S4U06478	-32.816600,116.379770	2024-02-11	2024-02-12	2	X	X	.	.	X	X	X	.
BB011	S4U06478	-32.816600,116.379770	2024-02-09	2024-02-10	2	X	X	.	.	X	X	X	X
BB012	S4U06484	-32.830550,116.357890	2024-02-11	2024-02-12	2	.	.	.	.	X	X	X	.
BB013	S4U11651	-22.114890,119.916880	2024-02-11	2024-02-12	2	X	.	X	X	X	X	X	.
BB014	644439	-22.209053,119.813850	2024-02-07	2024-02-08	2	.	.	.	.	X	.	X	.
BB015	S4U11658	-32.791420,116.382810	2024-02-09	2024-02-10	2	X	X	.	.	X	X	X	X
BB016	S4U11651	-22.114890,119.916880	2024-02-05	2024-02-06	2	X	X	X	.	X	X	.	X
BB017	644440	-22.231794,119.898666	2024-02-07	2024-02-08	2	X	X	.	.	X	X	X	.
BB019	636488	-22.175192,119.854073	2024-02-07	2024-02-08	2	X	X	.	.	X	X	.	X
BB020	S4U11651	-22.114890,119.916880	2024-02-07	2024-02-08	2	X	.	.	.	X	X	.	X
BB021	S4U11658	-32.791420,116.382810	2024-02-11	2024-02-12	2	X	.	X	.	X	X	X	.
BB022	S4U06478	-32.816600,116.379770	2024-02-07	2024-02-08	2	X	X	X	.	X	X	X	X
BB023	S4U06484	-32.830550,116.357890	2024-02-07	2024-02-08	2	X	X	.	.	X	X	X	X
BB024	S4U06484	-32.830550,116.357890	2024-02-05	2024-02-06	2	.	.	.	.	.	X	X	.

						C. gouldii	*C. jobensis*	*O. lumsdenae*	*R. aurantia*	*S. flaviventris*	*S. greyii*	*T. georgianus*	*V. finlaysoni*
Site	**Detector serial**	**Coordinates**	**First night**	**Last night**	**Nights**								
BB025	S4U11723	-32.911090,116.475810	2024-02-05	2024-02-06	2	X	X	X	.	X	X	X	X
BB026	S4U11657	-32.816600,116.379770	2024-02-05	2024-02-06	2	X	X	.	.	X	X	X	X
BB027	S4U06478	-32.816600,116.379770	2024-02-05	2024-02-06	2	X	.	.	.	.	X	X	.
BB028	S4U11658	-32.791420,116.382810	2024-02-05	2024-02-06	2	.	.	.	.	.	X	.	.
BB029	S4U11659	-32.781330,116.495450	2024-02-05	2024-02-06	2	X	X	X	.	X	X	X	.
BB030	636494	-22.011641,119.931221	2024-02-05	2024-02-06	2	X	.	.	.	X	.	X	.
BB031	636488	-22.015392,119.875801	2024-02-09	2024-02-10	2	X	.	.	.	X	.	X	.
BB032	644436	-22.145529,119.928078	2024-02-05	2024-02-06	2	X	.	.	.	.	X	.	.
BB033	644440	-21.964575,119.868095	2024-02-11	2024-02-12	2	X	.	.	.	X	X	.	X
BB034	S4U11651	-22.114890,119.916880	2024-02-09	2024-02-10	2	X	.	.	.	X	X	X	X
BB035	S4U06484	-32.830550,116.357890	2024-02-09	2024-02-10	2	X	X	.	.	X	X	X	.
BB036	644440	-22.033985,119.914337	2024-02-05	2024-02-06	2	X	X	.	.	X	X	X	X
BB037	644440	-22.045576,119.883087	2024-02-09	2024-02-10	2	X	.	.	.	X	.	X	.
BB038	636494	-22.209028,119.868584	2024-02-07	2024-02-08	2	X	X	.	.	X	X	X	X
BB039	S4U11659	-32.781330,116.495450	2024-02-11	2024-02-12	2	X	.	.	X	X	X	X	X
BB040	644439	-22.058601,119.935104	2024-02-05	2024-02-06	2	X	.	.	.	X	X	X	.

Table 7. Species detected at each site in March 2024 ('BB' sites; continued next page).

						C. gouldii	*C. jobensis*	*O. lumsdenae*	*R. aurantia*	*S. flaviventris*	*S. greyii*	*T. georgianus*	*V. finlaysoni*
Site	**Detector serial**	**Coordinates**	**First night**	**Last night**	**Nights**								
BB002	S4U11651	-22.112400,119.871900	2024-03-22	2024-03-23	2	.	.	.	.	X	.	X	.
BB004	644439	-21.949398,119.793747	2024-03-18	2024-03-19	2	X	.	.	.	X	X	X	X
BB006	S4U11657	-21.951290,119.792600	2024-03-21	2024-03-22	2	X	X	.	.	X	X	X	X
BB007	636488	-22.051115,119.825081	2024-03-18	2024-03-19	2	X	.	.	.	X	X	.	.
BB008	S4U11657	-21.951290,119.792600	2024-03-25	2024-03-26	2	X	.	.	.	X	.	X	X
BB009	S4U06478	-22.079100,119.814400	2024-03-25	2024-03-26	2	X	X	.	.	X	X	X	.
BB014	655145	-22.210754,119.813789	2024-03-23	.	1	.	.	.	.	X	.	.	.
BB015	S4U11659	-22.079630,119.814300	2024-03-21	2024-03-22	2	X	X	.	.	X	X	.	X
BB016	S4U11723	-22.199810,119.920150	2024-03-17	2024-03-19	3	X	X	X	.	X	X	X	.
BB017	S4U11723	-22.199810,119.920150	2024-03-20	2024-03-22	3	X	X	.	.	X	X	.	X
BB018	636473	-22.247828,119.842186	2024-03-23	2024-03-24	2	X	.	.	.	X	X	.	X
BB019	S4U11723	-22.199810,119.920150	2024-03-23	2024-03-24	2	X	X	.	.	X	X	X	.
BB021	S4U11651	-22.112400,119.871900	2024-03-24	2024-03-25	2	X	.	X	.	X	X	X	X
BB022	S4U06484	-22.102180,119.825030	2024-03-23	2024-03-24	2	X	X	.	.	X	X	.	X
BB023	644439	-21.975859,119.996063	2024-03-26	2024-03-27	2	X	X	X	.	X	X	.	.
BB024	S4U11651	-22.112400,119.871900	2024-03-26	2024-03-27	2	X	.	X	.	X	X	X	.
BB025	S4U11659	-22.079630,119.814300	2024-03-26	2024-03-27	2	X	.	X	.	X	X	.	.
BB026	636488	-21.906364,119.951920	2024-03-26	2024-03-27	2	X	X	X	.	X	X	X	.
BB027	S4U06484	-22.102180,119.825030	2024-03-26	2024-03-27	2	.	.	.	.	.	.	X	.
BB028	S4U11658	-21.919290,119.783830	2024-03-26	2024-03-27	2	X	X	.	.	.	X	X	.
BB029	S4U11657	-21.951290,119.792600	2024-03-23	2024-03-24	2	.	.	.	.	X	X	X	.
BB030	S4U11723	-22.199810,119.920150	2024-03-26	2024-03-27	2	X	.	X	.	X	X	X	X
BB031	S4U11658	-21.919290,119.783830	2024-03-21	2024-03-22	2	X	.	.	.	X	X	X	.
BB032	644439	-22.145163,119.928123	2024-03-21	2024-03-22	2	X	X	.	.	X	X	.	.

						C. gouldii	*C. jobensis*	*O. lumsdenae*	*R. aurantia*	*S. flaviventris*	*S. greyii*	*T. georgianus*	*V. finlaysoni*
Site	**Detector serial**	**Coordinates**	**First night**	**Last night**	**Nights**								
BB033	S4U11658	-21.919290,119.783830	2024-03-23	2024-03-24	2	.	.	.	.	.	.	.	.
BB034	S4U11659	-22.079630,119.814300	2024-03-23	2024-03-24	2	X	.	.	.	X	.	X	X
BB036	644439	-22.034061,119.914505	2024-03-23	2024-03-24	2	X	.	X	.	X	X	X	X
BB037	636488	-22.045712,119.883575	2024-03-23	2024-03-24	2	.	.	.	.	.	.	X	.
BB038	636472	-22.208471,119.869171	2024-03-23	2024-03-24	2	.	X	.	.	X	X	.	.
BB039	S4U06484	-22.102180,119.825030	2024-03-18	2024-03-19	2	X	.	.	.	X	X	.	X
BB040	S4U06478	-22.079100,119.814400	2024-03-23	2024-03-24	2	X	.	.	.	.	.	X	X

Table 8. Species detected at each site in March 2024 ('BDDP' sites).

						C. gouldii	*C. jobensis*	*O. lumsdenae*	*R. aurantia*	*S. flaviventris*	*S. greyii*	*T. georgianus*	*V. finlaysoni*
Site	**Detector serial**	**Coordinates**	**First night**	**Last night**	**Nights**								
BB003/BDDP16	S4U11658	-21.919290,119.783830	2024-03-18	2024-03-20	3	X	X	.	.	X	X	X	X
BDDP14	S4U11657	-21.951290,119.792600	2024-03-19	.	1	X	X	.	.	X	X	X	.
BDDP15	636494	-22.029480,119.826431	2024-03-18	2024-03-20	3	.	.	.	.	.	.	.	.
BDDP17	S4U11651	-22.112400,119.871900	2024-03-19	2024-03-21	3	.	X	.	.	X	.	X	.
BDDP18	636488	-21.893881,119.785057	2024-03-20	2024-03-22	3	X	.	.	.	X	X	X	X
BDDP19	S4U11659	-22.079630,119.814300	2024-03-17	2024-03-19	3	X	.	.	.	X	X	.	X
BDDP20	S4U06478	-22.079100,119.814400	2024-03-17	2024-03-19	3	X	X	.	.	X	X	X	X
BDDP22	S4U06478	-22.079100,119.814400	2024-03-20	2024-03-22	3	X	.	.	.	X	X	X	.
BDDP23	S4U11651	-22.112400,119.871900	2024-03-16	2024-03-18	3	X	.	.	.	X	X	X	X
DBOPP1	636472	-21.900614,119.884453	2024-03-26	2024-03-27	3	X	X	.	.	X	X	X	X

Table 9. Summary of analyses of the acoustic lure recordings (Chorus bat detector and two infrared camera traps per site).

Site	Chorus	Coordinates	Video timestamp
BDGB01	641036	-22.034065 119.914177	.
BDGB02	636474	-21.888155 119.781609	.
BDGB03	rec fail	.	18:52:22 and 18:52:54
BDGB04	641036	-22.100115 119.988914	.
BDGB05	636473	-21.905867 119.865448	.
BDGB06	641036	-21.975908 119.999283	.
BDGB07	636474	-21.915771 120.013268	.

Table 10. Summary of detections of the Pilbara Diamond-faced Bat from all sites (blue highlight aid inspection by separating sites; continued next page).

Site-unit	Night of	Passes	Sunset	Dusk	Dawn	Sunrise	Time of first detection	Time of last detection	Time since sunset	Time until sunrise
May 2023										
BBD01 MDSM4-02	27/05/2023	8	27/05/2023 17:25	27/05/2023 17:49	28/05/2023 6:07	28/05/2023 6:31	20:38:32	1:39:06	3H 13M 4S	4H 52M 50S
BBD02 MDSM4-03	28/05/2023	1	28/05/2023 17:25	28/05/2023 17:49	29/05/2023 6:08	29/05/2023 6:32	20:11:13	20:11:13	2H 45M 58S	10H 21M 9S
BBD06 MDSM4-07	30/05/2023	1	30/05/2023 17:24	30/05/2023 17:49	31/05/2023 6:09	31/05/2023 6:33	23:29:49	23:29:49	6H 4M 55S	7H 3M 25S
BDBAT01 MDSM4-06	28/05/2023	1	28/05/2023 17:25	28/05/2023 17:49	29/05/2023 6:08	29/05/2023 6:32	23:29:31	23:29:31	6H 4M 16S	7H 2M 51S
BDDP03 MDSM4-01	23/05/2023	1	23/05/2023 17:26	23/05/2023 17:50	24/05/2023 6:06	24/05/2023 6:30	23:25:59	23:25:59	5H 59M 32S	7H 4M 11S
BDDP06 MDSM4-05	26/05/2023	1	26/05/2023 17:25	26/05/2023 17:49	27/05/2023 6:07	27/05/2023 6:31	20:34:04	20:34:04	3H 8M 23S	9H 57M 26S
BDDP06 MDSM4-05	27/05/2023	9	27/05/2023 17:25	27/05/2023 17:49	28/05/2023 6:07	28/05/2023 6:31	19:53:28	2:01:34	2H 28M 0S	4H 30M 22S
BDDP06 MDSM4-05	28/05/2023	10	28/05/2023 17:25	28/05/2023 17:49	29/05/2023 6:08	29/05/2023 6:32	21:00:22	2:01:46	3H 35M 7S	4H 30M 36S
BDDP06 MDSM4-05	29/05/2023	21	29/05/2023 17:25	29/05/2023 17:49	30/05/2023 6:08	30/05/2023 6:32	21:13:34	1:23:40	3H 48M 30S	5H 9M 8S
BDDP07 MDSM4-04	27/05/2023	1	27/05/2023 17:25	27/05/2023 17:49	28/05/2023 6:07	28/05/2023 6:31	21:02:40	21:02:40	3H 37M 12S	9H 29M 16S
October 2023										
BDDP13 MDSM4-02	14/10/2023	1	14/10/2023 18:04	14/10/2023 18:26	15/10/2023 5:06	15/10/2023 5:29	0:21:28	0:21:28	6H 17M 24S	5H 8M 10S
BB011 MDSM4-03	16/10/2023	17	16/10/2023 18:04	16/10/2023 18:27	17/10/2023 5:05	17/10/2023 5:27	22:34:05	2:31:13	4H 29M 12S	2H 56M 42S
BB011 MDSM4-03	17/10/2023	6	17/10/2023 18:05	17/10/2023 18:28	18/10/2023 5:04	18/10/2023 5:27	21:36:50	1:45:44	3H 31M 32S	3H 41M 21S
BB036 MDSM4-07	13/10/2023	3	13/10/2023 18:03	13/10/2023 18:26	14/10/2023 5:07	14/10/2023 5:30	20:02:06	23:09:58	1H 58M 25S	6H 20M 32S

Site-unit	Night of	Passes	Sunset	Dusk	Dawn	Sunrise	Time of first detection	Time of last detection	Time since sunset	Time until sunrise
BB03 TC39-644439	15/10/2023	11	15/10/2023 18:04	15/10/2023 18:27	16/10/2023 5:05	16/10/2023 5:28	19:32:11	3:50:51	1H 27M 43S	1H 37M 55S
BB03 TC39-644439	16/10/2023	6	16/10/2023 18:04	16/10/2023 18:27	17/10/2023 5:05	17/10/2023 5:27	19:30:17	3:08:43	1H 25M 24S	2H 19M 12S
February 2024										
BB03	9/02/2024	1	9/02/2024 18:44	9/02/2024 19:08	10/02/2024 5:24	10/02/2024 5:47	20:30:37	20:30:37	1H 46M 0S	9H 17M 21S
BB13	11/02/2024	1	11/02/2024 18:43	11/02/2024 19:06	12/02/2024 5:25	12/02/2024 5:49	2:16:32	2:16:32	7H 32M 58S	3H 32M 38S
BB39	11/02/2024	2	11/02/2024 18:43	11/02/2024 19:06	12/02/2024 5:25	12/02/2024 5:49	3:04:05	3:04:27	8H 20M 31S	2H 44M 43S

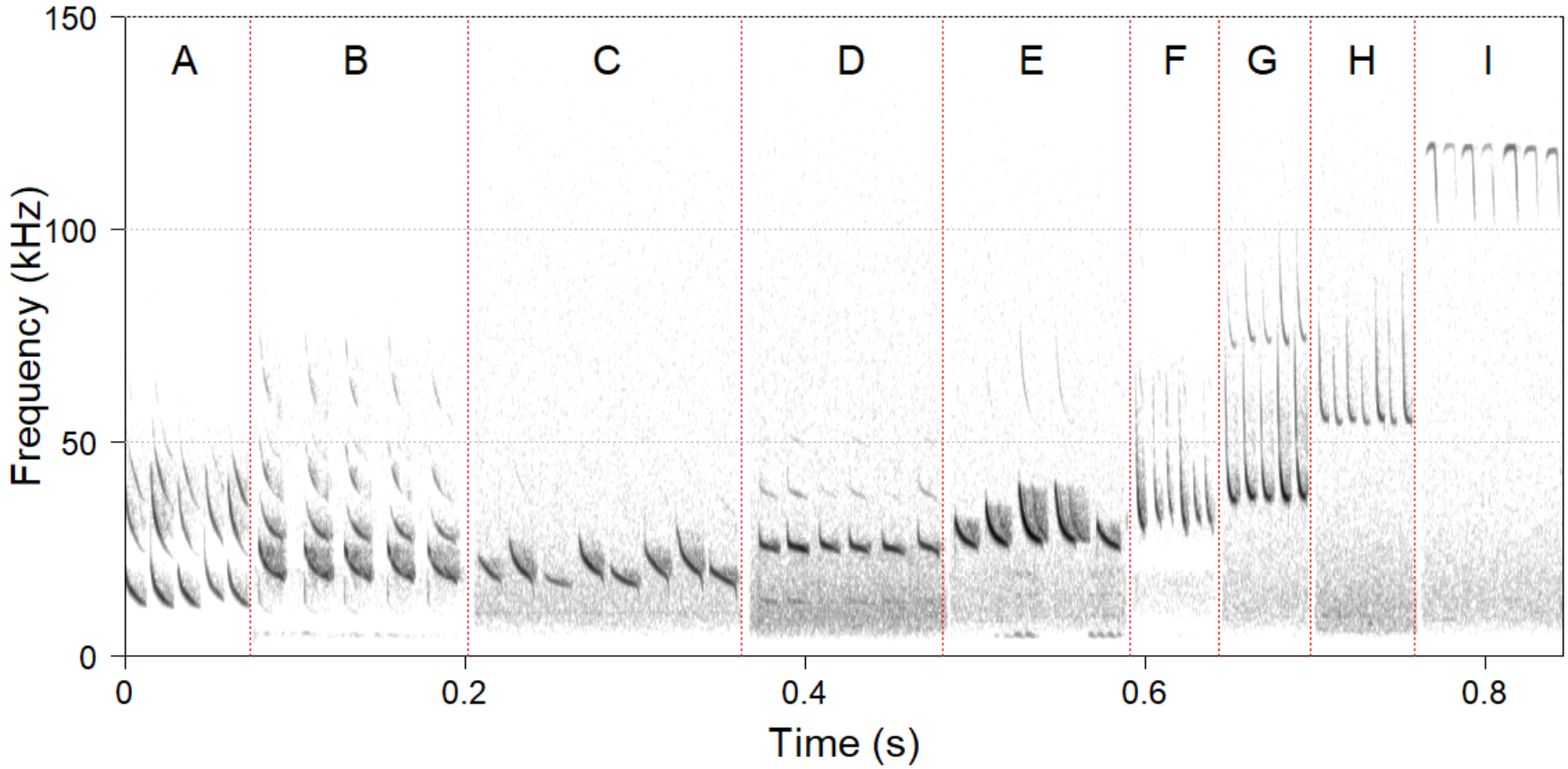


Figure 2. Representative echolocation call sequence portions of the species identified (**A**: *Austronomus australis;* **B**: *Saccolaimus flaviventris*; **C**: *Chaerephon jobensis*; **D**: *Taphozous georgianus*; **E**: *Ozimops lumsdenae*; **F**: *Chalinolobus gouldii*; **G**: *Scotorepens greyii*; **H**: *Vespadelus finlaysoni*; **I**: *Rhinonicteris aurantia*; time between pulses has been compressed).



Figure 3. Composite image of a 'fly-by' by one Ghost Bat at site BDGB03. No bat detector recordings were available from this site to confirm the observation, but the likelihood that this was a Ghost Bat is high (based on recognition of: anterior parts resembling long ears; the broadness of the wings, and lack of a distinct tail).



Figure 4. Examples of organisms that had features inconsistent with those of the Ghost Bat (**Top and middle**: Spotted Nightjar; **Bottom**: moth).

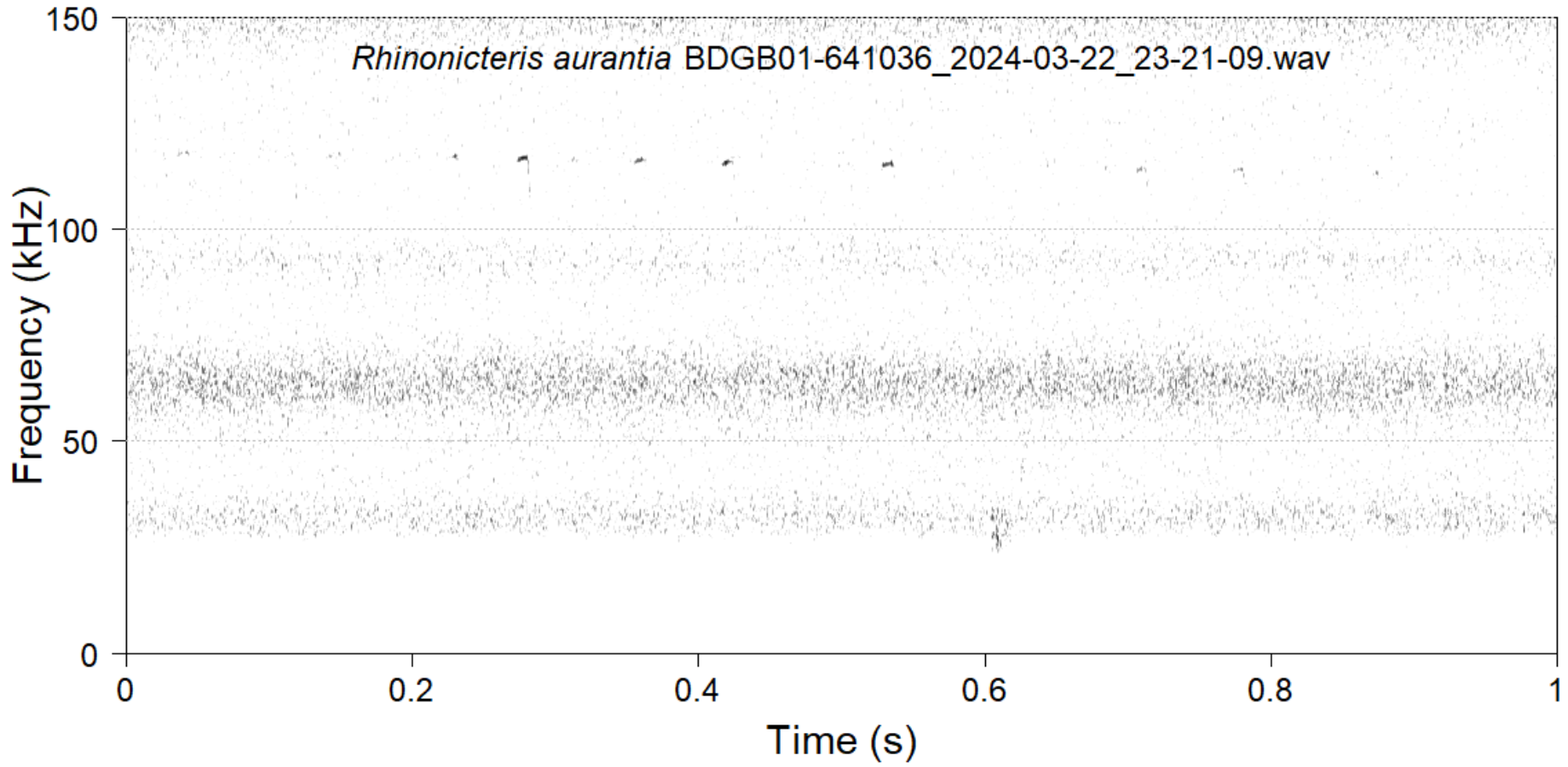


Figure 5. Representative echolocation call sequence portion of the Pilbara Diamond-faced Bat from acoustic lure site BDGB01.

Appendix 1. Summarising collision risk—a possible starting point

To understand the 'collision risk' of different bat Pilbara bat species, it might be useful to apply a modified generic risk matrix. I have provided a possible starting point for the development of a scheme in this appendix. In place of 'Probability' (rows), I have used the frequency of detection values calculated across all sites surveyed in 2023 – 2024, as sorted into four frequency ranges between 0 and 1; and in place of 'Consequence' (columns), I have used three likelihood categories of the species being present above 50 metres in altitude (turbine absent). The latter is an authoritative estimate based on my own accumulated casual field observations. The final score in the matrix is then divided into three risk categories. The final Risk Score and Collision Risk for each species is given in **Table A1**; and predictions for species not detected on the survey are given in **Table A2**. The Risk Scores and their Collision Risk categorisation seem to be sensible outcomes, though greater sampling effort for the Ghost Bat will give a more robust understanding of Collision Risk for this species.

	Likelihood of presence above 50 metres altitude	**Low**	**Medium**	**High**
Frequency of detection		1	2	3
0 – 0.25	1	1	2	3
0.25 – 0.50	2	2	4	6
0.50 – 0.75	3	3	6	9
0.75 – 1.0	4	4	8	12

Risk Score	**Collision Risk**
0 – 2	Low risk
3 – 6	Medium risk
7 – 12	High risk

Table A1. Calculated Risk Scores for each species based on the surveys in 2023 – 2024.

		High altitude likelihood	Altitude category	Frequency across all surveys	Frequency category	Risk Score	Collision Risk
MEGADERMATIDAE							
Ghost Bat	*Macroderma gigas*	Medium	2	0.14	1	2	Low
RHINONYCTERIDAE							
Pilbara Diamond-faced Bat	*Rhinonicteris aurantia*	Low	1	0.10	1	1	Low
EMBALLONURIDAE							
Yellow-bellied Sheath-tailed Bat	*Saccolaimus flaviventris*	Medium	2	0.71	3	6	Medium
Common Sheath-tailed Bat	*Taphozous georgianus*	High	3	0.70	3	9	High
VESPERTILIONIDAE							
Gould's Wattled Bat	*Chalinolobus gouldii*	Low	1	0.85	4	4	Medium
Little Broad-nosed Bat	*Scotorepens greyii*	Low	1	0.85	4	4	Medium
Finlayson's Cave Bat	*Vespadelus finlaysoni*	Low	1	0.53	3	3	Medium
MOLOSSIDAE							
White-striped Free-tailed Bat	*Austronomus australis*	High	3	0.07	1	3	Medium
Greater Northern Free-tailed Bat	*Chaerephon jobensis*	Medium	2	0.55	3	6	Medium
Northern Free-tailed Bat	*Ozimops lumsdenae*	Medium	2	0.18	1	2	Low

Table A2. Predicted Risk Score and Collision Risk categories for Pilbara species of bat not observed on the survey (based on distributions given by Milne et al. 2023; 'estimated frequency' was 'imagined' based on records of occurrence in the Atlas of Living Australia).

		High altitude likelihood	'Estimated frequency'	Risk Score	Collision Risk
Black Flying-fox	*Pteropus alecto*	High	0.30	6	Medium
Little Red Flying-fox	*Pteropus scapulatus*	High	0.10	3	Medium
Hill's Sheath-tailed Bat	*Taphozous hilli*	High	0.20	3	Medium
Pallid Long-eared Bat	*Nyctophilus daedalus*	Low	0.10	1	Low
Lesser Long-eared Bat	*Nyctophilus geoffroyi*	Low	0.90	4	Medium
Northern Coastal Free-tailed Bat	*Ozimops cobourgianus*	Medium	0.00	0	Low

Appendix 2. Use of acoustic lures

Specialised Zoological provided the equipment for the acoustic lure surveys, and provided advice on how set and use it. The equipment and procedure are broadly consistent with recently released guidelines in the Northern Territory for the use of acoustic lures for Ghost Bat detection (Ruykys et al. 2024). In the Introduction to these guidelines, the authors state that "…*it is expected that further application across the species' distribution will improve its generality and functionality.*"; (see also section 2.8). Given my own experience with the use of this method on several projects, and some practical considerations, I have provided advice in the present survey that I consider to be important improvements. These include:

1. The use of a bat detector directly under the portable speaker to detect the echolocation calls of a Ghost Bat that approaches and might briefly circle the post with this equipment. I address the five cautions articulated in the third 'author's tip' in section 2.6 of the guidelines:

   i. **"ghost bats do not consistently use echolocation when in flight"** Indeed Ghost Bats are thought not to echolocate continuously while in flight, but they are more likely to echolocate when approaching an object of their attention. In my own experience (not yet in the public domain; n = >20; exact number not given to preserve project anonymity), 74% of approaches could be validated unambiguously by the concurrent detection of an echolocation sequence on a bat detector placed under the speaker. For the remaining 26% of sites, it is possible that echolocation calls were not detected because of a combination of the low amplitude of the calls and the direction of flight relative to the zone of sound reception of the microphone.

   ii. **"the acoustic lure may mask any echolocation pulses from ghost bats"** This is not the case. No echolocation calls are part of the broadcast sequence used. Further, echolocation pulses are of a different frequency range than the various social calls, and overlapping of broadcast social calls and the echolocation calls of an approaching bat does not prevent them from being distinguished, either buy casual observation in a spectrogram, or the semi-automated analysis method used by Specialised Zoological.

   iii. **"no ghost bats were detected acoustically during the study by Ruykys et al. (2023), despite ghost bats routinely flying with 1 m of bat detectors"** In that study, bat detectors were not placed in an ideal position (see underlined segments) for recording echolocation calls, and consequently the usefulness of bat detectors is under-emphasised in the guidelines:

   "*To determine whether the echolocation calls of lured ghost bats could be passively detected, a bat detector (Anabat Swift, Titley Scientific, Queensland, Australia) was deployed on the reference tree at each survey site for both the control and active treatment. Detectors were deployed at chest height, with the ultrasonic omnidirectional microphone placed on the far side of the tree, away from the speaker. The microphone was angled at 45° down from vertical.*" (Ruykys et al. 2023; my underline)

iv. **"expertise is required to identify bats – particularly ghost bats – via their echolocation call"** Specialised Zoological has a long track record of being able to identify these calls reliably, using an efficient semi-automated method, and being able to distinguish them from signals of similar shape produced by other cave-roosting bat species.

v. **"the analysis of acoustic recordings will add significant analysis time to a project"** The analysis of bat detector recordings from acoustic lure sites using Specialised Zoological's semi-automated method is efficient, requiring relatively little time for analysis, and certainly far less than a full manual inspection of the dataset. Most importantly, a validation of observations from videos from an independent, unambiguous identification based on diagnostic echolocation calls is extremely valuable. While some visitations of Ghost Bats might be very clearly of this species in the videos, there can be uncertainty with others. Echolocation call detection provides adequate validation.

In addition, there is comment in the guidelines about the difficulty of recognising juvenile Ghost Bats in videos, and consequently a recommendation to avoid using the technique when juveniles are likely to be present (section 2.3.1; p. 15). This is unnecessary because juveniles can also be recognised by echolocation calls in the same way as adults.

2. Much detail is given in the guidelines about the density of sampling and the probability of detection—especially for a 'first stage' survey (see section 2). But it should be noted that probability of detection is likely to be different in other landscapes, given the number of nearby roosts, and the colony size in those roosts. In addition, the effective broadcast range of the acoustic lure is relatively limited, and has not yet been properly estimated (or standardised), though a diameter of 200 metres seems reasonable. The size of this stimulus zone might be too small for some situations, especially where different habitats and landscape features might need to be investigated to address specific requirements. Thus, increased sampling density consistent with the notion of the 'second stage' survey might be required for questions such as '*Which habitats do Ghost Bats use in this study area?*' or '*Do Ghost Bats visit this feature?*' The notion of the appropriate sampling density for different regions and study objectives is deserving of more discussion. This is acknowledged in section 2.8 of the guidelines.

3. Further empirical observations will provide a better understanding of the potential impact of the technique on the Ghost Bat, which will either support or diminish concern for the various ethical considerations mentioned throughout the guidelines. In my own experience in one comprehensive study, visitations typically involved either a single pass of the speaker, or else presence of a few seconds only, and typically less than one minute. Key to understanding impacts is knowing how many individuals might be detected (this information cannot be determined), the total visitation time, number of visitations per night, associated behaviours, and whether a roost site is likely to be nearby (relevant for the time when broadcasts are started). At present, I have recommended that broadcasts continue for longer than is recommended in the guidelines because the aim is to maximise the chance of detection in relatively large,

complex geological terrains. In my experience, the time of first detection of a Ghost Bat can be anytime throughout the night, though certainly most detections are within the first 2 – 3 hours after sunset.

4. The equipment described and illustrated in the guidelines comprises a single video camera. I recommend two 4K video cameras placed at right angles so that a second view of any approaching bat is available for situations where an identification is ambiguous. It also provides redundancy in case of equipment set-up issues, given the high cost of remote field surveys. I also recommend speakers that play from a micro-SD card rather than Bluetooth. The equipment set-up used on the present survey has been used successfully elsewhere, though it has several constraints, and the system will likely keep evolving with experience, feedback and the availability of newer technology.

5. In the guidelines there is an emphasis on the manual review of video streams and how this should be undertaken. The semi-automated analysis conducted by Specialised Zoological represents a significant improvement over manual reviews, and is undertaken with a different set of considerations designed to maximise robustness. Most of the information in section 2.6 on page 20 is not relevant to the present study.

6. I consider that effort for the discovery of diurnal roost sites is still the primary consideration for environmental impact assessments, but that the acoustic lure method is useful for confirming presence both near roosts and away from them, and for characterising the use of a study area for foraging.

7. Specialised Zoological has had minimal input into the sampling design and level of sampling intensity in this study.

This study used squabble calls provided by Dr Nicola Hanrahan with permission. I have confirmed with her that no registration number is required for this project because it began before the guidelines were released.

Specialised Zoological

Identification of bat species from Bonney Downs South, Western Australia

Prepared for **Spectrum Ecology Pty Ltd**

Version **3 September 2024 (2024-09-03rev2)**

SZ project reference **SZ716**

Specialised Zoological ABN 92 265 437 422
Dr Kyle Armstrong and Yuki Konishi
Tel +61 (0)404 423 264
kyle.n.armstrong@gmail.com

This report should be included as an appendix in any larger submission to Government, and cited as:

Specialised Zoological (2024). Identification of bat species from Bonney Downs South, Western Australia. Unpublished report by Specialised Zoological for Spectrum Ecology Pty Ltd, 3 September 2024, project reference SZ716.

Version history

Date	Version	Note
2024-09-02	2024-09-02	Final version
2024-09-03	2024-09-03	Updated version
2024-09-03	2024-09-03rev2	Updated version

© Copyright - Specialised Zoological, ABN 92 265 437 422. This document and its content are copyright and may not be copied, reproduced or distributed (in whole or part) without the prior written permission of Specialised Zoological other than by the Client for the purposes authorised by Specialised Zoological ("Intended Purpose"). The Client acknowledges that the Final Report is intended for the sole use of the Client, and only to be used for the Intended Purpose. Any representation or recommendation contained in the Final Report is made only to the Client. Specialised Zoological will not be liable for any loss or damage whatsoever arising from the use and/or reliance on the Final Report by any third party. To the extent that the Intended Purpose requires the disclosure of this document and/or its content to a third party, the Client must procure such agreements, acknowledgements and undertakings as may be necessary to ensure that the third party does not copy, reproduce, or distribute this document and its content other than for the Intended Purpose. This disclaimer does not limit any rights Specialised Zoological may have under the *Copyright Act 1968 (Cth)*.

Summary

Bat identifications from acoustic recordings are provided from the Bonney Downs South project area, in the Pilbara region of Western Australia. The datasets reported on here are from two surveys:

- **October 2023**—a total of 17 survey sites, 40 recording nights and 118,500 WAV files
- **April 2024**—a total of 12 survey sites, 35 recording nights and 54,483 WAV files

Particular attention was given to the detection of two bat species of conservation significance: Ghost Bat *Macroderma gigas* (Megadermatidae) and Pilbara Leaf-nosed Bat *Rhinonicteris aurantia* (Rhinonycteridae).

Eight species of bat were detected (**Tables 1** – **3**; **Figure 1**), which includes the Pilbara Leaf-nosed Bat. The Ghost Bat was not detected.

The Pilbara Leaf-nosed Bat was detected well after sunset and well before sunrise at three sites in October 2023 (**Table 4**) and two sites in April 2024 (**Table 5**).

Methods

The data provided were recorded in full spectrum WAV format from Wildlife Acoustics Song Meter SM4BAT bat detectors (sampling rate 384 kHz, set to turn on automatically at sunset and off at sunrise).

The echolocation calls of the Pilbara Leaf-nosed Bat were detected by scanning all WAV files with the software SCAN'R version 1.8.3 (Binary Acoustic Technology) using search parameters optimised to find calls of this species. All WAV files containing putative calls of the Pilbara Leaf-nosed Bat were inspected in Adobe Audition 23.1 software, and listings of files containing false positive identifications were discarded. Custom [R] language scripts assisted with summarisation of the remaining data, and the calculation of times of first detection after sunset and last detection before sunrise.

Searches for the echolocation calls of the Ghost Bat were also made by scanning all WAV files with the software SCAN'R version 1.8.3 (Binary Acoustic Technology) using search parameters optimised to find calls of this species. The outputs were then used to determine if putative bat pulses measured in SCAN'R could be attributed to the Ghost Bat. This was done using a custom [R] language application (Armstrong et al. 2021a,b) that performed three tasks:

1. undertook a Discriminant Function Analysis on training data from representative calls of Pilbara cave-roosting bat species (K.N. Armstrong unpublished dataset);

2. from the measurements of each putative bat pulse from SCAN'R, calculated values for the first two Discriminant Functions that could separate the echolocation call types derived from the analysis of training data, and plotted these resulting coordinates over ellipses representing one standard deviation of the variation for the defined call types; and

3. facilitated an inspection in a spectrogram of multiple examples the call type for each recording night by opening the original WAV files containing pulses of interest in Adobe Audition.

The remaining bat species were identified in Titley Scientific Anabat Insight software version 2.1.2 using a semi-automated Decision Tree process optimised for Pilbara echolocating bat species. Identifications were verified by examination of examples in spectrograms.

Species were identified based on information in the author's own unpublished material. Nomenclature follows Jackson and Groves (2015). Identifications were supported by distribution information in a curated source of distribution records maintained by the Australasian Bat Society, Inc. (https://www.ausbats.org.au/batmap.html) (Milne et al. 2023).

Limitations

The identifications presented in this report have been made within the following context:

1. The identifications made herein were based on the ultrasonic acoustic data recorded and provided by a 'third party' (the client named on the front of this report).
2. The scope of this report extended to providing information on the identification of bat species in bulk ultrasonic recordings. Further extended comment on these species and the possible impacts of a planned project on bat species were not part of the scope.
3. In the case of the present report, the recording equipment was not set up and supplied by Specialised Zoological. The equipment was operated by the third party during the survey.
4. Other than the general location of the study area, Specialised Zoological has not been provided with detailed information of the survey area, has not made a visit to observe the habitats available for bats, nor have we visited the specific project areas on a previous occasion.
5. Specialised Zoological has had no input into the overall design and timing of this bat survey, recording site placement, nor the degree of recording site replication.
6. While Specialised Zoological has made identifications to the best of our ability given the available materials, and reserves the right to re-examine the data and revise any identification following a query, it is the client's and / or proponent's responsibility to provide supporting evidence for any identification, which might require follow-up trapping effort or non-invasive methods such as video recordings. Specialised Zoological bears no liability for any follow-up work that may be required to support an identification based initially on the analysis of acoustic recordings undertaken and reported on here.
7. There are a variety of factors that affect the 'detectability' of each bat species, given the frequency, power and shape characteristics of their calls. Further information on the analysis and the various factors that can impinge on the reliability of identifications can be provided upon request.
8. The analysis of ultrasonic recordings is one of several methods that can be used to survey for bats, and comprehensive surveys typically employ more than one method. If an identification in the present report is ambiguous or in question, a trapping programme would help to resolve the presence of the possibilities in the project area.
9. The most reliable way of detecting the Ghost Bat with bat detectors is to place the equipment with the microphone facing into a potential cave roosting site. The echolocation calls of this species are of low amplitude, and therefore most detectable when a Ghost Bat flies close to the bat detector as it exits the underground structure. If there is uncertainty about whether Ghost Bats are present in a cave, then video recordings can be a useful addition to the survey. The detection of Ghost Bats with bat detectors away from cave entrances is less reliable, unless an approach based on an acoustic lure is used (Ruykys et al. 2023; Hanrahan et al. 2023).
10. Predictions about whether the Pilbara Leaf-nosed Bat roosts within a particular surveyed cave (where a bat detector was placed at the entrance), or somewhere nearby, based on the time of first detection should be considered indicative only. If unambiguous confirmation of diurnal roosting of this species is required, this should be undertaken using the entrance sheeting method that is described in DEWHA (2010).
11. This version of the document supersedes any previous version. Previous drafts are not authorised by us for submission to the regulator or the public domain.

References

Armstrong K.N., Broken-Brow J., Hoye G., Ford G., Thomas M. and Corben C. (2021a). Effective detection and identification of sheath-tailed bats of Australian forests and woodlands. *Australian Journal of Zoology* 68:346–363. https://doi.org/10.1071/ZO20044

Armstrong K.N., Clarke S., Linke A., Scanlon A., Roetman P., Hitch, A.T. and Donnellan S.C. (2021b). Citizen science implements the first intensive acoustics-based survey of insectivorous bat species across the Murray-Darling Basin of South Australia. *Australian Journal of Zoology* 68: 364–381. https://doi.org/10.1071/ZO20051

DEWHA (2010). Survey guidelines for Australia's threatened bats. Guidelines for detecting bats listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999. Department of the Environment, Water, Heritage and the Arts, Canberra.

Hanrahan, N., Turbill C., Armstrong K.N., Dalziell A.H. and Welbergen J.A. (2023). Calling up ghosts: acoustic playback of social vocalisations reveals complex communication in a cryptic bat and provides a promising tool for monitoring disturbance-sensitive species. *Mammal Research*. https://doi.org/10.1007/s13364-023-00727-w

Jackson, S.M. and Groves, C.P. (2015). *Taxonomy of Australian mammals*. CSIRO Publishing, Victoria.

Milne D.J., Reardon T.B. and Ford G. (2023) BatMap – authoritative distribution maps for Australian bats. *Australian Mammalogy*. 45: 350–355. https://doi.org/10.1071/AM23005

Ruykys, L., Hanrahan, N. and Stokeld, D. (2023). Novel acoustic lure methodology facilitates detection of the cryptic ghost bat at a landscape scale. *Wildlife Research* 51. https://doi.org/10.1071/WR22189

Table 1. Species identified in the present survey from all sites combined.

RHINONYCTERIDAE	
Pilbara Leaf-nosed Bat (Pilbara Diamond-faced Bat)	*Rhinonicteris aurantia*
EMBALLONURIDAE	
Yellow-bellied Sheath-tailed Bat	*Saccolaimus flaviventris*
Common Sheath-tailed Bat	*Taphozous georgianus*
VESPERTILIONIDAE	
Gould's Wattled Bat	*Chalinolobus gouldii*
Little Broad-nosed Bat	*Scotorepens greyii*
Finlayson's Cave Bat	*Vespadelus finlaysoni*
MOLOSSIDAE	
Greater Northern Free-tailed Bat	*Chaerephon jobensis*
Northern Free-tailed Bat	*Ozimops lumsdenae*

Table 2. Species identifications for all nights at each recording site in October 2023 (see *Table 1* for full species names).

						C. gouldii	*C. jobensis*	*O. lumsdenae*	*R. aurantia*	*S. flaviventris*	*S. greyii*	*T. georgianus*	*V. finlaysoni*
Site	**Detector serial**	**Coordinates**	**First night**	**Last night**	**Nights**								
BDS02	SM4-6081	50K 804618 7545083	18/10/2023	19/10/2023	2	X	X	.	.	X	X	X	X
BDS04	SM4-6081	50K 787844 7536107	20/10/2023	21/10/2023	2	.	.	.	.	X	X	.	X
BDSOPP16EM	SM4-6081	50K 802603 7546267	22/10/2023	23/10/2023	2	X	X	.	.	X	X	X	.
BDS12	SM4-6174	50K 787900 7540955	20/10/2023	21/10/2023	2	X	X	X	.	X	X	X	.
BDS03	SM4-6186	50K 794222 7539582	18/10/2023	19/10/2023	2	X	X	X	.	.	X	X	.
BDS CAMP	SM4-6186	50K 802622 7543944	21/10/2023	23/10/2023	3	X	X	.	.	.	X	.	X
BDS11	SM4-6253	50K 798305 7540215	18/10/2023	19/10/2023	2	X	X	.	.	.	.	X	X
BDS06	SM4-6253	50K 797776 7542441	20/10/2023	21/10/2023	2	X	X	X	X	.	X	X	X
Windmill2	SM4-6253	50K 790459 7543663	22/10/2023	23/10/2023	2	X	X	.	X	X	X	X	X
BDS08	SM4-6257	50K 816139 7536999	18/10/2023	19/10/2023	2	X	.	.	.	X	X	.	X
Windmill1	SM4-6257	50K 816639 7537199	20/10/2023	23/10/2023	4	X	.	.	.	X	X	.	X
BDS10	SM4-6266	50K 801551 7535295	18/10/2023	19/10/2023	2	X	.	.	.	X	X	X	X
BDSOPP13EM	SM4-6266	50K 789249 7544301	22/10/2023	23/10/2023	2	X	X	.	X	X	X	.	X
BDS07	SM4-6270	50K 814167 7535310	18/10/2023	19/10/2023	2	X	.	.	.	X	X	X	.
BDS09	SM4-6270	50K 799693 7545402	20/10/2023	22/10/2023	3	X	X	.	.	X	X	.	X
BDS05	SM4-6285	50K 800735 7542320	18/10/2023	19/10/2023	2	X	X	X	X	X	X	X	X
BDSOPP06	SM4-6285	50K 800986 7542234	20/10/2023	23/10/2023	4	X	X	X	X	X	X	X	X

Table 3. Species identifications summarised across all nights for each recording site in April 2024 (see *Table 1* for full species names).

						C. gouldii	*C. jobensis*	*O. lumsdenae*	*R. aurantia*	*S. flaviventris*	*S. greyii*	*T. georgianus*	*V. finlaysoni*
Site	**Detector serial**	**Coordinates**	**First night**	**Last night**	**Nights**								
BDS 08-Bat2	SM4 6081	50K 799667 7545407	2024-04-07	2024-04-09	3	X	X	X	.	X	X	.	X
BDS OPP2-Bat2	SM4 6081	50K 782735 7529320	2024-04-10	2024-04-12	3	X	X	.	.	X	X	X	X
BDS S2-Bat2	SM4 6259	50K 806364 7550244	2024-04-10	2024-04-12	3	X	.	.	X	.	X	.	X
BDS 09-Bat2	SM4 6259	50K 801745 7535217	2024-04-07	2024-04-09	3	X	X	X	.	X	X	X	X
BDS 03-Bat2	SM4 6262	50K 794172 7539619	2024-04-07	2024-04-09	3	X	X	.	.	X	X	X	X
BDS 05-Bat2	SM4 6262	50K 797781 7542444	2024-04-11	2024-04-13	3	X	X	.	.	X	X	X	X
BDS 11-Bat2	SM4 6266	50K 787814 7540945	2024-04-07	2024-04-09	3	X	.	.	.	.	X	.	X
BDS OPP1-Bat2	SM4 6266	50K 790401 7543707	2024-04-12	2024-04-12	1	X	X	X	.	X	X	X	X
BDS 10-Bat2	SM4 6269	50K 798358 7540023	2024-04-07	2024-04-09	3	X	X	.	.	X	X	.	X
BDS OPP3-Bat2	SM4 6269	50K 791266 7538715	2024-04-10	2024-04-12	3	X	.	.	.	.	X	X	X
BDS 03-Bat1	SM4 6282	50K 787861 7536092	2024-04-07	2024-04-10	4	X	.	.	.	.	X	.	.
BDS Dam-Bat2	SM4 6282	50K 800885 7542269	2024-04-11	2024-04-13	3	X	X	.	X	X	X	X	X

Table 4. Summary of detections of the Pilbara Leaf-nosed Bat from all sites in October 2023.

Bat detector serial	Night of	Passes	Sunset	Dusk	Dawn	Sunrise	Time of first detection	Time of last detection	Time since sunset	Time until sunrise
SM4-6253	21/10/2023	1	21/10/2023 18:07	21/10/2023 18:30	22/10/2023 5:01	22/10/2023 5:24	23:07:16	23:07:16	5H 0M 7S	6H 17M 33S
SM4-6253	22/10/2023	14	22/10/2023 18:07	22/10/2023 18:30	23/10/2023 5:01	23/10/2023 5:24	21:42:48	2:18:22	3H 35M 13S	3H 5M 42S
SM4-6253	23/10/2023	2	23/10/2023 18:08	23/10/2023 18:30	24/10/2023 5:00	24/10/2023 5:23	23:52:07	2:26:46	5H 44M 4S	2H 56M 34S
S4U06285	19/10/2023	2	19/10/2023 18:06	19/10/2023 18:29	20/10/2023 5:03	20/10/2023 5:26	23:09:44	23:10:59	5H 3M 27S	6H 15M 22S
S4U06285	20/10/2023	8	20/10/2023 18:06	20/10/2023 18:29	21/10/2023 5:02	21/10/2023 5:25	22:10:22	0:05:02	4H 3M 40S	5H 20M 33S
S4U06285	21/10/2023	10	21/10/2023 18:07	21/10/2023 18:30	22/10/2023 5:01	22/10/2023 5:24	21:49:59	1:07:33	3H 42M 50S	4H 17M 16S
S4U06285	22/10/2023	11	22/10/2023 18:07	22/10/2023 18:30	23/10/2023 5:01	23/10/2023 5:24	22:47:15	2:15:52	4H 39M 40S	3H 8M 12S
S4U06285	23/10/2023	20	23/10/2023 18:08	23/10/2023 18:30	24/10/2023 5:00	24/10/2023 5:23	21:38:00	0:59:04	3H 29M 57S	4H 24M 16S
SM46266	23/10/2023	2	23/10/2023 18:08	23/10/2023 18:30	24/10/2023 5:00	24/10/2023 5:23	0:31:19	1:39:24	6H 23M 16S	3H 43M 56S

Table 5. Summary of detections of the Pilbara Leaf-nosed Bat from all sites in April 2024.

Site Detector unit	Night of	Passes	Sunset	Dusk	Dawn	Sunrise	Time of first detection	Time of last detection	Time since sunset	Time until sunrise
BDS S2-Bat2 S4U06259	11/04/2024	1	11/04/2024 17:52	11/04/2024 18:15	12/04/2024 5:50	12/04/2024 6:12	23:28:40	23:28:40	5H 36M 1S	6H 44M 14S
BDS Dam-Bat2 S4U06282	13/04/2024	4	13/04/2024 17:50	13/04/2024 18:13	14/04/2024 5:51	14/04/2024 6:13	0:52:22	1:29:04	7H 1M 27S	4H 44M 31S

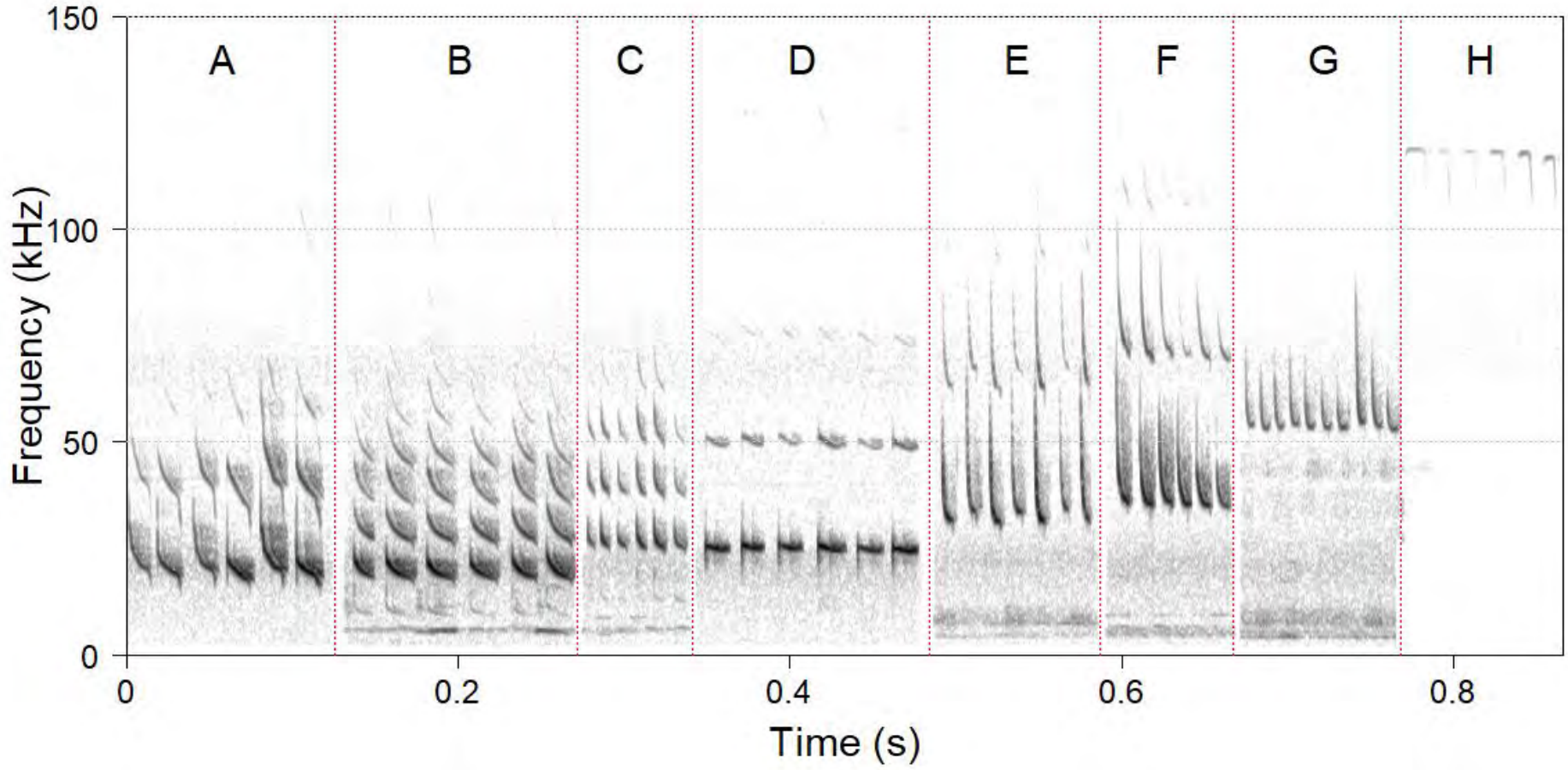


Figure 1. Representative echolocation call sequence portions of the species identified (**A**: *Chaerephon jobensis;* **B**: *Saccolaimus flaviventris*; **C**: *Taphozous georgianus*; **D**: *Ozimops lumsdenae*; **E**: *Chalinolobus gouldii*; **F**: *Scotorepens greyii*; **G**: *Vespadelus finlaysoni*; **H**: *Rhinonicteris aurantia*; time between pulses has been compressed).

Appendix E Fauna habitat assessments

BDBAT01

Date	28/05/2023		
Site type	Habitat assessment		
Coordinate	-22.02800799, 119.834838		
Habitat type	Drainage Line/River/Creek (major)		
Habitat type (other)			
Habitat description	Major creekline, with standing water over sandy clay soils. Banks highly disturbed by cattle and invested with low grazed buffel grass. Tall Eucalypts and medium Melaleuca line banks over low scattered shrubs over tussocks grasses and buffel grass.		
Habitat condition	Good		
Suitability for significant species	Grey falcon, Pilbara olive python, Northern Quoll dispersal, Bat forforaging		
Evidence of significant species	No		
Disturbance	Major cattle trampling and buffel grass investation along banks.		
Time since fire	> 5 yrs		
Leaf litter cover	< 10		
Woody debris	< 10		
Rocky crevices/caves	NA		
Large trees	Yes		
Tree hollows	Yes		
Landform	Creek	**Landform (other)**	
Slope	Negligible	**Aspect**	NA
Soil colour	Brown	**Soil texture**	Sandy clay
Bare soil	< 10	**Drainage**	Major creek (5-30 m)
Rock type	Basalt	**Rock size**	Mixed
Rock abundance	10 – 30		
Upper stratum	Scattered tall trees		
Middle stratum	Scattered low shrubs		
Lower stratum	Tussock grass land / sedgeland / herbland		



BBD02

Date	28/05/2023
Site type	Habitat assessment
Coordinate	-21.97385503, 119.925104
Habitat type	Drainage Line/River/Creek (major)
Habitat type (other)	
Habitat description	Creekline with semi-permanent water, lined with basalt bedrock and large eucalypts.
Habitat condition	Good
Suitability for significant species	POP
Evidence of significant species	No
Disturbance	Cattle, weeds
Time since fire	No evidence
Leaf litter cover	< 10
Woody debris	< 10
Rocky crevices/caves	< 10
Large trees	Yes
Tree hollows	Yes
Landform	Creek
Slope	Negligible
Soil colour	Brown
Bare soil	< 10
Rock type	Basalt
Rock abundance	30 – 70
Upper stratum	Tall open woodland
Middle stratum	Open shrubland
Lower stratum	Tussock grass land / sedgeland / herbland

Landform (other)	
Aspect	NA
Soil texture	Sand
Drainage	Major creek (5-30 m)
Rock size	Boulders (> 265 mm)



BBD03

Date	30/05/2023
Site type	Habitat assessment
Coordinate	-21.96400696, 119.867175
Habitat type	Plain (stony/gibber)
Habitat type (other)	
Habitat description	Undulating stony plain supporting open shrubland over hummock grassland
Habitat condition	Good
Suitability for significant species	
Evidence of significant species	No
Disturbance	Cattle grazing
Time since fire	> 5 yrs
Leaf litter cover	< 10
Woody debris	< 10
Rocky crevices/caves	NA
Large trees	No
Tree hollows	No
Landform	Undulating plain
Landform (other)	
Slope	Gentle
Aspect	North
Soil colour	Red
Soil texture	Clay loam
Bare soil	10 – 30
Drainage	NA
Rock type	Mixed
Rock size	Cobbles (64-256 mm)
Rock abundance	30 – 70
Upper stratum	
Middle stratum	Open shrubland
Lower stratum	Open hummock grassland



BBD04

Date	30/05/2023		
Site type	Habitat assessment		
Coordinate	-21.95355196, 119.936995		
Habitat type	Plain (stony/gibber)		
Habitat type (other)			
Habitat description	Undulating stony plain supporting open shrubland over hummock grassland		
Habitat condition	Very Good		
Suitability for significant species			
Evidence of significant species	No		
Disturbance	Cattle		
Time since fire	> 5 yrs		
Leaf litter cover	< 10		
Woody debris	< 10		
Rocky crevices/caves	NA		
Large trees	No		
Tree hollows	No		
Landform	Undulating plain	**Landform (other)**	
Slope	Gentle	**Aspect**	Northwest
Soil colour	Red	**Soil texture**	Clay loam
Bare soil	10 – 30	**Drainage**	NA
Rock type	Mixed	**Rock size**	Cobbles (64-256 mm)
Rock abundance	> 70		
Upper stratum			
Middle stratum	Open shrubland		
Lower stratum	Open hummock grassland		



BBD05

Date	30/05/2023
Site type	Habitat assessment
Coordinate	-22.05059504, 119.848587
Habitat type	Plain (stony/gibber)
Habitat type (other)	
Habitat description	Undulating stony plain supporting open shrubland over hummock grassland
Habitat condition	Very Good
Suitability for significant species	
Evidence of significant species	No
Disturbance	Cattle
Time since fire	> 5 yrs
Leaf litter cover	< 10
Woody debris	< 10
Rocky crevices/caves	NA
Large trees	No
Tree hollows	No
Landform	Undulating plain
Slope	Gentle
Soil colour	Red
Bare soil	10 – 30
Rock type	Mixed
Rock abundance	30 – 70
Upper stratum	Scattered trees
Middle stratum	Open shrubland
Lower stratum	Open hummock grassland

Landform (other)	
Aspect	Northwest
Soil texture	Clay loam
Drainage	NA
Rock size	Cobbles (64-256 mm)



BBD06

Date	30/05/2023		
Site type	Habitat assessment		
Coordinate	-22.07395499, 119.853415		
Habitat type	Drainage Line/River/Creek (major)		
Habitat type (other)			
Habitat description	Minor creekline with open shrubland of tall eucalypts over medium myrtacae shrubs over spinifex hummocks. Infestation of buffel grass along banks and around bore in vicinity.		
Habitat condition	Good		
Suitability for significant species			
Evidence of significant species	No		
Disturbance	Cattle, weeds		
Time since fire	> 5 yrs		
Leaf litter cover	< 10		
Woody debris	< 10		
Rocky crevices/caves	NA		
Large trees	Yes		
Tree hollows	Yes		
Landform	Creek	**Landform (other)**	
Slope	Negligible	**Aspect**	NA
Soil colour	Brown	**Soil texture**	Sandy clay loam
Bare soil	10 – 30	**Drainage**	Major creek (5-30 m)
Rock type	Mixed	**Rock size**	Cobbles (64-256 mm)
Rock abundance	< 10		
Upper stratum	Tall open woodland		
Middle stratum	Tall open shrubland		
Lower stratum	Scattered hummock grassland		



BBD07

Date	30/05/2023
Site type	Habitat assessment
Coordinate	-22.10184904, 119.845078
Habitat type	Drainage Line/River/Creek (major)
Habitat type (other)	
Habitat description	Creekline with Eucalypts over open shrubland ovwr tussock and hummock grasses.
Habitat condition	Good
Suitability for significant species	
Evidence of significant species	No
Disturbance	Cattle, weeds
Time since fire	> 5 yrs
Leaf litter cover	< 10
Woody debris	< 10
Rocky crevices/caves	NA
Large trees	Yes
Tree hollows	Yes
Landform	Creek
Landform (other)	
Slope	Negligible
Aspect	NA
Soil colour	Reddish brown
Soil texture	Sandy clay loam
Bare soil	10 – 30
Drainage	Major creek (5-30 m)
Rock type	Mixed
Rock size	Cobbles (64-256 mm)
Rock abundance	10 – 30
Upper stratum	Tall open woodland
Middle stratum	Tall open shrubland
Lower stratum	Scattered hummock grassland



BDHA1

Date	28/05/2023		
Site type	habitat assessment		
Coordinate	50K 793048.19 mE 7561364.05 mN		
Habitat type	Hummock Grassland		
Habitat type (other)			
Habitat description	Undulating plain with spinifex grassland.		
Habitat condition	Good		
Suitability for significant species			
Evidence of significant species	No		
Disturbance	cattle		
Time since fire	No evidence		
Leaf litter cover	< 10		
Woody debris	< 10		
Rocky crevices/caves	NA		
Large trees	No		
Tree hollows	No		
Landform	Undulating plain	**Landform (other)**	
Slope	Negligible	**Aspect**	NA
Soil colour	Light brown	**Soil texture**	Sandy clay
Bare soil	10 – 30	**Drainage**	NA
Rock type	Basalt	**Rock size**	Cobbles (64-256 mm)
Rock abundance	< 10		
Upper stratum			
Middle stratum	Tall open shrubland		
Lower stratum	Mid-dense hummock grassland		



BHA01

Date	28/05/2023		
Site type	Habitat assessment		
Coordinate	50K 804114.38 mE 7566381.58 mN		
Habitat type	Plain (stony/gibber)		
Habitat type (other)			
Habitat description	Undulating stony plain with scattered eucalypts and corymbias over acacias and hakeas over Triodia hummock grassland		
Habitat condition	Excellent		
Suitability for significant species	PMM		
Evidence of significant species	No		
Disturbance	NA		
Time since fire	> 5 yrs		
Leaf litter cover	< 10		
Woody debris	< 10		
Rocky crevices/caves	NA		
Large trees	No		
Tree hollows	No		
Landform	Undulating plain	**Landform (other)**	
Slope	Gentle	**Aspect**	East
Soil colour	Dark red	**Soil texture**	Clay loam
Bare soil	< 10	**Drainage**	NA
Rock type	Mixed	**Rock size**	Cobbles (64-256 mm)
Rock abundance	> 70		
Upper stratum	Scattered trees		
Middle stratum	Tall open shrubland		
Lower stratum	Hummock grassland		



BHA02

Date	28/05/2023		
Site type	Habitat assessment		
Coordinate	50K 803454.51 mE 7573050.82 mN		
Habitat type	Plain (stony/gibber)		
Habitat type (other)			
Habitat description	Undulating stony plain supporting open shrubland over hummock grassland		
Habitat condition	Excellent		
Suitability for significant species	PMM		
Evidence of significant species	No		
Disturbance	NA		
Time since fire	> 5 yrs		
Leaf litter cover	< 10		
Woody debris	< 10		
Rocky crevices/caves	NA		
Large trees	No		
Tree hollows	No		
Landform	Undulating plain	**Landform (other)**	
Slope	Gentle	**Aspect**	North
Soil colour	Dark red	**Soil texture**	Clay loam
Bare soil	< 10	**Drainage**	NA
Rock type	Mixed	**Rock size**	Cobbles (64-256 mm)
Rock abundance	> 70		
Upper stratum			
Middle stratum	Open shrubland		
Lower stratum	Open hummock grassland		



BHA03

Date	28/05/2023		
Site type	Habitat assessment		
Coordinate	50K 814471.55 mE 7572835.84 mN		
Habitat type	Plain (Cracking clays)		
Habitat type (other)			
Habitat description	Gilgai plains associated with the Wona Landsystem. Self mulching cracking clays supporting scsttered shrubs over herbs and tussock grasses.		
Habitat condition	Very Good		
Suitability for significant species	Leggadina lakedownensis		
Evidence of significant species	Yes		
Disturbance	Cattle grazing		
Time since fire	No evidence		
Leaf litter cover	< 10		
Woody debris	< 10		
Rocky crevices/caves	NA		
Large trees	No		
Tree hollows	No		
Landform	Gilgai	**Landform (other)**	
Slope	Gentle	**Aspect**	East
Soil colour	Reddish brown	**Soil texture**	Cracking clay
Bare soil	< 10	**Drainage**	NA
Rock type	Mixed	**Rock size**	Cobbles (64-256 mm)
Rock abundance	> 70		
Upper stratum			
Middle stratum	Scattered shrubs		
Lower stratum	Tussock grass land / sedgeland / herbland		



BPHA01

Date	31/05/2023
Site type	Habitat assessment
Coordinate	50K 807839.34 mE 7564376.98 mN
Habitat type	Drainage Line/River/Creek (major)
Habitat type (other)	
Habitat description	Permanent water in major creekline lined with rock face walls with crevices, banks lined with tall eucalypts, acacia shrubs and buffel grass/sedges.
Habitat condition	Good
Suitability for significant species	Northern quoll dispersal/habitat in rocky faces on banks. Olive python habitat. Bat foraging.
Evidence of significant species	No
Disturbance	Buffel grass infestation and cattle trampling.
Time since fire	No evidence
Leaf litter cover	10 – 40
Woody debris	10 – 40
Rocky crevices/caves	< 10
Large trees	Yes
Tree hollows	Yes
Landform	Creek
Landform (other)	
Slope	Negligible
Aspect	NA
Soil colour	Reddish brown
Soil texture	Sandy clay loam
Bare soil	< 10
Drainage	Major creek (5-30 m)
Rock type	Mixed
Rock size	Mixed
Rock abundance	< 10
Upper stratum	Open woodland
Middle stratum	Tall open shrubland
Lower stratum	Tussock grass land / sedgeland / herbland



BDDP01

Date	31/05/2023		
Site type	Fauna trapping site		
Coordinate	50K 797543.28 mE 7559313.23 mN		
Habitat type	Plain (Cracking clays)		
Habitat type (other)			
Habitat description	Gilgai soils with cracking clay. Acacia over spinifex grassland.		
Habitat condition	Good		
Suitability for significant species	northern short-tailed mouse		
Evidence of significant species	No		
Disturbance	cattle		
Time since fire	> 5 yrs		
Leaf litter cover	< 10		
Woody debris	< 10		
Rocky crevices/caves	NA		
Large trees	No		
Tree hollows	No		
Landform	Plain	**Landform (other)**	
Slope	Negligible	**Aspect**	NA
Soil colour	Brown	**Soil texture**	Clay loam
Bare soil	30 – 70	**Drainage**	NA
Rock type	Basalt	**Rock size**	Mixed
Rock abundance	30 – 70		
Upper stratum			
Middle stratum	Scattered shrubs		
Lower stratum	Mid-dense hummock grassland		



BDDP02

Date	31/05/2023		
Site type	Fauna trapping site		
Coordinate	50K 798857.56 mE 7567673.56 mN		
Habitat type	Hummock Grassland		
Habitat type (other)			
Habitat description	Triodia apactia grassland with scattered acacia shrubs and isolated low eucalypts.		
Habitat condition	Very Good		
Suitability for significant species			
Evidence of significant species	No		
Disturbance	cattle		
Time since fire	> 5 yrs		
Leaf litter cover	< 10		
Woody debris	< 10		
Rocky crevices/caves	NA		
Large trees	No		
Tree hollows	No		
Landform	Plain	**Landform (other)**	
Slope	Negligible	**Aspect**	NA
Soil colour	Brown	**Soil texture**	Clay loam
Bare soil	10 – 30	**Drainage**	NA
Rock type	NA	**Rock size**	NA
Rock abundance	NA		
Upper stratum	Scattered trees		
Middle stratum	Scattered shrubs		
Lower stratum	Mid-dense hummock grassland		



BDDP03

Date	31/05/2023		
Site type	Fauna trapping site		
Coordinate	50K 800682.48 mE 7569245.51 mN		
Habitat type	Plain (Cracking clays)		
Habitat type (other)			
Habitat description	Low open shrubland over open tussock grassland/herbland with minor depressions of cracking clay banked by herbs. Wona land system with self-mulching cracking clays.		
Habitat condition	Excellent		
Suitability for significant species	Northern short tailed mouse captures. Potential grey falcon and bat foraging.		
Evidence of significant species	Yes		
Disturbance	Cattle tracks and grazing.		
Time since fire	> 5 yrs		
Leaf litter cover	< 10		
Woody debris	< 10		
Rocky crevices/caves	NA		
Large trees	No		
Tree hollows	No		
Landform	Undulating plain	**Landform (other)**	
Slope	Negligible	**Aspect**	NA
Soil colour	Reddish brown	**Soil texture**	Clay loam
Bare soil	< 10	**Drainage**	NA
Rock type	Mixed	**Rock size**	Mixed
Rock abundance	30 – 70		
Upper stratum	Low open woodland		
Middle stratum	Low open shrubland		
Lower stratum	Open tussock grassland / sedgeland / herbland		



BDDP04

Date	29/05/2023
Site type	Fauna trapping site
Coordinate	50K 799970.41 mE 7552678.01 mN
Habitat type	Rocky Escarpments (Ridges/Mesa/Cliffs/Outcrops/Breakaways)
Habitat type (other)	
Habitat description	Low rocky outcrop with caves and crevices suitable for the northern quoll. Isolated eucalypts over scattered shrubs with spinifex understorey.
Habitat condition	Excellent
Suitability for significant species	northern quoll
Evidence of significant species	Yes
Disturbance	
Time since fire	No evidence
Leaf litter cover	< 10
Woody debris	< 10
Rocky crevices/caves	10 – 30
Large trees	No
Tree hollows	No
Landform	Low hill
Landform (other)	
Slope	Gentle
Aspect	North
Soil colour	Brown
Soil texture	Sandy loam
Bare soil	30 – 70
Drainage	NA
Rock type	Ironstone
Rock size	Mixed
Rock abundance	> 70
Upper stratum	Scattered low trees
Middle stratum	Scattered shrubs
Lower stratum	Mid-dense hummock grassland



BDDP05

Date	31/05/2023		
Site type	Fauna trapping site		
Coordinate	50K 795764.74 mE 7562262.13 mN		
Habitat type	Hummock Grassland		
Habitat type (other)			
Habitat description	Mid-dense large unburnt spinifex grassland with minor drainage, scattered low eucalypts over scattered acacia shrubs.		
Habitat condition	Excellent		
Suitability for significant species	Bat and grey falcon foraging.		
Evidence of significant species	No		
Disturbance	Cattle tracks and grazing, buffel grass pockets.		
Time since fire	No evidence		
Leaf litter cover	< 10		
Woody debris	< 10		
Rocky crevices/caves	NA		
Large trees	No		
Tree hollows	No		
Landform	Undulating plain	**Landform (other)**	
Slope	Negligible	**Aspect**	NA
Soil colour	Reddish brown	**Soil texture**	Loamy sand
Bare soil	< 10	**Drainage**	Drainage line
Rock type	Mixed	**Rock size**	Mixed
Rock abundance	10 – 30		
Upper stratum	Scattered trees		
Middle stratum	Scattered low shrubs		
Lower stratum	Mid-dense hummock grassland		



BDDP06

Date	29/05/2023		
Site type	Fauna trapping site		
Coordinate	50K 796913.16 mE 7562587.64 mN		
Habitat type	Drainage Line/River/Creek (major)		
Habitat type (other)			
Habitat description	Creekline supporting large eucalyps over open shrubland over triodia hummock grasses and tussock grasses. evidence of cattle use and buffel grass present. grey falcons recorded in the vicinity.		
Habitat condition	Good		
Suitability for significant species	grey falcon		
Evidence of significant species	Yes		
Disturbance	cattle, buffel grass		
Time since fire	No evidence		
Leaf litter cover	< 10		
Woody debris	10 – 40		
Rocky crevices/caves	NA		
Large trees	Yes		
Tree hollows	Yes		
Landform	Creek	**Landform (other)**	
Slope	Negligible	**Aspect**	NA
Soil colour	Brown	**Soil texture**	Sand
Bare soil	30 – 70	**Drainage**	Major creek (5-30 m)
Rock type	Basalt	**Rock size**	Pebbles (2-64 mm)
Rock abundance	30 – 70		
Upper stratum	Scattered trees		
Middle stratum	Scattered shrubs		
Lower stratum	Open hummock grassland		

BDDP07

Date	29/05/2023		
Site type	Fauna trapping site		
Coordinate	50K 807723.55 mE 7563397.88 mN		
Habitat type	Drainage Line/River/Creek (minor)		
Habitat type (other)			
Habitat description	Open eucalypt and acacia woodland over acacia shrubland over a predominantly buffel tussock and hummock grassland, adjacent to a minor creekline with standing water		
Habitat condition	Poor		
Suitability for significant species	Bat and grey falcon foraging, low potential quoll and POP dispersal		
Evidence of significant species	No		
Disturbance	Profuse buffel grass cover, cattle trampling and grazing		
Time since fire	> 5 yrs		
Leaf litter cover	10 – 40		
Woody debris	10 – 40		
Rocky crevices/caves	NA		
Large trees	Yes		
Tree hollows	Yes		
Landform	Creek	**Landform (other)**	
Slope	Negligible	**Aspect**	
Soil colour		**Soil texture**	Sandy clay
Bare soil	< 10	**Drainage**	Minor creek (< 5 m)
Rock type	Mixed	**Rock size**	Mixed
Rock abundance	< 10		
Upper stratum	Open woodland		
Middle stratum	Tall open shrubland		
Lower stratum	Tussock grass land / sedgeland / herbland		



BDDP08

Date	31/05/2023
Site type	Fauna trapping site
Coordinate	50K 798740.46 mE 7556310.49 mN
Habitat type	Plain (stony/gibber)
Habitat type (other)	
Habitat description	Undulating stony plain supporting open shrubland over long unburnt triodia hummock grassland
Habitat condition	Excellent
Suitability for significant species	
Evidence of significant species	No
Disturbance	
Time since fire	No evidence
Leaf litter cover	< 10
Woody debris	< 10
Rocky crevices/caves	NA
Large trees	No
Tree hollows	No
Landform	Undulating plain
Slope	Gentle
Soil colour	Red
Bare soil	10 – 30
Rock type	Mixed
Rock abundance	> 70
Upper stratum	Scattered low trees
Middle stratum	Scattered shrubs
Lower stratum	Hummock grassland

Landform (other)	
Aspect	Northeast
Soil texture	Clay loam
Drainage	NA
Rock size	Pebbles (2-64 mm)



BDDP09

Date	29/05/2023		
Site type	Fauna trapping site		
Coordinate	50K 796366.93 mE 7563997.19 mN		
Habitat type	Rocky Escarpments (Ridges/Mesa/Cliffs/Outcrops/Breakaways)		
Habitat type (other)			
Habitat description	Low rocky outcrop with caves and crevices suitable for the northern quoll. Isolated eucalypts over scattered shrubs with spinifex understorey.		
Habitat condition	Excellent		
Suitability for significant species	northern quoll		
Evidence of significant species	No		
Disturbance			
Time since fire	No evidence		
Leaf litter cover	< 10		
Woody debris	< 10		
Rocky crevices/caves	10 – 30		
Large trees	No		
Tree hollows	No		
Landform	Low hill	**Landform (other)**	
Slope	Gentle	**Aspect**	East
Soil colour	Brown	**Soil texture**	Sandy loam
Bare soil	< 10	**Drainage**	NA
Rock type	Ironstone	**Rock size**	Mixed
Rock abundance	> 70		
Upper stratum			
Middle stratum	Scattered shrubs		
Lower stratum	Mid-dense hummock grassland		



BDDP10

Date	29/05/2023
Site type	Fauna trapping site
Coordinate	50K 803316.93 mE 7557100.11 mN
Habitat type	Hills/Ranges/Plateaux
Habitat type (other)	
Habitat description	Low hills with slight breakaways and rocky crevices in top extent of landform. Drainage lines of larger Eucalypts over low Acacia shrubs cut through low rolling hills of open hummock grassland.
Habitat condition	Excellent
Suitability for significant species	Northern quoll capture. Grey falcon and bat foraging potential.
Evidence of significant species	Yes
Disturbance	No evidence
Time since fire	> 5 yrs
Leaf litter cover	< 10
Woody debris	< 10
Rocky crevices/caves	10 – 30
Large trees	Yes
Tree hollows	Yes
Landform	Low hill
Landform (other)	
Slope	Moderate
Aspect	West
Soil colour	Reddish brown
Soil texture	Clay loam
Bare soil	< 10
Drainage	Drainage line
Rock type	Ironstone
Rock size	Mixed
Rock abundance	30 – 70
Upper stratum	Scattered trees
Middle stratum	Scattered low shrubs
Lower stratum	Open hummock grassland



BDDP11

Date	12/11/2023		
Site type	Fauna trapping site		
Coordinate	50K 794075.87 mE 7554608.78 mN		
Habitat type	Rocky Escarpments (Ridges/Mesa/Cliffs/Outcrops/Breakaways)		
Habitat type (other)			
Habitat description	Rocky escarpment with small caves and crevices suitable for quolls. Scattered corymbia over isolated low shrubs over spinifex.		
Habitat condition	Excellent		
Suitability for significant species	northern quoll		
Evidence of significant species			
Disturbance			
Time since fire	2 – 5 yrs		
Leaf litter cover	< 10		
Woody debris	< 10		
Rocky crevices/caves	10 – 30		
Large trees	No		
Tree hollows	No		
Landform	Hill	**Landform (other)**	
Slope	Moderate	**Aspect**	North
Soil colour	Red	**Soil texture**	Sandy loam
Bare soil	< 10	**Drainage**	NA
Rock type	Ironstone	**Rock size**	Mixed
Rock abundance	30 – 70		
Upper stratum	Scattered low trees		
Middle stratum	Scattered low shrubs		
Lower stratum	Hummock grassland		

BDDP12

Date	13/10/2023		
Site type	Fauna trapping site		
Coordinate	50K 794577.72 mE 7556630.35 mN		
Habitat type	Plain (stony/gibber)		
Habitat type (other)			
Habitat description	Undulating stony plain supporting open shrubland over triodia hummock grassland		
Habitat condition	Excellent		
Suitability for significant species	northern quoll, perigren falcon?, grey falcon?, POP?, WPMM?		
Evidence of significant species	No		
Disturbance	na		
Time since fire	> 5 yrs		
Leaf litter cover	< 10		
Woody debris	< 10		
Rocky crevices/caves	10 – 30		
Large trees	No		
Tree hollows	No		
Landform	Hill	**Landform (other)**	
Slope	Steep	**Aspect**	NA
Soil colour	Reddish brown	**Soil texture**	Sandy clay
Bare soil	< 10	**Drainage**	NA
Rock type	Ironstone	**Rock size**	Mixed
Rock abundance	> 70		
Upper stratum	Scattered low trees		
Middle stratum	Low open shrubland		
Lower stratum			



BDDP13

Date	13/10/2023		
Site type	Fauna trapping site		
Coordinate	50K 802018.58 mE 7570490.94 mN		
Habitat type	Plain (Cracking clays)		
Habitat type (other)			
Habitat description	Acacia synchronisia shrub mid stratum, shared with Vachelia farnesiana (weed), lower stratum tussok grass dominated, shared with triodia		
Habitat condition	Good		
Suitability for significant species	Leggadina		
Evidence of significant species	No		
Disturbance	Cattle		
Time since fire	> 5 yrs		
Leaf litter cover	< 10		
Woody debris	< 10		
Rocky crevices/caves	NA		
Large trees	No		
Tree hollows	No		
Landform	Plain	**Landform (other)**	
Slope	Negligible	**Aspect**	NA
Soil colour	Reddish brown	**Soil texture**	Sandy loam
Bare soil	< 10	**Drainage**	NA
Rock type	Basalt	**Rock size**	Pebbles (2-64 mm)
Rock abundance	> 70		
Upper stratum			
Middle stratum	Scattered shrubs		
Lower stratum	Tussock grass land / sedgeland / herbland		



BDDP14

Date	18/03/2024
Site type	Fauna trapping site
Coordinate	-21.9514869, 119.7962016
Habitat type	Rocky Escarpments (Ridges/Mesa/Cliffs/Outcrops/Breakaways)
Habitat type (other)	
Habitat description	Rocky ridgeline/hill with scattered low Eucalypt trees over scattered Acacia shrubs over Triodia grassland
Habitat condition	Excellent
Suitability for significant species	Quoll
Evidence of significant species	No
Disturbance	
Time since fire	2 – 5 yrs
Leaf litter cover	< 10
Woody debris	< 10
Rocky crevices/caves	< 10
Large trees	No
Tree hollows	No
Landform	Ridge
Landform (other)	
Slope	Moderate
Aspect	West
Soil colour	Reddish brown
Soil texture	Clay loam
Bare soil	< 10
Drainage	NA
Rock type	Mixed
Rock size	Mixed
Rock abundance	30 – 70
Upper stratum	Scattered low trees
Middle stratum	Scattered low shrubs
Lower stratum	Hummock grassland



BDDP15

Date	18/03/2024
Site type	Fauna trapping site
Coordinate	-22.02975369, 119.8260531
Habitat type	Drainage Line/River/Creek (major)
Habitat type (other)	
Habitat description	Major drainage line with Acacia and Eucalypts over scattered shrubs and Triodia
Habitat condition	Good
Suitability for significant species	Quoll, Grey Falcon, Peregrine Falcon, Ghost Bat, Pilbara Leaf-nosed Bat
Evidence of significant species	No
Disturbance	Cattle, buffel grass
Time since fire	> 5 yrs
Leaf litter cover	< 10
Woody debris	10 – 40
Rocky crevices/caves	NA
Large trees	Yes
Tree hollows	Yes
Landform	Creek
Slope	Negligible
Soil colour	Light brown
Bare soil	30 – 70
Rock type	Mixed
Rock abundance	10 – 30
Upper stratum	Scattered trees
Middle stratum	Scattered shrubs
Lower stratum	Open hummock grassland

Landform (other)	
Aspect	NA
Soil texture	Sandy loam
Drainage	Major creek (5-30 m)
Rock size	Mixed



BDDP16

Date	18/03/2024		
Site type	Fauna trapping site		
Coordinate	-21.91962376, 119.7825883		
Habitat type	Drainage Line/River/Creek (major)		
Habitat type (other)			
Habitat description	Major creekline with Eucalypts and Meleleuca, buffel grass with occasional Triodia hummock		
Habitat condition	Good		
Suitability for significant species	Quoll, Grey Falcon, Peregrine Falcon, Ghost Bat, Pilbara Leaf-nosed Bat		
Evidence of significant species	No		
Disturbance	Cattle, buffel grass		
Time since fire	> 5 yrs		
Leaf litter cover	10 – 40		
Woody debris	< 10		
Rocky crevices/caves	NA		
Large trees	Yes		
Tree hollows	Yes		
Landform	River	**Landform (other)**	
Slope	Negligible	**Aspect**	NA
Soil colour	Brown	**Soil texture**	Sand
Bare soil	30 – 70	**Drainage**	Major creek (5-30 m)
Rock type	Mixed	**Rock size**	Mixed
Rock abundance	10 – 30		
Upper stratum	Open woodland		
Middle stratum	Shrubland		
Lower stratum	Tussock grass land / sedgeland / herbland		



BDDP17

Date	19/03/2024		
Site type	Fauna trapping site		
Coordinate	-21.89581201, 119.783736		
Habitat type	Hummock Grassland		
Habitat type (other)			
Habitat description	Sparse low Eucalypt over scattered Acacia shrubs over Triodia grassland		
Habitat condition	Very Good		
Suitability for significant species	Peregrine Falcon		
Evidence of significant species	No		
Disturbance	Cattle		
Time since fire	> 5 yrs		
Leaf litter cover	< 10		
Woody debris	< 10		
Rocky crevices/caves	NA		
Large trees	No		
Tree hollows	No		
Landform	Valley	**Landform (other)**	
Slope	Negligible	**Aspect**	NA
Soil colour	Grey	**Soil texture**	Clay loam
Bare soil	< 10	**Drainage**	NA
Rock type	Mixed	**Rock size**	Pebbles (2-64 mm)
Rock abundance	30 – 70		
Upper stratum	Scattered low trees		
Middle stratum	Scattered shrubs		
Lower stratum	Hummock grassland		



BDDP18

Date	19/03/2024		
Site type	Fauna trapping site		
Coordinate	-21.89461831, 119.7856959		
Habitat type	Rocky Escarpments (Ridges/Mesa/Cliffs/Outcrops/Breakaways)		
Habitat type (other)			
Habitat description	Rocky ridgeline/hill with low shrubs over Triodia grassland		
Habitat condition	Excellent		
Suitability for significant species	Quoll		
Evidence of significant species	No		
Disturbance			
Time since fire	2 – 5 yrs		
Leaf litter cover	< 10		
Woody debris	< 10		
Rocky crevices/caves	10 – 30		
Large trees	No		
Tree hollows	No		
Landform	Hill	**Landform (other)**	
Slope	Moderate	**Aspect**	West
Soil colour	Light brown	**Soil texture**	Sandy loam
Bare soil	< 10	**Drainage**	NA
Rock type	Ironstone	**Rock size**	Mixed
Rock abundance	> 70		
Upper stratum			
Middle stratum	Scattered low shrubs		
Lower stratum	Hummock grassland		

BDDP19

Date	17/03/2024		
Site type	Fauna trapping site		
Coordinate	-22.08602332, 119.7991386		
Habitat type	Rocky Escarpments (Ridges/Mesa/Cliffs/Outcrops/Breakaways)		
Habitat type (other)			
Habitat description	Rocky ridgeline/hill with Eucalypts over Triodia		
Habitat condition	Excellent		
Suitability for significant species	Quoll, dunnart		
Evidence of significant species	No		
Disturbance			
Time since fire	2 – 5 yrs		
Leaf litter cover	< 10		
Woody debris	< 10		
Rocky crevices/caves	10 – 30		
Large trees	No		
Tree hollows	Yes		
Landform	Hill	**Landform (other)**	
Slope	Moderate	**Aspect**	South
Soil colour	Light brown	**Soil texture**	Sandy loam
Bare soil	30 – 70	**Drainage**	NA
Rock type	Ironstone	**Rock size**	Mixed
Rock abundance	> 70		
Upper stratum	Scattered trees		
Middle stratum	Scattered shrubs		
Lower stratum	Hummock grassland		



BDDP20

Date	17/03/2024		
Site type	Fauna trapping site		
Coordinate	-22.08052839, 119.8132339		
Habitat type	Hummock Grassland		
Habitat type (other)			
Habitat description	Eucalypts over Triodia grassland with minor drainage lines		
Habitat condition	Excellent		
Suitability for significant species	Ghost Bat, Pilbara Leaf-nosed Bat		
Evidence of significant species	No		
Disturbance	Minor cattle evidence		
Time since fire	> 5 yrs		
Leaf litter cover	10 – 40		
Woody debris	< 10		
Rocky crevices/caves	NA		
Large trees	Yes		
Tree hollows	Yes		
Landform	Plain	**Landform (other)**	
Slope	Negligible	**Aspect**	NA
Soil colour	Light brown	**Soil texture**	Clay loam
Bare soil	30 – 70	**Drainage**	Drainage line
Rock type	Ironstone	**Rock size**	Mixed
Rock abundance	10 – 30		
Upper stratum	Scattered trees		
Middle stratum	Open shrubland		
Lower stratum	Mid-dense hummock grassland		



BDDP21

Date	26/03/2024		
Site type	Fauna trapping site		
Coordinate	-22.02653026, 119.8256633		
Habitat type	Hummock Grassland		
Habitat type (other)			
Habitat description	Eucalypts over Triodia grassland with minor drainage lines		
Habitat condition	Excellent		
Suitability for significant species	Grey Falcon, Western Pebble-mound Mouse, Gane's Blind Snake		
Evidence of significant species	No		
Disturbance	Cattle tracks		
Time since fire	2 – 5 yrs		
Leaf litter cover	< 10		
Woody debris	< 10		
Rocky crevices/caves	NA		
Large trees	No		
Tree hollows	No		
Landform	Undulating plain	**Landform (other)**	
Slope	Negligible	**Aspect**	NA
Soil colour	Reddish brown	**Soil texture**	Clay loam
Bare soil	< 10	**Drainage**	NA
Rock type	Ironstone	**Rock size**	Mixed
Rock abundance	> 70		
Upper stratum	Scattered trees		
Middle stratum	Scattered low shrubs		
Lower stratum	Open hummock grassland		



BDDP22

Date	28/03/2024
Site type	Fauna trapping site
Coordinate	-22.10035883, 119.9887742
Habitat type	Drainage Line/River/Creek (major)
Habitat type (other)	
Habitat description	Open Eucalypt and Melaleuca woodland over open Acacia shrubland over open, mixed Triodia and Buffel grassland
Habitat condition	Degraded
Suitability for significant species	Grey falcon
Evidence of significant species	No
Disturbance	Buffel grass, cattle
Time since fire	No evidence
Leaf litter cover	< 10
Woody debris	< 10
Rocky crevices/caves	NA
Large trees	Yes
Tree hollows	Yes
Landform	Creek
Slope	Negligible
Soil colour	Reddish brown
Bare soil	30 – 70
Rock type	Mixed
Rock abundance	< 10
Upper stratum	Open woodland
Middle stratum	Open shrubland
Lower stratum	Open hummock grassland

Landform (other)	
Aspect	NA
Soil texture	Loamy sand
Drainage	Major creek (5-30 m)
Rock size	Pebbles (2-64 mm)



BDDP23

Date	17/03/2024
Site type	Fauna trapping site
Coordinate	-22.11209798, 119.8715194
Habitat type	Woodland (open)
Habitat type (other)	
Habitat description	Mulga woodland, with isolated Eucalypts over Triodia grassland.
Habitat condition	Excellent
Suitability for significant species	No
Evidence of significant species	No
Disturbance	Road nearby, minor cattle evidence
Time since fire	> 5 yrs
Leaf litter cover	< 10
Woody debris	< 10
Rocky crevices/caves	NA
Large trees	No
Tree hollows	No
Landform	Plain
Slope	Negligible
Soil colour	Reddish brown
Bare soil	30 – 70
Rock type	Ironstone
Rock abundance	30 – 70
Upper stratum	Scattered low trees
Middle stratum	Tall open shrubland
Lower stratum	Hummock grassland

Landform (other)	
Aspect	NA
Soil texture	Clay loam
Drainage	NA
Rock size	Pebbles (2-64 mm)



Site	Habitat Type	Landform	Substrate	Vegetation Description	Easting	Northing	Site Photo
BDSS1	Major Creeklines	Major drainage	Clay, loam	Large, dense *Eucalyptus camaldulensis*, *E. victrix*, *Melaleuca* sp. woodland, over *Acacia* sp. open shrubland, over Buffel grass **Cenchrus ciliaris* and *Triodia* sp. mixed native grassland. Large water pool present. Little wood and leaf litter.	806684	7550454	
BDS02	Major Creeklines	Major drainage	Clay	*Eucalyptus victrix* woodland, over *Acacia* sp. open shrubland, over heavily grazed Buffel grass **Cenchrus ciliaris* and adjacent *Triodia* sp. mixed native grassland. Some wood and leaf litter.	804616	7545084	

Site	Habitat Type	Landform	Substrate	Vegetation Description	Easting	Northing	Site Photo
BDS03	Plain (Cracking Clay)	Plain	Basalt, cracking clay	Isolated shrubs of *Acacia inaequilatera* over isolated tussock grasses with patches of hummock grasses *Triodia longiceps* on cracking clay. Large rocks, no wood or leaf litter.	794272	7539586	
BDS04	Plain (Cracking Clay)	Plain	Clay	Isolated shrubs of *Acacia inaequilatera,* over sparse tussock grasses. Large rocks and boulders on cracking clay. No wood or leaf litter.	787811	7536109	

Site	Habitat Type	Landform	Substrate	Vegetation Description	Easting	Northing	Site Photo
BDS05	Rocky Escarpments	Mesa	Rocky stony loam	Mixed shrubland of *Acacia monticola* and scattered *A. inaequilatera* over mixed moderately dense hummock grassland on bedrock with continuous layer of pebbles and rocks. Sparse wood and leaf litter.	800493	7542383	
BDS06	Rocky Escarpments	Mesa/Breakaway	Rocky, stoney sand	Isolated shrubs of *Acacia pruinocarpa* over sparse *A. aptaneura* over sparse hummock *Triodia* sp. grassland on rocky slope with sections of exposed rock. No wood or leaf litter present.	797872	7542485	

Site	Habitat Type	Landform	Substrate	Vegetation Description	Easting	Northing	Site Photo
BDS07	Mulga Woodland	Plain	Clay	Moderately dense shrubland of *Acacia aneura* (Mulga), with scattered *A. pruinocarpa*, over *Triodia epactia* hummock grassland. Plenty of wood litter and some leaf litter on hard clay with plenty of small pebbles.	814110	7535287	
BDS08	Mulga Woodland	Plain	Clay	Scattered *Corymbia* sp. over scattered *Acacia pruinocarpa* and over closed shrubland of *Acacia aneura* (Mulga) over patches of mixed hummock and tussock grassland. Plenty of wood litter, some leaf litter underneath shrubs on hard clay. No rocks or pebbles.	816126	7537054	

Site	Habitat Type	Landform	Substrate	Vegetation Description	Easting	Northing	Site Photo
BDS09	Plain (stony/gibber)	Undulating Hills	Rocky, sandy loam	Sparse shrubland of *Acacia inaequilatera,* over moderate to dense tussock grassland of *Triodia* sp. on rocky clay. No wood or leaf litter.	799715	7545309	
BDS10	Plain (stony/gibber)	Plain	Clay, Sandy loam	Isolated trees of *Corymbia hamersleyana over,* sparse shrubland of *Acacia inaequilatera and Hakea chordophylla,* over mixed hummock grassland. Some wood and leaf litter on sandy substrate.	801524	7535149	

Site	Habitat Type	Landform	Substrate	Vegetation Description	Easting	Northing	Site Photo
BDS11	Plain (stony/gibber)	Plain	Clay, Stony loam	Scattered shrubs of *Acacia inaequilatera*, over moderate tussock grassland of *Triodia* sp. Few wood and leaf litter. Plenty of pebbles on sandy clay.	798283	7540228	
BDS12	Major Creeklines	Major drainage	Sandy loam	*Eucalyptus victrix, Melaleuca argentia* sp. woodland, over *Acacia* sp. open shrubland, over Buffel grass **Cenchrus ciliaris* closed hummock grassland.	788164	7540954	

Appendix F Night parrot call analysis.

Results of acoustic surveys conducted for Night Parrot (*Pezoporus occidentalis*) Bonney Downs July-October 2023

Report to:

Ecologia

Prepared by:

Nick Leseberg

Adaptive NRM

19th May 2024

1. Summary

Between July and October 2023, autonomous recording units (ARUs) were deployed at nine sites in the Bonney Downs project area to survey for Night Parrots (*Pezoporus occidentalis*). The project area is approximately 70 km northeast of Fortescue Marsh, within the Chichester bioregion of Western Australia. Resulting acoustic data was analysed using signal parameters optimised for detecting Night Parrot calls. No Night Parrot calls were detected during the analysis.

2. Survey effort

Analysis of historical Night Parrot records suggest it was formerly found throughout arid central Australia, before undergoing a significant decline and range contraction during the late-19th and early-20th centuries (Leseberg *et al*. 2021). The species is now known from a small area in western Queensland, and the central and northern inland of Western Australia. There are several historical reports from the Chichester bioregion, although none that are considered of high veracity (Leseberg *et al*. 2021). There are several contemporary records from the Fortescue Marsh which is only 70 km southwest of the project area (Leseberg 2022), so it is feasible that if suitable habitat exists, Night Parrots could be resident in the survey area.

Research in western Queensland has demonstrated Night Parrots occupy long-term stable roost sites for periods of up to several years. These long-term stable roost sites support both roosting and breeding. The birds also have predictable year-round calling periods at dusk and dawn (Murphy *et al*. 2017a, Leseberg *et al*. 2019). This ensures that if Night Parrots are roosting at a particular site, the likelihood of detecting them using ARUs is very high, provided the ARU is placed for a minimum of four nights in calm weather, and the recorder is set to record during the peak calling periods. During breeding, and following large rain events, calling is more frequent, extends throughout the night, and the likelihood of detection is increased (Murphy *et al*. 2017a). Preliminary results from research in central Western Australia suggest patterns of behaviour in that region are similar (Jackett *et al*. 2017).

Night Parrots are also known to call during the night at feeding and drinking sites (S. Murphy, N. Leseberg, N. Jackett unpubl. data). Anecdotal evidence suggests they may call when moving between these sites (N. Leseberg, N. Jackett, S. Murphy unpubl. data). However, the detection of birds away from roosting sites is likely to be a chance event given the large area over which

birds range at night (Murphy *et al*. 2017b). Night Parrots are known to drink, and modelling suggests they may be reliant on free-standing water (or succulent food containing >55% water) during hot weather (Kearney *et al*. 2016). Birds have been detected in the Great Sandy Desert by focusing survey effort at water sources (J. Brown pers. comm.). It is likely this technique will be most effective during periods of water scarcity, when survey effort can focus on just a few possible locations.

The likelihood of detection is also influenced by the type of ARU being used. In calm conditions, a Song Meter 4 (Wildlife Acoustics, MA, USA), is known to be capable of reliably detecting 95% of Night Parrot calls out to a range of around 205 m (Leseberg *et al*. 2022). SM4s were used at seven of the nine sites surveyed. Titley Chorus machines were used at two sites. How these machines compare to SM4s is unclear, although a qualitative assessment of the recordings from these machines suggest their recording radius was less than that of the SM4s.

Ecologia conducted sampling for the Night Parrot across two blocks, during July/August, and also October 2023. A total of nine sites were surveyed in the project area, and a combined total of 60 nights of data was recorded (Table 1). Several different recording programs were used. During the July/August phase, all four machines recorded two periods each night, one at sunset the other at sunrise. Two machines recorded an hour either side of sunset and sunrise, and two recorded ninety minutes either side of sunset and sunrise. While it is recommended that recordings are made from sunset to sunrise, in each case the peak Night Parrot calling period would have been captured, allowing conclusions around the presence or absence of a long-term stable roost site in the immediate vicinity of the ARU. During the October surveys, all five machines recorded from before sunset until after sunrise, capturing the recommended period for Night Parrot surveys. All ARUs recorded a minimum of four non-windy nights. It is likely that any long-term stable roost sites in the vicinity of these ARUs would have been detected.

3. Data analysis

ANRM received the raw acoustic data as '.wav' files. These were scanned using the software Kaleidoscope Pro v5.2.1, targeting the frequency range of 1500 – 3500 Hz, within which all known Night Parrot calls are distributed (Leseberg *et al*. 2019). Search parameters were optimised using a random selection of 250 Night Parrot call examples manually detected from

both Great Sandy Desert and East Murchison datasets, of which 205 (82.0%) were automatically detected. Calls not detected were typically extremely faint. The probability of non-detection of a true-positive call was 18.0%; two true-positive calls was 3.2%; three true-positive calls was 0.6%; etc. Of the data tested, the median number of consecutive (spaced at < 5 minutes apart) calls in a sequence when Night Parrots were recorded was 5 (1–34, n = 29). The probability of at least one call being detected within a sequence of median length, assuming there was variation in the location of the source of the call, was > 99.9%.

Table 1. Bioacoustic recordings analysed from the July/August and October 2023 survey.

Site name	ARU Type	Recording start date (PM)	Recording end date (AM)	Total recording nights
BDNP01	SM4	24-Jul-23	2-Aug-23	9
BDNP02	SM4	24-Jul-23	2-Aug-23	9
BDNP03	Chorus*	27-Jul-23	2-Aug-23	6
BDNP04	Chorus *	27-Jul-23	2-Aug-23	6
BDNP05	SM4	13-Oct-23	19-Oct-23	6
BDNP06	SM4	13-Oct-23	19-Oct-23	6
BDNP07	SM4	13-Oct-23	19-Oct-23	6
BDNP08	SM4	13-Oct-23	19-Oct-23	6
BDNP09	SM4	13-Oct-23	19-Oct-23	6
			Total	60

Potential Night Parrot calls detected during the analysis were compared to a reference library comprising several thousand Night Parrot calls from Western Australia. This library consists of calls recorded at sites where Night Parrots have been confirmed using visual means and is therefore considered of high reliability. The library also comprises multiple examples of all known call types from Western Australia (Leseberg *et al*. 2019).

4. Survey results

No calls attributable to Night Parrots were detected during the analysis.

5. Conclusion

It is unlikely long-term stable Night Parrot roosts exist in the area immediately surrounding the points sampled during this survey at the time of sampling. Additionally, it is unlikely that Night

Parrots were foraging in proximity to these surveyed points at the time of sampling. It is important to reinforce that these results pertain specifically to that area immediately surrounding the survey points, and only for the period during which the survey was conducted. The results of these surveys do not enable robust conclusions about the presence or absence of Night Parrots in the wider landscape.

6. References

Jackett, N. A., B. R. Greatwich, G. Swann, and A. Boyle. 2017. A nesting record and vocalisations of the Night Parrot *Pezoporus occidentalis* from the East Murchison, Western Australia. *Australian Field Ornithology* **34**: 144-150.

Kearney, M. R., W. P. Porter, and S. A. Murphy. 2016. An estimate of the water budget for the endangered night parrot of Australia under recent and future climates. *Climate Change Responses* **3**: 1-17.

Leseberg, N. P. 2022. Results of acoustic surveys conducted for the Night Parrot (*Pezoporus occidentalis*) in the Nydinghu area, Fortescue Marsh May 2021 – August 2022. Report to Fortescue Metals Group. Adaptive NRM, Malanda, QLD.

Leseberg, N. P., S. A. Murphy, N. A. Jackett, B. R. Greatwich, J. Brown, N. Hamilton, L. Joseph, and J. E. M. Watson. 2019. Descriptions of known vocalisations of the Night Parrot *Pezoporus occidentalis*. *Australian Field Ornithology* **36**: 79-88.

Leseberg, N. P., W. N. V. Venables, S. A. Murphy, N. A. Jackett, and J. E. M. Watson. 2022. Accounting for both automated recording unit detection space and signal recognition performance in acoustic surveys: A protocol applied to the cryptic and critically endangered Night Parrot (*Pezoporus occidentalis*). *Austral Ecology* **47**: 440-455.

Murphy, S. A., J. J. Austin, R. K. Murphy, J. Silcock, L. Joseph, S. T. Garnett, N. P. Leseberg, J. E. M. Watson, and A. H. Burbidge. 2017a. Observations on breeding Night Parrots (*Pezoporus occidentalis*) in western Queensland. *Emu* **117**: 107-113.

Murphy, S. A., J. Silcock, R. K. Murphy, J. R. W. Reid, and J. J. Austin. 2017b. Movements and habitat use of the night parrot *Pezoporus occidentalis* in south-western Queensland. *Austral Ecology* **42**: 858-868.

Results of acoustic surveys
Project 2339
Bonney Downs South
Night Parrot Surveys
April 2024

Report to:

Spectrum Ecology

Prepared by:

Nick Leseberg

Adaptive NRM

20th June 2024

1. Summary

In April 2024, autonomous recording units (ARUs) were deployed at six sites within the Bonney Downs South project area, in the Chichester subregion of Western Australia to survey for Night Parrots (*Pezoporus occidentalis*). No Night Parrot calls were detected during the analysis.

2. Survey effort

Analysis of historical Night Parrot records suggest it was formerly found throughout arid central Australia, before undergoing a significant decline and range contraction during the late-19th and early-20th centuries (Leseberg *et al*. 2021). The species is now known from a small area in western Queensland, and the central and northern inland of Western Australia, including the Pilbara. While there are only historical records from the Chichester subregion, there are several historical and contemporary records of Night Parrot from the neighbouring Fortescue subregion, mainly from the Fortescue Marsh area, approximately 50 km southwest of the project area (Leseberg *et al*. 2021). Given this pattern of records, it is feasible that if suitable habitat exists, Night Parrots could be resident in the survey area.

Research in western Queensland has demonstrated Night Parrots occupy long-term stable roost sites for periods of up to several years. These long-term stable roost sites support both roosting and breeding. The birds also have predictable year-round calling periods at dusk and dawn (Murphy *et al*. 2017a, Leseberg *et al*. 2019). This ensures that if Night Parrots are roosting at a particular site, the likelihood of detecting them using ARUs is very high, provided the ARU is placed for a minimum of four nights in calm weather, and the recorder is set to record during the peak calling periods. During breeding, and following large rain events, calling is more frequent, extends throughout the night, and the likelihood of detection is increased (Murphy *et al*. 2017a). Preliminary results from research in central Western Australia suggest patterns of behaviour in that region are similar (Jackett *et al*. 2017).

Night Parrots are also known to call during the night at feeding and drinking sites (S. Murphy, N. Leseberg, N. Jackett unpubl. data). Anecdotal evidence suggests they may call when moving between these sites (N. Leseberg, N. Jackett, S. Murphy unpubl. data). However, the detection of birds away from roosting sites is likely to be a chance event given the large area over which birds range at night (Murphy *et al*. 2017b). Night Parrots are known to drink, and modelling

suggests they may be reliant on free-standing water (or succulent food containing >55% water) during hot weather (Kearney *et al*. 2016). Birds have been detected in the Great Sandy Desert by focusing survey effort at water sources (J. Brown pers. comm.). It is likely this technique will be most effective during periods of water scarcity, when survey effort can focus on just a few possible locations.

The likelihood of detection is also influenced by the type of ARU being used. In calm conditions, the Song Meter 4 (Wildlife Acoustics, MA, USA), which was used at two of the sites surveyed here, is known to be capable of reliably detecting 95% of Night Parrot calls out to a range of around 205 m (Leseberg *et al*. 2022). Song Meter Minis were also used for these surveys. Their performance is comparable to that of an SM4.

Spectrum Ecology conducted sampling at six sites in the project area. All ARUs were set to record from 25 minutes after sunset until 25 minutes before sunrise, and each recorded for a minimum of five nights. These ARUS all recorded at least four calm nights, and for the recommended period when trying to establish the presence of a long-term stable roost site. The number of nights of data collected was sufficient to allow robust conclusions around the presence of long-term stable roost sites in the immediate vicinity of each survey point. Details of the data recorded at each site are given at Table 1.

Table 1. Bioacoustic recordings analysed from the April 2024 survey.

Site name	Recording start date (PM)	Recording end date (AM)	Total recording nights
BDS 01-PAR2	8-Apr-24	14-Apr-24	6
BDS 02-PAR2	8-Apr-24	14-Apr-24	6
BDS 03-PAR2	8-Apr-24	13-Apr-24	5
BDS 06-PAR2	8-Apr-24	14-Apr-24	6
BDS 09-PAR2	7-Apr-24	13-Apr-24	6
BDS 11-PAR2	7-Apr-24	13-Apr-24	6
		Total	35

3. Data analysis

ANRM received the raw acoustic data in '.wav' format. All files were scanned using the software Kaleidoscope Pro v5.2.1, targeting the frequency range of 1500 – 3500 Hz, within

which all known Night Parrot calls are distributed (Leseberg *et al*. 2019), and most other bird calls. These parameters have been tested on a random selection of 250 Night Parrot call examples manually detected from both Great Sandy Desert and East Murchison datasets, of which 205 (82.0%) were automatically detected. Calls not detected were typically extremely faint. The probability of non-detection of a true-positive call was 18.0%; two true-positive calls was 3.2%; three true-positive calls was 0.6%; etc. Of the data tested, the median number of consecutive (spaced at < 5 minutes apart) calls in a sequence when Night Parrots were recorded was 5 (1–34, n = 29). The probability of at least one call being detected within a sequence of median length, assuming there was variation in the location of the source of the call, was > 99.9%.

The resulting 'detections' were then compared to a reference library comprising several thousand Night Parrot calls from Western Australia and Queensland. This library consists of calls recorded at sites where Night Parrots have been confirmed using visual means and is therefore considered of high reliability. The library also comprises multiple examples of all known call types from Western Australia and Queensland (Leseberg *et al*. 2019).

4. Survey results

A total of 35,989 Kaleidoscope detections were manually assessed for Night Parrot vocalisations. No calls attributable to Night Parrots were detected during the analysis.

5. Conclusion

It is unlikely long-term stable Night Parrot roosts exist within approximately 200 m of the six sites that were sampled, at the time of sampling. Additionally, it is unlikely that Night Parrots were foraging in proximity to these surveyed points at the time of sampling. It is important to reinforce that these results pertain specifically to that area immediately surrounding the survey points, and only for the period during which the survey was conducted. The results of these surveys do not enable robust conclusions about the presence or absence of Night Parrots in the wider landscape.

6. References

Jackett, N. A., B. R. Greatwich, G. Swann, and A. Boyle. 2017. A nesting record and vocalisations of the Night Parrot *Pezoporus occidentalis* from the East Murchison, Western Australia. *Australian Field Ornithology* **34**: 144-150.

Kearney, M. R., W. P. Porter, and S. A. Murphy. 2016. An estimate of the water budget for the endangered night parrot of Australia under recent and future climates. *Climate Change Responses* **3**: 1-17.

Leseberg, N. P., S. A. Murphy, N. A. Jackett, B. R. Greatwich, J. Brown, N. Hamilton, L. Joseph, and J. E. M. Watson. 2019. Descriptions of known vocalisations of the Night Parrot *Pezoporus occidentalis*. *Australian Field Ornithology* **36**: 79-88.

Leseberg, N. P., W. N. V. Venables, S. A. Murphy, N. A. Jackett, and J. E. M. Watson. 2022. Accounting for both automated recording unit detection space and signal recognition performance in acoustic surveys: A protocol applied to the cryptic and critically endangered Night Parrot (*Pezoporus occidentalis*). *Austral Ecology* **47**: 440-455.

Murphy, S. A., J. J. Austin, R. K. Murphy, J. Silcock, L. Joseph, S. T. Garnett, N. P. Leseberg, J. E. M. Watson, and A. H. Burbidge. 2017a. Observations on breeding Night Parrots (*Pezoporus occidentalis*) in western Queensland. *Emu* **117**: 107-113.

Murphy, S. A., J. Silcock, R. K. Murphy, J. R. W. Reid, and J. J. Austin. 2017b. Movements and habitat use of the night parrot *Pezoporus occidentalis* in south-western Queensland. *Austral Ecology* **42**: 858-868.

Appendix G Post-survey likelihood of occurrence.

Taxon	Common name	WA status	EPBC status	Number of records		Latest record	Preferred habitat type	Comments	Likelihood of occurrence
				DBCA	Fortescue				
BIRD									
Actitis hypoleucos	Common sandpiper	MI	MI	4	6	2020	Inland wetlands and sheltered coastal areas, utilises permanent and ephemeral wetlands.	Closest record (Fortescue) within 3 km of study area, with most records associated with Fortescue Marsh. Permanent habitat does not occur within study area and presence of species is unlikely. Potential usage of habitat within the study area restricted to transient presence rather than permanent occupancy.	**Moderate**
Apus pacificus	Fork-tailed swift	MI	MI	4	25	2014	Occupies low to very high airspace over varied habitat. Aerial specialist.	Closest records (DBCA and Fortescue) 27 km from study area. Species does not utilise terrestrial habitats; however, may utilise the airspace above the study area while transiting.	**Moderate**
Calidris acuminata	Sharp-tailed sandpiper	MI	MI	7	1	2020	Prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation.	Closest Fortescue records 11 km from study area, with most records associated with Fortescue Marsh. Permanent habitat does not occur within study area and presence of species is unlikely. Potential usage of habitat within the study area restricted to transient presence rather than permanent occupancy.	**Moderate**
Calidris ruficollis	Red-necked stint	MI	MI	2	1	2017	Edge of sheltered estuaries, beaches and salt lakes both on the mainland and on offshore islands. Occasionally occur on inland salt lakes and freshwater swamps.	Closest records (DBCA) located 24 km from study area, in association with the Fortescue Marsh. Permanent habitat does not occur within study area and presence of species is unlikely. Potential usage of habitat within the study area restricted to transient presence rather than permanent occupancy.	**Moderate**
Charadrius veredus	Oriental plover	MI	MI	4	1	2017	Inland wetlands and sheltered coastal areas, utilises permanent and ephemeral wetlands.	Recorded within 14 km of study area, with most records associated with Fortescue Marsh. Permanent habitat does not occur within study area and presence of species is unlikely. Potential usage of habitat within the study area restricted to transient presence rather than permanent occupancy.	**Moderate**
Falco hypoleucos	Grey falcon	VU	VU	18	20	2024	Resident or nomadic to most of semi-arid interior.	One historical (1977) DBCA database record located within 70m of the study area. Species recorded on 11 occasions in and around the study area during the current surveys, with nine records in/around Bonney Downs North and two records in Bonney Downs South.	**Recorded (current survey)**
Falco peregrinus	Peregrine falcon	OS	-	32	13	2018	Cliffs and gorges, inland drainage systems, lowland plains, *Acacia* shrublands intersected by water courses.	Numerous database records within 10 km of study area, with closest record located 3 km south of Bonney Downs South survey area. All bar one record are located south of study area and study area appears to be located within a region of species distribution with fewer records/less frequent sightings (ALA database). Suitable breeding and foraging habitat present within study area within Drainage Line/River/Creek (major) habitat type. Species not recorded during current surveys.	**High**
Gelochelidon nilotica	Gull-billed tern	MI	MI	10	15	2020	The species utilises sheltered coastal seas, watered flatlands, estuaries, salt lakes, freshwater wetlands, and dams.	Thirteen records within 10 km of study area, with most records associated with Fortescue Marsh. Permanent habitat does not occur within study area and presence of species is unlikely. Potential usage of habitat within the study area restricted to transient presence rather than permanent occupancy.	**Moderate**
Hydroprogne caspia	Caspian tern	MI	MI	2	21	2020	Occurs in sheltered seas, inlands watercourses such as estuaries, tidal creeks, near-coastal salt lakes, and brackish pools in the lower courses of rivers.	Closest Fortescue records located approximately 6 km from study area, with all records associated with Fortescue Marsh. Permanent habitat does not occur within study area and presence of species is unlikely. Potential usage of habitat within the study area restricted to transient presence rather than permanent occupancy.	**Moderate**
Macronectes giganteus	Southern giant petrel	MI	EN	3	0	2011	Widespread throughout the Southern Ocean, utilises offshore islands for breeding.	Three records located approximately 70 km south of study area, south of the Fortescue Marsh. Permanent habitat does not occur within study area and species is considered unlikely to occur. Potential usage of habitat within the study area restricted to transient presence rather than permanent occupancy.	**Low**
Motacilla cinerea	Grey wagtail	MI	MI	1	0	2012	Typically occurs along freshwater habitats such as creeks and streams, however species could occur in any habitats during migration.	A single DBCA record located approximately 62 km from study area. Potential usage of habitat within the study area restricted to transient presence rather than permanent occupancy.	**Low**

Taxon	Common name	WA status	EPBC status	Number of records		Latest record	Preferred habitat type	Comments	Likelihood of occurrence
				DBCA	Fortescue				
Ninox connivens connivens	Barking owl (southwest subpop.)	P3	-	2	0	1981	Occurs primarily in sclerophyll woodland. Nests in large hollows in live eucalypts.	Two historical records located between 75-80 km from the study area. This subspecies is restricted to the south-west of Western Australia and does not occur within the study area based on the current modelled distribution. Historical records instead represent *Ninox connivens peninsularis*, which is not listed under state or national legislation and is considered locally common and widespread.	**Does not occur**
Pandion haliaetus	Osprey	MI	MI	2	0	2012	Usually associated with coastal habitats and occasional visitor to inland water bodies.	Closest record located within 49 km of study area. Permanent habitat does not occur within study area and species is considered unlikely to occur. Potential usage of habitat within the study area restricted to transient presence rather than permanent occupancy.	**Low**
Pezoporus occidentalis	Night parrot	CR	EN	2	1	2005	Old, long unburnt, ring-forming *Triodia* grasslands and/or chenopod shrublands in arid and semi-arid zones.	Species recorded on two occasions (DBCA) within 100 kilometres of study area. Recorded south-west (2005) and northeast of study area (1980). Potential roosting and foraging habitat occurs within the study area, which is located within the High Priority region for night parrot surveys.	**Moderate**
Plegadis falcinellus	Glossy ibis	MI	MI	3	5	2017	The preferred habitat is shallows and adjacent flats of freshwater lakes and swamps, but it is also found in river pools, flooded samphire, and sewage ponds.	Three Fortescue records within 7 km of study area, with all records associated with Fortescue Marsh. Potential usage of habitat within the study area likely to be restricted to transient presence rather than permanent occupancy.	**Moderate**
Polytelis alexandrae	Princess parrot	P4	VU	2	0	2012	Preferred habitat is lightly wooded country, including desert oak (*Casuarina decaisneana*), open mallee-spinifex and open marble gum (*Eucalyptus gongylocarpa*) woodland.	Two records of species identified approximately 63 km from study area. Suitable habitat highly restricted within study area which generally lacks open woodland, desert oak and mallee.	**Low**
Rostratula australis	Australian painted snipe	EN	EN	2	0	2012	Usually found in shallow inland wetlands that are either permanently or temporarily filled.	Two DBCA records of species identified approximately 36 km from study area, in the vicinity of the Fortescue Marsh. Permanent habitat does not occur within study area and species is considered unlikely to occur. Potential usage of habitat within the study area restricted to transient presence rather than permanent occupancy.	**Moderate**
Tringa glareola	Wood sandpiper	MI	MI	16	4	2017	Occurs most commonly in coastal, better-watered regions of the state but will visit areas of suitable habitat in the interior. Occurs around the muddy or grassy margins of freshwater wetlands, including swamps, lagoons, river pools, dams, bore overflows and sewage ponds.	Two DBCA records located approximately 11 km from study area. Permanent habitat does not occur within study area and presence of species is unlikely. Potential usage of habitat within the study area restricted to transient presence rather than permanent occupancy.	**Moderate**
Tringa nebularia	Common greenshank	EN	MI	5	18	2020	Found in shallow, fresh waters (e.g. claypans, swamps, river pools) and salt waters (e.g. estuaries, samphire flats, reef flats).	Closest records (DBCA) located within 3 km of study area, with most records in the vicinity of the Fortescue Marsh. Permanent habitat does not occur within study area and species is considered unlikely to occur. Potential usage of habitat within the study area restricted to transient presence rather than permanent occupancy.	**Moderate**
Tringa stagnatilis	Marsh sandpiper	MI	MI	2	0	2016	Inhabit permanent or ephemeral wetlands of varying salinity, including swamps, lagoons, billabongs, saltpans, saltmarshes, estuaries, pools on inundated floodplains, and intertidal mudflats as well as sewage farms and saltworks.	Closest record located 14 km from study area in the vicinity of the Fortescue Marsh. Permanent habitat does not occur within study area and species is considered unlikely to occur. Potential usage of habitat within the study area restricted to transient presence rather than permanent occupancy.	**Moderate**
Calidris ferruginea	Curlew sandpiper	CR	CR	0	0	?	The species utilises coastal and near-coastal waterbodies including saltmarshes, wetlands, sewage ponds and shallow estuaries.	No known records of species within 40 km of study area. EPBC Act Protected Matters Search identified species/species habitat may occur within study area.	**Low**
Erythrotriorchis radiatus	Red goshawk	VU	EN	0	0	?	The preferred habitat is tall open eucalypt forest and riparian areas, including paperbark forest and gallery forests.	No known records of species within 40 km of study area. EPBC Act Protected Matters Search identified species/species habitat may occur within study area.	**Low**

Taxon	Common name	WA status	EPBC status	Number of records		Latest record	Preferred habitat type	Comments	Likelihood of occurrence
				DBCA	Fortescue				
Motacilla flava	Yellow wagtail	MI	MI	0	0	?	Non-breeding habitat only. Well- watered open grasslands and fringes of wetlands. Roosts in mangroves and dense vegetation.	No known records of species within 40 km of study area. EPBC Act Protected Matters Search identified species/species habitat may occur within study area.	**Low**
MAMMALS									
Dasycercus blythi/*Dasycercus* sp.	Brush-tailed mulgara	P4	-	50	275	2023	Occur in spinifex grasslands throughout much of the arid zone and dig burrows in flats between low sand dunes.	Species recorded at Bonney Downs South during the current surveys, within the Plain (stony gibber) habitat type. Species not recorded at Bonney Downs North.	**Recorded (current survey)**
Dasycercus cristicauda	Crest-tailed mulgara, Minyiminyi	P4	-	2	0	2011	Restricted to central Simpson Desert. Digs and inhabits burrows predominantly in dunes with a sparse cover of Sandhill Canegrass (*Zygochloa paradoxa*) or areas around salt lakes with Nitre Bush (*Nitraria billardieri*).	Two DBCA records from 2011 located 84 km from study area. Study area does not intersect known distribution of the crest-tailed mulgara (previously known as *D. hillieri*) after taxonomic revision undertaken in 2005. Records of the "crest-tailed mulgara" within the study area instead represent the brush-tailed mulgara, *D. blythi* (previously referred to as *D. cristicauda*).	**Does not occur**
Dasyurus hallucatus	Northern quoll	EN	EN	624	310	2024	Rocky escarpments provide denning and shelter habitats, also known to inhabit riverine habitats and utilise drainage lines for distribution.	Numerous records in vicinity of study area, with 85 Fortescue records located within the study area. Species recorded on motion cameras and captured in cage traps within Rocky Escarpments (Ridges/Mesa/Cliffs/Outcrops/Breakaways) and Drainage Line/River/Creek (major) habitat types. A single individual was recorded at Bonney Downs South.	**Recorded (current survey)**
Lagorchestes conspicillatus leichardti	Spectacled hare-wallaby (mainland)	P4	-	5	0	2014	Inhabits grasslands, open forests, open woodlands and tall shrublands and shelters during the day under tussocks of *Triodia* spp.	Closest DBCA records located 50.5 km from study area. Suitable habitat generally absent from study area.	**Low**
Leggadina lakedownensis	Short-tailed mouse, Lakeland Downs mouse, kerakenga	P4	-	44	13	2023	Semi-arid habitats including spinifex and tussock grasslands, samphire and sedge lands. *Acacia* shrublands and stony ranges. Known to occur in seasonally inundated areas with red or white sandy clay soils.	Closest Fortescue database record located within 300m of study area (2004). Three captures were recorded at Bonney Downs North within Plain (cracking clays) habitat type and one capture was recorded in Drainage Line/River/Creek (minor) habitat. Four captures recorded at Bonney Downs South within Plain (cracking clay) habitat type.	**Recorded (current survey)**
Macroderma gigas	Ghost bat	VU	VU	133	37	2024	Rocky habitat for roosting, will forage in all habitat types.	Numerous DBCA database records within 10 km of study area. Potential nocturnal refugia present within the Hills/Ranges/Plateaux and Rocky Escarpments habitat types; however, no suitable roosting habitat identified within the study area. Species recorded by a ghost bat lure deployed at acoustic lure site BDGB03 within Drainage Line/River/Creek (major) habitat type during current surveys. Species not recorded at Bonney Downs South.	**Recorded (current survey)**
Macrotis lagotis	Greater bilby, dalgyte, ninu	VU	VU	279	212	2021	Occupies a variety of habitats, including open tussock grasslands, *Acacia* (mulga) shrubland and woodlands, hummock grasslands on plains and alluvial areas and cracking clays	Numerous historical records in vicinity of study area with two historic (1982 & 1984) DBCA records within study area. No evidence of species recorded during current surveys, with limited suitable habitat identified.	**Recorded (historical)**
Pseudomys chapmani	Western pebble-mound mouse, ngadji	P4	-	312	679	2023	Restricted to Pilbara and Gascoyne regions. Occupies stony habitat with hummock grasslands. Constructs large mounds of pebbles on stony slopes, with active mounds characterised by craters.	Two Fortescue records located within study area and numerous records within 10 km of study area. Ten mounds constructed by this species recorded on occasions within the Plain (stony/gibber) and Rocky Escarpments (Ridges/Mesa/Cliffs/Outcrops/Breakaways) habitat types at Bonney Downs North. Two mounds recorded in Plain (stony/gibber) habitat at Bonney Downs South.	**Recorded (current survey)**
Rhinonicteris aurantia (Pilbara form)	Pilbara leaf-nosed bat	VU	VU	1,397	441	2024	Restricted to Pilbara region. Roosts in deep caves and mines with high temperatures and humidity and will forage in all habitat types.	Numerous records in vicinity of study area. Closest database record located approximately 20 kilometres from study area. Echolocation calls recorded at 15 sites (20 nights) at Bonney Downs North and BBSUS survey areas. Echolocation calls recorded at five sites across two phases at Bonney Downs South. No low time calls indicative of a potential roost site recorded during current or previous surveys. May forage in all habitat types. Species appears to utilise waterbodies within the site during the dry season, with very low activity recorded in the post-wet season. Known roost locations occur north of the study area in vicinity of Corunna Downs. No suitable roost caves were recorded during targeted searches in rocky habitats.	**Recorded (current survey)**

Taxon	Common name	WA status	EPBC status	Number of records		Latest record	Preferred habitat type	Comments	Likelihood of occurrence
				DBCA	Fortescue				
Antechinomys longicaudata	Long-tailed dunnart	P4	-	7	3	2011	Rugged, rocky habitat in areas with hummock grasses, shrubs and open shrubland or woodland.	Two DBCA database records (2005) located within 2 km of study area. Suitable rocky habitats occur within the study area.	**High**
REPTILES									
Liasis olivaceus barroni	Pilbara olive python	VU	VU	47	17	2024	Range restricted to Pilbara region, northern Western Australia, and the Dampier Archipelago. Occupies rocky escarpments, gorges, and waterholes.	Recorded within study area on three occasions between 2011- 2019. Species recorded during phase 2 and phase 3 detailed surveys at Bonney Downs North. Species not recorded at Bonney Downs South. Suitable dispersal habitat present within Drainage Line/River/Creek (major) habitat type and permanent and semi-permanent pools provide foraging opportunities for the species. Hills/Range/Plateaux, Gorges/Gullies and Rocky Escarpments within the study area provide shelter and foraging opportunities for the Pilbara olive python.	**Recorded (current survey)**
Anilios ganei	Gane's blind snake (Pilbara)	P1	-	8	1	2024	Often recorded in rocky or stony areas, potentially associated within moist gorges and gullies.	Closest database record (DBCA) within 40 km of the study area. Species recorded within Plain (stony/gibber) habitat type during the phase three detailed fauna survey. Species not recorded at Bonney Downs South.	**Recorded (current survey)**
Ctenotus nigrilineatus	Pin-striped finesnout Ctenotus	P1	-	47	0	2014	Spinifex plains adjacent to granite outcrops and water courses.	Numerous DBCA records 10 kilometres east of study area, in association with extensive granite outcropping. Limited to no suitable habitat present within study area.	**Low**
Liopholis kintorei	Great desert skink	VU	VU	0	0	?	Arid sandflats and clay based, or loamy soils vegetated with spinifex.	No known records of species within 40km of study area. EPBC Act Protected Matters Search identified species/species habitat may occur within study area. Limited to no suitable habitat identified within study area and total absence of records within 100 kilometres makes it unlikely that this species is present within study area.	**Low**

Appendix 4: Collision Risk Monitoring Feasibility Assessment (ecologia, 2024c)

AUGUST 2024



Providing sustainable environmental strategies,
management and monitoring solutions
to industry and government.

ecologia
ENVIRONMENT

FORTESCUE
BONNEY DOWNS STAGE 1 WIND FARM
COLLISION RISK MODELLING FEASIBILITY ASSESSMENT

This page has been left blank intentionally.

Document Status						
***ecologia* project number: 2009**						
Rev.	**Author(s)**	**Reviewer**	**Date**	**Approved for Issue**		
				Name	**Distributed To**	**Date**
0	C. Buters, T. McCabe	S. Grein	21/06/2024	S. Grein	Sophie Monaco Mimi d'Auvergne Jesse Harper	21/06/2024
1	C. Buters, T. McCabe	S. Grein	09/08/2024	S. Grein	Mimi d'Auvergne Jesse Harper	09/08/2024
2	C. Buters, T. McCabe	S. Grein	28/08/2024	S. Grein	Mimi d'Auvergne Jesse Harper	28/08/2024

***ecologia* Environment (2024)**. Reproduction of this report in whole or in part by electronic, mechanical or chemical means, including photocopying, recording or by any information storage and retrieval system, in any language, is strictly prohibited without the express approval of *ecologia* Environmental Consultants and Fortescue.

ecologia Environment

463 Scarborough Beach Rd

OSBORNE PARK WA 6017

Phone: 08 6168 7200

Email: *admin@ecologia.com.au*

This page has been left blank intentionally.

EXECUTIVE SUMMARY

Ecologia Environment (*ecologia*) was engaged by Fortescue to undertake 24 months of bird and bat site utilisation surveys (BBSUS) within the Bonney Downs survey area. Timing of BBSUS was designed to coincide with seasonal variation in the Pilbara region, with surveys undertaken in summer (December-February), autumn (March-May), winter (June-August) and spring (September-November) each year. A total of three BBSUS have been completed to date: October 2023 (spring), February 2024 (summer) and March 2024 (autumn). Additionally, three phases of detailed vertebrate fauna assessments and two targeted surveys have been undertaken within the broader Bonney Downs survey area which have been used to provide supplementary information for this assessment. This report consolidates the results of the first three BBSUS surveys and provides an interim collision risk assessment for at-risk species occurring within the Bonney Downs Stage 1 project area.

Avifauna Assemblage

A total of 95 avifauna taxa have been recorded at Bonney Downs during bird utilisation surveys with an additional 10 species have been recorded incidentally. Species most commonly recorded during BBSUS belong to the Passeriformes order (46 species); however, these taxa are typically low-flying, canopy-dwelling species which are unlikely to be at risk of collision with turbines. At-risk species recorded during BBSUS were predominantly raptors (11 species) and waterbirds (21 species). Although seven nocturnal bird taxa have been recorded on site, none of the species recorded are known to fly at or near RSA height and are considered unlikely to represent a significant strike risk. One EPBC Act listed species, the grey falcon (*Falco hypoleucos* [Vulnerable]) has been recorded at BBSUS sites on two occasions and has been incidentally recorded on nine occasions.

Bat Assemblage

Analysis of echolocation calls recorded at Bonney Downs indicate the presence of at least 10 species of bat within the local area, comprising the ghost bat (Megadermatidae), two species of sheath-tailed bat (Emballonuridae), three species of freetail bat (Molossidae), the Pilbara leaf-nosed bat (Rhinonycteridae) and three species of evening bats (Vespertilionidae). An additional species (the black flying fox) was opportunistically recorded roosting in a large date palm outside the Bonney Downs Stage 1 project area. Five additional bat species were assessed as having the potential to occur within the project area, despite not having been recorded at the site to date: little red flying-fox (*Pteropus scapulatus*), Hill's sheath-tailed bat (*Taphozous hilli*), pallid long-eared bat (*Nyctophilus daedalus*), lesser long-eared bat (*Nyctophilus geoffroi*) and the northern free-tailed bat (*Ozimops lumsdenae*). These species have been included in the risk assessment under the precautionary principle.

Echolocation calls belonging to the Pilbara leaf-nosed bat (*Rhinonicteris aurantia* (Pilbara form) [Vulnerable]) were recorded at seven sites during May 2023, four sites during October 2023 and three sites in February 2024. In addition to records obtained at systematic survey sites, a single Pilbara leaf-nosed bat echolocation sequence was incidentally recorded at ghost bat lure site BDGB01 during March 2024. Although the Pilbara leaf-nosed bat has been consistently recorded at Bonney Downs, no low-time calls indicative of a nearby roost site have been recorded and utilisation of habitat within the survey area appears to be restricted to foraging and transit only.

A single 'fly-by' record, identified as ghost bat (*Macroderma gigas* [Vulnerable]), was documented at acoustic lure site BDGB03 in March 2024. This species has the potential to use all habitat types while foraging and rocky habitats within the broader Bonney Downs survey area may provide roosting habitat and nocturnal shelter.

The modified generic risk matrix adapted by Specialised Zoological for the purposes of this project indicated that both the ghost bat and Pilbara leaf-nosed bat are likely to have a low collision risk, based on likelihood of high-altitude flight and frequency of occurrence across surveys conducted to date.

Collision Risk Assessment

Turbine risk analysis was based on the maximum flight heights exhibited by raptors and waterbirds recorded during set-time surveys in comparison to the Rotor-Swept Area (RSA) of turbines to be installed as part of the Bonney Downs Stage 1 Wind Farm (90-290m). The majority (75.1%) of set-time survey observations involving raptors and waterbirds were recorded at heights below 60m, with an additional 13.5% of flights recorded at heights between 60-80m and 7.3% of flights recorded at heights between 80-100m. No waterbirds were recorded flying at heights above 100m during set time surveys and only 4.2% of raptor flights recorded during set-time surveys were at heights greater than 100m. A total of 19.18% of waterbird flights observed during set time surveys were recorded at RSA height, compared to 41.67% of raptor flights recorded at RSA height.

Waterbirds were not recorded flying at heights greater than 100m during set-time surveys. The pacific black duck, black-fronted dotterel, white-faced heron and white-necked heron were all recorded flying at heights of up to 100m during set-time surveys. Five species of raptor were recorded flying at heights greater than 100m during set-time surveys: the brown falcon, grey falcon (VU), spotted harrier, wedge-tailed eagle and the whistling kite. Of these, all species, other than the grey falcon, were recorded flying at heights up to 160m.

Collision Risk Modelling (CRM) Feasibility Assessment

Collision Risk Modelling (CRM) is a method used to predict the number of bird (or bat) collisions that might be caused by a wind farm development. CRM is particularly important for projects involving significant fauna taxa, as the utilisation of appropriate collision risk models can help anticipate potential collision risks experienced by significant species and may inform placement of infrastructure to mitigate risks associated with turbine layouts. As two EPBC Act listed species (grey falcon and Pilbara leaf-nosed bat) have been recorded within the Bonney Downs Stage 1 project area and surrounds, a feasibility assessment was undertaken by Symbolix Pty Ltd (Symbolix) (on behalf of *ecologia*) to determine whether adequate data has been collected to consider attempting a formal CRM for these species, or whether further data collection and refinement is required.

As no systematic grey falcon observations have been recorded with an associated distance from observer, utilisation of proxy species is not advisable at this stage, as detectability distances and flight behaviour patterns of potential proxies cannot be reliably compared and contrasted with those exhibited by the species of interest. Potential proxies occurring on site have not been recorded frequently enough to undertake reliable flight density estimates, and robust biological and behavioural suitability assessment of potential proxy species has not been undertaken. Although proxies are likely to be required regardless of the number of surveys conducted, even a small number of grey falcon observations with associated distance data will provide increased certainty regarding the suitability of proxy selection.

Given the paucity of grey falcon observations recorded, it is not possible to determine whether any patterns of utilisation exist across the site. There is currently no data available to meaningfully assign relative risk ratings to individual turbines and it is likely that a flat utilisation rate will be suitable for the grey falcon based on patterns exhibited by other raptors across the site. Further surveys may provide clarity regarding these assumptions and assist with resolving uncertainty.

Based on the CRM feasibility analysis undertaken by Symbolix and their associated recommendations, further data collection is recommended prior to attempting to undertake quantitative CRM. If CRM was attempted for the grey falcon based on data collected to date, the resulting collision estimate would be too imprecise to provide sufficient insight or understanding of grey falcon collision risk. It is likely that CRM for the grey falcon will still require use of proxy species; however, additional systematic observations incorporating the above recommendations would provide increased certainty regarding CRM outputs.

TABLE OF CONTENTS

EXECUTIVE SUMMARY ..... **V**

1 INTRODUCTION **1**
1.1 PROJECT BACKGROUND 1
1.2 SURVEY OBJECTIVES 1
1.3 LEGISLATIVE AND REGULATORY FRAMEWORK 2

2 DESKTOP ASSESSMENT **4**
2.1 DESKTOP METHODOLOGY 4
2.2 DATABASE SEARCHES 4
2.3 SIGNIFICANT FAUNA 1

3 SURVEY METHODOLOGY **3**
3.1 SURVEY TIMING 3
3.2 SITE SELECTION 3
3.3 FIXED-POINT SURVEYS 3
3.4 INCIDENTAL RECORDS 4
3.5 AUTONOMOUS RECORDING UNITS - BATS 5
3.6 ACOUSTIC RECORDING UNITS – NIGHT PARROTS 5
3.7 TARGETED FALCON SEARCHES 5
3.8 GHOST BAT ACOUSTIC LURES 5
3.9 SURVEY EFFORT 10
3.10 STUDY TEAM AND LICENCES 13
3.11 LIMITATIONS AND CONSTRAINTS 14

4 COLLISON RISK MODELLING **16**

5 SITE CHARACTERISATION **18**
5.1 CLIMATE 18
5.2 IBRA 7 BIOREGIONS 19
5.3 VEGETATION 19
5.4 NATIONALLY IMPORTANT WETLANDS 20
5.5 FAUNA HABITAT 23

6 RESULTS AND DISCUSSION **27**
6.1 AVIFAUNA ASSEMBLAGE 27
6.2 BAT ASSEMBLAGE 40
6.3 SIGNIFICANT FAUNA 49
6.4 COLLISION RISK MODELLING (CRM) FEASIBILITY ANALYSIS 58

7 CONCLUSIONS.....61

8 REFERENCES.....63

9 APPENDICES.....67

TABLES

Table 1: Databases queried for the desktop study. 4

Table 2: Criteria used to classify habitat use by species potentially occurring within the survey area...4

Table 3: Summary of fauna database search results within the study area (Appendix B). 1

Table 4: Survey dates of three surveys completed at the time of preparing this report 3

Table 5: Daily weather conditions experienced during the BBSUS. 9

Table 6: Survey site locations, habitat types and fixed-point survey effort..... 10

Table 7: Night parrot acoustic recorder survey effort. 11

Table 8: Targeted search effort. 11

Table 9: Ultrasonic ARU survey effort. 12

Table 10: Ghost bat lure survey effort. 13

Table 11: Study team and licences. 13

Table 12: Fauna survey limitations. 14

Table 13:Vegetation associations of the project area..... 19

Table 14: Fauna habitats in the project area. 24

Table 15: Summary of avifauna observations made during BBSUS. 28

Table 16: Raptor observations recorded during set-time surveys. 28

Table 17: Summary of incidental grey falcon observations. 32

Table 18: Flight height intervals recorded for raptor and waterbird observations during set-time surveys. 34

Table 19: Avifauna recorded during BBSUS, habitat preferences and flight demographics. 38

Table 20: Bat taxa recorded at Bonney Downs. 40

Table 21: Summary of detections of the Pilbara leaf-nosed bat from systematic sites (Specialised Zoological 2024). Grey shading highlights records from sites located within the project area. 42

Table 22: Calculated risk scores for bat species recorded in surveys between 2023-2024 (Specialised Zoological 2024). 46

Table 23: Predicted risk score and collision risk categories for Pilbara bat species with the potential to occur within the project area (based on distributions given by Milne et.al. 2023) and species recorded incidentally (black flying-fox). 'Estimated frequency' determined based on frequency on ALA occurrence records in the area (Specialised Zoological 2024)..... 47

Table 24: Bats recorded at BBSUS sites, habitat preferences and flight demographics. 48

Table 25: Potential site use assessment for significant fauna identified through database searches (DBCA, Fortescue and Protected Matters). 50

FIGURES

Figure 1: Ghost bat lure field layout.....7
Figure 2: Climate data from Bonney Downs (rainfall) and Marble Bar (temperature). Blue arrows indicate approximate timing of BBSUS. 18
Figure 3: Raptor activity patterns and densities recorded during set-time surveys. 29
Figure 4: Raptor flight heights recorded during set-time surveys. Note: RSA = 90m -290m. 30
Figure 5: Distance of raptor observations from observer (at the time of first observation). 31
Figure 6: Maximum flight heights recorded for waterbirds recorded during set-time surveys. 36
Figure 7: Maximum flight heights recorded for raptors during set-time surveys. 37

MAP FIGURES

Map 1: Location of the project area.....3
Map 2: Significant bird and bat records within 100 km of the project area (DBCA and Fortescue database). 2
Map 3: Location of fixed-point survey sites. 8
Map 4: Pre-European vegetation associations (Shepherd *et al.* 2002)..... 21
Map 5: Nationally Important Wetlands near the project area. 22
Map 6: Fauna habitat types identified within the project area. 26
Map 7: Grey falcon records. 56
Map 8: Pilbara leaf-nosed bat and ghost bat records. 57

APPENDICES

Appendix A Definitions.
Appendix B Fauna database search results.
Appendix C Bat call analysis and preliminary risk assessment (Specialised Zoological 2024).
Appendix D Avifauna site by species matrix.
Appendix E Night parrot call analysis (Adaptive NRM 2024).
Appendix F Significant fauna which may utilise habitat within the survey area for foraging, roosting and breeding
Appendix G Bonney Downs Year 1 Collision Risk Modelling Suitability Analysis (Symbolix 2024).

ABBREVIATIONS

ALA	Atlas of Living Australia
ARU	Autonomous Recording Unit
BACI	Before-After, Control Impact
BAM Act	*Biosecurity and Agriculture Management Act* 2007
BBSUS	Bird and Bat Site Utilisation Surveys
BC Act	*Biodiversity Conservation Act* 2016
BOM	Bureau of Meteorology
CRM	Collision Risk Modelling
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DAWE	Department of Agriculture, Water and the Environment (now DCCEEW)
DBCA	Department of Biodiversity, Conservation and Attractions (previously DPaW)
DCCEEW	Department of Climate Change, Energy, Environment and Water (previously DAWE)
DWER	Department of Water and Environmental Regulation
DoEE	Department of Environment and Energy (previously DSEWPaC, now DCCEEW)
DPaW	Department of Parks and Wildlife (now DBCA)
DPIRD	Department of Primary Industry and Regional Development (previously DAFWA)
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities (now DCCEEW)
EPA	Environment Protection Authority
EP Act	Environmental Protection Act
EPBC Act	*Environment Protection and Biodiversity Conservation Act* 1999
IBRA	Interim Biogeographic Regionalisation for Australia
IBSA	Index of Biodiversity Surveys for Assessments
IUCN	International Union for Conservation of Nature
MNES	Matters of National Environmental Significance
RSA	Rotor Swept Area
SAC	Species Accumulation Curve
SPRAT	Species Profile and Threats
WA	Western Australia
WC Act	*Wildlife Conservation Act* 1950

This page has been left blank intentionally.

1 INTRODUCTION

1.1 PROJECT BACKGROUND

Fortescue are proposing to develop a small scale 'pilot' wind farm, the Bonney Downs Stage 1 Wind Farm (hereafter referred to as the "project area"), previously known as the Nullagine Pilot Wind Farm, to determine the feasibility of the full-scale wind farm proposed for development at the site. The project area is proposed to be constructed adjacent to Fortescue's Nullagine Mine and is located approximately 45km north of the Christmas Creek Mine. A full-scale wind project is also proposed for later development at Bonney Downs; however, the full-scale project is not part of this scope of work. The location of the project area is shown in Map 1.

The proposed Bonney Downs Stage 1 Wind Farm will be comprised of up to 17 wind generation turbines (WGTs) with 7.6MW capacity, located around the existing Nullagine Mine. The pilot wind farm also includes supporting infrastructure such as an on-site collector substation, 220kV power transmission line, internal electrical communications reticulation, turkey's nests, concrete batching plant, borrow pits, laydowns and access tracks. The proposed turbine is the EN7.8MW with 182m rotor radius and hub height at 190m. The maximum Rotor Swept Area (RSA) of the blade height is 290m with the minimum height of 90m.

Fortescue engaged Ecologia Environment (*ecologia*) to undertake 24 months of bird and bat site utilisation surveys (BBSUS) (eight surveys total) at Bonney Downs to inform future environmental impact assessments. Surveys are undertaken four times per year, with timing coinciding with seasonal changes in the Pilbara. A total of three surveys have been undertaken to date: spring (October 2023), summer (February 2024) and autumn (March 2024). This report consolidates the results of the first three surveys and provides an interim collision risk assessment for at-risk species occurring within the project area.

1.2 SURVEY OBJECTIVES

The Department of Climate Change, Energy, the Environment and Water (DCCEEW) has developed a Draft Onshore Wind Farm Guidance (DCCEEW 2024b) which aims to avoid and minimise impacts to Matters of National Environmental Significance (MNES) and support the restoration of the environment.

The aim of this document is to consolidate all available data collected on-site to date and to outline potential risks the wind farm may pose to significant bird and bat species. The following requests will be addressed if sufficient data is available:

- Collate data from Bird and Bat Site Utilisation Surveys (BBSUS) completed to date for analysis and use.
- Undertake a review of preliminary data and publicly available information to identify if there is a risk to birds and bats from collision, taking into consideration presence, likelihood of occurrence, habitat, species ecology (i.e. flight height) and site-specific factors (i.e. wind direction, velocity, temperature).
- For each species identified as at-risk, undertake mathematical collision risk modelling (CRM) (if possible, using data collected to date). This is to include the estimated annual number of bird collisions with turbines by species, a justification of the choice of the model used and a statement of all assumptions and uncertainties associated with the interpretation of results.
- As a minimum, CRM must be completed for the grey falcon (*Falco hypoleucos*).
- Estimate the worst-case collision risk, based on Band CRM (Band, et al., 2007), which assumes that birds take no action to avoid collision.

- Estimate a realistic case collision risk based on a suitable model or models. A justification of the choice of the model used and a statement of all assumptions and uncertainties associated with the interpretation of results is to be included.
- If CRM is not required to be undertaken for a particular species, then a justification and explanation is to be provided.

1.3 LEGISLATIVE AND REGULATORY FRAMEWORK

The survey was designed and undertaken to comply with the following statutory legislation and policies (definitions can be seen in Appendix A):

- *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act);
- *Biodiversity Conservation Act* 2016 (BC Act); and
- *Environmental Protection Act* 1986 (EP Act).

The assessments complied with all necessary Environmental Protection Authority (EPA) and Commonwealth guidelines, including but not limited to:

- Draft Onshore Wind Farm Guidance (DCCEEW 2024b);
- EPBC Act Significant Impact Guidelines 1.1 – Matters of National Environmental Significance (DEWHA 2013);
- Conservation Advice for the Grey Falcon (Threatened Species Scientific Committee 2020);
- Survey Guidelines for Australia's Threatened Bats (DSEWPaC 2010);
- Survey Guidelines for Australia's Threatened Birds (DEWHA 2010); and
- Interim Guideline for Preliminary Surveys of Night Parrot (*Pezoporus occidentalis*) in Western Australia (DBCA 2017).



Bonney Downs Phase 1 Project Area

ecologia ENVIRONMENT

Project No.: 2009
Author: TM
Created Date: 10 June 2024
Coordinate System: GCS GDA 1994
Scale: 1:1,200,000 @A3

Map 1: Location of the project area.

0 13.3 26.7 40 80 Kilometers

Esri, TomTom, Garmin, FAO, NOAA, USGS, Esri, USGS

2 DESKTOP ASSESSMENT

2.1 DESKTOP METHODOLOGY

Searches of the databases listed in Table 1, along with a review of relevant survey data was undertaken to identify bird and bat species and significant species previously recorded within 100 kilometres (km) of the project area (the "study area"). As DBCA and Fortescue database search buffers are applied based on the availability of significant fauna records in the local area, the buffers utilised for these databases may differ from those applied for other databases. Habitat preferences were sourced, where available, from relevant taxonomic literature or the DCCEEW Species Profiles and Threats (SPRAT) Database. The presence of potentially suitable habitat within the project area was determined using broad landforms, soils, and vegetation associations in comparison to cited preferred habitat (if available) for each species.

Table 1: Databases queried for the desktop study.

Database	Search details
DCCEEW Protected Matters Database	Records of matters of national significance under the EPBC Act within 40 km of the project area.
DBCA Threatened and Priority Fauna Database	Bird and bat records within 100 km of the project area
BirdLife Australia's Birdata Database	All bird records within 40 km of the project area.
Atlas of Living Australia Database	All bird records within 40 km of the project area.
Fortescue Internal Fauna Databases	All bird and bat records within 40 km of the project area.

Results of database searches were compiled, and significant species were identified. A site utilisation assessment was undertaken for significant species identified during DBCA, Fortescue and Protected Matters searches as having the potential to occur within the survey area. The categories described in Table 2 were used to classify likely site use by each significant species identified during database searches.

Table 2: Criteria used to classify habitat use by species potentially occurring within the survey area.

Rating	Criterion
Transitory	Temporary utilisation of airspace within survey area while transiting to breeding, roosting or foraging habitat.
Foraging	Use of habitat within the survey area during foraging activities.
Breeding	Use of habitat within the survey area for breeding activities.
Roosting	Use of habitat within the survey area for nocturnal roosting.
Unlikely to occur	Survey area lacks suitable habitat for species and no records identified within 40-100km of project area.
Does not occur	Historical records located well beyond current species distribution or anomalous/misidentified records.

2.2 DATABASE SEARCHES

According to database search results, 17 bats and 200 bird species have been recorded within 40-100km of the project area (Appendix B). A summary outlining the results of database searches within the study area can be seen in Table 3.

Table 3: Summary of fauna database search results within the study area (Appendix B).

Database	Search date	Bats	Birds
Atlas of Living Australia (ALA) (40 km)	20/06/2023	17	200
DBCA Threatened and Priority Fauna Search (100 km)	01/02/2023	2	20
Birdlife Australia Birdata (40 km)	20/06/2023	-	149
DCCEEW Protected Matters Search (40 km)	20/06/2023	2	21

2.3 SIGNIFICANT FAUNA

DBCA Threatened and Priority fauna database and Fortescue significant fauna database search results identified eight Threatened species (two bats and six birds), one Specially Protected bird and 13 Migratory birds (Map 2). Although DBCA database records identified two historical records classified as the Priority 3 barking owl (southwest subpop.); however, this Priority 3 listing only relates to the population that occurs in the south-west of Western Australia. Populations that occur in the Pilbara are not listed under state or national legislation.

EPBC Act Protected Matters Report identified 13 Threatened species (seven birds and two bats), 10 Migratory birds and four Marine birds as having the potential to occur within the project area (Appendix B). Species listed as Marine under the EPBC Act have been excluded from the site utilisation assessment as these species are not listed at a State or National level, are generally common and widespread in the Pilbara and the project area does not encompass marine habitats.

119.1667°E
120°E
120.8333°E
20.8333°S
21.6667°S
22.5°S
23.3333°S
255 m
364 m
336 m
599 m
555 m
Mullagine
580 m
977 m
1242 m
600 m
802 m
Newman
Fortescue River
The Dyke Range
Ripon Hills

Bonney Downs Phase 1 Project Area

Threatened Birds
- Australian painted snipe
- Grey falcon
- Night parrot
- Peregrine falcon
- Princess parrot
- Southern giant petrel

Migratory Birds
- Caspian tern
- Common greenshank
- Common sandpiper
- Fork-tailed swift
- Glossy ibis
- Grey wagtail
- Gull-billed tern
- Marsh sandpiper
- Oriental plover
- Osprey
- Red-necked stint
- Sharp-tailed sandpiper
- Wood sandpiper

Threatened Bats
- Ghost bat
- Pilbara leaf-nosed bat

Specially Protected fauna
- Peregrine falcon

Priority fauna
- Barking owl (southwest subpop.)

ecologia ENVIRONMENT

Project No.: 2009
Author: TM
Created Date: 10 June 2024
Coordinate System: GCS GDA 1994
Scale: 1:1,000,000 @A3

Map 2: Significant bird and bat records within 100 km of the project area.

0 11 22 33 66 Kilometers

Esri, TomTom, Garmin, Foursquare, FAO, METI/NASA, USGS, Esri, USGS

3 SURVEY METHODOLOGY

3.1 SURVEY TIMING

To date, three bird and bat site utilisation surveys have been conducted over three seasons. Each survey was conducted over an eight-day period by three *ecologia* zoologists (Table 4). The survey methods implemented accord with the *Draft Onshore Wind Farm Guidance* (DCCEEW 2024b). Daily weather conditions for the project area during each field survey are provided in Table 5. The three surveys included in this interim report form part of a greater 24-month (eight survey) bird and bat site utilisation study which is still being undertaken at the time of this report. Additionally, three phases of detailed fauna and two phases of targeted fauna surveys were undertaken by *ecologia* within the broader Bonney Downs survey area, with the results and survey effort associated with these surveys incorporated into this report as appropriate.

Table 4: Survey dates of three surveys completed at the time of preparing this report

Survey	Date	Season	Staff
Survey 1	12-19 October 2023	Spring, Southward Migration	Tim McCabe, Claudia Buters, Thomas Burley
Survey 2	5-12 February 2024	Summer, Wet Season	Tim McCabe, Simon Cherriman, Thomas Burley
Survey 3	21-28 March 2024	Autumn, Northward migration	Tim McCabe, Simon Cherriman, Thomas Burley

3.2 SITE SELECTION

Indicative habitat types were delineated following analysis and extrapolation of land systems and aerial photography. Habitat representation within both the project area and broader landscape was taken into consideration in selecting fixed time survey sites. Habitat features known to provide shelter and foraging opportunities for significant fauna species (e.g. creek lines and ridgelines) were preferentially targeted.

3.3 FIXED-POINT SURVEYS

Set-time survey sites were established to align with the Before-After, Control-Impact (BACI) design approach to allow future monitoring of potential impacts. A total of 40 fixed time survey sites were established across the broader Bonney Downs survey area (Table 6, Map 3). BBSUS sites were selected in the context of the full-scale wind farm project, encompassing representative habitat types and ensuring the inclusion of both impact and reference locations.

Thirty-minute set-time surveys were conducted at each site to record avifauna species present and understand how each species is utilising the site. Each site was surveyed three times during daylight hours - once within three hours of sunrise, once at mid-day and once within three hours of sunset (three surveys total) during each survey phase. A unique survey identification (ID) was allocated to each individual survey and climatic conditions (cloud cover, weather conditions and prevailing wind) were recorded at the start of each set-time survey period. A total of 360 fixed point surveys have been undertaken to date (120 per survey phase), spanning three seasons.

The following parameters were recorded during each survey during the October 2023 (spring) and February 2024 (summer) surveys:

- Site ID
- Date
- Survey start and end time
- Species ID
- Abundance

- Behaviour
- Species presence (ongoing, transitory/migratory)
- Site use (transit, roosting, breeding and/or foraging)
- Flight paths in relation to the site (including migratory flight paths)
- Flight or demographic factors (flight height zones (e.g. 'below RSA', 'at RSA', 'above RSA'), soaring, flocking and population numbers)

Following the first two surveys and the publication of the the *Draft Onshore Wind Farm Guidance* (DCCEEW 2024b), further refinement of parameters recorded was undertaken in March 2024 to align with the draft guidelines and improve capacity to undertake CRM analysis on data collected.

Based on the parameters outlined in the *Draft Onshore Wind Farm Guidance* (DCCEEW 2024b) and discussions undertaken with Symbolix regarding refinement of data collection for CRM modelling, the following information was recorded for each species observed during the March 2024 (autumn) surveys:

- Site ID
- Date
- Survey start and end time
- Species ID
- Age (adult, juvenile, sub-adult) and sex (male, female, indeterminate)
- Observation period (start time and end time)
- Abundance
- Height of first observation (specific heights)
- Minimum and maximum flight height (as accurately as possible)
- Distance to first observation
- Flight behaviour: perched, directed flight (disturbed, transiting or moving to a perch), foraging, soaring/gliding
- Prevailing wind
- Other comments (e.g. other behaviours exhibited)

Additionally, an assessment of species presence (ongoing, transitory/migratory), site usage (transit, roosting, breeding or foraging), flight paths (including migratory flight paths) and relative population numbers will be undertaken following the collection of 24 months data. This will allow identification of seasonal and spatial variation in site usage to be identified.

3.4 INCIDENTAL RECORDS

In addition to the fixed-point surveys, incidental observations of species of concern and raptors were recorded while traversing site. Detailed vertebrate fauna assessments were conducted concurrently with the October 2023 and March 2024 BBSUS, and all avifauna taxa recorded have been included in the incidental records which helps to compile a comprehensive species list.

For incidental records, the following parameters were recorded (where possible);

- Date
- Species ID
- Age
- Observation start time and end time
- Abundance
- Height of first observation
- Minimum and maximum flight height (as accurately as possible)
- Distance to first observation
- Flight behaviour: perched, directed flight (disturbed, transiting or moving to a perch), foraging, soaring/gliding

- Prevailing wind conditions

3.5 AUTONOMOUS RECORDING UNITS - BATS

Song Meter 4 (SM4) ultrasonic Autonomous Recording Units (ARUs) and Titley Chorus ARUs have a high sampling frequency and enable the full spectrum of bat echolocation calls to be recorded without transformation, allowing greater accuracy and sensitivity. ARUs were deployed with microphones facing towards the sky at a height of at least a metre above the ground, to record bat echolocation calls in the vicinity of the device. ARUs were deployed at all BBSUS sites for a minimum of two nights during the surveys, resulting in a total of 360 recording nights across three survey phases (Table 9). Thirty-four additional bat detectors were placed along potential flight pathways, cave entrances and water bodies across the project area to investigate utilisation of possible movement pathways and potential roosting and foraging resources within the project area.

To provide an indication of site proximity to any potential roost locations, the period between sunset and the first detection, and the period between the last detection and sunrise was calculated. The presence or absence of low time calls (calls recorded within 20 minutes of sunset or sunrise) are used to indicate proximity of the detector to a potential roost location. Echolocation calls recorded were analysed by bat specialist Dr Kyle Armstrong of Specialised Zoological (Appendix C).

3.6 ACOUSTIC RECORDING UNITS – NIGHT PARROTS

SM4 acoustic ARUs and Titley Chorus ARUs were programmed, in accordance with night parrot survey guidance, to sample for the presence of night parrot calls between sunset and sunrise each evening. The targeted night parrot surveys were undertaken in the months following significant rainfall events when breeding is more likely to occur and therefore, detectability of the species is expected to be higher (DBCA 2017). ARUs were deployed in areas supporting old, long unburnt spinifex (with particular focus on the species *Triodia longiceps*), as these areas represent prospective night parrot roosting habitat (DBCA 2017). A total of nine ARUs were deployed in prospective night parrot habitat for a minimum of six nights in accordance with the interim survey guidelines for night parrots (DBCA 2017) (Table 9). Analysis of acoustic data for possible night parrot calls was undertaken by Nick Leseberg (Adaptive NRM 2024).

3.7 TARGETED FALCON SEARCHES

Targeted grey falcon and peregrine falcon searches were undertaken by walking transects within their preferred habitat type, Drainage Line/River/Creek (major), to identify primary sightings or suitably sized corvid or raptor nests which may be utilised by the species. A total of 306 person hours were spent walking major drainage lines looking for falcons. Identification and mapping of intact stick nests located in large eucalypts or telecommunication towers, of a suitable size and condition to be utilised by falcons was undertaken during the targeted searches (Schoenjahn *et al.* 2020). Targeted searches were undertaken during the grey falcon breeding season (June-November) when detectability of the species and confirmation of nest utilisation is likely to be higher (Schoenjahn *et al.* 2020). Suitable nest locations were recorded, and secondary evidence of recent use (if present), in the form of feeding debris and mutes within the drop zone below the nest, was documented during searches. Targeted survey effort was focused within major drainage lines, with particular focus on habitat associated with Bonnie Creek, as this habitat type represents the most prospective breeding and foraging habitat for the species in the local area. Additionally, rocky habitats encompassing cliffs and ledges which may be utilised by the peregrine falcon were searched for evidence of utilisation (e.g. whitewash) during the targeted surveys.

3.8 GHOST BAT ACOUSTIC LURES

An acoustic lure system was utilised at seven locations at Bonney Downs North for a single night per site during the March 2024 targeted fauna survey to increase detection of ghost bats (Table 10). The

inclusion of this method is based on recent research demonstrating the utility of the method by Hanrahan *et al.* (2024) and Ruykys *et al.* (2023). Each site consists of one portable speaker, two camera traps, two infrared spotlights and a bat detector (Figure 1). Portable speakers were loaded with a micro-SD card containing a sequence of sound files containing 'squabble' calls of the ghost bat (*sensu* Hanrahan et al. 2023), with sound files played for a 2-minute period, followed by a 2-minute period of silence. Each camera trap was programmed to record 3-minute black and white video files at high resolution continuously upon start up. Infrared spotlights were set to turn on when ambient illumination levels drop below the threshold required for quality colour video recordings. A bat detector was placed on the star picket, below the portable speaker to maximise the chance of echolocation call detection if a ghost bat approached the speaker. Detection of echolocation calls provides a way to independently validate any detections made from video recordings.

Previous studies utilising this method demonstrate short-term visitation to the lure site rather than long-term presence in the vicinity of the lure. Each site was sampled for a single night, before the lure was relocated to a new location, ensuring that behavioural impacts associated with sampling over repeated nights are avoided. All sites sampled on the same night were located a minimum of 10km apart to avoid interference or movement of bats between sites. The distance at which ghost bats can hear the signals at night is unknown but assumed to be at least 100m (Kyle Armstrong, pers. comm.).

An expedient and robust analysis method has been developed by Supersensory Technologies Pty Ltd (Dr R. C. Morgans) to detect Ghost Bats within the video recordings. The analysis involves 'background subtraction', whereby moving objects in video were 'found' by comparing successive images in a sequence. All videos were processed with a custom Python (https://www.python.org/) script that applied a background subtraction algorithm from the open cv framework (https://opencv.org/) to the recordings and constructed a concatenated short video containing only portions of the recording with moving objects above a certain size. These concatenated videos are watched at <50% speed in the MPV MEDIA PLAYER (https://mpv.io/), which allows fine control of frame advancement. Objects of interest were located and re-examined in the original recording using the embedded timestamp information.

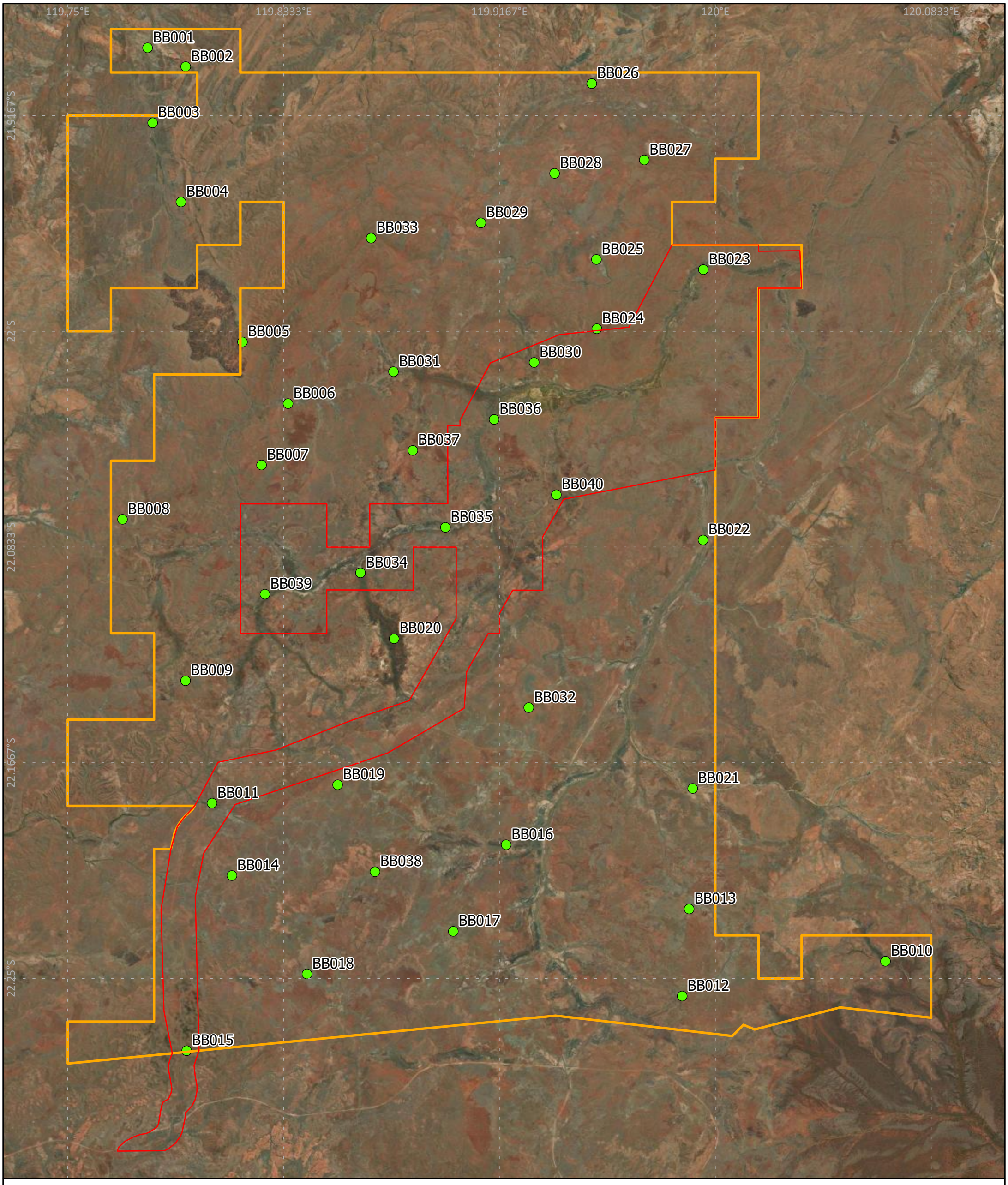
Smaller species of bat can be relatively common in the infrared videos. Without careful consideration, these species can very easily be confused for the Ghost Bat because they sometimes approached the lure—a behaviour that might intuitively be expected only from the Ghost Bat. Ghost Bats can be distinguished in infrared and thermal video recordings from other bat species and insects based on the observation of any combination of the following morphological and behavioural features that provide an empirical basis for the identification:

- flight pattern (four distinct behaviours classified as: 'circling' of the post containing the speaker; 'hover' in front of the speaker; 'long glide' towards the speaker; and 'drop in' whereby they would sometimes approach at c. 2 m above the speaker and then drop vertically towards it);
- body size relative to other objects in the frame;
- large ear size;
- lack of a tail;
- bright eyeshine of the reflected infrared light from their large eyes (infrared recordings only, though not always visible); and
- corroboration with concurrently recorded diagnostic echolocation calls.

All bats observed in videos are examined by single manual frame advancement to check for diagnostic features. The relatively high resolution and video frame rate provides a reasonable level of image quality.



Figure 1: Ghost bat lure field layout.



- Fixed Point Survey Site
- Bonney Downs Phase 1 Project Area
- Bonney Downs Survey Area

ecologia ENVIRONMENT

Project No.: 2009
Author: TM
Created Date: 10 June 2024
Coordinate System: GCS GDA 1994
Scale: 1:150,000 @A3

Map 3: Location of fixed point survey sites.

0 1.7 3.3 5 9.9 Kilometers

Earthstar Geographics

Table 5: Daily weather conditions experienced during the BBSUS.

Survey phase	Date	Maximum temperature (°C)	Minimum temperature (°C)	Rainfall (mm)	Survey phase	Date	Maximum temperature (°C)	Minimum temperature (°C)	Rainfall (mm)
Survey 1	12/10/2023	41.3	19.3	0	Survey 3	21/03/2024	37.5	25.1	0
	13/10/2023	41.5	23.3	0		22/03/2024	38.4	26.8	0
	14/10/2023	42	24.2	0		23/03/2024	36.3	26.4	0
	15/10/2023	41.8	24.7	0		24/03/2024	32.6	23.1	0
	16/10/2023	40	23.8	0		25/03/2024	32.7	22.9	0
	17/10/2023	40	20.9	0		26/03/2024	33.8	21.7	0
	18/10/2023	41.4	19	0		27/03/2024	35.2	22.2	0
	19/10/2023	42.4	22.6	0		28/03/2024	36.8	24.4	0
Survey 2	5/2/2024	41.8	26.9	0					
	6/2/2024	40	27.8	0					
	7/2/2024	42.1	26.1	0					
	8/2/2024	45.5	29.1	0					
	9/2/2024	44.6	27.1	0					
	10/2/2024	44.1	26.1	0					
	11/2/2024	45.2	25.6	0					
	12/2/2024	46.4	25.9	0					

3.9 SURVEY EFFORT

The survey effort undertaken during each BBSUS is shown in Table 6 - Table 10.

Table 6: Survey site locations, habitat types and fixed-point survey effort.

Site	Habitat	Latitude	Longitude	Number of BBSUS		
				October 2023	February 2024	March 2024
BB001	Drainage Line/River/Creek (major)	-21.8905	119.7808	3	3	3
BB002	Plain (stony/gibber)	-21.8978	119.7955	3	3	3
BB003	Drainage Line/River/Creek (major)	-21.9195	119.7828	3	3	3
BB004	Plain (stony/gibber)	-21.9500	119.7937	3	3	3
BB005	Plain (stony/gibber)	-22.0041	119.8175	3	3	3
BB006	Drainage Line/River/Creek (major)	-22.0279	119.8351	3	3	3
BB007	Plain (stony/gibber)	-22.0517	119.8248	3	3	3
BB008	Plain (stony/gibber)	-22.0726	119.7711	3	3	3
BB009	Plain (stony/gibber)	-22.1350	119.7955	3	3	3
BB010	Woodland (open)	-22.2433	120.0657	3	3	3
BB011	Drainage Line/River/Creek (major)	-22.1823	119.8057	3	3	3
BB012	Plain (stony/gibber)	-22.2568	119.9872	3	3	3
BB013	Drainage Line/River/Creek (major)	-22.2231	119.9899	3	3	3
BB014	Plain (stony/gibber)	-22.2102	119.8134	3	3	3
BB015	Hills/Ranges/plateaux	-22.2779	119.7959	3	3	3
BB016	Station Dam, permanent water	-22.1983	119.9193	3	3	3
BB017	Plain (stony/gibber)	-22.2318	119.8989	3	3	3
BB018	Drainage Line/River/Creek (major)	-22.2482	119.8424	3	3	3
BB019	Plain (stony/gibber)	-22.1752	119.8542	3	3	3
BB020	Woodland (open)	-22.1188	119.8760	3	3	3
BB021	Drainage Line/River/Creek (major)	-22.1766	119.9913	3	3	3
BB022	Drainage Line/River/Creek (major)	-22.0806	119.9953	3	3	3
BB023	Drainage Line/River/Creek (major)	-21.9762	119.9954	3	3	3
BB024	Plain (stony/gibber)	-21.9990	119.9543	3	3	3
BB025	Plain (stony/gibber)	-21.9723	119.9541	3	3	3
BB026	Hills/Ranges/Plateaux	-21.9043	119.9523	3	3	3
BB027	Plain (stony/gibber)	-21.9338	119.9726	3	3	3
BB028	Plain (Cracking clays)	-21.9390	119.9380	3	3	3
BB029	Plain (Cracking clays)	-21.9581	119.9095	3	3	3
BB030	Rocky Escarpments	-22.0120	119.9301	3	3	3
BB031	Drainage Line/River/Creek (major)	-22.0156	119.8758	3	3	3
BB032	Plain (stony/gibber)	-22.1454	119.9280	3	3	3
BB033	Plain (stony/gibber)	-21.9640	119.8671	3	3	3
BB034	Woodland (open)	-22.0933	119.8630	3	3	3
BB035	Plain (stony/gibber)	-22.0757	119.8958	3	3	3
BB036	Drainage Line/River/Creek (major)	-22.0340	119.9146	3	3	3
BB037	Plain (Cracking clays)	-22.0460	119.8832	3	3	3
BB038	Plain (stony/gibber)	-22.2088	119.8686	3	3	3
BB039	Drainage Line/River/Creek (major)	-22.1016	119.8261	3	3	3

Site	Habitat	Latitude	Longitude	Number of BBSUS		
				October 2023	February 2024	March 2024
BB040	Rocky Escarpments	-22.0631	119.9386	3	3	3
Total				120	120	120

Table 7: Night parrot acoustic recorder survey effort.

Site ID	Habitat	Nights deployed
BDNP01	Old, unburnt spinifex	8
BDNP02	Old, unburnt spinifex	8
BDNP03	Old, unburnt spinifex	7
BDNP04	Old, unburnt spinifex	7
BDNP05	Foraging habitat	6
BDNP06	Foraging habitat	6
BDNP07	Foraging habitat	6
BDNP08	Foraging habitat	6
BDNP09	Foraging habitat	6
Total		**60**

Table 8: Targeted search effort.

Site/Transect ID	Habitat type	Active search (mins)
Targeted searches (grey falcon, peregrine falcon) - Phase 1 detailed fauna survey	Drainage Line/River/Creek (major)	1,680
Targeted searches (grey falcon, peregrine falcon) - Targeted survey 1	Drainage Line/River/Creek (major)	2,880
Targeted searches (grey falcon, peregrine falcon) - Phase 2 detailed fauna survey	Drainage Line/River/Creek (major)	1,080
Targeted searches (grey falcon, peregrine falcon) - Targeted survey 2	Drainage Line/River/Creek (major)	1,440
Targeted searches (grey falcon, peregrine falcon) - Phase 3 detailed fauna survey	Drainage Line/River/Creek (major)	960
Spotlighting for nocturnal species - Phase 1	Assorted habitats	990
Spotlighting for nocturnal species - Phase 2	Assorted habitats	2,850
Spotlighting for nocturnal species - Phase 3	Assorted habitats	720
Total		**18,360 (306 hours)**

Table 9: Ultrasonic ARU survey effort.

Site ID	Habitat	Nights deployed	Site ID	Habitat	Nights deployed
BDBD01	Plain (stony/gibber)	4	BB004	Plain (stony/gibber)	6
BDBD02	Drainage Line/River/Creek (major)	2	BB005	Plain (stony/gibber)	6
BDBD03	Plain (stony/gibber)	2	BB006	Drainage Line/River/Creek (major)	6
BDBD04	Plain (stony/gibber)	2	BB007	Plain (stony/gibber)	6
BDBD05	Drainage Line/River/Creek (minor)	2	BB008	Plain (stony/gibber)	6
BDBD06	Drainage Line/River/Creek (major)	2	BB009	Plain (stony/gibber)	6
BDBD07	Drainage Line/River/Creek (major)	2	BB010	Woodland (open)	6
BDTBD01	Drainage Line/River/Creek (major)	8	BB011	Drainage Line/River/Creek (major)	6
BDTBD02	Drainage Line/River/Creek (major)	4	BB012	Plain (stony/gibber)	6
BDTBD03	Drainage Line/River/Creek (major)	7	BB013	Drainage Line/River/Creek (major)	6
BDTBD04*	Drainage Line/River/Creek (major)	4	BB014	Plain (stony/gibber)	6
BDDP01	Plain (Cracking clays)	3	BB015	Hills/Ranges/plateaux	6
BDDP02	Hummock Grassland	3	BB016	Station Dam, permanent water	6
BDDP03	Plain (Cracking clays)	4	BB017	Plain (stony/gibber)	6
BDDP04	Rocky Escarpments	3	BB018	Drainage Line/River/Creek (major)	6
BDDP05	Hummock Grassland	3	BB019	Plain (stony/gibber)	6
BDDP06	Drainage Line/River/Creek	4	BB020	Woodland (open)	6
BDDP07	Drainage Line/River/Creek	4	BB021	Drainage Line/River/Creek (major)	6
BDDP08	Hummock Grassland	4	BB022	Drainage Line/River/Creek (major)	6
BDDP09	Rocky Escarpments	3	BB023	Drainage Line/River/Creek (major)	6
BDDP10	Rocky Escarpments	3	BB024	Plain (stony/gibber)	6
BDDP11	Rocky Escarpments	3	BB025	Plain (stony/gibber)	6
BDDP12	Rocky Escarpments	3	BB026	Hills/Ranges/Plateaux	6
BDDP13	Plain (Cracking clays)	3	BB027	Plain (stony/gibber)	6
BDDP14	Rocky Escarpments	3	BB028	Plain (Cracking clays)	6
BDDP15	Drainage Line/River/Creek	3	BB029	Plain (Cracking clays)	6
BDDP16	Drainage Line/River/Creek	3	BB030	Rocky Escarpments	6
BDDP17	Hummock Grassland	3	BB031	Drainage Line/River/Creek (major)	6
BDDP18	Rocky Escarpments	3	BB032	Plain (stony/gibber)	6
BDDP19	Rocky Escarpments	3	BB033	Plain (stony/gibber)	6
BDDP20	Hummock Grassland	3	BB034	Woodland (open)	6
BDDP21	Hummock Grassland	3	BB035	Plain (stony/gibber)	6
BDDP22	Drainage Line/River/Creek	3	BB036	Drainage Line/River/Creek (major)	6
BDDP23	Woodland	3	BB037	Plain (Cracking clays)	6
BB001	Drainage Line/River/Creek (major)	6	BB038	Plain (stony/gibber)	6
BB002	Plain (stony/gibber)	6	BB039	Drainage Line/River/Creek (major)	6
BB003	Drainage Line/River/Creek (major)	6	BB040	Rocky Escarpments	6

*Sites indicated in bold were surveyed during the detailed and targeted vertebrate fauna assessment.

Table 10: Ghost bat lure survey effort.

Site ID	Habitat	Nights deployed
BDGB01	Drainage Line/River/Creek (major)	1
BDGB02	Drainage Line/River/Creek (major)	1
BDGB03	Drainage Line/River/Creek (major)	1
BDGB04	Drainage Line/River/Creek (major)	1
BDGB05	Gorges/Gullies	1
BDGB06	Plain (stony/gibber)	1
BDGB07	Gorges/Gullies	1
Total		7

3.10 STUDY TEAM AND LICENCES

The fauna assessment was planned, coordinated, executed, and reported by those summarised below in Table 11.

Table 11: Study team and licences.

Project staff				
Name	Qualification	Experience	Role	Project role
Shaun Grein	B. Sc. Biol.; Grad. Dip. Nat. Resources; MBA	>30 yrs	Managing Director/Senior Principal Scientist	Project management, reporting, QA
Tim McCabe	B.Sc. Env. Biol, Dip Proj Mngment, Cert III Vert Pest Mngment	>15 yrs	Principal Zoologist	Project management, field assessment, reporting, GIS
Claudia Buters	B.Sc. Cons. Biol. & Zool.; MWildlifeHth	>5 yrs	Senior Zoologist	Field assessment, GIS, reporting
Simon Cherriman	B.Sc. Hons (Env. Biol), MSciComm (Nat. Hist. Film.) PhD. Candidate, Murdoch University	>15 yrs.	Ornithologist	Field assessment
Thomas Burley	B. Sc Cons. Biol.	>5 yrs	Ornithologist	Field assessment
Sammantha Plant	B. Sc WildlifeBiol. EnvSc.; MWildlifeHth; Cert II ConsLandMngment.	>5 yrs	Zoologist	Reporting
Licences				
Holder	Type			Number
Tim McCabe	Authorisation to Take or Disturb Threatened Species – Section 40			TFA 2223-0255
Tim McCabe	Fauna Taking (Biological Assessment) Licence – Regulation 27			BA27000835
Ecologia Environment	WAEC Ethics Approval			WAEC 23-07-41

3.11 LIMITATIONS AND CONSTRAINTS

An assessment of survey-specific issues and limitations is detailed in Table 12.

Table 12: Fauna survey limitations.

Aspect	Limitation?	Comment
Competency/experience of the consultant carrying out the survey.	Nil	The principal zoologist leading the surveys has 15+ years of experience conducting terrestrial vertebrate fauna and avifauna surveys in the Pilbara bioregion of Western Australia. Experienced zoologists with 5+ years of avifauna survey experience were used to undertake bird and bat site utilisation surveys.
Scope (what faunal groups were sampled and were some sampling methods not able to be employed because of constraints such as weather conditions).	Nil	The fauna survey focussed on collecting baseline avifauna and bat data, focussing on significant fauna species occurring in the project area which may be impacted by wind farm infrastructure in order to quantify turbine strike risk. The scope was well defined. Standardised and well-established techniques were used to conduct surveys, with further refinement of methods undertaken in conjunction with advice from statistical analysts. Relevant databases and previous surveys of the project area were reviewed.
Proportion of fauna identified, recorded and/or collected.	Nil	A comprehensive desktop study adequately gathered background information on the study area and detailed/targeted fauna surveys collected baseline data on faunal assemblages and habitat types within the project area. BBSUS focussed on identification of significant species occurring in the project area and summary of flight heights and behaviours exhibited by these species in situ to inform CRM analysis. All taxa observed were identified and incidental records of raptors and significant species were collected to supplement systematic survey methods.
Sources of information (previously available information as distinct from new data).	Moderate	Database records, including significant fauna species, were available for the area and are considered adequate in providing appropriate contextual information for the study. Published literature relating to maximum flight heights and flight behaviours of significant fauna in the context of wind farm risk assessments was limited for most species.
The proportion of the task achieved and further work which might be needed.	Moderate	Planned survey works were conducted and completed. This report represents an interim summary of findings from the first three BBSUS, with an additional five surveys still to be conducted over the course of a two-year period. Further survey phases are required to obtain additional systematic grey falcon records and site utilisation information, as well as flight height and behaviours and investigate suitability of proxy species (e.g. other raptors) for CRM.
Timing/weather/season/cycle	Nil	The surveys were conducted during an appropriate time/season. Seasonal conditions during the February 2024 and March 2024 surveys were conducive to high levels of migratory bird and waterfowl activity, following above-average rainfall.

Aspect	Limitation?	Comment
Disturbances which affected results of the survey (e.g. fire, flood, accidental human intervention).	Nil	The surveys were conducted without disturbance and survey effort was not adversely affected by weather events, natural disasters or accidental human intervention.
Intensity (in retrospect was the intensity adequate).	Minor	Although the size of the project area and availability of access tracks prevents comprehensive visual coverage of the BBSUS area, spatial analysis of systematic survey sites indicates that the number and placement of sites provides suitable coverage to gain a representative sample.
Completeness (e.g. was relevant area fully surveyed).	Negligible	Due to Fortescue heritage and LUC restrictions, small portions of the project area could not be accessed. Permission was granted to access most of these areas via foot and sites were either surveyed within these areas or in representative habitat in close proximity.
Resources (e.g. degree of expertise available in animal identification to taxon level).	Nil	Resources were adequate to carry out the survey and survey participants were competent in the identification of species. There were no resource issues encountered.
Remoteness and/or access problems.	Nil	There were no access issues.
Availability of contextual (e.g. biogeographic) information on the region.	Nil	Sufficient contextual information was available on the Pilbara region and the study area.
Efficacy of sampling methods (i.e. any groups not sampled by survey methods).	Moderate	Data analysis indicates that the current survey methodology displays good site coverage and sampling of different seasons. Based on recommendations provided in Appendix G, additional parameters will be collected (height at first observation and horizontal distance to first sighting) using a range finder to improve observation accuracy and improve CRM confidence. Although low activity rates of grey falcons have been recorded during systematic surveys, this is expected of a rare species and may require use of proxies to estimate collision risk for this species. Further discussion regarding this provided in Appendix G.

4 COLLISON RISK MODELLING

Collision Risk Modelling (CRM) is used to predict the number of bird (or bat) collisions that might be caused by a wind farm development. If feasible, using survey data collected to date, CRM is proposed to be undertaken for the Bonney Downs Stage 1 Wind Farm to inform placement of turbines and associated infrastructure and quantify risk to significant bird and bat taxa occurring within the proposed project area.

CRM requires the following components to be addressed:

- The number of flights (per unit area per unit time)
- The probability of interaction with a turbine, given a flight
- The probability of collision with a turbine, given an interaction
- The overall probability of avoidance

The number of flights will be obtained from the survey data. To account for survey effort, unsurveyed area, and the decay of visibility with distance, distance correction will be made (Buckland et al. 2001). This requires certain types, amounts and distributions of data to be collected and a review of the spatial data (flight paths) will be undertaken and assessed for its suitability for spatial modelling. If the number of flights or the spatial coverage is insufficient, the assumption of flat usage will be applied (i.e. every turbine has an equal probability of collision). The probability of collision (given interaction) is generated using the standard form of W. Band, Madders, and Whitfield (2007), and B. Band (2012).

The collision risk model is applied via the following equation:

$N_{collisions} = F \times P(I/F) \times P(C/I) \times [1 - AR]$

where:

- $N_{collisions}$ is the estimated number of flights ending in collisions, the metric of interest
- F is the distance-corrected number of flights on-site (estimated), per unit time per unit area
- *P (I/F) is* the probability of collision, assuming an interaction occurs (assumed here to have no spatial dependence, i.e. is a constant)
- $P(C/I)$ is the probability of collision given an interaction, which depends on turbine parameters and bird parameters
- *AR* is the avoidance rate. This is an estimate of the proportion of post-construction flights that will exhibit turbine avoidance.

Some inputs can be sourced through desktop review, i.e.:

- Species specific biological and morphological data; e.g. body length, wingspan and average flight speed. This can usually be obtained from grey and peer-reviewed literature or through expert consultation.
- Proportion of the year the species is active on site
- Proportion of the day the species is active on site
- Turbine specifications including blade length, hub height, location, revolutions per minute (average), and anticipated percentage downtime. This data is readily available or reliably estimated.

Inputs and data sourced during the desktop review must be combined with field surveys to inform the following inputs:

- Average activity rate (flights / area / time)
- Proportion of flights at rotor swept height

The whole-site model can be expanded to provide per-turbine spatial collision prediction, but this requires either:

- sufficient flight path data to resolve a spatial flight distribution map (we advise 50-100 flight paths); or
- sufficient data to inform a spatial distribution model where location is predicted from landscape features.

In order to investigate the feasibility of CRM as a tool for quantifying the expected annual collisions between significant species and turbines based on data collected to date, Symbolix were engaged to undertake a review and interrogation of available data to determine whether the requirements for CRM were met. As part of their scope, Symbolix were engaged to determine whether interim CRM analysis was feasible for the pilot windfarm proposal and provide recommendations for data collection and analysis moving forward. The results of this analysis are presented in Appendix G and discussed in Section 6.4.

5 SITE CHARACTERISATION

Background environmental information for the project area was reviewed to identify key environmental features of the site which may influence occupancy and/or utilisation of the project area by at-risk species. A review of climate (Bureau of Meteorology, BOM), biogeography (IBRA 7) (DSEWPaC 2012), pre-European native vegetation of Western Australia (Shepherd et al. 2002), Nationally Important Wetlands (DCCEEW 2023) and fauna habitat mapping was undertaken to assist with site characterisation and identification of areas which provide important habitat for significant fauna.

5.1 CLIMATE

The project area is located in the Pilbara region of Western Australia (WA) and experiences an arid-tropical climate with two distinct seasons: a hot summer from October to April and a mild winter from May to September. Temperatures are generally high, with summer temperatures frequently approaching 40°C. Light frosts occasionally occur inland during the winter months of July and August. Climate data from the nearest long-term Bureau of Meteorology (BOM) weather station was obtained from Bonney Downs (Station No.4006, 7km south of the project area) for rainfall prior to the 15th of March 2024 and temperature data was obtained from Marble Bar (Station No.4106, 77km north of the project area).

A total of 279.5 mm of rainfall was recorded during the 12 months prior to the first survey in October 2023, which was 85.97% of mean annual rainfall (325.1 mm) (Figure 2)(BoM 2023). Significant rainfall fell in the Eastern Pilbara in January and March 2024 after very little rain between May and December 2023. This rainfall led to the inundation of waterbodies onsite and the Fortescue Marsh. The inundation of the Fortescue Marsh is a notable occurrence for waterbirds as it provides suitable habitat for Migratory species.

Maximum daytime temperatures frequently exceed 40°C between November and January, and minimum temperatures can drop below 14°C between June and August.

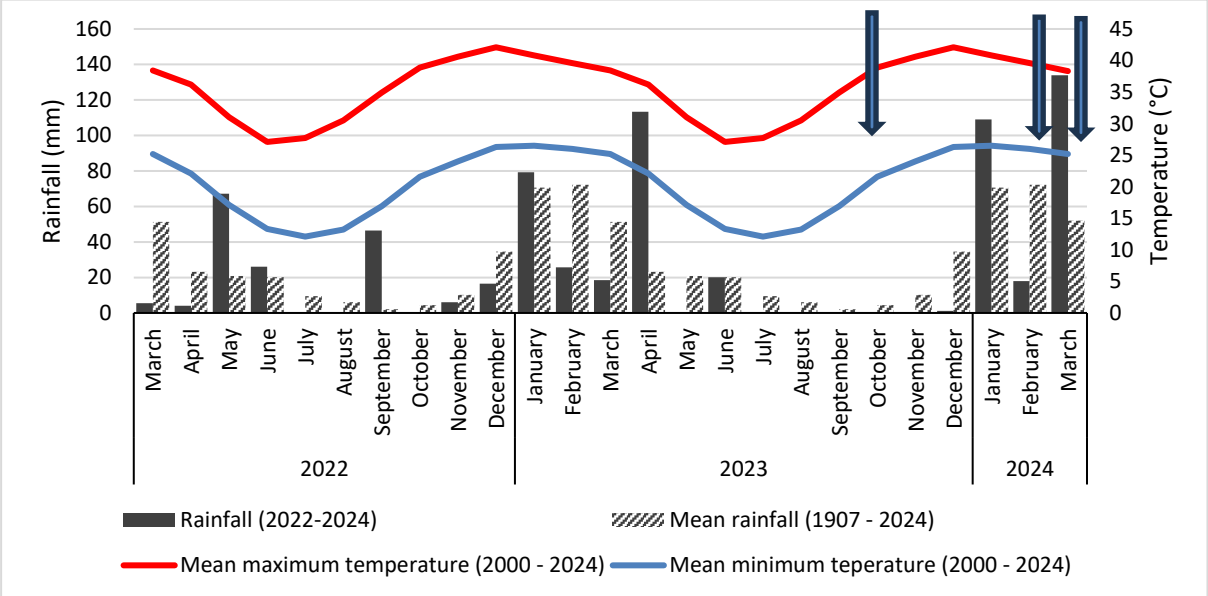


Figure 2: Climate data from Bonney Downs (rainfall) and Marble Bar (temperature). Blue arrows indicate approximate timing of BBSUS.

5.2 IBRA 7 BIOREGIONS

The Interim Biogeographic Regionalisation for Australia (IBRA) classifies the Australian continent into regions or bioregions on the basis of similar geology, landform, vegetation, fauna and climate characteristics (DSEWPC 2012). The project area is situated entirely within the Pilbara bioregion according to IBRA 7 (DSEWPC 2012). The Pilbara region is further divided into four subregions: Hamersley (PIL03), Fortescue Plains (PIL02), Chichester (PIL01) and Roebourne (PIL04). Majority of the project area (99.72%, 18,156.73ha) occurs within the Chichester subregion with a small portion (0.28%, 50.10ha) occurring within the Fortescue Plains subregion.

The Chichester subregion (PIL01) comprises the northern section of the Pilbara Cration. Undulating Archaean granite and basalt plains include significant areas of basaltic ranges. Plains support a shrub steppe characterised by *Acacia inaequilatera* over *Triodia wiseana* (formerly *Triodia pungens*) hummock grasslands, while *Eucalyptus leucophloia* tree steppes occur on ranges. The climate is Semi-desert-tropical and receives ~300mm of rainfall annually. Drainage occurs to the north via numerous rivers (e.g. De Grey, Oakover, Nullagine, Shaw, Yule, Sherlock). Subregional area is 9,044,560ha (Kendrick and McKenzie 2001).

5.3 VEGETATION

The Western Australian Land Use and Vegetation Data Project (Shepherd *et al.* 2002) produced a 1:250,000 scale digital spatial dataset of the pre-European native vegetation of Western Australia, compiled from previous vegetation mapping exercises, primarily by J.S. Beard from 1964 to 1981, with updates reflecting the National Vegetation Information System (NVIS) standards. Two vegetation associations (173 and 562) are mapped within the project area (Table 13, Map 4). The majority of the project area (99.7%) is comprised of vegetation association 173, characterised by *Triodia wiseana* hummock grassland and low *Eucalyptus* steppe.

The pre-European and current extent of each vegetation association is available from the Statewide Vegetation Statistics dataset (Government of Western Australia 2018). The National Objectives and Targets for Biodiversity Conservation 2001-2005 (DEH 2001) recognise that the retention of 30% or more of the pre-clearing extent of an ecological community is necessary if Australia's biological diversity is to be protected, as this is the threshold below which species loss appears to accelerate exponentially (EPA 2000). Vegetation associations at less than 30% of their pre-European extent are classified as either 'Vulnerable' (10-30%) or 'Endangered' (< 10 %) (DER 2014). The current extent of vegetation associations in the Chichester bioregion within the project area are well above this 30% threshold (Table 13) and are classified as 'Least concern' (DER 2014).

Table 13:Vegetation associations of the project area.

Shepherd et al. (2002) vegetation association	Description	Pre-European extent within Pilbara IBRA region (ha)	Extent remaining within Pilbara IBRA region	Current percentage protected for conservation within Pilbara IBRA region	Extent within project area (ha)	Extent within project area (%)
173	Hummock grasslands, shrub steppe; kanji over soft spinifex & *Triodia wiseana* on basalt	1,752,520.89	1,747,677.63	99.72	18,141.5	99.7
562	Mosaic: Low woodland; mulga in valleys / Hummock grasslands, open low tree-steppe; snappy gum over *Triodia wiseana*	103,606.82	103,606.82	100	63.70	0.003

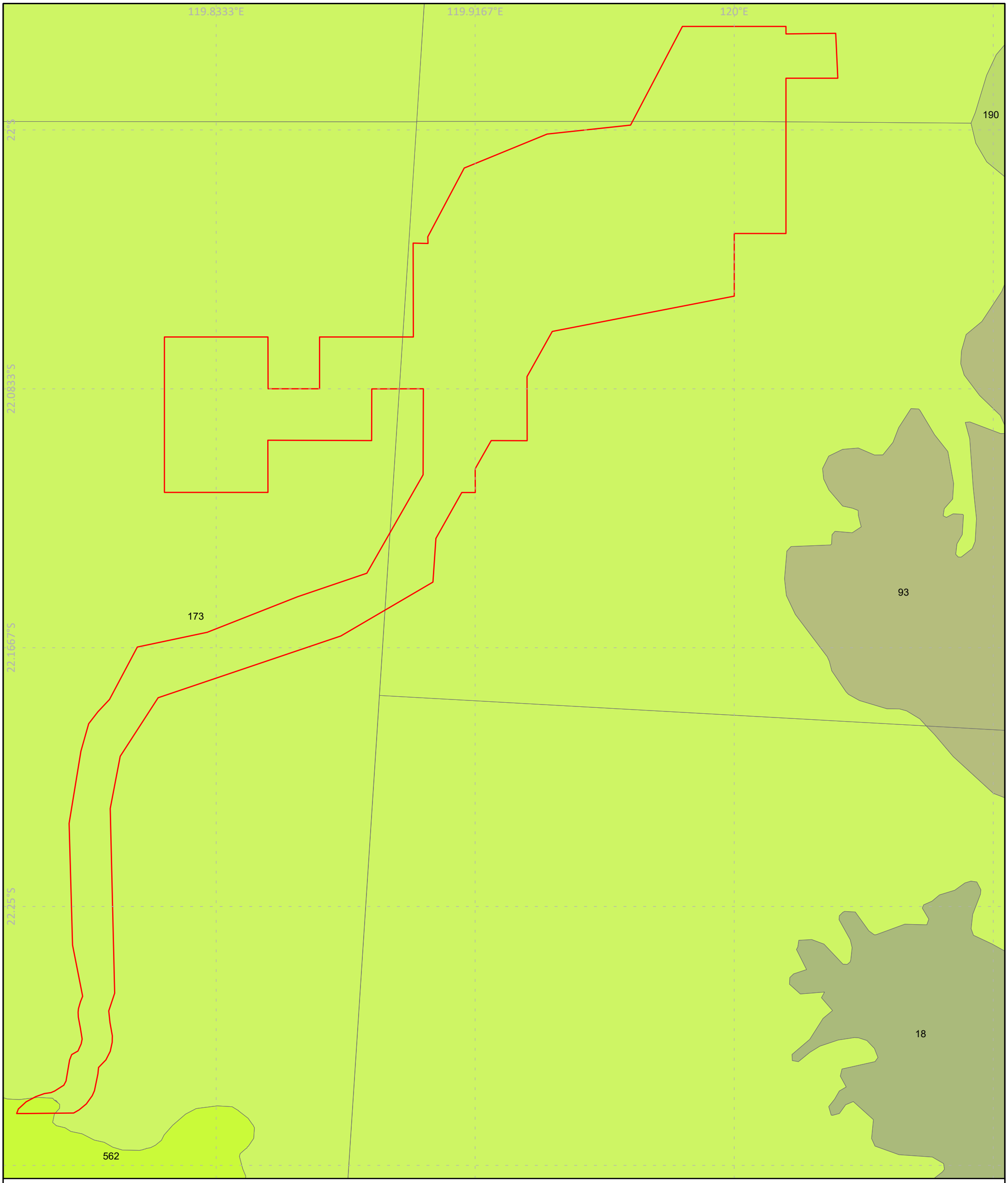
5.4 NATIONALLY IMPORTANT WETLANDS

The project area is intersected by Bonnie Creek, Bonnie Pools, Nullagine River and minor tributaries associated with the Coongan River which provide important seasonal and permanent habitat for a wide range of terrestrial vertebrate fauna taxa, including birds and bats.

The DCCEEW (DCCEEW 2023) directory of important wetlands was queried for Ramsar Wetlands, Nationally Important Wetlands, and DBCA managed lands and waters occurring within the study area. Ten Nationally Important Wetlands occur within 300km of the project area: De Gray River (140km north), Eighty Mile Beach System (220 km north), Fortescue Marshes (50km south), Karijinni (Hamersley Range) Gorges (135km southwest), Lake Disappointment (Savory Creek) System (320 km southeast), Lake Dora (Rudall River) System (300 km east), Leslie (Port Hedland) Saltfields System (215km north-northwest), Mandora Salt Marsh (270km north-northeast), Mt Bruce Coolibah - Lignum Flats (190km northeast) and the Pools of the Durba Hills (325km southeast) (Map 5).

The Fortescue Marshes (124,932ha) form the largest ephemeral wetland in the Pilbara and provides foraging and breeding habitat for large numbers of migratory waterbirds (Spectrum Ecology 2022) (DBCA 2018). Following inundation, two major inland wetlands (Fortescue Marshes and Mandora Marsh) located within 300km of the project area can cumulatively support up to 1 million individual waterbirds (Halse *et al.* 2006). These wetlands may provide stepping stones for Migratory birds transiting from the coast to the Fortescue Marshes. The Fortescue Marshes are episodically inundated, predominately as a result of rainfall associated with tropical low pressure cyclonic weather systems that generally occur between December and April (EPA 2013).

Approximately 250 km north-east of the project area is the RAMSAR listed Eighty Mile beach which includes the Mandora Salt Marsh. Eighty-mile Beach represents the greatest extent of continuous intertidal mudflat in excellent condition within the Northwest (IMCRA) bioregion (DCCEEW 2024a). In addition, Mandora Salt Marsh contains an important and rare group of wetlands within the arid Northwestern Plateau bioregion in particular the peat mound springs can be considered both bio-regionally rare and outstanding examples of this wetland type in Western Australia (DCCEEW 2024a). The Eighty-mile Beach RAMSAR site is considered one of the most important sites for stop-over and feeding by migratory shorebirds in Australia; second only to Roebuck Bay in the total number of migratory species for which it is considered internationally important (DCCEEW 2024a). Furthermore, Eighty-mile Beach represents the most important site internationally (in terms of total number of individuals) for nine species of migratory shorebird in the East Asian-Australasian flyway (DCCEEW 2024a). Mandora Salt Marsh supports the critical life stage of breeding for at least 13 species of waterbird, including large numbers of Australian pelicans and black swans (DCCEEW 2024a).



Bonney Downs Phase 1 Project Area

Vegetation association

- 18: Low woodland; mulga (Acacia aneura)
- 93: Hummock grasslands, shrub steppe; kanji over soft spinifex
- 173: Hummock grasslands, shrub steppe; kanji over soft spinifex & Triodia wiseana on basalt
- 190: Hummock grasslands, sparse shrub steppe; Acacia bivenosa & A. trachycarpa over hard spinifex, Triodia wiseana, Very poor rocky country on gneiss
- 562: Mosaic: Low woodland; mulga in valleys / Hummock grasslands, open low tree-steppe; snappy gum over Triodia wiseana

ecologia ENVIRONMENT

Project No.: 2009
Author: TM
Created Date: 10 June 2024
Coordinate System: GCS GDA 1994
Scale: 1:125,000 @A3

Map 4: Pre-European vegetation associations (Shepherd et al. 2002).

Earthstar Geographics

0 1.4 2.7 4.1 8.2 Kilometers



Bonney Downs Phase 1 Project Area

Important Wetlands

- De Grey River
- Eighty Mile Beach System
- Fortescue Marshes
- Karijinni (Hamersley Range) Gorges
- Lake Disappointment (Savory Creek) System
- Lake Dora (Rudall River) System
- Leslie (Port Hedland) Saltfields System
- Mandora Salt Marsh
- Mt Bruce Coolibah - Lignum Flats
- Pools of the Durba Hills

ecologia ENVIRONMENT

Project No.: 2009
Author: TM
Created Date: 10 June 2024
Coordinate System: GCS GDA 1994
Scale: 1:2,000,000 @A3

Map 5: Nationally Important Wetlands near the project area.

Earthstar Geographics

0 21.7 43.3 65 130 Kilometers

5.5 FAUNA HABITAT

Fauna habitat assessments were undertaken to describe and map fauna habitat types with the potential to support significant fauna species within the project area. After assessing the fauna habitat types identified, based on vegetation types, soil units, and landforms present, six broad fauna habitat types were identified within the project area: Woodland (open), Plain (stony/gibber), Plain (cracking clays), Drainage Line/River/Creek (major), Drainage Line/River/Creek (minor) and Rocky Escarpments (Ridges/Mesa/Cliffs/Outcrops/ Breakaways) (Table 14, Map 6). An additional 2.99% of the project area was mapped as Cleared, lacking suitable habitat for terrestrial vertebrate fauna.

From a local perspective, habitat features that are disjunct and provide sources of shelter, food and mesic qualities required for restricted species may be considered important. The Plain (stony/gibber) (78.44%) habitat type is the dominant feature of the project area, with widespread grazing and trampling disturbances from European cattle documented throughout these areas. This habitat is widespread at a local and regional level and is not restricted to the project area.

Permanent pools and the ephemeral inundation of Bonney Creek, Bonney Pools, the Nullagine River and minor tributaries associated with the Coongan River provide seasonal habitat for terrestrial fauna (including avifauna and bats) within the project area.

Where possible, turbines and associated infrastructure for the proposed pilot windfarm are planned to be installed within cleared areas in the vicinity of the Fortescue's Nullagine Mine to minimise impacts to native vegetation and fauna habitat.

Table 14: Fauna habitats in the project area.

Broad habitat type	Area (ha)	%	Vegetation description	Habitat description	Representative photos
Woodland (open)	59.83	0.33	Open *Acacia aptaneura* (mulga) woodland over scattered mixed shrubs over scattered tussock grassland and herblands on red soil, sandy loam plains and stony substrates	Mulga woodlands are only found in small, isolated patches within the project area usually associated with alluvial deposits. Some areas of the mulga woodland habitat were burnt at the time of survey. Refuges for fauna include woody debris and substrates conduce for burrowing by monitor species and trap door spiders. Widespread habitat degradation associated with grazing and trampling by European cattle was recorded within this habitat type, particularly in areas of mulga woodland adjacent to water sources.	
Plain (stony/gibber)	14,300.47	78.44	Low open *Eucalyptus leucophloia* woodland over *Acacia bivenosa* and *Acacia inaequilatera* scattered shrubs over *Triodia longiceps, Triodia* epactia, *Triodia brizoides, Triodia wiseana* mid-dense hummock grassland. Some areas supporting *Acacia xiphophylla* (snakewood) tall shrubland.	Stony or stony sand on undulating plains and low rises with spinifex hummock grasslands on loam-clay with a stony mantle. Mixed *Acacia* open shrubland may be present in isolated areas. Coarse stony red clay soils provide habitat for the western pebble-mound mouse (Priority 4). The northern quoll, Pilbara leaf-nosed bat and ghost bat are known to forage in these areas. This habitat type is well represented at a local and regional scale and is not restricted to the project area.	
Plain (cracking clays)	1,839.18	10.09	Mid-sparse *Acacia synchronicia* and *Vachellia farnesiana* shrubland over low *Aristida latifolia*, *Cynodon convergens*, *Rhynchosia minima* tussock grassland/ herbland.	Basalt upland gilgai plains associated with the Wona Landsystem supporting scattered shrubs over grasses and herbs. Provides quality foraging for granivores including cockatoos and budgerigars with large flocks recorded foraging in this habitat type. Provides habitat for the Priority 4 (DBCA) Northern short-tailed mouse (*Leggadina lakedownensis*). Habitat degradation associated with grazing and trampling by European cattle.	

Broad habitat type	Area (ha)	%	Vegetation description	Habitat description	Representative photos
Rocky Escarpments (Ridges/Mesa/Cliffs/ Outcrops/Breakaways)	666.12	3.65	Mixed shrubland of *Acacia* sp., *Senna* sp., *Hakea* sp., *Eremophila*, *Ptilotus obovatus*, *Paspalidium clementii* and *Solanum lasiophyllum* over hummock grassland of *Triodia* sp.	Rocky features from small-scale rock face to large protruding rocks/boulders and mesas, usually associated with the tops or bases of ridgelines, stony hills and rises. Ridgelines, cliff, breakaways, boulders, crevices and caves within this habitat type provide shelter, denning and roosting habitat for species such as the northern quoll, Pilbara leaf-nosed bat and peregrine falcon. This habitat type is well represented at a local and regional scale and is not restricted to the project area.	
Drainage Line/River/Creek (major)	456.71	2.51	Open woodland of *Eucalyptus camaldulensis* and *Eucalyptus victrix* over and *Acacia coriacea* subsp. *pendens* over mixed *Cenchrus* and *Triodia* low tussock and hummock grassland.	Generally encompassing major drainage lines and associated tributaries, this habitat type feature deeply incised drainage channels and a higher density of vegetation than surrounding areas. Substrates of gravelly, sand or rocks on clay/loam soils provide quality burrowing substrates. Scattered trees and shrub species provide habitat for birds and shelter for species using this habitat for dispersal (northern quoll, Pilbara leaf-nosed bat, ghost bat and Pilbara olive python). This habitat type is well represented at a local and regional scale and is not restricted to the project area.	
Drainage Line/River/Creek (minor)	362.35	1.99	Scattered *Eucalyptus leucophloia* subsp. *leucophloia* over *Acacia pruinocarpa* over *Triodia epactia*, *Eriachne lanata* low hummock/tussock grassland.	This habitat type features shallow incised drainage channels and a higher density of vegetation than surrounding areas. Substrates of gravelly, sand or rocks on clay/loam soils supports scattered trees and shrubs. This habitat type is well represented at a local and regional scale and is not restricted to the project area.	
Cleared	546.21	2.99	N/A	Anthropogenic clearing with little to no vegetation.	N/A
Total	18230.87	100			

119.75°E
119.8333°E
119.9167°E
120°E
22°S
22.0833°S
22.1667°S
22.25°S
333°S

Bonney Downs Phase 1 Project Area

Habitat type

- Cleared
- Drainage Line/River/Creek (major)
- Drainage Line/River/Creek (minor)
- Plain (Cracking clays)
- Plain (stony/gibber)
- Rocky Escarpments (Ridges/Mesa/Cliffs/Outcrops/Breakaways)
- Woodland (open)

ecologia ENVIRONMENT

Project No.: 2009
Author: TM
Created Date: 10 June 2024
Coordinate System: GCS GDA 1994
Scale: 1:135,000 @A3

Map 6: Fauna habitat types identified within the project area.

Earthstar Geographics

0 1.5 3 4.5 8.9 Kilometers

N

6 RESULTS AND DISCUSSION

A risk assessment overview undertaken by Biosis Research (2006) on behalf of the Department of Environment and Heritage (DEH) identified a number of key species/groups which should be considered in the context of proposed wind farm sites.

Key species/groups which require consideration include:

- data deficient significant avifauna species,
- uncommon or infrequently recorded species,
- species which occur at relatively low densities,
- waders and seabirds,
- species that are active at night,
- all bats,
- larger birds (e.g. eagles, cranes, swans, geese and pelicans).

Several of these groups are important considerations for wind farm assessments due to existing knowledge gaps and a poor understanding of flight demographics and strike risk (Biosis Research 2006). Additionally, some groups (e.g. bats, raptors and large waterbirds) exhibit behavioural and flight characteristics that are likely to increase the risk of utilising airspace in contact with wind turbines and may therefore experience increased strike risk (Roemer *et al.* 2011; Sandhu *et al.* 2022; Kamata *et al.* 2023).

6.1 AVIFAUNA ASSEMBLAGE

Atlas of Living Australia and Birdlife Australia database searches identified 200 and 149 bird species respectively as potentially occurring within the project area. One hundred and five avifauna taxa have been recorded at Bonney Downs by *ecologia* across all surveys (detailed, targeted and BBSUS) conducted in 2023 and 2024. The species assemblage recorded to date represents between 53-71.1% of avifauna taxa with the potential to occur within the project area based on database searches. A site-by-species matrix is provided in Appendix D**.**

A total of 95 avifauna taxa have been recorded during the BBSUS, with a further 10 species recorded incidentally (Appendix D). The majority of species recorded during BBSUS belong to the Passeriformes order (perching birds) (46 species); however, these species are typically low-flying, canopy-dwelling species which are unlikely to be at risk of collision with turbines. At-risk species recorded during BBSUS included raptors (11 species) and waterbirds (21 species). A total of 2077 avifauna observations were recorded during the three BBSUS. The number of species recorded and total number of avifauna records documented in February and March 2024 was higher than that recorded in October 2023 (Table 15), which is likely to be attributable to above-average rainfall conditions prior to the surveys and presence of increased surface water, attracting nomadic species.

A single significant avifauna species, the grey falcon (*Falco hypoleucos* [Vulnerable EPBC Act and BC Act]) has been recorded within both the project area and broader BBSUS area. Further discussion regarding this species is provided in Section 6.3.1.1.

Table 15: Summary of avifauna observations made during BBSUS.

Year	Month	Season	Total number of observations (all species)	Total number of species observed	Number of grey falcon observations	Maximum Number of grey falcons observed
2023	October	Spring	578	67	1	2
2024	February	Summer	663	78	1	1
2024	March	Autumn	836	76	0	0
		Total	2077	221	2	3

6.1.1 Raptors

According to database search results, 20 raptor species, comprised of three families, occur within 40 km of the project area.

Eleven raptor species, representing two families (Falconidae and Accipitridae), were recorded during BBSUS at Bonney Downs. Ten species were recorded during set-time surveys (Table 16) and one additional species (square-tailed kite) was recorded incidentally.

Table 16: Raptor observations recorded during set-time surveys.

Common name	Scientific name	Number of observations	Minimum number of birds observed	Maximum number of birds observed.
Whistling kite	*Haliastur sphenurus*	22	1	2
Brown falcon	*Falco berigora*	18	1	3
Grey falcon	*Falco hypoleucos*	2	1	2
Wedge-tailed eagle	*Aquila audax*	11	1	2
Nankeen kestrel	*Falco cenchroides*	41	1	2
Spotted harrier	*Circus assimilis*	16	1	2
Collared sparrowhawk	*Accipiter cirrocephalus*	6	1	1
Australian hobby	*Falco longipennis*	3	1	1
Brown goshawk	*Accipiter fasciatus*	1	1	1
Black-shouldered kite	*Elanus axillaris*	5	1	1

Figure 3 provides indicative flight patterns demonstrated by the 10 raptor species recorded during set-time surveys. Raptors observed during set-time surveys appear to be most active during morning and afternoon surveys; however, midday observations have also been recorded for several species. Figure 4 outlines the maximum flight heights recorded for raptors observed during set-time surveys, with further information regarding flight heights and behaviours provided in Table 19. Figure 5 summarises the horizontal distance of raptors from the observer at first observation, with most raptors first observed at starting distances less than 500m from the survey site. Generally, larger species are likely to be first observed at further distances than smaller raptors; however, this is not always the case.

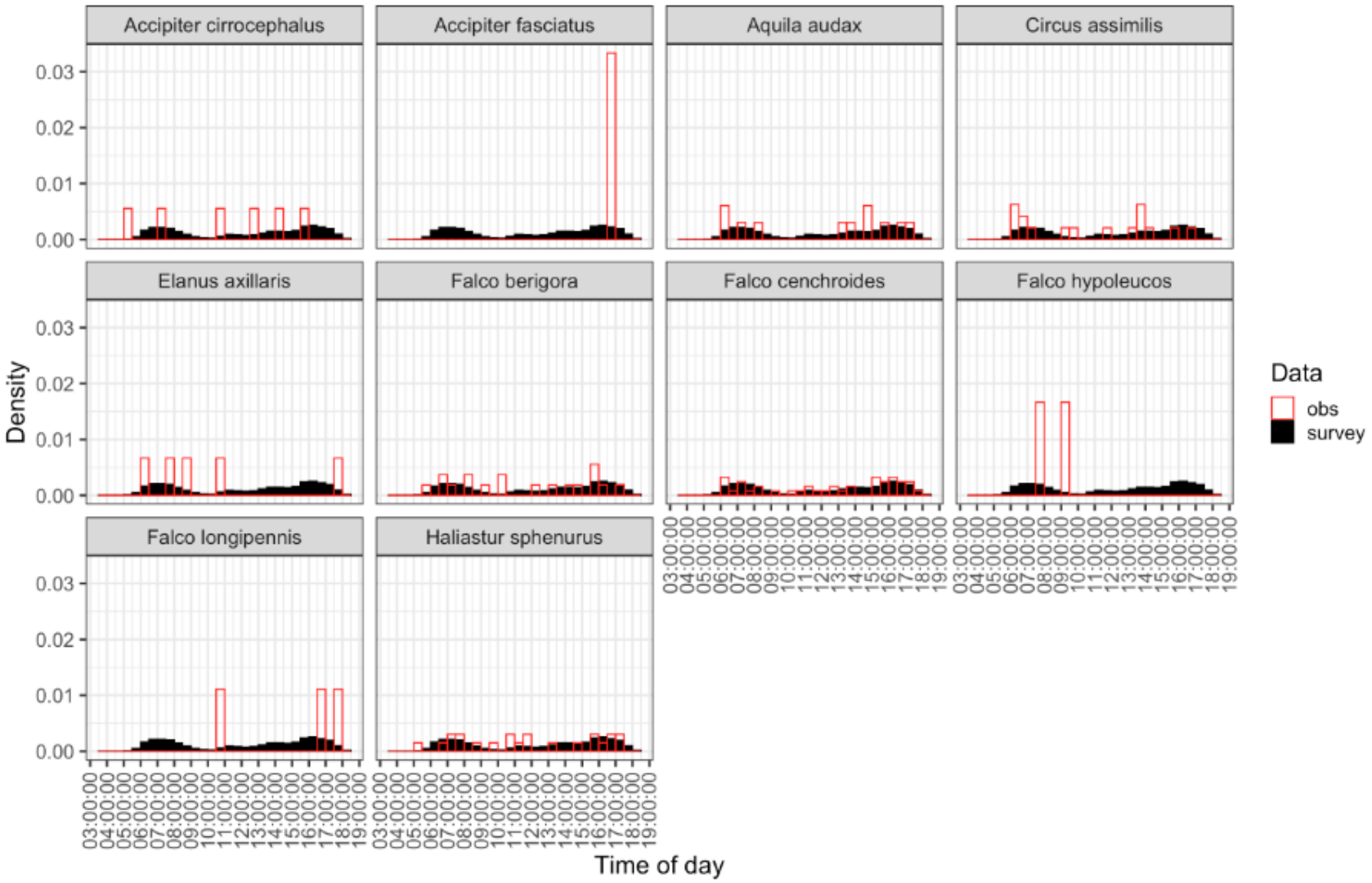


Figure 3: Raptor activity patterns and densities recorded during set-time surveys.

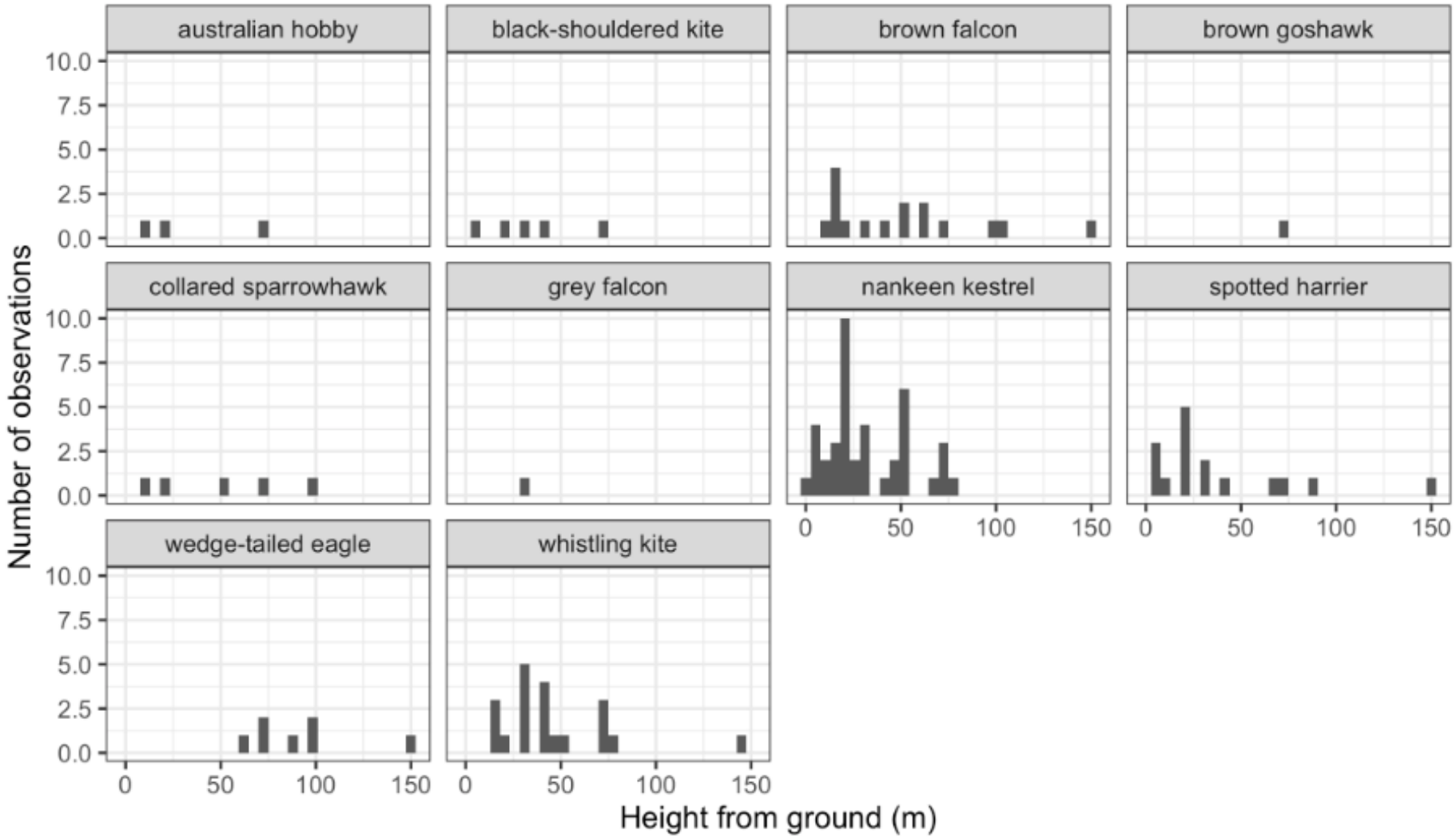


Figure 4: Raptor flight heights recorded during set-time surveys. Note: RSA = 90m -290m.

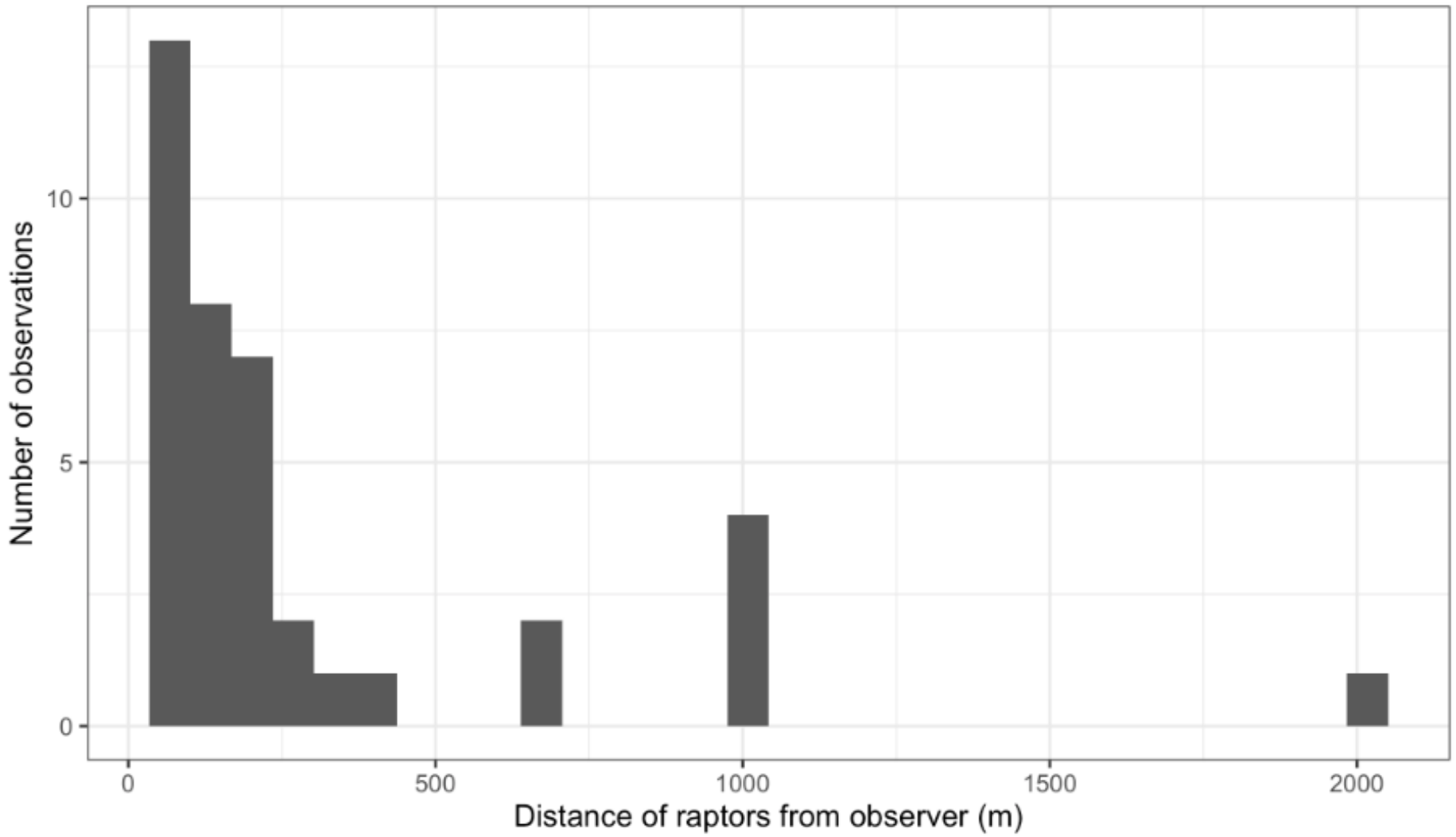


Figure 5: Distance of raptor observations from observer (at the time of first observation).

6.1.1.1 Grey falcon (*Falco hypoleucos*) – Vulnerable EPBC Act and BC Act

The grey falcon has been recorded at set-time survey sites on two occasions (Table 15) and has been incidentally recorded on nine occasions (Table 17, Map 7). Further discussion regarding incidental and systematic grey falcon records is provided below.

Incidental observations

Based on the results of surveys completed to date, it is apparent that the grey falcon utilises habitat within both the project area and surrounds. The species has been consistently recorded at Bonney Downs across all seasons and the species is considered to represent a potential collision risk given the spatial extent of records obtained to date. Although incidental records may be used to inform spatial distribution patterns and habitat usage, these records cannot be used to calculate an activity rate for the species as they may be influenced by observer biases and are not suitable for inclusion in CRM analysis.

Although incidental observations cannot be utilised as part of the CRM analysis, these records may provide some insights into grey falcon behaviour and site utilisation patterns in the absence of systematic observations. Opportunistic grey falcon records on site have recorded a variety of behaviours, including perching, standing in water and consumption of prey. Flight observations have included a variety of flight behaviours, including soaring, gliding and directional flight. Flight heights recorded during incidental observations range from 0m (ground level) to 150m, with three incidental observations (33.33%) involving birds flying within the proposed RSA height. Incidental grey falcon observations have been recorded at all times of day, with four observations recorded in the morning, three observations recorded around midday and two observations recorded in the afternoon. Grey falcon records have been obtained inside and outside of the project area, with observations recorded in a range of habitat types.

Table 17: Summary of incidental grey falcon observations.

Year	Month	Season	Number of grey falcon observations	Minimum number of birds observed	Maximum number of birds observed per observation
2023	May	Outside survey period (detailed fauna survey)	2	2	2
2023	July	Outside survey period (targeted survey)	3	1	2
2024	February	Summer	2	1	1
2024	March	Autumn	1	1	1
2024	April	Autumn	1	2	2

Systematic observations

Currently too few systematic grey falcon observations have been recorded to undertake accurate analysis of spatial and temporal patterns of activity across the site. Further surveys will hopefully collect sufficient data to understand spatial patterns, seasonal patterns and daily activity patterns.

If similar in behaviour and detectability, other raptor taxa recorded during BBSUS at Bonney Downs may provide useful information for CRM (such as typical distances and heights of observations). These species may be useful as proxy species for the grey falcon; however, proxy data would only be suitable for quantification of detection distances and flight height profiles. Flight density calculations and predicted collision rates would need to be based on grey falcon observations. Further discussion on CRM suitability and limitations with regards to the grey falcon is provided in Section 6.4.

6.1.2 Waterbirds

According to database search results, 67 waterbird species, comprised of 18 families, occur within 40 km of the project area.

Twenty-one waterbird species, comprised of nine families, have been recorded during BBSUS at Bonney Downs. Seventeen species were recorded at set-time survey sites, with an additional four species recorded incidentally. As no Migratory birds have been recorded on site to date, detailed analysis and discussion regarding CRM feasibility has not been included as part of this report.

Seasonal movements and species-specific flight heights for waterbird and migratory species are poorly known and literature is not widely available for every species. Additionally, these species typically spend extended periods of time foraging on-ground at waterbodies. The flight height data collected during surveys may not accurately reflect species-specific flight height capability.

Further information regarding waterbird species is detailed in Table 19.

6.1.3 Nocturnal Birds

A total of seven nocturnal bird species have been recorded at Bonney Downs through a combination of incidental sightings, nocturnal spotlighting and motion camera trap images. Nocturnal species recorded on site include three owls (southern boobook, barking owl and eastern barn owl), tawny frogmouth, bush stone-curlew, Australian owlet nightjar and spotted nightjar. Although these species are active at night and therefore represent a key group for consideration during wind farm projects, none of these species are known to fly at heights at (or near) the proposed RSA height. These species have been assessed to represent a low strike-risk group and are not discussed in further detail.

6.1.4 Flight Heights

Flight height analysis was undertaken for systematic raptor and waterbird observations recorded during set-time surveys. Maximum flight heights recorded were pooled into 20m intervals and plotted number of flights recorded in each height range for waterbirds (Figure 6) and raptors (Figure 7). Data analysis shows that the majority of flights (75.1%) recorded during set-time surveys were undertaken at heights below 60m, 13.5% of flights were undertaken at heights between 60-80m and 7.3% of flights were undertaken at heights between 80-100m (Table 18). Only 4.1% of raptor flights recorded during set-time surveys were undertaken at heights of greater than 100m (Table 18).

No waterbirds were recorded flying at heights greater than 100m during set-time surveys (Table 18) though the pacific black duck, black-fronted dotterel, white-faced heron and white-necked heron were recorded flying at heights of up to 100m during set-time surveys (Table 18). Five species of raptor were recorded flying at heights greater than 100m during set-time surveys: the brown falcon, grey falcon (VU), spotted harrier, wedge-tailed eagle and the whistling kite (Table 18). Of these, all species besides the grey falcon were recorded flying at heights up to 160m (Table 18).

Table 18: Flight height intervals recorded for raptor and waterbird observations during set-time surveys.

Species	Maximum height recorded (m)										Sum	Maximum # flights within RSA	% flights within RSA
	0-20	21-40	41-60	61-80	>70	>80	81-100	>100	101-120	141-160			
Waterbird													
Australasian darter	3			1							4	1	25
Australasian grebe	2										2	0	0
Australian wood duck	1										1	0	0
Black-fronted dotterel	14	1					4				19	4	21.05
Great egret		2									2	0	0
Grey teal	4			2							6	2	33.33
Hardhead				1							1	1	100
Hoary-headed grebe	1										1	0	0
Nankeen night heron	1										1	0	0
Pacific black duck	8			1			1				10	2	20
Pink-eared duck	1										1	0	0
Plumed whistling duck	1										1	0	0
Straw-necked ibis	2										2	0	0
White-faced heron	6	6		1			1				14	2	28.57
White-necked heron	1	5		1			1				8	2	25
Total	45	14	0	7	0	0	7	0	0	0	73	14	19.18
Raptor													
Australian hobby	2			1							3	1	33.33
Black-shouldered kite	2	1	1	1							5	1	20
Brown falcon	6	2	4	1			1		1	1	16	4	25
Brown goshawk		1									1	0	0
Collared sparrowhawk	2		1	1			1				5	2	40

Species	Maximum height recorded (m)										Sum	Maximum # flights within RSA	% flights within RSA
	0-20	21-40	41-60	61-80	>70	>80	81-100	>100	101-120	141-160			
Grey falcon		2						1			3	3	33.33
Nankeen kestrel	18	9	8	5		1					41	6	14.63
Spotted harrier	9	3		2			1			1	16	4	25
Wedge-tailed eagle			1	2	2		3	2		1	11	10	90.91
Whistling kite	4	7	4	4						1	20	5	25
Total	43	24	19	17	2	1	6	3	1	4	120	36	30
Percentage of total flights	45.6	19.7	9.8	12.4	1	0.5	6.7	1.6	0.5	2.1	100	50	41.67

Green shading indicates flights below RSA (<80m), orange represents potential strike risk and red shading indicates flights within RSA (80-290m).

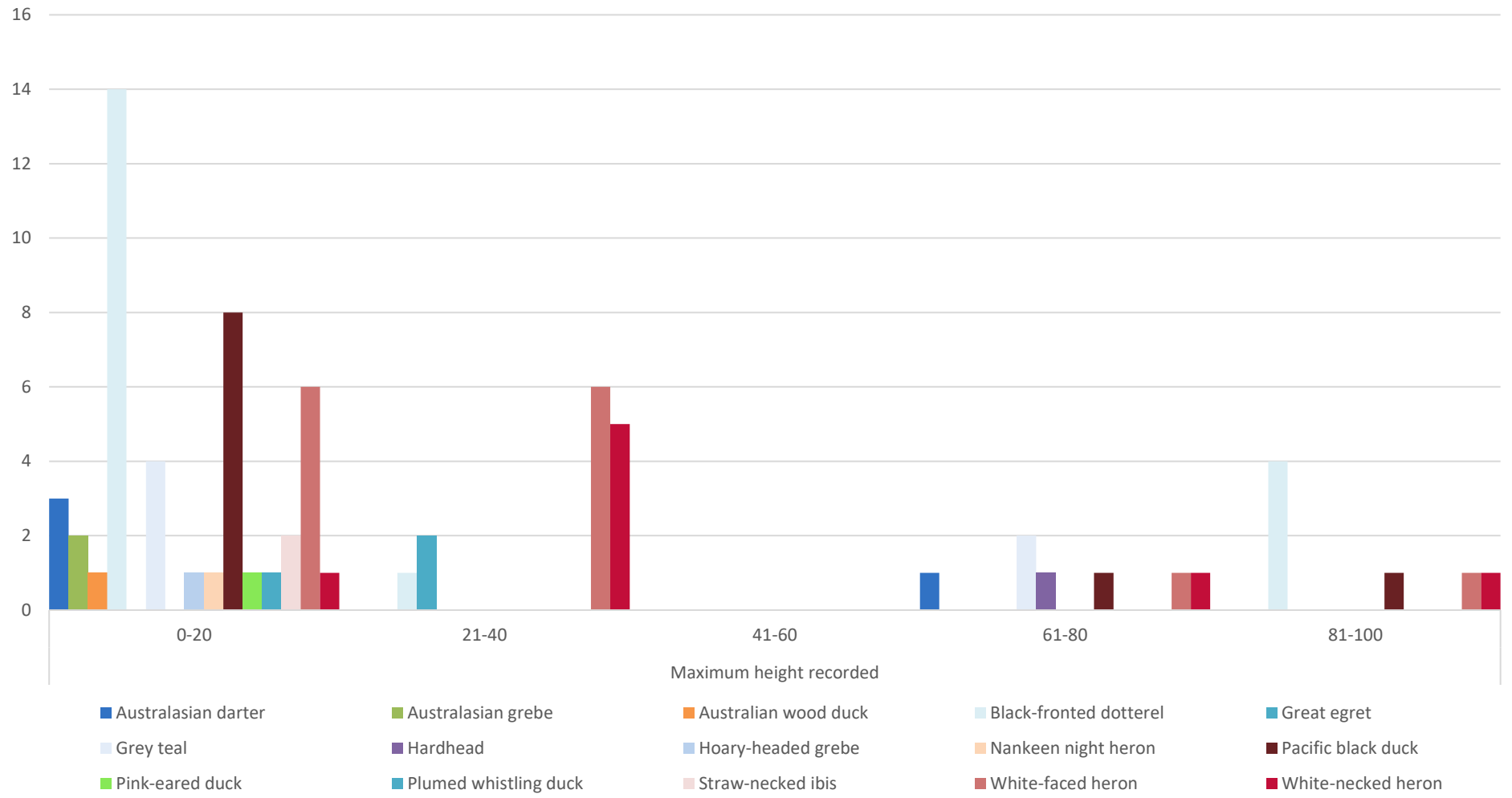


Figure 6: Maximum flight heights recorded for waterbirds recorded during set-time surveys.

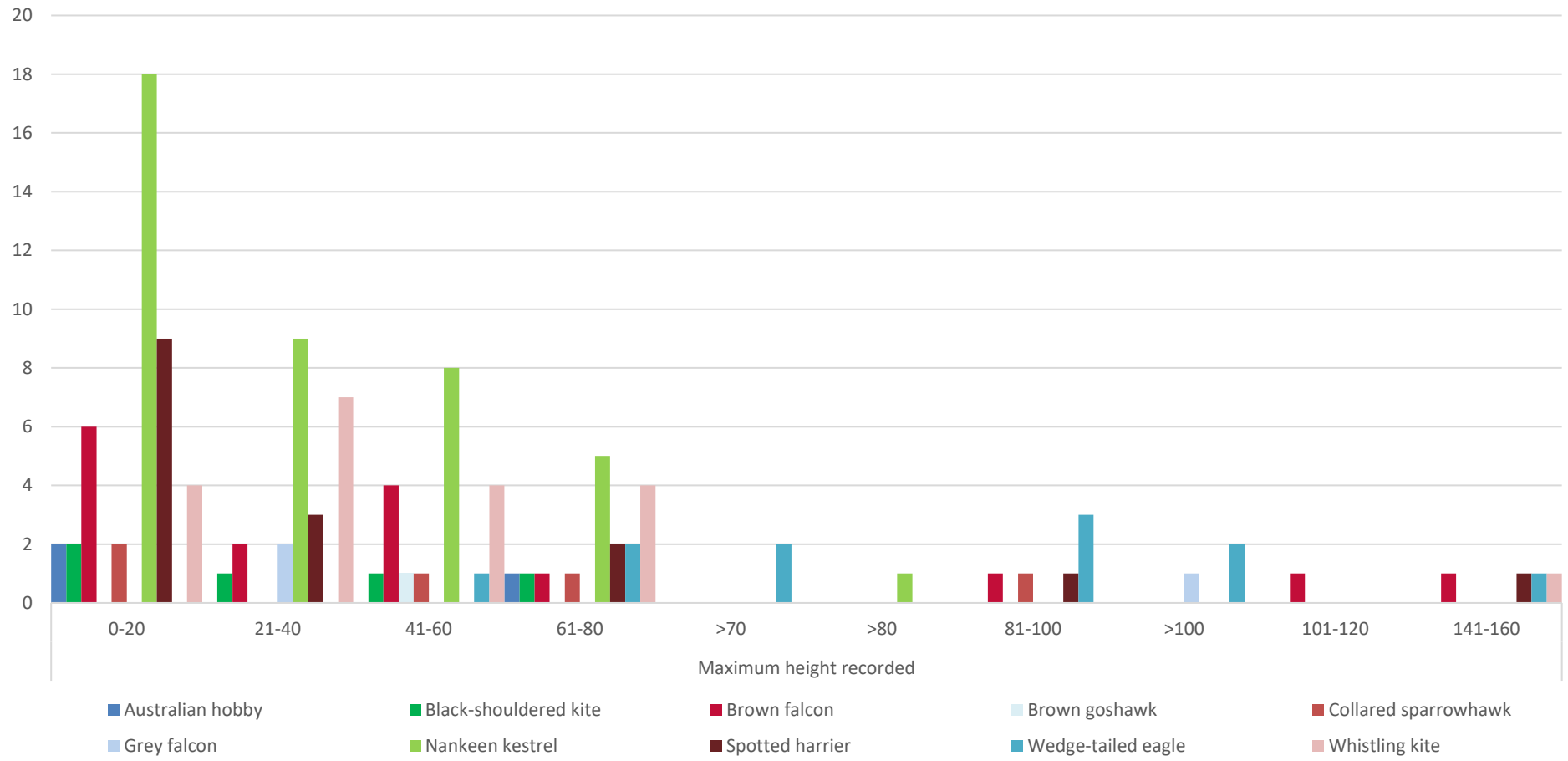


Figure 7: Maximum flight heights recorded for raptors during set-time surveys.

Table 19: Avifauna recorded during BBSUS, habitat preferences and flight demographics.

Common name	Taxon	Recorded		Habitat	Presence	Site use	Movement and flight paths	Soaring	Flocking
		BBSUS	Incidental						
Water Birds									
Anatidae									
Australian wood duck	*Chenonetta jubata*	X		Grasslands, swamps, rain pools, dams, irrigation channels, pastureland. Predominantly freshwater habitats, sometimes coastal saltmarsh.	Ongoing/ migratory/ transit	Foraging/ transit	Dispersive, migratory	Yes	Yes
Black swan	*Cygnus atratus*		X	Coastal and inland, fresh, brackish or wetlands	Ongoing/ migratory/ transit	Foraging/ transit	Dispersive, fly at night	Yes	Yes
Grey teal	*Anas gracilis*	X	X	Most terrestrial wetlands, including freshwater and saltwater, irrigation, dams, sewage ponds, lakes, reservoirs, rivers, saltmarshes, tidal reaches.	Ongoing/ migratory/ transit	Foraging/ transit	Breeds year-round in suitable conditions and habitat, dispersive with climatic changes	Yes	Yes
Hardhead	*Aythya australis*	X	X	Most terrestrial wetlands, predominantly deep freshwater lakes, swamps and creeks. Occasionally lagoons, salt lakes and mangrove swamps.	Ongoing/ migratory/ transit	Foraging/ transit	Breeding year-round in suitable conditions, dispersive with climatic changes.	Yes	Large flocks
Pacific black duck	*Anas superciliosa*	X	X	Fresh and saltwater wetlands, deep and shallow waterbodies, pastures, mudflats, broad habitat tolerance.	Ongoing/ migratory/ transit	Foraging/ transit	Breeding year-round in suitable conditions, dispersive with climatic changes.	Yes	Small to large flocks
Pink-eared duck	*Malacorhynchus membranaceus*	X	X	Terrestrial wetlands, preferring shallow turbid water, including sewage ponds, irrigation, but typically on floodwater plains. Occasionally brackish or saltwater shallow habitats.	Ongoing/ migratory/ transit	Foraging/ transit	Breeding year-round in suitable conditions, highly dispersive with climatic changes, nomadic.	Yes	Small to large flocks
Plumed whistling duck	*Dendrocygna eytoni*	X		Open terrestrial freshwater wetlands including swamps, creeks, lagoons, sewage ponds, floodwaters Less common in heavily wooded areas.	Migratory/ transit	Foraging/ transit	Migratory, flock from south to northern inland Australia during wet season to breed.	Yes	Yes
Anhingidae									
Australasian darter	*Anhinga novaehollandiae*	X		Prefer deep terrestrial waterbodies, including swamps, lakes, rivers, estuaries. Also sheltered coastal waters, unaffected by levels of vegetation.	Ongoing/ transit	Foraging/ transit	Breeding sporadic in favourable conditions, dispersive with climatic changes.	Yes	No
Ardeidae									
Great egret	*Ardea alba*	X		Range of terrestrial habitats, preference for permanent waterbodies on floodplains. Also, lakes, flooded pasture, irrigation, sewage and dams, mangroves, saltmarsh, estuaries and tidal reaches.	Migratory/ transit	Foraging/ transit	Dispersive	Yes	Yes
Nankeen night heron	*Nycticorax caledonicus*	X	X	Estuarine and terrestrial habitats. Roosts in dense cover during the day, commonly trees or large shrubs near waterbodies. Prefers permanent waterbodies with wooded edges, also utilises flooded grasslands and watercourses to forage, recorded in ornamental parks in urban settings.	Ongoing/ transit	Foraging/ transit	Nomadic, sedentary in suitable conditions, nocturnal	Yes	No
White-faced heron	*Egretta novaehollandiae*	X	X	Occupies a wide variety of terrestrial and coastal habitat, will utilise most waterbodies.	Ongoing/ transit	Foraging/ transit	Breeding and movements variable with climate events	Yes	Small flocks
White-necked heron	*Ardea pacifica*	X	X	Occupies a wide variety of terrestrial and coastal habitat, will utilise most waterbodies.	Ongoing/ transit	Foraging/ transit	Breeding and movements variable with climate events	Yes	Small flocks
Charadriidae									
Black-fronted dotterel	*Elseyornis melanops*	X	X	Freshwater swamps, lakes, dams.	Ongoing/ transit	Foraging/ transit	Mostly sedentary	Yes	Small flocks
Red-kneed dotterel	*Erythrogonys cinctus*		X	Coastal and inland, fresh, brackish or shallow wetlands.	Ongoing/ transit	Foraging/ transit	Variable, in response to climate events, may move inland after wet season	Yes	Small to large flocks
Pelecanidae									
Australian pelican	*Pelecanus conspicillatus*		X	Estuarine, marine and terrestrial wetlands, ephemeral wetlands in the arid region, may gather in large numbers on open floodplains.	Ongoing/ transit	Foraging/ transit	Breeding and movements variable with climate events	Yes	Yes
Phalacrocoracidae									
Little black cormorant	*Phalacrocorax sulcirostris*	X		Large range of terrestrial and coastal wetlands, deep waters favoured.	Ongoing/ transit	Foraging/ transit	Dispersive with climate events	Yes	Yes
Little pied cormorant	*Microcarbo melanoleucos*	X	X	Large range of terrestrial and coastal wetlands, deep waters favoured.	Ongoing/ transit	Foraging/ transit	Dispersive with climate events	Yes	Yes
Podicipedidae									
Australasian grebe	*Tachybaptus novaehollandiae*	X		Predominantly found large range of freshwater wetlands, rarely saline or brackish. Requires fringing or emergent vegetation for breeding.	Ongoing/ transit	Foraging/ transit/ breeding	Movements poorly known	Yes	Yes
Hoary-headed grebe	*Poliocephalus poliocephalus*	X		Large range of terrestrial, estuarine and brackish waterbodies. Prefers permanent waters for breeding, with fringing and emergent vegetation.	Ongoing/ transit	Foraging/ transit / breeding	Movements poorly known	Yes	Yes
Recurvirostridae									
Black-winged stilt	*Himantopus himantopus*		X	Fresh and saltwater wetlands, intertidal mudflats.	Ongoing/ transit/ migratory (some populations)	Foraging/ transit	Dispersive or sedentary with climate events	Yes	Yes
Threskiornithidae									
Straw-necked ibis	*Threskiornis spinicollis*	X	X	Occurs on terrestrial wetlands, grasslands, pasturelands. Sometimes permanent or ephemeral arid wetlands.	Ongoing/ transit	Foraging/ transit	Locally sedentary or dispersive in response to climate	Yes	Yes

Common name	Taxon	Recorded		Habitat	Presence	Site use	Movement and flight paths	Soaring	Flocking
		BBSUS	Incidental						
Raptors									
Accipitridae									
Black-shouldered kite	*Elanus axillaris*	X	X	Prefers open grasslands, open and remnant woodlands, pastureland and floodplains. Avoids dense woodland and shrubland.	Ongoing and/or transit	Foraging/ transit / breeding	Mostly sedentary, drought and rodent plagues can lead to dispersal.	Yes	No
Brown goshawk	*Accipiter fasciatus*	X		Open woodland and forest, Acacia shrublands, waterholes and bore swamps, pastureland	Ongoing and/or transit	Foraging/ transit / breeding	Mostly sedentary, southern residents may migrate north during winter.	Yes	No
Collared sparrowhawk	*Accipiter cirrocephalus*	X	X	Open woodlands and forest, tall shrublands, wetlands, swamps, plantations.	Ongoing and/or transit	Foraging/ transit / breeding	Mostly sedentary	Yes	No
Spotted harrier	*Circus assimilis*	X	X	Grasslands and pasturelands, open woodlands, tall shrublands, vegetated swamps.	Ongoing and/or transit	Foraging/ transit / breeding	Mostly sedentary, nomadic and dispersive in response to climate events	Yes	No
Square-tailed kite	*Lophoictinia isura*		X	Occupies open woodland and forest, Mulga woodland.	Migratory/ transit	Foraging/ transit	Mostly non-breeding migratory visitor to north Australia	Yes	No
Wedge-tailed eagle	*Aquila audax*	X	X	Woodland, scrubland, grasslands, pasturelands, riverine, saltmarsh. Common around ridges and escarpments.	Ongoing and/or transit	Foraging/ transit / breeding	Resident and dispersive	Yes	No
Whistling kite	*Haliastur sphenurus*	X	X	Open woodland and forest, Acacia shrublands, waterholes and bore swamps, pastureland.	Ongoing and/or transit	Foraging/ transit / breeding	Mostly sedentary	Yes	No
Falconidae									
Australian hobby	*Falco longipennis*	X	X	Occupies open woodland and forest, Mulga woodland.	Ongoing and/or transit	Foraging/ transit / breeding	Mostly sedentary	Yes	No
Brown falcon	*Falco berigora*	X	X	Open grassland, open woodland, pastureland, shrublands, floodplains, Mulga woodlands.	Ongoing and/or transit	Foraging/ transit / breeding	Sedentary and dispersive	Yes	No
Grey falcon (BC & EPBC Act: Vulnerable)	*Falco hypoleucos*	X	X	Inland rivers and coastal plains. Grey falcons also occupy Eucalypt woodlands, Acacia shrubland, hummock grasslands, Mulga woodlands and gibber plains.	Ongoing and/or transit	Foraging/ transit / breeding	Semi-permanent with nomadic movements, triggered by environmental conditions	Yes	No
Nankeen kestrel	*Falco cenchroides*	X	X	Open woodlands and grasslands, pasturelands, Acacia shrublands, pine plantations.	Ongoing and/or transit	Foraging/ transit / breeding	Sedentary and/or migratory	Yes	No

Note: Rows highlighted in grey contain BC and EPBC Act listed species.

6.2 BAT ASSEMBLAGE

According to ALA database search results, 17 bat species, representing six families, have the potential to occur within 40 km of the project area. A total of 11 bat taxa have been recorded at Bonney Downs to date, representing 64.7% of bat taxa potentially occurring within the local area.

Echolocation calls belonging to at least 10 bat species were recorded at fixed-point survey sites (BBSUS and detailed trapping sites) and targeted sampling locations at Bonney Downs (Table 20). Bat species recorded include the ghost bat (Megadermatidae), two species of sheath-tailed bat (Emballonuridae), three species of freetail bat (Molossidae), the Pilbara leaf-nosed bat (Rhinonycteridae) and three species of evening bats (Vespertilionidae). Additionally, the black flying fox was opportunistically recorded roosting in a large date palm in close proximity to site BB006. A site-by-species matrix for bat species recorded at Bonney Downs during each survey is provided in Appendix C.

Table 20: Bat taxa recorded at Bonney Downs.

Scientific name	Common name
EMBALLONURIDAE	
Saccolaimus flaviventris	Yellow-bellied sheath-tailed bat
Taphozous georgianus	Common sheath-tailed bat
VESPERTILIONIDAE	
Chalinolobus gouldii	Gould's wattled bat
Scotorepens greyii	Little broad-nosed bat
Vespadelus finlaysoni	Finlayson's cave bat
MOLOSSIDAE	
Chaerephon jobensis	Greater northern free-tailed bat
Austronomus australis	White-striped free-tailed bat
Ozimops lumsdenae	Northern free-tailed bat
RHINONYCTERIDAE	
Rhinonicteris aurantia (Pilbara form)	Pilbara leaf-nosed bat
MEGADERMATIDAE	
Macroderma gigas	Ghost bat
PTEROPODIDAE	
Pteropus alecto	Black flying-fox

Although not recorded to date, an additional five bat species have the potential to occur within the project area: little red flying-fox (*Pteropus scapulatus*), Hill's sheath-tailed bat (*Taphozous hilli*), pallid long-eared bat (*Nyctophilus daedalus*), lesser long-eared bat (*Nyctophilus geoffroyi*) and the northern coastal free-tailed bat (*Ozimops lumsdenae*). Three of these species either do not echolocate (little red flying-fox) or produce calls that may be masked by other bats recorded within the survey area (Hill's sheath-tailed bat, pallid long-eared bat and lesser long-eared bat). The remaining species (northern free-tailed bat) is uncommonly recorded inland and is typically found along the coast, in association with mangrove habitats. Although not recorded to date, these species have been included in the risk assessment undertaken by Specialised Zoological as they occur within the region and are known to forage or commute above the tree canopy and may therefore range within the RSA of a wind turbine if present.

An assessment of predicted collision risk was undertaken for species occurring and potentially occurring at Bonney Downs. The results of this analysis are summarised in Section 6.2.3, with the full analysis provided in Appendix C.

6.2.1 Pilbara leaf-nosed bat (*Rhinonicteris aurantia* [Pilbara form])- Vulnerable

The Pilbara leaf-nosed bat was recorded at ARU sites on 19 nights (13 sites) and three survey phases (May 2023, October 2023 and February 2024) (Table 21). Additionally, an incidental record consisting of a single echolocation sequence was recorded at 23:21:09 by the bat detector deployed at a ghost bat lure site BDGB01 in March 2024. In total, Pilbara-leaf nosed bat calls have been recorded within the project area on seven nights (six sites), with an additional 13 nights of Pilbara leaf-nosed bat records obtained from eight sites outside of the boundary of the proposed Stage 1 project area. A summary of Pilbara leaf-nosed bat detections is provided in Appendix C.

No low time calls indicative of a nearby Pilbara-leaf nosed roost site have been recorded to date, suggesting that habitat within the broader survey area is utilised intermittently for foraging and dispersal only. This conclusion is supported by the fact that the majority of echolocation records obtained to date have been associated with sites located in or adjacent to major drainage lines.

6.2.2 Ghost bat (*Macroderma gigas*) - Vulnerable

Although echolocation and social calls belonging to the ghost bat were not recorded by bat detectors deployed at detailed or BBSUS sites within the broader Bonney Downs project area, analysis by Specialised Zoological indicates the species was highly likely to have been detected by motion cameras at acoustic ghost bat lure site BDGB03 in March 2024. Although confirmatory echolocation recordings were not available for this site, identification of the species was based on the presence of an “anteriorly-directed structure resembling long ears, the broad wings and lack of a distinct tail” (Specialised Zoological 2024). Comparison of ghost bat images with other potential species occurring at the site (birds and insects) was also undertaken with further discussion provided in Appendix C.

Table 21: Summary of detections of the Pilbara leaf-nosed bat from systematic sites (Specialised Zoological 2024). Grey shading highlights records from sites located within the project area.

Site-unit	Night of	Passes	Sunset	Dusk	Dawn	Sunrise	Time of first detection	Time of last detection	Time since sunset	Time until sunrise
May 2023										
BBD01-MDSM4-02	27/05/2023	8	27/05/2023 17:25	27/05/2023 17:49	28/05/2023 6:07	28/05/2023 6:31	20:38:32	1:39:06	3H 13M 4S	4H 52M 50S
BBD02-MDSM4-03	28/05/2023	1	28/05/2023 17:25	28/05/2023 17:49	29/05/2023 6:08	29/05/2023 6:32	20:11:13	20:11:13	2H 45M 58S	10H 21M 9S
BBD06-MDSM4-07	30/05/2023	1	30/05/2023 17:24	30/05/2023 17:49	31/05/2023 6:09	31/05/2023 6:33	23:29:49	23:29:49	6H 4M 55S	7H 3M 25S
BDBAT01-MDSM4-06	28/05/2023	1	28/05/2023 17:25	28/05/2023 17:49	29/05/2023 6:08	29/05/2023 6:32	23:29:31	23:29:31	6H 4M 16S	7H 2M 51S
BDDP03-MDSM4-01	23/05/2023	1	23/05/2023 17:26	23/05/2023 17:50	24/05/2023 6:06	24/05/2023 6:30	23:25:59	23:25:59	5H 59M 32S	7H 4M 11S
BDDP06-MDSM4-05	26/05/2023	1	26/05/2023 17:25	26/05/2023 17:49	27/05/2023 6:07	27/05/2023 6:31	20:34:04	20:34:04	3H 8M 23S	9H 57M 26S
BDDP06-MDSM4-05	27/05/2023	9	27/05/2023 17:25	27/05/2023 17:49	28/05/2023 6:07	28/05/2023 6:31	19:53:28	2:01:34	2H 28M 0S	4H 30M 22S
BDDP06-MDSM4-05	28/05/2023	10	28/05/2023 17:25	28/05/2023 17:49	29/05/2023 6:08	29/05/2023 6:32	21:00:22	2:01:46	3H 35M 7S	4H 30M 36S
BDDP06-MDSM4-05	29/05/2023	21	29/05/2023 17:25	29/05/2023 17:49	30/05/2023 6:08	30/05/2023 6:32	21:13:34	1:23:40	3H 48M 30S	5H 9M 8S
BDDP07-MDSM4-04	27/05/2023	1	27/05/2023 17:25	27/05/2023 17:49	28/05/2023 6:07	28/05/2023 6:31	21:02:40	21:02:40	3H 37M 12S	9H 29M 16S
October 2023										
BDDP13-MDSM4-02	14/10/2023	1	14/10/2023 18:04	14/10/2023 18:26	15/10/2023 5:06	15/10/2023 5:29	0:21:28	0:21:28	6H 17M 24S	5H 8M 10S
BB011-MDSM4-03	16/10/2023	17	16/10/2023 18:04	16/10/2023 18:27	17/10/2023 5:05	17/10/2023 5:27	22:34:05	2:31:13	4H 29M 12S	2H 56M 42S
BB011-MDSM4-03	17/10/2023	6	17/10/2023 18:05	17/10/2023 18:28	18/10/2023 5:04	18/10/2023 5:27	21:36:50	1:45:44	3H 31M 32S	3H 41M 21S

Site-unit	Night of	Passes	Sunset	Dusk	Dawn	Sunrise	Time of first detection	Time of last detection	Time since sunset	Time until sunrise
BB036-MDSM4-07	13/10/2023	3	13/10/2023 18:03	13/10/2023 18:26	14/10/2023 5:07	14/10/2023 5:30	20:02:06	23:09:58	1H 58M 25S	6H 20M 32S
BB03-TC39-644439	15/10/2023	11	15/10/2023 18:04	15/10/2023 18:27	16/10/2023 5:05	16/10/2023 5:28	19:32:11	3:50:51	1H 27M 43S	1H 37M 55S
BB03-TC39-644439	16/10/2023	6	16/10/2023 18:04	16/10/2023 18:27	17/10/2023 5:05	17/10/2023 5:27	19:30:17	3:08:43	1H 25M 24S	2H 19M 12S
February 2024										
BB03	9/02/2024	1	9/02/2024 18:44	9/02/2024 19:08	10/02/2024 5:24	10/02/2024 5:47	20:30:37	20:30:37	1H 46M 0S	9H 17M 21S
BB13	11/02/2024	1	11/02/2024 18:43	11/02/2024 19:06	12/02/2024 5:25	12/02/2024 5:49	2:16:32	2:16:32	7H 32M 58S	3H 32M 38S
BB39	11/02/2024	2	11/02/2024 18:43	11/02/2024 19:06	12/02/2024 5:25	12/02/2024 5:49	3:04:05	3:04:27	8H 20M 30 S	2H 44M 43S

6.2.3 Flight Heights and Collision Risk Assessment

To understand the potential collision risk of bat species occurring and potentially occurring at Bonney Downs, a preliminary risk assessment was undertaken by Specialised Zoological (2024). In the absence of validated collision risk models for non-avifauna taxa, a modified generic risk matrix was utilised to provide an understanding of likely collision risk for each bat species. In the place of probability (rows), frequency of detection values (0-0.25, 0.25-0.5, 05-0.75 and 0.75-1.0) were calculated across all sites surveyed in 2023 and 2024 (Specialised Zoological 2024). In place of consequence (columns), three likelihood categories were used to classify the likelihood of the species being present above 50m in altitude (in the absence of turbines) (Specialised Zoological 2024). In order to assess the predicted presence of a species above 50m altitude, Dr Armstrong utilised his accumulated field observations to provide an indication of species behaviour (Specialised Zoological 2024). The resultant score in the matrix was then divided into three risk categories (high, medium and low) (Specialised Zoological 2024).

Frequency of detection	**Likelihood of presence above 50 metres altitude**	**Low**	**Medium**	**High**
		1	**2**	**3**
0 – 0.25	**1**	1	2	3
0.25 – 0.50	**2**	2	4	6
0.50 – 0.75	**3**	3	6	9
0.75 – 1.0	**4**	4	8	12

Risk Score	**Collision Risk**
0 – 2	Low risk
3 – 6	Medium risk
7 – 12	High risk

Three bat species (ghost bat [VU], Pilbara leaf-nosed bat [VU] and northern free-tailed bat) were assessed as having a low collision risk due to low frequency of occurrence and low-medium altitude flight (Specialised Zoological 2024) (Table 22). An additional six bat species (yellow-bellied sheath-tailed bat, Gould's wattled bat, little broad-nosed bat, Finlayson's cave bat, white-striped free-tailed bat and the greater northern free-tailed bat) were assessed to have a medium risk of collision with turbines based on predicted flight altitude and/or frequency of occurrence within the survey area (Table 22). One species (common sheath-tailed bat) was assessed as having a high collision risk based on the generally high flight altitude exhibited by the species and high frequency of detections across the site (Table 22).

Although the black flying -fox has been incidentally recorded on site, this species does not echolocate, and an accurate estimate of occurrence frequency was unable to be determined (Specialised Zoological 2024). In the absence of site-specific data, ALA records and distributions were used to inform the likely collision risk for this species (Specialised Zoological 2024). Additionally, predicted risk scores were assigned in a similar manner for five species of bat which have not been observed on site to date, but have the potential to occur (Specialised Zoological 2024). Of these species, four species (black flying-fox, little red flying-fox, Hill's sheath-tailed bat and the lesser long-eared bat) constitute a medium collision risk for the project and two species (pallid long-eared bat and northern coastal free-tailed bat) present a low collision risk for the project (if present) (Specialised Zoological 2024) (Table 23).

Further discussion regarding bats recorded in the project area and those with the potential to occur within the project area is detailed in Appendix C and Table 24.

Table 22: Calculated risk scores for bat species recorded in surveys between 2023-2024 (Specialised Zoological 2024).

Common name	Scientific name	High altitude likelihood	Altitude category	Frequency across all surveys	Frequency category	Risk score	Collision risk
MEGADERMATIDAE							
Ghost bat	*Macroderma gigas*	Medium	2	0.14	1	**2**	**Low**
RHINONYCTERIDAE							
Pilbara leaf-nosed bat	*Rhinonicteris aurantia*	Low	1	0.10	1	**1**	**Low**
EMBALLONURIDAE							
Yellow-bellied sheath-tailed bat	*Saccolaimus flaviventris*	Medium	2	0.71	3	**6**	**Medium**
Common sheath-tailed bat	*Taphozous georgianus*	High	3	0.70	3	**9**	**High**
VESPERTILIONIDAE							
Gould's wattled bat	*Chalinolobus gouldii*	Low	1	0.85	4	**4**	**Medium**
Little broad-nosed bat	*Scotorepens greyii*	Low	1	0.85	4	**4**	**Medium**
Finlayson's cave bat	*Vespadelus finlaysoni*	Low	1	0.53	3	**3**	**Medium**
MOLOSSIDAE							
White-striped free-tailed bat	*Austronomus australis*	High	3	0.07	1	**3**	**Medium**
Greater northern free-tailed bat	*Chaerephon jobensis*	Medium	2	0.55	3	**6**	**Medium**
Northern free-tailed bat	*Ozimops lumsdenae*	Medium	2	0.18	1	**2**	**Low**

Table 23: Predicted risk score and collision risk categories for Pilbara bat species with the potential to occur within the project area (based on distributions given by Milne et.al. 2023) and species recorded incidentally (black flying-fox). 'Estimated frequency' determined based on frequency on ALA occurrence records in the area (Specialised Zoological 2024).

Common name	Scientific name	High altitude likelihood	'Estimated frequency'	Risk score	Collision risk
Black flying-fox	*Pteropus alecto*	High	0.30	**6**	**Medium**
Little red flying-fox	*Pteropus scapulatus*	High	0.10	**3**	**Medium**
Hill's sheath-tailed bat	*Taphozous hilli*	High	0.20	**3**	**Medium**
Pallid long-eared bat	*Nyctophilus daedalus*	Low	0.10	**1**	**Low**
Lesser long-eared bat	*Nyctophilus geoffroyi*	Low	0.90	**4**	**Medium**
Northern coastal free-tailed bat	*Ozimops cobourgianus*	Medium	0.00	**0**	**Low**

Table 24: Bats recorded at BBSUS sites, habitat preferences and flight demographics.

Common name	Taxon	Recorded	Habitat	Presence	Site use	Movement and flight paths	Soaring	Flocking
Pteropodidae								
Black flying-fox	*Pteropus alecto*	Yes	This species will utilise a range of habitats for roosting and foraging including Melaleuca open forests, tall eucalypt forest, monsoon rainforest, mangroves and floodplains	Ongoing and/or transit	Foraging/ transit/ breeding	Nocturnal	No	No
Little red flying-fox	*Pteropus scapulatus*	No. Species does not echolocate.	This species is highly nomadic. Roosts are found among trees in wet and dry eucalypt forests, mangroves, Melaleuca and Casuarina swamps, rainforest, dense vine thickets and bamboo communities.	Ongoing and/or transit	Foraging/ transit/ breeding	Nocturnal	No	No
Rhinonycteridae								
Pilbara leaf-nosed bat (BC & EPBC Act: Vulnerable)	*Rhinonicteris aurantia* (Pilbara form)	Yes	Restricted to Pilbara region. Roosts in deep caves and mines with high temperatures and humidity and will forage in all habitat types.	Ongoing	Foraging/ transit	Nocturnal	No	No
Emballonuridae								
Yellow-bellied sheath-tailed bat	*Saccolaimus flaviventris*	Yes	Widespread across Australia. In forested areas it feeds above the canopy, but in mallee and open country it comes lower to the ground. Regular visitor to dams and waterholes. Roosts in tree hollows.	Ongoing	Foraging/ transit / roosting	Nocturnal	No	No
Common sheath-tailed bat	*Taphozous georgianus*	Yes	Roosts in the twilight zone near cave entrances in the rocky country of northern Australia.	Ongoing	Foraging/ transit / roosting	Nocturnal	No	No
Hill's sheath-tailed bat	*Taphozous hilli*	No. Calls may not be distinguished from *T. georgianus*.	Widely distributed in the semi-arid Pilbara. Typically roosts only a short distance inside the entrances of caves and mines, often in semi-daylight.	Ongoing	Foraging/ transit / roosting	Nocturnal	No	No
Vespertilionidae								
Gould's wattled bat	*Chalinolobus gouldii*	Yes	One of Australia's most cosmopolitan and adaptable bats, occurring in a wide range of habitats, including open forest, woodland, mallee, tall shrubland and dense forest. Typically roosts in tree hollows, often inside dead spouts with entrance diameter of approximately 10cm.	Ongoing	Foraging/ transit / roosting	Nocturnal	No	No
Little broad-nosed bat	*Scotorepens greyii*	Yes	Habitat includes dry grassland and woodland, sandy deserts, inland rivers, monsoon forest and paperbark swamps, Roosts in tree hollows.	Ongoing	Foraging/ transit / roosting	Nocturnal	No	No
Finlayson's cave bat	*Vespadelus finlaysoni*	Yes	Associated with rocky outcrops and hilly terrain, where caves and overhangs provide natural roost sites. Also roosts in abandoned mine shafts and adits as well as abandoned nests of fairy martins.	Ongoing	Foraging/ transit / roosting	Nocturnal	No	No
Pallid long-eared bat	*Nyctophilus daedalus*	No. Calls usually of low altitude and may be masked by clutter calls belonging to the little broad-nosed bat.	Species exhibits a disjunct distribution in the Pilbara. Locally common within restricted habitat types including monsoon forest, vine thickets, riparian areas (particularly with permanent pools) and adjoining open forests and woodlands.	Ongoing	Foraging/ transit/roosting	Nocturnal	No	No
Lesser long-eared	*Nyctophilus geoffroyi*	No. Calls usually of low altitude and may be masked by clutter calls belonging to the little broad-nosed bat.	Species is distributed throughout Australia and occupies a range of environments.	Ongoing	Foraging/ transit/ roosting	Nocturnal	No	No
Megadermatidae								
Ghost bat	*Macroderma gigas*	Yes	Prey captured on the ground or while in flight and taken to an established feeding site in a rock overhang or cave entrance. Diurnal roosting occurs in deep caves and mines and occasionally in rock fissures and boulder piles.	Ongoing	Foraging/ transit	Nocturnal	No	No
Molossidae								
White-striped free-tailed bat	*Austronomus australis*	Yes	In Western Australia, this species is known to migrate 1,200km north during winter, then return south with the onset of hot and humid summer. Roosts in large eucalypts, typically within hollow trunks.	Ongoing	Foraging/ transit / roosting	Nocturnal	No	No
Greater northern free-tailed bat	*Chaerephon jobensis*	Yes	Species occurs widely across the tropical savannas. Typically roosts in hollow tree spouts.	Ongoing	Foraging/ transit / roosting	Nocturnal	No	No
Northern free-tailed bat	*Ozimops lumsdenae*	Yes	Occupies tropical Australia, foraging over riverine habitat, floodplains and eucalypt woodland and savannah. Usually roosts in tree hollows.	Ongoing	Foraging/ transit / roosting	Nocturnal	No	No
Northern coastal free-tailed bat	*Ozimops cobourgianus*	No. Found only along Pilbara coast.	Population on Australia's west coast only recorded from mangrove stands.	Unlikely	Foraging/ transit	Nocturnal	No	No

Note: Rows highlighted in grey contain BC and EPBC Act listed species

6.3 SIGNIFICANT FAUNA

A site utilisation assessment was undertaken for 22 significant avifauna and two bat taxa identified during DBCA, Fortescue and Protected Matters database searches, taking into consideration the field survey results, habitat types identified, and the desktop survey results (Table 25).

Three significant species have been recorded at Bonney Downs, including:

- Grey falcon (*Falco hypoleucos*) – Vulnerable EPBC Act and BC Act;
- Ghost bat (*Macroderma gigas*) – Vulnerable EPBC Act and BC Act;
- Pilbara leaf-nosed bat (*Rhinonicteris aurantia* (Pilbara form)) - Vulnerable EPBC Act and BC Act.

Further discussion surrounding these species is provided in Section 6.3.1. Locations of significant avifauna and bat records are provided in Map 7.

The site utilisation assessment identified 17 significant birds which have the potential to utilise aerial habitat within the project area while transiting (Table 25). Although these species may occasionally pass over the project area, critical foraging habitat for these species does not occur within the survey area and potential occurrence is restricted to transitory occupancy only. Additionally, two significant birds (peregrine falcon [OS] and night parrot [CR/EN]) identified during database searches were assessed to have the potential to utilise habitat within the survey area for foraging, roosting and breeding despite not being recorded on site to date (Table 25). Further discussion about the peregrine falcon and night parrot is provided in Appendix F.

Two significant birds (southern whiteface [VU] and red goshawk [VU/EN]) were identified by the Protected Matters search tool as having the potential to occur within the project area based on the modelled distribution and presence of potentially suitable habitat (Table 25). These species have not been recorded within 100km of the project area and are considered unlikely to occur based on currently available data. Further discussion regarding these species is not provided as part of this report.

Table 25: Potential site use assessment for significant fauna identified through database searches (DBCA, Fortescue and Protected Matters).

Taxon	Common name	WA status	EPBC status	Number of records		Latest record	Preferred habitat type	Movements, flight and flocking behaviours	Comments	Potential site use
				DBCA	Fortescue					
BIRD										
Actitis hypoleucos	Common sandpiper	MI	MI	4	11	2020	Inland wetlands and sheltered coastal areas, utilises permanent and ephemeral wetlands.	Does not soar, seen in small flocks in Australia, non-breeding visitor, movements poorly known in Australia.	Very few records within 100km of the project area, with closest record located 27km. Most records associated with Fortescue Marsh. Critical habitat does not occur within the project area; however, species may occasionally utilise airspace above the project area during migratory flights to/from the Fortescue Marsh.	**Transitory only**
Apus pacificus	Fork-tailed swift	MI	MI	3	1	2014	Occupies low to very high airspace over varied habitat. Aerial specialist.	Flocks in low numbers to thousands, does not soar, non-breeding visitor, movements nomadic	Very few records within 100km of the project area. Closest record located 45km from the project area. Species does not utilise terrestrial habitats; however, may utilise the airspace above the project area while transiting.	**Transitory only**
Calidris acuminata	Sharp-tailed sandpiper	MI	MI	7	1	2020	Prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation.	Non-breeding visitor, does not soar, flocks in small or large groups	Closest record located 11.5km from the project area, with most records associated with Fortescue Marsh. Critical habitat does not occur within the project area; however, species may occasionally utilise airspace above the project area during migratory flights to/from the Fortescue Marsh.	**Transitory only**
Calidris ruficollis	Red-necked stint	MI	MI	2	1	2017	Edge of sheltered estuaries, beaches and salt lakes both on the mainland and on offshore islands. Occasionally occur on inland salt lakes and freshwater swamps.	Non-breeding visitor, does not soar, flocks in small or large groups	Very few records within 100km of the project area. Closest record 49km from project area, with most records associated with Fortescue Marsh. Critical habitat does not occur within the project area; however, species may occasionally utilise airspace above the project area during migratory flights to/from the Fortescue Marsh.	**Transitory only**
Charadrius veredus	Oriental plover	MI	MI	3	1	2017	Inland wetlands and sheltered coastal areas, utilises permanent and ephemeral wetlands.	Non-breeding visitor, dispersive in Australia with climate events, does not soar, flocks in small or large flocks	Very few records within 100km of the project area. Closest record 45km from project area, with most records associated with Fortescue Marsh. Critical habitat does not occur within the project area; however, species may occasionally utilise airspace above the project area during migratory flights to/from the Fortescue Marsh.	**Transitory only**
Falco hypoleucos	Grey falcon	VU	VU	18	2	2021	Resident or nomadic to most of semi-arid interior.	Semi-permanent with nomadic movements, triggered by environmental conditions, does not flock, soar	Closest database record within 6km of project area. Pair/s of birds recorded on numerous occasions during current survey. Species may utilise Drainage Line/River/Creek (major) habitat within the survey area while foraging or breeding and may overfly all habitat types.	**Permanent occupancy. Foraging, roosting, breeding (unconfirmed)**
Falco peregrinus	Peregrine falcon	OS	-	29	6	2018	Cliffs and gorges, inland drainage systems, lowland plains, *Acacia* shrublands intersected by water courses.	Sedentary and dispersive, soars at heights (<1200m), does not flock	Closest database record 20km from the project area. All existing records located south of the project area and the project area appears to be located within a region of species distribution with fewer records/less frequent sightings (based on ALA database observations). Suitable breeding and foraging habitat present within the Drainage Line/River/Creek (major) habitat type. Species not recorded during current surveys.	**Breeding, roosting and foraging**
Gelochelidon nilotica	Gull-billed tern	MI	MI	10	20	2020	The species utilises sheltered coastal seas, watered flatlands, estuaries, salt lakes, freshwater wetlands, and dams.	Australian movements not well understood, flocks in small or large groups, does not soar	Closest database record within 8km of the project area, with most records associated with Fortescue Marsh. Critical habitat does not occur within the project area; however, species may occasionally utilise airspace above the project area during migratory flights to/from the Fortescue Marsh.	**Transitory only**
Hydroprogne caspia	Caspian tern	MI	MI	2	21	2020	Occurs in sheltered seas, inlands watercourses such as estuaries, tidal creeks, near-coastal salt lakes, and brackish pools in the lower courses of rivers.	Mostly sedentary, also dispersive, flocks in small or large groups, does not soar	Closest record 42km from the project area, with all records associated with Fortescue Marsh. Critical habitat does not occur within the project area; however, species may occasionally utilise airspace above the project area during migratory flights to/from the Fortescue Marsh.	**Transitory only**
Macronectes giganteus	Southern giant petrel	MI	EN	3	0	2011	Widespread throughout the Southern Ocean, utilises offshore islands for breeding.	Partially migratory, highly dispersive, forms small groups	Recorded 100km from the project area, south of the Fortescue Marsh. Critical habitat does not occur within the project area; however, species may occasionally utilise airspace above the project area during migratory flights to/from the Fortescue Marsh.	**Transitory only**
Motacilla cinerea	Grey wagtail	MI	MI	1	0	2012	Typically occurs along freshwater habitats such as creeks and streams, however species could	Non-breeding visitor, spring to autumn, does not soar, does not flock	A single record of species identified 74km from the project area, in the vicinity of the Fortescue Marsh. Permanent occupancy of the survey area unlikely; however, species may occasionally utilise airspace above the project area during migratory flights.	**Transitory only**

Taxon	Common name	WA status	EPBC status	Number of records		Latest record	Preferred habitat type	Movements, flight and flocking behaviours	Comments	Potential site use
				DBCA	Fortescue					
							occur in any habitats during migration.			
Pandion haliaetus	Eastern osprey	MI	MI	2	0	2012	Usually associated with coastal habitats and occasional visitor to inland water bodies.	Mainly coastal, may sporadically occur inland after weather events, does not flock, soars at height	Two records of species identified >80km from project area, in the vicinity of the Fortescue Marsh. Permanent occupancy of the survey area unlikely; however, species may occasionally utilise airspace above the project area.	**Transitory only**
Pezoporus occidentalis	Night parrot	CR	EN	2	0	2005	Old, long unburnt, ring-forming *Triodia* grasslands and/or chenopod shrublands in arid and semi-arid zones.	Poorly known species	Species recorded on two occasions within 100km of the project area. Recorded 55km south-west of project area in vicinity of Fortescue Marsh and 83km northeast of the project area. Potentially suitable roosting habitat occurs within the project area, which is located within the High Priority region for night parrot surveys. No night parrot calls recorded during the current survey.	**Foraging, roosting, breeding (if present)**
Plegadis falcinellus	Glossy Ibis	MI	MI	3	5	2020	The preferred habitat is shallows and adjacent flats of freshwater lakes and swamps, but it is also found in river pools, flooded samphire, and sewage ponds.	Sporadic movements, typically north in winter, fly at height in large flocks	Closest record 42.5km from the project area, with all records associated with Fortescue Marsh. Permanent occupancy of the survey area unlikely; however, species may occasionally utilise airspace above the project area or may temporarily utilise aquatic habitat associated with Bonney Creek and Bonney Pools.	**Transitory only**
Polytelis alexandrae	Princess parrot	P4	VU	2	0	2012	Preferred habitat is lightly wooded country, including desert oak (*Casuarina decaisneana*), open mallee-spinifex and open marble gum (*Eucalyptus gongylocarpa*) woodland.	Flocks in small or large groups (<100), may fly at height, does not soar, movements poorly known, thought to be nomadic	Two records of species identified 95km from project area. Suitable habitat highly restricted within project area which generally lacks open woodland, desert oak and mallee.	**Transitory only**
Rostratula australis	Australian painted snipe	EN	EN	2	0	2012	Usually found in shallow inland wetlands that are either permanently or temporarily filled.	Rare in Western Australia, movements poorly known	Two records of species identified 70km from project area, in the vicinity of the Fortescue Marsh. Critical habitat does not occur within the project area; however, species may occasionally utilise airspace above the project area during migratory flights to/from the Fortescue Marsh.	**Transitory only**
Tringa glareola	Wood sandpiper	MI	MI	16	4	2017	Occurs most commonly in coastal, better-watered regions of the state but will visit areas of suitable habitat in the interior. Occurs around the muddy or grassy margins of freshwater wetlands, including swamps, lagoons, river pools, dams, bore overflows and sewage ponds.	Non-breeding visitor, flocks in medium sized groups, does not soar	Closest record 10km from project area. Critical habitat does not occur within the project area; however, species may occasionally utilise airspace above the project area during migratory flights to/from the Fortescue Marsh.	**Transitory only**
Tringa nebularia	Common greenshank	MI	MI	5	18	2020	Found in shallow, fresh waters (e.g. claypans, swamps, river pools) and salt waters (e.g. estuaries, samphire flats, reef flats).	May be resident or dispersive in Australia, moves at night, flocks in small or large numbers, does not soar	Closest record located 27km from project area, with most records in the vicinity of the Fortescue Marsh. Critical habitat does not occur within the project area; however, species may occasionally utilise airspace above the project area during migratory flights to/from the Fortescue Marsh.	**Transitory only**
Tringa stagnatilis	Marsh sandpiper	MI	MI	2	1	2016	Inhabit permanent or ephemeral wetlands of varying salinity, including swamps, lagoons, billabongs, saltpans, saltmarshes, estuaries, pools on inundated floodplains, and intertidal mudflats as well as sewage farms and saltworks.	Mostly summer migrant, non-breeders may be present year-round, flocks in small or large numbers	Very few records within 100km, with the closest record located 45km from project area, with most records in the vicinity of the Fortescue Marsh. Critical habitat does not occur within the project area; however, species may occasionally utilise airspace above the project area during migratory flights to/from the Fortescue Marsh.	**Transitory only**
Aphelocephala leucopsis	Southern whiteface	-	VU	0	0	?	Occupies a wide range of open woodlands and shrublands with an understorey of grasses and/or shrubs. Habitat usually dominated by *Acacia* or *Eucalyptus* on ranges, foothills, lowlands and plains.	Mostly sedentary, flocks in small groups, does not soar	No known records of species within 40km of the project area. EPBC Act Protected Matters Search identified species/species habitat occurring within study area; however, project area is located north of modelled distribution and species is considered unlikely to occur.	**Unlikely to occur**

Taxon	Common name	WA status	EPBC status	Number of records		Latest record	Preferred habitat type	Movements, flight and flocking behaviours	Comments	Potential site use
				DBCA	Fortescue					
Calidris ferruginea	Curlew sandpiper	CR	CR	0	0	?	The species utilises coastal and near-coastal waterbodies including saltmarshes, wetlands, sewage ponds and shallow estuaries.	Mostly non-breeding visitor, occasionally inland, small or large flocks	No known records of species within 40km of the project area. EPBC Act Protected Matters Search identified species/species habitat may occur within study area. Critical habitat does not occur within the project area; however, species may occasionally utilise airspace above the project area during migratory flights to/from the Fortescue Marsh.	**Transitory only**
Erythrotriorchis radiatus	Red goshawk	VU	EN	0	0	?	The preferred habitat is tall open eucalypt forest and riparian areas, including paperbark forest and gallery forests.	Movements poorly known, possibly sedentary and occasionally dispersive, does not flock, likely to soar at heights	No known records of species within 40km of the project area; however, EPBC Act Protected Matters Search identified species/species habitat may occur within study area.	**Unlikely to occur**
MAMMALS										
Macroderma gigas	Ghost bat	VU	VU	133	3	2018	Rocky habitat for roosting, will forage in all habitat types.	Nocturnal, resident, does not flock or soar	Numerous records in vicinity of project area. Closest record located 13.8km from project area. Potential roosting habitat and nocturnal refugia present within the Hills/Ranges/Plateaux and Rocky Escarpments habitat types. No echolocation or social calls recorded during BBSUS or targeted surveys; however, species recorded at ghost bat lure site BDGB03 within Drainage Line/River/Creek (major) habitat type. May forage in all habitat types.	**Foraging (confirmed), roosting/nocturnal shelter (potential)**
Rhinonicteris aurantia (Pilbara form)	Pilbara leaf-nosed bat	VU	VU	1397	0	2020	Restricted to Pilbara region. Roosts in deep caves and mines with high temperatures and humidity and will forage in all habitat types.	Nocturnal, resident, does not flock or soar	Numerous records in vicinity of project area. Closest database record located 21km from project area. Echolocation calls recorded during BBSUS, detailed and targeted surveys. No low time calls indicative of a potential roost site recorded to date and no suitable roosting caves identified within the project area. May forage in all habitat types. Known roost locations occur north of the project area in vicinity of Corunna Downs	**Foraging (confirmed)**

6.3.1 Significant Fauna Recorded

6.3.1.1 Grey falcon (*Falco hypoleucos*) – Vulnerable EPBC Act and BC Act

The grey falcon (*Falco hypoleucos*) is a stocky, elusive species endemic to mainland Australia and is the rarest of the Australian members of the *Falco* genus (Marchant and Higgins 1993); (Schoenjahn 2011b). The total population size is accepted to be <1,000 mature individuals (Schoenjahn 2011a) and as a result, this species was listed as Vulnerable under the EPBC Act in September 2019. The grey falcon is also listed as Vulnerable under the BC Act.

The grey falcon is a medium-sized raptor, with average body mass for males around 390 grams and for females around 560 grams (Schoenjahn 2011b). A sleek, grey plumaged falcon with a swift, direct flight pattern, patrolling low over groundcover below treetop level with shallow wing beats and brief glides (Morcombe 2022). Soars with wings held close to level with dark tipped primaries slightly spread to give a blunt wingtip (Morcombe 2022).

Grey falcons of all ages feed almost exclusively on birds including doves, pigeons, parrots, cockatoos and finches (Schoenjahn *et al.* 2020). Grey falcons hunt predominantly in open country, often over treeless grassland, which is also a key feeding habitat of prey species (Schoenjahn 2013) and are well known for hunting over natural and artificial water sources (Schoenjahn 2018).

The grey falcon is distributed sparsely over parts of Australia's arid and semi-arid zone with the breeding distribution of the species confined to climate zones which are unlikely to experience winter rainfall and which exhibit the highest average annual temperatures (Schoenjahn *et al.* 2020). This species occurs in low densities across inland Australia and is considered to comprise a single, monotypic population (Marchant and Higgins 1993). The species frequents timbered lowland plains, particularly acacia shrublands that are crossed by tree-lined water courses (Garnett *et al.* 2011); (Ehmann and Watson 2008); (Schoenjahn 2013). The species has been observed hunting in treeless areas and frequents tussock grassland and open woodland, especially in winter (Schoenjahn 2018); (Olsen and Olsen 1986).

Grey falcons do not build their own nests and use old stick-nests of other birds, mainly corvids and other raptors in trees or on artificial structures such as telecommunication towers and powerline poles (Schoenjahn *et al.* 2020); (Johnstone and Storr 1998). Nesting usually occurs high in the tallest trees in the area usually along watercourses or river pools (Morcombe 2022) particularly in *Eucalyptus camaldulensis* and *Eucalyptus coolabah* (Threatened Species Scientific Committee 2020). Breeding takes place between June and November with a clutch size of 2-4, a nestling number of 1-4 and a nestling period of >38 days (Schoenjahn 2013).

DBCA and Fortescue database searches indicate that a total of 20 grey falcon records have previously been documented within 100 km of the project area. Grey falcons were recorded on two occasions in May 2023, with two birds recorded soaring in the vicinity of a cattle yard at sites and two birds recorded feeding on a dead spinifex pigeon before flying to a large eucalypt. Three observations comprising between 1-2 individual birds were recorded in July 2023, one systematic observation of two birds was recorded during a set-time survey in October 2023, three observations were recorded in February 2024 (one systematic and two incidental), one incidental sighting was documented in March 2024 and one incidental record in April 2024. Based on the records obtained to date, it is likely that these observations represent one or two pairs of birds, recorded on multiple occasions. Repeated sightings of the birds suggests permanent utilisation of habitat within the project area, including Drainage Line/River/Creek (major) habitat associated with the Bonnie Downs Creek system. Drainage Line/River/Creek (major) habitat within the project area encompasses suitable breeding and foraging habitat for the species. Locations of grey falcon records collected within the project area and broader Bonney Downs survey area are shown in Map 7.

6.3.1.2 Pilbara leaf-nosed bat (*Rhinonicteris aurantia* (Pilbara form)) – Vulnerable EPBC Act and BC Act

This small insectivorous bat occurs throughout the Pilbara and adjacent upper Gascoyne regions of Western Australia (Threatened Species Scientific Committee 2016a). The species was listed under the EPBC Act as Vulnerable in April 2001 as it had undergone a substantial reduction in numbers, its geographic distribution is precarious for its survival (being limited to the Pilbara), the estimated total number of mature individuals is limited, and the number is likely to continue to decline. The Pilbara leaf-nosed bat has very restrictive habitat requirements, including caves and disused mines with hot to very hot and humid roost sites with temperatures in the 28° to 32°C range and 96% to 100% relative humidity (Armstrong 2001; Churchill 2008). During the Pilbara dry, winter months, preceding the heavy summer rains , Pilbara leaf-nosed bat colonies are thought to contract to the deepest mines and caves that maintain microclimates suitable for roosting (Armstrong 2001; van Dyck and Strahan 2008b; Bullen and McKenzie 2011). During the hotter wetter and more humid summer months, the species has a greater ability to disperse through the landscape. The Pilbara leaf-nosed bat has been observed foraging in a variety of habitats including *Triodia* hummock grasslands covering low rolling hills and shallow gullies, with scattered *Eucalyptus camaldulensis* along the creeks (DoE 2023). This species are most commonly encountered over small pools of water in rocky gullies and gorges (DoE 2023).

Echolocation calls of the Pilbara leaf-nosed bat have been recorded at 15 sites (14 systematic and one incidental) to date, with detections recorded on 20 nights. The Pilbara leaf-nosed bat has been recorded at six sites within the Bonney Downs Stage 1 project area, with records obtained from an additional eight sites across the broader Bonney Downs area (Map 8). The species was assigned a low collision risk rating by Specialised Zoological based on the low frequency of occurrence throughout the survey area and low likelihood of flight activity above 50m (Specialised Zoological 2024). Call patterns recorded to date do not indicate the presence of a nearby roost, with no low time calls recorded at or near civil twilight during any survey phase. Therefore, usage of habitat types within the project area appears to be restricted to foraging and dispersal activities only.

6.3.1.3 Ghost bat (*Macroderma gigas*) - Vulnerable EPBC Act and BC Act

The ghost bat was historically distributed across much of Australia but now has a fragmented although widespread distribution restricted to northern Australia (Threatened Species Scientific Committee 2016b). Following European settlement, the distribution of this species contracted northward with arid zone populations undergoing the greatest contractions (Threatened Species Scientific Committee 2016b). Ghost bat populations are highly structured and are considered to be genetically distinct at both local and regional scales (Threatened Species Scientific Committee 2016b).

The ghost bat is the largest microchiropteran bat in Australia, is strictly carnivorous and captures its prey mainly on the ground before returning to an established feeding site to devour its catch (Van Dyck and Strahan 2008a). The diet of this species includes amphibians, reptiles, birds, small terrestrial mammals, insects and other bats (Van Dyck and Strahan 2008a). Unlike other microchiropterans, the ghost bat does not continuously call when in flight and instead uses its eyes and ears to scan for prey (Van Dyck and Strahan 2008a). Females reach reproductive maturity between two and three years of age (Hoyle *et al.* 2001).

Preferred roosting habitat in the Pilbara includes caves beneath bluffs of low, rounded hills composed of Marra Mamba geology, and granite rock piles. Ghost bats have also been known to roost in large colonies within sandstone caves, under boulder piles and in abandoned mines (Churchill 1998). Permanent roost sites are typically deep caves, rock crevices or old mine adits with a relatively stable temperature (23-28°C) and high humidity (50-100%) (Threatened Species Scientific Committee 2016b). During daylight hours, ghost bats roost in large caves, mines or deep rock fissures (Van Dyck and Strahan 2008a). In some parts of its range, the ghost bat shares roosts with the Pilbara leaf-nosed bat, Finlayson's cave bat, common heath-tailed bat, and possibly Hill's sheath-tailed bat.

Ghost bats are known to seasonally move between a number of caves or as dictated by weather conditions (Hutson *et al.* 2001) and disperse widely when not breeding but concentrate in a relatively few roost sites when breeding (Threatened Species Scientific Committee 2016b). In the Pilbara, preferred roosting habitat appears to be caves beneath bluffs of low rounded hills composed of Marra Mamba geology, and larger hills of Brockman Iron Formation (Armstrong and Anstee 2000). Maternity caves are relatively uncommon, with only eleven recorded in the Pilbara region (three natural caves and eight mines) (Armstrong and Anstee 2000). Diurnal roost caves usually contain one or more large chambers with additional geological features including fissures and chambers which are fully dark and have a minimum roof height of 2-3 m (Bat Call 2016). Maternal roost sites exhibit the features outlined for diurnal roosts with the addition of an interior chamber that rises towards the rear of the cave and creates a warm and humid environment for breeding females and pups (Bat Call 2016). Nocturnal roosts or feeding caves (middens), which are only used at night, are usually present in rock overhangs and small caves which are well lit during the day and can be easily recognised based on the presence of discarded prey pieces and faeces on the floor (Richards *et al.* 2008). Armstrong and Anstee (2000) suggested that ghost bats occur in small groups within the Hamersley Ranges and may move about in a local area, possibly in response to disturbance, microclimate or social factors.

The ghost bat was recorded at a single acoustic lure site (BDGB03) located outside of the project area (Map 8); however, it should be noted that this species exhibits cryptic call patterns when hunting and may not reliably be detected using passive survey methods alone (e.g. ARUs). Therefore, acoustic lures were used at seven sites within major drainage lines and potential flight pathways to target the species during foraging activities. This species was assigned a low collision risk rating by Specialised Zoological based on the low frequency of occurrence throughout the survey area and moderate likelihood of flight activity above 50m (Specialised Zoological 2024).

Although Rocky Escarpment habitat within the project area may provide nocturnal refugia and feeding perches for the ghost bat, no caves with attributes required to support roosting were identified within the project area. This species has the potential to forage in all habitat types and was recorded on an acoustic lure located within Drainage Line/River/Creek (major) habitat in March 2024.

119.75°E
119.8333°E
119.9167°E
120°E
120.0833°E
21.9167°S
22°S
22.0833°S
22.1667°S
22.25°S

Grey falcon records

Bonney Downs Phase 1 Project Area

Bonney Downs survey area

ecologia ENVIRONMENT

Project No.: 2009
Author: TM
Created Date: 10 June 2024
Coordinate System: GCS GDA 1994
Scale: 1:145,235 @A3

Map 7: Grey falcon records.

Earthstar Geographics

0 1.6 3.2 4.8 9.5 Kilometers

119.7675°E
119.835°E
119.9025°E
119.97°E
120.0375°E
21.8925°S
21.96°S
22.0275°S
22.095°S
22.1625°S
22.23°S
22.2975°S

Bonney Downs Phase 1 project area

Bonney Downs survey area

Ghost bat

Pilbara leaf-nosed bat

ecologia ENVIRONMENT

Project No.: 2009
Author: CB
Created Date: 27 August 2024
Coordinate System: GCS GDA 1994
Scale: 1:145,536 @A3

Map 8: Pilbara leaf-nosed bat and ghost bat records.

0 1.6 3.2 4.8 9.6 Kilometers

Earthstar Geographics

6.4 COLLISION RISK MODELLING (CRM) FEASIBILITY ANALYSIS

A feasibility assessment was undertaken by Symbolix on behalf of *ecologia* with the purpose of interrogating survey data collected to date and determine whether adequate information was available to undertake CRM for at-risk significant fauna occurring at Bonney Downs in the context of the Bonney Downs Stage 1 Project. A summary of the analysis is provided below, with full details provided in Appendix G.

6.4.1 Species suitability

As site-specific flight height data is not currently available for the Pilbara leaf-nosed bat and CRM methods have not been established or validated for non-avian species (including bats), CRM analysis therefore was only considered for the grey falcon. Unfortunately, as CRM can only be undertaken for systematic observations, and the majority of grey falcon observations recorded to date have been incidental sightings, CRM analysis appears to be unsuitable for the grey falcon at present.

6.4.2 Spatial coverage

To ensure site-specific spatial variability in habitat utilisation is captured, systematic coverage across the entire site is important. Where this is not feasible, or no significant spatial variability is observed, CRM can proceed under the assumption that average flight density is constant for all turbines. The radius of the 90th percentile of observation distances for raptor observations was used to investigate the spatial coverage of fixed-point survey sites and highlight areas where the current survey sites are unable to detect raptors. As distance from the observer was only documented from March 2024 onwards, no grey falcon observations with an associated distance recorded were available for analysis. To provide an indication of spatial coverage across the BBSUS area, it was assumed that observers had a similar ability to detect all raptors and observations of all raptors in March 2024. Although some observations were recorded at large distances from the site (up to 2km), there is limited observed area across the site.

Site placement is considered optimal, with a large number of sites placed relatively evenly across the site. However, due to the large size of the BBSUS area, complete coverage is likely to be logistically impossible. Therefore, sites should be representative of the site in order to provide a reliable indication of site usage.

6.4.3 Spatial and temporal patterns

Currently, there have been too few grey falcon observations recorded across the site to understand spatial patterns of flight activity for this species. Additional surveys will hopefully document further records of the species and provide additional insights into spatial patterns and activity levels, seasonality and daily patterns of activity.

6.4.4 Data assessment

Data collected during October 2023, February 2024 and March 2024 BBSUS were reviewed against the requirements of CRM to determine the following:

- Is there sufficient data to estimate flight density for the grey falcon?
- Is there sufficient data to model height distribution of the grey falcon and reliably estimate the proportion of flights at rotor-swept heights?
- Is there sufficient spatial coverage to inform patterns of utilisation across the site?
- Does any information exist to inform an evidence-based value for the avoidance rate of grey falcons?

Ability to estimate flight density

To determine the number of flights per square kilometre per year (flight rate), the following is required:

- Positive identification of target species during formal surveys (e.g. non-incidental observations) – we have this for grey falcons.
- Known survey duration – we have this for set-time avifauna surveys.
- Distance from observer for at least 50-70 positive observations of the target species – we do not have this for grey falcons.

For rare species, proxies can be used to derive a detectability curve; however, this relies on having an analogous species with a similar likelihood of being detected as the target species (e.g. morphologically and behaviourally similar), with sufficient detections for modelling.

As no systematic grey falcon observations have been recorded with an associated distance, it is not advisable to consider utilisation of proxy species given that detectability distances cannot be compared with species. Furthermore, as none of the potential proxies have been recorded frequently enough to fulfil the third criteria for flight density estimates robust biological and behavioural suitability assessment of potential proxy species has not been undertaken. Although proxies are likely to be required regardless of the number of surveys conducted, even a small number of grey falcon observations with associated distance data will provide increased certainty regarding the suitability of proxy selection.

Ability to determine flight height

Sufficient numbers of flight height observations are required to determine the proportion of flights which will take place at rotor swept heights. Ideally 50+ observations would be recorded; however, proxies may be used. Only one systematic grey falcon observation record involved a bird in flight, therefore confidence associated with the suitability of potential proxies is low. For future grey falcon observation, flight height at first observation will be recorded using a rangefinder to give a representative sample of flight heights without biasing the proportion of flights at rotor swept height.

Patterns of spatial utilisation

Given the paucity of grey falcon observations recorded, it is not possible to determine whether any patterns of utilisation exist across the site. Although flight path data is ideal for resolving spatial use patterns, given the magnitude of the site and the inability to obtain full coverage, it is unlikely that flight path would assist in meaningfully resolving spatial patterns of occurrence. As such, it is considered best to assume that a flight could occur in any direction or manner. This assumption aligns with behavioural patterns and relatively flat site utilisation demonstrated by other raptors observed across the site. There is currently no data available to meaningfully assign relative risk ratings to individual turbines and it is likely that application of a flat utilisation rate, which assumes that each turbine has equal probability of collision will be suitable for the grey falcon. Further surveys may provide clarity regarding these assumptions and assist with resolving uncertainty.

Avoidance rates

Although species-specific avoidance rate data is unlikely to be available, further research into potential proxy species is required to determine whether avoidance rates exhibited by other raptor species may be suitable for use in the absence of a grey falcon specific rate.

Recommendations

- Record height and horizontal distance at first observation of the species (all raptors and waterbirds) – this has been incorporated into June 2024 survey methodology
- Height and distance data should be recorded as precisely as possible – use of rangefinder has been incorporated into June 2024 survey methodology

- Ecological assessment of potential proxy species required to increase certainty regarding suitability of these species for CRM – to be undertaken in conjunction with Harry Butler Institute (HBI)
- Additional survey sites are not recommended given the size of the study area and relatively even coverage provided by existing site locations
- Further data collection is recommended prior to attempting to undertake quantitative collision risk modelling. If CRM was attempted for the grey falcon based on data collected to date, the resulting collision estimate would be too imprecise to provide sufficient insight or understanding of grey falcon collision risk. It is likely that CRM will still require use of proxy species; however, additional systematic observations incorporating the above recommendations would provide increased certainty regarding CRM outputs.

7 CONCLUSIONS

The key conclusions from the three BBSUS completed to date are as follows:

- Although eight fauna habitat types occur within the broader Bonney Downs survey area, only six of these habitat types occur within the Bonney Downs Stage 1 project area: Drainage Line/River/Creek (major and minor), Plain (stony/gibber and cracking clays), Woodland (open) and Rocky Escarpments. The remainder of the project area encompasses previously cleared areas.
- Echolocation calls belonging to at least 10 bat species, including two species of sheath-tailed bat (Emballonuridae), three species of freetail bat (Molossidae), the Pilbara leaf-nosed bat (Rhinonycteridae), the ghost bat (Macrodermatidae) and three species of evening bats (Vespertilionidae) have been recorded at Bonney Downs. One additional species, the black flying fox was opportunistically recorded during the detailed fauna surveys. Based on analysis by Specialised Zoological, an additional five species (northern coastal free-tailed bat, pallid long-eared bat, lesser long-eared bat, Hill's sheath-tailed bat and the little red flying fox) have the potential to occur within the project area and may fly at RSA height while foraging and transiting (if present within the area).
- The EPBC Act listed Pilbara leaf-nosed bat (*Rhinonicteris aurantia* (Pilbara form) [Vulnerable]), and ghost bat (*Macroderma gigas* [Vulnerable]) have both been recorded within the broader Bonney Downs survey area. The leaf-nosed bat has been recorded at 14 sites (six within the project area) and the ghost bat has been recorded at a single location outside of the project area. Both species were assessed as having a low collision risk, based on flight altitudes and frequency of species observations across the survey area.
- 105 avifauna taxa have been recorded within the BBSUS area, representing between 53-71.1% of species potentially occurring based on ALA and Birdlife database searches. Ninety-five avifauna taxa have been recorded during set-time surveys and a further 10 species have been recorded incidentally.
- Twenty-one waterbird taxa, comprised of nine families, have been recorded within the BBSUS area. Seventeen species were recorded during set-time surveys, with an additional four species recorded incidentally. No significant or migratory waterbird taxa were recorded.
- Eleven raptor species, representing two families (Falconidae and Accipitridae), were recorded during the surveys. Raptors observed during set-time surveys appear to be most active during morning and afternoon surveys; however, midday observations have also been recorded for most several species. Generally, larger raptors (eagles, harriers and kites) were first observed at further distances compared to smaller species (falcons, hawks, hobbies and kestrels); however, this is not always the case.
- No waterbirds were recorded flying at heights greater than 100m during set-time surveys. The pacific black duck, black-fronted dotterel, white-faced heron and white-necked heron were recorded flying at heights of up to 100m during set-time surveys. Five raptor species were recorded flying at heights above 100m during set-time surveys: the brown falcon, grey falcon (VU), spotted harrier, wedge-tailed eagle and the whistling kite. Of these, all species besides the grey falcon were recorded flying at heights up to 160m.
- A single EPBC Act listed avifauna species, the grey falcon (*Falco hypoleucos* [Vulnerable]) was recorded at Bonney Downs on 11 occasions. This species is known to utilise habitat at Bonney Downs across all seasons and is considered to represent a collision risk. Currently too few systematic observations of grey falcon have been recorded to adequately understand spatial

and temporal patterns of activity across the site and further surveys are required to increase confidence in CRM outputs.

- Further data collection is recommended prior to attempting to undertake quantitative CRM. If CRM was attempted for the grey falcon based on data collected to date, the resulting collision estimate would be too imprecise to provide sufficient insight or understanding of grey falcon collision risk. It is likely that CRM undertaken following the completion of the two-year monitoring will still require use of proxy species; however, additional systematic observations incorporating the above recommendations would provide increased certainty regarding CRM outputs.

8 REFERENCES

2024. Results of acoustic surveys conducted for night parrot (*Pezoporus occidentalis*)- Bonney Downs July-October 2023.

Armstrong, K. and Anstee, S. D. 2000. The Ghost Bat in the Pilbara: 100 years on. Australian Mammalogy:93-101.

Armstrong, K. N. 2001. The distribution and roost habitat of the Orange Leaf-nosed Bat, *Rhinonicteris aurantius*, in the Pilbara region of Western Australia. Wildlife Research. 28:95-104.

Bat Call. 2016. Mesa B and C: Ghost Bat Roost Cave Assessment. Prepared for Rio Tinto by Bat Call WA Pty Ltd.

Biosis Research. 2006. Wind farm collision risk for birds: Cumulative risks for threatened and migratory species. Prepared for the Australian Government Department of the Environment and Heritage by Biosis Research Pty Ltd.

BoM. 2023. Bureau of Meteorology. Available at: http://www.bom.gov.au. Commonwealth of Australia, Canberra.

Bullen, R. D. and McKenzie, N. L. 2011. Recent developments in studies of the community structure, foraging ecology and conservation of Western Australian bats. pp. 31-43 *in* Law, B., Eby, P., Lunney, D., and Lumsden, L., eds. The Biology and Conservation of Australasian Bats. Royal Zoological Society of NSW, Mosman, New South Wales.

Churchill, S. 1998. Australian Bats. Reed New Holland, Sydney.

Churchill, S. 2008. Australian Bats. Jacana Books, Crows Nest NSW.

DBCA. 2017. Interim guideline for preliminary surveys of night parrot (Pezoporus occidentalis) in Western Australia. Perth, Western Australia.

DBCA. 2018. Fortescue Marsh Management Strategy, 2018-24 *in* Department of Biodiversity Conservation and Attractions, ed, Karratha.

DCCEEW. 2023. EPBC Act Protected Matters Search Tool Report *in* Department of Climate Change, E., the Environment and Water, ed. Department of Climate Change, Energy, the Environment and Water, Canberra.

DCCEEW. 2024a. Australian Wetlands Database - Ramsar Wetlands - Eighty Mile Beach. Accessed 12/6/2024. https://www.environment.gov.au/cgi-bin/wetlands/ramsardetails.pl?refcode=34#.

DCCEEW. 2024b. Onshore Wind Farm Guidance - Best practice approaches when seeking approval under Australia's national environment law, Department of Climate Change, Energy, the Environment and Water.

DEH. 2001. National Objectives and Targets for Biodiversity Conservation 2001–2005, Canberra.

DER. 2014. A guide to the assessment of applications to clear native vegetation Under Part V Division 2 of the Environmental Protection Act 1986 December 2014. Accessed http://maps.dec.wa.gov.au/idelve/nv/index.jsp

DEWHA. 2010. Survey Guidelines for Australia's Threatened Birds. Department of the Environment, Water, Heritage and the Arts.

Department of the Environment Water Heritage and the Arts. 2013. Matters of National Environmental Significance. Significant Impact Guidelines 1.1. Environment Protection and Biodiversity Conservation Act 1999. 2013

DoE. 2023. *Rhinonicteris aurantia* (Pilbara form) - Pilbara Leaf-nosed Bat in Species Profile and Threats Database. Accessed https://www.environment.gov.au/sprat.

DSEWPaC. 2010. Survey Guidelines for Australia's Threatened Bats. Department of Sustainability, Environment, Water, Population and Communities.

DSEWPaC. 2012. Interim Biogeographic Regionalisation for Australia (IBRA), Version 7. Australian Government, Canberra.

DSEWPC. 2012. Interim Biogeographic Regionalisation for Australia (IBRA) Version 7. Department of Sustainability Environment Water Population and Communities, Canberra.

Ehmann, H. and Watson, M. 2008. Grey Falcon, *Falco hypoleuca.* South Australia.

EPA. 2000. Position Statement No. 2: Environmental protection of native vegetation in Western Australia: clearing of native vegetation, with particular reference to the agricultural area. . Environment Protection Authority, Western Australia.

EPA. 2013. Environmental and water assessments relating to mining and mining-related activities in the Fortescue Marsh management area.

EPA. 2016. Environmental Factor Guideline: Terrestrial Fauna. Environmental Protection Authority, Perth, Western Australia.

Garnett, S. T., Szabo, J. K., and Dutson, G. 2011. The Action Plan for Australian Birds 2010. CSIRO Publishing and Birds Australia., Collingwood, Victoria.

Government of Western Australia. 2018. 2017 Statewide Vegetation Statistics incorporating the CAR Reserve Analysis (Full Report). Current as of December 2017. WA Department of Biodiversity Conservation and Attractions, Perth, https://catalogue.data.wa.gov.au/dataset/dbca-statewide-vegetation-statistics

Halse, S. A., Pinder, A. M., Powling, J., and McRae, J. 2006. Wetlands of the Pilbara. Landscope. 21:25-29.

Hanrahan, N., Turbill C, Armstrong K.N, A.H, D., and J.A, W. 2024. Calling up ghosts: acoustic playback of social vocalisations reveals complex communication in a cryptic bat and provides a promising tool for monitoring disturbance-sensitive species. Mammal Research.

Hoyle, S. D., Pople, A. R., and Toop, G. J. 2001. Mark–recapture may reveal more about ecology than about population trends: Demography of a threatened ghost bat (*Macroderma gigas*) population. Austral Ecology. 26:80-92.

Hutson, A. M., Mickleburgh, S. P., and Racey, P. A. 2001. Microchiropteran Bats: Global Status Survey and Action Plan. *Macroderma gigas*. Accessed 17th July 2008. www.iucnredlist.org.

International Union for Conservation of Nature. 2014. Guidelines for using the IUCN Red List Categories and Criteria, Version 11. Prepared by the IUCN Standards and Petitions Subcommittee. Downladable from http://www.iucnredlist.org/documents/RedListGuidelines.pdf.

Jackett, N. A., Greatwich, B. R., Swann, G., and Boyle, A. 2017. A nesting record and vocalisations of the Night Parrot *Pezoporus occidentalis* from the East Murchison, Western Australia. Australian Field Ornithology. 34:144–150.

Johnstone, R. E. and Storr, G. M. 1998. Handbook of Western Australian Birds, Volume I - Non-Passerines (Emu to Dollarbird). Western Australian Museum, Perth.

Kamata, T., Sato, H., Mukai, H., Sato, T., Yamada, S., and Sekijima, T. 2023. Sensitivity analysis of collision risk at wind turbines based on flight altitude of migratory waterbirds. Ecological Solutions and Evidence. 4:e12222.

Marchant, S. and Higgins, P. J. 1993. Handbook of Australian, New Zealand and Antarctic Birds. Oxford University Press, Melbourne.

Morcombe, M. 2022. eGuide to Australian Birds.

Murphy, S. A., Silcock, J., Murphy, R., Reid, J., and Austin, J. J. 2017. Movements and habitat use of the night parrot *Pezoporus occidentalis* in south-western Queensland. Austral Ecology. 42:858-868.

Olsen, P. D. and Olsen, J. 1986. Distribution, status, movements and breeding of the Grey Falcon *Falco hypoleuca*.

Richards, G. C., Hand, S., and Armstrong, K. N. 2008. Ghost Bat, *Macroderma gigas*. pp. 449-450 *in* van Dyck, S., and Strahan, R., eds. The Mammals of Australia. Reed New Holland, Sydney.

Roemer, C., Bas, Y., Disca, T., and Coulon, A. 2011. Influence of landscape and time of year on bat-wind turbines collision risks. Landscape Ecology. 34:2869-2881.

Ruykys, L., Hanrahan, N., and Stokeld, D. 2023. Novel acoustic lure methodology facilitates detection of the cryptic ghost bat at a landscape scale. Wildlife Research.

Sandhu, R., Tripp, C., Quon, E., Thedin, R., Lawson, M., Brandes, D., Farmer, C. J., Miller, T. A., Draxl, C., Doubrawa, P., Williams, L., Duerr, A. E., Braham, M. A., and Katzner, T. 2022. Stochastic agent-based model for predicting turbine-scale raptor movements during updraft-subsidized directional flights. Ecological Modelling. 466:109876.

Schoenjahn, J. 2011a. How scarce is the Grey falcon? Boobook. 29:24-25.

Schoenjahn, J. 2011b. Morphometric data from recent specimens and live individuals of the Grey Falcon *Falco hypoleucos*. Corella. 35:16-22.

Schoenjahn, J. 2013. A hot environment and one type of prey: investigating why the Grey Falcon (*Falco hypoleucos*) is Australia's rarest falcon. Emu.

Schoenjahn, J. 2018. Adaptations of the rare endemic Grey Falcon Falco hypoleucos that enable its permanent residence in the arid zone of Australia.

Schoenjahn, J., Pavey, C. R., and Walter, G. H. 2020. Ecology of the Grey Falcon Falco hypoleucos – current and required knowledge. Emu - Austral Ornithology. 120:74-82.

Shepherd, D. P., Beeston, G. R., and Hopkins, A. J. M. 2002. Native vegetation in Western Australia: Extent, type and status. Technical Report 249. Department of Agriculture, South Perth, Western Australia.

Specialised Zoological. 2024. Identification of bat species from Bonney Downs, Western Australia. Unpublished report by Specialised Zoological for Ecologia Environment Pty Ltd, 22 August 2024, project reference SZ720.

Spectrum Ecology. 2022. Fortescue Marsh Migratory Shorebird and Waterbird Survey.

Stephen A. Murphy, J. J. A., Rachel K. Murphy, Jennifer Silcock, Leo Joseph, Stephen T. Garnett, Nicholas P. Leseberg, James E. M. Watson & Allan H. Burbidge. 2017. Observations on breeding Night Parrots (Pezoporus occidentalis) in western Queensland. Emu - Austral Ornithology.

Threatened Species Scientific Committee. 2016a. Conservation Advice for *Rhinonicteris aurantius* (Pilbara form) (Pilbara Leaf-nosed Bat).

Threatened Species Scientific Committee. 2016b. *Macroderma gigas* (ghost bat) Conservation Advice,.

Threatened Species Scientific Committee. 2020. Conservation advice for Falco hypoleucos (grey falcon).

Van Dyck, S. and Strahan, R. 2008a. *The Mammals of Australia*. Reed New Holland, Sydney.

van Dyck, S. and Strahan, R. 2008b. The Mammals of Australia. Australian Museum Trust and Queensland Museum, Sydney, New South Wales.

9 APPENDICES

Appendix A Definitions.

SIGNIFICANT FAUNA

According to the *EPA Factor Guideline: Terrestrial* Fauna (EPA 2016) animal taxa (or records) may be considered significant for a number of reasons including, but not restricted to, the following:

A taxon listed as 'Threatened' under the Biodiversity Conservation Act 2016 (WA) or the Environment Protection and Biodiversity Conservation Act 1999 (Cwlth);

- A taxon on the Department of Biodiversity, Conservation and Attractions (DBCA) Priority Fauna List;
- Species with restricted distributions;
- Degree of historical impact from threatening processes;
- Providing an important function required to maintain the ecological integrity of a significant ecosystem.

Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) (Cwlth)

At a Commonwealth level, Threatened species are protected under the EPBC Act, which lists species in accordance with the criteria of the International Union for Conservation of Nature (International Union for Conservation of Nature 2014), that is, 'Critically Endangered', 'Endangered', 'Vulnerable', 'Conservation Dependant', 'Extinct', or 'Extinct in the Wild' (see http://www.environment.gov.au/cgi-bin/sprat/public/publicthreatenedlist.pl?wanted=flora and http://www.environment.gov.au/cgi-bin/sprat/public/publicthreatenedlist.pl?wanted=fauna).

Biodiversity Conservation Act 2016 (Western Australia)

At a State level, Threatened species are protected under the BC Act. These are taxa which have been adequately surveyed and are deemed to be either rare, in danger of extinction, or otherwise in need of special protection in the wild and are gazetted as Threatened (Declared Rare) Flora. Threatened species are further categorised by the Department of Biodiversity, Conservation and Attractions (DBCA) according to their level of threat using the International Union for Conservation of Nature (IUCN) red list criteria ((International Union for Conservation of Nature 2014) (see https://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities for definitions).

Priority Fauna (DBCA)

The DBCA maintains a list of Priority species, which are considered poorly known, uncommon or under threat but for which there is insufficient justification to be listed as Threatened, based on known distribution and population sizes. Priority species are assigned to one of four categories, described below. DBCA listed Priority species do not have any statutory protection (see https://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/threatened-plants for definitions.)

Appendix B Fauna database search results.

Birdata Species List

Emu
Dromaius novaehollandiae
5 (1.58%)

Plumed Whistling-Duck
Dendrocygna eytoni
10 (3.15%)

Pink-eared Duck
Malacorhynchus membranaceus
11 (3.47%)

Black Swan
Cygnus atratus
15 (4.73%)

Australian Shelduck
Tadorna tadornoides
6 (1.89%)

Hardhead
Aythya australis
14 (4.42%)

Pacific Black Duck
Anas superciliosa
35 (11.04%)

Grey Teal
Anas gracilis
20 (6.31%)

Freckled Duck
Stictonetta naevosa
2 (0.63%)

Australian Wood Duck
Chenonetta jubata
8 (2.52%)

Brown Quail
Synoicus ypsilophora
4 (1.26%)

Australasian Grebe
Tachybaptus novaehollandiae
6 (1.89%)

Hoary-headed Grebe
Poliocephalus poliocephalus
15 (4.73%)

Spinifex Pigeon
Geophaps plumifera
46 (14.51%)

Common Bronzewing
Phaps chalcoptera
10 (3.15%)

Crested Pigeon
Ocyphaps lophotes
71 (22.40%)

Diamond Dove
Geopelia cuneata
87 (27.44%)

Peaceful Dove
Geopelia placida
26 (8.20%)

Horsfield's Bronze-Cuckoo
Chalcites basalis
12 (3.79%)

Pallid Cuckoo
Heteroscenes pallidus
15 (4.73%)

Australian Bustard
Ardeotis australis
16 (5.05%)

Tawny Frogmouth
Podargus strigoides
4 (1.26%)

Spotted Nightjar
Eurostopodus argus
8 (2.52%)

Australian Owlet-nightjar
Aegotheles cristatus
12 (3.79%)

Buff-banded Rail
Hypotaenidia philippensis
1 (0.32%)

Black-tailed Native-hen
Tribonyx ventralis
3 (0.95%)

Eurasian Coot
Fulica atra
6 (1.89%)

Bush Stone-curlew
Burhinus grallarius
2 (0.63%)

Black-winged Stilt
Himantopus leucocephalus
8 (2.52%)

Red-capped Plover
Charadrius ruficapillus
3 (0.95%)

Oriental Plover
Charadrius veredus
1 (0.32%)

Black-fronted Dotterel
Elseyornis melanops
40 (12.62%)

Red-kneed Dotterel
Erythrogonys cinctus
3 (0.95%)

Sharp-tailed Sandpiper
Calidris acuminata
1 (0.32%)

Wood Sandpiper
Tringa glareola
2 (0.63%)

Little Button-quail
Turnix velox
20 (6.31%)

Silver Gull
Chroicocephalus novaehollandiae
1 (0.32%)

Australian Gull-billed Tern
Gelochelidon macrotarsa
2 (0.63%)

Caspian Tern
Hydroprogne caspia
2 (0.63%)

Whiskered Tern
Chlidonias hybrida
7 (2.21%)

Black-necked Stork
Ephippiorhynchus asiaticus
8 (2.52%)

Australian Pelican
Pelecanus conspicillatus
18 (5.68%)

Nankeen Night-Heron
Nycticorax caledonicus
1 (0.32%)

Cattle Egret
Bubulcus ibis
1 (0.32%)

White-necked Heron
Ardea pacifica
19 (5.99%)

Great Egret
Ardea alba
18 (5.68%)

White-faced Heron
Egretta novaehollandiae
30 (9.46%)

Little Egret
Egretta garzetta
6 (1.89%)

Australian White Ibis
Threskiornis moluccus
3 (0.95%)

Straw-necked Ibis
Threskiornis spinicollis
16 (5.05%)

Yellow-billed Spoonbill
Platalea flavipes
7 (2.21%)

Royal Spoonbill
Platalea regia
8 (2.52%)

Glossy Ibis
Plegadis falcinellus
1 (0.32%)

Little Pied Cormorant
Microcarbo melanoleucos
26 (8.20%)

Great Cormorant
Phalacrocorax carbo
1 (0.32%)

Little Black Cormorant
Phalacrocorax sulcirostris
21 (6.62%)

Pied Cormorant
Phalacrocorax varius
1 (0.32%)

Australasian Darter
Anhinga novaehollandiae
26 (8.20%)

Black-shouldered Kite
Elanus axillaris
4 (1.26%)

Black-breasted Buzzard
Hamirostra melanosternon
2 (0.63%)

Wedge-tailed Eagle
Aquila audax
32 (10.09%)

Little Eagle
Hieraaetus morphnoides
10 (3.15%)

Swamp Harrier
Circus approximans
4 (1.26%)

Spotted Harrier
Circus assimilis
8 (2.52%)

Brown Goshawk
Accipiter fasciatus
9 (2.84%)

Collared Sparrowhawk
Accipiter cirrocephalus
4 (1.26%)

White-bellied Sea-Eagle
Haliaeetus leucogaster
1 (0.32%)

Whistling Kite
Haliastur sphenurus
97 (30.60%)

Black Kite
Milvus migrans
10 (3.15%)

Barn Owl
Tyto alba
1 (0.32%)

Southern Boobook
Ninox boobook
12 (3.79%)

Rainbow Bee-eater
Merops ornatus
63 (19.87%)

Sacred Kingfisher
Todiramphus sanctus
26 (8.20%)

Red-backed Kingfisher
Todiramphus pyrrhopygius
35 (11.04%)

Blue-winged Kookaburra
Dacelo leachii
42 (13.25%)

Nankeen Kestrel
Falco cenchroides
52 (16.40%)

Australian Hobby
Falco longipennis
15 (4.73%)

Brown Falcon
Falco berigora
43 (13.56%)

Peregrine Falcon
Falco peregrinus
1 (0.32%)

Cockatiel
Nymphicus hollandicus
74 (23.34%)

Galah
Eolophus roseicapilla
70 (22.08%)

Little Corella
Cacatua sanguinea
65 (20.50%)

Australian Ringneck
Barnardius zonarius
56 (17.67%)

Bourke's Parrot
Neopsephotus bourkii
6 (1.89%)

Budgerigar
Melopsittacus undulatus
54 (17.03%)

Western Bowerbird
Ptilonorhynchus guttatus
2 (0.63%)

Black-tailed Treecreeper
Climacteris melanurus
2 (0.63%)

Variegated Fairy-wren
Malurus lamberti
37 (11.67%)

White-winged Fairy-wren
Malurus leucopterus
36 (11.36%)

Striated Grasswren
Amytornis striatus
4 (1.26%)

Black Honeyeater
Sugomel niger
5 (1.58%)

Brown Honeyeater
Lichmera indistincta
54 (17.03%)

Black-chinned Honeyeater
Melithreptus gularis
5 (1.58%)

Pied Honeyeater
Certhionyx variegatus
3 (0.95%)

Crimson Chat
Epthianura tricolor
20 (6.31%)

Orange Chat
Epthianura aurifrons
3 (0.95%)

White-gaped Honeyeater
Stomiopera unicolor
1 (0.32%)

Spiny-cheeked Honeyeater
Acanthagenys rufogularis
25 (7.89%)

Singing Honeyeater
Gavicalis virescens
57 (17.98%)

Grey-headed Honeyeater
Ptilotula keartlandi
13 (4.10%)

Grey-fronted Honeyeater
Ptilotula plumula
1 (0.32%)

White-plumed Honeyeater
Ptilotula penicillata
129 (40.69%)

White-fronted Honeyeater
Purnella albifrons
1 (0.32%)

Yellow-throated Miner
Manorina flavigula
121 (38.17%)

Red-browed Pardalote
Pardalotus rubricatus
43 (13.56%)

Striated Pardalote
Pardalotus striatus
12 (3.79%)

Western Gerygone
Gerygone fusca
5 (1.58%)

Weebill
Smicrornis brevirostris
55 (17.35%)

Redthroat
Pyrrholaemus brunneus
1 (0.32%)

Rufous Fieldwren
Calamanthus campestris
1 (0.32%)

Slaty-backed Thornbill
Acanthiza robustirostris
1 (0.32%)

Chestnut-rumped Thornbill
Acanthiza uropygialis
12 (3.79%)

Grey-crowned Babbler
Pomatostomus temporalis
42 (13.25%)

White-browed Babbler
Pomatostomus superciliosus
3 (0.95%)

Ground Cuckoo-shrike
Coracina maxima
1 (0.32%)

Black-faced Cuckoo-shrike
Coracina novaehollandiae
88 (27.76%)

White-winged Triller
Lalage tricolor
21 (6.62%)

Chestnut-breasted Quail-thrush
Cinclosoma castaneothorax
1 (0.32%)

Rufous Whistler
Pachycephala rufiventris
41 (12.93%)

Grey Shrike-thrush
Colluricincla harmonica
15 (4.73%)

Crested Bellbird
Oreoica gutturalis
21 (6.62%)

Chiming Wedgebill
Psophodes occidentalis
1 (0.32%)

Australian Magpie
Gymnorhina tibicen
30 (9.46%)

Pied Butcherbird
Cracticus nigrogularis
66 (20.82%)

Grey Butcherbird
Cracticus torquatus
6 (1.89%)

Masked Woodswallow
Artamus personatus
3 (0.95%)

Black-faced Woodswallow
Artamus cinereus
63 (19.87%)

Little Woodswallow
Artamus minor
8 (2.52%)

Willie Wagtail
Rhipidura leucophrys
112 (35.33%)

Torresian Crow
Corvus orru
91 (28.71%)

Little Crow
Corvus bennetti
12 (3.79%)

Magpie-lark
Grallina cyanoleuca
132 (41.64%)

Red-capped Robin
Petroica goodenovii
30 (9.46%)

Hooded Robin
Melanodryas cucullata
13 (4.10%)

Mistletoebird
Dicaeum hirundinaceum
10 (3.15%)

Painted Finch
Emblema pictum
32 (10.09%)

Star Finch
Neochmia ruficauda
2 (0.63%)

Zebra Finch
Taeniopygia guttata
136 (42.90%)

Australasian Pipit
Anthus novaeseelandiae
36 (11.36%)

Horsfield's Bushlark
Mirafra javanica
7 (2.21%)

Brown Songlark
Cincloramphus cruralis
31 (9.78%)

Rufous Songlark
Cincloramphus mathewsi
34 (10.73%)

Spinifexbird
Poodytes carteri
9 (2.84%)

Australian Reed-Warbler
Acrocephalus australis
8 (2.52%)

Fairy Martin
Petrochelidon ariel
20 (6.31%)

Tree Martin
Petrochelidon nigricans
16 (5.05%)

Welcome Swallow
Hirundo neoxena
1 (0.32%)

Corella spp
1 (0.32%)

Crow & Raven spp
6 (1.89%)

Kingdom	Phylum	Class	Order	Family	Genus	Species Name	Vernacular Name	Number of records	Conservation	Invasive
Animalia	Chordata	Aves	Passeriformes	Acanthizidae	Acanthiza	Acanthiza (Acanthiza) apicalis	Red-rumped Tit	15		
Animalia	Chordata	Aves	Passeriformes	Acanthizidae	Acanthiza	Acanthiza (Geobasileus) chrysorrhoa	Yellow-tail	4		
Animalia	Chordata	Aves	Passeriformes	Acanthizidae	Acanthiza	Acanthiza (Geobasileus) uropygialis	Chestnut-rumped Tit	82		
Animalia	Chordata	Aves	Passeriformes	Acanthizidae	Acanthiza	Acanthiza (Milligania) robustirostris	Robust Thornbill	23		
Animalia	Chordata	Aves	Passeriformes	Acanthizidae	Aphelocephala	Aphelocephala leucopsis	Western Whiteface	1		
Animalia	Chordata	Aves	Passeriformes	Acanthizidae	Aphelocephala	Aphelocephala nigricincta	Black-banded Squeaker	1		
Animalia	Chordata	Aves	Passeriformes	Acanthizidae	Gerygone	Gerygone fusca	Fuscous Warbler	58		
Animalia	Chordata	Aves	Passeriformes	Acanthizidae	Pyrrholaemus	Pyrrholaemus brunneus	Redthroat	3		
Animalia	Chordata	Aves	Passeriformes	Acanthizidae	Smicrornis	Smicrornis brevirostris	Brown Weebill	319		
Animalia	Chordata	Aves	Accipitriformes	Accipitridae	Accipiter	Accipiter (Leucospiza) fasciatus	Grey-headed Goshawk	64		
Animalia	Chordata	Aves	Accipitriformes	Accipitridae	Accipiter	Accipiter (Paraspizias) cirrocephalus	Collared Sparrowhawk	38		
Animalia	Chordata	Aves	Accipitriformes	Accipitridae	Aquila	Aquila (Uroaetus) audax	Wedge-tailed Eagle	114		
Animalia	Chordata	Aves	Accipitriformes	Accipitridae	Circus	Circus approximans	Australasian Harrier	11		
Animalia	Chordata	Aves	Accipitriformes	Accipitridae	Circus	Circus assimilis	Spotted Harrier	78		
Animalia	Chordata	Aves	Accipitriformes	Accipitridae	Elanus	Elanus axillaris	Black-shouldered Kite	25		
Animalia	Chordata	Aves	Accipitriformes	Accipitridae	Haliaeetus	Haliaeetus (Pontoaetus) leucogaster	White-bellied Sea-eagle	5		
Animalia	Chordata	Aves	Accipitriformes	Accipitridae	Haliastur	Haliastur sphenurus	Whistling Eagle-hawk	359		
Animalia	Chordata	Aves	Accipitriformes	Accipitridae	Hamirostra	Hamirostra melanosternon	Black-breasted Buzzard	14		
Animalia	Chordata	Aves	Accipitriformes	Accipitridae	Hieraaetus	Hieraaetus (Hieraaetus) morphnoides	Little Eagle	63		
Animalia	Chordata	Aves	Accipitriformes	Accipitridae	Lophoictinia	Lophoictinia isura	Square-tailed Kite	5		
Animalia	Chordata	Aves	Accipitriformes	Accipitridae	Milvus	Milvus migrans	Black Kite	102		
Animalia	Chordata	Aves	Passeriformes	Acrocephalidae	Acrocephalus	Acrocephalus (Acrocephalus) australis	Australian Reed Warbler	86		
Animalia	Chordata	Aves	Apodiformes	Aegothelidae	Aegotheles	Aegotheles (Aegotheles) cristatus	Australian Owlet-nightjar	55		
Animalia	Chordata	Aves	Passeriformes	Alaudidae	Mirafra	Mirafra (Mirafra) javanica	Horsfield's Bushlark	63		
Animalia	Chordata	Aves	Coraciiformes	Alcedinidae	Ceyx	Ceyx azureus	Azure Kingfisher	1		
Animalia	Chordata	Aves	Coraciiformes	Alcedinidae	Dacelo	Dacelo (Dacelo) leachii	Blue-winged Kookaburra	218		
Animalia	Chordata	Aves	Coraciiformes	Alcedinidae	Todiramphus	Todiramphus (Cyanalcyon) pyrrhopygius	Red-backed Kingfisher	203		
Animalia	Chordata	Aves	Coraciiformes	Alcedinidae	Todiramphus	Todiramphus (Todiramphus) sanctus	Sacred Kingfisher	105		
Animalia	Chordata	Aves	Anseriformes	Anatidae	Anas	Anas (Anas) superciliosa	Parera	140		
Animalia	Chordata	Aves	Anseriformes	Anatidae	Anas	Anas (Nettion) castanea	Chestnut Teal	1		
Animalia	Chordata	Aves	Anseriformes	Anatidae	Anas	Anas (Nettion) gracilis	Oceanic Teal	111		
Animalia	Chordata	Aves	Anseriformes	Anatidae	Aythya	Aythya (Nyroca) australis	Brownhead	33		
Animalia	Chordata	Aves	Anseriformes	Anatidae	Chenonetta	Chenonetta jubata	Australian Wood Duckmaned Goose	26		
Animalia	Chordata	Aves	Anseriformes	Anatidae	Cygnus	Cygnus (Chenopis) atratus	Black Swan	25		
Animalia	Chordata	Aves	Anseriformes	Anatidae	Dendrocygna	Dendrocygna eytoni	Plumed Whistling-duck	14		
Animalia	Chordata	Aves	Anseriformes	Anatidae	Malacorhynchus	Malacorhynchus membranaceus	Pink-eared Duck	22		
Animalia	Chordata	Aves	Anseriformes	Anatidae	Stictonetta	Stictonetta naevosa	Freckled Duck	2		
Animalia	Chordata	Aves	Anseriformes	Anatidae	Tadorna	Tadorna (Casarca) tadornoides	Chestnut Sheldrake	12		
Animalia	Chordata	Aves	Pelecaniformes	Anhingidae	Anhinga	Anhinga novaehollandiae	Arrgarrg	113		
Animalia	Chordata	Aves	Apodiformes	Apodidae	Apus	Apus (Apus) pacificus	Fork-tailed Swift	4		
Animalia	Chordata	Aves	Ciconiiformes	Ardeidae	Ardea	Ardea alba	Baluun	41		
Animalia	Chordata	Aves	Ciconiiformes	Ardeidae	Ardea	Ardea intermedia	A-garnandharrh	8		
Animalia	Chordata	Aves	Ciconiiformes	Ardeidae	Ardea	Ardea pacifica	White-necked Heron	147		
Animalia	Chordata	Aves	Ciconiiformes	Ardeidae	Bubulcus	Bubulcus ibis	Cattle Egret	5		
Animalia	Chordata	Aves	Ciconiiformes	Ardeidae	Butorides	Butorides striata	Green-backed Bittern	3		
Animalia	Chordata	Aves	Ciconiiformes	Ardeidae	Casmerodius	Casmerodius modesta	Eastern Great Egret	60		

Animalia	Chordata	Aves	Ciconiiformes	Ardeidae	Egretta	Egretta garzetta	Lesser Egret	30		
Animalia	Chordata	Aves	Ciconiiformes	Ardeidae	Egretta	Egretta novaehollandiae	Matuka	179		
Animalia	Chordata	Aves	Ciconiiformes	Ardeidae	Ixobrychus	Ixobrychus flavicollis	Yellow-necked Bittern	4		
Animalia	Chordata	Aves	Ciconiiformes	Ardeidae	Nycticorax	Nycticorax caledonicus	Crane	28		
Animalia	Chordata	Aves	Passeriformes	Artamidae	Artamus	Artamus (Angroyan) cinereus	Black-faced Woodswallow	379		
Animalia	Chordata	Aves	Passeriformes	Artamidae	Artamus	Artamus (Angroyan) minor	Little Woodswallow	130		
Animalia	Chordata	Aves	Passeriformes	Artamidae	Artamus	Artamus (Campbellornis) personatus	Masked Woodswallow	88		
Animalia	Chordata	Aves	Passeriformes	Artamidae	Cracticus	Cracticus nigrogularis	Pied Butcherbird	428		
Animalia	Chordata	Aves	Passeriformes	Artamidae	Cracticus	Cracticus torquatus	Grey Butcherbird	63		
Animalia	Chordata	Aves	Passeriformes	Artamidae	Gymnorhina	Gymnorhina tibicen	Australian Magpie	151		
Animalia	Chordata	Aves	Charadriiformes	Burhinidae	Burhinus	Burhinus (Burhinus) grallarius	Bush Stone-curlew	33		
Animalia	Chordata	Aves	Psittaciformes	Cacatuidae	Cacatua	Cacatua (Licmetis) sanguinea	Little Corella	406		
Animalia	Chordata	Aves	Psittaciformes	Cacatuidae	Calyptorhynchus	Calyptorhynchus (Calyptorhynchus) banksii	Red-tailed Black Cockatoo	3		
Animalia	Chordata	Aves	Psittaciformes	Cacatuidae	Eolophus	Eolophus roseicapilla	Galah	516		
Animalia	Chordata	Aves	Psittaciformes	Cacatuidae	Lophochroa	Lophochroa leadbeateri	Major Mitchell's Cockatoo	2		
Animalia	Chordata	Aves	Psittaciformes	Cacatuidae	Nymphicus	Nymphicus hollandicus	Cockatiel	254		
Animalia	Chordata	Aves	Passeriformes	Campephagidae	Coracina	Coracina (Coracina) novaehollandiae	Black-faced Cuckoo-shrike	517		
Animalia	Chordata	Aves	Passeriformes	Campephagidae	Coracina	Coracina (Pteropodocys) maxima	Ground Cuckoo-shrike	7		
Animalia	Chordata	Aves	Passeriformes	Campephagidae	Lalage	Lalage (Lalage) tricolor	Australian White-winged Triller	70		
Animalia	Chordata	Aves	Caprimulgiformes	Caprimulgidae	Eurostopodus	Eurostopodus (Eurostopodus) argus	Spotted Nightjar	56		
Animalia	Chordata	Aves	Struthioniformes	Casuariidae	Dromaius	Dromaius novaehollandiae	Emu	57		
Animalia	Chordata	Aves	Charadriiformes	Charadriidae	Charadrius	Charadrius (Charadrius) ruficapillus	Red-capped Plover	13		
Animalia	Chordata	Aves	Charadriiformes	Charadriidae	Charadrius	Charadrius (Eupoda) veredus	Oriental Plover	3		
Animalia	Chordata	Aves	Charadriiformes	Charadriidae	Elseyornis	Elseyornis melanops	Black-fronted Dotterel	268		
Animalia	Chordata	Aves	Charadriiformes	Charadriidae	Erythrogonys	Erythrogonys cinctus	Red-kneed Dotterel	25		
Animalia	Chordata	Aves	Charadriiformes	Charadriidae	Vanellus	Vanellus (Lobipluvia) miles	Masked Plover	20		
Animalia	Chordata	Aves	Ciconiiformes	Ciconiidae	Ephippiorhynchus	Ephippiorhynchus (Ephippiorhynchus) asiaticus	Jabiru	36		
Animalia	Chordata	Aves	Passeriformes	Cinclosomatidae	Cinclosoma	Cinclosoma (Samuela) castaneothorax	Chestnut-breasted Quail-thrush	10		
Animalia	Chordata	Aves	Passeriformes	Cinclosomatidae	Cinclosoma	Cinclosoma (Samuela) marginatum		5		
Animalia	Chordata	Aves	Passeriformes	Climacteridae	Climacteris	Climacteris (Climacteris) melanurus	Black-tailed Treecreeper	38		
Animalia	Chordata	Aves	Columbiformes	Columbidae	Columba	Columba (Columba) livia	Rock Pigeon	1		
Animalia	Chordata	Aves	Columbiformes	Columbidae	Columba	Columba (Janthoenas) leucomela	White-headed Pigeon	1		
Animalia	Chordata	Aves	Columbiformes	Columbidae	Geopelia	Geopelia cuneata	Diamond Dove	528		
Animalia	Chordata	Aves	Columbiformes	Columbidae	Geopelia	Geopelia placida		86		
Animalia	Chordata	Aves	Columbiformes	Columbidae	Geophaps	Geophaps (Lophophaps) plumifera	Spinifex Pigeon	408		
Animalia	Chordata	Aves	Columbiformes	Columbidae	Ocyphaps	Ocyphaps lophotes	Crested Pigeon	415		
Animalia	Chordata	Aves	Columbiformes	Columbidae	Phaps	Phaps (Histriophaps) histrionica	Flock Bronzewing	2		
Animalia	Chordata	Aves	Columbiformes	Columbidae	Phaps	Phaps (Phaps) chalcoptera	Common Bronzewing	83		
Animalia	Chordata	Aves	Passeriformes	Corvidae	Corvus	Corvus bennetti	Little Crow	91		
Animalia	Chordata	Aves	Passeriformes	Corvidae	Corvus	Corvus orru	Torresian Crow	435		
Animalia	Chordata	Aves	Cuculiformes	Cuculidae	Centropus	Centropus phasianinus	Pheasant Coucal	19		
Animalia	Chordata	Aves	Cuculiformes	Cuculidae	Chalcites	Chalcites basalis	Horsfield's Bronze-cuckoo	65		
Animalia	Chordata	Aves	Cuculiformes	Cuculidae	Chalcites	Chalcites osculans	Black-eared Cuckoo	4		
Animalia	Chordata	Aves	Cuculiformes	Cuculidae	Heteroscenes	Heteroscenes pallidus	Pallid Cuckoo	140		
Animalia	Chordata	Aves	Passeriformes	Dicaeidae	Dicaeum	Dicaeum (Dicaeum) hirundinaceum	Mistletoebird	103		
Animalia	Chordata	Aves	Passeriformes	Estrildidae	Emblema	Emblema pictum	Painted Finch	330		
Animalia	Chordata	Aves	Passeriformes	Estrildidae	Neochmia	Neochmia (Neochmia) ruficauda	Star Finch	16		

Animalia	Chordata	Aves	Passeriformes	Estrildidae	Poephila	Poephila (Poephila) cincta	Black-throated Finch	1		
Animalia	Chordata	Aves	Passeriformes	Estrildidae	Taeniopygia	Taeniopygia guttata	Zebra Finch	817		
Animalia	Chordata	Aves	Falconiformes	Falconidae	Falco	Falco (Falco) longipennis	Australian Hobby	50		
Animalia	Chordata	Aves	Falconiformes	Falconidae	Falco	Falco (Hierofalco) hypoleucos	Grey Falcon	33		
Animalia	Chordata	Aves	Falconiformes	Falconidae	Falco	Falco (Hierofalco) peregrinus	Duck Hawk	20		
Animalia	Chordata	Aves	Falconiformes	Falconidae	Falco	Falco (Hierofalco) subniger	Black Falcon	5		
Animalia	Chordata	Aves	Falconiformes	Falconidae	Falco	Falco (Ieracidea) berigora	Chicken Hawk	199		
Animalia	Chordata	Aves	Falconiformes	Falconidae	Falco	Falco (Tinnunculus) cenchroides	Wala	253		
Animalia	Chordata	Aves	Charadriiformes	Glareolidae	Glareola	Glareola (Glareola) maldivarum	Oriental Pratincole	1		
Animalia	Chordata	Aves	Charadriiformes	Glareolidae	Stiltia	Stiltia isabella	Australian Pratincole	10		
Animalia	Chordata	Aves	Passeriformes	Hirundinidae	Cheramoeca	Cheramoeca leucosterna	White-backed Swallow	17		
Animalia	Chordata	Aves	Passeriformes	Hirundinidae	Hirundo	Hirundo (Hirundo) neoxena	Welcome Swallow	8		
Animalia	Chordata	Aves	Passeriformes	Hirundinidae	Petrochelidon	Petrochelidon (Hylochelidon) nigricans	Tree Martin	107		
Animalia	Chordata	Aves	Passeriformes	Hirundinidae	Petrochelidon	Petrochelidon (Petrochelidon) ariel	Fairy Martin	120		
Animalia	Chordata	Aves	Charadriiformes	Laridae	Chlidonias	Chlidonias (Pelodes) hybrida	Whiskered Tern	11		
Animalia	Chordata	Aves	Charadriiformes	Laridae	Chroicocephalus	Chroicocephalus novaehollandiae	Silver Gull	1		
Animalia	Chordata	Aves	Charadriiformes	Laridae	Gelochelidon	Gelochelidon nilotica	Gull-billed Tern	2		
Animalia	Chordata	Aves	Charadriiformes	Laridae	Hydroprogne	Hydroprogne caspia	Caspian Tern	3		
Animalia	Chordata	Aves	Charadriiformes	Laridae	Onychoprion	Onychoprion anaethetus	Bridled Tern	1		
Animalia	Chordata	Aves	Passeriformes	Locustellidae	Cincloramphus	Cincloramphus (Cincloramphus) cruralis	Brown Songlark	82		
Animalia	Chordata	Aves	Passeriformes	Locustellidae	Cincloramphus	Cincloramphus (Maclennania) mathewsi	Rufous Songlark	186		
Animalia	Chordata	Aves	Passeriformes	Locustellidae	Poodytes	Poodytes carteri	Spinifexbird	119		
Animalia	Chordata	Aves	Passeriformes	Locustellidae	Poodytes	Poodytes gramineus	Little Grassbird	2		
Animalia	Chordata	Aves	Passeriformes	Maluridae	Amytornis	Amytornis (Magnamytis) striatus	Striated Grasswren	46		
Animalia	Chordata	Aves	Passeriformes	Maluridae	Malurus	Malurus (Leggeornis) assimilis		103		
Animalia	Chordata	Aves	Passeriformes	Maluridae	Malurus	Malurus (Leggeornis) lamberti	Variegated Fairy-wren	137		
Animalia	Chordata	Aves	Passeriformes	Maluridae	Malurus	Malurus (Malurus) splendens	Splendid Fairy-wren	5		
Animalia	Chordata	Aves	Passeriformes	Maluridae	Malurus	Malurus (Musciparus) leucopterus	White-winged Fairy-wren	152		
Animalia	Chordata	Aves	Passeriformes	Maluridae	Stipiturus	Stipiturus ruficeps	Rufous-crowned Emu-wren	5		
Animalia	Chordata	Aves	Passeriformes	Meliphagidae	Acanthagenys	Acanthagenys rufogularis	Spiny-cheeked Honeyeater	171		
Animalia	Chordata	Aves	Passeriformes	Meliphagidae	Certhionyx	Certhionyx (Certhionyx) variegatus	Pied Honeyeater	22		
Animalia	Chordata	Aves	Passeriformes	Meliphagidae	Conopophila	Conopophila (Conopophila) rufogularis	Rufous-throated Honeyeater	1		
Animalia	Chordata	Aves	Passeriformes	Meliphagidae	Conopophila	Conopophila (Lacustroica) whitei	Grey Honeyeater	14		
Animalia	Chordata	Aves	Passeriformes	Meliphagidae	Epthianura	Epthianura (Aurepthianura) aurifrons	Orange Chat	9		
Animalia	Chordata	Aves	Passeriformes	Meliphagidae	Epthianura	Epthianura (Parepthianura) tricolor	Crimson Chat	133		
Animalia	Chordata	Aves	Passeriformes	Meliphagidae	Gavicalis	Gavicalis virescens	Singing Honeyeater	503		
Animalia	Chordata	Aves	Passeriformes	Meliphagidae	Lichmera	Lichmera (Lichmera) indistincta	Brown Honeyeater	316		
Animalia	Chordata	Aves	Passeriformes	Meliphagidae	Manorina	Manorina (Myzantha) flavigula	Yellow-throated Miner	597		
Animalia	Chordata	Aves	Passeriformes	Meliphagidae	Manorina	Manorina (Myzantha) melanocephala	Noisy Miner	1		
Animalia	Chordata	Aves	Passeriformes	Meliphagidae	Melithreptus	Melithreptus (Eidopsarus) gularis	Black-chinned Honeyeater	56		
Animalia	Chordata	Aves	Passeriformes	Meliphagidae	Ptilotula	Ptilotula keartlandi	Grey-headed Honeyeater	235		
Animalia	Chordata	Aves	Passeriformes	Meliphagidae	Ptilotula	Ptilotula penicillata	White-plumed Honeyeater	604		
Animalia	Chordata	Aves	Passeriformes	Meliphagidae	Ptilotula	Ptilotula plumula	Grey-fronted Honeyeater	7		
Animalia	Chordata	Aves	Passeriformes	Meliphagidae	Purnella	Purnella albifrons	White-fronted Honeyeater	17		
Animalia	Chordata	Aves	Passeriformes	Meliphagidae	Sugomel	Sugomel nigrum	Black Honeyeater	38		
Animalia	Chordata	Aves	Coraciiformes	Meropidae	Merops	Merops (Merops) ornatus	Rainbow Bee-eater	398		
Animalia	Chordata	Aves	Passeriformes	Monarchidae	Grallina	Grallina cyanoleuca	Magpie-lark	642		

Animalia	Chordata	Aves	Passeriformes	Motacillidae	Anthus	Anthus (Anthus) novaeseelandiae	Australian Pipit	154		
Animalia	Chordata	Aves	Passeriformes	Neosittidae	Daphoenositta	Daphoenositta (Neositta) chrysoptera	Varied Sittella	12		
Animalia	Chordata	Aves	Passeriformes	Oreoicidae	Oreoica	Oreoica gutturalis	Crested Bellbird	201		
Animalia	Chordata	Aves	Gruiformes	Otididae	Ardeotis	Ardeotis australis	Plain Turkey	113		
Animalia	Chordata	Aves	Passeriformes	Pachycephalidae	Colluricincla	Colluricincla (Colluricincla) harmonica	Grey Shrike-thrush	231		
Animalia	Chordata	Aves	Passeriformes	Pachycephalidae	Pachycephala	Pachycephala (Alisterornis) rufiventris	Rufous Whistler	338		
Animalia	Chordata	Aves	Passeriformes	Pardalotidae	Pardalotus	Pardalotus (Pardalotinus) rubricatus	Red-browed Pardalote	262		
Animalia	Chordata	Aves	Passeriformes	Pardalotidae	Pardalotus	Pardalotus (Pardalotinus) striatus	Striated Pardalote	93		
Animalia	Chordata	Aves	Pelecaniformes	Pelecanidae	Pelecanus	Pelecanus conspicillatus	Australian Pelican	110		
Animalia	Chordata	Aves	Passeriformes	Petroicidae	Melanodryas	Melanodryas (Melanodryas) cucullata	Hooded Robin	89		
Animalia	Chordata	Aves	Passeriformes	Petroicidae	Petroica	Petroica (Petroica) goodenovii	Red-capped Robin	85		
Animalia	Chordata	Aves	Pelecaniformes	Phalacrocoracidae	Microcarbo	Microcarbo melanoleucos	Little Cormorant	116		
Animalia	Chordata	Aves	Pelecaniformes	Phalacrocoracidae	Phalacrocorax	Phalacrocorax (Phalacrocorax) carbo	Great Cormorant	3		
Animalia	Chordata	Aves	Pelecaniformes	Phalacrocoracidae	Phalacrocorax	Phalacrocorax (Phalacrocorax) sulcirostris	Little Black Cormorant	116		
Animalia	Chordata	Aves	Pelecaniformes	Phalacrocoracidae	Phalacrocorax	Phalacrocorax (Phalacrocorax) varius	Black-and-white Shag	9		
Animalia	Chordata	Aves	Galliformes	Phasianidae	Coturnix	Coturnix (Coturnix) pectoralis	Grey Quail	1		
Animalia	Chordata	Aves	Galliformes	Phasianidae	Pavo	Pavo cristatus	Peafowl	1		
Animalia	Chordata	Aves	Galliformes	Phasianidae	Synoicus	Synoicus ypsilophora	Partridge Quail	25		
Animalia	Chordata	Aves	Caprimulgiformes	Podargidae	Podargus	Podargus strigoides	Tawny Frogmouth	25		
Animalia	Chordata	Aves	Podicipediformes	Podicipedidae	Podiceps	Podiceps cristatus	Crested Grebe	1		
Animalia	Chordata	Aves	Podicipediformes	Podicipedidae	Poliocephalus	Poliocephalus poliocephalus	Hoary-headed Dabchick	24		
Animalia	Chordata	Aves	Podicipediformes	Podicipedidae	Tachybaptus	Tachybaptus novaehollandiae	Australian Little Grebe	43		
Animalia	Chordata	Aves	Passeriformes	Pomatostomidae	Pomatostomus	Pomatostomus (Morganornis) superciliosus	White-browed Babbler	49		
Animalia	Chordata	Aves	Passeriformes	Pomatostomidae	Pomatostomus	Pomatostomus (Pomatostomus) temporalis	Grey-crowned Babbler	261		
Animalia	Chordata	Aves	Psittaciformes	Psittacidae	Barnardius	Barnardius zonarius	Australian Ringneck	301		
Animalia	Chordata	Aves	Psittaciformes	Psittacidae	Melopsittacus	Melopsittacus undulatus	Budgerigar	433		
Animalia	Chordata	Aves	Psittaciformes	Psittacidae	Neophema	Neophema (Neonanodes) elegans	Elegant Parrot	5		
Animalia	Chordata	Aves	Psittaciformes	Psittacidae	Neopsephotus	Neopsephotus bourkii	Bourke's Parrot	28		
Animalia	Chordata	Aves	Psittaciformes	Psittacidae	Pezoporus	Pezoporus occidentalis	Night Parrot	1		
Animalia	Chordata	Aves	Psittaciformes	Psittacidae	Polytelis	Polytelis alexandrae	Alexandra's Parrot	1		
Animalia	Chordata	Aves	Psittaciformes	Psittacidae	Psephotus	Psephotus (Psephotellus) varius	Mulga Parrot	6		
Animalia	Chordata	Aves	Passeriformes	Psophodidae	Psophodes	Psophodes (Sphenostoma) occidentalis	Chiming Wedgebill	4		
Animalia	Chordata	Aves	Passeriformes	Ptilonorhynchidae	Chlamydera	Chlamydera guttata	Western Bowerbird	115		
Animalia	Chordata	Aves	Gruiformes	Rallidae	Fulica	Fulica atra	Eurasian Coot	31		
Animalia	Chordata	Aves	Gruiformes	Rallidae	Gallirallus	Gallirallus philippensis		1		
Animalia	Chordata	Aves	Gruiformes	Rallidae	Porphyrio	Porphyrio (Porphyrio) porphyrio	Purple Gallinule	1		
Animalia	Chordata	Aves	Gruiformes	Rallidae	Porzana	Porzana (Porzana) tabuensis	Little Swamphen	4		
Animalia	Chordata	Aves	Gruiformes	Rallidae	Tribonyx	Tribonyx ventralis	Black-tailed Native Hen	9		
Animalia	Chordata	Aves	Charadriiformes	Recurvirostridae	Himantopus	Himantopus himantopus	Pied Stilt	39		
Animalia	Chordata	Aves	Charadriiformes	Recurvirostridae	Recurvirostra	Recurvirostra novaehollandiae	Australian Red-necked Avocet	7		
Animalia	Chordata	Aves	Passeriformes	Rhipiduridae	Rhipidura	Rhipidura (Rhipidura) albiscapa	Grey Fantail	12		
Animalia	Chordata	Aves	Passeriformes	Rhipiduridae	Rhipidura	Rhipidura (Sauloprocta) leucophrys	Willie Wagtail	682		
Animalia	Chordata	Aves	Charadriiformes	Rostratulidae	Rostratula	Rostratula australis	Australian Painted-snipe	1		
Animalia	Chordata	Aves	Charadriiformes	Scolopacidae	Actitis	Actitis hypoleucos	Common Sandpiper	9		
Animalia	Chordata	Aves	Charadriiformes	Scolopacidae	Calidris	Calidris (Ereunetes) minuta	Little Stint	2		
Animalia	Chordata	Aves	Charadriiformes	Scolopacidae	Calidris	Calidris (Ereunetes) subminuta	Long-toed Stint	3		
Animalia	Chordata	Aves	Charadriiformes	Scolopacidae	Calidris	Calidris (Erolia) acuminata	Sharp-tailed Sandpiper	8		

Animalia	Chordata	Aves	Charadriiformes	Scolopacidae	Tringa	Tringa (Glottis) nebularia	Greenshank	1		
Animalia	Chordata	Aves	Charadriiformes	Scolopacidae	Tringa	Tringa (Rhyacophilus) glareola	Wood Sandpiper	17		
Animalia	Chordata	Aves	Strigiformes	Strigidae	Ninox	Ninox (Hieracoglaux) connivens	Barking Owl	29		
Animalia	Chordata	Aves	Strigiformes	Strigidae	Ninox	Ninox (Ninox) boobook		38		
Animalia	Chordata	Aves	Strigiformes	Strigidae	Ninox	Ninox (Ninox) novaeseelandiae	Southern Boobook	67		
Animalia	Chordata	Aves	Ciconiiformes	Threskiornithidae	Platalea	Platalea (Platalea) regia	Royal Spoonbill	11		
Animalia	Chordata	Aves	Ciconiiformes	Threskiornithidae	Platalea	Platalea (Platibis) flavipes	Yellow-legged Spoonbill	16		
Animalia	Chordata	Aves	Ciconiiformes	Threskiornithidae	Plegadis	Plegadis falcinellus	Black Curlew	4		
Animalia	Chordata	Aves	Ciconiiformes	Threskiornithidae	Threskiornis	Threskiornis moluccus	Black-necked Ibis	6		
Animalia	Chordata	Aves	Ciconiiformes	Threskiornithidae	Threskiornis	Threskiornis spinicollis	Letter Bird	92		
Animalia	Chordata	Aves	Turniciformes	Turnicidae	Turnix	Turnix (Alphaturnia) velox	Dotterel Quail	127		
Animalia	Chordata	Aves	Strigiformes	Tytonidae	Tyto	Tyto alba	Barn Owl	7		
Animalia	Chordata	Aves	Strigiformes	Tytonidae	Tyto	Tyto javanica	Eastern Barn Owl	11		
Animalia	Chordata	Mamma	Chiroptera	Emballonuridae	Saccolaimus	Saccolaimus flaviventris	Yellow-bellied Sheathtail Bat	2		
Animalia	Chordata	Mamma	Chiroptera	Emballonuridae	Taphozous	Taphozous georgianus	Common Sheathtail-bat	70		
Animalia	Chordata	Mamma	Chiroptera	Emballonuridae	Taphozous	Taphozous hilli	Hill's Sheath-tailed Bat	4		
Animalia	Chordata	Mamma	Chiroptera	Megadermatidae	Macroderma	Macroderma gigas	Ghost Bat	58		
Animalia	Chordata	Mamma	Chiroptera	Molossidae	Austronomus	Austronomus australis	White-striped Freetail-bat	1		
Animalia	Chordata	Mamma	Chiroptera	Molossidae	Chaerephon	Chaerephon jobensis	Northern Mastiff Bat	19		
Animalia	Chordata	Mamma	Chiroptera	Molossidae	Ozimops	Ozimops lumsdenae	Northern Free-tailed Bat	40		
Animalia	Chordata	Mamma	Chiroptera	Pteropodidae	Pteropus	Pteropus alecto	Black Flying-fox	2		
Animalia	Chordata	Mamma	Chiroptera	Rhinonycteridae	Rhinonicteris	Rhinonicteris aurantia	Orange Leaf-nosed Bat	9		
Animalia	Chordata	Mamma	Chiroptera	Vespertilionidae	Chalinolobus	Chalinolobus gouldii	Gould's Wattled Bat	54		
Animalia	Chordata	Mamma	Chiroptera	Vespertilionidae	Chalinolobus	Chalinolobus morio	Chocolate Wattled Bat	3		
Animalia	Chordata	Mamma	Chiroptera	Vespertilionidae	Chalinolobus	Chalinolobus nigrogriseus	Hoary Wattled Bat	1		
Animalia	Chordata	Mamma	Chiroptera	Vespertilionidae	Nyctophilus	Nyctophilus geoffroyi	Lesser Long-eared Bat	22		
Animalia	Chordata	Mamma	Chiroptera	Vespertilionidae	Nyctophilus	Nyctophilus daedalus	Pallid Long-eared Bat	21		
Animalia	Chordata	Mamma	Chiroptera	Vespertilionidae	Scotorepens	Scotorepens greyii	Little Broad-nosed Bat	45		
Animalia	Chordata	Mamma	Chiroptera	Vespertilionidae	Scotorepens	Scotorepens balstoni	Inland Broad-nosed Bat	10		
Animalia	Chordata	Mamma	Chiroptera	Vespertilionidae	Vespadelus	Vespadelus finlaysoni	Finlayson's Cave Bat	257		

Appendix C Bat call analysis and preliminary risk assessment (Specialised Zoological 2024).

Specialised Zoological

Identification of bat species from Bonney Downs, Western Australia

Prepared for **Ecologia Environment Pty Ltd**

Version **22 August 2024**

SZ project reference **SZ720**

Specialised Zoological ABN 92 265 437 422
Dr Kyle Armstrong and Yuki Konishi
Tel +61 (0)404 423 264
kyle.n.armstrong@gmail.com

This report should be included as an appendix in any larger submission to Government, and cited as:

Specialised Zoological (2024). Identification of bat species from Bonney Downs, Western Australia. Unpublished report by Specialised Zoological for Ecologia Environment Pty Ltd, 22 August 2024, project reference SZ720.

Version history

Date	Version	Note
2024-06-20	2024-06-20	Interim results from partial analysis of the datasets
2024-08-19	2024-08-19	Final report with outcomes from full analysis
2024-08-22	2024-08-22	Final report with addition of 2023 data

© Copyright - Specialised Zoological, ABN 92 265 437 422. This document and its content are copyright and may not be copied, reproduced or distributed (in whole or part) without the prior written permission of Specialised Zoological other than by the Client for the purposes authorised by Specialised Zoological ("Intended Purpose"). The Client acknowledges that the Final Report is intended for the sole use of the Client, and only to be used for the Intended Purpose. Any representation or recommendation contained in the Final Report is made only to the Client. Specialised Zoological will not be liable for any loss or damage whatsoever arising from the use and/or reliance on the Final Report by any third party. To the extent that the Intended Purpose requires the disclosure of this document and/or its content to a third party, the Client must procure such agreements, acknowledgements and undertakings as may be necessary to ensure that the third party does not copy, reproduce, or distribute this document and its content other than for the Intended Purpose. This disclaimer does not limit any rights Specialised Zoological may have under the *Copyright Act 1968 (Cth)*.

Contents

1.0 Summary 4
1.1 Scope and data 4
1.2 Species richness 4
1.3 Ghost Bat 5
1.4 Pilbara Diamond-faced Bat 5
1.5 Bat species not detectable with the methods used 5
2.0 Methods 6
2.1 Ultrasonic recordings 6
2.2 Acoustic lure sites with infrared video recordings 6
3.0 Limitations 9
4.0 References 10
Appendix 1. Summarising collision risk—a possible starting point 28
Appendix 2. Use of acoustic lures 31

1.0 Summary

1.1 Scope and data

Bat identifications from acoustic recordings are provided from the Bonney Downs project area, in the Pilbara region of Western Australia. The datasets reported on here comprise a total of 144 sites, 320 recording nights and 475,151 WAV files:

- May 2023 'BBD' and 'BDDP' series—18 sites, 53 recording nights (119,133 sound files)
- July 2023 'BDTBD' series—4 sites, 18 recording nights (9,912 sound files)
- October 2023 'BB' and 'BDDP' series—42 sites, 80 recording nights (121,987 sound files)
- February 2024 'BB' series—39 sites, 78 recording nights (104,101 WAV sound files)
- March 2024 'BB' series—31 sites, 63 recording nights (65,952 WAV sound files)
- March 2024 'BDDP'—10 sites, 28 recording nights (54,066 WAV sound files)

Particular attention was given to the detection of two bat species of conservation significance: Ghost Bat *Macroderma gigas* (Megadermatidae) and Pilbara Diamond-faced Bat *Rhinonicteris aurantia* (Rhinonycteridae).

Two methods were used on the field survey:

1. Ultrasonic recordings with bat detectors to provide species identifications from echolocation calls;
2. Acoustic lure (portable speaker broadcasting Ghost Bat social calls; **Figure 1**) with detections and identification of the Ghost Bat from both infrared video and ultrasonic recordings; this is a targeted survey method to detect the species away from roost sites.

1.2 Species richness

Ten species of bat were detected (**Table 1**; **Figure 2**); which includes both the Ghost Bat and Pilbara Diamond-faced Bat. Each bat species was assigned to one of three categories representing the likelihood that they would be encountered above an altitude of 50 metres. This is an authoritative estimate based on my own accumulated casual field observations.

To give a further indication of the relative risk of collision of each species, the frequency of detection was calculated across sites for each species on each survey, and across all sites (**Table 2**). A risk matrix was devised based on the likelihood of detection at height categories and the frequency of detection values, which might be useful as a 'starting point' (conjecture) for considering the relative risk of collision with a turbine for each species (**Appendix 1**).

Details of detections at each site (collated across recording nights per site) are summarised in **Tables 3 – 8**.

One interesting observation was made for a high-flying species: the White-striped Free-tailed Bat *Austronomus australis* (Molossidae) is only seasonally present in the region from April to September according to an analysis presented by Bullen and McKenzie (2005). Observations

from the surveys were consistent with this analysis, with *A. australis* being detected only on the May and July 2023 surveys.

1.3 Ghost Bat

The Ghost Bat was detected at one acoustic lure site: BDGB03. One 'fly-by' was observed in in video recordings on both infrared camera traps at 18:52:22 and 18:52:54 (**Table 9**). The identification was based on the observation of an anteriorly-directed structure resembling long ears, the broad wings, and lack of a distinct tail (**Figure 3**; see comparison with images of birds and insects in **Figure 4**). It was not detected in echolocation recordings at the acoustic lure sites. However, the bat detector recording failed at site BDGB03. No other detections of the Ghost Bat were made on the surveys.

1.4 Pilbara Diamond-faced Bat

The Pilbara Diamond-faced Bat was detected from one echolocation sequence from acoustic lure site BDGB01 (unit 641036) on the night of 2024-03-22 at 23:21:09 (**Figure 5**). I have observed this species approaching a Ghost Bat social call broadcast on previous occasions. The Pilbara Diamond-faced Bat was also detected well after sunset and well before sunrise at 14 other sites in 2023 and 2024 (**Table 10**):

- 7 sites in May 2023
- 4 sites October 2023
- 3 sites in February 2024

1.5 Bat species not detectable with the methods used

Given that this survey was conducted to understand the possible effects of the construction and operation of wind turbines on bats, it is worth noting six species that were not detected in the analysis. Three of these are known to forage or commute above the tree canopy height and might range within the blade swept area of a wind turbine in this study area. These species cannot be detected using the methods described in the present report. Three other species not detected are either not found in this part of the Pilbara, or else have low detectability with bat detectors.

- **Black Flying-fox *Pteropus alecto* and Little Red Flying-fox *Pteropus scapulatus*** (Pteropodidae)—do not echolocate and are therefore not detected by acoustic recorders (bat detectors).
- **Hill's Sheath-tailed Bat *Taphozous hilli*** (Emballonuridae)—could be present in addition to *T. georgianus*, given its distribution in the region (Milne et al. 2023), but its calls cannot be distinguished reliably from those of *T. georgianus*.
- **Pallid Long-eared Bat *Nyctophilus daedalus* and Lesser Long-eared Bat *Nyctophilus geoffroyi*** (Vespertilionidae)—might be present but their echolocation calls are usually low in amplitude, and can be difficult to distinguish from clutter calls of the Little Broad-nosed Bat *Scotorepens greyii*.
- **Northern Coastal Free-tailed Bat *Ozimops cobourgianus*** (Molossidae)—found only along the Pilbara coast, usually in mangal habitat.

2.0 Methods

2.1 Ultrasonic recordings

The ultrasonic recordings provided were recorded in WAV format with Titley Scientific Anabat Chorus bat detectors (sampling rate 500 kHz, set to turn on automatically at sunset and off at sunrise), and Wildlife Acoustics SM4BAT-FS bat detectors (sampling rate 384 kHz).

A multi-step acoustic analysis procedure developed to process large full spectrum echolocation recording datasets from insectivorous bats (Armstrong et al. 2021a,b) was applied to the recordings made on the survey. Firstly, the WAV files were scanned for bat echolocation calls using several parameter sets in the software SCAN'R version 1.8.3 (Binary Acoustic Technology), which also provides measurements (SCAN'R parameters) from each putative bat pulse. The outputs were then used to determine if putative bat pulses measured in SCAN'R could be identified to species. This was done using a custom [R] language application that performed three tasks:

1. undertook a Discriminant Function Analysis on training data from representative calls from the Pilbara;
2. from the measurements of each putative bat pulse from SCAN'R, calculated values for the first two Discriminant Functions that could separate the echolocation call types derived from the analysis of training data, and plotted these resulting coordinates over data ellipses representing one standard deviation of the variation for the defined call types; and
3. facilitated an inspection in a spectrogram of multiple examples of each call type for each recording night by opening the original WAV files containing pulses of interest in ADOBE AUDITION version 23.1.

Species were identified based on information in the author's unpublished material and Churchill (2008). Nomenclature follows Jackson and Groves (2015). Identifications were supported by distribution information in a curated source of distribution records maintained by the Australasian Bat Society, Inc. (https://www.ausbats.org.au/batmap.html) (Milne et al. 2023). Custom [R] language scripts were used to summarise the analysis outcomes.

2.2 Acoustic lure sites with infrared video recordings

An acoustic lure system was set at seven sites for one night each. This method is based on recent demonstrations of its utility by Hanrahan et al. (2023) and Ruykys et al. (2023), and is broadly consistent with guidelines on the approach released in the Northern Territory (Ruykys et al. 2024). The system comprised a portable speaker (generic brand from Amazon), an Anabat Chorus bat detector, two infrared-capable camera traps (Jaycar model QC8051), and two 'long range infrared spotlights' (Jaycar model QC3654).

The portable speakers were loaded with a micro-SD card containing a sequence of sound files comprising 'squabble' calls; *sensu* Hanrahan et al. 2023; see **Appendix 2**) of the Ghost Bat. Sound files consisted of a 2-minute period with various examples of squabble calls, followed by a 2-minute period of silence. The speakers played sound files on a memory card

sequentially upon startup, for the entire night. The speaker volume was maximised. The distance at which Ghost Bats can hear the signals at night is unknown but assumed to be at least 100 m.

The camera trap was set to record back-to-back 3-minute black and white video files at high resolution (4K 3840 x 2160) continuously upon start up. Recordings were started after covering the camera lens so that the unit switched from colour to night (black and white) mode. The settings were adjusted so that built-in infrared LEDs were non-functional, and infrared light was instead provided by the long-range infrared spotlight, which was powered by 10 AA batteries that lasted c. 5 hours. Each camera trap contained a blank 256 GB Sandisk SD card, which had the capacity to save the recording from a full night.

The Chorus bat detector was placed on the central star picket underneath the portable speaker to maximise the chance of detection via echolocation calls if a Ghost Bat approached the speaker. Detection of echolocation calls provides a way to independently validate any detection made from the video recordings (**Appendix 2**).



Figure 1. Representation of the acoustic lure system deployment. There are two camera traps for redundancy and corroboration of images of bats, and a bat detector for validation of an identification made from videos based on echolocation calls only.

All videos were processed with an expeditious and robust analysis method. A custom Python (https://www.python.org/) script (Dr R. C. Morgans, Supersensory Technologies Pty Ltd unpublished) applied a background subtraction algorithm from the *opencv* framework (https://opencv.org/) to the recordings and constructed a concatenated short video containing only portions of the recording with moving objects above a certain size. These concatenated videos are watched at <50% speed in the MPV MEDIA PLAYER (https://mpv.io/), which allows fine control of frame advancement. Objects of interest were located and re-examined in the original 4K recording using the embedded timestamp information.

Smaller species of bat can be seen often in the infrared videos. Without careful consideration, these species can sometimes be confused for the Ghost Bat when they fly near the speaker—a behaviour that might intuitively be expected only from the Ghost Bat. Ghost Bats can be distinguished in infrared and thermal video recordings from other bat species and insects based on the observation of any combination of the following morphological and behavioural features that provide an empirical basis for the identification:

- flight pattern (four distinct behaviours classified as: ‘circling’ of the post containing the speaker; ‘hover’ in front of the speaker; ‘long glide’ towards the speaker; and ‘drop in’ whereby they would sometimes approach at c. 2 m above the speaker and then drop vertically towards it);
- body size relative to other objects in the frame;
- large ear size;
- lack of a tail;
- bright eyeshine of the reflected infrared light from their large eyes (infrared recordings only, though not always visible); and
- corroboration with concurrently-recorded diagnostic echolocation calls (**Appendix 2**).

All bats observed in videos are examined by single manual frame advancement to check for diagnostic features. The relatively high resolution and video frame rate provides a reasonable level of image quality.

3.0 Limitations

The identifications presented in this report have been made within the following context:

1. The identifications made herein were based on the ultrasonic sound recordings made and provided by a 'third party' (the client named on the front of this report).
2. In the case of the present report, the recording equipment was set up and supplied by Specialised Zoological. The equipment was operated by the third party during the survey.
3. Other than the general location of the study area, Specialised Zoological has not been provided with detailed information of the survey area, has not made a visit to observe the habitats available for bats, nor have we visited the specific project areas on a previous occasion.
4. Specialised Zoological has had no input into the overall design and timing of this bat survey, recording site placement, nor the degree of recording site replication.
5. This version of the document supersedes any previous version, including the interim report (Specialised Zoological 2024). Previous drafts are not authorised by us for submission to the regulator or the public domain.
6. Please see **Appendix 2** for more information about the application of the acoustic lure.

4.0 References

Armstrong K.N., Broken-Brow J., Hoye G., Ford G., Thomas M. and Corben C. (2021a). Effective detection and identification of sheath-tailed bats of Australian forests and woodlands. *Australian Journal of Zoology* 68:346–363. https://doi.org/10.1071/ZO20044

Armstrong K.N., Clarke S., Linke A., Scanlon A., Roetman P., Hitch, A.T. and Donnellan S.C. (2021b). Citizen science implements the first intensive acoustics-based survey of insectivorous bat species across the Murray-Darling Basin of South Australia. *Australian Journal of Zoology* 68: 364–381. https://doi.org/10.1071/ZO20051

Bullen, R.D. and McKenzie, N.L. (2005). Seasonal range variation of *Tadarida australis* (Chiroptera: Molossidae) in Western Australia: the impact of enthalpy. *Australian Journal of Zoology* 53: 145–156.

Churchill, S.K. (2008). *Australian bats.* 2nd ed. Allen and Unwin, Crows Nest, NSW.

Hanrahan, N., Turbill C., Armstrong K.N., Dalziell A.H. and Welbergen J.A. (2023). Calling up ghosts: acoustic playback of social vocalisations reveals complex communication in a cryptic bat and provides a promising tool for monitoring disturbance-sensitive species. *Mammal Research*. https://doi.org/10.1007/s13364-023-00727-w

Jackson, S.M. and Groves, C.P. (2015). *Taxonomy of Australian mammals*. CSIRO Publishing, Victoria.

Milne D.J., Reardon T.B. and Ford G. (2023) BatMap – authoritative distribution maps for Australian bats. *Australian Mammalogy*. 45: 350–355. https://doi.org/10.1071/AM23005

Ruykys, L., Hanrahan, N. and Stokeld, D. (2023). Novel acoustic lure methodology facilitates detection of the cryptic ghost bat at a landscape scale. *Wildlife Research* 51. https://doi.org/10.1071/WR22189

Ruykys L., Hanrahan N. and Stokeld D. (2024) Northern Territory guidelines for surveying for the ghost bat at the landscape scale. Technical Report 05/2024, Department of Environment, Parks and Water Security, Palmerston, Northern Territory and Charles Darwin University, Brinkin, Northern Territory.

Specialised Zoological (2024). Acoustic analysis and bat call identification from Bonney Downs, Western Australia: interim results. Unpublished report by Specialised Zoological for Ecologia Environment Pty Ltd, 20 June 2024, project reference SZ720.

Table 1. Species identified in the present survey from all sites combined. The predicted presence above 50 metres in altitude is an authoritative estimate based on my own accumulated casual field observations ('predicted to be encountered commonly above 50 m').

Predicted presence above 50 m altitude		
	MEGADERMATIDAE	
Medium	Ghost Bat	*Macroderma gigas*
	RHINONYCTERIDAE	
Low	Pilbara Diamond-faced Bat (Pilbara Leaf-nosed Bat)	*Rhinonicteris aurantia*
	EMBALLONURIDAE	
Medium	Yellow-bellied Sheath-tailed Bat	*Saccolaimus flaviventris*
High	Common Sheath-tailed Bat	*Taphozous georgianus*
	VESPERTILIONIDAE	
Low	Gould's Wattled Bat	*Chalinolobus gouldii*
Low	Little Broad-nosed Bat	*Scotorepens greyii*
Low	Finlayson's Cave Bat	*Vespadelus finlaysoni*
	MOLOSSIDAE	
High	White-striped Free-tailed Bat	*Austronomus australis*
Medium	Greater Northern Free-tailed Bat	*Chaerephon jobensis*
Medium	Northern Free-tailed Bat	*Ozimops lumsdenae*

Table 2. Frequency of detection across sites for each species on each survey (higher intensity of colour for higher values).

Species	May 2024	July 2024	October 2024	February 2024 (BB series)	March 2024 (BB series)	March 2024 (BDDP series)	Over all surveys
A. australis	0.00	0.00	0.00	0.44	0.50	0.00	0.07
C. gouldii	0.87	0.77	0.80	0.94	1.00	0.74	0.85
C. jobensis	0.54	0.39	0.50	0.83	1.00	0.45	0.55
O. lumsdenae	0.18	0.26	0.00	0.11	0.50	0.14	0.18
R. aurantia	0.08	0.00	0.00	0.39	0.00	0.10	0.10
S. flaviventris	0.87	0.84	0.90	0.50	0.25	0.48	0.71
S. greyii	0.87	0.74	0.80	0.89	1.00	0.79	0.85
T. georgianus	0.77	0.61	0.80	0.83	1.00	0.50	0.70
V. finlaysoni	0.49	0.42	0.60	0.50	1.00	0.55	0.53

Table 3. Species detected at each site in May 2023 ('BBD' and 'BDDP' sites).

						A. australis	*C. gouldii*	*C. jobensis*	*O. lumsdenae*	*R. aurantia*	*S. flaviventris*	*S. greyii*	*T. georgianus*	*V. finlaysoni*
Site	**Detector serial**	**Coordinates**	**First night**	**Last night**	**Nights**									
BBD01	S4U06484-MDSM4-02	-22.579550, 117.011240	2023-05-27	2023-05-30	4	X	X	X	.	X	.	X	X	X
BBD02	S4U11723-MDSM4-03	-22.579550, 117.011240	2023-05-28	2023-05-29	2	X	X	X	.	X	.	X	X	X
BBD03	S4U11658-MDSM4-05	-22.579330, 117.011580	2023-05-30	2023-05-31	2	.	X	X	.	.	.	X	.	.
BBD04	S4U11723-MDSM4-03	-22.579550, 117.011240	2023-05-30	2023-05-31	2	.	X	X	.	.	X	.	.	.
BBD05	S4U06478-MDSM4-01	-22.579550, 117.011240	2023-05-30	2023-05-31	2	.	X	X	.	.	X	X	X	.
BBD06	S4U11657-MDSM4-07	-22.140550, 118.563240	2023-05-30	2023-05-31	2	X	X	X	.	X	X	X	X	X
BBD07	S4U11659-MDSM4-04	-22.579330, 117.011240	2023-05-30	2023-05-31	2	.	X	X	.	.	X	X	X	X
BBDDP02	S4U11723-MDSM4-03	-22.579550, 117.011240	2023-05-25	2023-05-27	3	.	X	X	.	.	X	X	X	X
BDBAT01	S4U11651-MDSM4-06	-22.579330, 117.011580	2023-05-28	2023-05-30	3	X	X	X	X	X	.	.	X	X
BDDP01	S4U11651-MDSM4-06	-22.579330, 117.011580	2023-05-24	2023-05-26	3	X	X	.	.	.	X	X	X	.
BDDP03	S4U06478-MDSM4-01	-22.579550, 117.011240	2023-05-23	2023-05-26	4	X	X	X	.	X	.	X	X	.
BDDP04	S4U11657-MDSM4-07	-22.140550, 118.563240	2023-05-24	2023-05-26	3	X	X	X	.	.	X	X	X	X
BDDP05	S4U11658-MDSM4-05	-22.579330, 117.011580	2023-05-23	2023-05-25	3	.	X	X	X	.	X	X	X	X
BDDP06	S4U11658-MDSM4-05	-22.579330, 117.011580	2023-05-26	2023-05-29	4	.	X	X	.	X	.	X	X	X
BDDP07	S4U11659-MDSM4-04	-22.579330, 117.011240	2023-05-26	2023-05-29	4	.	X	X	.	X	.	X	X	.
BDDP08	S4U06484-MDSM4-02	-22.579550, 117.011240	2023-05-23	2023-05-26	4	.	X	.	.	.	.	X	X	.
BDDP09	S4U06478-MDSM4-01	-22.579550, 117.011240	2023-05-27	2023-05-29	3	.	X	.	.	.	.	X	.	.
BDDP10	S4U11657-MDSM4-07	-22.140550, 118.563240	2023-05-27	2023-05-29	3	X	.	X	.	.	X	X	X	.

Table 4. Species detected at each site in July 2023 ('BDTBD' sites).

						A. australis	*C. gouldii*	*C. jobensis*	*O. lumsdenae*	*R. aurantia*	*S. flaviventris*	*S. greyii*	*T. georgianus*	*V. finlaysoni*
Site	**Detector serial**	**Coordinates**	**First night**	**Last night**	**Nights**									
BDTBD01	636494	-22.018644, 119.971222	2023-07-25	2023-07-28	4	.	X	X	X	.	.	X	X	X
BDTBD02	644439	-22.021631, 119.964485	2023-07-25	2023-07-28	4	.	X	X	X	.	.	X	X	X
BDTBD03	644439	-21.973442, 119.999969	2023-07-26	2023-07-31	6	X	X	X	.	.	.	X	X	X
BDTBD04	636494	-21.978964, 119.990219	2023-07-29	2023-08-01	4	X	X	X	.	.	X	X	X	X

Table 5. Species detected at each site in October 2023 ('BB' and 'BDDP' sites; continued next page).

						A. australis	*C. gouldii*	*C. jobensis*	*O. lumsdenae*	*R. aurantia*	*S. flaviventris*	*S. greyii*	*T. georgianus*	*V. finlaysoni*
Site	**Detector serial**	**Coordinates**	**First night**	**Last night**	**Nights**									
BDDP13	S4U06484-MDSM4-02	.	2023-10-12	2023-10-14	3	.	.	.	.	X	.	X	X	X
BB017	S4U06484-MDSM4-02	.	2023-10-15	2023-10-16	2	.	X	X	.	.	X	X	.	X
BB012	S4U06484-MDSM4-02	.	2023-10-17	2023-10-18	2	.	X	.	.	.	X	X	.	X
BB040	S4U11723-MDSM4-03	.	2023-10-09	2023-10-10	2	.	X	.	.	.	.	X	.	.
BDDP11	S4U11723-MDSM4-03	.	2023-10-11	2023-10-13	3	.	X	X	.	.	X	X	X	X
BB039	S4U11723-MDSM4-03	.	2023-10-14	2023-10-15	2	.	X	X	.	.	X	X	X	.
BB011	S4U11723-MDSM4-03	.	2023-10-16	2023-10-18	3	.	X	X	.	X	X	X	X	X
BB028	S4U11659-MDSM4-04	.	2023-10-11	2023-10-12	2	.	.	.	.	.	.	X	X	.
BB026	S4U11659-MDSM4-04	.	2023-10-13	2023-10-14	2	.	X	X	.	.	.	.	X	X
BB018	S4U11659-MDSM4-04	.	2023-10-15	2023-10-16	2	.	X	.	.	.	.	X	.	X
BB015	S4U11659-MDSM4-04	.	2023-10-17	2023-10-18	2	.	X	X	X	.	X	X	X	X
BB033	S4U11658-MDSM4-05	.	2023-10-11	2023-10-12	2	.	X	X	X	.	.	X	.	.
BB030	S4U11658-MDSM4-05	.	2023-10-13	2023-10-14	2	.	X	X	.	.	.	X	X	.
BB002	S4U11658-MDSM4-05	.	2023-10-15	2023-10-16	2	.	.	.	.	.	.	.	.	.
BB029	MDSM4-06	no data	2023-10-11	2023-10-12	2	.	.	.	.	.	.	.	.	.
BB023	MDSM4-06	no data	2023-10-13	2023-10-14	2	.	.	.	.	.	.	.	.	.
BB001	MDSM4-06	no data	2023-10-15	2023-10-16	2	.	.	.	.	.	.	.	.	.
BB007	MDSM4-06	no data	2023-10-17	2023-10-18	2	.	.	.	.	.	.	.	.	.
BB032	S4U11659-MDSM4-07	-22.045100, 119.944370	2023-10-09	2023-10-10	2	.	X	X	.	.	.	X	X	.
BB025	S4U11659-MDSM4-07	-22.045100, 119.944370	2023-10-11	2023-10-12	2	.	X	X	.	.	X	X	X	X
BB036	S4U11659-MDSM4-07	-22.045100, 119.944370	2023-10-13	2023-10-14	2	.	X	X	X	X	X	X	X	X
BB005	S4U11659-MDSM4-07	-22.045100, 119.944370	2023-10-15	2023-10-16	2	.	X	X	.	.	.	X	X	X
BB010	S4U11659-MDSM4-07	-22.045100, 119.944370	2023-10-17	2023-10-18	2	.	X	.	.	.	X	X	.	X
BB020	TC36-644436	-22.107889, 119.867348	2023-10-11	2023-10-13	2	.	X	.	.	.	X	X	.	X

						A. australis	*C. gouldii*	*C. jobensis*	*O. lumsdenae*	*R. aurantia*	*S. flaviventris*	*S. greyii*	*T. georgianus*	*V. finlaysoni*
Site	**Detector serial**	**Coordinates**	**First night**	**Last night**	**Nights**									
BB016	TC36-644436	-22.198734, 119.918373	2023-10-13	2023-10-15	2	.	X	X	X	.	X	X	.	X
BB004	TC36-644436	-21.951029, 119.794090	2023-10-15	2023-10-17	2	.	X	.	.	.	X	X	.	X
BB021	TC36-644436	-22.196741, 120.013084	2023-10-17	2023-10-19	2	.	X	.	.	.	X	X	.	.
BB037	TC39-644439	-22.045776, 119.883430	2023-10-11	2023-10-13	2	.	.	.	.	.	.	X	X	.
BB022	TC39-644439	-22.114225, 119.975815	2023-10-13	2023-10-15	2	.	X	X	.	.	X	X	X	X
BB003	TC39-644439	-21.919384, 119.782402	2023-10-15	2023-10-17	2	.	X	X	.	X	X	X	X	X
BB008	TC39-644439	no data	.	.	.	.	.	.	.	.	.	.	.	.
BB035	TC40-644440	-22.076000, 119.895966	2023-10-11	2023-10-13	2	.	X	.	.	.	X	X	X	.
BB024	TC40-644440	-21.999393, 119.954002	2023-10-13	2023-10-15	2	.	X	X	X	.	.	.	X	X
BB038	TC40-644440	-22.225801, 119.852524	2023-10-15	2023-10-17	2	.	X	X	.	.	X	X	X	X
BB013	TC40-644440	-22.256664, 119.987633	2023-10-17	2023-10-19	2	.	X	.	.	.	X	X	.	X
BB031	TC88-636488	-22.015324, 119.875801	2023-10-11	2023-10-13	2	.	X	X	X	.	X	X	X	X
BB027	TC88-636488	-21.933846, 119.972397	2023-10-13	2023-10-15	2	.	X	.	.	.	.	.	X	.
BB014	TC88-636488	-22.209757, 119.814163	2023-10-15	2023-10-17	2	.	.	.	.	.	.	X	.	.
BB019	TC88-636488	-22.174740, 119.855011	2023-10-17	2023-10-19	2	.	X	X	.	.	.	X	.	.
BDDP12	TC94-636494	-22.070423, 119.854462	2023-10-11	2023-10-14	3	.	.	.	.	.	X	X	.	X
BB034	TC94-636494	-22.092993, 119.863396	2023-10-14	2023-10-16	2	.	X	.	.	.	.	X	X	X
BB009	TC94-636494	.	2023-10-17	2023-10-17	1	.	X	.	.	.	.	X	.	.

Table 6. Species detected at each site in February 2024 ('BB' sites; continued next page).

						C. gouldii	*C. jobensis*	*O. lumsdenae*	*R. aurantia*	*S. flaviventris*	*S. greyii*	*T. georgianus*	*V. finlaysoni*
Site	**Detector serial**	**Coordinates**	**First night**	**Last night**	**Nights**								
BB001	S4U11723	-32.911090,116.475810	2024-02-09	2024-02-10	2	X	X	.	.	X	X	X	X
BB002	S4U11657	-32.816600,116.379770	2024-02-09	2024-02-10	2	X	X	.	.	X	X	.	.
BB003	S4U11659	-32.781330,116.495450	2024-02-09	2024-02-10	2	X	X	X	X	X	X	X	X
BB004	644439	-21.949577,119.793472	2024-02-09	2024-02-10	2	X	X	.	.	X	.	X	X
BB005	636494	-22.003422,119.817451	2024-02-09	2024-02-10	2	X	.	.	.	X	X	X	X
BB006	644436	-22.025839,119.844109	2024-02-09	2024-02-10	2	X	.	.	.	X	X	.	.
BB007	636494	-22.053459,119.824661	2024-02-11	2024-02-12	2	X	X	.	.	.	X	.	.
BB008	S4U11657	-32.816600,116.379770	2024-02-11	2024-02-12	2	X	X	.	.	X	X	X	X
BB009	S4U11723	-32.911090,116.475810	2024-02-11	2024-02-12	2	.	X	.	.	X	X	X	.
BB010	S4U06478	-32.816600,116.379770	2024-02-11	2024-02-12	2	X	X	.	.	X	X	X	.
BB011	S4U06478	-32.816600,116.379770	2024-02-09	2024-02-10	2	X	X	.	.	X	X	X	X
BB012	S4U06484	-32.830550,116.357890	2024-02-11	2024-02-12	2	.	.	.	.	X	X	X	.
BB013	S4U11651	-22.114890,119.916880	2024-02-11	2024-02-12	2	X	.	X	X	X	X	X	.
BB014	644439	-22.209053,119.813850	2024-02-07	2024-02-08	2	.	.	.	.	X	.	X	.
BB015	S4U11658	-32.791420,116.382810	2024-02-09	2024-02-10	2	X	X	.	.	X	X	X	X
BB016	S4U11651	-22.114890,119.916880	2024-02-05	2024-02-06	2	X	X	X	.	X	X	.	X
BB017	644440	-22.231794,119.898666	2024-02-07	2024-02-08	2	X	X	.	.	X	X	X	.
BB019	636488	-22.175192,119.854073	2024-02-07	2024-02-08	2	X	X	.	.	X	X	.	X
BB020	S4U11651	-22.114890,119.916880	2024-02-07	2024-02-08	2	X	.	.	.	X	X	.	X
BB021	S4U11658	-32.791420,116.382810	2024-02-11	2024-02-12	2	X	.	X	.	X	X	X	.
BB022	S4U06478	-32.816600,116.379770	2024-02-07	2024-02-08	2	X	X	X	.	X	X	X	X
BB023	S4U06484	-32.830550,116.357890	2024-02-07	2024-02-08	2	X	X	.	.	X	X	X	X
BB024	S4U06484	-32.830550,116.357890	2024-02-05	2024-02-06	2	.	.	.	.	.	X	X	.

						C. gouldii	*C. jobensis*	*O. lumsdenae*	*R. aurantia*	*S. flaviventris*	*S. greyii*	*T. georgianus*	*V. finlaysoni*
Site	**Detector serial**	**Coordinates**	**First night**	**Last night**	**Nights**								
BB025	S4U11723	-32.911090,116.475810	2024-02-05	2024-02-06	2	X	X	X	.	X	X	X	X
BB026	S4U11657	-32.816600,116.379770	2024-02-05	2024-02-06	2	X	X	.	.	X	X	X	X
BB027	S4U06478	-32.816600,116.379770	2024-02-05	2024-02-06	2	X	.	.	.	.	X	X	.
BB028	S4U11658	-32.791420,116.382810	2024-02-05	2024-02-06	2	.	.	.	.	.	X	.	.
BB029	S4U11659	-32.781330,116.495450	2024-02-05	2024-02-06	2	X	X	X	.	X	X	X	.
BB030	636494	-22.011641,119.931221	2024-02-05	2024-02-06	2	X	.	.	.	X	.	X	.
BB031	636488	-22.015392,119.875801	2024-02-09	2024-02-10	2	X	.	.	.	X	.	X	.
BB032	644436	-22.145529,119.928078	2024-02-05	2024-02-06	2	X	.	.	.	.	X	.	.
BB033	644440	-21.964575,119.868095	2024-02-11	2024-02-12	2	X	.	.	.	X	X	.	X
BB034	S4U11651	-22.114890,119.916880	2024-02-09	2024-02-10	2	X	.	.	.	X	X	X	X
BB035	S4U06484	-32.830550,116.357890	2024-02-09	2024-02-10	2	X	X	.	.	X	X	X	.
BB036	644440	-22.033985,119.914337	2024-02-05	2024-02-06	2	X	X	.	.	X	X	X	X
BB037	644440	-22.045576,119.883087	2024-02-09	2024-02-10	2	X	.	.	.	X	.	X	.
BB038	636494	-22.209028,119.868584	2024-02-07	2024-02-08	2	X	X	.	.	X	X	X	X
BB039	S4U11659	-32.781330,116.495450	2024-02-11	2024-02-12	2	X	.	.	X	X	X	X	X
BB040	644439	-22.058601,119.935104	2024-02-05	2024-02-06	2	X	.	.	.	X	X	X	.

Table 7. Species detected at each site in March 2024 ('BB' sites; continued next page).

						C. gouldii	*C. jobensis*	*O. lumsdenae*	*R. aurantia*	*S. flaviventris*	*S. greyii*	*T. georgianus*	*V. finlaysoni*
Site	**Detector serial**	**Coordinates**	**First night**	**Last night**	**Nights**								
BB002	S4U11651	-22.112400,119.871900	2024-03-22	2024-03-23	2	.	.	.	.	X	.	X	.
BB004	644439	-21.949398,119.793747	2024-03-18	2024-03-19	2	X	.	.	.	X	X	X	X
BB006	S4U11657	-21.951290,119.792600	2024-03-21	2024-03-22	2	X	X	.	.	X	X	X	X
BB007	636488	-22.051115,119.825081	2024-03-18	2024-03-19	2	X	.	.	.	X	X	.	.
BB008	S4U11657	-21.951290,119.792600	2024-03-25	2024-03-26	2	X	.	.	.	X	.	X	X
BB009	S4U06478	-22.079100,119.814400	2024-03-25	2024-03-26	2	X	X	.	.	X	X	X	.
BB014	655145	-22.210754,119.813789	2024-03-23	.	1	.	.	.	.	X	.	.	.
BB015	S4U11659	-22.079630,119.814300	2024-03-21	2024-03-22	2	X	X	.	.	X	X	.	X
BB016	S4U11723	-22.199810,119.920150	2024-03-17	2024-03-19	3	X	X	X	.	X	X	X	.
BB017	S4U11723	-22.199810,119.920150	2024-03-20	2024-03-22	3	X	X	.	.	X	X	.	X
BB018	636473	-22.247828,119.842186	2024-03-23	2024-03-24	2	X	.	.	.	X	X	.	X
BB019	S4U11723	-22.199810,119.920150	2024-03-23	2024-03-24	2	X	X	.	.	X	X	X	.
BB021	S4U11651	-22.112400,119.871900	2024-03-24	2024-03-25	2	X	.	X	.	X	X	X	X
BB022	S4U06484	-22.102180,119.825030	2024-03-23	2024-03-24	2	X	X	.	.	X	X	.	X
BB023	644439	-21.975859,119.996063	2024-03-26	2024-03-27	2	X	X	X	.	X	X	.	.
BB024	S4U11651	-22.112400,119.871900	2024-03-26	2024-03-27	2	X	.	X	.	X	X	X	.
BB025	S4U11659	-22.079630,119.814300	2024-03-26	2024-03-27	2	X	.	X	.	X	X	.	.
BB026	636488	-21.906364,119.951920	2024-03-26	2024-03-27	2	X	X	X	.	X	X	X	.
BB027	S4U06484	-22.102180,119.825030	2024-03-26	2024-03-27	2	.	.	.	.	.	.	X	.
BB028	S4U11658	-21.919290,119.783830	2024-03-26	2024-03-27	2	X	X	.	.	.	X	X	.
BB029	S4U11657	-21.951290,119.792600	2024-03-23	2024-03-24	2	.	.	.	.	X	X	X	.
BB030	S4U11723	-22.199810,119.920150	2024-03-26	2024-03-27	2	X	.	X	.	X	X	X	X
BB031	S4U11658	-21.919290,119.783830	2024-03-21	2024-03-22	2	X	.	.	.	X	X	X	.
BB032	644439	-22.145163,119.928123	2024-03-21	2024-03-22	2	X	X	.	.	X	X	.	.

						C. gouldii	*C. jobensis*	*O. lumsdenae*	*R. aurantia*	*S. flaviventris*	*S. greyii*	*T. georgianus*	*V. finlaysoni*
Site	**Detector serial**	**Coordinates**	**First night**	**Last night**	**Nights**								
BB033	S4U11658	-21.919290,119.783830	2024-03-23	2024-03-24	2	.	.	.	.	.	.	.	.
BB034	S4U11659	-22.079630,119.814300	2024-03-23	2024-03-24	2	X	.	.	.	X	.	X	X
BB036	644439	-22.034061,119.914505	2024-03-23	2024-03-24	2	X	.	X	.	X	X	X	X
BB037	636488	-22.045712,119.883575	2024-03-23	2024-03-24	2	.	.	.	.	.	.	X	.
BB038	636472	-22.208471,119.869171	2024-03-23	2024-03-24	2	.	X	.	.	X	X	.	.
BB039	S4U06484	-22.102180,119.825030	2024-03-18	2024-03-19	2	X	.	.	.	X	X	.	X
BB040	S4U06478	-22.079100,119.814400	2024-03-23	2024-03-24	2	X	.	.	.	.	.	X	X

Table 8. Species detected at each site in March 2024 ('BDDP' sites).

						C. gouldii	*C. jobensis*	*O. lumsdenae*	*R. aurantia*	*S. flaviventris*	*S. greyii*	*T. georgianus*	*V. finlaysoni*
Site	**Detector serial**	**Coordinates**	**First night**	**Last night**	**Nights**								
BB003/BDDP16	S4U11658	-21.919290,119.783830	2024-03-18	2024-03-20	3	X	X	.	.	X	X	X	X
BDDP14	S4U11657	-21.951290,119.792600	2024-03-19	.	1	X	X	.	.	X	X	X	.
BDDP15	636494	-22.029480,119.826431	2024-03-18	2024-03-20	3	.	.	.	.	.	.	.	.
BDDP17	S4U11651	-22.112400,119.871900	2024-03-19	2024-03-21	3	.	X	.	.	X	.	X	.
BDDP18	636488	-21.893881,119.785057	2024-03-20	2024-03-22	3	X	.	.	.	X	X	X	X
BDDP19	S4U11659	-22.079630,119.814300	2024-03-17	2024-03-19	3	X	.	.	.	X	X	.	X
BDDP20	S4U06478	-22.079100,119.814400	2024-03-17	2024-03-19	3	X	X	.	.	X	X	X	X
BDDP22	S4U06478	-22.079100,119.814400	2024-03-20	2024-03-22	3	X	.	.	.	X	X	X	.
BDDP23	S4U11651	-22.112400,119.871900	2024-03-16	2024-03-18	3	X	.	.	.	X	X	X	X
DBOPP1	636472	-21.900614,119.884453	2024-03-26	2024-03-27	3	X	X	.	.	X	X	X	X

Table 9. Summary of analyses of the acoustic lure recordings (Chorus bat detector and two infrared camera traps per site).

Site	Chorus	Coordinates	Video timestamp
BDGB01	641036	-22.034065 119.914177	.
BDGB02	636474	-21.888155 119.781609	.
BDGB03	rec fail	.	18:52:22 and 18:52:54
BDGB04	641036	-22.100115 119.988914	.
BDGB05	636473	-21.905867 119.865448	.
BDGB06	641036	-21.975908 119.999283	.
BDGB07	636474	-21.915771 120.013268	.

Table 10. Summary of detections of the Pilbara Diamond-faced Bat from all sites (blue highlight aid inspection by separating sites; continued next page).

Site-unit	Night of	Passes	Sunset	Dusk	Dawn	Sunrise	Time of first detection	Time of last detection	Time since sunset	Time until sunrise
May 2023										
BBD01 MDSM4-02	27/05/2023	8	27/05/2023 17:25	27/05/2023 17:49	28/05/2023 6:07	28/05/2023 6:31	20:38:32	1:39:06	3H 13M 4S	4H 52M 50S
BBD02 MDSM4-03	28/05/2023	1	28/05/2023 17:25	28/05/2023 17:49	29/05/2023 6:08	29/05/2023 6:32	20:11:13	20:11:13	2H 45M 58S	10H 21M 9S
BBD06 MDSM4-07	30/05/2023	1	30/05/2023 17:24	30/05/2023 17:49	31/05/2023 6:09	31/05/2023 6:33	23:29:49	23:29:49	6H 4M 55S	7H 3M 25S
BDBAT01 MDSM4-06	28/05/2023	1	28/05/2023 17:25	28/05/2023 17:49	29/05/2023 6:08	29/05/2023 6:32	23:29:31	23:29:31	6H 4M 16S	7H 2M 51S
BDDP03 MDSM4-01	23/05/2023	1	23/05/2023 17:26	23/05/2023 17:50	24/05/2023 6:06	24/05/2023 6:30	23:25:59	23:25:59	5H 59M 32S	7H 4M 11S
BDDP06 MDSM4-05	26/05/2023	1	26/05/2023 17:25	26/05/2023 17:49	27/05/2023 6:07	27/05/2023 6:31	20:34:04	20:34:04	3H 8M 23S	9H 57M 26S
BDDP06 MDSM4-05	27/05/2023	9	27/05/2023 17:25	27/05/2023 17:49	28/05/2023 6:07	28/05/2023 6:31	19:53:28	2:01:34	2H 28M 0S	4H 30M 22S
BDDP06 MDSM4-05	28/05/2023	10	28/05/2023 17:25	28/05/2023 17:49	29/05/2023 6:08	29/05/2023 6:32	21:00:22	2:01:46	3H 35M 7S	4H 30M 36S
BDDP06 MDSM4-05	29/05/2023	21	29/05/2023 17:25	29/05/2023 17:49	30/05/2023 6:08	30/05/2023 6:32	21:13:34	1:23:40	3H 48M 30S	5H 9M 8S
BDDP07 MDSM4-04	27/05/2023	1	27/05/2023 17:25	27/05/2023 17:49	28/05/2023 6:07	28/05/2023 6:31	21:02:40	21:02:40	3H 37M 12S	9H 29M 16S
October 2023										
BDDP13 MDSM4-02	14/10/2023	1	14/10/2023 18:04	14/10/2023 18:26	15/10/2023 5:06	15/10/2023 5:29	0:21:28	0:21:28	6H 17M 24S	5H 8M 10S
BB011 MDSM4-03	16/10/2023	17	16/10/2023 18:04	16/10/2023 18:27	17/10/2023 5:05	17/10/2023 5:27	22:34:05	2:31:13	4H 29M 12S	2H 56M 42S
BB011 MDSM4-03	17/10/2023	6	17/10/2023 18:05	17/10/2023 18:28	18/10/2023 5:04	18/10/2023 5:27	21:36:50	1:45:44	3H 31M 32S	3H 41M 21S
BB036 MDSM4-07	13/10/2023	3	13/10/2023 18:03	13/10/2023 18:26	14/10/2023 5:07	14/10/2023 5:30	20:02:06	23:09:58	1H 58M 25S	6H 20M 32S

Site-unit	Night of	Passes	Sunset	Dusk	Dawn	Sunrise	Time of first detection	Time of last detection	Time since sunset	Time until sunrise
BB03 TC39-644439	15/10/2023	11	15/10/2023 18:04	15/10/2023 18:27	16/10/2023 5:05	16/10/2023 5:28	19:32:11	3:50:51	1H 27M 43S	1H 37M 55S
BB03 TC39-644439	16/10/2023	6	16/10/2023 18:04	16/10/2023 18:27	17/10/2023 5:05	17/10/2023 5:27	19:30:17	3:08:43	1H 25M 24S	2H 19M 12S
February 2024										
BB03	9/02/2024	1	9/02/2024 18:44	9/02/2024 19:08	10/02/2024 5:24	10/02/2024 5:47	20:30:37	20:30:37	1H 46M 0S	9H 17M 21S
BB13	11/02/2024	1	11/02/2024 18:43	11/02/2024 19:06	12/02/2024 5:25	12/02/2024 5:49	2:16:32	2:16:32	7H 32M 58S	3H 32M 38S
BB39	11/02/2024	2	11/02/2024 18:43	11/02/2024 19:06	12/02/2024 5:25	12/02/2024 5:49	3:04:05	3:04:27	8H 20M 31S	2H 44M 43S

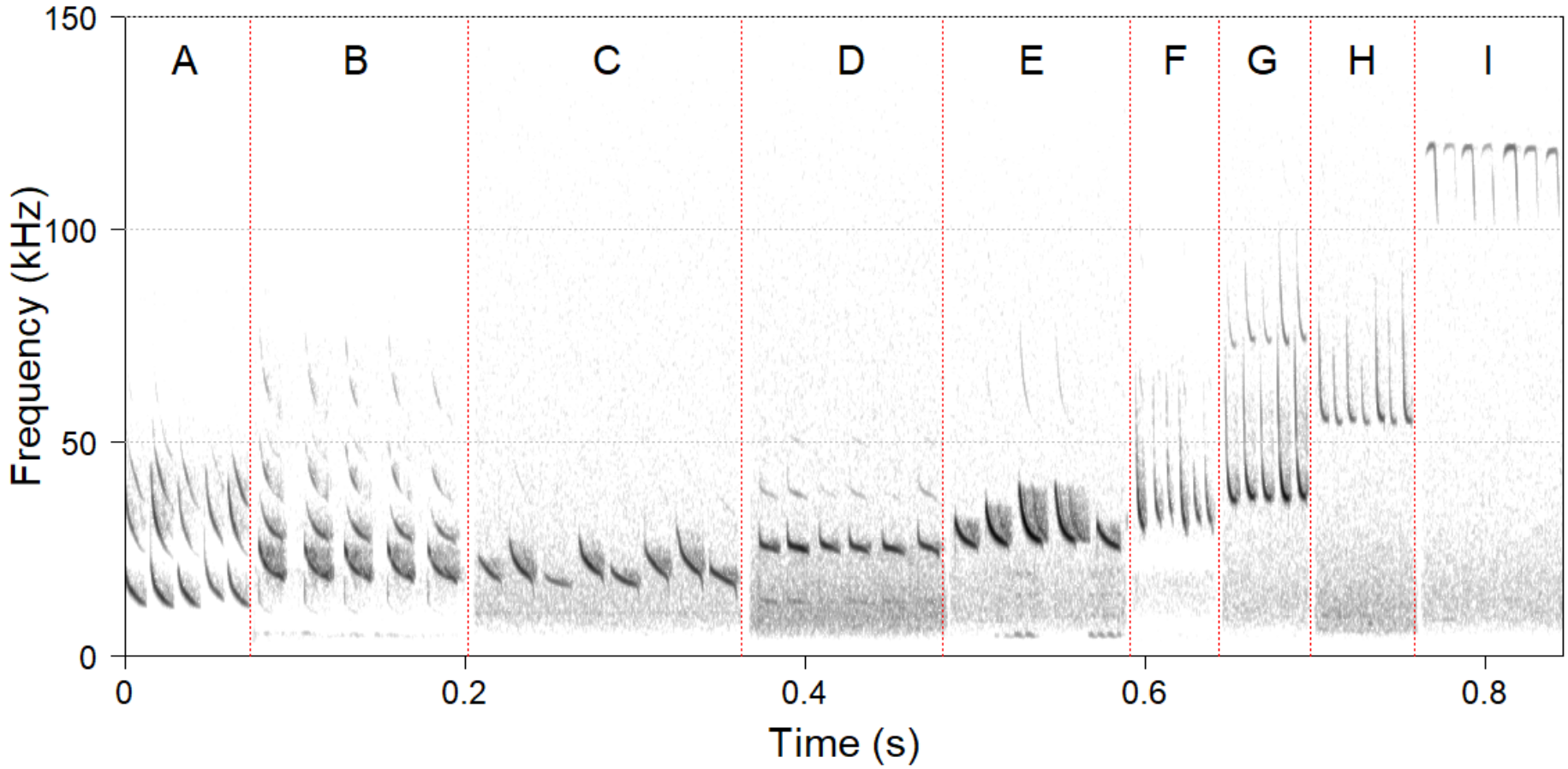


Figure 2. Representative echolocation call sequence portions of the species identified (**A**: *Austronomus australis;* **B**: *Saccolaimus flaviventris*; **C**: *Chaerephon jobensis*; **D**: *Taphozous georgianus*; **E**: *Ozimops lumsdenae*; **F**: *Chalinolobus gouldii*; **G**: *Scotorepens greyii*; **H**: *Vespadelus finlaysoni*; **I**: *Rhinonicteris aurantia*; time between pulses has been compressed).



Figure 3. Composite image of a 'fly-by' by one Ghost Bat at site BDGB03. No bat detector recordings were available from this site to confirm the observation, but the likelihood that this was a Ghost Bat is high (based on recognition of: anterior parts resembling long ears; the broadness of the wings, and lack of a distinct tail).



Figure 4. Examples of organisms that had features inconsistent with those of the Ghost Bat (**Top and middle**: Spotted Nightjar; **Bottom**: moth).

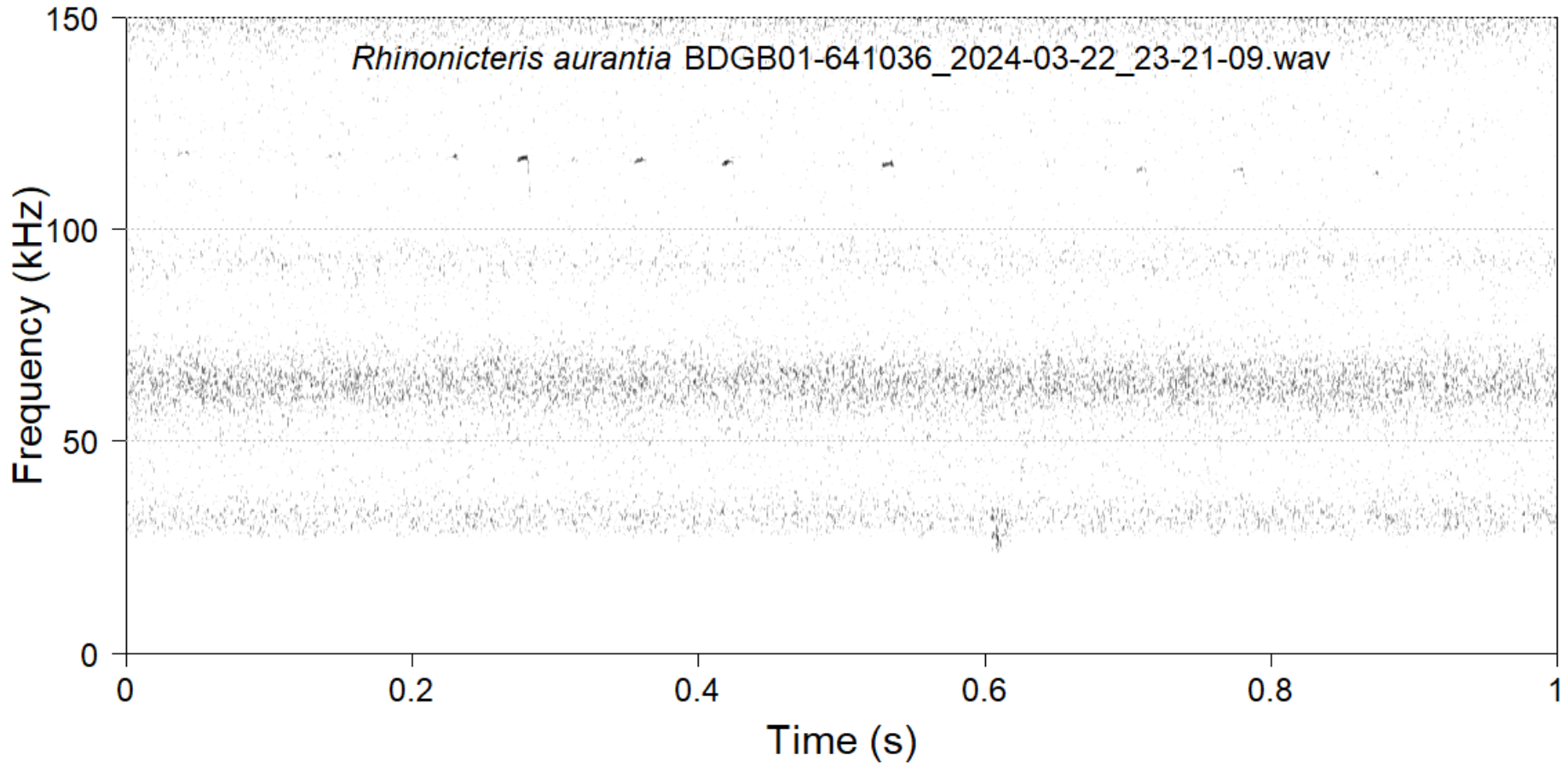


Figure 5. Representative echolocation call sequence portion of the Pilbara Diamond-faced Bat from acoustic lure site BDGB01.

Appendix 1. Summarising collision risk—a possible starting point

To understand the 'collision risk' of different bat Pilbara bat species, it might be useful to apply a modified generic risk matrix. I have provided a possible starting point for the development of a scheme in this appendix. In place of 'Probability' (rows), I have used the frequency of detection values calculated across all sites surveyed in 2023 – 2024, as sorted into four frequency ranges between 0 and 1; and in place of 'Consequence' (columns), I have used three likelihood categories of the species being present above 50 metres in altitude (turbine absent). The latter is an authoritative estimate based on my own accumulated casual field observations. The final score in the matrix is then divided into three risk categories. The final Risk Score and Collision Risk for each species is given in **Table A1**; and predictions for species not detected on the survey are given in **Table A2**. The Risk Scores and their Collision Risk categorisation seem to be sensible outcomes, though greater sampling effort for the Ghost Bat will give a more robust understanding of Collision Risk for this species.

	Likelihood of presence above 50 metres altitude	**Low**	**Medium**	**High**
Frequency of detection		1	2	3
0 – 0.25	1	1	2	3
0.25 – 0.50	2	2	4	6
0.50 – 0.75	3	3	6	9
0.75 – 1.0	4	4	8	12

Risk Score	**Collision Risk**
0 – 2	Low risk
3 – 6	Medium risk
7 – 12	High risk

Table A1. Calculated Risk Scores for each species based on the surveys in 2023 – 2024.

		High altitude likelihood	Altitude category	Frequency across all surveys	Frequency category	Risk Score	Collision Risk
MEGADERMATIDAE							
Ghost Bat	*Macroderma gigas*	Medium	2	0.14	1	2	Low
RHINONYCTERIDAE							
Pilbara Diamond-faced Bat	*Rhinonicteris aurantia*	Low	1	0.10	1	1	Low
EMBALLONURIDAE							
Yellow-bellied Sheath-tailed Bat	*Saccolaimus flaviventris*	Medium	2	0.71	3	6	Medium
Common Sheath-tailed Bat	*Taphozous georgianus*	High	3	0.70	3	9	High
VESPERTILIONIDAE							
Gould's Wattled Bat	*Chalinolobus gouldii*	Low	1	0.85	4	4	Medium
Little Broad-nosed Bat	*Scotorepens greyii*	Low	1	0.85	4	4	Medium
Finlayson's Cave Bat	*Vespadelus finlaysoni*	Low	1	0.53	3	3	Medium
MOLOSSIDAE							
White-striped Free-tailed Bat	*Austronomus australis*	High	3	0.07	1	3	Medium
Greater Northern Free-tailed Bat	*Chaerephon jobensis*	Medium	2	0.55	3	6	Medium
Northern Free-tailed Bat	*Ozimops lumsdenae*	Medium	2	0.18	1	2	Low

Table A2. Predicted Risk Score and Collision Risk categories for Pilbara species of bat not observed on the survey (based on distributions given by Milne et al. 2023; 'estimated frequency' was 'imagined' based on records of occurrence in the Atlas of Living Australia).

		High altitude likelihood	'Estimated frequency'	Risk Score	Collision Risk
Black Flying-fox	*Pteropus alecto*	High	0.30	6	Medium
Little Red Flying-fox	*Pteropus scapulatus*	High	0.10	3	Medium
Hill's Sheath-tailed Bat	*Taphozous hilli*	High	0.20	3	Medium
Pallid Long-eared Bat	*Nyctophilus daedalus*	Low	0.10	1	Low
Lesser Long-eared Bat	*Nyctophilus geoffroyi*	Low	0.90	4	Medium
Northern Coastal Free-tailed Bat	*Ozimops cobourgianus*	Medium	0.00	0	Low

Appendix 2. Use of acoustic lures

Specialised Zoological provided the equipment for the acoustic lure surveys, and provided advice on how set and use it. The equipment and procedure are broadly consistent with recently released guidelines in the Northern Territory for the use of acoustic lures for Ghost Bat detection (Ruykys et al. 2024). In the Introduction to these guidelines, the authors state that "…*it is expected that further application across the species' distribution will improve its generality and functionality.*"; (see also section 2.8). Given my own experience with the use of this method on several projects, and some practical considerations, I have provided advice in the present survey that I consider to be important improvements. These include:

1. The use of a bat detector directly under the portable speaker to detect the echolocation calls of a Ghost Bat that approaches and might briefly circle the post with this equipment. I address the five cautions articulated in the third 'author's tip' in section 2.6 of the guidelines:

   i. **"ghost bats do not consistently use echolocation when in flight"** Indeed Ghost Bats are thought not to echolocate continuously while in flight, but they are more likely to echolocate when approaching an object of their attention. In my own experience (not yet in the public domain; n = >20; exact number not given to preserve project anonymity), 74% of approaches could be validated unambiguously by the concurrent detection of an echolocation sequence on a bat detector placed under the speaker. For the remaining 26% of sites, it is possible that echolocation calls were not detected because of a combination of the low amplitude of the calls and the direction of flight relative to the zone of sound reception of the microphone.

   ii. **"the acoustic lure may mask any echolocation pulses from ghost bats"** This is not the case. No echolocation calls are part of the broadcast sequence used. Further, echolocation pulses are of a different frequency range than the various social calls, and overlapping of broadcast social calls and the echolocation calls of an approaching bat does not prevent them from being distinguished, either buy casual observation in a spectrogram, or the semi-automated analysis method used by Specialised Zoological.

   iii. **"no ghost bats were detected acoustically during the study by Ruykys et al. (2023), despite ghost bats routinely flying with 1 m of bat detectors"** In that study, bat detectors were not placed in an ideal position (see underlined segments) for recording echolocation calls, and consequently the usefulness of bat detectors is under-emphasised in the guidelines:

   "*To determine whether the echolocation calls of lured ghost bats could be passively detected, a bat detector (Anabat Swift, Titley Scientific, Queensland, Australia) was deployed on the reference tree at each survey site for both the control and active treatment. Detectors were deployed at chest height, with the ultrasonic omnidirectional microphone placed on the far side of the tree, away from the speaker. The microphone was angled at 45° down from vertical.*" (Ruykys et al. 2023; my underline)

iv. **"expertise is required to identify bats – particularly ghost bats – via their echolocation call"** Specialised Zoological has a long track record of being able to identify these calls reliably, using an efficient semi-automated method, and being able to distinguish them from signals of similar shape produced by other cave-roosting bat species.

v. **"the analysis of acoustic recordings will add significant analysis time to a project"** The analysis of bat detector recordings from acoustic lure sites using Specialised Zoological's semi-automated method is efficient, requiring relatively little time for analysis, and certainly far less than a full manual inspection of the dataset. Most importantly, a validation of observations from videos from an independent, unambiguous identification based on diagnostic echolocation calls is extremely valuable. While some visitations of Ghost Bats might be very clearly of this species in the videos, there can be uncertainty with others. Echolocation call detection provides adequate validation.

In addition, there is comment in the guidelines about the difficulty of recognising juvenile Ghost Bats in videos, and consequently a recommendation to avoid using the technique when juveniles are likely to be present (section 2.3.1; p. 15). This is unnecessary because juveniles can also be recognised by echolocation calls in the same way as adults.

2. Much detail is given in the guidelines about the density of sampling and the probability of detection—especially for a 'first stage' survey (see section 2). But it should be noted that probability of detection is likely to be different in other landscapes, given the number of nearby roosts, and the colony size in those roosts. In addition, the effective broadcast range of the acoustic lure is relatively limited, and has not yet been properly estimated (or standardised), though a diameter of 200 metres seems reasonable. The size of this stimulus zone might be too small for some situations, especially where different habitats and landscape features might need to be investigated to address specific requirements. Thus, increased sampling density consistent with the notion of the 'second stage' survey might be required for questions such as '*Which habitats do Ghost Bats use in this study area?*' or '*Do Ghost Bats visit this feature?*' The notion of the appropriate sampling density for different regions and study objectives is deserving of more discussion. This is acknowledged in section 2.8 of the guidelines.

3. Further empirical observations will provide a better understanding of the potential impact of the technique on the Ghost Bat, which will either support or diminish concern for the various ethical considerations mentioned throughout the guidelines. In my own experience in one comprehensive study, visitations typically involved either a single pass of the speaker, or else presence of a few seconds only, and typically less than one minute. Key to understanding impacts is knowing how many individuals might be detected (this information cannot be determined), the total visitation time, number of visitations per night, associated behaviours, and whether a roost site is likely to be nearby (relevant for the time when broadcasts are started). At present, I have recommended that broadcasts continue for longer than is recommended in the guidelines because the aim is to maximise the chance of detection in relatively large,

complex geological terrains. In my experience, the time of first detection of a Ghost Bat can be anytime throughout the night, though certainly most detections are within the first 2 – 3 hours after sunset.

4. The equipment described and illustrated in the guidelines comprises a single video camera. I recommend two 4K video cameras placed at right angles so that a second view of any approaching bat is available for situations where an identification is ambiguous. It also provides redundancy in case of equipment set-up issues, given the high cost of remote field surveys. I also recommend speakers that play from a micro-SD card rather than Bluetooth. The equipment set-up used on the present survey has been used successfully elsewhere, though it has several constraints, and the system will likely keep evolving with experience, feedback and the availability of newer technology.

5. In the guidelines there is an emphasis on the manual review of video streams and how this should be undertaken. The semi-automated analysis conducted by Specialised Zoological represents a significant improvement over manual reviews, and is undertaken with a different set of considerations designed to maximise robustness. Most of the information in section 2.6 on page 20 is not relevant to the present study.

6. I consider that effort for the discovery of diurnal roost sites is still the primary consideration for environmental impact assessments, but that the acoustic lure method is useful for confirming presence both near roosts and away from them, and for characterising the use of a study area for foraging.

7. Specialised Zoological has had minimal input into the sampling design and level of sampling intensity in this study.

This study used squabble calls provided by Dr Nicola Hanrahan with permission. I have confirmed with her that no registration number is required for this project because it began before the guidelines were released.

Appendix D Avifauna site by species matrix.

Species	BBSUS site																																								Incidental
	BB001	BB002	BB003	BB004	BB005	BB006	BB007	BB008	BB009	BB010	BB011	BB012	BB013	BB014	BB015	BB016	BB017	BB018	BB019	BB020	BB021	BB022	BB023	BB024	BB025	BB026	BB027	BB028	BB029	BB030	BB031	BB032	BB033	BB034	BB035	BB036	BB037	BB038	BB039	BB040	
Acanthizidae																																									
Redthroat														1										1	1													1			
Slaty-backed thornbill										12																															
Weebill			3		1	5				1		2	7		2	4	3	10			5	1	4		23	4					4						6	4		23
Accipitridae																																								
Black-shouldered kite													2						1													2								
Brown goshawk																									1															
Collared sparrowhawk	1		1			1							1			1																				1				8
Spotted harrier			1		1		1							3			1				1		3		4	2	1									1				6
Square-tailed kite																																								
Wedge-tailed eagle				2				4	1		2		1	1																							1	3	1		8
Whistling kite	2			1									2			4						1	6			2			2				1		1	1	1				9
Aegothelidae										1																															
Australian owlet-nightjar										1																															1
Alaudidae																																								
Horsfield's bush lark				1	1		15	2				8		9				2	10					5			4	16	13			7					10			1	12
Alcedinidae																																								
Blue-winged kookaburra	2		2		1	4							3			3		2	1		2	3	16								4									16
Red-backed kingfisher																																									1
Sacred kingfisher	9		13			2					6										8	5	26		2											8			1		12
Anatidae																																								
Australian wood duck																1																									
Black swan																																								1
Grey teal																79						6																			1
Hardhead																2																									
Pacific black duck	9															16						16	4		2																31
Pink-eared duck																2																									
Plumed whistling duck																10																									
Anhingidae																																								
Australasian darter																							26																		21
Ardeidae																																								
Great egret																1							1																		2
Nankeen night heron						2																																		4
White-faced heron	9					1										4						7	3		1															16
White-necked heron	2		2													4						4																			12
Artamidae																																								
Australian magpie	2	3											3			1	2	5				1	2	2	1		1				6		6					2		17
Black-faced woodswallow	3	4	5		2		12		1	1	1	36		3		2			1				2	3		14	5	9	10		4	8		12	24		9	1		2	72

Species	BBSUS site																																									Incidental
	BB001	BB002	BB003	BB004	BB005	BB006	BB007	BB008	BB009	BB010	BB011	BB012	BB013	BB014	BB015	BB016	BB017	BB018	BB019	BB020	BB021	BB022	BB023	BB024	BB025	BB026	BB027	BB028	BB029	BB030	BB031	BB032	BB033	BB034	BB035	BB036	BB037	BB038	BB039	BB040	
Grey butcherbird													1				1		2												1										x
Little woodswallow				4																																					
Masked woodswallow																				10																						
Pied butcherbird	6	1	1	2	3	1	1	4		1	4	1	6	1		3	1	14		1	10	2	1		2	2	1				1		1		1	1		4	4	1	54
Burhinidae																																									
Bush stone-curlew																					2		1																		7
Cacatuidae																																									
Cockatiel	52	25				2	2	10	4				5	1		7	31	3			9				4					2			7					7	14		28
Galah	51		5	1	2	45		17	13	12		9	26		2	54	2	26		2	11	1	2		87						55		123	1		14	9	7	36	7	212
Little corella	53	80	35	12		83		1		5	2	37	265	1		153		20			176	19	25		144	1			1		116					5	29	2	5		359
Campephagidae																																									
Black-faced cuckooshrike			2			1			2		4	1			1	4						5	12		4	2					1			1				2	2	2	22
White-winged triller														1	1					2																					
Caprimulgidae																																									
Spotted nightjar										1																															3
Casuariidae																																									
Emu																																									3
Charadriidae																																									
Black-fronted dotterel	3					1										33					3	8	10		1																23
Red-kneed dotterel																																									
Columbidae																																									
Common bronzewing		1								3			3			1				1																			2		1
Crested pigeon					3			6				17	52			6		13	2		2	11		1	7	2					38		25	4			36		5	3	86
Diamond dove	4	2	6				1		2	1	7	13	30	3	8	3	2	2	2		1	3	10						1		16	5			1		38				59
Peaceful dove	4		5													4			1			5	18		1																13
Spinifex pigeon	23	9	3		2	7	1	16			3	2	34		1	5		8		3	1	17	9	16	25	2	1	6		4	79	1	103			6	6	2	2	7	206
Corvidae																																									
Torresian crow	3		3			9	1		1	4		1	3	1		10	3		2		5	6	1				2		2		6	13	1			3	6				74
Cuculidae																																									
Horsfield's bronze cuckoo											1	2				1		1	1			1																		1	
Pallid cuckoo													2																												1
Pheasant coucal											1					1			1		1																				2
Estrildidae																																									
Australian zebra finch	26	20	17	7	108	40	73	8		31	5	15	4	6	35	47	67		20			45	6	18	62	7	32	11	69	10	82	4	3		1	36	56	80	5	8	502
Painted finch	18	3	10	6	7	2	4	7		2	4	6		2	52		11		17	5	2	28	97	52	5	6	2	10		6	71		23		8	21	8	20		52	164
Falconidae																																									

Species	BBSUS site																																							Incidental
	BB001	BB002	BB003	BB004	BB005	BB006	BB007	BB008	BB009	BB010	BB011	BB012	BB013	BB014	BB015	BB016	BB017	BB018	BB019	BB020	BB021	BB022	BB023	BB024	BB025	BB026	BB027	BB028	BB029	BB030	BB031	BB032	BB033	BB034	BB035	BB036	BB037	BB038	BB039	BB040	
Australian hobby													2												1																
Brown falcon		1				1				2		1				1			1		2	1			2		1				6		1				1	1			16
Grey falcon																					2												1								9
Nankeen kestrel	3				1					1		3	2	4	5		2		1		2	3	3	3				1	1	1	1		1		1	2	2	1			9
Hirundinidae																																								
Fairy martin																40																									1
Tree martin	3										1				6	55					9	2	25			1								2							6
Locustellidae																																								
Brown songlark												8		9			1		4									4	4			1						4				
Rufous songlark	1										10	4		2		1		1	4		1	18				1															
Spinifexbird		1	1	1	1			2	1	1		1			1				1	1				2	1	5	1			1			1	1	5				1	4	2
Maluridae																																								
Pilbara grasswren								2											3											1			1	2					3	2
Purple-backed fairywren		4								1					3		2			15		4	5	4									12	4	1		7	3		25
White-winged fairywren												3							1									5				12					2			3
Meliphagidae																																								
Black honeyeater	1																																							
Brown honeyeater								1		8									2				1		1	1								3	1			1			
Crimson chat												2		2						3												12			2						
Grey-fronted honeyeater																										5	2														22
Grey-headed honeyeater	6		1	3	10										2		1		3	13							1				19			21	11			1	3	20
Singing honeyeater					5		4	2	3	2		4	2	3	1		5	1	7	3			3	7	1		5	2	3	1	10	7	1	1	4	1	5	1			39
Spiny-cheeked honeyeater										3										2																					
White-plumed honeyeater	55		31		1	24					65		25		10	220		1	1		7	61	38		6									1	2	18					50
Yellow-throated miner	17	6	20		2	14		6	2	11	3	3	58		2	79	8	28	4	4	24	10	19		22	12		7		4	19	1	13	4	5	7		12	6		82
Meropidae																																								
Rainbow bee-eater	8	1	9								14				1	41					3	21	16		2					2	4					2					25
Monarchidae																																								
Magpie-lark	9	3	5		2	5	1				1	1	16			26		10			9	8	25		12	3		1		1	9				1	10	2				96
Motacillidae																																								
Australian pipit												1																				1					1				x
Oreoicidae																																								
Crested bellbird												3								1				1											1					2	
Otididae																																								
Australian bustard																									4																4
Pachycephalidae																																								
Grey shrikethrush			3	2						1	2				1							2												1							4

Species	BBSUS site																																								Incidental
	BB001	BB002	BB003	BB004	BB005	BB006	BB007	BB008	BB009	BB010	BB011	BB012	BB013	BB014	BB015	BB016	BB017	BB018	BB019	BB020	BB021	BB022	BB023	BB024	BB025	BB026	BB027	BB028	BB029	BB030	BB031	BB032	BB033	BB034	BB035	BB036	BB037	BB038	BB039	BB040	
Rufous whistler		1	3			1				16	5					1				13	4	4	2															1	1		3
Pardalotidae																																									
Red-browed pardalote	1												1		6			2			4	1	4		1	1				1					1		2	1		5
Striated pardalote																	3																								
Pelecanidae																																									
Australian pelican																																									
Petroicidae																																									
Hooded robin										3										3															1					1
Red-capped robin										3																															
Phalacrocoracidae																																									
Little black cormorant																10							2																	2
Little pied cormorant																1						2	6																	4
Phasianidae																																									
Brown quail			1								1														1															1
Podargidae																																									
Tawny frogmouth			2								1							2			2																	1		4
Podicipedidae																																									
Australasian grebe																6																								
Hoary-headed Grebe																1																								
Pomatostomidae																																									
Grey-crowned babbler	12	4	16			4					23	6				10				4		14	28		6						6					3					22
Psittaculidae																																									
Australian ringneck	11		2								8	3	10		2	4		3			6	8	4		2						3										8
Budgerigar	79	3	36	41	110	22	36	70	54		27	60	42	16	43	18	451	24	102	5	73	75	47	21	13	32	2		27	5		20	33	3	9	110	155	42	22	24	67
Ptilonorhynchidae																																									
Western bowerbird	2							1			1					1				1			3																		3
Recurvirostridae																																									
Black-winged stilt																																									
Rhipiduridae																																									
Grey fantail																																									2
Willie wagtail	1	1				1		2	1	6	1	2	1		4	4	1		3	8	2	5	6		4						2	1	1	6	2	7	2	1	1	1	76
Strigidae	2		5			1																																			
Southern boobook	2		5			1																																			1
Threskiornithidae																																									
Straw-necked ibis																2																									1
Turnicidae																																									
Little buttonquail		2					3			2		2					1							3		1	1			1		1	3			1			1	17
Tytonidae																																									
Eastern barn owl																																									x

Appendix E Night parrot call analysis (Adaptive NRM 2024).

Results of acoustic surveys conducted for Night Parrot (*Pezoporus occidentalis*) Bonney Downs July-October 2023

Report to:

Ecologia

Prepared by:

Nick Leseberg

Adaptive NRM

19th May 2024

1. Summary

Between July and October 2023, autonomous recording units (ARUs) were deployed at nine sites in the Bonney Downs project area to survey for Night Parrots (*Pezoporus occidentalis*). The project area is approximately 70 km northeast of Fortescue Marsh, within the Chichester bioregion of Western Australia. Resulting acoustic data was analysed using signal parameters optimised for detecting Night Parrot calls. No Night Parrot calls were detected during the analysis.

2. Survey effort

Analysis of historical Night Parrot records suggest it was formerly found throughout arid central Australia, before undergoing a significant decline and range contraction during the late-19th and early-20th centuries (Leseberg *et al*. 2021). The species is now known from a small area in western Queensland, and the central and northern inland of Western Australia. There are several historical reports from the Chichester bioregion, although none that are considered of high veracity (Leseberg *et al*. 2021). There are several contemporary records from the Fortescue Marsh which is only 70 km southwest of the project area (Leseberg 2022), so it is feasible that if suitable habitat exists, Night Parrots could be resident in the survey area.

Research in western Queensland has demonstrated Night Parrots occupy long-term stable roost sites for periods of up to several years. These long-term stable roost sites support both roosting and breeding. The birds also have predictable year-round calling periods at dusk and dawn (Murphy *et al*. 2017a, Leseberg *et al*. 2019). This ensures that if Night Parrots are roosting at a particular site, the likelihood of detecting them using ARUs is very high, provided the ARU is placed for a minimum of four nights in calm weather, and the recorder is set to record during the peak calling periods. During breeding, and following large rain events, calling is more frequent, extends throughout the night, and the likelihood of detection is increased (Murphy *et al*. 2017a). Preliminary results from research in central Western Australia suggest patterns of behaviour in that region are similar (Jackett *et al*. 2017).

Night Parrots are also known to call during the night at feeding and drinking sites (S. Murphy, N. Leseberg, N. Jackett unpubl. data). Anecdotal evidence suggests they may call when moving between these sites (N. Leseberg, N. Jackett, S. Murphy unpubl. data). However, the detection of birds away from roosting sites is likely to be a chance event given the large area over which

birds range at night (Murphy *et al*. 2017b). Night Parrots are known to drink, and modelling suggests they may be reliant on free-standing water (or succulent food containing >55% water) during hot weather (Kearney *et al*. 2016). Birds have been detected in the Great Sandy Desert by focusing survey effort at water sources (J. Brown pers. comm.). It is likely this technique will be most effective during periods of water scarcity, when survey effort can focus on just a few possible locations.

The likelihood of detection is also influenced by the type of ARU being used. In calm conditions, a Song Meter 4 (Wildlife Acoustics, MA, USA), is known to be capable of reliably detecting 95% of Night Parrot calls out to a range of around 205 m (Leseberg *et al*. 2022). SM4s were used at seven of the nine sites surveyed. Titley Chorus machines were used at two sites. How these machines compare to SM4s is unclear, although a qualitative assessment of the recordings from these machines suggest their recording radius was less than that of the SM4s.

Ecologia conducted sampling for the Night Parrot across two blocks, during July/August, and also October 2023. A total of nine sites were surveyed in the project area, and a combined total of 60 nights of data was recorded (Table 1). Several different recording programs were used. During the July/August phase, all four machines recorded two periods each night, one at sunset the other at sunrise. Two machines recorded an hour either side of sunset and sunrise, and two recorded ninety minutes either side of sunset and sunrise. While it is recommended that recordings are made from sunset to sunrise, in each case the peak Night Parrot calling period would have been captured, allowing conclusions around the presence or absence of a long-term stable roost site in the immediate vicinity of the ARU. During the October surveys, all five machines recorded from before sunset until after sunrise, capturing the recommended period for Night Parrot surveys. All ARUs recorded a minimum of four non-windy nights. It is likely that any long-term stable roost sites in the vicinity of these ARUs would have been detected.

3. Data analysis

ANRM received the raw acoustic data as '.wav' files. These were scanned using the software Kaleidoscope Pro v5.2.1, targeting the frequency range of 1500 – 3500 Hz, within which all known Night Parrot calls are distributed (Leseberg *et al*. 2019). Search parameters were optimised using a random selection of 250 Night Parrot call examples manually detected from

both Great Sandy Desert and East Murchison datasets, of which 205 (82.0%) were automatically detected. Calls not detected were typically extremely faint. The probability of non-detection of a true-positive call was 18.0%; two true-positive calls was 3.2%; three true-positive calls was 0.6%; etc. Of the data tested, the median number of consecutive (spaced at < 5 minutes apart) calls in a sequence when Night Parrots were recorded was 5 (1–34, n = 29). The probability of at least one call being detected within a sequence of median length, assuming there was variation in the location of the source of the call, was > 99.9%.

Table 1. Bioacoustic recordings analysed from the July/August and October 2023 survey.

Site name	ARU Type	Recording start date (PM)	Recording end date (AM)	Total recording nights
BDNP01	SM4	24-Jul-23	2-Aug-23	9
BDNP02	SM4	24-Jul-23	2-Aug-23	9
BDNP03	Chorus*	27-Jul-23	2-Aug-23	6
BDNP04	Chorus *	27-Jul-23	2-Aug-23	6
BDNP05	SM4	13-Oct-23	19-Oct-23	6
BDNP06	SM4	13-Oct-23	19-Oct-23	6
BDNP07	SM4	13-Oct-23	19-Oct-23	6
BDNP08	SM4	13-Oct-23	19-Oct-23	6
BDNP09	SM4	13-Oct-23	19-Oct-23	6
			Total	60

Potential Night Parrot calls detected during the analysis were compared to a reference library comprising several thousand Night Parrot calls from Western Australia. This library consists of calls recorded at sites where Night Parrots have been confirmed using visual means and is therefore considered of high reliability. The library also comprises multiple examples of all known call types from Western Australia (Leseberg *et al*. 2019).

4. Survey results

No calls attributable to Night Parrots were detected during the analysis.

5. Conclusion

It is unlikely long-term stable Night Parrot roosts exist in the area immediately surrounding the points sampled during this survey at the time of sampling. Additionally, it is unlikely that Night

Parrots were foraging in proximity to these surveyed points at the time of sampling. It is important to reinforce that these results pertain specifically to that area immediately surrounding the survey points, and only for the period during which the survey was conducted. The results of these surveys do not enable robust conclusions about the presence or absence of Night Parrots in the wider landscape.

6. References

Jackett, N. A., B. R. Greatwich, G. Swann, and A. Boyle. 2017. A nesting record and vocalisations of the Night Parrot *Pezoporus occidentalis* from the East Murchison, Western Australia. *Australian Field Ornithology* **34**: 144-150.

Kearney, M. R., W. P. Porter, and S. A. Murphy. 2016. An estimate of the water budget for the endangered night parrot of Australia under recent and future climates. *Climate Change Responses* **3**: 1-17.

Leseberg, N. P. 2022. Results of acoustic surveys conducted for the Night Parrot (*Pezoporus occidentalis*) in the Nydinghu area, Fortescue Marsh May 2021 – August 2022. Report to Fortescue Metals Group. Adaptive NRM, Malanda, QLD.

Leseberg, N. P., S. A. Murphy, N. A. Jackett, B. R. Greatwich, J. Brown, N. Hamilton, L. Joseph, and J. E. M. Watson. 2019. Descriptions of known vocalisations of the Night Parrot *Pezoporus occidentalis*. *Australian Field Ornithology* **36**: 79-88.

Leseberg, N. P., W. N. V. Venables, S. A. Murphy, N. A. Jackett, and J. E. M. Watson. 2022. Accounting for both automated recording unit detection space and signal recognition performance in acoustic surveys: A protocol applied to the cryptic and critically endangered Night Parrot (*Pezoporus occidentalis*). *Austral Ecology* **47**: 440-455.

Murphy, S. A., J. J. Austin, R. K. Murphy, J. Silcock, L. Joseph, S. T. Garnett, N. P. Leseberg, J. E. M. Watson, and A. H. Burbidge. 2017a. Observations on breeding Night Parrots (*Pezoporus occidentalis*) in western Queensland. *Emu* **117**: 107-113.

Murphy, S. A., J. Silcock, R. K. Murphy, J. R. W. Reid, and J. J. Austin. 2017b. Movements and habitat use of the night parrot *Pezoporus occidentalis* in south-western Queensland. *Austral Ecology* **42**: 858-868.

Appendix F Significant fauna which may utilise habitat within the survey area for foraging, roosting and breeding

Peregrine falcon (*Falco peregrinus*) – Other Specially Protected Fauna BC Act

This species is widespread in Australia but requires specific nesting sites. It does not build a nest but requires cliffs, rocky outcrops, or large tree hollows (Johnstone and Storr 1998). Suitable breeding habitat has the potential to occur in the project area in the form of tree hollows and breakaways; however, due to its widespread movements, the species may also overfly all habitat types intermittently. Peregrine falcons feed almost entirely on birds, especially ducks, parrots, and pigeons.

According to DBCA and Fortescue database searches, the peregrine falcon has been recorded on 35 occasions within 100 km of the project area. Although no evidence of this species was recorded during the current survey, the peregrine falcon has the potential to utilise all habitat types while foraging. Rocky Escarpment habitat supports cliffs and overhangs for breeding activities and Drainage Line/River/Creek (major) habitat provide foraging habitat and encompass large trees which may provide nesting opportunities for this species.

Night parrot (*Pezoporus occidentalis*) – Endangered EPBC Act and Critically Endangered BC Act

The night parrot is a cryptic, nocturnal parrot that is endemic to Australia primarily feeding on the ground inhabiting remote arid and semi-arid areas of Australia (DBCA 2017). Historical evidence indicates that night parrots were distributed over much of semi-arid and arid Australia (Garnett *et al.* 2011). This elusive parrot was thought to be extinct for a long period of time prior to purported sightings in 2005 in the vicinity of Fortescue Marsh and the discovery of night parrots in western Queensland by John Young in 2013. Since 2013, detailed studies at Pullen Pullen Reserve in western Queensland have provided critical information relating to breeding behaviour, physiology, roosting and foraging habitat, nocturnal movements, and calling behaviour (Stephen A. Murphy 2017). This species has subsequently been recorded and sighted in the East Murchison by (Jackett *et al.* 2017).

The structure of the Triodia recorded by (Jackett *et al.* 2017) was similar to that described by Murphy *et al.* (2017) at Pullen Pullen, being dense, and ring-shaped. Murphy *et al.* (2017) recording a nest located in *Triodia longiceps* while (Jackett *et al.* 2017) recorded the nest in *Triodia* aff. *plurinervata*. night parrot nest site selection may be more reliant on the structure of the spinifex and not necessarily the size of the spinifex expanse, or the substrate type (Jackett *et al.* 2017). It is also suggested that the proximity of dense ground layer vegetation (e.g., *Triodia*) to suitable foraging grounds is likely to play a role in nest (and roost) site selection, suggesting the samphire and herbfields adjacent to the *Triodia* expanse could be a food source (Jackett *et al.* 2017; Murphy *et al.* 2017).

Night parrot calls were not recorded during the current survey. It is unlikely long-term stable night parrot roosts exists in the area immediately surrounding the points sampled during this survey at the time of sampling and it is unlikely that night parrots were foraging in proximity to these surveyed points at the time of sampling (Adaptive NRM 2024). No database records of the night parrot were identified within 100km of the project area; however, recent changes to DBCA database search outputs means that this is not a reliable indicator that no records occur within the study area.

Appendix G Bonney Downs Year 1 Collision Risk Modelling Suitability Analysis (Symbolix 2024).

symbolix

making your data work harder

To: Tim MacCabe
Ecologia Environment
Via email

Ref #: ELGBONN20240613
Date: 13 June 2024
CC: Claudia Buters

Re: Bonney Downs Year 1 Collision Risk Modelling Suitability

To Tim,

We understand that Ecologia Environment (Ecologia) have undertaken the first year of Bird Utilisation Surveys (BUS) at the proposed site for Bonney Downs Wind Farm (BDWF), north-west Western Australia. From these surveys, Ecologia have identified one Environment Protection and Biodiversity Conservation Act (EPBC 1999) listed species present on site and potentially at risk - the Grey Falcon (*Falco hypoleucos*).

Ecologia wish to assesses the feasibility of collision risk modelling (CRM) as a tool for quantifying the expected annual collisions between Grey Falcon and turbines with the current dataset. To understand the suitability of CRM for this species and for the data collected during the BUS conducted at BDWF, we have reviewed the BUS data collected to date.

1 Data requirements for Collision Risk Modelling

CRMs are used globally to quantify risk of turbine collision to Avian species. While most CRMs derive from Band (2012) and its predecessors, the CRMs commonly employed today include varying degrees of differences in their implementations (Masden and Cook 2016). Despite the differences we can make some generalisations about the structure and the data needed. Most CRMs use a step-wise risk model (Reason 1997), where the total risk is the probabilistic combination of the risk of each step in the process.

The process can be summarised by the equation:

$$N_{\text{collision}} = F \times P(I|F) \times P(C|I) \times (1 - \text{AR})$$

where:

- $N_{\text{collision}}$ is the estimated number of flights ending in collision
- F is the estimated activity rate of flights in the region (flights / area / time)
- $P(I|F)$ is the probability of a flight interacting with a turbine or power line (given a flight in the region)
- $P(C|I)$ is the probability of collision, given an interaction occurs
- AR is the avoidance rate. This is an estimate of the proportion of post-construction flights that will exhibit turbine avoidance (fly above, below, change path because of blade position), i.e. micro- and meso-avoidance. It is notoriously difficult to measure Cook et al. (2012) and usually the most uncertain of any input.

Some inputs can be sourced through desktop review, i.e.:

- Species specific biological and morphological data; e.g. body length, wingspan and average flight speed. This can usually be obtained from grey and peer-reviewed literature or through expert consultation.
- Proportion of the year the species is active on site
- Proportion of the day the species is active on site
- Turbine specifications including blade length, hub height, location, revolutions per minute (average), and anticipated percentage downtime. This data is readily available or reliably estimated.

This data must be combined with field surveys to inform the following inputs:

- Average activity rate (flights / area / time)
- Proportion of flights at rotor swept height

The whole-site model can be expanded to provide per-turbine spatial collision prediction but this requires either:

- sufficient flight path data to resolve a spatial flight distribution map (we advise 50-100 flight paths); or
- sufficient data to inform a spatial distribution model where location is predicted from landscape features.

In the following sections we will break down the specific data requirements and evaluate the data collected during the previous BUS to establish whether:

- sufficient data exists to drive a quantitative collision risk model, or
- additional data collection is likely to lead to sufficient data.

1.1 Species suitability

Models based on the above equation have been widely used for Avian species worldwide. There are, however, currently no established methods for other volant species. For example, there are no CRMs currently available that predict bat collision rates. Some preliminary approaches have been discussed at relevant conferences (e.g. Rodrigues et al. (2023)) but no robust framework exists.

2 Bonney Downs BUS Summary

2.1 Survey effort

We have reviewed data collected between 2023-10-13 and 2024-04-18 across 3 seasons (Spring 2023, Summer 2024 and Autumn 2024). The survey effort for this period is summarised in Table 1.

Table 1: Survey effort completed to date

Year	Season	Start date	End date	Number of surveys	Total survey hours (hours)	Number of sites
2023	Spring	2023-10-13	2023-10-19	120	61.83	40
2024	Summer	2024-02-06	2024-02-12	120	59.58	40
2024	Autumn	2024-03-18	2024-04-18	120	59.75	40

2.2 Summary of observations

During BUS, Ecologia have recorded all observations of all avian species. This includes observations of 95 species and 10,194 individual birds.

Of these observations, the only EPBC listed species and species considered a collision risk recorded was the Grey Falcon. During these surveys, only 2 observations of Grey Falcons were recorded (3 individuals in total). Additionally, 9 observations (13 individuals in total) were made outside of the BUS. Incidentals can be used to inform spatial patterns, but cannot be used to calculate an activity rate.

These observations are summarised in Table 2 and Table 3, BUS and incidental observations respectively.

For the first two surveys periods, Ecologia collected the following data per observation:

- Survey date
- Survey start and end time
- Survey location
- Observation start and end time
- Number of individuals observed
- Minimum and maximum height of birds

Additionally, in the most recent survey (2024 Autumn), the distance of the bird from the observer was also recorded (346 records) - however, no Grey Falcon observations were made during this season.

Table 2: Summary of observations made during the BUS

Year	Month	Season	Number of GF obs.	Number of GF individuals	Total number of obs.	Number of species
2023	10	Spring	1	2	578	67
2024	2	Summer	1	1	663	78
2024	3	Autumn	0	NA	836	76

Table 3: Summary of incidental observations made outside the formal BUS

Year	Month	Survey period	Number of individuals observed
2024	4	Autumn	2
2023	7	Outside of survey period	4
2024	2	Summer	2
2023	5	Outside of survey period	4
2024	3	Autumn	1

2.2.1 Other Raptor observations

Additionally to Grey Falcon, several other raptor species have been observed. This includes Whistling Kite, Brown Falcon, Wedge-Tailed Eagle, Nankeen Kestrel, Spotted Harrier, Collared Sparrowhawk, Australian Hobby, Brown Goshawk and Black-Shouldered Kite, which were observed during the BUS. Table 4 summarises the number of each potential proxy species recorded over the three seasons of BUS.

If similar in behaviour and detectability, these species may provide useful information (such as typical distances and heights of observations), which may be used in lieu of sufficient data on the Grey Falcon. Note proxy data would only be used to quantify observer detection distances

and height profiles. Actual flight density calculations and subsequent collision rates would only use Grey Falcon data.

Table 4: Summary of potential proxy species seen during BUS

Common Name	Observations	Individuals
Whistling Kite	22	24
Brown Falcon	18	22
Grey Falcon	2	3
Wedge-Tailed Eagle	11	16
Nankeen Kestrel	41	44
Spotted Harrier	16	19
Collared Sparrowhawk	6	6
Australian Hobby	3	3
Brown Goshawk	1	1
Black-Shouldered Kite	5	5

2.3 Site coverage

To capture spatial variability of utilisation, survey coverage (visibility) of the whole turbine envelope is important. If this is not feasible, or no significant spatial pattern is recorded, CRM can proceed under the assumption that the average flight density is constant for all turbines.

To investigate the spatial coverage of the current field placement we calculated the radius of the 90th percentile of observation distance to capture the area in which the majority of raptors were observed, highlighting areas where the current survey sites cannot detect raptors. This is a indicator of observability only, and we acknowledge that the visibility is unlikely to be consistent in every direction from the site.

As we have no instances where distances were recorded for Grey Falcon (and few observations in total being made), we use the observations of all raptors. This assumes observers have a similar ability to detect Grey Falcon and other raptors during their surveys.

Figure 1 displays the location of each observation site with the site number and radius of the 90th percentile of observations distances around each site to indicate coverage for each site. Despite some observations being recorded at large distances away from the site (up to 2000m away from the observer), their is limited observed area across the site.

The site placement is ideal, i.e. there are a large number of sites placed relatively evenly across the study area. However, due to the very large extent of the study area, complete coverage will be either extremely difficult or logistically impossible. As such, we simply need to ensure that the sites are representative of the site as a whole.

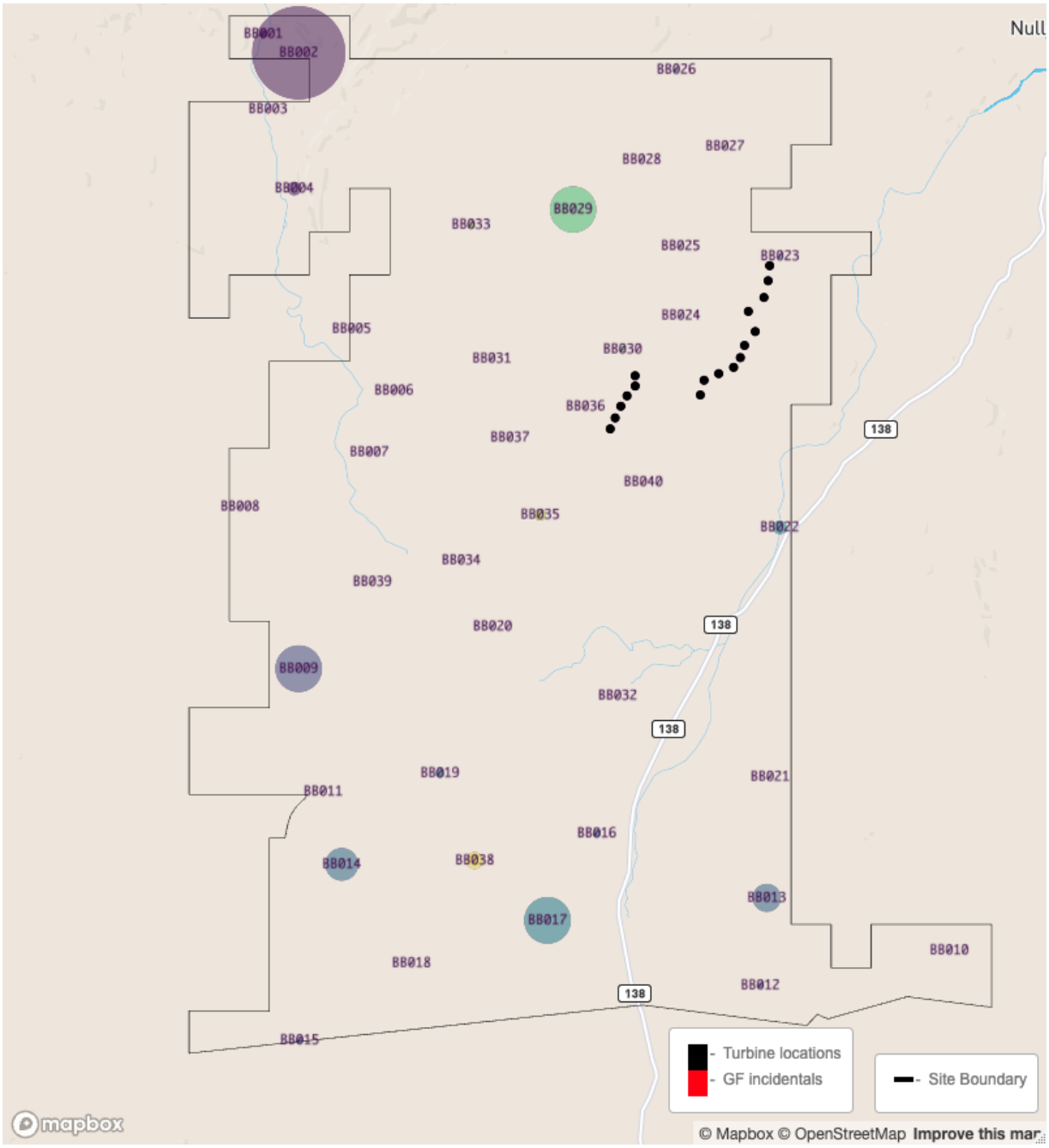


Figure 1: Observation coverage of each site across the survey area.

2.4 Spatial and temporal patterns

Currently too few observations of Grey Falcon exist across the site to understand spatial and temporal patterns of activity. Ideally, additional surveys will collect sufficient data to understand spatial patterns (i.e. which sites have higher activity), seasonal patterns, and daily patterns in activity.

3 Data assessment

We reviewed the data against the requirements for CRM. In particular, we considered:

- Is there sufficient data to estimate the flight density for Grey Falcon within and outside of the distance observable from the BUS sites?
- Is there sufficient data to model the height distribution to reliably estimate the proportion of Grey Falcon flights at rotor swept height?
- Is there sufficient spatial coverage to information patterns of utilisation across the site? Flat utilisation across the site can be used where this is not available
- Does any information exist to inform an evidence-based value for the avoidance rate (i.e. the propensity for a given species to modify their behaviour onsite to avoid turbines)?

3.1 Ability to estimate the flight density

To determine the flight rate (flights per square kilometre per year) you need:

- Positive identification of target species during formal surveys - We have this for Grey Falcon.
- Known survey duration - We have this for BUS
- A 'distance from observer' for at least 50-70 positive observations of the target species (as recommended by Buckland et al. 1993). This data is used to generate a detectability curve which allows us to correct for the fact that an observer is more likely to detect close individuals than those further away. This distribution changes depending on the species (for example, a Wedge-tailed Eagle can be identified from further away then a Sparrow).

For rare species, proxies can be used to derive a detectability curve. This relies on having an analogous species that has a similar likelihood of being detected to the rare species (determined by its size, shape, colour and behaviour) and has sufficient detections for modelling.

Currently, no observations of Grey Falcon with an associated distance measure have been recorded. There are several raptors on site that could likely be used as proxies. However, we would have low confidence currently in selecting proxies as we have no Grey Falcon distances

to compare to other raptors. There is a high likelihood that we will need to use proxies regardless of the number of additional surveys, given than after a three seasons only 2 have been observed (and therefore, we are unlikely to get to 50-70 positive observations in the two year duration typical for surveys). However, even a small number of observations with associated distance data would give us increase confidence and justification for proxy selection. We note that there appears to be some rounding in the distance data. This is not ideal when performing distance analysis, as it makes model fitting more difficult and less robust. We would recommend recording distances as precisely as possible (even if there is low confidence that the observer is recording the exact distance at which the bird is away).

3.2 Ability to determine flight height

To determine the proportion of flights at rotor swept height we need to have sufficient height observations. As with the distance distribution we ideally want 50+ observations to resolve the height distribution, but this can involve the use of proxies. Only 1 observation of Grey Falcon was of a bird in flight and therefore has an associated flight height. This again is not enough to have confidence as to which species might have similar flight heights that could be used as a proxy.

Additionally, we would recommend recording the flight height at first observation. The flight height at first observation gives the best representative sample of all flight and does not bias the proportion of flights at rotor swept height low or high.

3.3 Spatial patterns of utilisation

As there are few Grey Falcon records, we cannot determine patterns of utilisation across the site. Flight path data is ideal for resolving spatial patterns of use. However, given the extent of the site and the improbability of being able to get full coverage, it is likely that even with flight paths for Grey Falcon that we would not be able to resolve spatial patterns. Given the rarity of its occurrence it would be best to assume that a (rare) flight could cross the site in any manner. This also fits with observations of other raptors who have been observed relatively evenly across the site. The relatively flat utilisation of raptors is observable in Figure 2. Therefore, there is no data to meaningfully assign a relative risk rating of turbines across the site currently, and it is likely that a flat utilisation rate will be suitable for Grey Falcon. However, this may be resolved with further surveys and auxliary studies (such as nest searches).

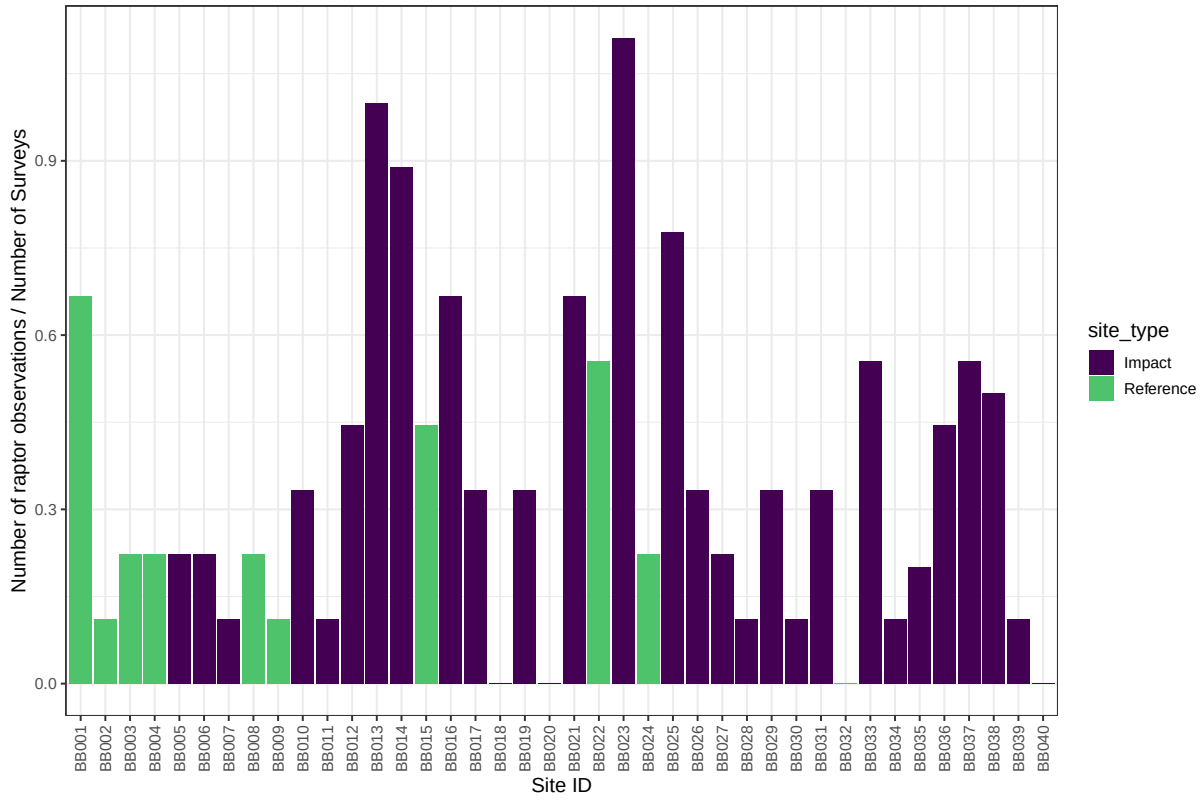


Figure 2: Number of raptors per survey observed across sites

3.4 Avoidance rates

This review does not include the review of literature to determine the availability of avoidance rate data for the Grey Falcon. To our knowledge, avoidance rate data is not available for this species. However, available avoidance rates for Wedge-tailed Eagles are available and could be used in the absence of a Grey Falcon specific avoidance rate.

4 Conclusions and recommendations

The current survey methodology displays good site coverage and sampling of different seasons onsite. The current approach to recording height and distance limits our ability to use the data as a CRM input, and the low activity rate of Grey Falcon also requires caution. We list the current strengths and weaknesses, and our recommendations below. With these recommendations in place the data is more likely to support collision risk modelling, or (at least) a robust collision assessment.

Considering the survey methods, survey effort effort and data collected we conclude:

Survey design and data collection

The survey methods overall are suitable for Collision Risk Modelling, and should continue to collect distance and height data going forward. There is currently insufficient distance data to undertake distance correction to estimate the flight density for Grey Falcon, nor compare it to proxy species. There is currently insufficient data to model the height distribution to reliably estimate the proportion of all flights at rotor swept height for Grey Falcon, nor compare it to proxy species. We recommend:

- Heights should be recorded at the first sighting of the species (for all BUS species).
- Horizontal distance should be recorded at the first sighting of the species (for all BUS species).
- Height and distance data should be recorded as precisely as is feasible in the field.
- Ecological assessment of potential proxy species is needed to increase the likelihood we will be able to undertake height and distance analysis for CRM.

Assessing relative spatial risk

The number and placement of sites is suitable to gain a representative sample across the site, but given the large extent of the site, we are unlikely to have visual coverage to get a detailed model of spatial variability in utilisation across the site. We recommend:

- CRM could proceed under an assumption of constant flight activity for each turbine.
- Given the size of the study area additional survey sites are not recommended.

Final remarks

Taking this into account we recommend waiting for further data collection before attempting quantitative collision risk modelling at BDWF. The resulting collision estimate would be too imprecise to provide sufficient insight understand the collision risk.

Although Grey Falcon are rare, with additional surveys conducted that collect flight height and distance data (without rounding) a CRM should be possible, but may need to rely on data from proxy species (i.e. other raptors).

Regards,



Dr Elizabeth Stark

Managing Director - Symbolix Pty Ltd;

e: estark@symbolix.com.au; m: 0412 075 235.

References

Band, Bill. 2012. "Using a Collision Risk Model to Assess Bird Collision Risks for Offshore Windfarms."

Buckland, S., D. Anderson, K. Burnham, and Jeffrey Laake. 1993. *Distance Sampling: Estimating Abundance of Biological Populations*. *Biometrics*. Vol. 50. https://doi.org/10.2307/2532812.

Cook, Aonghais, Alison Johnston, Lucy Wright, and Niall Burton. 2012. "A Review of Flight Heights and Avoidance Rates of Birds in Relation to Offshore Wind Farms."

Hull, Cindy L., and Stuart C. Muir. 2013. "Behavior and Turbine Avoidance Rates of Eagles at Two Wind Farms in Tasmania, Australia." *Wildlife Society Bulletin* 37 (1): 49–58. https://doi.org/10.1002/wsb.254.

Masden, E. A., and A. S. C. P. Cook. 2016. "Avian Collision Risk Models for Wind Energy Impact Assessments." *Environmental Impact Assessment Review* 56 (January): 43–49. https://doi.org/10.1016/j.eiar.2015.09.001.

Reason, J. 1997. *Managing the Risks of Organizational Accidents (1st Ed.)*. routledge.

Rodrigues, S., P. de Zea Bermudex, K. Turkman, H. Coelho, and M. Mascarenhas. 2023. "Poster: A 3D Model-Based Approach for Spatial Bat Risk Assessment for Wind Farms." In *Conference on Wind Energy and Wildlife Impacts*, 233. https://tethys.pnnl.gov/sites/default/files/publications/CWW-2023-Abstracts.pdf.

Appendix 5: Land Use Certification Acquisitions and Tenements Procedure (100-PR-TA-0001)

Procedure

Land Use Certification

Acquisitions & Tenements
(Business Process Owner)

26 April 2023
100-PR-TA-0001 Rev 2

This document is protected by copyright, no part of this document may be reproduced or adapted without the consent of the originator/company owner, all rights are reserved. This document is “uncontrolled when printed”.

Land Use Certification			
Document & Revision Number	100-PR-TA-0001	Rev 2	**26/04/2023**
Status	IFU - Issued for Use		
Summary of Changes	Procedure updated to reflect removal of LUC Extensions and Retrospective LUCs. Amendment to the LUA Team and the process for LUCs		
Author	Melissa Carter		
Checked or Squad Review# (if applicable)	Sarah Mason Durack		
Approved	Sarah Mason Durack		
Access to this document:	Fortescue Staff & Contractors	**Next Review Date (if applicable)**	30/06/2024

Revision History ***(to be completed for each version retained by Document Control)***

Author	Checker	Approver	Rev No.	Status	Issued Date
M Carter	Initial/Surname	**S Mason Durack**	2B	IFT	26/04/2023
Initial/Surname	Initial/Surname	Initial/Surname		Choose an item.	Click here to enter a date.

TABLE OF CONTENTS

1. PURPOSE 6

2. BACKGROUND 7

2.1 RECENT CHANGES 7

3. SCOPE 8

4. KEY ROLES 9

5. DEFINITIONS 11

6. LEGISLATIVE CONTEXT 14

7. PROCEDURE 15

7.1 WHEN A LUC IS REQUIRED 15

7.2 LUC TYPE SELECTION 15

7.3 LUC TRAINING AND GENERAL SUPPORT 16

7.4 STANDARD LUC PROCESSES 17

7.5 OPTIONAL LUC PROCESSES 17

7.6 LUC STATUS OVERVIEW 18

7.7 SENSITIVITY CHECKS OVERVIEW 19

7.8 LAND USE ADVISORS 20

8. GUIDELINES 22

8.1 CREATING AND SUBMITTING A LUC 22

8.1.1 LUC Drafting Overview 22

8.1.2 Roles & Responsibilities 22

8.1.3 Defining a LUC Scope of Works 23

8.1.3.1 Work Categorisation 23

8.1.3.2 Topsoil Management 23

8.1.3.3 Supplementary Questions 24

8.1.4 Defining a LUC Area 24

8.1.5 Reviewing Sensitivity Checks 24

8.2 ENDORSING A LUC 25

8.2.1 Endorsement Overview 26

8.2.2 Endorsement Timeframes 26

8.2.3 Reviewing Sensitivity Checks 27

8.2.4 Conditional & Remedy Mark-ups 27

8.2.5 Returning a LUC 27
8.3 APPROVING A LUC 28
8.3.1 Approval Overview 28
8.3.2 Approval Timeframes 29
8.3.3 Reviewing Sensitivity Checks 29
8.3.4 Conditional & Remedy Mark-ups 30
8.3.5 Returning a LUC 30
8.3.6 Approval Conditions 30
8.3.7 Tenure Approval 31
8.3.8 State Agreement Approval 31
8.3.9 Environment Approval 31
8.3.10 Heritage Approval 31
8.3.11 Pastoral Access Approval 31
8.3.12 Water Infrastructure Approval 32
8.4 REVIEWING, AMENDING AND ACCEPTING CONDITIONS 32
8.5 LUC ACTIVATION & CERTIFICATE 33
8.5.1 The Certificate 34
8.6 LUC CLOSE-OUT 35
8.7 AMENDING A LUC 35
8.7.1 Amendments During Application 35
8.7.2 Amendments Post Activation 36
8.8 WITHDRAWING A LUC 36
8.9 CANCELLING A LUC 36
8.10 CLONING A LUC 37
8.11 RETURNING A LUC 38
8.12 EXTENDING A LUC 38

9. MONITORING AND REVIEW 38

10. DOCUMENTATION AND RECORDS MANAGEMENT 39

List of Tables

Table 1: **Key Accountabilities** 9
Table 2: **Definition of Terms/Acronyms** 11
Table 3: **Legislation/Obligations** 14
Table 4: **Standard LUC Process** 17
Table 5: **Optional LUC Steps** 18
Table 6: **LUC Statuses** 18
Table 7: **Land Use Advisors (LUAs)** 20
Table 8: **LUC Creation and Submission** 22
Table 9: **LUC Endorsement Process** 26
Table 10: **LUC Approval Process** 28
Table 11: **Assessing and Accepting LUC Conditions** 33
Table 12: **Assessing and Accepting LUC Conditions** 35
Table 13: **Programmes and Schedules** 38
Table 14: **Policy, Standard, Work Instructions, Forms (Templates)** 39

LIST OF APPENDICES

Appendix 1: Standard LUC Process Flowchart

1. PURPOSE

This procedure details the requirements of Fortescue's Land Management System (LMS) as it relates to land use and the associated certification process.

Following this Land Use Certification Procedure (Procedure) ensures that the appropriate approvals have been obtained for all proposed activities before the activities commence and any related obligations can be effectively managed.

This is critical for protecting Fortescue's licence to operate.

Fortescue's land use certification process is managed in the InfoScope LMS software with an embedded web-map (Fortescue Maps), which is integrated with Fortescue GIS.

The Procedure:

- defines when a Land Use Certificate (LUC) is required and what type
- details the steps and associated guidelines for obtaining and managing LUCs (at a high-level)
- provides business justifications for key requirements
- defines key roles and responsibilities

The Procedure does not provide full details of how the LUC process is managed in InfoScope and Fortescue Maps. Detailed training and guidance, such as *Quick Reference Guides* (QRGs) for each process, are also available on the Fortescue Hub.

2. BACKGROUND

In June 2017, Fortescue upgraded its system for managing land use in WA, to achieve better protection of our licence to operate through improved transparency and accountability. The key changes that were implemented were:

- Ground Disturbance Permits (GDPs) were phased out and replaced by LUCs
- Retirement of the GDP module of the Business Management System (BMS)
- Management of the LUC process commenced in the InfoScope Land Management System (LMS)
- The scope for managing land use was increased - LUCs are required to cover more work types, i.e. not just ground disturbance activities
- An increased auditing and enforcement function of LUC close-outs was developed to improve accountability and reporting
- Overall, a more comprehensive and efficient application, assessment and approvals process was established

The changes were implemented following more than two (2) years of stakeholder consultation, assessment of previous and alternate systems, development and testing.

2.1 RECENT CHANGES

In 2020 an independent review of the system was undertaken by an external consultancy group called Veev and recommendations were made to assist FMG to manage our internal approvals and reduce risk to the business.

In 2021 LUC extensions and Retrospective LUCs were revoked, LUCs by Jurisdiction were implemented to encompass South Australia to start and reductions in size and shapes for geospatial mapping were also introduced.

In 2022 LUC Extensions were reinstated with approvals to ensure compliance. MRF Disturbance accounting grids were introduced along with selection of Tenure and ELP per work category. Partial Returns for cookie cut reductions and Pre-Endorsements were also introduced. Additional Jurisdictions for LUCs include Kazakhstan, Queensland, Gabon and FFI.

3. SCOPE

This procedure applies to all situations where a LUC is required, whenever a Fortescue employee, or contractor engaged to work on Fortescue's behalf, will be:

- disturbing new ground
- re-disturbing rehabilitated ground
- changing the purpose/usage of land[1]
- increasing the previously approved capacity of an area[2]
- accessing an area to conduct a Non-exempt Activity
- conducting maintenance work that involves earth movement or relocation of fixed infrastructure
- rehabilitating previously disturbed ground

Refer to Sections 7.1 and 7.2 of the procedure for full details of when a LUC is required, and if so, what type.

[1] For example, an area previously cleared and used as a laydown being transitioned to be a fuel storage area.
[2] For example, increased number of rooms at a camp, increased amount of fuel at storage location.

4. KEY ROLES

To ensure the integrity and effectiveness of the LUC process is maintained, there are several key roles with specific responsibilities, as listed in Table 1.

Table 1: Key Accountabilities

Role	Responsibility	Accountable Person(s)
Applicant	The person responsible for oversight, facilitation and/or conduct of an eligible activity. Works together with the Secondary Contact(s) and On-site Responsible Person(s) (optional) to manage all LUC activity.	Fortescue employees with appropriate level of authority to oversee activities.
Application Owner	The person responsible for ensuring the software application used to deliver the LUC business process (InfoScope) continues to meet business requirements, and if it does not the Application Owner will sponsor the required enhancement(s).	Acquisitions & Tenements Manager
Approver	The person responsible for assessing whether a LUC application has any constraints or obligations relating to their business unit. For example: A Tenure Approver assesses potential tenement constraints and obligations; an Environment Approver conducts an assessment of potential environmental constraints and obligations; etc.	Nominated Fortescue employees from the Tenure, Government & CSR, Environment, Heritage, Pastoral Access and Water Management teams. The persons nominated as Approvers representing each team are at the discretion of the team or group managers (Manager Acquisitions & Tenements; Manager Government & CSR; Site HSES Managers; Manager Exploration; Manager Heritage; Manager Pastoral Access; Manager Water Planning).
Business Process Owner	The person responsible for ensuring the LUC process and associated system(s) continue to meet Fortescue business requirements – driving enhancements where required.	Acquisitions & Tenements Manager
Endorser	The person responsible for conducting a first-pass assessment of whether a Ground Disturbing LUC application is as per the expected mining, exploration or development plan.	Nominated Fortescue employees from Mine Planning, Mining Operations and Exploration teams. The persons nominated are at the discretion of each site General Manager. The Primary Endorser role for an operations area is generally filled by Manager Operations Planning (or a nominated direct report). The Primary Endorser role for an exploration area is generally filled by Manager Exploration (or a nominated direct report).

Role	Responsibility	Accountable Person(s)
Endorser & Approver Teams	Those responsible for conducting a first-pass assessment of whether a Ground Disturbing LUC application is as per the expected mining, exploration or development plan. Both a Primary Endorser Team and Backup Endorser Team are required to be nominated for each Activity Area to avoid an individual person becoming a 'bottleneck'. These Teams are also responsible for the development and maintenance of internal team/departmental processes for assessing LUCs.	Endorser Teams: nominated Fortescue employees from Mine Planning, Mining Operations and Exploration teams. Approver Teams: nominated Fortescue employees from the Tenure, Government & CSR, Environment, Heritage, Pastoral Access and Water Management teams.
Interested Parties	Persons who have an interest in being informed/alerted about LUCs of certain types or in certain areas. Adding a watch to a LUC will trigger email notifications when certain LUC processes occur.	Any Fortescue employee who has LUC access
Land Use Advisor(s) (LUA)	Persons within the business who have authority to provide high level advice on the LUC process. LUAs are the only people who can provide advice that a LUC is not required for a particular activity. If there is uncertainty after reading this procedure advice should be obtained in writing.	See Section 7.8 Land Use Advisors
LMS Team	Responsible for InfoScope/LUC Support, application development and maintenance.	Sarah Mason Durack – Approvals Senior Advisor Melissa Carter – Systems Analyst Sophie Papalia – Approval Support Nicole Broderick – Approvals Support
On-site Responsible Person	The person responsible for assessing and accepting LUC conditions, oversight, facilitation or conduct of an eligible activity at a site-level. The Applicant and On-site Responsible Person may be the same.	Fortescue employees or contractors with appropriate level of authority to oversee activities.
Pre-Endorser	The person responsible for basic fact check of the LUC application; Estimated disturbance to be equivalent to shapefile submitted, Detailed scope of Works and spatial sensitivities.	LMS Team
Proxies	To ensure sufficient people have capacity to draft, edit, review and manage a LUC and the associated activities, once a LUC is created by an Applicant, the additional roles can act as proxies: • Secondary Contact(s) • On-site Responsible Person(s) • Responsible Team members Collectively, these people are responsible.	Refer to details provided for Secondary Contact, On-site Responsible Person, and Responsible Team.

Role	Responsibility	Accountable Person(s)
Responsible Team	The team of people responsible for oversight, facilitation or conduct of a LUC activity. Teams are not extracted from SAP or Org Charts, but setup in InfoScope through discussion with an LMS Application Specialist(s). Nominating a Responsible Team may assist in searching for and managing LUCs for your work area.	Groups of Fortescue employees nominated/setup as Teams in InfoScope.
Secondary Contact	A person who assists or works together with the LUC Applicant to ensure the LUC is obtained and provided to the correct personnel.	Fortescue employees with appropriate level of authority to oversee activities.

5. DEFINITIONS

Key definitions used in the Procedure are set out in Table 2.

Table 2: Definition of Terms/Acronyms

Word/Term	Definition
Activity Area	Spatially defined area where Fortescue conducts activities, either at an exploration, development, or operations level (i.e. Port, Solomon, Chichesters, Iron Bridge, Eliwana, Rail, FFI, Exploration ALL).
Application Date	Date on which a LUC is submitted for assessment.
Approval Date	Date on which all required endorsements & approvals have been received and any LUC conditions have been accepted. This is also the date at which the LUC status becomes 'Active'.
BMS	Refer to Business Management System for full definition.
Business Management System (BMS)	A web-based Fortescue IT system used for tracking and managing several processes, including: Incidents & Events; Environmental Approvals; Environmental Obligations; Field Leadership; etc. Prior to June 2017, GDPs were also managed in BMS. BMS is available via the Fortescue Hub App Centre https://fmgl.sharepoint.com/apps/Pages/BMS.aspx
ELP	Environmental Licence or Permit
ELP ID	BMS unique identifier given to individual environmental licence or permit approvals records.
Estimated Disturbance	The approximate area to be designated to a work category in Ha. When including multiple work categories under the one Ground Disturbing LUC, the approximate Ha for each category must be provided.

Word/Term	Definition
Estimated Topsoil Volume	The approximate amount of topsoil to be disturbed during the proposed Works in M^2.
Exempt Activity	Activity defined as not requiring a LUC - See Procedure section 7.1
Expiry Date	Date on which a LUC ceases to be valid and no longer covers any proposed works.
FM	Fortescue Maps
Fortescue	Fortescue Metals Group Limited all subsidiaries and employees.
Fortescue Maps (FM)	A web-based Fortescue IT system providing specialised GIS web-map services. FM is a self-service mapping package that will allow anyone with a current Fortescue account to access certain GIS data directly from the live GIS database. FM is also embedded into InfoScope and provides the web-map functionality for the LUC process. For all LUC processes users should log in to InfoScope first. Additional information, training materials and direct access to FM are available via the Fortescue Hub App Centre App Centre - Fortescue Maps (sharepoint.com)
GDP	Ground Disturbance Permit
Ground Disturbance Permit (GDP)	A historical certificate or permit issued to confirm that proposed ground disturbing activities had been assessed against various potential constraints and obligations. In June 2017, GDP were replaced by LUCs.
InfoScope	A web-based Vendor IT system used for tracking and handling a number of processes, including: Land Use Certification; Tenement acquisition & management; Tenement, Pastoral, Native Title & Heritage obligations; Aboriginal heritage surveys & approvals; VTEC training & case management. InfoScope and all training materials are available via the Fortescue Hub App Centre App Centre - InfoScope (sharepoint.com)
Land Use Certificate	A certificate issued to confirm that proposed land use activities adhere to the correct approvals granted by Government departments and have been assessed against various potential constraints and obligations.
LUC Area	The spatially defined location that the proposed or approved activity will take place.
LUC Breach	A breach has occurred if: • LUC condition(s) have not been complied with

Word/Term	Definition
	• The LUC activity took place outside of the active LUC period (i.e. before the LUC became active or after the LUC expired, including where no LUC Application has been made) • The activity took place outside the approved LUC Areas • The activity conducted was not in line with the defined scope
LUC ID	Infoscope unique identifier given to individual Land Use Certificate record.
LUC Short Name	A brief, anecdotal title or descriptor given to a LUC to provide a useful search or reference term. Naming conventions are recommended
LUC Type	The category of LUC applicable to a specific activity. See Procedure section 7.2
Mining Rehabilitation Fund (MRF)	An established fund to provide the State Government with a secure source of funding for the rehabilitation of abandoned mine sites and other land affected by mining operations. The fund is administered by the Department of Mines and Petroleum.
Non-exempt Activity	Activity defined as requiring a LUC application - See Procedure section 7.1
Proposed End Date	Date the proposed works are expected to be completed; This can be amended following approval if plans change, or works are delayed.
Proposed Start Date	Date the proposed works are expected to commence; This can be amended following approval if plans change, or works are delayed.
Sensitivity Checks	A series of assessments conducted in Fortescue Maps which check a LUC Area and Type against numerous GIS data sets and provide feedback on possible issues.
Topsoil Storage Location	A designated area used for the purpose of storing topsoil when it is disturbed. Topsoil Storage Locations are a type of Ground Disturbing LUC activity, but must stand alone (cannot be captured with other work categories under a broader LUC).

6. LEGISLATIVE CONTEXT

The following Legislation, Agreements and Management Plans provides the broad framework for which this procedure must operate and with which it needs to comply. The endorsement and approval steps included in the LUC process ensure key areas of the Fortescue business can assess proposed activities against the relevant obligations.

Table 3: Legislation/Obligations

Legislation, Agreements, Management Plans
Aboriginal and Torres Strait Islander Heritage Protection Act 1984 (ATSIHP Act)
Aboriginal Heritage Act 1972 (WA)
Access and Commercial Agreements between Fortescue and 3rd party landholders
Agreements between Fortescue and Pastoralists
Agriculture and Related Resources Protection Act 1976 (WA)
Conservation and Land Management Act 1984 (WA)
Cultural Heritage Management Plans
Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)
Environmental Management Plans
Environmental Protection (Clearing of Native Vegetation) Regulations 2004 (WA)
Environmental Protection Act 1986 (WA) (EP Act)
Environmental Protection Regulations 1987 (WA)
Heritage, Land Access, Land Use and Project Area Agreements between Fortescue and Aboriginal stakeholders
Iron Ore (FMG Chichester Pty Ltd) Agreement Act 2006 (WA)
Mineral Resources) Act 2019 (SA)
Mines Safety and Inspection Regulations 1995 (WA)
Mining Act 1971 (SA)
Mining Act 1978 (WA)
Mining Regulations 2020 (SA)
Mining Rehabilitation Fund Act 2012 (WA)
Railway and Port (The Pilbara Infrastructure Pty Ltd) Agreement Act 2004 (WA)
Rights in Water and Irrigation Act 1914 (WA)
Soil and Land Conservation Act 1945 (WA)
Statutes Amendment (Mineral Resources) Act 2019 (SA)
Wildlife Conservation Act 1950 (WA)

7. PROCEDURE

7.1 WHEN A LUC IS REQUIRED

An active LUC is required whenever a Fortescue Employee, or contractor engaged to work on Fortescue's behalf, will be:

- disturbing new ground
- rehabilitating previously disturbed ground
- re-disturbing rehabilitated ground
- changing the purpose/usage of land[3]
- increasing the previously approved capacity of an area[4]
- accessing an area to conduct a Non-exempt Activity
- conducting maintenance work that involves earth movement (including grading or digging)

Along with the above description of circumstances, carefully read section 7.2 of this Procedure, which further clarifies the type of LUC you should obtain for the activity being undertaking.

7.2 LUC TYPE SELECTION

The most appropriate LUC type should be selected based on the activity being conducted, referring to the following definitions:

- **Ground Disturbing** – disturbance of previously undisturbed ground, re-disturbance of rehabilitated ground or a change in purpose/usage of land
- **Maintenance** – upkeep of existing infrastructure or disturbance that involves earth movement (without any increase in footprint or change in purpose)
- **Rehabilitation** – rehabilitation of previously disturbed ground
- **Access** – conduct of only non-ground disturbing, 'Non-exempt Activity'

[3] For example, an area previously cleared and used as a laydown being transitioned to be a fuel storage area.

[4] For example, increased number of rooms at a camp, increased amount of fuel at storage location.

‘Exempt Activities’ are those using existing tracks and roads to access active mining, rail and port operations (i.e. offices, OPF, conveyors, rail, port.), or exploration camps, to conduct only non-ground disturbing, routine operational activities. This includes:

- Travelling to and from established operations and office facilities
- Transport of materials (i.e. extracted ore, waste, tailings etc) via existing mine operations road network
- Routine maintenance of processing and non-processing infrastructure in operations areas

‘Non-exempt Activities’ are those not covered by the previous definition, and include:

- Heritage, environmental, and hydrological surveys, studies and monitoring
- Non-ground disturbing/low impact geological investigations (i.e. gravity survey, rock-chipping/sampling, etc)
- Accessing areas that require travel off existing tracks/roads
- Maintenance of fixed infrastructure outside of operations area.

If, after reading Procedure sections 7.1 and 7.2 along with the Definitions section, you require further clarification of:

(i) whether a LUC is required for the activity you will be involved in, or

(ii) the most appropriate LUC type for your activity,

you should contact an LUA to discuss. Only Fortescue employees who are designated LUAs have the authority to provide confirmation that an activity can proceed without a LUC. Such approval to proceed should be obtained in writing (via email LUAs@fmgl.com.au) to ensure transparency and accountability.

7.3 LUC TRAINING AND GENERAL SUPPORT

To ensure you understand when this procedure might apply; your role and responsibilities as an Applicant/Proxy, Endorser or Approver; and how to use the InfoScope and Fortescue Maps systems to implement the LUC process, it is a requirement to complete the LUC training. Training can be undertaken through each individual’s SuccessFactors. Once the training has been completed LMS Support grant permissions.

A copy of this procedure, along with other support and training materials, such as Quick Reference Guides (QRGs) for each process, can be accessed on the Fortescue Hub, via:

- InfoScope Quick Reference Guides;
- LUC Training Videos; or
- Land Management System Hub

A central mailbox is also monitored by the LMS team to assist or redirect general support enquiries (lmssupport@fmgl.com.au).

To be able to fulfil the role of Applicant/Proxy, Endorser or Approver in the LUC process you will also need to be granted the relevant security permissions in InfoScope. This will be completed following LUC Training.

7.4 STANDARD LUC PROCESSES

The process below is to be followed to apply for a LUC

Table 4: Standard LUC Process

Responsibility	Steps (Tasks)	Refer Guideline
Applicant	1. Create and **Submit** a LUC	Section 8.1
Endorser(s)	2. Assess and **endorse** the LUC (Ground Disturbing LUCs WA only)	Section 8.2
Approver(s)	3. Assess and **approve** the LUC (with conditions)	Section 8.3
On-Site Responsible or Proxies	4. Assess and **accept conditions** of the LUC and **finalise map** in FM	Section 8.4
Applicant and Proxies	5. Receive **LUC Certificate** and proceed with approved activity in line with scope and conditions	Section 8.5
Applicant or Proxies	6. Complete approved activity and **close out** LUC	Section 8.6

Refer to Attachment 1 for a workflow map of the Standard LUC process.

7.5 OPTIONAL LUC PROCESSES

In addition to the standard LUC steps, there are several optional steps included in Table 5, which may occur depending on:

- Edits made to a LUC during the drafting and assessment stages.
- Outcome of assessments conducted by Endorsers and Approvers (before a LUC becomes active).
- How your approved activities progress following the issue of an active LUC.

Table 5: Optional LUC Steps

Responsibility	Steps (Tasks)	Refer Guideline
Applicant and/or Proxies	Edit or **Amend** the LUC	Section 8.7
Applicant and/or Proxies	**Withdraw** the LUC	Section 8.8
LMS Application Specialist	**Cancel** the LUC	Section 8.9
New Applicant	**Clone** a LUC	Section 8.10
Endorser(s) or Approver(s)	**Partially Return** or **Return** the LUC to the Applicant for review or amendment	Section 8.11

7.6 LUC STATUS OVERVIEW

As a LUC progresses from initial draft through to close-out, it will change status to clearly indicate the stage it has reached. Table 6 lists the various statuses a LUC can have and the associated definitions.

Table 6: LUC Statuses

Status	Definition
Draft	A LUC application has commenced but is yet to be submitted OR a returned LUC application has been reverted to draft whilst amendments are made.
Pending	A LUC application has been submitted / resubmitted and is awaiting endorsement / approval.
Returned	An Endorser or Approver has returned a LUC to the Applicant, following assessment, requesting review or changes.
Partial Return	An Approver requires a sensitivity to be cookie cut out of the spatial data. All other approvals are left intact.
Conditional	A LUC application has been endorsed (if applicable) and approved and is waiting for the On-Site Responsible Person or Applicant to review and accept any conditions.
Active	A LUC has been issued following endorsement (if applicable) and approval, and conditions have been accepted.
Withdrawn	A LUC has been retracted before becoming active (i.e. no longer required).
Expired	A LUC is no longer active (expiry date has passed), but close-out is not yet complete
Cancelled	A LUC was active, but after no work being conducted, was no longer required. IMPORTANT NOTE: If any work is conducted under a LUC, it must be closed-out, not cancelled.
Completed	LUC is no longer active, and close-out has been completed.

7.7 SENSITIVITY CHECKS OVERVIEW

A key part of the LUC process is the capability to assess a proposed LUC Area against current GIS data. This is achieved in the embedded web-map Fortescue Maps, which is integrated with Fortescue GIS.

When a proposed LUC Area is assessed a comprehensive set of GIS data sets are checked and results are provided based on the potential sensitivity of the data. The level of sensitivity of data sets can vary depending on the potential for the intersecting data to constrain the LUC activity. For example:

- an Access LUC is likely to result in less warnings and lower warning levels than a Ground Disturbing LUC in the same area, because of the low impact nature of activities conducted under an Access LUC
- intersection with a Heritage Place will present a higher level of warning compared to intersection with a Heritage Place Buffer
- intersection with an Environmental Restriction Zone may present a higher level of warning compared to intersection with an area of Introduced Flora

A full list of sensitivity checks and their resulting warnings is maintained by the GIS team, in consultation with the LMS Team; however, the level of sensitivity of various data sets is based on advice from the relevant business unit.

The results provided through the sensitivity check process provide valuable information on potential constraints which may affect a LUC, enabling the Applicant, Endorser and Approvers to complete the LUC process accurately and efficiently.

The sensitivity checks run at three (3) stages during the standard LUC Process:

- When an Applicant defines the LUC Area during the drafting and submission process.
- When a Pre-Endorser / Endorser assesses the LUC Area.
- When an Approver assesses the LUC Area.

Most of the checks provide information to guide the application and assessment stages and will not stop a LUC application from progressing. There are some results which will prevent a LUC from receiving approval by the relevant Approver group; however, these results will also not prevent a LUC application from being submitted[5].[5] It may simply mean that further approvals or actions must be completed by the Approver group before the data can be updated and the LUC can proceed. This prevents human error from occurring in relation to certain high sensitivity matters.

[5] For example, a Ground Disturbing LUC that intersects with a Heritage Place can be submitted but cannot be approved by a Heritage Approver until the conflict is resolved. This may require further survey, consultation or approval to be completed to enable Heritage Place GIS data to be updated, thereby removing the constraint and allowing approval to proceed.

7.8 EXCEPTIONS

Exceptions to the standard LUC requirements will only be accommodated in special circumstances.

7.8.1 EMERGENCIES

In the even of an emergency on site where there is an imminent threat to life, critical infrastructure or larges portions of the environment, work can be conducted without a LUC as State or Local Government agencies will generally step in to manage the situation. In this situation, a Fortescue assisting in managing the emergency or their delegate must contact the LMS team within 24 hours to request a Retroactive LUC to account for any clearing that has taken place. Only in these circumstances will a Retroactive LUC be issued.

7.8.2 IMMEDIATE INCIDENT RESPONSE PROCESS

In the event of an incident or event occurring on site, where lives, critical infrastructure or large portions of the environment are not at imminent risk, an Immediate Incident Response Process (IIRP) must be followed. This process is the same as the Ground Disturbing LUC, however approval can be obtained within 24 hours or less. The purpose of this process is to allow rapid recovery and clean up after a major incident once the threat has been neutralised and the area has been declared safe to enter. An example is collapse of the tailing dam wall – once the spill has been contained and wall secured, a recovery team will need an IIRP to contain the spread of the slurry and clean up any environment that has been contaminate.

7.9 LAND USE ADVISORS

Several roles/people in the business have been delegated responsibility as Land Use Advisors (LUAs). The LUAs work as a team to ensure the LUC process aligns with business requirements and that clear and consistent advice is available to employees and contractors regarding the LUC process. The current LUAs are:

Table 7: Land Use Advisors (LUAs)

Position	Name	Job Title
Chair	Sarah Mason Durack	Approvals Senior Advisor
Member	Rebekah Jenaway	Manager Projects and Access
Member	Damon Edwards	General Manager Acquisitions & Tenements
Member	Jenny Thomson	Senior Manager Data & Information
Member	Johanna Hopfmueller	Superintendent Information Management Delivery
Member	Zena Harman	Senior Manager Governance
Member	Marlene Lootz	Manager Environment Operations

Position	Name	Job Title
Member	Peter Hood	Manager Approvals & Compliance
Member	Stuart Badock	Manager Exploration Iron WA
Member	Yuluwiri Mcgrady	Manager Heritage Compliance and Operations
Member	Rosalyn Sloan	Senior Geologist Approvals & Tenements
Member	Justin Barclay	Manager Water Planning
Member	Michael Carroll	Specialist Hydrogeologist (Delegate)
Member	Wendy Treasure	Principal Native Title
Member	Max Coyne	Land Access Specialist
Member	Melissa Carter	LMS Systems Analyst
Member	Sophie Papalia	Approval Support Officer
Member	Nicole Broderick	Approval Support Officer

The LUAs come from different business units, but are responsible for representing the full spectrum of business needs (i.e. not only representing their business unit). Collectively the LUAs have a soft reporting line to the LUC Business Process Owner and work together with the LMS Team to ensure procedural requirements and software functionality align.

In addition to providing general advice on procedural matters (i.e. what type of LUC to apply for, what level of detail is required for certain works) LUAs are the only people who can provide advice that a LUC is not required for a particular activity.

In this situation an approval to proceed should be obtained in writing (via email) to ensure transparency and accountability.

8. GUIDELINES

The LUC process is detailed through the LUC lifecycle below.

8.1 CREATING AND SUBMITTING A LUC

8.1.1 LUC Drafting Overview

To create a new LUC a Fortescue employee must have the correct security permissions in InfoScope, as a potential LUC Applicant. Once a new LUC has been created, only the people nominated as the Applicant, Secondary Contact(s) or On-site Responsible Person(s) or Responsible Team can edit that LUC.

The steps involved in creating a LUC are set out in Table 8:

Table 8: LUC Creation and Submission

Steps (Tasks)	Notes
1. Create a new draft LUC in InfoScope and enter the relevant details	Type and level of detail to be entered will vary depending on the proposed activity and LUC type
2. Spatially define the LUC Area in the FM web-map.	There are a number of options for doing this, i.e. using the map drawing tools or uploading spatial data.
3. Assess the results of the Sensitivity Checks and decide whether any amendments are required to the application.	Refer to section 7.7 Sensitivity Checks Overview and section 8.3.3 Reviewing Sensitivity Checks for more information.
4. Add Work Category details to the MRF Grid by Tenement and ELP	Where work category areas span multiple tenements then each tenement must be defined separately.
5. Submit the LUC application for assessment.	Ground Disturbing LUCs require Endorsement and Approvals; other LUC types only require Approvals.

For detailed technical instructions on creating and submitting a LUC in the LMS, refer to the following QRGs:

- Enter Details for Ground Disturbing LUC/ Access, Maintenance or Rehabilitation LUC/Topsoil LUCs; and
- Define Work Area.

8.1.2 Roles & Responsibilities

The person who is responsible for overseeing or facilitating an eligible land use activity should apply for a LUC and be the nominated LUC Applicant. At least one Secondary Contact should be nominated for a LUC application to ensure enquiries can be dealt with effectively. In most cases the Secondary Contact will be an Applicant's 'back-to-back' and/or a person in the same reporting line (a supervisor or a direct report).

In addition, if appropriate and/or different to the Applicant and Secondary Contact(s), On-site Responsible Person(s) can be nominated. The On-site Responsible Person(s) are those with the appropriate authority to oversee or facilitate the conduct and completion of the LUC activity, once the LUC becomes active.

Note that if an On-site Responsible Person is nominated, they will be allocated the task of reviewing and accepting the LUC conditions before a LUC is issued. They will also be allocated responsibility for close out tasks, though they can redirect such tasks back to the Applicant or Secondary Contact(s) if it is appropriate to do so.

LUC Applicants, Secondary Contact(s), On-site Responsible Person(s) and Responsible Teams are jointly responsible for ensuring the LUC accurately reflects the proposed activities and the activities proceed in line with LUC conditions.

8.1.3 Defining a LUC Scope of Works

The information requested and the level of detail required for a LUC differs somewhat based on the LUC type. Ground Disturbing LUCs require detailed explanations of works to be conducted as well as any applicable approvals and agreements i.e. POW reference

The information requested during the drafting and application process is used to ensure Endorsers and Approvers have sufficient and appropriate information to complete their assessment, and to ensure Fortescue can meet statutory and contractual reporting obligations.

8.1.3.1 Work Categorisation

Applicants will be requested to select Work Categories and Sub-categories, from pre-defined lists, along with the relevant tenement and ELP to define the proposed scope at a high level. For some LUCs the categorisation aligns with that defined by the relevant government department i.e. Ground Disturbing LUCs aligns with the Mining Rehabilitation Fund (MRF) categories in WA; hence, it is important to ensure the categorisation used matches the government definition for the activity.

If an Applicant cannot find a category/sub-category that is appropriate to the proposed scope of works, they should contact the LMS team, via LMS Support, to discuss. The LMS team will facilitate a discussion with the Business Process Owner and LUAs, and additional categorisation will be incorporated if required.

A list of Work Categories & Sub-Categories, along with their definitions, can be viewed by clicking on the ‘info tool’ button  adjacent to the Work Category field on any LUC record in InfoScope.

8.1.3.2 Topsoil Management

Ground Disturbing LUC applications will be required to provide details relating to the management of topsoil, including an Estimated Topsoil Volume to be moved and proposed Topsoil Storage Location(s).

Topsoil Storage Locations must also be covered by active LUCs specific to that Work Category (purpose). Applicants can search for active Topsoil Storage Locations in several ways to assist in confirming the most appropriate and efficient option(s).

LUC Applicants will be asked to nominate one or more LUC IDs (which correspond to active Topsoil Storage LUCs) as the proposed Topsoil Storage Location. If an Applicant is proposing to use a Topsoil Storage Location which is not currently covered by an active LUC, that Topsoil Storage LUC must be created and approved before the other LUC application can be submitted.

An exception to the above-mentioned situation applies when you are intending to retain disturbed topsoil at the clearing location (i.e. pushed temporarily to the edge of the cleared area), rather than relocate it to a Topsoil Storage location. For details of how to reflect this in the LUC, refer to the Enter Details for Ground Disturbing LUCs QRG.

8.1.3.3 Supplementary Questions

LUC Applicants may also be asked some supplementary questions about the proposed scope of works (i.e. about blasting, unaccompanied consultants, new native vegetation clearing, infrastructure construction, underground services or travel methods) which enable comprehensive workflow and reporting requirements to be achieved.

8.1.4 Defining a LUC Area

The LUC Area is the spatially defined location where the proposed activity will take place. A LUC Area may vary in size, up to a maximum of 10,000Ha, and specificity depending on a number of factors, including:

- the LUC type and proposed activity; and
- the degree of detail which is known about the proposed activity (scope of works) at the point of application.

It may be appropriate for a LUC Area to be larger than the exact area of the proposed activity, however Applicants should ensure they provide sufficient level of detail to enable assessment to be effectively conducted and a reasonable level of accountability to be achieved. Submitting a LUC Application over a large LUC Area, with limited details of proposed work, has a greater potential of being returned by an Endorser or Approver, who may require more information.

As a general guide, the greater potential a particular activity has for constraints and obligations, the more specific the Applicant will need to be to enable effective assessment.

8.1.5 Reviewing Sensitivity Checks

Refer to Section 7.7 Sensitivity Checks Overview for general information about the purpose of Sensitivity Checks.

During the LUC drafting process, the Sensitivity Checks process will run in the FM web-map once a LUC Area has been defined. The results show potential constraints that spatially relate to the LUC Area and are provided to assist Applicants in forecasting whether:

- The LUC scope or Area may need to be amended.
- The LUC application may be delayed whilst further studies/surveys/approvals/permits /licences are obtained.

- Conditions may be applied by an Approver and, if so, what type.

After reviewing the results of the Sensitivity Checks, an Applicant may choose to make changes before submission, (i.e. amend the LUC Area to avoid a Priority Flora Area or overlapping Ground Disturbing LUCs), or submit the LUC without changes and await assessment by the Endorser(s)/Approvers.

If an Endorser/Approver proposes that an amendment is required based on the results of the Sensitivity Checks, they may return the LUC application to the Applicant for review and potential amendment. Endorsers/Approvers do not have the capacity to make direct changes to the LUC details or LUC Area; this must be done by the Applicant.

8.2 ENDORSING A LUC

The endorsement process applies to Ground Disturbing LUCs in WA only.

LUC pre-endorsements allow the LMS team to review the basic minimum standards required for a LUC i.e. detailed scope of works is understandable and written so that any new team member can understand what is expected of them.

LUC endorsement allows the person(s) responsible for managing a particular site (Activity Area) to conduct a high-level assessment of whether the proposed activity is in line with their expectations.

The Endorsers for a LUC are selected based on the spatially intersecting Activity Areas; however, only certain Activity Areas in InfoScope are used to assign Endorsers. The Activity Areas which currently meet that criteria are:

- Christmas Creek Project
- Cloudbreak Project
- Eliwana Project
- Eliwana Rail Infrastructure
- Exploration Project
- Herb Elliott Port Infrastructure
- Iron Bridge Project
- Pilbara Transmission Project
- Port Authority Area
- Power Generation Project Infrastructure
- Rail (Mainline & Hamersley) Infrastructure
- Solomon Project

If a LUC Area intersects with multiple Activity Areas, multiple Endorsers will assess.

8.2.1 Endorsement Overview

An overview of the endorsement processes (which includes both pre-endorsers and endorsers) for a LUC and the related QRGs which provide the technical instructions, is set out in Table 9. Each endorsement team is responsible for developing and maintaining internal procedures or guidelines about how they assess LUCs against the legislative and procedural obligations for their area.[6]

Table 9: LUC Endorsement Process

Steps (Tasks)	Notes
1. Submitted Ground Disturbing LUC is ready for review	
2. Endorser assesses the LUC details in InfoScope	
3. Endorser continues assessment of the LUC in the FM web-map	Conditional mark-ups can be added in the map.
4. Endorser can EITHER: • Endorse the LUC; or • Return the LUC back to the Applicant for review/amendment.	Endorsing a LUC means it will proceed to Approvers for assessment. Remedy mark-ups should be added in the map if returning LUC. Refer to Section 8.2.5 for more details on the process of returning a LUC.

For detailed technical instructions on completing the endorsement process in the LMS, refer to the following QRGs:

- LUC Overview Endorsers
- Endorse LUC
- View Sensitivity Checks
- Add Conditional Markup
- Add Remedy Markup (Return LUC)

8.2.2 Endorsement Timeframes

Endorsers are allocated three (3) business days to complete a LUC endorsement assessment (i.e. review and endorse or review and return to the Applicant). If an endorsement assessment is not completed within the allocated time, the task will display as overdue.

[6] For example, some operations areas elect to use a spatial check against the “MODE” (approved clearing boundary) to guide the management of ground clearing limits.

8.2.3 Reviewing Sensitivity Checks

Refer to Section 7.7 Sensitivity Checks Overview for general information about the purpose of Sensitivity Checks.

During the LUC endorsement process, the Sensitivity Checks process will run in the FM web-map, providing results of any potential constraints that spatially relate to the LUC Area. The results are provided to assist Endorsers in assessing whether:

- a proposed LUC activity should proceed; or
- a LUC scope or Area needs to be amended.

The level of warning and the data sets that are checked during the Sensitivity Checks are managed by GIS, as directed by each Approvals Team.

If an Endorser believes there is an issue with the Sensitivity Checks or wishes to add additional checks to assist in the completion of their assessment, this should be discussed with the LMS Team.

If an Endorser recommends, after review of the Sensitivity Checks, that the LUC Area should be amended, this can be done through annotations on the web-map (remedy mark-ups). Endorsers do not have the capacity to directly make changes to the LUC details or LUC Area; this must be done by the Applicant.

8.2.4 Conditional & Remedy Mark-ups

When an Endorser is assessing a LUC in the FM web-map, there are two (2) types of annotations which can be made for the reference of the Applicant and Proxies:

- Conditional Mark-ups; and
- Remedy Mark-ups.

Adding a Conditional Mark-up to the FM web-map means that the LUC is going to receive endorsement, but there is a condition to be applied to the endorsement. If an Endorser creates a Conditional Mark-up it will appear on the LUC Certificate, once it is issued, as a reference for the Applicant and Proxies.

Adding a Remedy Mark-up to the FM web-map means that an amendment is proposed to the LUC before it can be endorsed. For example, the LUC Area may need to be shifted to another location based on a competing priority in the mine plan. This can be annotated on the web-map by the Endorser before the LUC is returned to the Applicant for review.

8.2.5 Returning a LUC

If an Endorser returns a LUC to the Applicant for amendments to be made, they should provide context and clarification of this decision by adding a Remedy Mark-up to the map and in the final return process. This can then be viewed on the LUC by the Applicant and Proxies. When a LUC is returned the LUC status is changed to ‘Returned’. If there are multiple Endorsers for a LUC and one Endorser returns the LUC all other Endorser workflows will stop to avoid unnecessary work being conducted.

8.3 APPROVING A LUC

The Approvers required to assess a LUC may differ based on the LUC type and location. The full list of potential Approvers, which correspond to Fortescue business units who will assess a LUC against known obligations and constraints, are:

- Tenure
- State Agreement
- Environment
- Heritage
- Pastoral Access
- Water Infrastructure

8.3.1 Approval Overview

An overview of the approval processes for a LUC, and the related QRGs which provide the technical instructions, is set out in Table 10. Each approval group or team is responsible for developing and maintaining internal departmental procedures or guidelines about how they assess LUCs against the legislative, contractual and procedural obligations for their approval area. This is important for ensuring consistency.

Table 10: LUC Approval Process

Steps (Tasks)	Notes
1. Submitted LUC is ready for review	For Ground Disturbing LUCs, Endorsement must have already been received.
2. Approver assesses the LUC details in InfoScope	
3. Approver continues assessment of the LUC in the FM web-map	Conditional mark-ups can be added in the map.
4. Approver can EITHER: • Approve the LUC with no conditions; or • Approve the LUC with conditions; or • Partially Return just their approval for a cookie cut of the shapefile from a sensitivity; or • Return the LUC back to the Applicant for review/amendment.	Remedy mark-ups should be added in the map if returning LUC. Refer to Section 8.3.5 for more details on the process of returning a LUC.

Refer to Section 8.3.7 (Tenure Approval) and Section 8.3.9 (Environment Approval) for details of an additional step specific to those business units.

For detailed technical instructions on completing the approval process in the LMS, refer to the following QRGs:

- Approve LUC – Assess in Map
- View Sensitivity Checks
- Approve LUC – Set Conditions
- Add Conditional Markup
- Add Remedy Markup (Partial or Full LUC Return)

8.3.2 Approval Timeframes

Approvers are allocated seven (7) business days to complete a LUC approval assessment (i.e. review and approve, or review and return to the Applicant). If an approval assessment is not completed within the allocated time, the task will display as overdue and the task escalation process will be initiated.

8.3.3 Reviewing Sensitivity Checks

Refer to Section 7.7 Sensitivity Checks Overview for general information about the purpose of Sensitivity Checks.

During the LUC approval process, the Sensitivity Checks process will run in the FM web-map, providing results of any potential constraints that spatially relate to the LUC Area. The results are provided to assist Approvers in assessing whether:

- The LUC scope or Area needs to be amended.
- The LUC requires a further study/survey/approval/permit/licence to be obtained before the activity can proceed.
- Certain conditions need to be applied to a LUC as part of the LUC approval process.
- An error or omission in the GIS or obligations data needs to be corrected[7].

The level of warning and the data sets that are checked during the Sensitivity Checks are managed by GIS, as directed by each Approvals Team. If an Approver and Approvals Team believes the Sensitivity Checks for their business unit needs to be adjusted, this should be discussed with the LMS Team.

If an Approver recommends that the results of Sensitivity Checks be used to amend the LUC Area (i.e. an intersecting Heritage Place needs to be cut out of the LUC Area), this can be done through annotations on the FM web-map (Remedy Mark-ups). Approvers do not have the capacity to make changes to the LUC details or LUC Area; this must be done by the Applicant.

[7] If a particular sensitivity warning appears due to an error or omission in the GIS or other data (BMS or InfoScope obligations), Approvers are responsible for correcting this issue, not simply disregarding the warning. If an Approver is not the custodian/person responsible for the relevant data set, they should communicate with the relevant custodian to alert them to the issue.

8.3.4 Conditional & Remedy Mark-ups

When an Approver is assessing a LUC in the FM web-map, there are two (2) types of annotations which can be made for the reference of the Applicant and Proxies:

- Conditional Mark-ups; and
- Remedy Mark-ups.

Adding a Conditional Mark-up to the FM web-map means that the LUC is going to receive approval, but there are conditions which require further explanation in a spatial context. For example, if no amendments are required to the LUC, but the Heritage Approval includes a condition requiring the installation of flags in a nominated location before clearing commences, the proposed location can be drawn as an annotation on the map as a Conditional Mark-up.

If an Approver creates a Conditional Mark-up it will appear on the LUC Certificate, once issued, as a reference for the Applicant and Proxies.

Adding a Remedy Mark-up to the FM web-map means that an amendment is proposed to the LUC before it can be approved. For example, a section of the LUC Area may need to be excised because it intersects with an area of protected flora. This can be annotated on the FM web-map by the Environment Approver before the LUC is partially returned to the Applicant for review.

8.3.5 Returning a LUC

If an Approver returns a LUC the Approver should provide context and clarification of this decision by adding a Remedy Mark-up to the map. If the LUC can be amended through a sensitivity cookie cut then a partial return is sufficient so the rest of the LUC approvals can continue. If the change required cannot be completed this way, then the LUC must be Returned. Returning a LUC changes the LUC status to ‘Returned’. If one Approver returns the LUC, all other Approver workflows will stop to avoid unnecessary work being conducted.

8.3.6 Approval Conditions

When reviewing a LUC, Approvers may deem it appropriate to propose certain conditions to ensure the activities are conducted in accordance with specific obligations. It is critical that Approvers ensure only relevant conditions are selected or applied to a LUC, to avoid creating an unmanageable or seemingly redundant task for LUC holders.

There are three (3) potential ways of assigning conditions to a LUC during the approval process[8]:

- Selecting the commonly used conditions for your Approval area.
- Manually drafting an ad-hoc condition.

[8] Options 1 and 2 are always available, whereas option 3 may only be available if there are centrally managed obligations in BMS or InfoScope which relate to the LUC Area.

- Selecting the obligations which have been imported from corresponding Tenement Obligations or Environmental Obligations.

8.3.7 Tenure Approval

Assessment by a Tenure Approver is always required. In addition to the standard approval process, Tenure Approvers are also responsible for selecting which tenement(s) relate to a LUC application. For example, if there are overlapping tenements (i.e. an Exploration licence and a Miscellaneous licence) the tenement which is relevant to the proposed LUC activity should be selected.

This process is important for future compliance reporting and ensures only the Tenement Obligations which potentially relate to the LUC are pulled across for possible selection as LUC Approval Conditions.

8.3.8 State Agreement Approval

Assessment by a State Agreement Approver is only required when a LUC Area spatially intersects with the State Agreement data set managed in GIS.

8.3.9 Environment Approval

Assessment by an Environment Approver is always required. To enable a more automated process for assessing potential applicable Environmental Approvals and associated obligations, the LMS is integrated with sections of BMS and GIS. Environmental Approvals are read from BMS, referencing the associated ELP ID, and cross referenced against spatial data held by GIS. The integrity and accuracy of the source data should be managed by the Environment team to ensure that the full value can be gained from the integration between the systems.

In addition to the standard approval process, Environment Approvers are also responsible for selecting which Environmental Approval(s) relate to a LUC application. For example, if there are multiple intersecting approvals (i.e. a Program of Works Approval, an EP Act Part IV Approval and an EPBC Act approval) only the approvals which are relevant to the proposed LUC activity should be selected.

This process is important for future compliance reporting and ensures only the Environmental Obligations for the selected approval are available for selection as LUC Approval Conditions.

8.3.10 Heritage Approval

Assessment by a Heritage Approver is always required; however, the individual/team allocated the approver task will vary based on the native title area the LUC Area intersects with.

8.3.11 Pastoral Access Approval

Assessment by a Pastoral Access Approver is always required.

8.3.12 Water Infrastructure Approval

Assessment by a Water Infrastructure Approver is required in WA. The remit of water infrastructure approval is to assess each LUC for:

- Interaction with any water planning (dewatering, raw water supply, surface water management and monitoring) infrastructure (managed by sensitivity checks)
- Suitability against any RIWI Act licences (5C, 26D, Bed and Banks) and associated Groundwater Operating Strategies (managed by sensitivity checks and review of scope)
- Risk of unwanted impact owing to interaction with groundwater or surface water resources (i.e. risk of exceeding design flow in established drainage infrastructure from upstream activity). Managed by scope review and broader spatial review of LUC outside of designated LUC boundary

It is important to note the Water Infrastructure Approver will not be checking against groundwater or surface water approvals/management plans under EP Act or Mining Act legislation.

Additionally, a proposed LUC activity that impacts the surface water flow regime may trigger additional approval requirements or mitigation works before the LUC can be approved internally. Examples include:

- Increased flood levels that overlap with heritage restricted zones or unsurveyed land. In this case surveys, consultation and/or further approvals may be required.
- Changes to flow velocity that increase erosion on 3rd party tenure or proximal to 3rd party infrastructure. In this case an engineering solution may need to be built.

Applicant teams are encouraged to engage with the Water Planning – Water Engineering team during the design phase to work through these potential risks.

8.4 REVIEWING, AMENDING AND ACCEPTING CONDITIONS

Once Endorsement(s) (if applicable) and Approvals have been received for a LUC, the status is set to ‘Conditional’ and the Applicant and Proxies are notified. The LUC will not become ‘Active’ until any assigned Approval Conditions have been reviewed and accepted and the Spatial Mapping requirements have been confirmed in Fortescue Maps.

If an On-site Responsible Person is nominated on a LUC application, they are responsible for reviewing and accepting the Approval Conditions. If no On-site Responsible Person is nominated this is the Applicant’s or Secondary Contact’s responsibility.

Applicants/Proxies should be sure to complete a thorough review of Approval Conditions before accepting, as they are accountable for complying. If a condition is unclear, seems unnecessary or contradicts/conflicts with another condition, this should be queried.

Any concerns with Approval Conditions should be discussed with the relevant Approver during the review period. If agreed, amendments to conditions can be made by Approvers using the 'Amend Conditions' function on the LUC Approval. This can only be done whilst the LUC status is 'Conditional'. Once the conditions have been accepted and the LUC is active, no further changes can be made.

A LUC maintains the status of 'Conditional' for 180 days, after which it will expire; hence, Applicant/Proxies should ensure they review and accept the conditions in this period.

The process for assessing and accepting LUC Conditions is set out in Table 11.

Table 11: Assessing and Accepting LUC Conditions

Steps (Tasks)	Notes
1. Applicant and Proxies receive notification that LUC is Endorsed and Approved and is ready for review.	LUC status is set to 'Conditional'
2. On-site Responsible Person or, if none, Applicant/Secondary Contact review the LUC Approval Conditions and accepts.	180 days to complete review and accept.
3. On-site Responsible Person or, if none, Applicant/Secondary Contact confirms the data export and mapping options required for the LUC in Fortescue Maps	LUC status is set to 'Active'
4. The LUC is now 'Active'. The certificate and associated data package are issued.	This can take up to 1 hour following Activation in FM.

For detailed technical instructions on reviewing, amending, and accepting LUC conditions in the LMS, refer to the following QRGs:

- Accept LUC Conditions; and
- Approve LUC – Amend Approval.

8.5 LUC ACTIVATION & CERTIFICATE

Once a LUC becomes 'Active' it will be issued for use and the following actions occur:

- Expiry Date is set for twelve (12) months from the Approval Date (the date it became 'Active').
- LUC Certificate is generated in PDF format and attached as a Document in InfoScope.
- A zip file containing maps and spatial data (.shp, .dxf and .kml) is generated and attached as a Document in InfoScope.
- An email is generated notifying the Applicant, Proxies and any Interested Parties that the LUC has been issued.

The initial period of certificate activity (12 months) is automatically assigned for all LUC types. It is possible for the LUC Expiry Date to be amended to reflect the expiry of the supporting ELP if it is less than 12 months. It is also possible for the LUC Expiry Date to exceed the Proposed End Date of the activity, meaning you may Close out the LUC earlier than the Expiry Date, once the scope is complete.

Refer to Section 8.6 LUC Close Out for details of how to proceed with closing a LUC once the scope is complete.

For detailed technical instructions on the LUC Activation process in the LMS, refer to the following QRGs:

- Accept LUC Conditions; and
- View LUC Certificate and Attachments.

8.5.1 The Certificate

The LUC Certificate contains all the information critical to the assessment outcome and should be reviewed closely by the Applicant/Proxies. It will include the following crucial details:

- LUC ID, Type, Responsible Team and Short Name
- Key dates (Expiry Date, Application Date, Approval Date, Proposed Start Date, Proposed End Date)
- Key contacts, roles, and details
- Summary of Works
- Standard Conditions
- High Risk Heritage Conditions (if applicable)
- Assigned Conditions from Approvers
- Endorsement details
- Approval details
- LUC Area overview map
- If Conditional Mark-ups have been used by an Endorser/Approver, a map showing those annotations with details.

If an Applicant or Proxy is unclear about any of the details or conditions displayed on the Certificate, they should contact the relevant Endorser/Approver that corresponds to that section. If in doubt about who to contact, please discuss with an LMS Specialist.

8.6 LUC CLOSE-OUT

A LUC should be closed-out by the Applicant or Proxies once the approved activities have been completed and/or no further activity is proposed under that LUC. The process for LUC Close-out is set out in Table 12.

Table 12: Assessing and Accepting LUC Conditions

Steps (Tasks)	Notes
1. Confirm the actual start and end dates for the activities conducted	
2. Confirm whether LUC approval conditions were complied with	If there was a condition non-compliance annotate the breach details against the condition
3. If there was a LUC Breach provide a BMS incident number	See “LUC Breach” in the Definitions section for more details.
4. If required (only applied to certain LUCs) confirm and upload ‘as built’ data	

For detailed technical instructions on completing the close-out process in the LMS, refer to the Close Out a LUC QRG.

8.7 AMENDING A LUC

Once initiated, an individual LUC can only be amended in InfoScope by the Applicant or Proxies; this ensures transparency and accountability.

8.7.1 Amendments During Application

Most details of a LUC can still be amended up to the point of becoming Active, at three (3) key stages of drafting:

- During initial drafting stages, before submission (i.e. draft LUCs can be saved at key points and Applicants can complete an application over numerous sittings).
- After being submitted, an Applicant or Proxy realises an error has been made or a change is required and chooses to amend.[9]
- After being submitted, an Endorser/Approver refers a LUC back to the Applicant for review and the Applicant elects to make a change.

[9] Amending a LUC application after it is submitted will stop any endorsement/approval workflows which have triggered. Endorser/Approver workflows will trigger again once the amended LUC is resubmitted.

8.7.2 Amendments Post Activation

After a LUC has been approved and becomes Active, edits can still be made to the following fields:

- LUC Short Name
- Primary Site
- Applicant
- Secondary Contact(s)
- On-site Responsible Person(s)
- Responsible Team
- Proposed Start Date and End Date
- Topsoil Storage Location (if applicable)

Note that InfoScope maintains a record of all previous field entries and the user responsible for making edits, so historical information is available if required for reporting and compliance purposes.

For detailed technical instructions on amending a LUC in the LMS, refer to the Edit Active LUC QRG.

8.8 WITHDRAWING A LUC

A LUC application can be withdrawn by the Applicant or Proxies at any time during the drafting and assessment process. An Applicant/Proxy might withdraw a LUC application because plans have changed and the proposed works are no longer proceeding, or alternate plans enable multiple scopes (previously proposed under multiple LUCs) to be managed under one LUC (i.e. scopes can be combined and a LUC becomes defunct).

Once a LUC becomes Active and is issued for use, it can no longer be withdrawn and any changes to plans should be managed either by:

- Cancelling a LUC if no work has commenced (refer to Procedure section 8.9); or
- Closing out the LUC (refer to Procedure section 8.6) and applying for an alternate LUC.

For detailed technical instructions on withdrawing a LUC in the LMS, refer to the Withdraw LUC QRG.

8.9 CANCELLING A LUC

A LUC can be cancelled by an LMS Specialist while it is still Active, but only if no work has been conducted under that LUC. Confirmation is required that no work has been conducted and this correspondence is added to the documents tab for audit purpose.

If any work has been conducted under a LUC it cannot be cancelled and must be closed-out to confirm the outcome of the work conducted (even if only a portion of the scope was complete). This is important for compliance and reporting reasons.

For detailed technical instructions on cancelling a LUC in the LMS, refer to the Cancel LUC QRG.

8.10 CLONING A LUC

A LUC can be copied or 'cloned' in InfoScope to assist with streamlining the drafting process (i.e. to save having to re-enter the same details again if a new LUC application is similar to another already in the system). When a LUC is cloned, the following information is maintained in the cloned version:

- Jurisdiction;
- LUC Type;
- Secondary Contact(s), On-Site Responsible Person(s), Responsible Team;
- Proposed Start Date & End Date;
- LUC Short Name;
- Work categorisation details and Detailed Scope of Works text;
- Topsoil management information;
- Answers to supplementary questions; and
- spatially defined LUC Area.

Using the clone functionality may be useful when:

- Creating a LUC which is similar to another one created previously.
- Creating a new LUC type over the same LUC Area as another LUC.[10]
- Where a newly disturbed area is to be added to an existing maintenance LUC, so that one LUC can continue to be used to cover that activity (i.e. a site road maintenance network);[11]

For detailed technical instructions on cloning a LUC in the LMS, refer to the Clone LUC QRG.

[10] For example, an Applicant could clone a Ground Disturbing LUC which was approved for a drilling program, then adjust the type to Rehabilitation to cover the rehab work over that same LUC Area.

[11] The Applicant could clone the existing LUC, add the newly disturbed area to the overall LUC Area, get approvals, then close-out the previous version which has now been superseded.

8.11 RETURNING A LUC

During an assessment by an Endorser or Approver it is possible for them to return the LUC to the Applicant for amendments to be made. Endorsers/Approvers should provide context and clarification of their decision by adding a Remedy Mark-up to the map, which can then be reviewed by the Applicant before any changes are made.

Returning a LUC to an Applicant changes the LUC status to 'Returned'.

In addition, referring a LUC back stops any open Endorser/Approver workflows and avoids unnecessary work being conducted. After the Applicant has reviewed, potentially amended the LUC, and resubmitted the application, new workflows will be triggered.

For detailed technical instructions on returning a LUC in the LMS, refer to the Add Remedy Markup (Return LUC) QRG.

8.12 EXTENDING A LUC

A LUC can be extended with the final 30 days of the Active LUC. The extension will be considered for an additional 12 months following a completion of the Close Out record on the original LUC. Once completed, with the close out saved and validated the extension is then submitted and a full set of approval records are created. The LUC will follow the usual approval process. If the approval is granted when the new LUC has been activated the original LUC will be automatically completed.

The maximum length of time a LUC can be active for is three 93) year s or thirty six (36) months. Initial application period plus an additional two (2) extension applications.

9. MONITORING AND REVIEW

This Procedure will be reviewed according to the schedule set out in Table 13.

Table 13: Programmes and Schedules

Monitor (Audit) and Review	Frequency	Responsibility
Procedure Review	Annually (or as required following business process changes)	LUAs and LMS Systems Analyst

10. DOCUMENTATION AND RECORDS MANAGEMENT

This Procedure and all supporting documents will be managed as per Fortescue Document Governance Standards.

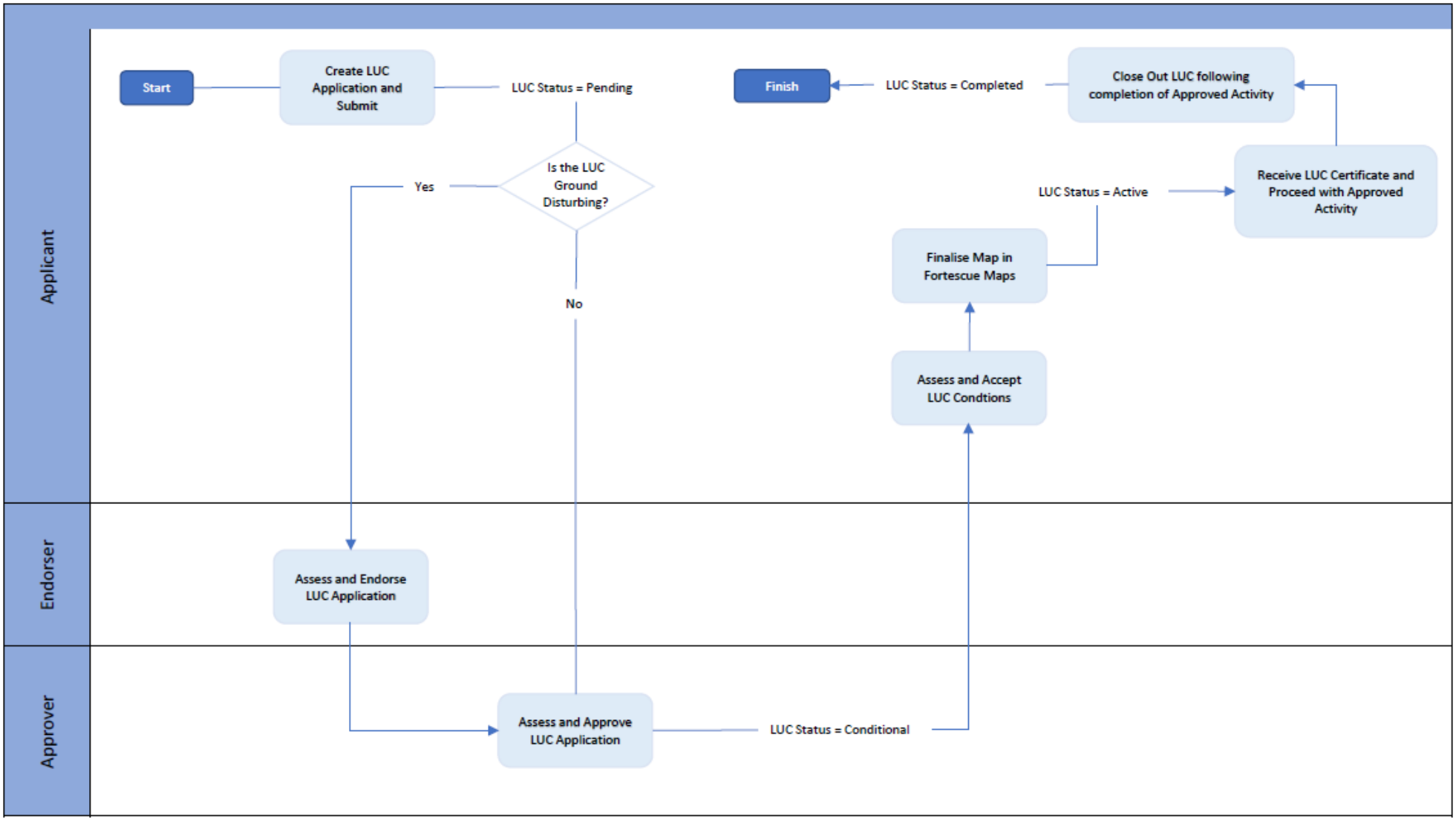
The following documents should be read in conjunction with this procedure:

Table 14: Policy, Standard, Work Instructions, Forms (Templates)

Document ID	Title of Document
InfoScope Training & Quick Reference Guides	InfoScope - Training & Quick Reference Guides (sharepoint.com)
100-PR-EN-1058	Approving Land Use Certificates for Environment
E-PL-EN-0002	Exploration Environmental Management Plan
EX-WI-EX-0039	Exploration Clearing Gridlines and Pads - without EEMIS Work Instruction
EX-WI-EX-0001	Exploration Clearing Gridlines and Pads Work Instruction
EX-WI-EX-0007	Exploration Clearing Gridlines and Pads - without EEMIS Work Instruction
100-PR-HE-0003 (Rev 9)	Heritage Blasting Procedure
SWI-CC-WI-GE-0008	Clearing Procedure
EW-03000-PR-OP-0001	Eliwana - Resource Definition Drill Pad Preparation
SO-PR-GY-0001	Solomon LUC/ LCA Definition Procedure
SO-00000-PR-OP-0006	Solomon Resource Definition Drill Pad Creation Preparation Procedure
EX-GU-EX_0003	Exploration Working and/ or Operating a Vehicle Outside of GDP Approved or Previously Cleared Areas Guideline
EX-WI-EX-0006	Exploration Maintenance of Pre-Existing Tracks Work Instruction

Subject Matter Expert(s) are responsible to ensure all records as described above are forwarded to Fortescue Document Control Department for retention and archiving in accordance with the Fortescue Records Retention Manual.

Appendix 1: Standard LUC Process Flowchart


Applicant
Endorser
Approver
Start
Create LUC Application and Submit
LUC Status = Pending
Is the LUC Ground Disturbing?
Yes
No
Assess and Endorse LUC Application
Assess and Approve LUC Application
LUC Status = Conditional
Assess and Accept LUC Condtions
Finalise Map in Fortescue Maps
LUC Status = Active
Receive LUC Certificate and Proceed with Approved Activity
Close Out LUC following completion of Approved Activity
LUC Status = Completed
Finish

Appendix 6: Weed Management Plan (NU-PL-EN-0003)

Fortescue

Plan

Nullagine Weed Management Plan

Environment

11 October 2024

NU-PL-EN-0003

Rev: 0

This document is protected by copyright, no part of this document may be reproduced or adapted without the consent of the originator/company owner, all rights are reserved.

TABLE OF CONTENTS

1 INTRODUCTION 3
1.1 Proposal 3
1.2 Definitions and Legislation 3
1.3 Rationale and approach 3
1.3.1 Weed prioritisation 3
1.3.2 Weed risk areas 6
2 MANAGEMENT PLAN COMPONENTS 7
2.1 Environmental management objective 7
2.2 Environmental risk 7
2.2.1 Risk reviews 7
2.2.2 Compliance 8
3 MONITORING GUIDELINES 10
3.1 Objectives 10
3.2 Monitoring site selection 10
3.3 Monitoring Methods 12
3.3.1 Data handling and statistical analysis 14
4 ADAPTIVE MANAGEMENT AND REVIEW 15
5 REFERENCES 16
FIGURE 1 FORTESCUE TENEMENTS AND PROJECT AREAS 18
FIGURE 2 WEED RISK AREAS AND MONITORING SITES – NULLAGINE 19
APPENDIX A RELEVANT LEGISLATION RELATING TO WEEDS 20
APPENDIX B ACRONYMS AND DEFINITIONS 21
APPENDIX C ROLES AND RESPONSIBILITIES 23

LIST OF TABLES

Table 1: Weeds recorded at the Project 5
Table 2: Descriptions of key elements of environmental management process to achieve identified objectives 7
Table 3: Management table 9
Table 4: Weed monitoring 13
Table 5: Total weed cover 14

1 INTRODUCTION

Fortescue Ltd (Fortescue) is an integrated green technology, energy, and metals company. The mining assets in the Pilbara region of Western Australia comprises of mine, rail, and port operations (Figure 1). FMG Nullagine Pty Ltd is a wholly owned subsidiary company of Fortescue that acquired the Nullagine Iron Ore mine (the Project), located near Christmas Creek, in 2016.

1.1 Proposal

The Project is located approximately 45 km north of Christmas Creek mine site. In 2013, the EPA made the decision to not assess the Nullagine Iron Ore project with the proposal to be dealt under Part V Division 2 of the Act (Clearing of Native Vegetation). Federal approval was granted under the *Environmental Protection Biodiversity Conservation* (EPBC) Act 1999 with EPBC 2009/4930 granted in 2010 and EPBC 2013/6887 granted in 2016. The Project comprised of above water table surface mining, waste dumps, stockpiles, borefield, roads, accommodation village, mine operation centre and semi-mobile crushing and screening plants. In 2016 notification of suspension of mining operations was provided to the Department of Mines, Industry Regulation and Safety. Many of the facilities were decommissioned during the preparation for temporary suspension.

1.2 Definitions and Legislation

Fortescue employees and contractors are obliged to comply with all relevant environmental Commonwealth and State legislation. Environment legislation directly relevant to this Plan is provided in Appendix A.

Definitions of terms and acronyms used throughout this Plan are provided in Appendix B.

1.3 Rationale and approach

Weed management and monitoring activities are included in the *Temporary Suspension of Operations* (NU-PL-EN-0002) as environmental management measures for meeting site requirements required during temporary suspension.

1.3.1 Weed prioritisation

For the purposes of this Plan, weed management and monitoring activities are targeted at priority weeds species. This is a cautionary principal approach to focus on priority weed species that have higher ecological impacts and are fast spreading invasive species. This approach aligns with the DBCA's priorities of the Pilbara region of management of high impact, rapidly-moderately invasive species that are impacting on high conservation assets.

Priority weeds include:

- Weeds of National Significance (WONS).
- Western Australian Organism List (WAOL) declared pests that require management within the Local Government Area(s) where the Fortescue site is located.
- Environmental weeds rated by DBCA with an ecological rating of High or Unknown and invasiveness rating of Rapid or Moderate within the Pilbara Ranking Summary. Environmental weeds rated as High or Unknown and Rapid or Moderate considered important for pastoralists purposes (e.g., Buffel grass and Birdwood grass) are only Priority Weeds within pastoral exclusion areas or where an approval condition requires their management.
- Weeds that have not been recorded in the Pilbara as Declared Pests or Environmental Weeds within the Pilbara Ranking Summary and have been determined to be introduced into the project area as a result of the implementation of the proposal.

Table 1 outlines the weed species that have been recorded either through weed surveys or BMS Plant and Animal records, at the Project (areas within EPBC 2009/4930 and EPBC 2013/6887), with their classification as Priority. No Weeds of National Significance have been recorded at the Project.

The categorisation of Priority weed species will be reviewed when changes are made to the Declared Pests or Environmental Weeds listing to ensure Fortescue's weed management and monitoring program reflect current requirements in the Pilbara region.

Table 1: Weeds recorded at the Project

Species	Common Name	Declared Pests - WOAL	Environmental weeds	Fortescue priority weed classification
**Aerva javanica*[4]	Kapok Bush	Permitted	H (R)	Yes
**Argemone ochroleuca*	Mexican Poppy	Permitted	U (R)	Yes
**Asphodelus fistulosus*	Onion Weed	Permitted	U (R)	Yes
**Bidens bipinnata*[1]	Bipinnate Begger's Tick	Permitted	U (R)	Yes (Pastoral exclusion areas only)
**Calotropis procera*[2]	Rubber Tree	Declared Pest	ALERT	Yes
**Cenchrus ciliaris*	Buffel Grass	Permitted	H (R)	Yes (Pastoral exclusion areas only)
**Cenchrus setiger*[4]	Birdwood Grass	Permitted	H (R)	Yes (Pastoral exclusion areas only)
**Cynodon dactylon*	Couch	Permitted	H (R)	Yes
**Echinochloa colona*	Awnless Barnyard Grass	Permitted	H (R)	Yes
**Eragrostis minor*	Smaller Stinkgrass	Permitted	Not listed	No
**Flaveria trinervia*	Speedy Weed	Not listed	Not listed	No
**Malvastrum americanum*	Spiked Malvastrum	Permitted	H (R)	Yes
**Setaria verticillata*	Whorled Pigeon Grass	Permitted	H (R)	Yes
**Solanum nigrum*	Black Berry Nightshade	Permitted	L (R)	No
**Sonchus oleraceus*	Common Sowthistle	Permitted	L (R)	No
**Vachellia farnesiana*	Mimosa Bush	Permitted	H (R)	Yes

[1] *Bidens bipinnata* is currently under assessment by the WA Herbarium, with recent changes to Florabase resulting in *Bidens bipinnata* being restricted to eastern Australia.
[2] Reported under the *Biosecurity and Agriculture Management Act 2007* (UID 96483).

1.3.2 Weed risk areas

Weed risk areas assessments have been completed for the Project to identify where the greatest risk from weeds infestation occurs (i.e., weeds have the potential to quickly establish and/or have impact on areas with conservation significance). Risk areas are identified through intersecting infrastructure risk areas (i.e., areas and/or activities that have potential to transport potentially infested materials) and environmental risk areas (i.e., high ecological impact areas).

Infrastructure risks areas were identified by buffering the following infrastructure datasets by 100 meters to address edge effects:

- Fortescue infrastructure layers
- Fortescue mine pits boundaries
- Land Use Certificate areas (approved, completed and expired).

Environmental risks areas were identified by buffering the following datasets by 100 meters:

- Creeks and rivers
- Conservation significant flora and fauna locations
- Mulga vegetation
- Significant fauna habitat
- Threatened and Priority Ecological Communities.

Current risk areas are defined in Figure 2.

2 MANAGEMENT PLAN COMPONENTS

2.1 Environmental management objective

A series of environmental management objectives have been developed to mitigate environmental impacts associated with the spread of weeds on conservation values of conservation significant flora, vegetation and/or fauna habitat that could potentially be caused by Fortescue's activities (exploration, construction, operation, and decommissioning). These include:

1. Identify the location of priority weed species at the Project and ensure the potential for weed outbreaks is included in project planning (refer to Section **Error! Reference source not found.**).
2. Establish management strategies to minimise the potential impacts of weeds on conservation values of conservation significant flora, vegetation and/or fauna habitat (refer to Table 3 with key elements within the table described in Table 2).
3. Develop weed monitoring programs that employ adaptive management methods to detect impacts on conservation values of conservation significant flora, vegetation and/or fauna habitat (refer to Section 3).

Table 2: Descriptions of key elements of environmental management process to achieve identified objectives

Element	Definition/ description
Management Action	Tasks undertaken to enable the objective to be met
Evidence	Demonstrates that the Management Action has been applied and the outcome evaluated.
Timing	Period during which the Management Action should be undertaken.
Responsibility	Accountability for ensuring management action is completed. The responsible role is dependent on project timing. Refer to Appendix C.

2.2 Environmental risk

2.2.1 Risk reviews

Fortescue actively manages risk by undertaking a risk assessment prior to relevant approval submissions to identify high risk areas where weeds have been identified and potential impacts are likely. Annual Environmental Risk Reviews are undertaken during construction and operations phase where all environmental risks are considered with a focus on high-risk impacts. The review considers the effectiveness of management actions that are currently in place for these impacts. The review also considers any relevant incidents that have occurred, if the actions from incident investigations have translated into new management actions, and generally considers the need for any new management actions to ensure lower risk targets can be achieved.

2.2.2 Compliance

Fortescue ensures compliance with its legal obligations through first party quality assurance by site and corporate environment teams with a focus on effective environmental management through the implementation of the Fortescue wide Environmental Management System.

Fortescue has adopted a risk-based approach to monitor compliance with its legal obligations. Site environment teams will monitor their compliance with this Plan.

Where non-conformances occur, the incident will be reported in accordance with the *Incident Event Management Procedure* (45-PR-SA-0080).

Non-conformance issues and/or opportunities for improvement identified will be documented and tracked via Fortescue's business management system.

Table 3: Management table

Management actions	Evidence	Timing	Responsibility[3]	Monitoring	Reporting
Identify risk areas (refer to Section 0) to ensure spatial data for presence and distribution of weeds at the Project is up to date to enable effective weed management practices to be implemented. **Risk based priority:** High	Weed risk mapping (Figure 2) • Weed risk areas identified. • GIS dataset	Prior to relevant approval submission[4] Every two years during operation	Manager Nature and Science	Refer to: **Monitoring:** Table 4 **Statistical analysis methods:** Section 3.3.1	***Biosecurity and Agricultural Management Act* reporting** Where a declared pest is identified during a weed survey, weed mapping activity or weed monitoring event, the presence or suspected presence of the declared pest must be reported to the Director General in accordance with the requirements under Section 26 of the *Biosecurity and Agriculture Management Act* 2007.
Conduct a desktop assessment for Land Use Certificate (LUC)[5] applications in accordance with *Land Use Certificate Procedure* (100-PR-TA-0001) to identify weed locations within the proposed disturbance area. **Risk based priority:** High	LUC: • Weed locations identified	During the LUC assessment	Manager Exploration / Manager Environment Projects / Manager Environment Operations		
Prior to conducting ground disturbance activities, ensure known locations of priority weed populations are identified and management measures to minimise the potential for weed spread are included in the LUC. Ensure clearing is conducted in accordance with a permit issued under the *Land Use Certificate Procedure* (100-PR-TA-0001) and the *Ground Disturbance and Topsoil Management Procedure* (IO-PR-EN-0010). **Risk based priority:** High	LUC: • Disturbance is undertaken with a LUC. • Relevant weed management measures are identified in the LUC.	Prior to LUC approval	Manager Exploration / Manager Environment Projects / Manager Environment Operations		
Implement weed hygiene requirements for high-risk vehicles, plant, and equipment in identified weed risk areas and/or in areas where weed populations have been identified and high-risk activities are proposed to be undertaken as outlined in the *Weed hygiene procedure* (45-PR-EN-0035). **Risk based priority:** High	LUC: • High risk activities are identified. • Relevant weed hygiene and management measures are identified in the LUC. Audits: • Weed hygiene undertaken where required.	Following completion of activity	Manager Exploration / Manager Environment Projects / Manager Environment Operations		
Implement a weed control program in identified weed risk areas, with the focus of control activities on priority weed species (refer to Section 1.3.1), in accordance with *Weed Control Guidelines* (45-GU-EN-0011). **Risk based priority:** High	Weed control report: • Weed control program undertaken.	Annually during operations	Manager Environment Projects / Manager Environment Operations		
Undertake inspections, with focus on high-risk areas (see Section 0), to ensure new populations or extension of existing populations of priority weed species are identified and included in the site-specific weed control program. **Risk based priority:** High	BMS Plant and Animal record: • Weed records	Ongoing inspections during operations	Manager Environment Operations		
Undertake weed mapping, with focus on high-risk areas (see Section 0), to ensure new populations or extension of existing populations of priority weed species are identified and included in the site-specific weed control program. **Risk based priority:** High	GIS dataset	Every two years during operations.	Manager Nature and Science		
Where monitoring results indicate a potential impact on conservation values of conservation significant flora, vegetation and/or conservation significant fauna critical habitat, implement any reporting requirements. Update the following to reflect the monitoring outcomes: • The weed mapping dataset and the weed control program. • The Plan where required, to inform an adaptive management approach to weed management across the business.	Plan updated as required.	When required in response to monitoring outcomes, within 21 days of receiving the final consultant's report	Manager Nature and Science		

[3] Refer to Appendix C for details on roles and responsibilities.
[4] Relevant approval submission may include an approval issued under the *Environmental Protection Act 1986*, *Environment Protection and Biodiversity Conservation Act 1999*, the *Mining Act 1978, the Rights in Water and Irrigation Act 1914* or the *Bush Fires Act 1954*.
[5] Refer to Appendix B for description of Land Use Certificates.

3 MONITORING GUIDELINES

A weed monitoring program is required to measure the effectiveness of the management actions outlined in this Plan. The outcomes of the monitoring program for the Project will contribute to ongoing improvements in management actions to ensure an adaptive management approach is adopted.

3.1 Objectives

The overall objective of Fortescue's weed monitoring program is to monitor and measure the success and effectiveness of management actions to minimise impacts on conservation significant vegetation and flora and ensure compliance with applicable State and Commonwealth approval conditions.

The guiding objectives of the weed monitoring program include:

1. Develop and maintain an accurate record of weed populations within and adjacent to the Project.
2. Identify changes in the cover and diversity of weed species within the Project.
3. Monitor and measure the success of management measures to inform an adaptive management approach.
4. Determine if changes in weed cover and diversity within the Project is a direct or indirect result of Fortescue activities or broader regional changes.

Operational monitoring will be informed by the findings of the monitoring itself as they become available. Refinements to this Plan and its management strategies will be made as required based on monitoring findings to ensure an adaptive management approach is undertaken during Fortescue activities.

3.2 Monitoring site selection

An effective weed monitoring program should be based on replicable sampling at reference and impact sites:

- Control sites are sites that are not directly or indirectly impacted by Fortescue's disturbance activities (away from disturbance).
- Impact sites are sites that are in close proximity to Fortescue's disturbance activities that are exposed to the direct and indirect impacts of operational activities (i.e., located within areas where priority weed species (as defined in Section 1.3.1) have been recorded).
- Adequate design to provide evidence of the effectiveness of management measures undertaken to achieve the objectives of the Weed Management Plan:

- Minimise the potential impacts of weeds on conservation values of conservation significant flora, vegetation and/or fauna habitat.
- Detect impacts on conservation values of conservation significant flora, vegetation and/or fauna habitat.

Appropriate control and impact monitoring sites should:

- Be located within a typical area in terms of weed species composition and cover determined by reviewing the existing survey and spatial data for the project area.
- Have as many of the preferred habitat types for conservation significant fauna species represented in the monitoring program, with at least one monitoring site per representative habitat type, where possible. This should be reflected in both impact and control sites (1:1).
- Have conservation significant flora and vegetation units represented in the monitoring program, with at least one monitoring site per unit, where possible. This should be reflected in both impact and control sites.
- Use the type and variety of substrate, vegetation, topography, geographic extent and habitat variation to help determine the number and location of control and impact sites required.
- Employ the same design and monitoring method at both impact and control sites and monitoring be undertaken concurrently at both impact and control sites.
- Consider site project plans and mine plans when selecting monitoring sites to avoid the need to relocate sites and impacts to data continuity.
- In accessible areas, including:
  - Safely accessible.
  - Near tracks, that require no additional disturbance.
  - On Unallocated Crown Land or Fortescue tenure to ensure ongoing accessibility (where possible).
  - Outside of significant heritage sites, unless approval has been obtained from Traditional Owners.

To allow for comparisons of change overtime moving monitoring sites should be avoided; however, on occasion changes to operational plans (i.e., mine plan changes), land access (i.e., relinquishment of tenure / heritage constraints) or safety requirements (i.e., accessing areas after significant rainfall), may require a change to monitoring locations. Any changes, and impacts of these, will be detailed in the annual monitoring report, and captured in the next revision of the management plan.

3.3 Monitoring Methods

An effective long-term weed monitoring program is adaptive. Innovations in monitoring techniques and methods should be incorporated into the program design over time. This is however dependent on, and driven by, the quality and quantity of data collected from each site. Any changes will be detailed in the annual monitoring report and captured in the next revision of the management plan.

A set of monitoring parameters and methods have been selected to provide broad coverage of changes in weed populations and distributions that can be expected under a range of different mining related impacts. The number of monitoring parameters will vary depending on the site-specific conditions.

Table 4 provides a summary of the weed monitoring parameters and monitoring effort for all weeds monitored under this Plan.

Table 4: Weed monitoring

Type	Design	Monitoring parameters	Method	Monitoring effort	Timing/ frequency	Monitoring location
All weeds • Priority weeds • Other weeds	**Quadrats** Plot-based monitoring based on replicable sampling at impact and reference sites. Each plot-based site consists of three 10 m x 10 m quadrats	Diversity	Count the number of different weed species present within each monitoring site	Assessment per quadrat	**Timing:** 6-8 weeks post wet season (approximate timing) **Frequency:** Biennially	Figure 2
		Cover	Calculate total weed cover within each monitoring site (Table 5)			
		Environmental Threats	Observation, mapping, photographs etc.			
		Meteorological data	Data from Weather Stations installed near monitoring site locations	One per operating site		
		Photo Point Monitoring	Fixed photo points	At least one per site		

Table 5 outlines the parameters, percentage and ratings for weed cover.

Table 5: Total weed cover

Monitoring Parameter	Method	Percentage	Rating
Total weed cover	Calculate total weed cover within each monitoring site	0%	(0)
		<1%	(1)
		1-20%	(2)
		21-40%	(3)
		41-60%	(4)
		61-80%	(5)
		81-100%	(6)

3.3.1 Data handling and statistical analysis

Data will be handled in accordance with the data handling protocol established as part of the annual monitoring tender. The protocol will include the requirements as to data storage and protection, data extraction, quality control, analysis, interpretation, reporting and presentation. The protocol will also directly reference and align with the requirements detailed in *Document Control, Information Management* (100-ST-DC-001) and *Geographic Information Systems and Raw Data Guidelines* (100-GU-EN-0009).

Statistical analysis of monitoring results will be undertaken using univariate or multivariate analysis (i.e., T-test, ANOVA) to determine whether there is any statistical difference in the parameter values between impact and reference sites.

4 ADAPTIVE MANAGEMENT AND REVIEW

Fortescue will implement adaptive management practices to learn from the implementation of mitigation measures and monitoring. Adaptive management practices that will be assessed for the weed management and monitoring program as part of this approach include as required:

- Evaluation of the monitoring program, data and comparison to baseline data and reference sites on an annual basis to verify whether responses to project activities are the same or similar to predictions.
- Evaluation of assumptions and uncertainties of the weed management and monitoring program.
- Re-evaluation of the risk assessment and revision of risk based priorities as a result of monitoring outcomes.
- Review of data and information gathered over the review period that has increased understanding of site environment in the context of the regional ecosystem.
- Review of management actions as the project matures and new management measures and technologies become available that may be more effective for weed management.
- Assessment of changes which are outside the control of the project and the management measures identified (i.e., a new project within the area or region; regional change affecting weed management).
- Evaluation and introduction of new or different monitoring methods due to changes in technology.

5 REFERENCES

This report and all internal supporting documents will be managed as per Fortescue Document Governance Standards. These may be read in conjunction with this report.

[1] Department of Primary Industries and Regional Development, Biosecurity and Regulation, Invasive Species Program (DPIRD 2017). “Review of the Declared Pests of Western Australia 2016: 2017 Revision”, September 2016 and December 2017.

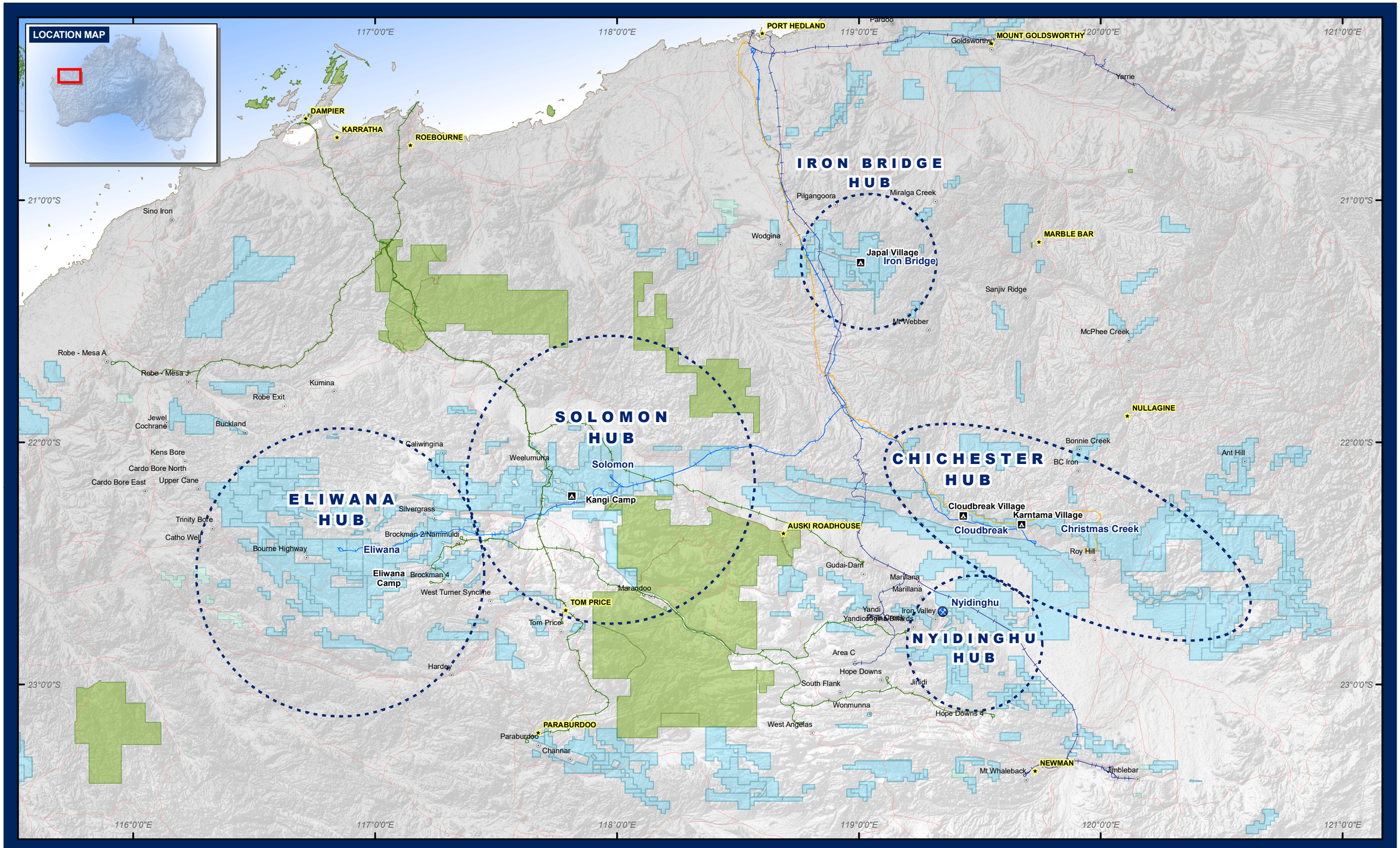
[2] *Weed Hygiene Procedure* (45-PR-EN-0035)

[3] *Weed Control Guidelines* (45-GU-EN-0011)

DOCUMENT CONTROL

Nullagine Weed Management Plan		
Status	IFU - Issued for Use	11-Oct-24
Summary of Changes		
Author	Jane Humphrey	Signature
Checked or Squad Review# (if applicable)	IR-00261451	Signature
Approved	Todd Edwards	Signature
Next Review Date (if applicable)	11-Oct-29	

FIGURE 1 FORTESCUE TENEMENTS AND PROJECT AREAS



LEGEND

- Towns
- Project Area
- FMG Camp
- Other Mines & Prospects
- Roads
- FMG Rail Alignments
- BHP
- Rio Tinto
- Roy Hill
- FMG Non-managed Exploration Tenements
- FMG Managed Exploration Tenements
- Reserves

Data Sources:
Tenements, sourced from DMIRS, 2019.
Roads, Towns, Reserves, Landgate.
3rd Rail, RTIO. BHPB, RHIO.
DEM, GA.

N W E S

0 20 40 60 80 100
Kilometres

Requested By: J. Humphrey
Drawn By: S.Costello
Revised By: todea
Approved By: N/A
Scale: 1:1,600,000
Coordinate System: GCS GDA 1994
Document Name: 100_MP_OP_0058.010_r6

Date: 8/05/2023
Size: A3L
Revision: 6
Confidentiality: 0

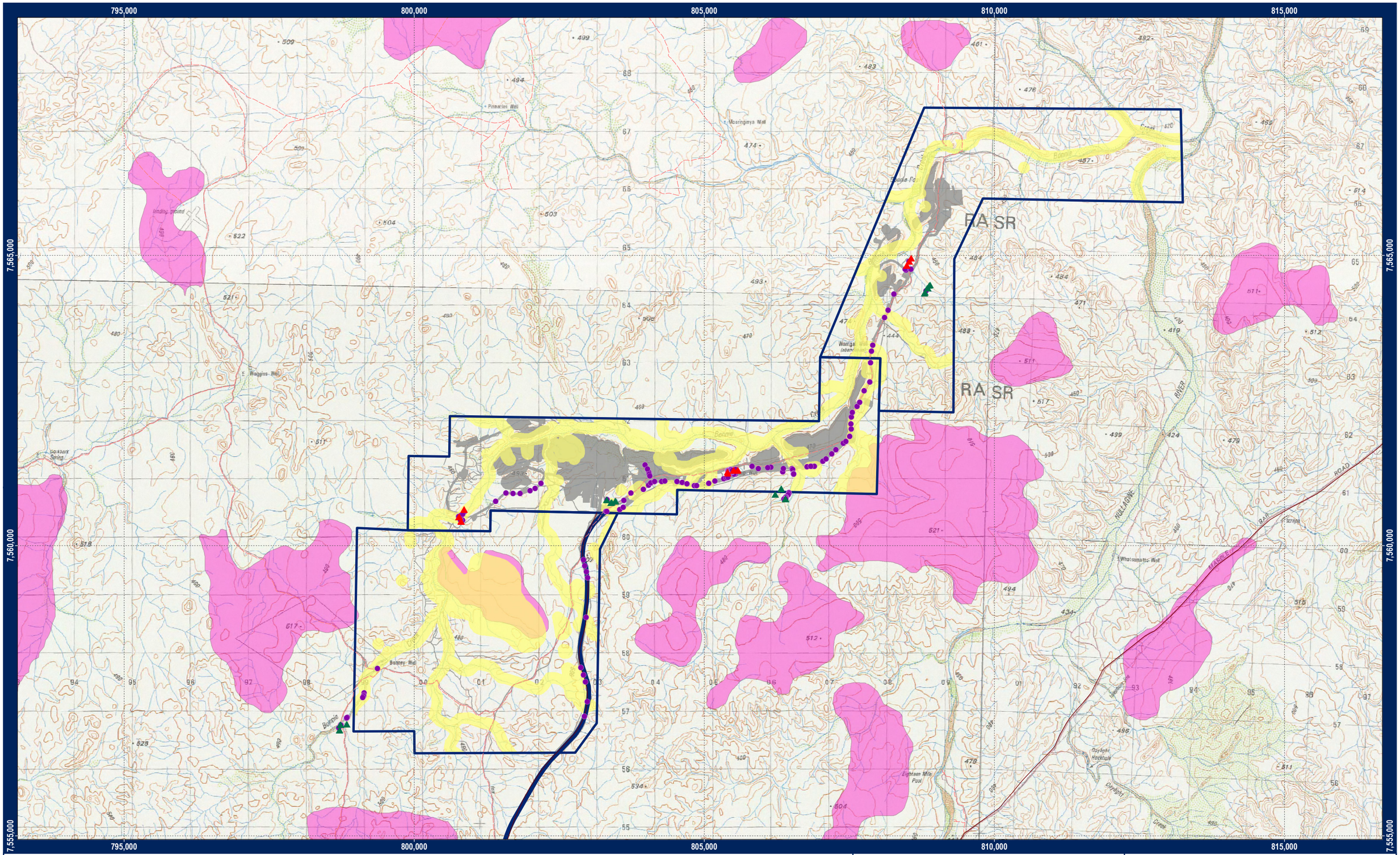
FMG accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose.

FMG ExplorationTenements and Project Areas

May 2023

Fortescue

FIGURE 2 WEED RISK AREAS AND MONITORING SITES – NULLAGINE



LEGEND

- Priority Weeds

Weed Monitoring Sites

- Impact
- Reference

- FMG Rail Alignments
- Road
- Minor Track

- Nullagine EPBC Boundaries
- Weed Risk Areas
- PEC Site
- Cleared Areas

Data Sources:
Topography; Geoscience Au

N

0 1 2 3
Kilometres

Requested By: J. Waterhouse
Drawn By: S. Costello
Revised By: scostello
Approved By: P. Mastalir
Scale: 1:60,000
Coordinate System: GDA 1994 MGA Zone 50
Document Name: 100_MP_EN_0079_011_r0

Date: 25/10/2023
Size: A3L
Revision: 0
Confidentiality: 0

FMG accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose.

Weed Risk Areas and Monitoring Sites
Nullagine Mine

Fortescue

APPENDIX A RELEVANT LEGISLATION RELATING TO WEEDS

Legislation	Application
Biosecurity and Agriculture Management Act 2007 and Regulations 2013	Prevents new animal and plant pests and diseases from entering the state and manages the impact and spread of those pests already present in the State.
Biodiversity Conservation Act 2016 (WA)	Conservation and protection of biodiversity and biodiversity components. This Act repeals the Wildlife Conservation Act 1950.
Conservation and Land Management Act 1984 (WA)	Provides for the vesting or reservation of land for conservation purposes, and the ability to enter into agreements with private landholders and pastoral leases. It establishes a number of statutory bodies including the Conservation and Parks Commission.
Environment Protection and Biodiversity Conservation Act 1999 (Cth)	Protection on environmental matters of national significance.
Environment Protection Act 1986 (WA)	Prevention, control and abatement or pollution and conservation protection and enhancement of environment.
Environmental Protection (Clearing of Native Vegetation) Regulations 2004 (WA)	Regulates the clearing of native vegetation.
Rights in Water and Irrigation Act 1914 (WA)	Relates to rights in water resources, to make provisions for the regulation, management, use and protection of water resources, to provide for irrigation schemes and for related purposes.

APPENDIX B ACRONYMS AND DEFINITIONS

Acronym / Term	Definition
DBCA	Department of Biodiversity, Conservation and Attractions
Declared pests	The Western Australian Organism List (WAOL) classifies organisms under the *Biosecurity and Agriculture Management (BAM) Act 2007*, into four categories: • Declared Pests (section 22) • Permitted (section 11) • Declared pest - Prohibited (section 12) • Permitted Requiring a Permit (73, BAM Regulations 2013). Under this Act, Declared Pests are listed as one of three categories: • The C1 category (Exclusion) – Pests will be assigned to this category if they are not present in Western Australia and control measures are to be taken, including border checks, in order to prevent them entering and establishing in the State. • The C2 category (Eradication) – Pests will be assigned to this category if they are present in Western Australia in low enough numbers or in sufficiently limited areas that their eradication is still feasible. • The C3 category (Management) – Pests will be assigned to this category if they are established in Western Australia but is feasible, or desirable, to manage them in order to limit their damage. Control measures can prevent a C3 pest from increasing in population size or density or moving from an area in which it is established into an area which currently is free of that pest. Unlisted organisms have not been declared by the Minister for Agriculture and Food, and therefore permission is required before they can be brought into the State for assessment.
DPAW	Department of Parks and Wildlife Service (part of DBCA)
DPIRD	Department of Primary Industries and Regional Development
DWER	Department of Water and Environmental Regulation
Environmental exclusion zone	Geospatial locations of features that have legislative or other assigned protection (e.g., areas that are not permitted by Ministerial Statement to be disturbed).
Environmental weeds	DBCA rank weeds for each region through the *Weed Prioritisation Process for DPAW – "An integrated approach to Weed Management on DPaW-managed lands in WA"* (2013). The process ranks weeds based on their current and potential distribution, survey effort, abundance, ecological impact, impact attributes, invasiveness, feasibility of control, general trend and status. Within each region each species has been ranked by ecological impact, as one of the following: • A – Alert • H – High • M – Medium • L – Low • U – Unknown Alert refers to those species identified through the regional weed prioritisation process as being either not found in Western Australia, not found in the DBCA Pilbara Region but known to exist in an adjacent region or found in the region but not on DBCA managed lands or water. Within each region each weed species have also been ranked by invasiveness, which is the rate of spread in native vegetation, encompassing factors of establishment, reproduction and long-distance dispersal (>100 m). Invasiveness rankings include: • R – Rapid • M - Moderate

	• S - Slow • U - Unknown The full Pilbara ranking for environmental weeds can be accessed at https://www.dbca.wa.gov.au/parks-and-wildlife-service/threat-management/plant-diseases/weeds.
EPA	Environmental Protection Authority
GIS	Geographic information system
LUC	Land Use Certificate. A certificate issued through a web-based system to confirm that proposed land use activities adhere to the correct approvals granted by Government departments. A LUC is required whenever any work (e.g., access, ground disturbance, maintenance, rehabilitation) is undertaken. The LUC has sensitivity checks against GIS spatial data to determine if the area proposed for works intersects with any mapped constraints, including conservation significant flora/vegetation, weeds and environmental exclusion zones datasets. Depending on the type of constraint, proposed works will be referred for assessment or blocked. The LUC is then assessed by key Fortescue stakeholders (e.g., Tenure, Environment, Heritage, Water Infrastructure) to determine if the activities can be approved. Approval may be unconditional, or subject to conditions (i.e., implement weed hygiene measures).
WAOL	Western Australian Organism List
WONS	Weeds of National Significance The Australian and State/Territory governments have agreed on a list of 32 Weeds of National Significance, based on the weed species' invasiveness, impacts, potential to spread and socio-economic and environmental values. The full list of WONS can be accessed at https://weeds.org.au/weeds-profiles/. The WONS list is currently managed by the DPIRD. The WoNS list is complimented by the National Environmental Alert List, a list of 28 non-native weeds that have established populations in the wild. Species were identified for the Alert List based on three criteria: posing a high or serious potential threat to the environment; having limited distribution within Australia at present; and being amenable to successful eradication or containment programs.

APPENDIX C ROLES AND RESPONSIBILITIES

All Fortescue employees and contractors are required to comply with the requirements of this Plan.

Accountability for fulfilling the requirements of this Plan is dependent on the stage of project development (construction, operations, decommissioning) and the project type (rail or mine).

During construction stages, whether activities are undertaken by an external service provider or internal Fortescue personnel, the Project Director (rail or mine) will be accountable for ensuring the requirements of this Plan are met.

During operational, decommissioning and closure stages, the General Manager (rail or mine) will be accountable for ensuring the requirements of this Plan are met.

Where responsibilities are delegated, this must be clearly recorded and communicated.

The RASCI framework should be utilised to delegate roles, responsibilities, and review and approval levels. RASCI is used to denote:

R-Responsible	Those who do the work to achieve the task.
A-Accountable	Those who are ultimately accountable for the completion of the deliverable or task and the one to whom the Responsible person is accountable.
S-Supportive	Resources allocated to the Responsible person and who will also assist in completing the task.
C-Consulted	Those whose opinions are sought, two-way communication.
I-Informed	Those whom are kept informed, one-way communication.

Appendix 7: Conservation Significant Fauna Management Plan (45-PL-EN-0034)

Fortescue™

Plan

Conservation Significant Fauna Management Plan

Pilbara Operations Environment

1 November 2024

45-PL-EN-0034

Rev 0

This document is protected by copyright, no part of this document may be reproduced or adapted without the consent of the originator/company owner, all rights are reserved.

EXECUTIVE SUMMARY

State approval						
Proponent name	Fortescue Ltd					
Proposal name	Pilbara Iron Ore & Infrastructure Project: Port & North-South Railway (Stage A)	Cloudbreak Life of Mine	Christmas Creek Mine, East-West Railway and Mindy Mindy Mine	Solomon Iron Ore Project – Sustaining Production	Eliwana Railway Project	Eliwana Iron Ore Mine Project
Ministerial number	MS 690	MS 899	MS 1033	MS 1062	MS 1108	MS 1109
Condition/s	7	10	6 and 8	7 and 12	10	10
Plan status	**Approved:** 100-PL-EN-0022 Rev 2 (UID-40643; 25/09/2014)	**Approved:** 100-PL-EN-0022 Rev 0 (UID-47486; 27/11/2013)	**Approved:** 100-PL-EN-0022 Rev 3b (UID-79154; 13/03/2018)	**Approved:** 100-PL-EN-0022 Rev 4a (UID-83724; 21/08/2018)	**Approved:** 100-PL-EN-0022 Rev 6e (UID-108293; 8/06/2020)	**Approved:** 100-PL-EN-0022 Rev 6e (UID-108294; 8/06/2020)
Purpose of EMP	To identify the potential direct and indirect impacts on conservation significant fauna species and develop management and monitoring measures that maximize the ongoing protection and long term conservation of these species within and adjacent to Fortescue controlled sites.					
Environmental factor	Terrestrial Fauna					
Objective	"*To protect terrestrial fauna so that biological diversity and ecological integrity are maintained*."					
Federal approval						
Proponent name	Fortescue Ltd					
ACN	002594872					
Project name	Cloudbreak Open Pit Iron Ore Mine	Additional Rail Infrastructure between Herb Elliot Port Facility and Cloudbreak Mine Site	Christmas Creek Iron Ore Mine expansion project	Solomon Iron Ore Project	Solomon Iron Ore Project – Sustaining Production	Eliwana Iron Ore Project	Eliwana Railway Project
Instrument number	EPBC 2005/2205	EPBC 2010/5513	EPBC 2013/7055	EPBC 2010/5567	EPBC 2014/7275	EPBC 2017/8024	EPBC 2017/8025
Condition/s	1	2	9d	4	3h	2	2
Approved action	To develop an iron ore mine within the Chichester Range of the Pilbara region of Western Australia	The construction and operation of additional rail infrastructure along the existing rail line between the Herb Elliot Port Facility at Port Hedland and the Cloudbreak Mine Site in the Pilbara region, WA.	To expand existing mining operations at Christmas Creek, located on the southern slopes of the Chichester Range, in the East Pilbara approximately 200 km east of Tom Price, WA	The approved action is the Solomon Iron Ore project, which includes the construction and operation of two mining areas, namely the Kings and Firetail deposits, and a new heavy duty standard gauge railway line and rail spur in the Pilbara region of Western Australia. The action also incorporates the construction of support infrastructure, including ore processing and storage facilities. haul roads and accommodation camps.	To expand existing mining operations at Solomon Iron Ore Project, located in the Pilbara approximately 60 km north of Tom Price, WA	To clear native vegetation to allow for the development of above and below water table mine pits, along with associated infrastructure, processing facilities, water management infrastructure for groundwater abstraction and surplus water disposal, temporary and permanent waste landforms and tailings storage facilities.	To clear native vegetation to construct a 120 km railway corridor linking Eliwana Iron Ore Mine with the existing Fortescue rail network, approximately 90 km west-north-west Tom Price, in the Pilbara region of Western Australia.
Location of the action	Cloudbreak Mine, Pilbara, Western Australia.	East West Rail, Pilbara, Western Australia.	Christmas Creek Mine, Pilbara, Western Australia.	Solomon Mine, Pilbara, Western Australia.	Solomon Mine, Pilbara, Western Australia.	Eliwana Mine, Pilbara, Western Australia.	Eliwana Rail, Pilbara, Western Australia.
Plan Status	**Approved:** 100-PL-EN-0022 Rev 5c (UID-95201; 02/07/2019)	**Approved:** 100-PL-EN-0022 Rev 5c (UID-952031; 02/07/2019)	**Submitted:** 100-PL-EN-0022 Rev 3 (UID-71761; 08/08/2017)	**Approved:** 100-PL-EN-0022 Rev 5c (UID-95204; 02/07/2019)	**Submitted:** 100-PL-EN-0022 Rev 4a (UID-81605; 19/06/2018)	**Submitted:** 100-PL-EN-0022 Rev 7 (UID-108313; 10/06/20200)	**Submitted:** 100-PL-EN-0022 Rev 7 (UID-108314; 10/06/2020)
EMP preparation date	Conservation Significant Fauna Management Plan (45-PL-EN-0034 Rev 0) - November 2024						

TABLE OF CONTENTS

1 INTRODUCTION 7
1.1 Legislative context 7
1.2 Definitions 7
1.3 Objective 7
1.4 Rationale and approach 7
1.4.1 Relevant standards and guidelines 12
2 MANAGEMENT PLAN COMPONENTS 14
2.1 Environmental management objective 14
2.2 Environmental risk 15
2.2.1 Risk reviews 15
2.2.2 Compliance 15
3 MONITORING GUIDELINES 20
3.1 Objectives 20
3.2 Baseline sampling 20
3.3 Monitoring site selection 21
3.3.1 Night Parrot 21
3.3.2 Northern Quoll 22
3.3.3 Conservation significant bats (Ghost Bat and Pilbara Leaf-nosed Bat) 22
3.3.4 Greater Bilby 22
3.3.5 Pilbara Olive Python 23
3.3.6 Conservation significant birds (excluding Night Parrot) 23
3.4 Monitoring methods 23
3.4.1 Monitoring program review 27
3.4.2 Data handling and statistical analysis 27
4 CONTINGENCY ACTIONS 29
5 REPORTING 32
5.1 Annual compliance reporting 32
5.1.1 State government reporting 32
5.1.2 Federal government reporting 32
5.2 Reporting of potential non-compliances 33
5.2.1 State government reporting 33
5.2.2 Federal government reporting 34
6 ADAPTIVE MANAGEMENT AND REVIEW 36
7 STAKEHOLDER CONSULTATION 37
8 REFERENCES 41
FIGURE 1 FORTESCUE TENEMENTS AND PROJECT AREAS 45

FIGURE 2 NORTHERN QUOLL MONITORING SITES – REGIONAL OVERVIEW 46
FIGURE 3 NORTHERN QUOLL MONITORING SITES – MAIN LINE RAIL 47
FIGURE 4 NORTHERN QUOLL MONITORING SITES – HAMERSLEY RAIL 48
FIGURE 5 NORTHERN QUOLL MONITORING SITES – CHRISTMAS CREEK MINE 49
FIGURE 6 NORTHERN QUOLL MONITORING SITES – SOLOMON MINE 50
FIGURE 7 NORTHERN QUOLL MONITORING SITES – ELIWANA MINE 51
FIGURE 8 CONSERVATION SIGNIFICANT BATS MONITORING SITES – REGIONAL OVERVIEW 52
FIGURE 9 CONSERVATION SIGNIFICANT BATS MONITORING SITES – CHRISTMAS CREEK MINE 53
FIGURE 10 CONSERVATION SIGNIFICANT BATS MONITORING SITES – MAIN LINE RAIL 54
FIGURE 11 CONSERVATION SIGNIFICANT BATS MONITORING SITES – SOLOMON MINE 55
FIGURE 12 CONSERVATION SIGNIFICANT BATS MONITORING SITES – ELIWANA MINE 56
FIGURE 13 GREATER BILBY MONITORING SITES – REGIONAL OVERVIEW . 57
FIGURE 14 GREATER BILBY MONITORING SITES – MAIN LINE TO PORT 58
FIGURE 15 GREATER BILBY MONITORING SITES – MAIN LINE RAIL SITE 1. 59
FIGURE 16 GREATER BILBY MONITORING SITES – MAIN LINE RAIL SITE 2. 60
FIGURE 17 GREATER BILBY MONITORING SITES – MAIN LINE AND HAMERSLEY RAIL 61
FIGURE 18 GREATER BILBY MONITORING SITES – MAIN LINE TO CLOUDBREAK MINE 62
FIGURE 19 GREATER BILBY MONITORING SITES – CHRISTMAS CREEK MINE 63
FIGURE 20 PILBARA OLIVE PYTHON MONITORING SITES – REGIONAL OVERVIEW 64
FIGURE 21 PILBARA OLIVE PYTHON MONITORING SITES – CHRISTMAS CREEK MINE 65
FIGURE 22 PILBARA OLIVE PYTHON MONITORING SITES – SOLOMON MINE 66
FIGURE 23 PILBARA OLIVE PYTHON MONITORING SITES – ELIWANA MINE 67
FIGURE 24 CONSERVATION SIGNIFICANT BIRDS MONITORING SITES – REGIONAL OVERVIEW 68
FIGURE 25 CONSERVATION SIGNIFICANT BIRDS MONITORING SITES – CHRISTMAS CREEK AND CLOUDBREAK MINES 69
FIGURE 26 CONSERVATION SIGNIFICANT BIRDS MONITORING SITES – MAIN LINE RAIL SITE 1 70
FIGURE 27 CONSERVATION SIGNIFICANT BIRDS MONITORING SITES – MAIN LINE RAIL SITE 2 71

FIGURE 28 CONSERVATION SIGNIFICANT BIRDS MONITORING SITES – MAIN LINE AND HAMERSLEY RAIL..... 72
FIGURE 29 CONSERVATION SIGNIFICANT BIRDS MONITORING SITES – SOLOMON MINE 73
FIGURE 30 CONSERVATION SIGNIFICANT BIRDS MONITORING SITES – ELIWANA MINE 74
FIGURE 31 *SRE ANTICHIROPUS* 1021DNA02 SITE RECORD – ELIWANA MINE 75
FIGURE 32 CULVERT LOCATIONS ON THE HAMERSLEY LINE WITHIN NORTHERN QUOLL HABITAT..... 76
FIGURE 33 CONSERVATION SIGNIFICANT FAUNA MONITORING SITES – ELIWANA RAIL 77
APPENDIX A PROPOSAL DETAILS..... 78
APPENDIX B LEGISLATIVE CONTEXT..... 80
APPENDIX C CONDITION REQUIREMENTS 82
APPENDIX D 90
APPENDIX E MS 1033 SCHEDULE 92
APPENDIX F MS 1062 SCHEDULE 93
APPENDIX G MS 1108 PROVISION TABLE 94
APPENDIX H MS 1109 PROVISION TABLE 95
APPENDIX I ACRONYMS AND DEFINITIONS 96
APPENDIX J ROLES AND RESPONSIBILITIES 98
APPENDIX K RISK ASSESSMENT RELATIONSHIP MATRIX 99
APPENDIX L BASELINE MONITORING REPORT – CLOUDBREAK MINE (CB-AS-EN-0045 AND CB-AS-EN-0046)..... 100
APPENDIX M BASELINE MONITORING REPORT – CHRISTMAS CREEK MINE (CC-AS-EN-0019) 101
APPENDIX N BASELINE MONITORING REPORT – SOLOMON MINE (SO-RP-EN-0020 AND SO-AS-EN-0040)..... 102
APPENDIX O BASELINE MONITORING REPORT – HAMERSLEY RAIL (510RC0024-00000-RP-EN-0001 AND SS-AS-EN-0001)..... 103
APPENDIX P BASELINE MONITORING REPORT – MAIN LINE RAIL (R-AS-EN-0008) 104
APPENDIX Q BASELINE MONITORING REPORT – ELIWANA MINE AND RAILWAY (45-RP-EN-1027)..... 105
APPENDIX R FAUNA HANDLING, RECLOCATION AND REHABILITATION PROCEDURE (45-PR-EN-0026)..... 106
APPENDIX S FERAL CAT TRAPPING PROCEDURE (45-PR-EN-0042)..... 107

LIST OF TABLES

Table 1: Conditioned environmental management objectives / requirements and measures / targets 8
Table 2: Conservation significant fauna species recorded in Fortescue controlled sites 11
Table 3: Key elements of environmental management process to achieve identified objectives 14
Table 4: Key management actions for conservation significant fauna management in Fortescue controlled sites 16
Table 5: Conservation significant fauna monitoring parameters and methods 24
Table 6: Summary of conservation significant fauna monitoring 25
Table 7: Target criteria and contingency measures 30
Table 8: Stakeholder consultation, comments and responses 37

1 INTRODUCTION

Fortescue Ltd (Fortescue) is an integrated green technology, energy, and metals company. The mining assets in the Pilbara region of Western Australia comprises of mine, rail, and port operations (Figure 1). Background details regarding Proposals are outlined in Appendix A.

1.1 Legislative context

Fortescue employees and contractors are obliged to comply with all relevant environmental Commonwealth and State legislation. Environment legislation directly relevant to this Plan is provided in Appendix B.

The conditioned objectives for fauna management are outlined in Table 1. State and federal approval conditions relevant to this Plan and how they are addressed are outlined in Appendix C. Schedules and provisions tables are provided for approval conditions under MS 1033 (Appendix E), MS 1062 (Appendix F), MS 1108 (Appendix G) and MS 1109 (Appendix H).

1.2 Definitions

Definitions of terms and acronyms used throughout this Plan are provided in Appendix I.

1.3 Objective

This Plan addresses EPA's objective for the key environmental factor Terrestrial Fauna: "*to protect terrestrial fauna so that biological diversity and ecological integrity are maintained*."

The objective of this Plan is to identify the potential direct and indirect impacts on conservation significant fauna species and develop management and monitoring measures that maximize the ongoing protection and long-term conservation of these species within and adjacent to Fortescue controlled sites[1].

1.4 Rationale and approach

For the purposes of this Plan, conservation significant fauna (refer to Appendix I for definition) have been limited to terrestrial vertebrate fauna species and terrestrial invertebrate fauna (including short range endemics) that have been recorded within Fortescue controlled sites and/or management/monitoring requirements have been specified in State and/or Federal conditions. Table 2 outlines the conservation significant fauna species at each of the Fortescue sites and is correct at the time of writing and will be updated when the Plan is reviewed to reflect any changes.

[1] Fortescue controlled site means sites that are under the legislative control of Fortescue including exploration sites, sites under construction, operational sites (sites that are managed and operated by Fortescue and sites that are managed by Fortescue but operated by contractors) and the Perth offices.

Table 1: Conditioned environmental management objectives / requirements and measures / targets

Approval	Condition type	Conditioned environmental objective / requirement[2]	Measure / target
MS 690 Condition 7	Management	**Condition:** Conduct fauna surveys prior to ground-disturbing activities and if significant fauna are identified, do not disturb the land surface until significant fauna have been relocated or otherwise appropriately protected in accordance with a Site Fauna Management Plan. **Objective 1**: Identify the potential direct and indirect impacts on conservation significant fauna and their critical habitats within Fortescue controlled sites.	100% of conservation significant fauna high risk areas are identified and available in the spatial system
		Objective 2: Establish management strategies to minimise the potential impacts on conservation significant fauna and their critical habitats within Fortescue controlled sites.	No direct mortality to recorded conservation significant fauna within their recorded habitats as a result of ground disturbance activities within the project area. No direct loss to recorded conservation significant fauna habitat within the project area that is not approved [3] for disturbance.
		Objective 3: Where species presence and critical habitat has been confirmed within Fortescue controlled sites, develop monitoring programs to detect any impacts on conservation significant fauna and their critical habitats	No statistically significant[4] decline in the relative abundance of conservation significant species across impact sites compared to reference sites. OR Conservation significant species recorded within the area of impact for the project continue to have an ongoing presence.[4]
MS 899 Condition 10	Management	**Objective 1**: Identify the potential direct and indirect impacts on conservation significant fauna and their critical habitats within Fortescue controlled sites.	100% of conservation significant fauna risk areas are identified and available in the spatial system
		Objective 2: Establish management strategies to minimise the potential impacts on conservation significant fauna and their critical habitats within Fortescue controlled sites.	No direct mortality to recorded conservation significant fauna within their recorded habitats within the project area as a result of ground disturbance activities. No direct loss to recorded conservation significant fauna habitat that is not approved[3] for disturbance within the project area.
		Objective 3: Where species presence and critical habitat has been confirmed within Fortescue controlled sites, develop monitoring programs to detect any impacts on conservation significant fauna and their critical habitats	No statistically significant[4] decline in the relative abundance of conservation significant species across impact sites compared to reference sites. OR Conservation significant species recorded within the area of impact for the project continue to have an ongoing presence.[4]
MS 1033 Condition 8 EPBC 2013/7055	Management	**Condition:** Minimise direct and indirect impacts on conservation significant fauna species and their habitat, including but not limited to the Pilbara Olive Python, Northern Quoll, Greater Bilby, Night Parrot and migratory birds. **Objective 1**: Identify the potential direct and indirect impacts on conservation significant fauna and their critical habitats within Fortescue controlled sites.	100% of conservation significant fauna risk areas are identified and available in the spatial system.
		Objective 2: Establish management strategies to minimise the potential impacts on conservation significant fauna and their critical habitats within Fortescue controlled sites.	No direct mortality to recorded conservation significant fauna within their recorded habitats within the project area as a result of ground disturbance activities. No direct loss to recorded conservation significant fauna habitat within the project area that is not approved[3] for disturbance.
		Objective 3: Where species presence and critical habitat has been confirmed within Fortescue controlled sites, develop monitoring programs to detect any impacts on conservation significant fauna and their critical habitats.	No statistically significant[4] decline in the relative abundance of conservation significant species across impact sites compared to reference sites. OR Conservation significant species recorded within the area of impact for the project continue to have an ongoing presence.[4]
MS 1062 Condition	Management	**Condition:** Minimise direct and indirect impacts on conservation significant fauna species and their habitat, including, but not limited to the Pilbara Olive Python, Northern Quoll, and Pilbara Leaf-nosed Bat.	100% of conservation significant fauna risk areas are identified and available in the spatial system.

[2] Under EPBC 2005/2205, EPBC 2010/5513, EPBC 2010/5567, EPBC 2012/6530. EPBC 2013/7055 - there are no conditioned environmental objectives

[3] Approved refers to an approval issued under the *Environmental Protection Act 1986*, *Environment Protection and Biodiversity Conservation Act 1999*, the *Mining Act 1978* or the *Bush Fires Act 1954*.

[4] When conservation significant species have been recorded in low densities during previous baseline surveys, they may not have adequate population numbers to allow statistical comparison over time. Analytical test and power levels will be set at appropriate levels to detect change in spatial distribution and relative abundance of low density species. Where records are still inadequate, only ongoing presence will be measured to demonstrate compliance with Objective 3.

Approval	Condition type	Conditioned environmental objective / requirement[2]	Measure / target
12 EPBC 2014/7275		**Objective 1:** Identify the potential direct and indirect impacts on conservation significant fauna and their critical habitats within Fortescue controlled sites.	
		Objective 2: Establish management strategies to minimise the potential impacts on conservation significant fauna and their critical habitats within Fortescue controlled sites.	No direct mortality to recorded conservation significant fauna within their recorded habitats within the project area as a result of ground disturbance activities. No direct loss to recorded conservation significant fauna habitat within the project area that is not approved[3] for disturbance.
		Objective 3: Where species presence and critical habitat has been confirmed within Fortescue controlled sites, develop monitoring programs to detect any impacts on conservation significant fauna and their critical habitats	No statistically significant[4] decline in the relative abundance of conservation significant species across impact sites compared to reference sites. OR Conservation significant species recorded within the area of impact for the project continue to have an ongoing presence.[4]
EPBC 2005/2205	Management	Ensure protection and management of the Night Parrot (*Pezoporus occidentalis*) in Fortescue controlled areas. **Objective 1:** Establish management strategies to minimise the potential impacts on the Night Parrot and its habitats at Cloudbreak.	No direct mortality to Night Parrot within its recorded habitats within the project area as a result of ground disturbance activities. No direct loss to Night Parrot habitat within the project area that is not approved[3] for disturbance.
		Objective 2: Undertake spatially and temporally comprehensive Night Parrot surveys within and immediately adjacent to Fortescue's areas of operation at the Fortescue Marsh using the best available information about Night Parrot ecology, survey design and analyses systems.	Night Parrot Monitoring program developed and implemented in accordance with the requirements of 100-PP-EN-0041.
EPBC 2010/5513 EPBC 2010/5567	Management	Protect and manage EPBC Act listed threatened fauna species within the Fortescue controlled areas both during construction and operation of the project. **Objective 1:** Identify the potential direct and indirect impacts on conservation significant fauna and their habitats within Fortescue controlled sites.	100% of conservation significant fauna risk areas are identified and available in the spatial system.
		Objective 2: Establish management strategies to minimise the potential impacts on conservation significant fauna and their habitats within Fortescue controlled sites.	No direct mortality to recorded conservation significant fauna within their recorded habitats within the project area as a result of ground disturbance activities. No direct loss to recorded conservation significant fauna habitat within the project area that is not approved[3] for disturbance.
		Objective 3: Where species presence and habitat has been confirmed within Fortescue controlled sites, develop monitoring programs to detect any impacts on conservation significant fauna and their habitats	No statistically significant[4] decline in the relative abundance of conservation significant species across impact sites compared to reference sites. OR Conservation significant species recorded within the area of impact for the project continue to have an ongoing presence.[4]
MS 1108 Condition 10 EPBC 2017/8025	Management	**Condition:** Avoid where possible, and minimise direct and indirect impacts to significant fauna and their habitats, including, but not limited to: (a) Pilbara Leaf-nosed Bat (b) Ghost Bat (c) Pilbara Olive Python (d) Northern Quoll. **Objective 1:** Identify the potential direct and indirect impacts on conservation significant fauna and their habitats within Fortescue controlled sites.	100% of conservation significant fauna risk areas are identified and available in the spatial system.
		Objective 2: Establish management strategies to minimise the potential impacts on conservation significant fauna and their habitats within Fortescue controlled sites.	No direct mortality to recorded conservation significant fauna within their recorded habitats within the project area as a result of ground disturbance activities. No direct loss to recorded conservation significant fauna habitat within the project area that is not approved[3] for disturbance.
		Objective 3: Where species presence and habitat has been confirmed within Fortescue controlled sites, develop monitoring programs to detect any impacts on conservation significant fauna and their habitats	No statistically significant[4] decline in the relative abundance of conservation significant species across impact sites compared to reference sites. OR Conservation significant species recorded within the area of impact for the project continue to have an ongoing presence.[4]

Approval	Condition type	Conditioned environmental objective / requirement[2]	Measure / target
MS 1109 Condition 10 EPBC 2017/8024	Management	**Condition 10-1(1):** Avoid where possible, and minimise direct and indirect impacts to significant fauna and their habitats, including, but not limited to: (a) Pilbara Leaf-nosed Bat (b) Ghost Bat (c) Pilbara Olive Python (d) Northern Quoll. **Objective 1:** Identify the potential direct and indirect impacts on conservation significant fauna and their habitats within Fortescue controlled sites.	100% of conservation significant fauna risk areas are identified and available in the spatial system.
		Objective 2: Establish management strategies to minimise the potential impacts on conservation significant fauna and their habitats within Fortescue controlled sites.	No direct mortality to recorded conservation significant fauna within their recorded habitats within the project area as a result of ground disturbance activities. No direct loss to recorded conservation significant fauna habitat within the project area that is not approved[3] for disturbance.
		Objective 3: Where species presence and habitat has been confirmed within Fortescue controlled sites, develop monitoring programs to detect any impacts on conservation significant fauna and their habitats	No statistically significant[4] decline in the relative abundance of conservation significant species across impact sites compared to reference sites. OR Conservation significant species recorded within the area of impact for the project continue to have an ongoing presence.[4]
MS 1109 Condition 10	Management	**Condition 10-1(2)** Avoid all impacts to the known location of the short range endemic species *Antichiropus* 1021DNA02 as described in Eliwana Iron Ore Mine Project: Environmental Review Document (FMG, October 2018) until the species has been demonstrated to the satisfaction of the CEO to exist in an area unlikely to be disturbed by any foreseeable proposal.	No direct impact to known locations of *Antichiropus* 1021DNA02[5]. OR No direct or indirect impact to the known locations of *Antichiropus 1021DNA02*[6].

[5] This management target applies when survey results are limited to locations within impact areas and the criteria for a monitoring program is unable to be met.

[6] This management target applies when survey results demonstrate species locations inside and outside proposed impact areas. This target does not apply where surveys demonstrates the species exists in an area unlikely to be disturbed by any foreseeable proposal.

Table 2: Conservation significant fauna species recorded in Fortescue controlled sites

Class	Genus	Species (Terrestrial) Taxon (Invertebrate)	Subspecies	Common Name	EPBC Act	BC Act	Other	Port	Cloudbreak	Christmas Creek	Solomon	Mainline Rail (including duplication)	Hamersley Rail	Eliwana Railway	Eliwana Mine
Aves	*Pezoporus*	*occidentalis*		Night Parrot	EN	CR			Recorded	MS1033[7]		EPBC 2010/5513 [7,8]			
Mammalia	*Dasyurus*	*hallucatus*		Northern Quoll	EN	EN			Recorded	MS1033[7]	Recorded	Recorded	Recorded		Recorded
Mammalia	*Rhinonicteris*	*aurantia*		Pilbara Leaf-nosed Bat	VU	VU			Recorded[9]		Recorded[7]	EPBC 2010/5513[7]	EPBC 2010/5567	Recorded[7]	Recorded
Mammalia	*Macrotis*	*lagotis*		Greater Bilby	VU	VU				Recorded		Recorded			
Mammalia	*Macroderma*	*gigas*		Ghost Bat	VU	VU				Recorded	Recorded	Recorded		Recorded[7]	Recorded
Reptilia	*Liasis*	*olivaceus*	barroni	Pilbara Olive Python	VU	VU				Recorded	Recorded	EPBC 2010/5513 [7,8]		Recorded	Recorded
Aves	*Falco*	*hypoleucos*		Grey Falcon		VU			Recorded			Recorded	Recorded		
Aves	*Apus*	*pacificus*		Fork-tailed Swift	M	MI					Recorded			Recorded	Recorded
Aves	*Tringa*	*glareola*		Wood Sandpiper	M	MI				Recorded		Recorded			
Aves	*Tringa*	*nebularia*		Common Greenshank	M	MI				Recorded		Recorded			
Aves	*Actitis*	*hypoleucos*		Common Sandpiper	M	MI						Recorded			
Aves	*Falco*	*peregrinus*		Peregrine Falcon[4]		OS			Recorded	Recorded	Recorded	Recorded	Recorded	Recorded	Recorded
SRE	*Antichiropus*	1021DNA02					SRE								Restricted[10]

[7] This species has not been recorded and is not likely to occur within Fortescue sites however MS 1033, pending Ministerial Statements for Eliwana Railway and Mine and/or Controlled Actions, EPBC 2010/5513, 2005/2205, and EPBC 2010/5706 requires management and/or monitoring strategies to be implemented.

[8] Monitoring for this species ceased in 2015 following a review of monitoring and absence of confirmed records within the project areas. See Annual EPBC Compliance Audit and Milestone Report 2015 (100-RP-EN-9634).

[9] This species has been recorded foraging within Fortescue controlled sites but no roosting or nesting sites have been recorded and as a result no management and monitoring strategies will be implemented.

[10] In accordance with Condition 10-1(2) of MS 1109 for Eliwana Mine this species requires management and monitoring strategies to be implemented until the species has been demonstrated to the satisfaction of DWER to exist in an area unlikely to be disturbed by any foreseeable proposal.

1.4.1 Relevant standards and guidelines

The following Federal and State guidelines are of relevance to this Plan:

EPBC Referral Guidelines:

- *EPBC Act Referral guidelines for the endangered northern quoll, Dasyurus hallucatus. EPBC Act Policy Statement 3.25*. Australian Government, Department of the Environment (2016).

EPBC Survey Guidelines:

- *EPBC Act Survey Guidelines for Australia's Threatened Bats, Guidelines for Detecting Bats Listed as Threatened Under the EPBC Act 1999*. Australia Government. Department of Water, Heritage and the Arts (2010).
- *EPBC Act Survey Guidelines for Australia's Threatened Birds, Guidelines for Detecting Birds as Threatened Under the EPBC Act 1999*. Australian Government. Department of Water, Heritage and the Arts (2010). (Note, for Night Parrot refer to the Night Parrot recovery team's survey methods: https://nightparrot.com.au/index.php/advice/).
- *EPBC Act Survey Guidelines for Australia's Threatened Frogs, Guidelines for Detecting Frogs Listed as Threatened Under the EPBC Act 1999*. Australian Government. Department of Water, Heritage and the Arts (2010).
- *EPBC Act Survey Guidelines for Australia's Threatened Fish, Guidelines for Detecting Fish Listed as Threatened Under the EPBC Act 1999.* Australian Government, Department of Sustainability, Environment, Water, Population and Communities (2011).
- *EPBC Act Survey Guidelines for Australia's Threatened Mammals, Guidelines for Detecting Mammals Listed as Threatened Under the EPBC Act 1999.* Australian Government, Department of Sustainability, Environment, Water, Population and Communities (2011).
- *EPBC Act Survey Guidelines for Australia's Threatened Reptiles, Guidelines for Detecting Reptiles Listed as Threatened Under the EPBC Act 1999*. Australian Government, Department of Sustainability, Environment, Water, Population and Communities (2011).

Conservation Advice:

- Conservation Advice, *Pezoporus occidentalis (Night Parrot)*, Threatened Species Scientific Committee (2016).
- Conservation Advice, *Rhinonicteris aurantia* (Pilbara form) (Pilbara Leaf-nosed Bat), Threatened Species Scientific Committee (2016).

- Conservation Advice, *Macrotis lagotis (Greater Bilby)*, Threatened Species Scientific Committee (2016).
- Conservation Advice, *Lialis olivaceus barroni (Olive Python – Pilbara subspecies)*, Threatened Species Scientific Committee (2008).
- Conservation Advice, *Macroderma gigas (Ghost Bat)*, Threatened Species Scientific Committee (2016).

Recovery Plans:

National Recovery Plan for the Greater Bilby *Macrotis lagotis*, Northern Territory Department of Natural Resources, Environment and the Arts (2006).

- National recovery Plan for the Northern Quoll *Dasyurus hallucatus*, Northern Territory Department of Natural Resources, Environment and the Arts (2010).

Threat Abatement Plans:

- Threat Abatement Plan for Predation by Feral Cats, Commonwealth of Australia, 2015.
- Threat Abatement Plan for Predation by the European Red Fox, Department of the Environment, Water, Heritage and the Arts (2008).

Western Australian Technical Guidance

- *Guidelines for surveys to detect the presence of bilbies, and assess the importance of habitat in Western Australia, Department of Biodiversity, Conservation and Attractions (2017)*.
- *Pilbara Northern Quoll Regional Project, Surveying and monitoring Dasyurus hallucatus in the Pilbara*. West Australian Government, Department of Parks and Wildlife (2014).
- *Technical Guidance – Terrestrial fauna surveys.* Environmental Protection Authority (2016).
- *Technical Guidance – Sampling methods for Terrestrial vertebrate fauna*. Environmental Protection Authority (2016).
- *Technical Guidance – Sampling of short range endemic invertebrate fauna*. Environmental Protection Authority (2016).
- *Environmental Factor Guideline – Terrestrial Fauna*. Environmental Protection Authority (2016).

Application of the EPBC guidelines in the Plan are outlined in Appendix D.

2 MANAGEMENT PLAN COMPONENTS

2.1 Environmental management objective

A series of management objectives have been developed to mitigate environmental impacts on conservation significant fauna that could potentially be caused by Fortescue's activities (exploration, construction, operation and decommissioning). These are:

1. Identify the potential direct and indirect impacts on conservation significant fauna and their critical habitats[11] within Fortescue controlled sites.
2. Establish management strategies to minimise the potential impacts on conservation significant fauna and their critical habitat within Fortescue controlled sites.
3. Where species presence and/or critical habitat has been confirmed within Fortescue controlled sites, develop monitoring programs to detect any impacts on conservation significant fauna and their critical habitats.

For each objective, management actions have been developed to ensure the impacts from Fortescue's operations are managed, and that appropriate monitoring, reporting and corrective action functions are implemented to support the successful implementation of the management actions.

The key elements of the environmental management process associated with each objective are described in Table 3.

Table 3: Key elements of environmental management process to achieve identified objectives

Element	Definition/ description
Objective	What is intended to be achieved?
Management Action	Tasks undertaken to enable the objective to be met
Performance indicators	Metrics for evaluating the outcomes achieved by Management Action.
Reporting / Evidence	Demonstrates that the Management Action has been applied and the outcome evaluated.
Timing	Period during which the Management Action should be undertaken.
Responsibility	Accountability for ensuring management action is completed. The responsible role is dependent on project timing. Refer to Appendix J.

[11] Critical habitat are areas with a high biodiversity value (IUCN, 2017). For the purposes of this plan are, critical habitat for conservation significant fauna species has been determined as being denning habitat areas for Northern Quolls, roosting areas for Pilbara Leaf-nosed and Ghost Bats, burrowing areas for Greater Bilbys, shelter areas for Pilbara Olive Pythons, nesting areas for conservation significant bird species.

2.2 Environmental risk

2.2.1 Risk reviews

Fortescue actively manages risk by undertaking annual Environmental Risk Reviews during construction and operations phases where all environmental risks are considered with a focus on high risk impacts. The review considers the effectiveness of management actions that are currently in place for these impacts. The review also considers any relevant incidents that have occurred, if the actions from incident investigations have translated into new management actions, and generally considers the need for any new management actions to ensure lower risk targets can be achieved.

2.2.2 Compliance

Fortescue ensures compliance with its legal obligations through first party quality assurance by site and corporate environment teams with a focus on effective environmental management through the implementation of the Fortescue wide Environmental Management System.

Fortescue has adopted a risk-based approach to monitor compliance with its legal obligations. Site environment teams will monitor their compliance with this Plan.

Where non-conformances occur the incident will be reported in accordance with the *Incident Event Management Procedure* (45-PR-SA-0080) and implement contingency actions defined in Table 7 and any reporting requirements defined in Section 5.

Non-conformance issues and/or opportunities for improvement identified will be documented and tracked via Fortescue's business management system.

Table 4: Key management actions for conservation significant fauna management in Fortescue controlled sites

Ref	Site Location: Rail	Christmas Creek	Cloudbreak	Solomon	Eliwana	Management Action	Performance Indicators	Reporting / Evidence	Timing	Responsibility
Objective 1: Identify the potential direct and indirect impacts on conservation significant fauna and their critical habitats within Fortescue Controlled Sites										
1.1	X	X	X	X	X	Undertake targeted fauna surveys in accordance with applicable EPA and DCCEEW guidance (outlined in Section 1.4.1 of this Plan) to determine presence or absence of conservation significant fauna.	• Fauna surveys undertaken in accordance with applicable EPA and DCCEEW guidance. • GIS and PIMS updated	• Survey Reports • Approval documentation • GIS dataset • PIMS records	Prior to relevant approval submission	Manager, Environmental Approvals
1.2	X	X	X	X	X	Where conservation significant fauna presence has been recorded undertake mapping surveys, where data is not available, to determine relevant species critical habitat and if future monitoring is required.	• Mapping survey completed of species critical habitat • GIS and PIMS updated • Future monitoring defined	• Survey Reports • GIS dataset • PIMS record • Monitoring planned	Prior to relevant approval submission	Group Manager, Environment
1.3	X	X	X	X	X	Conduct a risk assessment to identify high risk areas where conservation significant fauna species and critical habitat have been identified and potential impacts are likely.	• Risk assessment conducted to identify high risk areas where conservation significant fauna species and critical habitat have been identified and potential impacts are likely. • High risk areas identified • See management target in Table 1	• Risk assessment outcomes / report	Prior to relevant approval submission	Manager Environmental Approvals/ Project Manager
Objective 2: Establish management strategies to minimise the potential impacts on conservation significant fauna and their critical habitats within Fortescue Controlled Sites										
2.1	X	X	X	X	X	Ensure staff and contractors are provided with appropriate training to ensure conservation significant fauna and associated critical habitat are protected.	• Inductions completed • Pre-start meetings informed • Role dependent training completed	• Induction materials and register of attendees • Record of Pre-start meetings • Training materials/ registers	Prior to new employee commencement Annually during operations	Manager Project Compliance/ Manager Environment Operations
2.2	X	X	X	X	X	Prior to conducting ground disturbance activities, ensure known locations of conservation significant fauna and their associated critical habitat and buffers are identified and management measures are implemented.	• LUC obtained • Management measures implemented • Groundwater and Surface water management measures implemented where required • Weed management measures implemented where required • Noise management measures implemented where required • See management targets in Table 1	• Completed LUC • Annual Compliance Reporting	Prior to LUC approval	Manager Project Compliance/ Manager Environment Operations
2.3	X	X	X	X	X	Ensure drainage infrastructure location and design aligns with the risk assessment outcomes to minimise interference and disruption of natural surface water flows that support conservation significant fauna habitat.	• Location and design of drainage infrastructure aligns with risk assessment outcomes where possible • See Action 3.4 of this table.	• Risk assessment • Monitoring reports	Prior to relevant approval submission	Manager Project Compliance/ Manager Environmental Approvals/ Manager Environment Operations
2.4	X	X	X	X	X	When conservation significant fauna species have been recorded in proposed impact areas within associated habitat, and the records have been verified through survey activities undertaken in the last five years, ground-truth the area and similar habitats within the area. Where individual animals are present implement mitigation measures, including the relocation of fauna, prior to disturbance.	• Impact areas where fauna has been recorded within associated habitat are assessed prior to ground disturbance • BMS/GIS updated • PaWS consulted and mitigation measures implemented	• BMS record • GIS Table • Annual Compliance Reporting • Consultation records	Prior to LUC approval	Manager Project Compliance/ Manager Environment Operations

Ref	Site Location					Management Action	Performance Indicators	Reporting / Evidence	Timing	Responsibility
	Rail	Christmas Creek	Cloudbreak	Solomon	Eliwana					
						See *Fauna Handling, Relocation and Rehabilitation Procedure* (Appendix R).	• Number of fauna successfully relocated • See management targets in Table 1			
2.5			X	X	X	Direct lighting onto active construction and operational areas to minimise the potential for light overspill resulting in fauna disturbance, injuries or deaths.	• Light overspill mitigation measures incorporated where required • No evidence of fauna disturbance, injury or death from light overspill • Pre-start meetings informed.	• Incident reports in BMS • Toolbox meeting minutes • Record of Pre-start meetings	During night activities	Project Manager/ Manager Mining
2.6	X	X	X	X	X	Prior to conducting ground disturbance activities, ensure known locations of priority weed populations are identified and management measures to minimise the potential for weed spread are included in the LUC. Management measures may include: • Identification of weed risk areas in the LUC approval • Implementation of weed hygiene requirements for plant and equipment in weed risk areas and/or in areas where weed populations have been identified and high-risk activities are proposed • Cleared material with identified weeds to be cleared separately and buried to ensure no re-emergence of weed species occur.	• Degradation of fauna habitat minimised • Weed populations and management measures are identified in the LUC	• Completed LUC	Prior to relevant approval submission	Manager Project Compliance/ Manager, Environment Operations

2.7		X	X	X	X	Fauna management measures, including exclusion or exit/egress structures, to minimise potential impacts to conservation significant fauna, are in place:
						• For mining infrastructure that poses a fauna entrapment and drowning risk (including storage ponds, operational mine void water and tailings storage areas).
						• When conducting excavation or trenching activities.
							• See management targets in Table 1
							• No mortality of conservation significant fauna:
							  • Due to entrapment and drowning in mining infrastructure
							  • As a result of excavation or trenching activities
								• BMS record
								• Annual Compliance Reporting
									Prior to relevant approval submission
									Prior to LUC approval
										Manager Project Compliance/ Manager Mine Services or Manager Technical Services/ Manager Environment Operations

2.8		X	X	X	X	Develop and implement a Feral Animal Control Program to effectively manage and control feral animals within Fortescue controlled sites to minimise impacts on conservation significant fauna. See the Feral Cat Trapping Procedure (Appendix S).	• No significant increase in feral animal records from sightings and road transect counts • Awareness material included in site induction programs • All opportunistic feral animal sightings are registered in BMS	• Annual Compliance Reporting	Annually during operations	Manager Project Compliance/ Manager Environment Operations
2.9		X	X	X	X	To minimise the potential for dust deposition on vegetation on conservation significant fauna habitat, implement relevant dust suppression measures within identified high risk areas.	• Dust suppression measures implemented • Vegetation Health Monitoring Program includes dust	• Annual Compliance Reporting • Monitoring report	During LUC approval implementation	Manager Project Compliance/ Manager Mining/ Manager Environment Operations
2.10	X	X	X	X	X	When constructing a fire break or carrying out a prescribed burn where conservation significant fauna and habitat have been identified, adhere to the requirements outlined in the: • LUC • Local shire's Firebreak Notice issued under the *Bush Fire Act 1954* • Permit to Burn issued by the local Bushfire Control Officer and the Burn Prescription that is developed.	• Fire breaks undertaken to the requirements of the Firebreak Notice • Prescribed burns undertaken to the requirements of Permit to Burn and the Burn Prescription • Fire breaks and prescribed burns are undertaken in accordance with the requirements of the LUC	• Relevant permits • Notice from the local authority • Correspondence with relevant Pastoral Lessee • Completed LUC	Prior to LUC approval	Project Manager/ Site HSES Manager
2.11		X	X	X	X	To minimise the potential for fauna injuries or deaths, implement appropriate traffic mitigation measures such as installation of fauna	• Appropriate signage in areas identified as high-risk areas	• Incident reports in BMS • Staff induction materials	Prior to LUC approval	Project Manager/ Site HSES Manager

Ref	Site Location: Rail	Christmas Creek	Cloudbreak	Solomon	Eliwana	Management Action	Performance Indicators	Reporting / Evidence	Timing	Responsibility
						related signage, speed limit restrictions and the prohibition of off-road driving.	• Awareness programs delivered	• Site notices		
2.12	X	X	X	X	X	All surface holes drilled for the purpose of resource definition are to be plugged immediately after drilling and sampling to prevent fauna entering the hole.	• See management targets in Table 1 • Drill holes plugged immediately after drilling and sampling.	• Inspection reports	After drilling and sampling, in accordance with the relevant Tenement Condition(s)	Manager Mining
2.13	X	X	X	X	X	Where a conservation significant fauna injury or death has occurred as a result of Fortescue Operations, internally report, investigate the incident and notify the Regulator where required. Update management actions, where required, to inform an adaptive management approach.	• Incident reported in BMS • Incident investigated • Significant Native Species Register includes details of the record	• BMS incident record • Annual Compliance Reporting • Significant Native Species Register (6-monthly)	**Internal Reporting** Within 24 hours of the Incident occurring **External Reporting** In accordance with any conditioned timeframe (see Section 5 of the Plan)	Manager Project Compliance/ Manager Environment Operations
2.14		X	X	X	X	Conduct progressive rehabilitation of disturbed areas no longer required for operations prioritising areas with known conservation significant fauna and associated habitat. Rehabilitation is managed under site specific plans approved under the *Environmental Protection Act 1986* and/or the *Mining Act 1978*.	• Disturbed areas no longer required for operations and with known conservation significant fauna and associated habitat progressively rehabilitated. • Monitoring program implemented in rehabilitation areas where conservation significant fauna habitat has been restored.	• Annual Compliance Reporting • GIS table and BMS record • Monitoring Program	In accordance with the Mine Closure Plan	Manager Exploration/ Manager Mining
Objective 3: Where species presence and/or critical habitat has been confirmed within Fortescue controlled sites, develop monitoring programs to detect any impacts on conservation significant fauna and their critical habitats										
3.1	X	X	X	X	X	Undertake a baseline conservation significant fauna survey prior to the first monitoring event where possible to: • Document conservation significant fauna populations within impact and reference sites • Identify the baseline for existing conservation significant fauna populations at impact and reference sites • Compare conservation significant fauna populations between potential impact and reference sites (and/or regional PaWS monitoring sites where available).	• Baseline survey undertaken for all monitoring sites • Baseline survey undertaken prior to the first monitoring event where possible • Baseline survey undertaken in accordance with the Technical Guide (EPA, 2016)	• Baseline monitoring reports	Prior to the first monitoring event	**Construction:** Manager Project Compliance **Operations**: Manager Nature and Science
3.2	X	X	X	X	X	Where populations of conservation significant fauna listed under the *Biodiversity Conservation Act 2016* or the *Environment Protection and Biodiversity Conservation Act 1999* have been recorded in Fortescue controlled sites and critical habitat has been identified, implement a Conservation Significant Fauna Monitoring Program.	• Conservation significant fauna and critical habitat identified • Monitoring Program developed and implemented • Where monitoring identifies the absence of conservation significant fauna, an independent review (see Section 3.4.1 of the monitoring results is undertaken. • See management targets in Table 1	• Monitoring Reports • Annual Compliance Reporting	Annually during operations	Manager Nature and Science

Ref	Site Location: Rail	Site Location: Christmas Creek	Site Location: Cloudbreak	Site Location: Solomon	Site Location: Eliwana	Management Action	Performance Indicators	Reporting / Evidence	Timing	Responsibility
3.3	X	X	X	X	X	When monitoring indicates a potential impact on conservation significant fauna, implement contingency actions defined in Table 7 and any reporting requirements defined in Section 5. Update this Plan where required, to inform an adaptive management approach to fauna management across the business using the approach detailed in Section 6.	• Corrective actions implemented • Reporting requirements met • Plan updated where required • See management targets in Table 1	• Monitoring reports • Reporting records • Updated Plan	When required in response to monitoring outcomes, within 21 days of receiving the consultant's report	**Corrective Actions:** Manager Project Compliance/ Manager Environment Operations **Reporting and Plan Update**: Environment Governance Manager
3.4	X	X	X	X	X	Implement the vegetation health monitoring program as defined in the Vegetation Health Monitoring and Management Plan to detect any impacts on conservation values of conservation significant fauna critical habitat.	• See Vegetation Health Monitoring and Management Plan (includes groundwater and surface water monitoring requirements)	• Vegetation Health Monitoring reports	See Vegetation Health Monitoring and Management Plan	Manager Nature and Science

3 MONITORING GUIDELINES

A conservation significant fauna monitoring program is required to measure the effectiveness of the broad management actions outlined in this Plan. The outcomes of the monitoring program for each site will contribute to ongoing improvements in management actions to ensure an adaptive management approach is adopted.

3.1 Objectives

The overall objective of Fortescue's fauna monitoring program is to monitor and measure the success of management actions to minimise impacts on conservation significant fauna species and ensure compliance with applicable State and Federal approval conditions.

The guiding objectives of the conservation significant fauna monitoring program include:

1. Undertake baseline surveys to determine presence of conservation significant fauna and their critical habitat.
2. Where baseline surveys have recorded conservation significant fauna and/or their critical habitat:
    (a) Measure impacts of Fortescue's activities on conservation significant fauna within Fortescue controlled sites,
    (b) Monitor and measure spatial and temporal changes in the abundance and distribution of conservation significant fauna within Fortescue controlled sites, and
    (c) Monitor and measure the success of management measures to inform an adaptive management approach.
    (d) Conduct an independent expert review of monitoring data every three years to inform monitoring frequency and ongoing monitoring requirements.

Operational monitoring will be informed by the findings of the monitoring itself as they become available. These findings may similarly lead to ongoing refinements to this Plan and its management strategies to ensure an adaptive management approach is undertaken during Fortescue activities.

3.2 Baseline sampling

Where possible, initial baseline survey(s) will be undertaken during the pre-construction phase to obtain accurate baseline data on the presence of habitat and species and population and distribution in accordance with the relevant EPBC Act Referral Guidelines (DWHA 2010a, 2010b, 2010c) and DoE (2011a, 2011b, 2011c), Level 2 terrestrial vertebrate fauna surveys (EPA, 2016a & b), Fortescue 2011) and SRE short range endemic sampling (EPA, 2016c).

Results of existing baseline fauna surveys are available in the following Appendices:

- Appendix L Cloudbreak Mine Baseline Monitoring Report
- Appendix M Christmas Creek Mine Baseline Monitoring Report
- Appendix N Solomon Mine Baseline Monitoring Report
- Appendix O Hamersley Rail Baseline Monitoring Report
- Appendix P Mainline Rail Baseline Report
- Appendix Q Eliwana Mine and Rail Baseline Monitoring Report

3.3 Monitoring site selection

Where populations of conservation significant fauna listed under the *Biodiversity Conservation Act 2016* or the *Environment Protection and Biodiversity Conservation Act 1999* have been recorded in Fortescue controlled sites and critical habitat has been identified monitoring sites will be established. Monitoring sites may include:

- Locations where species have been previously recorded (through direct or indirect methods),
- In suitable habitat and denning/shelter zones outside of direct impact areas (control sites)
- In suitable locations within impact areas (impact sites) to allow for replication of results.
- Critical habitat types for the conservation significant species will be represented in the monitoring program, with a least one monitoring site per representative habitat type where possible.

The number and approach to the selection of monitoring sites varies dependent upon the species being monitored.

3.3.1 Night Parrot

Night Parrot monitoring sites have been located in area of long unburnt areas of Spinifex on the fringe of the Fortescue Marsh.

Night parrot monitoring sites and methods have been selected based on recommendations arising upon conclusion of an intensive there year monitoring program implemented by Fortescue and Adaptive NRM (subject matter experts) (100-RP-EN-9766, Leseberg *et al*. 2021).

The three year monitoring program comprised a desktop assessment to select high priority Night Parrot Habitat at Christmas Creek and an Cloudbreak mine sites, followed by an

intensive monitoring program using acoustic recording units over three years. The program identified twenty potential Night parrot calls, of which 9 were classed as possible, 6 probable and 5 very likely. Most detections, occurred in mature, long unburnt Triodia along the fringes of the marsh (Leseberg *et al*. 2021).

3.3.2 Northern Quoll

Northern Quoll monitoring sites (Figure 2) are located in Northern Quoll critical habitat (i.e. breeding and denning habitat) within Fortescue operational sites where the species has been confirmed. This includes 3 sites at Main Line Rail (Figure 3), 3 sites at Hamersley Rail (Figure 4) and 3 sites at Solomon Mine (Figure 6).

Monitoring sites have also been identified for Eliwana Railway (Figure 33) and Mine (Figure 7). Control data will be utilised from the Solomon Mine and from the PaWS regional Northern Quoll monitoring program (i.e. PaWS sites at Indee Station, Dales Gorge and Millstream), to which the methods are aligned.

At Christmas Creek mine site 3 sites (Figure 5) have been established using non-invasive techniques, due to the absence of confirmed records of the species. Control data is utilised from PaWS regional Northern Quoll monitoring program (i.e. PaWS sites at Indee, Hoopoley and Mt Florance), to which the methods are aligned.

Culvert locations on the Hamersley Line are also monitored within Northern Quoll habitat to determine their usage (Figure 32).

3.3.3 Conservation significant bats (Ghost Bat and Pilbara Leaf-nosed Bat)

Conservation significant bat monitoring sites (Figure 8) are located in known bat foraging (no critical habitat (i.e. roosting habitat) are believed to occur) within Fortescue controlled sites and offsite for reference sites. Twelve impact and twelve reference sites are established at Christmas Creek (Figure 9) mine sites, Main Line Rail (Figure 10) and Solomon Mine (Figure 11).

Monitoring sites have also been identified for Eliwana Railway (Figure 33) and Mine (Figure 12). Control sites will also include sites from Solomon Mine.

Monitoring sites will be relocated if monitoring results indicate that recording units need to be more targeted (i.e. detection of a roost case for abundance monitoring).

3.3.4 Greater Bilby

Great Bilby monitoring methods are aligned to the PaWS regional Bilby monitoring program, and comprise abundance monitoring and occupancy monitoring sites (Figure 13).

Abundance monitoring sites have been established at two known populations, one reference site and one potential impact site at Main Line Rail (Figure 14). Due to the nomadic nature of

Greater Bilby populations, these two sites will not be static and will follow the population if they move (as far as practical).

Occupancy monitoring sites are located in potential critical habitat (i.e. burrowing habitat) at Main Line Rail (approx. 40 sites) (Figure 15, Figure 16, Figure 17, and Figure 18) and Christmas Creek mine site (approx. 30 sites) (Figure 19). These occupancy search sites are not fixed locations but located throughout the habitat mapping shown these figures.

3.3.5 Pilbara Olive Python

Pilbara Olive Python monitoring sites (Figure 20) are positioned in Pilbara Olive Python foraging and critical habitat (i.e. shelter habitat) within Fortescue operational sites and offsite for reference sites. Three impact and three reference sites are established at the Christmas Creek Mine (Figure 21) and Solomon Mine (Figure 22).

Monitoring sites have also been identified for Eliwana Railway (Figure 33) and Mine (Figure 23).

3.3.6 Conservation significant birds (excluding Night Parrot)

Conservation significant bird (excl. Night Parrot) monitoring sites (Figure 24) are positioned in suitable habitat within Fortescue operational sites and offsite for reference sites. Three impact and three reference sites are established at Cloudbreak and Christmas Creek mine sites (Figure 25), Main Line (Figure 26 and Figure 27), Main Line/ Hamersley Rail Line (Figure 28) and Solomon Mine (Figure 29). To note, Cloudbreak and Christmas Creek share reference sites.

Monitoring sites have also been identified for Eliwana Railway (Figure 33) and Mine (Figure 30).

3.4 Monitoring methods

An effective long-term conservation significant fauna monitoring program may be adaptive. Innovations in monitoring techniques and methods will be considered and where appropriate incorporated into the program design over time. This would, however, be dependent on, and driven by, the quality and quantity of data collected from each site, coupled with a periodic review of monitoring methods. Further, program design is based on replicable sampling at impact and reference sites.

A set of monitoring parameters and methods have been selected to provide broad coverage of potential changes in spatial distribution and relative abundance of conservation significant fauna that can be expected under a range of different mining related impacts. The number of parameters will vary depending on the site-specific conditions and the target conservation significant fauna.

The intention of the program is the repeat sampling at the same impact sites throughout the monitoring program. However, if access is prevented due to developments of the mine, changes to land access agreements or similar, sites will be relocated to the nearest suitable location. Any changes will be documented in annual monitoring reports.

The Conservation Significant Fauna Monitoring Program adopts recommended techniques and methodologies as described in the technical guidance referenced in Section 1.4.1 of this Plan. A summary of the key monitoring parameters and methods have been provided in Table 5.

Table 6 provides a summary of the conservation significant monitoring parameters and monitoring effort for conservation significant fauna monitored under this Plan. The timing of monitoring programs for each species is variable and based on the period of highest activity for each species whilst avoiding the reproductive season and undue stress to breeding individuals. A conservation significant fauna monitoring program will be undertaken annually. The program will be led by appropriately skilled, Pilbara experienced, ecologists who will conduct in-field monitoring, analyse monitoring results and write monitoring reports.

Table 5: Conservation significant fauna monitoring parameters and methods

Monitoring parameter	Method
Individual data/ biometric data	Direct results from trapping and observation monitoring methods
Population	Cumulative results from single season monitoring programs, as well as over annual programs
Habitat characteristics	Observation, habitat mapping, photographs etc.
Meteorological data	Data from Weather Stations installed near monitoring site locations
Environmental threats	Observation, mapping, photographs etc.

.

Table 6: Summary of conservation significant fauna monitoring

Fauna species	EPBC Act	BC Act	Method	Monitoring parameters	Monitoring effort	Timing / Frequency	Location
Night Parrot (*Pezoporous occidentalis*)	CR	CR	**Non-invasive:** Acoustic recording units	Presence Habitat characteristics Meteorological data Environmental threats	Minimum Effort (or suitable equivalent) [12] Approx. 10-15 • Acoustic Recording Units (ARUs) deployed in critical habitat (i.e. fringe of marsh – long unburnt Spinifex) over the wet season • Spacing of units should be 700-1000 m • Data analysis using the Night Parrot signal recognition software.	**Timing** Post wet season **Frequency** Annual	Cloudbreak (EPBC 2005/2205) Christmas Creek [13] (EPBC 2013/7055, MS1033)
Northern Quoll (*Dasyurus hallucatus*)	EN	EN	**Non-invasive:** Active searches and searches for scats and other signs, motion cameras **Invasive:** Cage traps and Elliott traps. Replicated control and impact sites.	Abundance Individual data/ biometric data • Sex • Body measurements • Health • Breeding status/ Reproductive condition • Behaviour Area of occupancy Habitat characteristics Meteorological data Environmental threats Culvert usage	Minimum Effort (or suitable equivalent) Medium to High population density: Elliott and Cage Traps: in alignment with "Pilbara northern Quoll Project, Surveyed and Monitoring *Dasyurus hallacatus* in the Pilbara, Western Australia" - (PaWS 2014). OR Low population density: Motion cameras: 5 cameras per sampling site. 4 nights Alternative Effort (or suitable equivalent) Active searches and searches for scats and other signs: ten hours per sampling site. Motion cameras: 5 cameras per sampling site. 4 nights Where possible, monitoring will align with DPaW regional monitoring programs.	**Timing** May to August **Frequency** Annual	Hamersley Rail Corridor Mainline Corridor Cloudbreak Christmas Creek (EPBC 2013/7055, MS1033) Solomon (MS 1062; EPBC 2014/7275) Eliwana Mine (MS 1109) Eliwana Rail (MS 1108)
Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*)	VU	VU	SM2Bat recorders	Presence Habitat characteristics Meteorological data Environmental threats	SM2Bat recorders: 1 recorder per sampling site. 12 impacts, 12 control sites. 28 detector nights per sampling site. 7 nights[14]. Where possible, monitoring will align with PaWS regional monitoring programs.	**Timing** November to May **Frequency** Annual	Mainline Corridor (EPBC 2010/5513) Hamersley Rail Corridor (EPBC 2010/5567) Solomon (MS 1062; EPBC 2014/7275) Eliwana Mine (MS 1109) Eliwana Rail (MS 1108)
Greater Bilby (*Macrotis lagotis*)	VU	VU	**Non-invasive:** Diurnal monitoring and diurnal searches for tracks and other signs, motion cameras on burrows, spotlighting, hair funnels	Abundance Area of occupancy Habitat characteristics Meteorological data Environmental threats Culvert Usage	Abundance (where known population) sites: • Diurnal monitoring and diurnal searches for tracks and other signs (2 ha sites) • Scat collection and genetic analysis to determine population size (2 ha sites) • Food plots (3 per site) • Remote cameras Occupancy sites: • Diurnal monitoring and diurnal searches for tracks and other signs (2 ha sites) • Two phase sampling (subset of sites) Where possible, monitoring will align with PaWS regional monitoring program.	**Timing** No specified time. **Frequency** Annual	Mainline Corridor (EPBC 2010/5513) Christmas Creek (EPBC 2013/7055, MS1033)

[12] Minimum effort and monitoring methods are in accordance with the recommendations outlined in Leseberg *et al.* (2021) and discussions with Adaptive NRM.

[13] This species has not been recorded at this site but a condition of a Ministerial Statement or Controlled Action specifies monitoring for this species.

[14] Bat monitoring methods were amended in 2017 following discussion with DBCA. This included decreasing the number of recording units at each site (from 4 to 1) but increasing the number of monitoring sites to improve spatial coverage of the monitoring. Net monitoring effort remains unchanged.

Fauna species	EPBC Act	BC Act	Method	Monitoring parameters	Monitoring effort	Timing / Frequency	Location
Ghost Bat (*Macroderma Gigas*)	VU	VU	SM2Bat recorders	Presence Habitat characteristics Meteorological data Environmental threats	As a minimum, SM2Bat recorders: 1 recorder per sampling site. 12 impacts, 12 control sites. 28 detector nights per sampling site. 7 nights, until such time that a new method suitable for Ghost Bat monitoring is developed (i.e. scat analysis) Where possible, monitoring will align with PaWS regional monitoring programs.	**Timing** November to May **Frequency** Annual	Christmas Creek Mainline Corridor (EPBC 2010/5513) Solomon (MS 1062; EPBC 2014/7275) Eliwana Mine (MS1109) Eliwana Rail (MS1108)
Pilbara Olive Python (*Liasis olivaceus barroni*)	VU	VU	Searches for signs, spotlighting	Individual data/biometric data • Weight • Length • General body condition Area of occupancy Habitat characteristics Meteorological data Environmental threats	Searches for signs: 2 hour search time for each hectare sampling site. 7 nights. Spotlighting: monitor two 200m transects per 5 hectare site, replicate across habitat types in areas > 5 hectares. Repeat same transects for a minimum of two separate nights. 7 nights. Where possible, monitoring will align with PaWS regional monitoring programs.	**Timing** December to February **Frequency** Annual	Christmas Creek (EPBC 2013/7055, MS1033) Solomon (MS 1062; EPBC 2014/7275) Eliwana Mine (MS1109) Eliwana Rail (MS 1108)
Grey Falcon (*Falco hypoleucos*)		VU	Area searches, transect point monitoring	Area of occupancy Habitat characteristics Meteorological data Environmental threats	Area searches: 20 minute search time for every 2 hectare sampling site.	**Timing** December to February **Frequency** Annual	Cloudbreak Mainline Hamersley Rail
Wood Sandpiper (*Tringa glareola*)	M	IA	Area searches, targeted resource and habitat searches, bird calls	Number of birds Habitat characteristics Meteorological data Environmental threats	Area searches: 20 minute search time for every 2 hectare sampling site	**Timing** December to February **Frequency** Annual	Christmas Creek (EPBC 2013/7055, MS1033) Mainline Corridor
Common Greenshank (*Tringa nebularia*)	M	IA	Area searches, targeted resource and habitat searches, bird calls	Number of birds Habitat characteristics Meteorological data Environmental threats	Area searches: 20 minute search time for every 2 hectare sampling site	**Timing** December to February **Frequency** Annual	Christmas Creek (EPBC 2013/7055, MS1033) Mainline Corridor
Common Sandpiper	M	IA	Area searches, targeted resource and habitat searches, bird calls	Number of birds Habitat characteristics Meteorological data Environmental threats	Area searches: 20 minute search time for every 2 hectare sampling site	**Timing** December to February **Frequency** Annual	Mainline Corridor
Fork-tailed Swift (*Apus pacificus*)	M	IA	Area searches, targeted resource and habitat searches, bird calls	Number of birds Habitat characteristics Meteorological data Environmental threats	Area searches: 20 minute search time for every 2 hectare sampling site	**Timing** December to February **Frequency** Annual	Solomon (MS 1062; EPBC 2014/7275) Eliwana Mine (MS 1109) Eliwana Rail (MS 1108)

3.4.1 Monitoring program review

The monitoring program will be technically assessed and reviewed upon acceptance of this plan[15] and then every three years thereafter. The main objective of the assessment and review will be to ensure that the methods, parameters and frequency used are considerate and appropriate to the findings of the monitoring program. If no triggers are exceeded (detailed in Table 7) after three years, the frequency of monitoring will be reduced to a frequency supported by the review. Where no conservation significant fauna has been recorded over the three-year period the review will determine whether monitoring may cease.

Monitoring sites may need to be adapted over time in response to project impacts.

The assessment and review will be undertaken by an independent Pilbara ecology expert with a relevant tertiary qualification and a minimum 10 years terrestrial Pilbara ecology experience.

Contingency action (Table 7) and reporting requirements (Section 5) will be implemented where required.

3.4.2 Data handling and statistical analysis

Data will be handled in accordance with the data handling protocol established as part of the annual monitoring tender. The protocol will include the requirements as to data storage and protection, data extraction, quality control, analysis, interpretation, reporting and presentation. The protocol will also directly reference and align with the requirements detailed in *Document Control, Information Management (100-ST-DC-001)* and *Geographic Information Systems and Raw Data Guidelines (100-GU-EN-0009)*.

Statistical analysis of data will be undertaken where data permits. Where data capture allows, analysis will include univariate or multivariate analysis, as deemed appropriate, to determine whether there are any statistical variation in monitoring data. Robust statistical analysis shall be completed for all programs, and shall comprise of the following (or similar):

- parametric and Non-Parametric univariate statistical analysis (*i.e.* Students T-tests, Mann-Whitney U test)
- parametric and Non-Parametric multivariate statistical analysis (*i.e.* ANOVA, Kruskal-Wallis ANOVA)
- parametric and Non-Parametric correlation and association tests (*i.e.* Spearman Rank and Pearson Correlation Coefficient, Linear Regression, Generalised Linear Models)
- distribution models and total distribution area, compared across monitoring periods

[15] This is primarily due to the fact that a number conservation significant fauna species monitoring programs have been ongoing for over 5 years.

- multivariate analysis (*i.e.* Principal Component Analysis)

Error analysis shall also be completed to understand the accuracy of the monitoring results.

Monitoring reports will also be provided to the State and Commonwealth Governments as dictated by annual reporting requirements. In addition, the monitoring raw data will be made available to the Western Australian State Government and the Commonwealth Government upon request or where conditioned to provide.

4 CONTINGENCY ACTIONS

Contingency actions will be initiated during construction, operational and decommissioning activities when an exceedance of a target is identified and monitoring indicates that implemented management measures are not successfully mitigating impacts on conservation significant fauna and their supporting habitats and/or the management objectives are not being achieved.

Contingency actions for conservation significant fauna monitoring triggers have been developed to meet requirements under the environmental approvals listed in Table 7 of this Plan.

Table 7: Target criteria and contingency measures

Approval	Target	Contingency measures

MS 690
EPBC 2010/5513
	• Statistically significant decline in the relative abundance of conservation significant species across impact sites compared to reference sites.
	• No continued presence of conservation significant species recorded within the impact areas.
		• Initiate implementation of contingency measures within 24 hours of the exceedance being identified.
		• Determine whether the changes observed in the impact sites are comparable to the observations in the reference sites.
		• Re-examine applied monitoring parameters to validate they are operating within management levels and where necessary implement changes to the management system to address exceedance.
		• Ground truth the results to validate if findings of the assessment are correct. Where the cause is identified during ground truthing and can be rectified, undertake immediate action. For actions which requite alternative resources, schedule works to be undertaken as soon as possible.
		• Cross reference conservation significant fauna results with the most recent environmental monitoring data (i.e. surface water/ groundwater/ vegetation/ weeds/ feral animals/ meteorological etc.) as well as regional bushfire data to determine whether the cause can be identified.
		• Verify any fauna management measures are operating as per design. Where issues are identified seek immediate rectification to ensure the management response can be met. For actions which require alternate resources, schedule works to be undertaken as soon as possible.
		• Where the exceedance was not caused by construction, operation or decommissioning activities, continue the management and monitoring program in accordance with the Plan.
		• Where the exceedance was caused by construction, operation or decommissioning activities:
		  • Review management measures with an adaptive management response.
		  • Undertake further communication and training to raise awareness with staff of the impact and the management measures (including new management measures identified) to reduce the potential impact on the species.
		  • Where cause is determined to be vehicle interaction, measures may include:
		  • Reduce speed limits in areas with target fauna records and suitable habitat
		  • Erect road signage to identify species and habitat areas.

MS 899	• Statistically significant decline in the relative abundance of conservation significant species across impact sites compared to reference sites. • No continued presence of conservation significant species recorded within the impact areas.	
MS 1033 EPBC 2013/7055	• Statistically significant decline in the relative abundance of conservation significant species across impact sites compared to reference sites. • No continued presence of conservation significant species recorded within the impact areas.	
MS 1062 EPBC 2010/5567 EPBC 2014/7275	• Statistically significant decline in the relative abundance of conservation significant species across impact sites compared to reference sites. • No continued presence of conservation significant species recorded within the impact areas.	
EPBC 2005/2205	• No direct mortality to Night Parrot within its recorded habitats within the project area as a result of ground disturbance activities. • No direct loss to Night Parrot habitat within the project area that is not approved3 for disturbance.	
MS 1108 Condition 10-1 EPBC 2017/8025	• Statistically significant decline in the relative abundance of conservation significant species across impact sites compared to reference sites. • No continued presence of conservation significant species recorded within the impact areas.	

MS 1109
Condition 10-1
EPBC 2017/8024
	• Statistically significant decline in the relative abundance of conservation significant species across impact sites compared to reference sites.
	• No continued presence of conservation significant species recorded within the impact areas.
		• Where the cause is determined to be habitat clearing or fragmentation of habitat:
		  • Review the LUC process and implement any further measures including changes to the process to reduce the potential for clearing outside approved areas
		• Where the cause is determined to be light or noise:
		  • Verify lighting is directed onto active construction and operational work areas. Amend lighting location(s) where required.
		  • Verify equipment is operating within Australian standard noise limits. Undertake maintenance on equipment that is in exceedance.
		• Where the cause is determined to be feral animals:
		  • Where a rise in feral animal numbers is linked to camp activities, undertake further training to raise awareness with staff on the management measures to reduce the potential impact on conservation significant species.
		  • Verify rubbish bins have lids and are covered, remedy where necessary.
		  • Implement feral animal control is areas where feral animals have been sighted, see Appendix S.
		• Once management actions have been completed, undertake a subsequent monitoring event to verify parameters are within acceptable limits
		• Continue to implement actions to remediate the exceedance until approval to cease has been given by the DWER.

MS 1109
Condition 10-2
	No direct mortality to known locations of the short range endemic species Antichiropus 1021DNA02 or the associated within the project area as described in the Eliwana Iron Ore Mine Project: Environmental Review Document (FMG, October 2018).	• Initiate implementation of contingency measures within 24 hours of the exceedance being identified.
		• Ground truth the results of the exceedance to validate findings of the assessment.
		• Where the exceedance was not caused by construction, operation or decommissioning activities, no further action is required.
		• Where the exceedance was caused by construction, operation or decommissioning activities:
		  • Review management measures with an adaptive management response
		  • Review the LUC process and implement any further measures including changes to the process to reduce the potential for clearing outside approved areas
		  • Continue to implement actions to remediate the exceedance until approval to cease has been given by the OEPA.

5 REPORTING

5.1 Annual compliance reporting

5.1.1 State government reporting

Fortescue is required to report against its compliance with this Plan in the Compliance Assessment Report prepared in accordance with the OEPA's Post Assessment Guideline for Preparing a Compliance Assessment Report, Post assessment Guideline No. 3.

Annual Compliance Assessment Reports (CAR) are required to be submitted in accordance with the following Ministerial Statements with conservation significant fauna related conditions:

- Condition 5-1 of MS690
- Condition 4-6 of MS899
- Condition 3-6 of MS1033
- Condition 3-6 of MS 1062
- Condition 4-6 and 4-7 of MS 1108
- Condition 4-6 of MS 1109.

The reporting requirements against management targets and conditioned environmental objectives are provided in Table 1. In the event that trigger criteria were exceeded during the reporting period, the CAR will include a description of the effectiveness of the contingency actions that have been implemented to manage the impact and any adaptive management measures applied as a result of the exceedance.

5.1.2 Federal government reporting

Fortescue is required to report against its compliance with this Plan in the annual compliance report prepared in accordance with the DCCEEWs Annual Compliance Report Guidelines, 2014.

Annual Compliance Reports are required to be submitted in accordance with the following EPBC Act Decisions with conservation significant fauna related conditions:

- Condition 8 of EPBC 2005/2205
- Condition 15 of EPBC 2010/5513
- Condition 4 of EPBC 2013/7055
- Condition 16 of EPBC 2014/7275

- Condition 13 of EPBC 2017/8024
- Condition 13 of EPBC 2017/8025.

5.2 Reporting of potential non-compliances

5.2.1 State government reporting

Fortescue is required to report against exceedances of management targets for management based environmental conditions within conditioned timeframes. This requirement is specific to MS1033, MS 1062, MS 1108 and MS 1109 for Eliwana Railway and Mine.

In the event that monitoring, tests, surveys or investigations indicate an exceedance of a management target in Table 1 has occurred within the reporting period, Fortescue will:

- Where the exceedance is attributable to construction, operation or decommissioning activities, report the exceedance in writing to the EPA Services of the DWER within 21 days of the exceedance being identified in accordance with Condition 6-4 (1) of MS1033, Condition 7-4(1) of MS1062, Condition 6-5(1) of MS 1109.
- Where the exceedance is attributable to construction, operation or decommissioning activities, report the exceedance in writing to the EPA Services of the DWER within 7 days of the exceedance being identified in accordance with Condition 6-5(1) of MS 1108.
- Investigate to determine the cause of the management targets being exceeded in accordance with Condition 6-4(2) of MS1033, Condition 7-4(2) of MS1062 and Condition 6-5(2) of MS 1108 and MS 1109.
- Provide a report to the EPA Services of the DWER within 90 days of the exceedance being reported as required by Condition 6-4(1) in accordance with the requirements of condition 6-4(3) of MS1033, Condition 7-4(3) of MS1062 and Condition 6-5(3) of MS 1108 and MS 1109.

In the event that monitoring of compliance, tests, surveys or investigations indicate that one or more management actions have not been implemented within the reporting period, Fortescue will:

- Report the failure to implement management action(s) in writing to the EPA Services of the DWER within 7 days of identification in accordance with Condition 6-5 (1) of MS1033 and Condition 7-5(1) of MS1062.
- Investigate to determine the cause of the management action(s) not being implemented in accordance with Condition 5-5(2) of MS1033, Condition 7-5(2) of MS1062 and Condition 6-6(1) of MS 1108 and MS1109.



- Investigate to provide information for the EPA Services of the DWER to determine potential environmental harm or alteration of the environment that occurred due to the failure to implement management actions in accordance with Condition 6-5(3) of MS1033 and Condition 7-5(3) of MS1062.
- Provide a report to the EPA Services of the DWER within 21 days of the reporting required by condition 6-5(1) in accordance with the requirements of condition 6-5(4) of MS1033 and Condition 7-5(4) of MS1062.
- Provide a report to the EPA Services of the DWER within 28 days of the non-compliance being identified in accordance with Condition 6-6(3) of MS 1109.
- Provide a report to the EPA Services of the DWER within 7 days of the non-compliance being identified in accordance with Condition 6-6(3) of MS 1108.

5.2.2 Federal government reporting

Fortescue is required to report non-compliances with conditions of its approvals within timeframes prescribed within the relevant approval. Non-compliance reporting is required in addition to Annual Compliance Reporting in accordance with the following Approval conditions:

- EPBC 2010/5567 Condition 15 – As soon as practicable and within no later than two business days of the detection of the non-compliance
- EPBC 2013/7055 Condition 3 – Within 48 hours of becoming aware of the potential or suspected non-compliance
- EPBC 2014/7275 Condition 18 - As soon as practicable and no later than 7 business days after becoming aware of the non-compliance.
- EPBC 2017/8024 and EPBC 2017/8025 Condition 14 – No later than two business days after becoming aware of the incident or non-compliance.

In accordance with condition 19 of EPBC 2014/7275 where a non-compliance has been recorded and reporting is required Fortescue will specify:

- The Condition which is in breach
- The nature of the non-compliance
- The effect the non-compliance will have on the action and the impacts of the action
- The time by when the non-compliance will be rectified.

In accordance with condition 15 of EPBC 2017/8024 and EPBC 2017/8025 where an incident or non-compliance has been recorded and reporting is required Fortescue will specify:

- Any corrective actions or investigation which the approval holder has already taken or intends to take in the immediate future
- The potential impacts of the incident or non-compliance
- The method and timing of any remedial action that will be undertaken.

6 ADAPTIVE MANAGEMENT AND REVIEW

Fortescue will implement adaptive management practices to learn from the implementation of mitigation measures, monitoring and evaluation against management targets, to more effectively meet the conditioned environmental objective. Adaptive management practices that will be assessed for the conservation significant fauna management and monitoring program as part of this approach will include:

- Evaluation of the monitoring program, data and comparison to baseline data and reference sites on an annual basis to verify whether responses to project activities are the same or similar to predictions,
- Evaluation of assumptions and uncertainties of the conservation significant fauna management and monitoring program,
- Re-evaluation of the risk assessment and revision of risk-based priorities as a result of monitoring outcomes,
- Review of data and information gathered over the review period that has increased understanding of site environment in the context of the regional ecosystem,
- Review of management actions as the project matures and new management measures and technologies become available that may be more effective for conservation significant fauna management, and
- Assessment of changes which are outside the control of the project and the management measures identified (i.e. a new project within the area or region; regional change affecting conservation significant fauna management).

Review of this Plan will be undertaken in response to:

- Amendments to the environmental risk assessment in response to a new Mining Proposal submitted under the *Mining Act 1978*
- Monitoring program review, inclusive of baseline data capture
- Adaptive management response
- Investigation outcomes from the non-achievement of management targets (as specified in the investigation report required under Condition 6-5(3) of MS 1108 and MS 1109.

Revisions of this Plan will be submitted to the relevant State and Commonwealth Government Agencies for approval, in accordance with the relevant approval conditions. Fortescue will continue to implement the latest approved version of the Plan in accordance with State and Commonwealth approval conditions.

7 STAKEHOLDER CONSULTATION

Fortescue has undertaken an extensive stakeholder consultation program whereby landowners, regulators and other relevant parties have been consulted with regard to investigation and design of the mine sites and port and rail infrastructure through the environmental approvals process.

The then Department of Environment Regulation (DER), the then Office of the Environmental Protection Authority (OEPA) and the then Department of the Environment (DoE) were consulted and, where required, approved the content of the original plans for which this Plan will replace.

Revision 2 of this Plan was submitted to the then OEPA to satisfy the requirements of Condition 10 of MS899 and was approved in November 2013 (CB-EN-0137.01). The Plan was also submitted to the then OEPA to satisfy the requirements of Condition 7-1 of MS 690 and MS707 and Condition 12-1 of MS862 and was approved in October 2014 (100-EN-0441.03).

Revision 2 was also submitted to the then Department of Environment (DoE) to satisfy condition 9 of EPBC 2005/2205, Condition 9 of EPBC 2010/5513 and Condition 10 of EPBC 2010/5567 in April 2014 (100-EN-0492). The DoE approved the revision 2 of The Plan in April 2015 (PUI-000008).

Revision 3 was submitted to the EPA Services of the DWER to satisfy condition 8 of MS 1033 in August 2017 (CC-EN-0313) and was approved in March 2018 (CC-EN-0313.06).

Revision 4 of was submitted to the EPA Services of the DWER for their review, comment and approval, and PaWS for their review and comment, in accordance with condition 12 of MS 1062. Approval was granted in August 2018 (SO-EN-0283.01).

Revision 5 was submitted to the DCCEEW to satisfy conditions under EPBC 2005/2205, EPBC 2010/5513, EPBC 2010/5567, EPBC 2013/7055 and EPBC 2014/7055 (100-EN-0802.01) and approved in July 2019 (100-EN-0802.07).

Table 8 will be updated following receipt of stakeholder comment as a result of the review and approvals process.

Table 8: Stakeholder consultation, comments and responses

Stakeholder	Correspondence	Comment	Changes
EPA Services of the DWER	MS 1033- Pilbara Iron Ore and Infrastructure Project (Christmas Creek Mine, East-West railway and Mindy Mindy Mine) • **Fortescue:** Plan issued for review (CC-EN-0313)	MS 1033 CC-EN-0313.01 CC-EN-0313.04 MS 1062 No comments received MS 1108 and MS 1109	MS 1033 CC-EN-0313.03 CC-EN-0313.05 MS 1108 and MS 1109 UID99808 UID99809

	• **DWER:** Comments provided on Plan (DWERA-000284) (Fortescue reference (CC-EN-0313.01)) • **Fortescue:** Rev 3a of Plan provided for approval (CC-EN-0313.03) • **DWER:** Comments provided on Rev 3a (CC-EN-0313.04) • **Fortescue:** Rev 3b of Plan provided for approval (CC-EN-0313.05) • **DWER:** Approval granted (CC-EN-0313.06) • **Fortescue:** Plan updated to reflect approval by EPA Services of DWER, Rev4 IFU MS 1062 – Solomon Iron Ore Project – Sustaining Production • **Fortescue:** Rev 4a of the Plan issued for review (SO-EN-0283) • **DWER:** Approval granted (SO-EN-0283.01) • **Fortescue:** Plan updated to reflect approval by EPA Services of DWER, Rev5 IFU MS 1108 and MS 1109- Eliwana Railway and Mine • **Fortescue**: Rev 6a of the Plan issued for review • **DWER**: Comments provided on Rev 6a • **Fortescue**: Response to comments and Rev 6b issued for review • **DWER**: Comments on Rev 6b • **Fortescue**: Response to comments and Rev 6c issued for review • **DWER**: Request for NQ reference for Eliwana Mine • **Fortescue**: Submission of Rev 6d • **Fortescue**: Submission of Rev 6e **DWER**: Approval granted (UID 108293)	UID 99807 PUI 0000186 UID 107804	UID 106941 UID 106626 UID 107812
DAWE	EPBC 2005/2205 – Cloudbreak Open Pit Iron Ore Mine • **Fortescue:** Plan issued for review (CC-EN-0312)	EPBC 2005/2205 100-EN-0802.01 100-EN-0802.03 100-EN-0802.05	EPBC 2005/2205 100-EN-0802.02 100-EN-0802.04 100-EN-0802.06

	• **Fortescue:** Rev 5 of the Plan issued for review (100-EN-0802) • **DAWE:** Comments provided on Rev 5 (100-EN-0802.01) • **Fortescue:** Rev 5a of the Plan issued for review (100-EN-0802.02) • **DAWE:** Comments provided on Rev 5a (100-EN-0802.03) • **Fortescue:** Rev 5b of the Plan issued for review (100-EN-0802.04) • **DAWE:** Comments provided on Rev 5b (100-EN-0802.05) • **Fortescue:** Rev 5c of the Plan issued for approval (100-EN-0802.06) • **DAWE:** Rev 5c of the Plan approved (100-EN-0802.07) • **Fortescue:** Plan updated to reflect approval by the DWER, Rev 6 IFU EPBC 2010/5513 – Additionally Rail Infrastructure • **Fortescue:** Rev 5 of the Plan issued for review (100-EN-0802) • **DAWE:** Comments provided on Rev 5 (100-EN-0802.01) • **Fortescue:** Rev 5a of the Plan issued for review (100-EN-0802.02) • **DAWE:** Comments provided on Rev 5a (100-EN-0802.03) • **Fortescue:** Rev 5b of the Plan issued for review (100-EN-0802.04) • **DAWE:** Comments provided on Rev 5b (100-EN-0802.05) • **Fortescue:** Rev 5c of the Plan issued for approval (100-EN-0802.06) • **DAWE:** Rev 5c of the Plan approved (100-EN-0802.07) • **Fortescue:** Plan updated to reflect approval by the DWER, Rev 6 IFU EPBC 2010/5567 – Solomon Iron Ore Project • **Fortescue:** Rev 4a of the Plan issued for review (SO-EN-0285) • **DAWE:** Comments provided on Rev 5 (100-EN-0802.01)	EPBC 2010/5513 100-EN-0802.01 100-EN-0802.03 100-EN-0802.05 EPBC 2010/5567 100-EN-0802.01 100-EN-0802.03 100-EN-0802.05	EPBC 2010/5513 100-EN-0802.02 100-EN-0802.04 100-EN-0802.06 EPBC 2010/5567 100-EN-0802.02 100-EN-0802.04 100-EN-0802.06

	• **Fortescue:** Rev 5a of the Plan issued for review (100-EN-0802.02) • **DAWE:** Comments provided on Rev 5a (100-EN-0802.03) • **Fortescue:** Rev 5b of the Plan issued for review (100-EN-0802.04) • **DAWE:** Comments provided on Rev 5b (100-EN-0802.05) • **Fortescue:** Rev 5c of the Plan issued for approval (100-EN-0802.06) • **DAWE:** Rev 5c of the Plan approved (100-EN-0802.07) • **Fortescue:** Plan updated to reflect approval by the DWER, Rev 6 IFU EPBC 2013/7055- Pilbara Iron Ore and Infrastructure Project (Christmas Creek Mine, East-West Railway and Mindy Mindy Mine) • **Fortescue:** Plan issued to meet Condition 3A (CC-EN-0312) EPBC 2014/7275 – Solomon Iron Ore Project Expansion **Fortescue:** Plan issued to meet condition 3A (UID 81605)		
PaWS	MS 1033- Pilbara Iron Ore and Infrastructure Project (Christmas Creek Mine, East-West railway and Mindy Mindy Mine) • **Fortescue:** Plan issued for review: CC-EN-0315 MS 1062 – Solomon Iron Ore Project – Sustaining Production • **Fortescue:** Plan issued for review: SO-EN-0284	MS 1033 No comments received MS 1062 No comments received	

8 REFERENCES

This Plan and all internal supporting documents will be managed as per Fortescue Document Governance Standards. These may be read in conjunction with this report.

[1] Adaptive NRM (2018). “Fortescue Night Parrot Monitoring Procedure and Program (2018-2021)”, 21 August 2018, 100-PP-EN-0041.

[2] Conservation Advice, *Pezoporus occidentalis*, Threatened Species Scientific Committee (2016).

[3] Conservation Advice, Rhinonicteris aurantia (Pilbara form), Threatened Species Scientific Committee (2016).

[4] Conservation Advice, Macrotis lagotis, Threatened Species Scientific Committee (2016).

[5] Conservation Advice, Liaiis olivaceus barroni, Threatened Species Scientific Committee (2008).

[6] Conservation Advice, Macroderma gigas, Threatened Species Scientific Committee (2016).

[7] Environmental Protection Authority, WA (2017). “Instructions on how to prepare Environmental Protection Act 1986 Part IV Environmental Management Plans” Version 1.1, 6 April 2017.”

[8] Environmental Protection Authority, WA (2016a). “Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment”

[9] Environmental Protection Authority, WA (2016b). “Technical Guide – Terrestrial Fauna Surveys”

[10] Environmental Protection Authority, WA (2016c). “Technical Guide – Sampling of Short Range Endemuc Invertebrate Fauna”EPBC Act Referral guidelines for the endangered northern quoll, Dasyurus hallucatus. EPBC Act Policy Statement 3.25. Australian Government, Department of the Environment (2016)

[11] EPBC Act Survey Guidelines for Australia’s Threatened Bats, Guidelines for Detecting Bats Listed as Threatened Under the EPBC Act 1999. Australia Government. Department of Water, Heritage and the Arts (2010).

[12] EPBC Act Survey Guidelines for Australia’s Threatened Birds, Guidelines for Detecting Birds as Threatened Under the EPBC Act 1999. Australian Government. Department of Water, Heritage and the Arts (2010). (Note, for Night Parrot refer to the Night Parrot recovery team’s survey methods: https://nightparrot.com.au/index.php/advice/)

[13] EPBC Act Survey Guidelines for Australia’s Threatened Frogs, Guidelines for Detecting Frogs Listed as Threatened Under the EPBC Act 1999. Australian Government. Department of Water, Heritage and the Arts (2010).

[14] EPBC Act Survey Guidelines for Australia's Threatened Fish, Guidelines for Detecting Fish Listed as Threatened Under the EPBC Act 1999. Australian Government, Department of Sustainability, Environment, Water, Population and Communities (2011).

[15] EPBC Act Survey Guidelines for Australia's Threatened Mammals, Guidelines for Detecting Mammals Listed as Threatened Under the EPBC Act 1999. Australian Government, Department of Sustainability, Environment, Water, Population and Communities (2011).

[16] EPBC Act Survey Guidelines for Australia's Threatened Reptiles, Guidelines for Detecting Reptiles Listed as Threatened Under the EPBC Act 1999. Australian Government, Department of Sustainability, Environment, Water, Population and Communities (2011).

[17] Fortescue Metals Group, WA (2013) "Environmental Management System Manual – 100-MA-EN-0004".

[18] Fortescue Metals Group, WA (2018) "Night Parrot surveys at Fortescue Marsh, Western Australia: Habitat analyses, survey review and recommendations – 100-RP-EN-9674

[19] Guidance Statement No.56 Terrestrial Fauna Surveys for Environmental Impact Assessments in Western Australia. West Australian Government, Environmental Protection Authority, (2004).

[20] Guidelines for surveys to detect the presence of bilbies, and assess the importance of habitat in Western Australia, Department of Biodiversity, Conservation and Attractions (2017).

[21] International Union for the Conservation of Nature (IUCN), (2017) "Red List of Threatened Species"

[22] National Recovery Plan for the Greater Bilby Macrotis lagotis, Northern Territory Department of Natural Resources, Environment and the Arts (2006).

[23] National recovery Plan for the Northern Quoll Dasyurus hallucatus, Northern Territory Department of Natural Resources, Environment and the Arts (2010).

[24] Pilbara Northern Quoll Regional Project, Surveying and monitoring Dasyurus hallucatus in the Pilbara. West Australian Government, Department of Parks and Wildlife (2014).

[25] Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment. Technical Report of the Environmental Protection Authority and the Department of Environment and Conservation (DEC) Edited by B.M. Hyder, J. Dell and M.A. Cowan. September 2010.

[26] Terrestrial Biological Surveys as an Element of Biodiversity Protection. Position Statement No. 3. West Australian Government, Environmental Protection Authority, (2002).

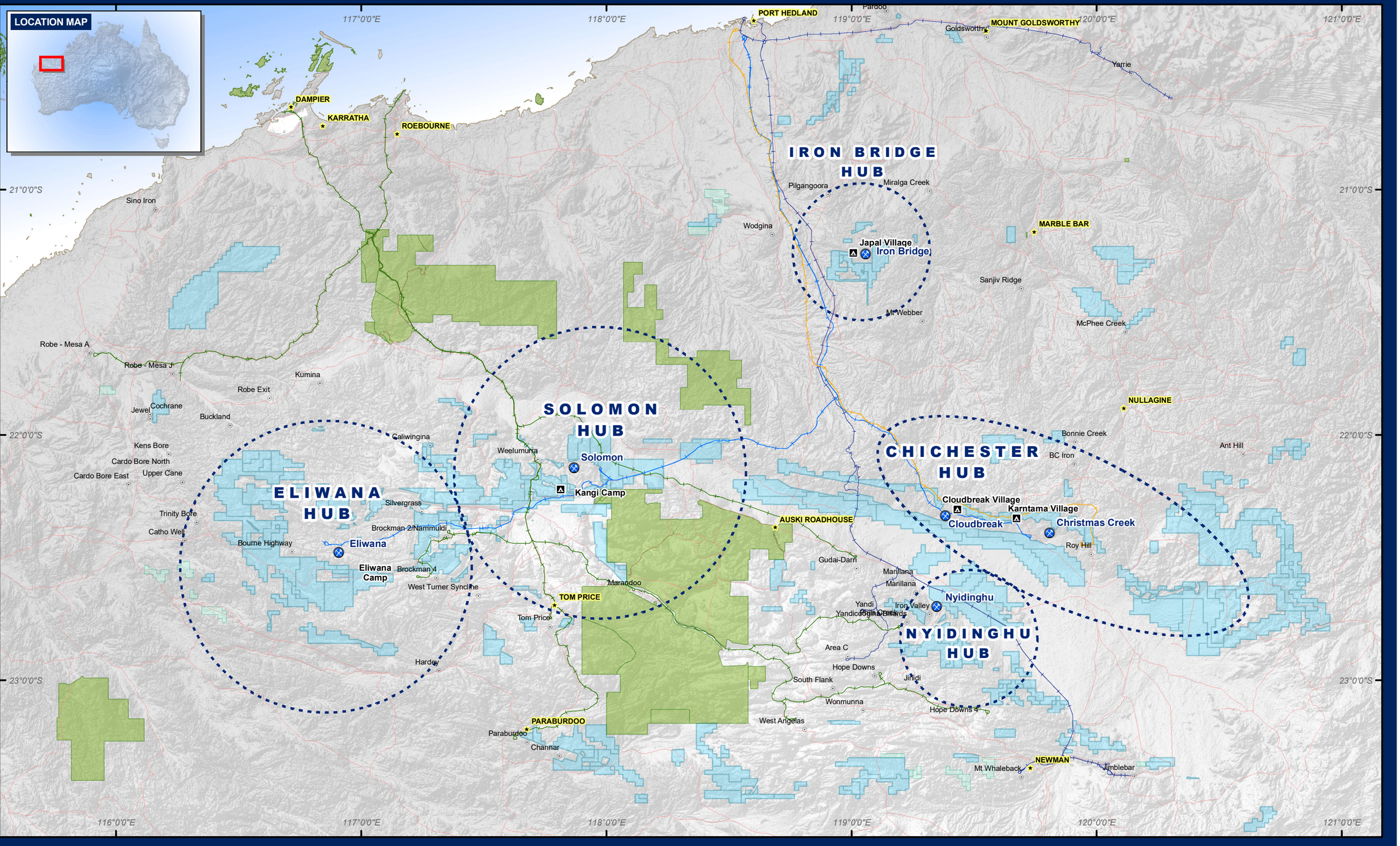
[27] Threat Abatement Plan for Predation by Feral Cats, Commonwealth of Australia, 2015.

[28] Threat Abatement Plan for Predation by the European Red Fox, Department of the Environment, Water, Heritage and the Arts (2008).

DOCUMENT CONTROL

Conservation Significant Fauna Management Plan		
Status	IFU - Issued for Use	1-Nov-24
Summary of Changes	Monitoring effort for Night Parrot and Section 3.3.1 on Night Parrot monitoring has been updated to reflect current monitoring results and efforts. Plan updated to current template Plan supersedes *Conservation Significant Fauna Management Plan* (100-PL-EN-0022).	
Author	Jane Humphrey	Signature
Checked or Squad Review# (if applicable)		Signature
Approved	Scott Poole	Signature
Next Review Date (if applicable)	1-Nov-29	

FIGURE 1 FORTESCUE TENEMENTS AND PROJECT AREAS



LEGEND

- Towns
- Project Area
- FMG Camp
- Other Mines & Prospects
- Roads
- FMG Rail Alignments
- BHP
- Rio Tinto
- Roy Hill
- FMG Non-managed Exploration Tenements
- FMG Managed Exploration Tenements
- Reserves

Data Sources:
Tenements, sourced from DMIRS, 2024.
Roads, Towns, Reserves, Landgate.
3rd Rail, RTIO. BHPB, RHIO.
DEM, GA.

N W E S

0 20 40 60 80 100
Kilometres

Requested By: J. Humphrey
Drawn By: S.Costello
Revised By: scostello
Approved By: N/A
Scale: 1:1,600,000
Coordinate System: GCS GDA 1994
Document Name: 100_MP_OP_0058.010_r7

Date: 16/08/2024
Size: A3L
Revision: 7
Confidentiality: 0

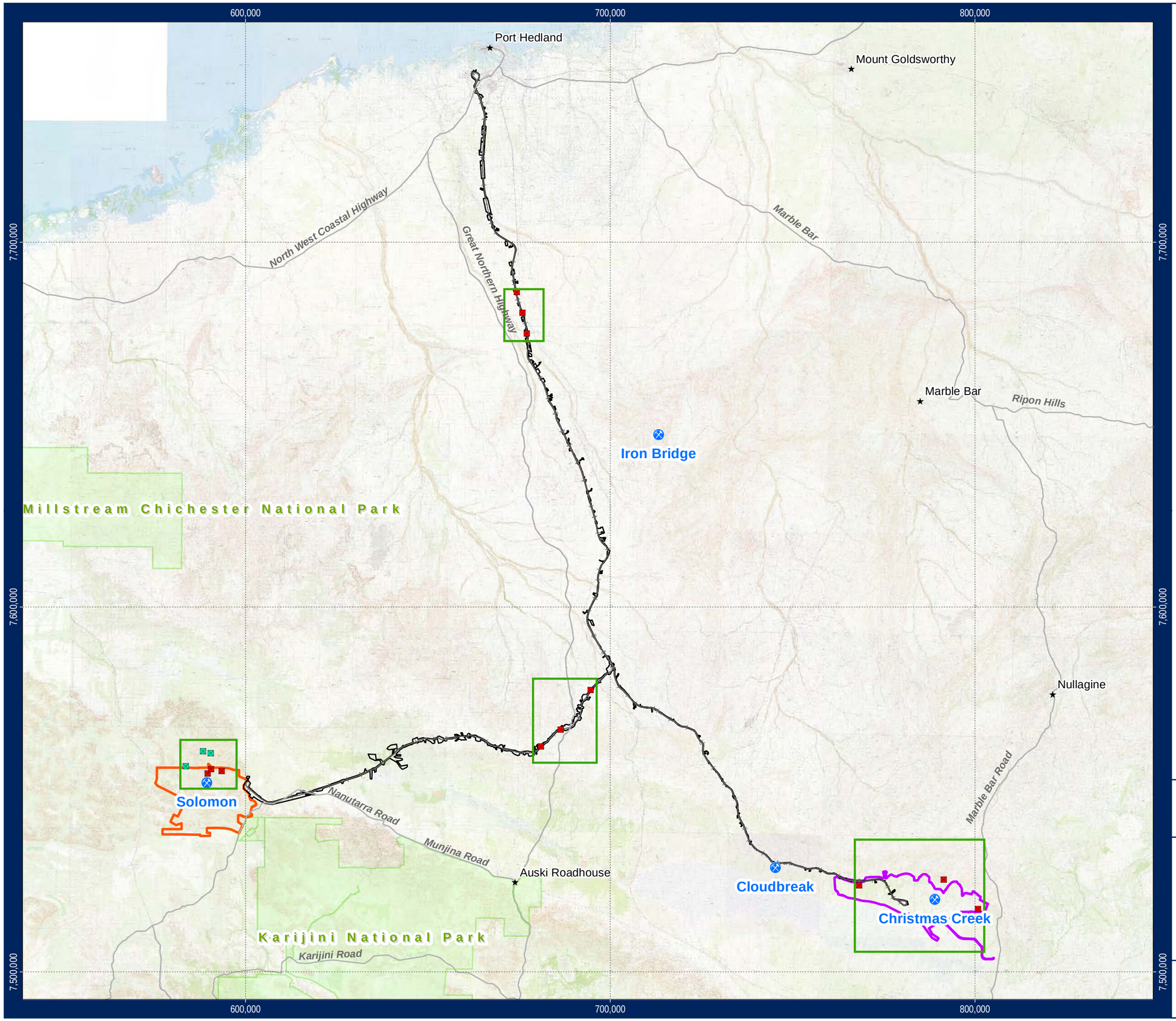
FMG accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose.

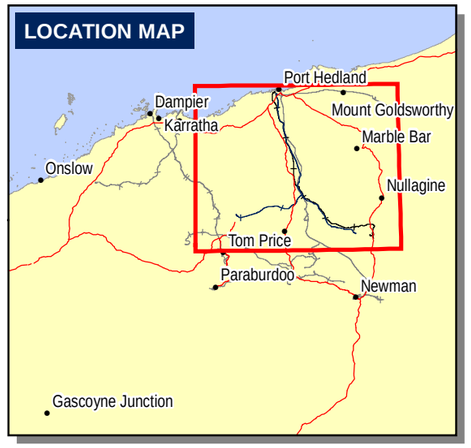
FMG ExplorationTenements and Project Areas

August 2024

Fortescue

FIGURE 2 NORTHERN QUOLL MONITORING SITES – REGIONAL OVERVIEW





LEGEND

- Northern Quoll Monitoring Sites - Impact
- Northern Quoll Monitoring Sites - Reference
- Towns
- FMG Mine
- Roads
- FMG Rail Alignments
- FMG Rail Corridors
- Christmas Creek Mine
- Solomon Mine
- National Park
- Map Index

Data Sources:
Roads, Landgate, 2012
Topography, Geoscience Australia
All other data, FMG, 2018

N

0 10 20 30 40 50
Kilometres

Fauna Monitoring
Northern Quoll

Requested By: Todd Edwards
Drawn By: H. Wallace
Revised By: scostello
Approved By: P.M.
Scale: 1:1,000,000
Coordinate System: GDA 1994 MGA Zone 50
Document Name: 045_MP_EN_0090.022_r2_Overview_NQ

Date: 11-Oct-18
Size: A3L
Revision: 1
Confidentiality: 1

FMG accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose.

Fortescue Metals Group Ltd
The New Force in Iron Ore

FIGURE 3 NORTHERN QUOLL MONITORING SITES – MAIN LINE RAIL

672,000 674,000 676,000 678,000 680,000

7,686,000 7,684,000 7,682,000 7,680,000 7,678,000 7,676,000 7,674,000

rocky outcrops
quarry
scrape
MOUNT NEWMAN
PORT HEDLAND
WITTENOOM ROAD
MAINLINE RAILWAY
Pooca Pools
Chinnamon Creek
Gillam Creek
Chinnamon Pool

LOCATION MAP
Port Hedland
Mount Goldsworthy
Roebourne
Marble Bar
Nullagine
Auski Roadhouse
Tom Price
Paraburdoo

LEGEND
- Significant Fauna Record - Northern Quoll
- Northern Quoll Monitoring Sites - Impact
- Roads
- FMG Rail Alignments
- FMG Rail Corridors
- Significant Fauna Habitat - Northern Quoll

Data Source(s):
Roads, Landgate, 2012
Topography, Geoscience Australia
All other data, FMG, 2018

N

0 1 2 3
Kilometres

Requested By: Olivia Hertsted
Drawn By: H. Wallace
Revised By: hwallace
Approved By: P.M.
Scale: 1:40,000
Coordinate System: GDA 1994 MGA Zone 50
Document Name: 045_MP_EN_0090.001_r0

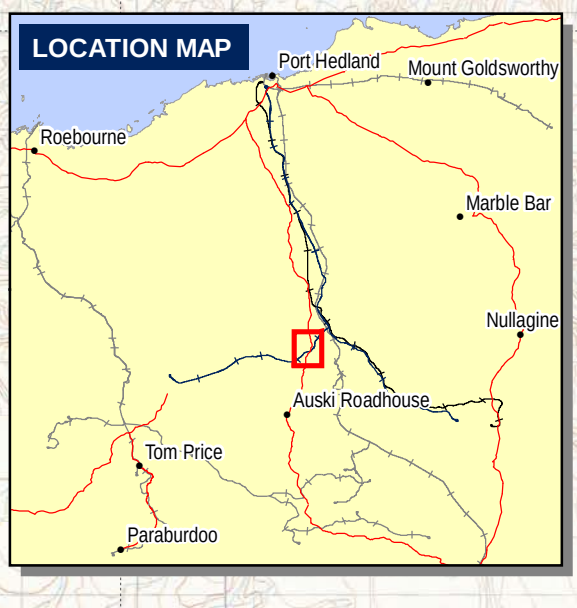
Date: 08-Feb-18
Size: A3P
Revision: 0
Confidentiality: 1

FMG accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose.

Fauna Monitoring: Northern Quoll
Mainline Rail (Including duplication)

Fortescue Metals Group Ltd
The New Force in Iron Ore

FIGURE 4 NORTHERN QUOLL MONITORING SITES – HAMERSLEY RAIL



680,000 685,000 690,000 695,000

7,580,000 7,575,000 7,570,000 7,565,000 7,560,095

YANDEEARRA ABORIGINAL

LEGEND

- Significant Fauna Record - Northern Quoll
- Northern Quoll Monitoring Sites - Impact
- Roads
- FMG Rail Alignments
- FMG Rail Corridors
- Significant Fauna Habitat - Northern Quoll

Data Source(s):
Roads, Landgate, 2012
Topography, Geoscience Australia
All other data, FMG, 2018

N

0 1 2 3
Kilometres

Requested By: Olivia Hertsted
Drawn By: H. Wallace
Revised By: hwallace
Approved By: P.M.
Scale: 1:65,000
Coordinate System: GDA 1994 MGA Zone 50
Document Name: 045_MP_EN_0090.002_r1

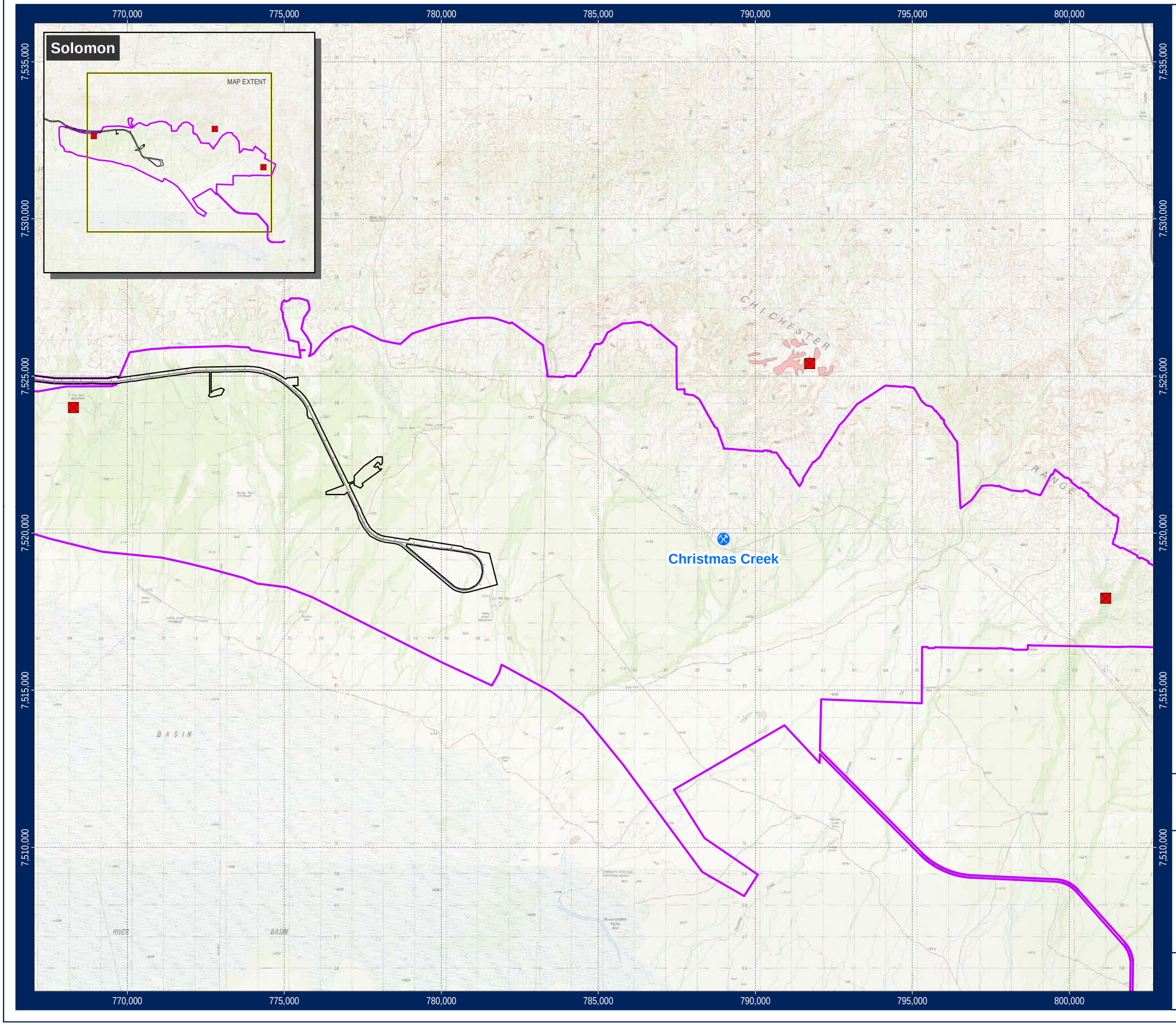
Date: 16-Feb-18
Size: A3P
Revision: 1
Confidentiality: 1

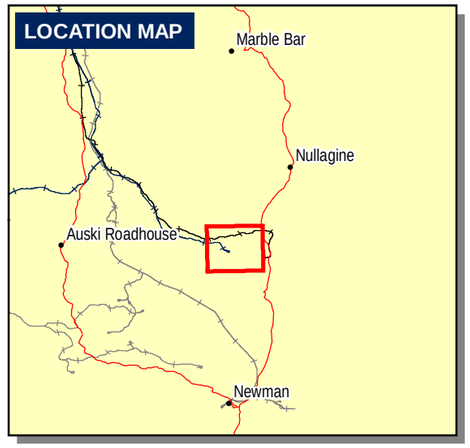
FMG accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose.

Fauna Monitoring: Northern Quoll
Hamersley Rail Line

Fortescue Metals Group Ltd
The New Force in Iron Ore

FIGURE 5 NORTHERN QUOLL MONITORING SITES – CHRISTMAS CREEK MINE





LEGEND

- Significant Fauna Record - Northern Quoll
- Northern Quoll Monitoring Sites - Impact
- FMG Mine
- Roads
- FMG Rail Alignments
- FMG Rail Corridors
- Christmas Creek Mine
- Significant Fauna Habitat - Northern Quoll

Data Source(s):
Roads, Landgate, 2012
Topography, Geoscience Australia
All other data, FMG, 2018

N

0 1 2 3 4 5
Kilometres

Fauna Monitoring: Northern Quoll

Christmas Creek Mine

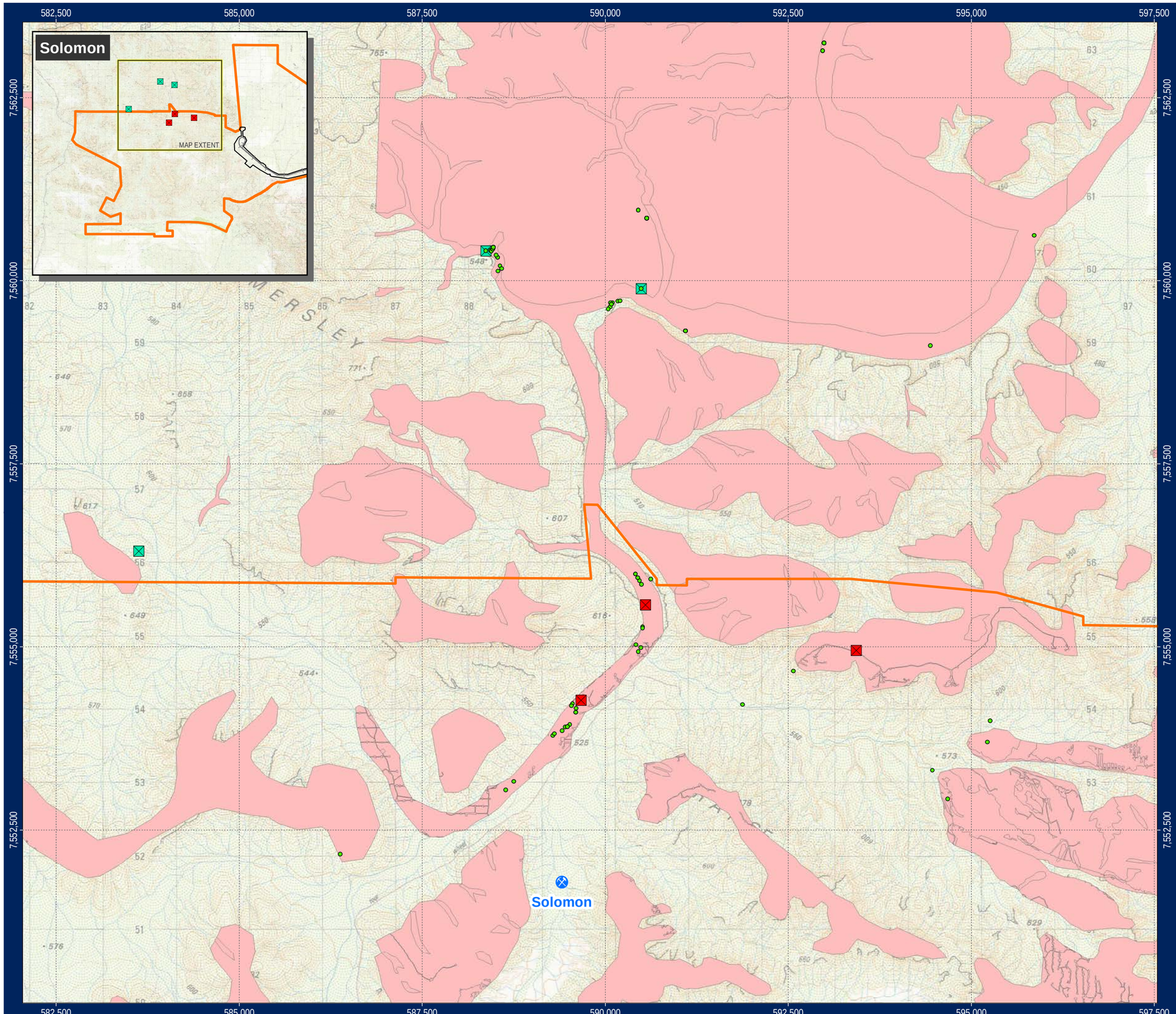
Requested By: Olivia Hertsted
Drawn By: H. Wallace
Revised By: hwallace
Approved By: P.M.
Scale: 1:115,000
Coordinate System: GDA 1994 MGA Zone 50
Document Name: 045_MP_EN_0090.004_r1

Date: 09-Feb-18
Size: A3L
Revision: 1
Confidentiality: 1

FMG accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose.

Fortescue Metals Group Ltd
The New Force in Iron Ore

FIGURE 6 NORTHERN QUOLL MONITORING SITES – SOLOMON MINE





LEGEND

- Significant Fauna Record - Northern Quoll
- Northern Quoll Monitoring Sites - Impact
- Northern Quoll Monitoring Sites - Reference
- FMG Mine
- Solomon Mine
- Significant Fauna Habitat - Northern Quoll

Data Source(s):
Roads, Landgate, 2012
Topography, Geoscience Australia
All other data, FMG, 2018

N

0 1 2 3
Kilometres

Fauna Monitoring: Northern Quoll
Solomon Mine

Requested By: Olivia Hertsted
Drawn By: H. Wallace
Revised By: hwallace
Approved By: P.M.
Scale: 1:50,000
Coordinate System: GDA 1994 MGA Zone 50
Document Name: 045_MP_EN_0090.003_r2

Date: 27-Apr-18
Size: A3L
Revision: 2
Confidentiality: 1

FMG accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose.

Fortescue Metals Group Ltd
The New Force in Iron Ore

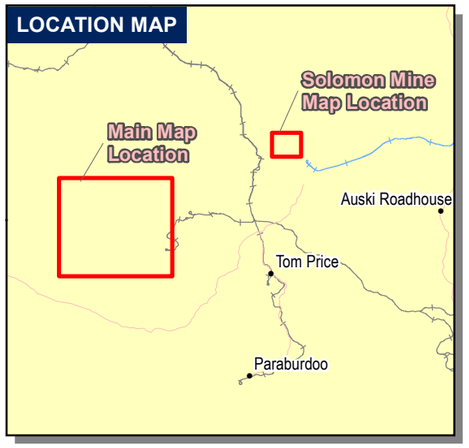
FIGURE 7 NORTHERN QUOLL MONITORING SITES – ELIWANA MINE

480,000
500,000
520,000
7,540,000
7,520,000
7,500,000

Solomon Mine – Reference Sites only

0 2.5 5 Kilometers

LOCATION MAP



LEGEND

- Mine Development Envelope
- Excess Water Discharge Extent

Significant Fauna Monitoring Sites

- Northern Quoll; Impact
- Northern Quoll; Reference

Significant Fauna Records

- Northern Quoll
- Significant Fauna Habitat
- Eliwana Indicative Mine Footprint
- Solomon Cleared Area

Data Sources:
SRTM, GA
All other data; FMG, 2020

0 5 10
Kilometres

N

Conservation Significant Fauna Monitoring Sites - Northern Quoll Eliwana Mine

Requested By: O. Hertsted
Drawn By: N. Rappa
Revised By: sanli
Approved By: P. Mastalir
Scale: 1:200,000
Coordinate System: GDA 1994 MGA Zone 50
Document Name: 751EW_MP_EN_0031.002_r1_quoll

Date: 26/05/2020
Size: A3L
Revision: 2
Confidentiality: 1

FMG accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose.

FMG Fortescue

FIGURE 8 CONSERVATION SIGNIFICANT BATS MONITORING SITES – REGIONAL OVERVIEW

600,000
700,000
800,000
7,700,000
7,600,000
7,500,000

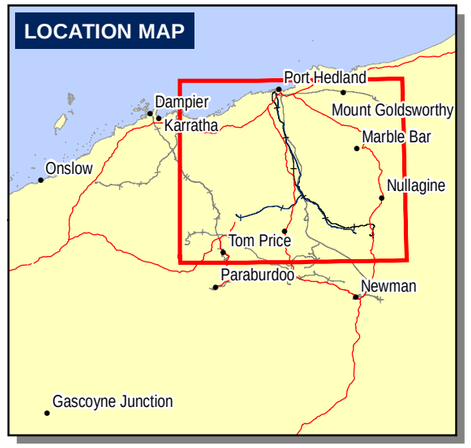
Port Hedland
Mount Goldsworthy
Marble Bar
Nullagine
Auski Roadhouse
Tom Price

North West Coastal Highway
Great Northern Highway
Marble Bar
Ripon Hills
Nanutarra Road
Munjina Road
Karijini Road
Marble Bar Road

Millstream Chichester National Park
Karijini National Park

Iron Bridge
Solomon
Cloudbreak
Christmas Creek

LOCATION MAP



LEGEND

- Bat Monitoring Site - Impact
- Bat Monitoring Site - Reference
- Towns
- FMG Mine
- Roads
- FMG Rail Alignments
- FMG Rail Corridors
- Christmas Creek Mine
- Solomon Mine
- National Park
- Map Index

Data Sources:
Roads, Landgate, 2012
Topography, Geoscience Australia
All other data, FMG, 2018

N

0 10 20 30 40 50
Kilometres

Fauna Monitoring
Bats

Requested By: Todd Edwards
Drawn By: H. Wallace
Revised By: scostello
Approved By: P.M.
Scale: 1:1,100,000
Coordinate System: GDA 1994 MGA Zone 50
Document Name: 045_MP_EN_0090.023_r1_Overview_Bats

Date: 11-Oct-18
Size: A3L
Revision: 0
Confidentiality: 1

FMG accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose.

Fortescue Metals Group Ltd
The New Force in Iron Ore

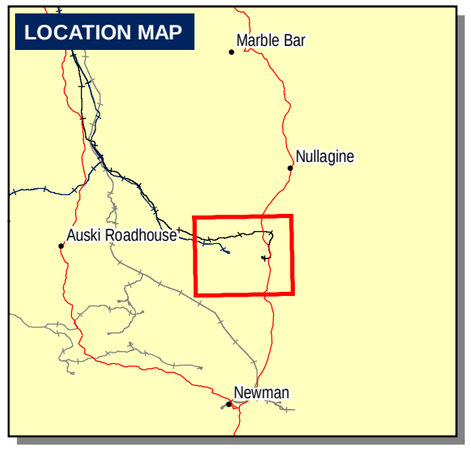
FIGURE 9 CONSERVATION SIGNIFICANT BATS MONITORING SITES – CHRISTMAS CREEK MINE

760,000 770,000 780,000 790,000 800,000 810,000 820,000

7,540,000 7,530,000 7,520,000 7,510,000 7,500,000 7,490,000

Christmas Creek

LOCATION MAP



LEGEND

- Ghost Bat
- Pilbara Leaf-nosed Bat
- Bat Monitoring Site - Impact
- Bat Monitoring Site - Reference
- FMG Mine
- Roads
- FMG Rail Alignments
- FMG Rail Corridors
- Christmas Creek Mine
- Significant Fauna Habitat - Bats

Data Source(s):
Roads, Landgate, 2012
Topography, Geoscience Australia
All other data, FMG, 2018

N

0 2 4 6 8 10
Kilometres

Fauna Monitoring: Bats
Christmas Creek Mine

Requested By: Olivia Hertsted
Drawn By: H. Wallace
Revised By: hwallace
Approved By: P.M.
Scale: 1:200,000
Coordinate System: GDA 1994 MGA Zone 50
Document Name: 045_MP_EN_0090.005_r0

Date: 14-Feb-18
Size: A3L
Revision: 0
Confidentiality: 1

FMG accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose.

Fortescue Metals Group Ltd
The New Force in Iron Ore

FIGURE 10 CONSERVATION SIGNIFICANT BATS MONITORING SITES – MAIN LINE RAIL

680,000 690,000 700,000 710,000 720,000

7,660,000 7,650,000 7,640,000 7,630,000 7,620,000 7,610,000 7,600,000

Iron Bridge

YANDEEARRA

ABORIGINAL LAND

LEGEND

- Ghost Bat
- Pilbara Leaf-nosed Bat
- Bat Monitoring Site - Impact
- Bat Monitoring Site - Reference
- FMG Mines
- Roads
- FMG Rail Alignments
- FMG Rail Corridors
- Significant Fauna Habitat - Bats

LOCATION MAP

Port Hedland
Mount Goldsworthy
Roebourne
Marble Bar
Nullagine
Auski Roadhouse
Tom Price
Paraburdoo

Data Source(s):
Roads, Landgate, 2012
Topography, Geoscience Australia
All other data, FMG, 2018

N

0 2 4 6 8 10
Kilometres

Requested By: Olivia Hertsted
Drawn By: H. Wallace
Revised By: hwallace
Approved By: P.M.
Scale: 1:200,000
Coordinate System: GDA 1994 MGA Zone 50
Document Name: 045_MP_EN_0090.008_r1

Date: 16-Feb-18
Size: A3P
Revision: 1
Confidentiality: 1

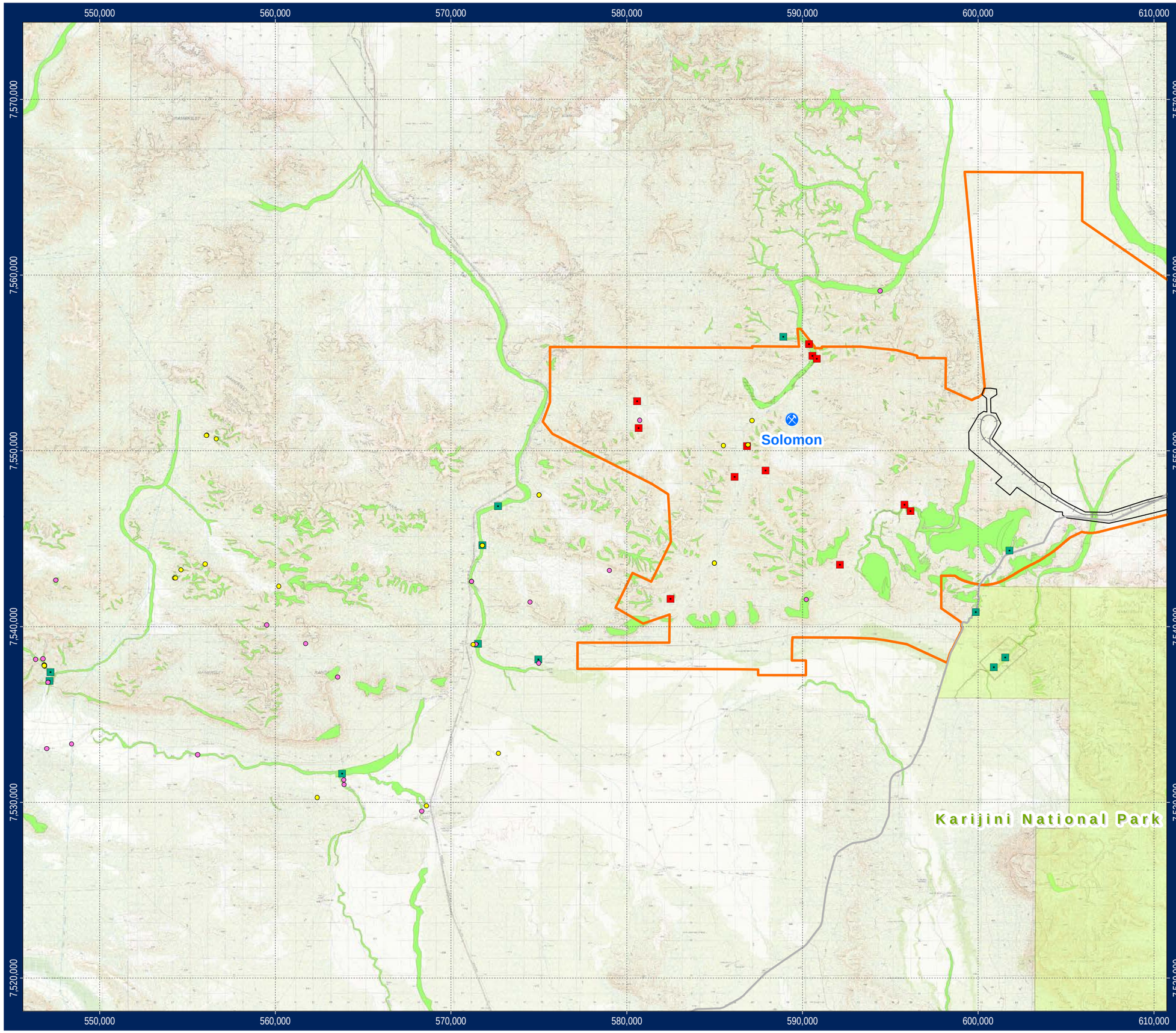
FMG accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose.

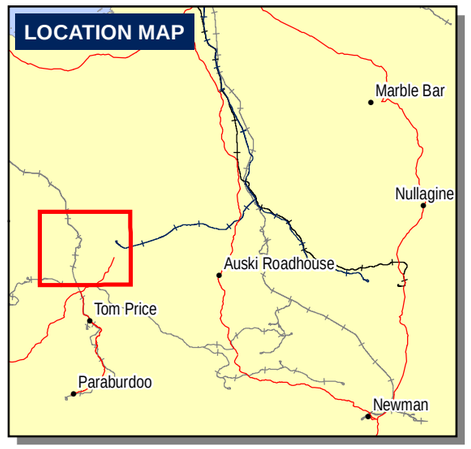
Fauna Monitoring: Bats

Mainline Rail (Including duplication)

Fortescue Metals Group Ltd
The New Force in Iron Ore

FIGURE 11 CONSERVATION SIGNIFICANT BATS MONITORING SITES – SOLOMON MINE





LEGEND

- Ghost Bat
- Pilbara Leaf-nosed Bat
- Bat Monitoring Site - Impact
- Bat Monitoring Site - Reference
- FMG Mine
- Roads
- FMG Rail Alignments
- FMG Rail Corridors
- National Park
- Solomon Mine
- Significant Fauna Habitat - Bats

Data Source(s):
Roads, Landgate, 2012
Topography, Geoscience Australia
All other data, FMG, 2018

N

0 2 4 6 8 10
Kilometres

Fauna Monitoring: Bats
Solomon Mine

Requested By: Olivia Hertsted
Drawn By: H. Wallace
Revised By: hwallace
Approved By: P.M.
Scale: 1:210,000
Coordinate System: GDA 1994 MGA Zone 50
Document Name: 045_MP_EN_0090.006_r1

Date: 27-Apr-18
Size: A3L
Revision: 1
Confidentiality: 1

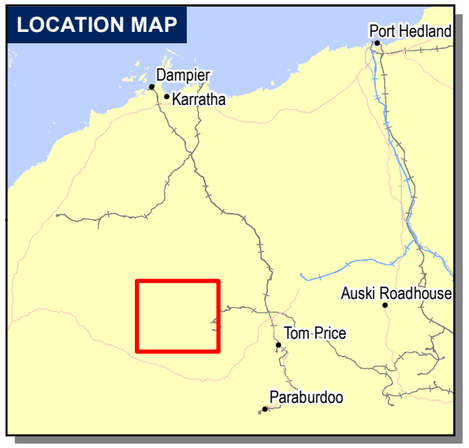
FMG accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose.

Fortescue Metals Group Ltd
The New Force in Iron Ore

FIGURE 12 CONSERVATION SIGNIFICANT BATS MONITORING SITES – ELIWANA MINE

460,000
480,000
500,000
520,000
7,540,000
7,520,000
7,500,000

LOCATION MAP



LEGEND

- Mine Development Envelope
- Excess Water Discharge Extent

Significant Fauna Monitoring Sites

- Pilbara Leaf-nosed Bat and Ghost Bat; Impact
- Pilbara Leaf-nosed Bat and Ghost Bat; Reference

Significant Fauna Records

- Ghost Bat
- Pilbara Leaf-nosed Bat
- Significant Fauna Habitat
- Eliwana Indicative Mine Footprint

Data Sources:
SRTM, GA
All other data; FMG, 2020

0 5 10
Kilometres

N

Conservation Significant Fauna Monitoring Sites - Significant Bats Eliwana Mine

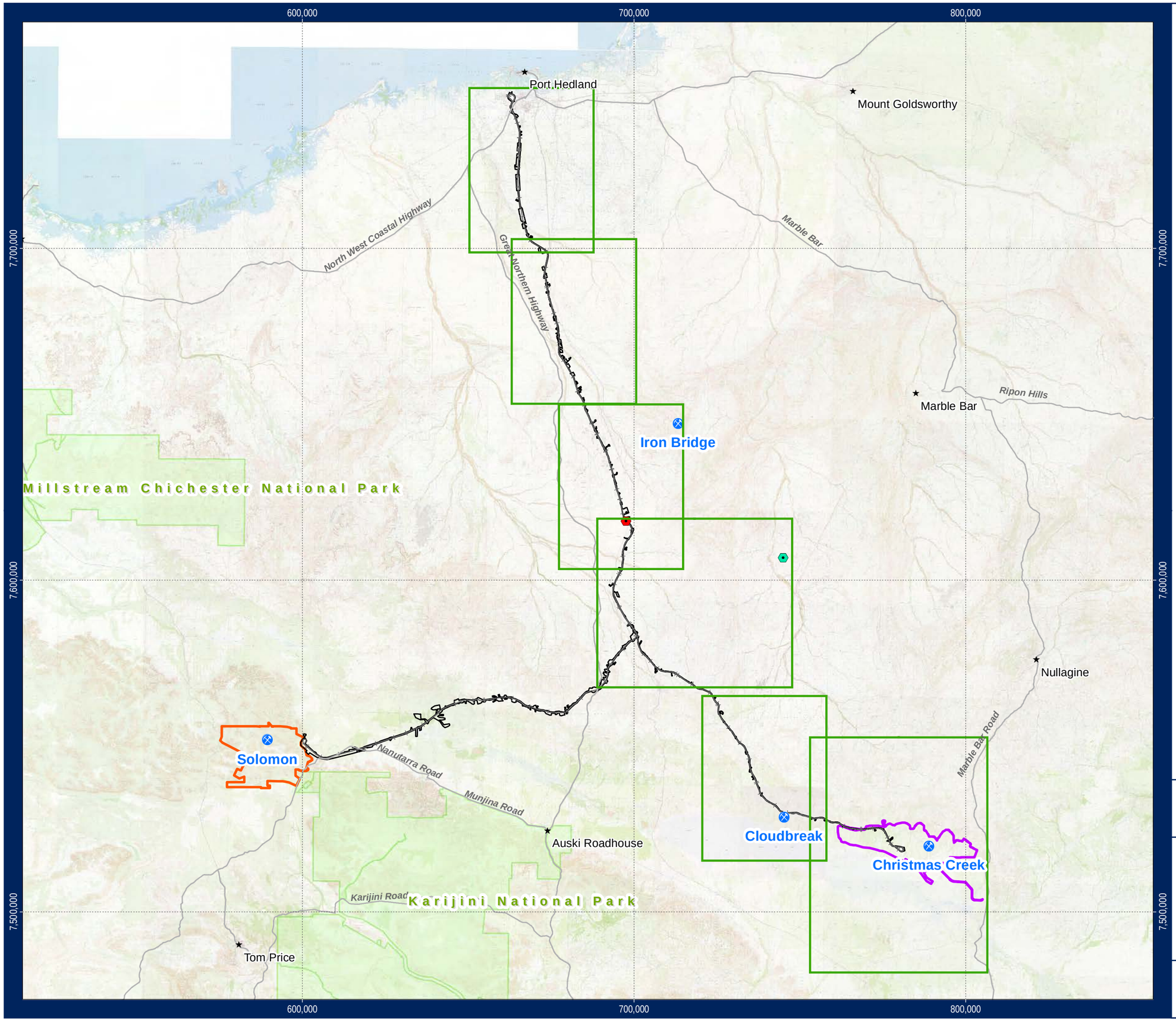
Requested By: O. Hertsted
Drawn By: N. Rappa
Revised By: sanli
Approved By: P. Mastalir
Scale: 1:230,000
Coordinate System: GDA 1994 MGA Zone 50
Document Name: 751EW_MP_EN_0031.004_r0_bats

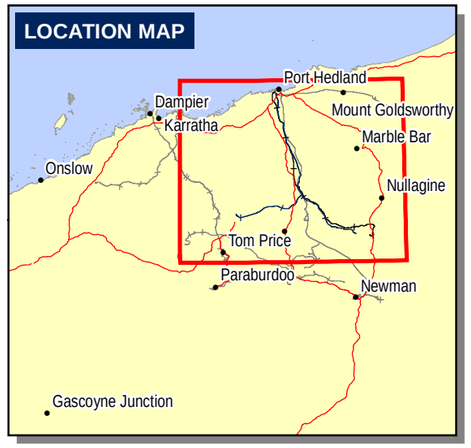
Date: 5/05/2020
Size: A3L
Revision: 0
Confidentiality: 1

FMG accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose.

FMG Fortescue

FIGURE 13 GREATER BILBY MONITORING SITES – REGIONAL OVERVIEW





LEGEND

- Bilby Monitoring Site - Impact
- Bilby Monitoring Site - Reference
- Towns
- FMG Mine
- Roads
- FMG Rail Alignments
- FMG Rail Corridors
- Solomon Mine
- Christmas Creek Mine
- National Park
- Map Index

Data Sources:
Roads, Landgate, 2012
Topography, Geoscience Australia
All other data, FMG, 2018

N

0 10 20 30 40 50
Kilometres

Fauna Monitoring
Greater Bilby

Requested By: Todd Edwards
Drawn By: H. Wallace
Revised By: scostello
Approved By: P.M.
Scale: 1:1,100,000
Coordinate System: GDA 1994 MGA Zone 50
Document Name: 045_MP_EN_0090.024_r1_Overview_Bilby

Date: 11-Oct-18
Size: A3L
Revision: 0
Confidentiality: 1

FMG accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose.

Fortescue Metals Group Ltd
The New Force in Iron Ore

FIGURE 14 GREATER BILBY MONITORING SITES – MAIN LINE TO PORT

660,000 670,000 680,000

7,740,000 7,730,000 7,720,000 7,710,000 7,700,000

LEGEND

- Significant Fauna Record - Bilby
- Roads
- FMG Rail Alignments
- FMG Rail Corridors
- Significant Fauna Habitat - Bilby

LOCATION MAP

Port Hedland
Mount Goldsworthy
Roebourne
Marble Bar
Nullagine
Auski Roadhouse
Tom Price
Paraburdoo

Data Source(s):
Roads, Landgate, 2012
Topography, Geoscience Australia
All other data, FMG, 2018

N

0 2 4 6 8 10
Kilometres

Requested By: Olivia Hertsted
Drawn By: H. Wallace
Revised By: hwallace
Approved By: P.M.
Scale: 1:140,000
Coordinate System: GDA 1994 MGA Zone 50
Document Name: 045_MP_EN_0090.010_r0

Date: 08-Feb-18
Size: A3P
Revision: 0
Confidentiality: 1

FMG accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose.

Fauna Monitoring: Bilby

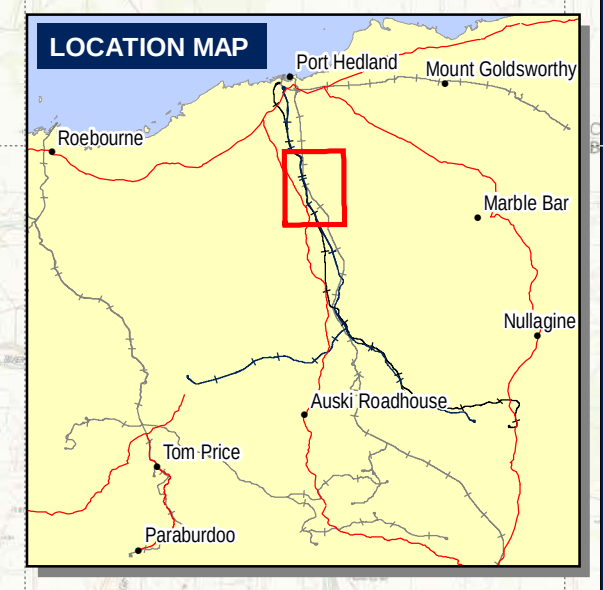
Mainline Rail (Including duplication)

Fortescue Metals Group Ltd
The New Force in Iron Ore

FIGURE 15 GREATER BILBY MONITORING SITES – MAIN LINE RAIL SITE 1

670,000 680,000 690,000 700,000

7,700,000 7,690,000 7,680,000 7,670,000 7,660,000



LEGEND

- Significant Fauna Record - Bilby
- Roads
- FMG Rail Alignments
- FMG Rail Corridors
- Significant Fauna Habitat - Bilby

Data Source(s):
Roads, Landgate, 2012
Topography, Geoscience Australia
All other data, FMG, 2018

N

0 2 4 6 8 10
Kilometres

Requested By: Olivia Hertsted
Drawn By: H. Wallace
Revised By: hwallace
Approved By: P.M.
Scale: 1:140,000
Coordinate System: GDA 1994 MGA Zone 50
Document Name: 045_MP_EN_0090.011_r0

Date: 08-Feb-18
Size: A3P
Revision: 0
Confidentiality: 1

FMG accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose.

Fauna Monitoring: Bilby

Mainline Rail (Including duplication)

Fortescue Metals Group Ltd
The New Force in Iron Ore

FIGURE 16 GREATER BILBY MONITORING SITES – MAIN LINE RAIL SITE 2

680,000 690,000 700,000 710,000

7,650,000 7,640,000 7,630,000 7,620,000 7,610,000

Iron Bridge

YANDEEARRA

ABORIGINAL

LAND

YANDEEARRA

LEGEND

- Significant Fauna Record - Bilby
- FMG Mines
- Roads
- FMG Rail Alignments
- FMG Rail Corridors
- Significant Fauna Habitat - Bilby

LOCATION MAP

Port Hedland
Mount Goldsworthy
Roebourne
Marble Bar
Nullagine
Auski Roadhouse
Tom Price
Paraburdoo

680,000 690,000 700,000 710,000

Data Source(s):
Roads, Landgate, 2012
Topography, Geoscience Australia
All other data, FMG, 2018

N

0 2 4 6 8 10
Kilometres

Requested By: Olivia Hertsted
Drawn By: H. Wallace
Revised By: hwallace
Approved By: P.M.
Scale: 1:140,000
Coordinate System: GDA 1994 MGA Zone 50
Document Name: 045_MP_EN_0090.012_r0

Date: 08-Feb-18
Size: A3P
Revision: 0
Confidentiality: 1

FMG accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose.

Fauna Monitoring: Bilby

Mainline Rail (Including duplication)

Fortescue Metals Group Ltd
The New Force in Iron Ore

FIGURE 17 GREATER BILBY MONITORING SITES – MAIN LINE AND HAMERSLEY RAIL

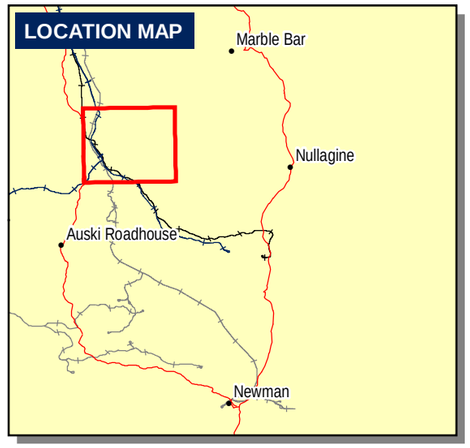
690,000 700,000 710,000 720,000 730,000 740,000

7,610,000
7,600,000
7,590,000
7,580,000
7,570,000

R_F_P_MRGB-I16

R_F_P_MRGB-C16

LOCATION MAP



LEGEND

- Significant Fauna Record - Bilby
- Bilby Monitoring Site - Impact
- Bilby Monitoring Site - Reference
- Roads
- FMG Rail Alignments
- FMG Rail Corridors
- Significant Fauna Habitat - Bilby

Data Source(s):
Roads, Landgate, 2012
Topography, Geoscience Australia
All other data, FMG, 2018

N

0 2 4 6 8 10
Kilometres

Fauna Monitoring: Bilby

Mainline Rail (Including duplication)

Requested By: Olivia Hertsted
Drawn By: H. Wallace
Revised By: hwallace
Approved By: P.M.
Scale: 1:190,000
Coordinate System: GDA 1994 MGA Zone 50
Document Name: 045_MP_EN_0090.009_r0

Date: 08-Feb-18
Size: A3L
Revision: 0
Confidentiality: 1

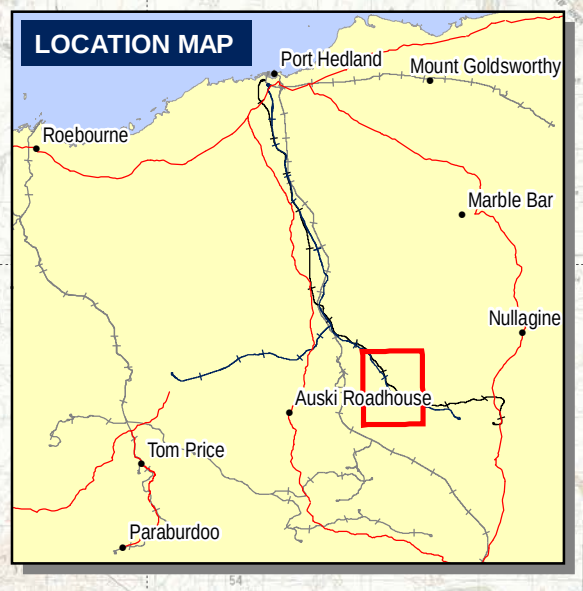
FMG accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose.

Fortescue Metals Group Ltd
The New Force in Iron Ore

FIGURE 18 GREATER BILBY MONITORING SITES – MAIN LINE TO CLOUDBREAK MINE

730,000 740,000 750,000

7,560,000 7,550,000 7,540,000 7,530,000 7,520,000



Cloudbreak

CHICHESTER RANGE

FORTESCUE RIVER BASIN

LEGEND

- Significant Fauna Record - Bilby
- FMG Mines
- FMG Rail Alignments
- FMG Rail Corridors
- Significant Fauna Habitat - Bilby

730,000 740,000 750,000

Data Source(s):
Roads, Landgate, 2012
Topography, Geoscience Australia
All other data, FMG, 2018

N

0 2 4 6 8 10
Kilometres

Requested By: Olivia Hertsted
Drawn By: H. Wallace
Revised By: hwallace
Approved By: P.M.
Scale: 1:140,000
Coordinate System: GDA 1994 MGA Zone 50
Document Name: 045_MP_EN_0090.013_r0

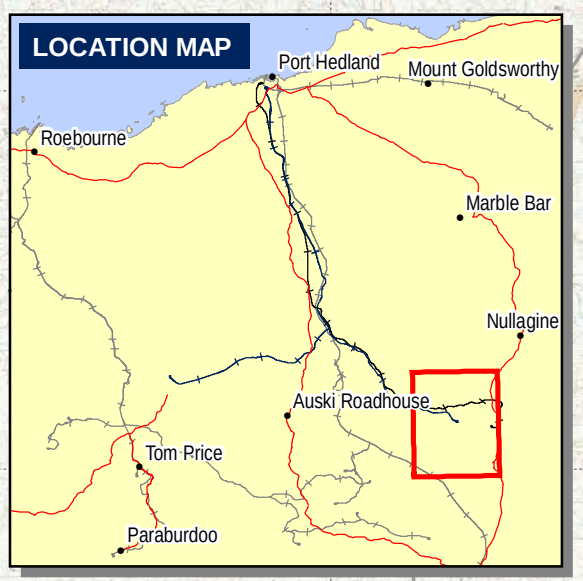
Date: 08-Feb-18
Size: A3P
Revision: 0
Confidentiality: 1

FMG accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose.

Fauna Monitoring: Bilby
Mainline Rail (Including duplication)

Fortescue Metals Group Ltd
The New Force in Iron Ore

FIGURE 19 GREATER BILBY MONITORING SITES – CHRISTMAS CREEK MINE



760,000 770,000 780,000 790,000 800,000

7,550,000 7,540,000 7,530,000 7,520,000 7,510,000 7,500,000 7,490,000

Christmas Creek

LEGEND

- Significant Fauna Record - Bilby
- FMG Mines
- Roads
- FMG Rail Alignments
- FMG Rail Corridors
- Christmas Creek Mine
- Significant Fauna Habitat - Bilby

Data Source(s):
Roads, Landgate, 2012
Topography, Geoscience Australia
All other data, FMG, 2018

N

0 2 4 6 8 10
Kilometres

Requested By: Olivia Hertsted
Drawn By: H. Wallace
Revised By: hwallace
Approved By: P.M.
Scale: 1:200,000
Coordinate System: GDA 1994 MGA Zone 50
Document Name: 045_MP_EN_0090.014_r0

Date: 09-Feb-18
Size: A3P
Revision: 0
Confidentiality: 1

FMG accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose.

Fauna Monitoring: Bilby

Christmas Creek Mine

Fortescue Metals Group Ltd
The New Force in Iron Ore

FIGURE 20 PILBARA OLIVE PYTHON MONITORING SITES – REGIONAL OVERVIEW

600,000
700,000
800,000
7,700,000
7,600,000
7,500,000

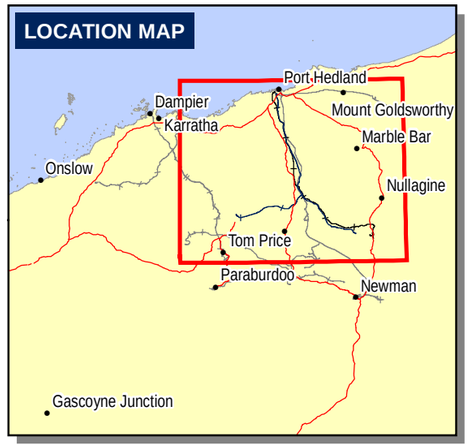
Port Hedland
Mount Goldsworthy
Marble Bar
Tom Price
Auski Roadhouse
Nullagine

North West Coastal Highway
Great Northern Highway
Marble Bar
Ripon Hills
Nanutarra Road
Munjina Road
Karijini Road
Marble Bar Road

Millstream Chichester National Park
Karijini National Park

Iron Bridge
Solomon
Cloudbreak
Christmas Creek

LOCATION MAP



LEGEND

Pilbara Olive Python Monitoring Sites

- Impact
- Reference

Pilbara Olive Python Transects

- Impact
- Reference
- Towns
- FMG Mine
- Roads
- FMG Rail Alignments
- FMG Rail Corridors
- Christmas Creek Mine
- Solomon Mine
- National Park
- Map Index

Data Sources:
Roads, Landgate, 2012
Topography, Geoscience Australia
All other data, FMG, 2018

N

0 10 20 30 40 50
Kilometres

Fauna Monitoring
Pilbara Olive Python

Requested By: Todd Edwards
Drawn By: H. Wallace
Revised By: scostello
Approved By: P.M.
Scale: 1:1,100,000
Coordinate System: GDA 1994 MGA Zone 50
Document Name: 045_MP_EN_0090.025_r1_Overview_POP

Date: 11-Oct-18
Size: A3L
Revision: 0
Confidentiality: 1

FMG accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose.

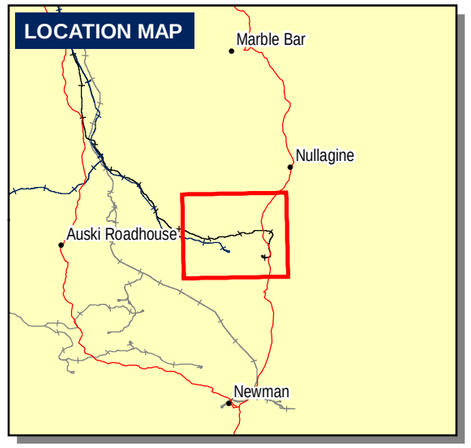
Fortescue Metals Group Ltd
The New Force in Iron Ore

FIGURE 21 PILBARA OLIVE PYTHON MONITORING SITES – CHRISTMAS CREEK MINE

760,000 770,000 780,000 790,000 800,000 810,000

7,550,000 7,540,000 7,530,000 7,520,000 7,510,000

Christmas Creek



LEGEND

- Significant Fauna Record - Pilbara Olive Python

Pilbara Olive Python Monitoring Sites

- Impact
- Reference

Pilbara Olive Python Transects

- Impact
- Reference
- FMG Mine
- Roads
- FMG Rail Alignments
- FMG Rail Corridors
- Christmas Creek Mine
- Significant Fauna Habitat - Pilbara Olive Python

Data Source(s):
Roads, Landgate, 2012
Topography, Geoscience Australia
All other data, FMG, 2018

N

0 2 4 6 8 10
Kilometres

Fauna Monitoring: Pilbara Olive Python

Christmas Creek Mine

Requested By: Olivia Hertsted
Drawn By: H. Wallace
Revised By: hwallace
Approved By: P.M.
Scale: 1:215,000
Coordinate System: GDA 1994 MGA Zone 50
Document Name: 045_MP_EN_0090.015_r0

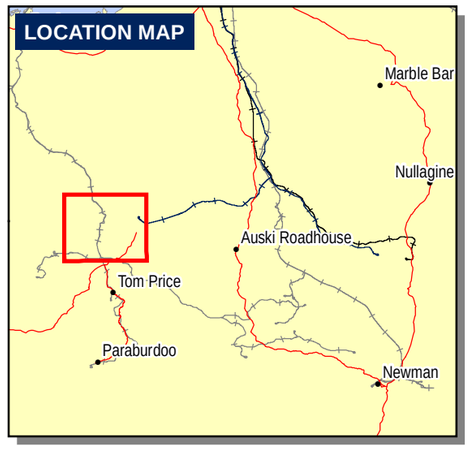
Date: 09-Feb-18
Size: A3L
Revision: 0
Confidentiality: 1

FMG accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose.

Fortescue Metals Group Ltd
The New Force in Iron Ore

FIGURE 22 PILBARA OLIVE PYTHON MONITORING SITES – SOLOMON MINE





LEGEND

- Significant Fauna Record - Pilbara Olive Python

Pilbara Olive Python Monitoring Sites

- Impact
- Reference
- FMG Mine
- Roads
- FMG Rail Alignments
- FMG Rail Corridors
- Solomon Mine
- Significant Fauna Habitat - Pilbara Olive Python
- National Park

Data Source(s):
Roads, Landgate, 2012
Topography, Geoscience Australia
All other data, FMG, 2018

N

0 2 4 6 8 10
Kilometres

Fauna Monitoring: Pilbara Olive Python

Solomon Mine

Requested By: Olivia Hertsted
Drawn By: H. Wallace
Revised By: hwallace
Approved By: P.M.
Scale: 1:200,000
Coordinate System: GDA 1994 MGA Zone 50
Document Name: 045_MP_EN_0090.016_r2

Date: 27-Apr-18
Size: A3L
Revision: 2
Confidentiality: 1

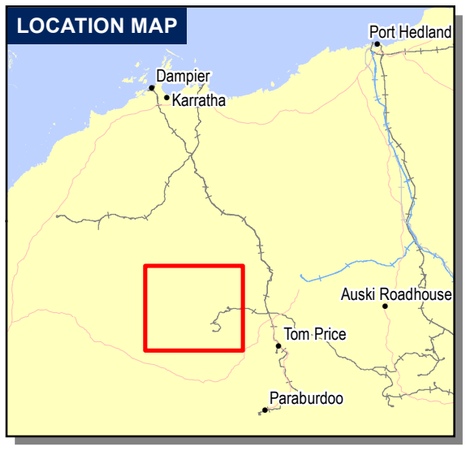
FMG accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose.

Fortescue Metals Group Ltd
The New Force in Iron Ore

FIGURE 23 PILBARA OLIVE PYTHON MONITORING SITES – ELIWANA MINE

480,000
500,000
520,000
540,000
7,540,000
7,520,000
7,500,000

LOCATION MAP



LEGEND

- Mine Development Envelope
- Excess Water Discharge Extent

Significant Fauna Monitoring Sites

- Pilbara Olive Python; Impact
- Pilbara Olive Python; Reference

Significant Fauna Records

- Pilbara Olive Python
- Significant Fauna Habitat
- Eliwana Indicative Mine Footprint

Data Sources:
SRTM, GA
All other data; FMG, 2020

0 5 10 15
Kilometres

N

Conservation Significant Fauna Monitoring Sites - Pilbara Olive Python Eliwana Mine

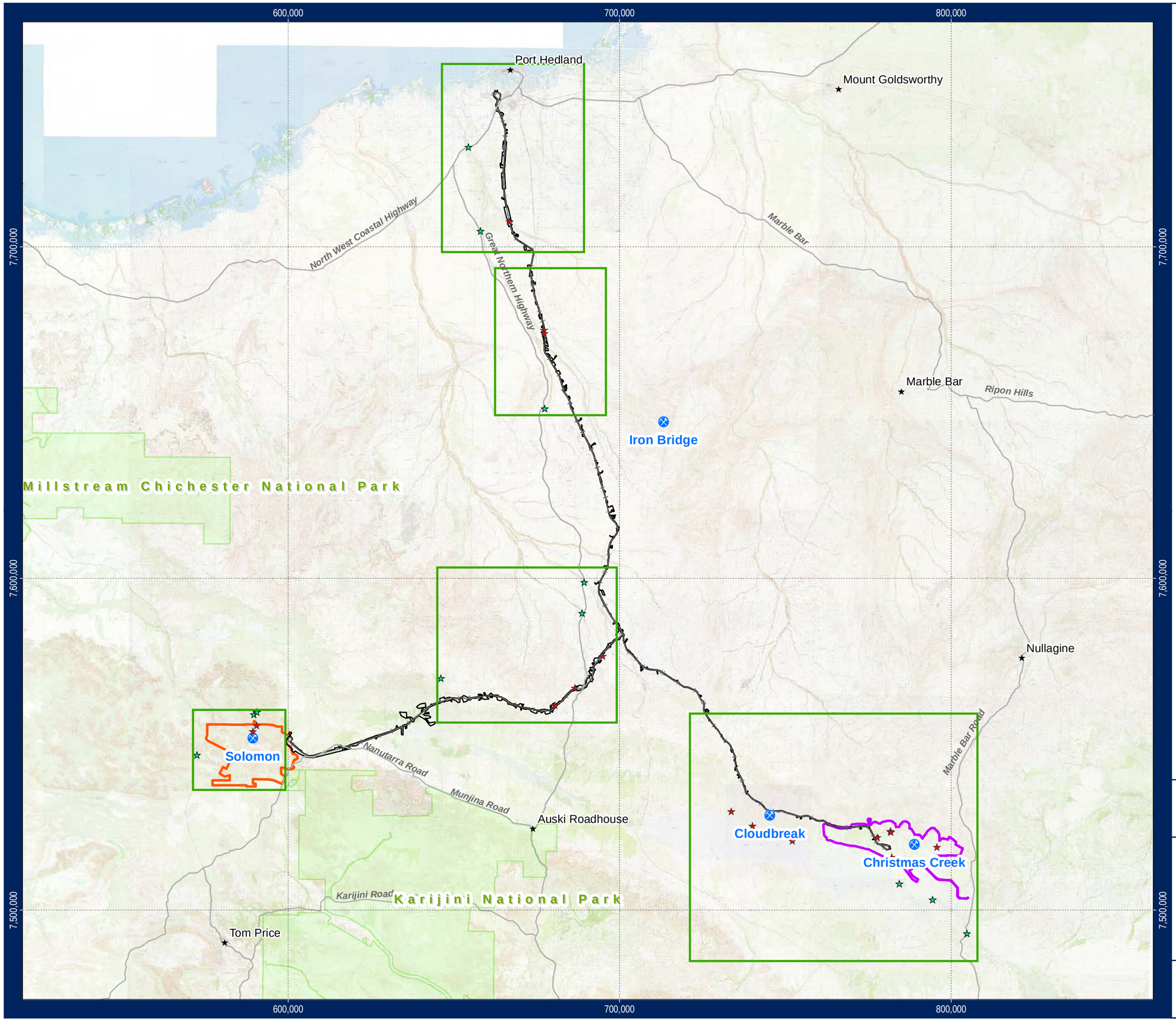
Requested By: O. Hertsted
Drawn By: N. Rappa
Revised By: sanli
Approved By: P. Mastalir
Scale: 1:275,000
Coordinate System: GDA 1994 MGA Zone 50
Document Name: 751EW_MP_EN_0031.005_r0_python

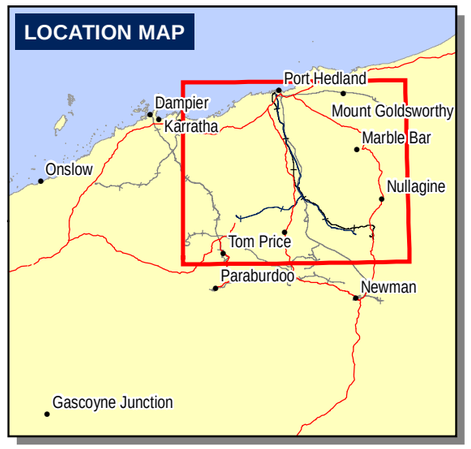
Date: 5/05/2020
Size: A3L
Revision: 0
Confidentiality: 1

FMG accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose.

FMG Fortescue

FIGURE 24 CONSERVATION SIGNIFICANT BIRDS MONITORING SITES – REGIONAL OVERVIEW





LEGEND

- Bird Monitoring Sites - Impact
- Bird Monitoring Sites - Reference
- Towns
- FMG Mine
- Roads
- FMG Rail Alignments
- FMG Rail Corridors
- Christmas Creek Mine
- Solomon Mine
- National Park
- Map Index

Data Sources:
Roads, Landgate, 2012
Topography, Geoscience Australia
All other data, FMG, 2018

N

0 10 20 30 40 50
Kilometres

Fauna Monitoring
Birds

Requested By: Todd Edwards
Drawn By: H. Wallace
Revised By: scostello
Approved By: P.M.
Scale: 1:1,100,000
Coordinate System: GDA 1994 MGA Zone 50
Document Name: 045_MP_EN_0090.026_r1_Overview_Birds

Date: 11-Oct-18
Size: A3L
Revision: 0
Confidentiality: 1

FMG accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose.

Fortescue Metals Group Ltd
The New Force in Iron Ore

FIGURE 25 CONSERVATION SIGNIFICANT BIRDS MONITORING SITES – CHRISTMAS CREEK AND CLOUDBREAK MINES

730,000 740,000 750,000 760,000 770,000 780,000 790,000 800,000

7,550,000 7,540,000 7,530,000 7,520,000 7,510,000 7,500,000 7,490,000

Cloudbreak

Christmas Creek

LOCATION MAP

Marble Bar
Nullagine
Auski Roadhouse
Tom Price
Newman

LEGEND

Significant Fauna Records

- Common Greenshank
- Common Sandpiper
- Fork-tailed Swift
- Grey Falcon
- Peregrine Falcon
- Wood Sandpiper

Bird Monitoring Sites

- Impact
- Reference
- FMG Mine
- Roads
- FMG Rail Alignments
- FMG Rail Corridors
- Christmas Creek Mine
- Cloudbreak Mine
- Significant Fauna Habitat - Birds

Data Source(s):
Roads, Landgate, 2012
Topography, Geoscience Australia
All other data, FMG, 2018

N

0 5 10 15
Kilometres

Fauna Monitoring: Birds

Christmas Creek & Cloudbreak Mines

Requested By: Olivia Hertsted
Drawn By: H. Wallace
Revised By: hwallace
Approved By: P.M.
Scale: 1:280,000
Coordinate System: GDA 1994 MGA Zone 50
Document Name: 045_MP_EN_0090.018_r1

Date: 16-Feb-18
Size: A3L
Revision: 1
Confidentiality: 1

FMG accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose.

Fortescue Metals Group Ltd
The New Force in Iron Ore

FIGURE 26 CONSERVATION SIGNIFICANT BIRDS MONITORING SITES – MAIN LINE RAIL SITE 1

650,000 660,000 670,000 680,000

7,750,000 7,740,000 7,730,000 7,720,000 7,710,000 7,700,000

Port Hedland



LEGEND

Significant Fauna Records
- Common Greenshank
- Common Sandpiper
- Fork-tailed Swift
- Grey Falcon
- Peregrine Falcon
- Wood Sandpiper

Bird Monitoring Sites
- Impact
- Reference
- Towns
- Roads
- FMG Rail Alignments
- FMG Rail Corridors
- Significant Fauna Habitat - Birds

650,000 660,000 670,000 680,000

Data Source(s):
Roads, Landgate, 2012
Topography, Geoscience Australia
All other data, FMG, 2018

N

0 2 4 6 8 10
Kilometres

Requested By: Olivia Hertsted
Drawn By: H. Wallace
Revised By: hwallace
Approved By: P.M.
Scale: 1:160,000
Coordinate System: GDA 1994 MGA Zone 50
Document Name: 045_MP_EN_0090.019_r0

Date: 12-Feb-18
Size: A3P
Revision: 0
Confidentiality: 1

FMG accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose.

Fauna Monitoring: Birds

Mainline Rail (Including duplication)

Fortescue Metals Group Ltd
The New Force in Iron Ore

FIGURE 27 CONSERVATION SIGNIFICANT BIRDS MONITORING SITES – MAIN LINE RAIL SITE 2

670,000 680,000 690,000

7,690,000 7,680,000 7,670,000 7,660,000 7,650,000



LEGEND

Significant Fauna Records

- Common Greenshank
- Common Sandpiper
- Fork-tailed Swift
- Grey Falcon
- Peregrine Falcon
- Wood Sandpiper

Bird Monitoring Sites

- Impact
- Reference
- Roads
- FMG Rail Alignments
- FMG Rail Corridors
- Significant Fauna Habitat - Birds

670,000 680,000 690,000

Data Source(s):
Roads, Landgate, 2012
Topography, Geoscience Australia
All other data, FMG, 2018

N

0 2 4 6 8 10
Kilometres

Requested By: Olivia Hertsted
Drawn By: H. Wallace
Revised By: hwallace
Approved By: P.M.
Scale: 1:125,000
Coordinate System: GDA 1994 MGA Zone 50
Document Name: 045_MP_EN_0090.020_r0

Date: 12-Feb-18
Size: A3P
Revision: 0
Confidentiality: 1

FMG accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose.

Fauna Monitoring: Birds

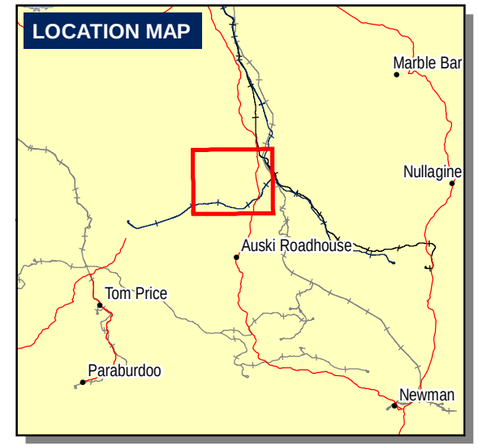
Mainline Rail (Including duplication)

Fortescue Metals Group Ltd
The New Force in Iron Ore

FIGURE 28 CONSERVATION SIGNIFICANT BIRDS MONITORING SITES – MAIN LINE AND HAMERSLEY RAIL

650,000 660,000 670,000 680,000 690,000

7,600,000 7,590,000 7,580,000 7,570,000 7,560,000



LEGEND

Significant Fauna Records

- Common Greenshank
- Common Sandpiper
- Fork-tailed Swift
- Grey Falcon
- Peregrine Falcon
- Wood Sandpiper

Bird Monitoring Sites

- Impact
- Reference
- Roads
- FMG Rail Alignments
- FMG Rail Corridors
- Significant Fauna Habitat - Birds

Data Source(s):
Roads, Landgate, 2012
Topography, Geoscience Australia
All other data, FMG, 2018

N

0 2 4 6 8 10
Kilometres

Fauna Monitoring: Birds
Hamersley Rail Line

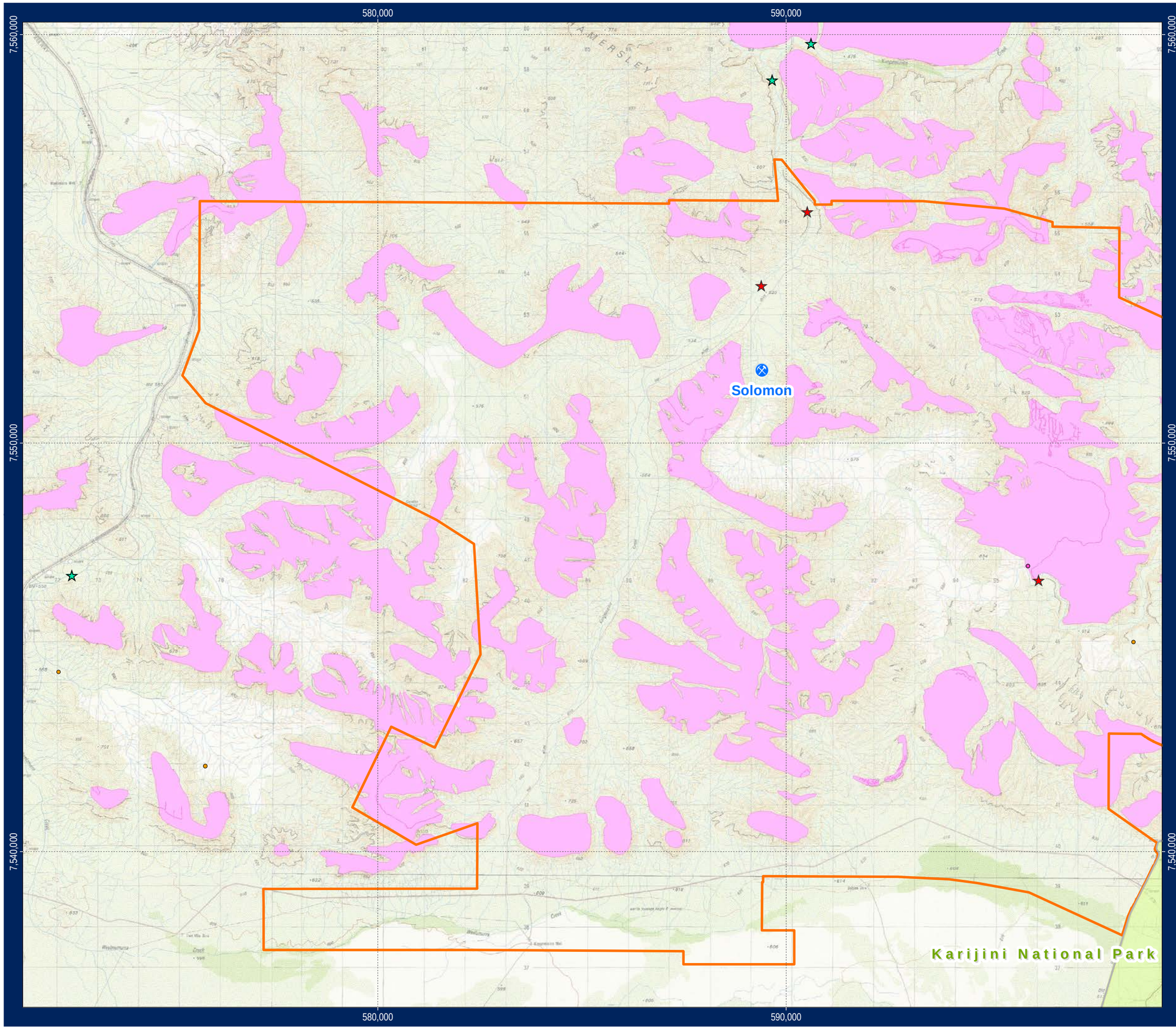
Requested By: Olivia Hertsted
Drawn By: H. Wallace
Revised By: hwallace
Approved By: P.M.
Scale: 1:175,000
Coordinate System: GDA 1994 MGA Zone 50
Document Name: 045_MP_EN_0090.017_r1

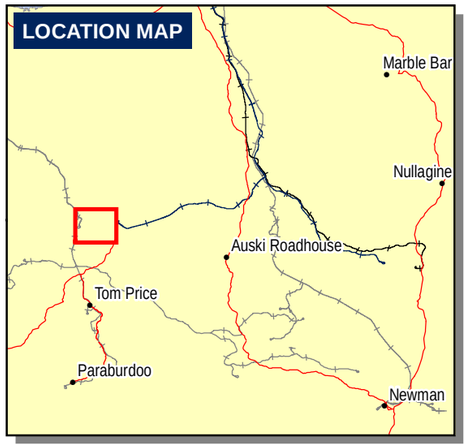
Date: 16-Feb-18
Size: A3L
Revision: 1
Confidentiality: 1

FMG accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose.

Fortescue Metals Group Ltd
The New Force in Iron Ore

FIGURE 29 CONSERVATION SIGNIFICANT BIRDS MONITORING SITES – SOLOMON MINE





LEGEND

Significant Fauna Records

- Common Greenshank
- Common Sandpiper
- Fork-tailed Swift
- Grey Falcon
- Peregrine Falcon
- Wood Sandpiper

Bird Monitoring Sites

- Impact
- Reference
- FMG Mine
- Roads
- Solomon Mine
- Significant Fauna Habitat - Birds
- National Park

Data Source(s):
Roads, Landgate, 2012
Topography, Geoscience Australia
All other data, FMG, 2018

N

0 1 2 3 4 5
Kilometres

Fauna Monitoring: Birds
Solomon Mine

Requested By: Olivia Hertsted
Drawn By: H. Wallace
Revised By: hwallace
Approved By: P.M.
Scale: 1:90,000
Coordinate System: GDA 1994 MGA Zone 50
Document Name: 045_MP_EN_0090.021_r1

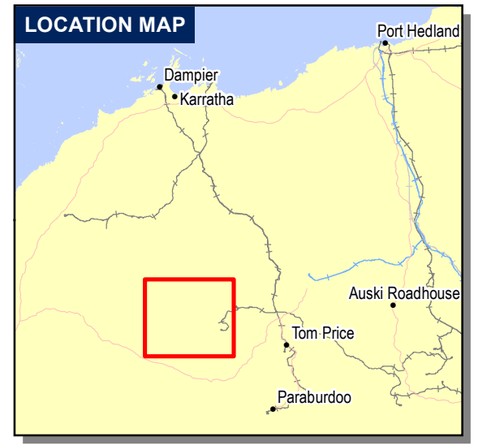
Date: 27-Apr-18
Size: A3L
Revision: 1
Confidentiality: 1

FMG accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose.

Fortescue Metals Group Ltd
The New Force in Iron Ore

FIGURE 30 CONSERVATION SIGNIFICANT BIRDS MONITORING SITES – ELIWANA MINE

460,000
480,000
500,000
520,000
7,540,000
7,520,000
7,500,000



LEGEND

- Mine Development Envelope
- Excess Water Discharge Extent

Significant Fauna Monitoring Sites

- Migratory Birds; Impact
- Migratory Birds; Reference

Significant Fauna Records

- Peregrine Falcon
- Significant Fauna Habitat
- Eliwana Indicative Mine Footprint

Data Sources:
SRTM, GA
All other data; FMG, 2020

0 5 10
Kilometres

N

Conservation Significant Fauna Monitoring Sites - Significant Birds Eliwana Mine

Requested By: O. Hertsted
Drawn By: N. Rappa
Revised By: sanli
Approved By: P. Mastalir
Scale: 1:250,000
Coordinate System: GDA 1994 MGA Zone 50
Document Name: 751EW_MP_EN_0031.003_r0_sig_bird

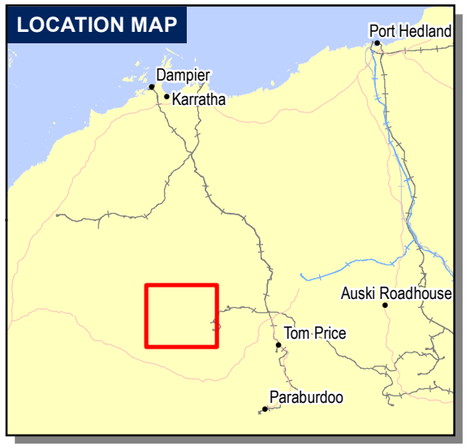
Date: 5/05/2020
Size: A3L
Revision: 2
Confidentiality: 1

FMG accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose.

FMG Fortescue

FIGURE 31 *SRE ANTICHIROPUS* 1021DNA02 SITE RECORD – ELIWANA MINE

480,000
500,000
520,000
7,540,000
7,520,000
7,500,000



LEGEND

- Mine Development Envelope
- Excess Water Discharge Extent

Significant Fauna Records

- SRE Antichiropus 1021DNA02
- Significant Fauna Habitat
- Eliwana Indicative Mine Footprint

Data Sources:
SRTM, GA
All other data; FMG, 2020

0 5 10
Kilometres

N

Conservation Significant Fauna - SRE *Antichiropus* 1021DNA02 - Eliwana Mine

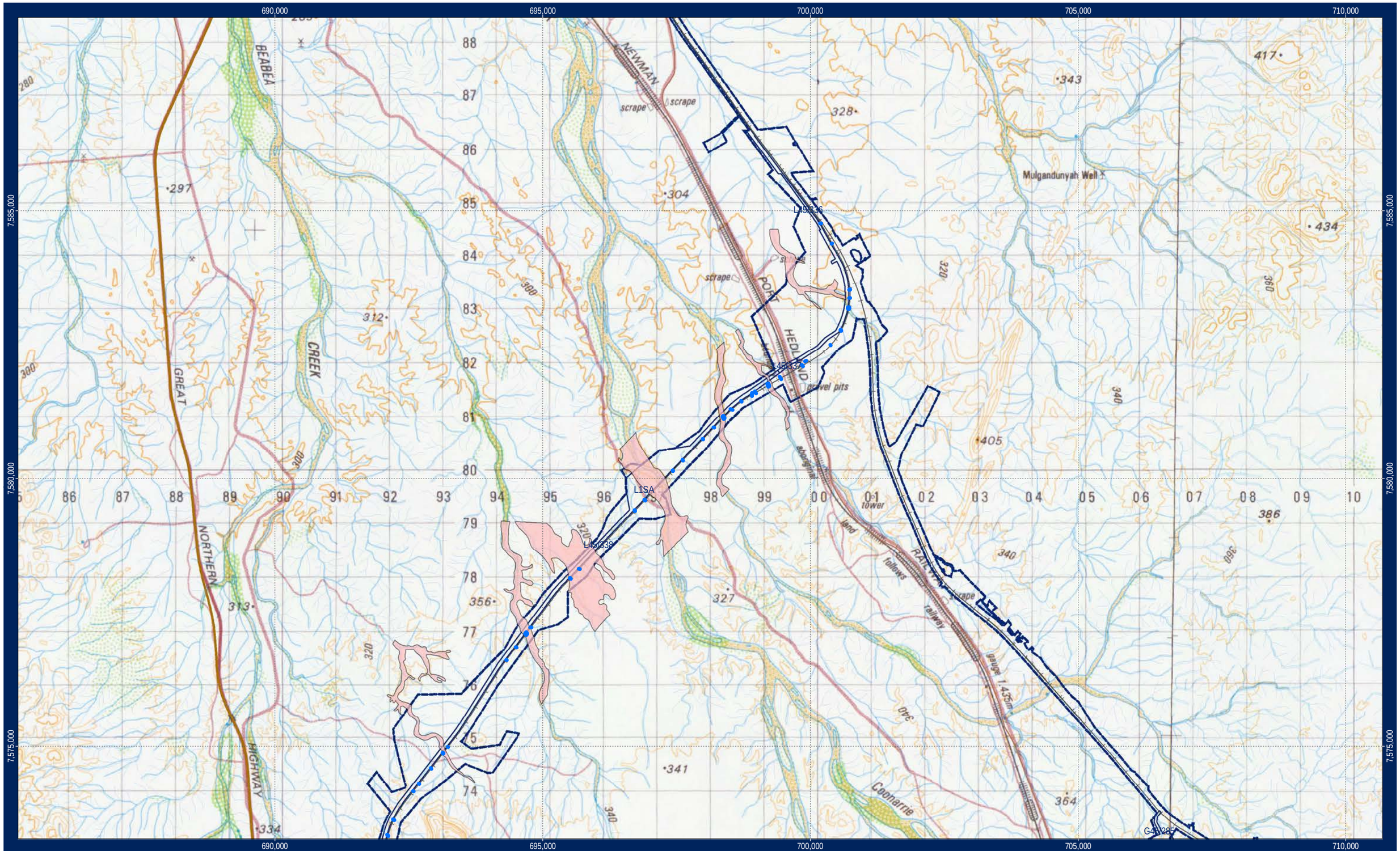
Requested By: O. Hertsted
Drawn By: N. Rappa
Revised By: sanli
Approved By: P. Mastalir
Scale: 1:200,000
Coordinate System: GDA 1994 MGA Zone 50
Document Name: 751EW_MP_EN_0031.006_r0_sre

Date: 5/05/2020
Size: A3L
Revision: 0
Confidentiality: 1

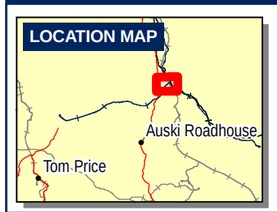
FMG accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose.

FMG Fortescue

FIGURE 32 CULVERT LOCATIONS ON THE HAMERSLEY LINE WITHIN NORTHERN QUOLL HABITAT



LOCATION MAP



LEGEND

- 50k Drainage Pilbara
- FMG Rail Culverts
- FMG Rail Alignments
- Northern Quoll Habitat
- FMG Rail Corridors
- FMG Tenements

Data Source(s):
Aerial Imagery: Landgate
All other data: FMG, 2018

N

0 1 2 3 4
Kilometres

Requested By: O. Hertsted
Drawn By: S. Roestenburg
Revised By: sroestenburg
Approved By:P. Mastalir
Scale: 1:65,000
Coordinate System: GDA 1994 MGA Zone 50
Document Name: R_MP_EN_0049.001_r1

Date: 4/23/2018
Size: A3L
Revision: 1
Confidentiality: 1
Page 1 of 7

INTERNAL USE ONLY

FMG accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose.

Culvert locations within Northern Quoll Habitat Hamersley Rail

Fortescue Metals Group Ltd
The New Force in Iron Ore

680,000 685,000 690,000 695,000 700,000 705,000

7,575,000 7,570,000 7,565,000

L45/339 L45/340 L45/348

487 COOLETHA HILL

Coonarrie Creek

Beabea Creek

NORTHERN HIGHWAY

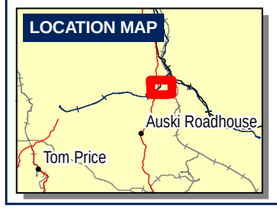
boundary of aboriginal land

bore (capped)

quarry

falls

black rock



LEGEND

- 50k Drainage Pilbara
- FMG Rail Culverts
- FMG Rail Alignments
- Northern Quoll Habitat
- FMG Rail Corridors
- FMG Tenements

Data Source(s):
Aerial Imagery: Landgate
All other data: FMG, 2018

N

0 1 2 3 4
Kilometres

Requested By: O. Hertsted
Drawn By: S. Roestenburg
Revised By: sroestenburg
Approved By:P. Mastalir
Scale: 1:65,000
Coordinate System: GDA 1994 MGA Zone 50
Document Name: R_MP_EN_0049.001_r1

Date: 4/23/2018
Size: A3L
Revision: 1
Confidentiality: 1

INTERNAL USE ONLY

FMG accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose.

Culvert locations within Northern Quoll Habitat Hamersley Rail

Fortescue Metals Group Ltd
The New Force in Iron Ore

665,000 670,000 675,000 680,000 685,000

7,565,000 7,560,000 7,555,000

L45/338 L45/339 L45/348 L45/340 L1SA E45/2497

Wall Creek Waterhole

black rock outcrops

Cockeraga

Creek

Wall

RIVER

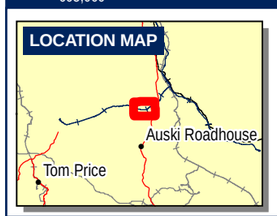
GREAT NORTHERN HIGHWAY

bore (capped)

landing (disused)

scrape

RANGE



LEGEND

- 50k Drainage Pilbara
- FMG Rail Culverts
- FMG Rail Alignments
- Northern Quoll Habitat
- FMG Rail Corridors
- FMG Tenements

Data Source(s):
Aerial Imagery: Landgate
All other data: FMG, 2018

N

0 1 2 3 4
Kilometres

Requested By: O. Hertsted
Drawn By: S. Roestenburg
Revised By: sroestenburg
Approved By:P. Mastalir
Scale: 1:65,000
Coordinate System: GDA 1994 MGA Zone 50
Document Name: R_MP_EN_0049.001_r1

FMG accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose.

INTERNAL USE ONLY

Date: 4/23/2018
Size: A3L
Revision: 1
Confidentiality: 1

Culvert locations within Northern Quoll Habitat Hamersley Rail

Fortescue Metals Group Ltd
The New Force in Iron Ore

650,000 655,000 660,000 665,000 670,000

7,570,000

7,565,000

7,560,000

CHICHESTER RANGE

CHICHESTER RANGE

Ebra Baranna Pool

landing ground (abandoned)

Wall Creek

Wall Creek Waterhole

landing ground (disused)

PEAK HESTER ▲ 507

E47/3397

L1SA

E47/1016

R47/14

SM17

LOCATION MAP

Auski Roadhouse

Tom Price

LEGEND

- 50k Drainage Pilbara
- FMG Rail Culverts
- FMG Rail Alignments
- Northern Quoll Habitat
- FMG Rail Corridors
- FMG Tenements

Data Source(s):
Aerial Imagery: Landgate
All other data: FMG, 2018

N

0 1 2 3 4
Kilometres

Requested By: O. Hertsted
Drawn By: S. Roestenburg
Revised By: sroestenburg
Approved By:P. Mastalir
Scale: 1:65,000
Coordinate System: GDA 1994 MGA Zone 50
Document Name: R_MP_EN_0049.001_r1

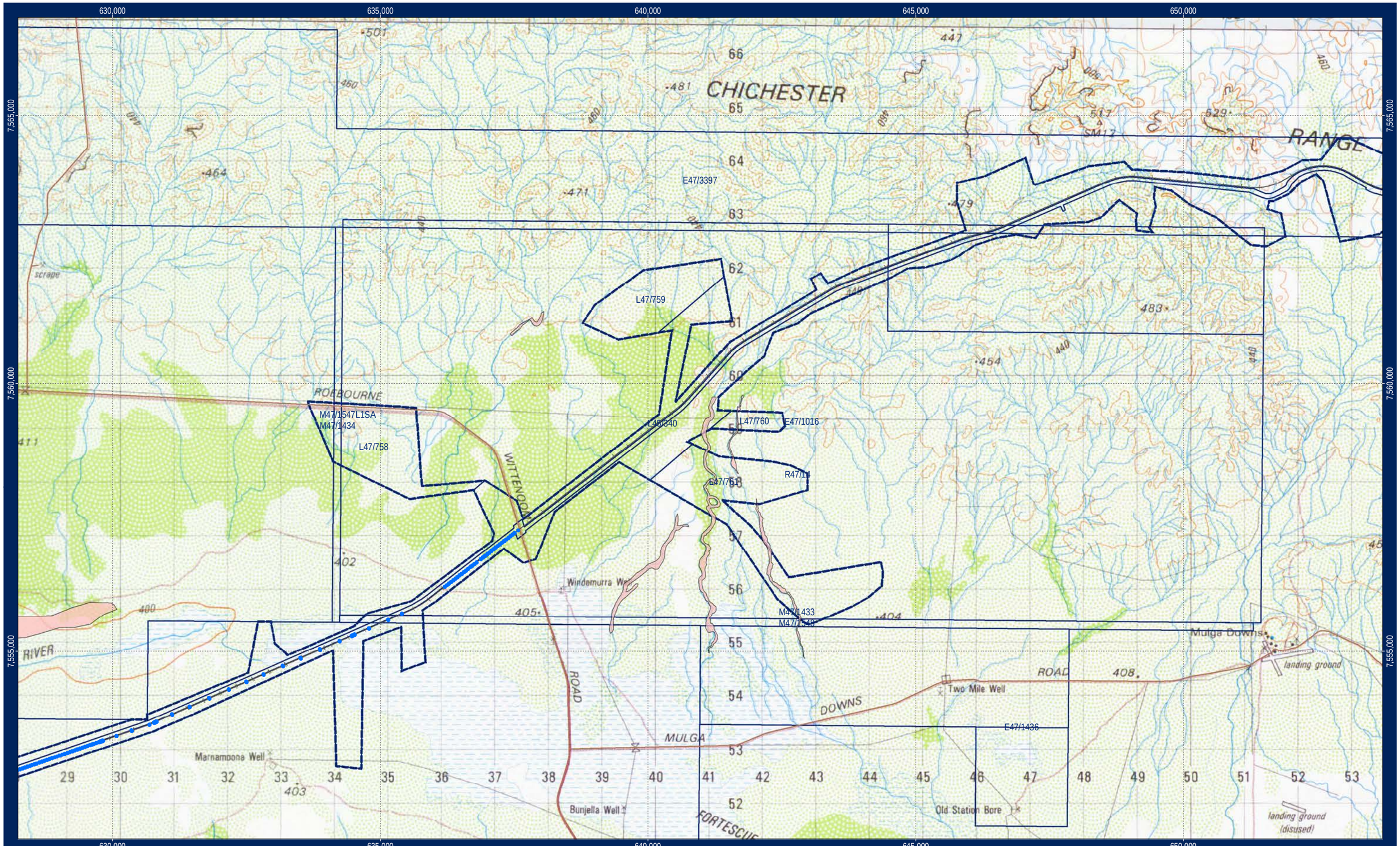
Date: 4/23/2018
Size: A3L
Revision: 1
Confidentiality: 1
Page 4 of 7

INTERNAL USE ONLY

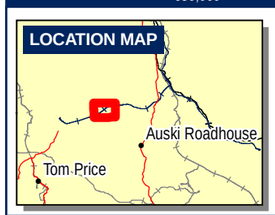
FMG accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose.

Culvert locations within Northern Quoll Habitat Hamersley Rail

Fortescue Metals Group Ltd
The New Force in Iron Ore



LOCATION MAP



LEGEND

- 50k Drainage Pilbara
- FMG Rail Culverts
- FMG Rail Alignments
- Northern Quoll Habitat
- FMG Rail Corridors
- FMG Tenements

Data Source(s):
Aerial Imagery: Landgate
All other data: FMG, 2018

N

0 1 2 3 4
Kilometres

Requested By: O. Hertsted
Drawn By: S. Roestenburg
Revised By: sroestenburg
Approved By:P. Mastalir
Scale: 1:65,000
Coordinate System: GDA 1994 MGA Zone 50
Document Name: R_MP_EN_0049.001_r1

INTERNAL USE ONLY

Date: 4/23/2018
Size: A3L
Revision: 1
Confidentiality: 1

Culvert locations within Northern Quoll Habitat Hamersley Rail

Fortescue Metals Group Ltd
The New Force in Iron Ore

FMG accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose.

615,000 620,000 625,000 630,000 635,000

7,555,000

7,550,000

7,545,000

L47/758

M47/1547 E47/1016
M47/1434 R47/14

M47/1548 M47/1429

L45/340

E47/1436

L47/1695

E47/1399

L47/361

L47/696

L47/697

M47/1481

Boundary Well

Nemunarrana Well

Powellinna Pool

Marnampoona Well

Mount King Well

Range Bore (abandoned)

bore

Lottys Well

landing ground

FORTESCUE RIVER

WITTENOOM ROAD

NANUTARRA WITTENOOM ROAD

Mount King

Gorge

399 400 401 402 403 405 409 414 417 424 428 433 434 444 455 709 725

10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35

44 45 46 47 48 49 50 51 52 53 54 55 56 57 58

615,000 620,000 625,000 630,000 635,000

LOCATION MAP

Auski Roadhouse

Tom Price

LEGEND

- 50k Drainage Pilbara
- FMG Rail Culverts
- FMG Rail Alignments
- Northern Quoll Habitat
- FMG Rail Corridors
- FMG Tenements

Data Source(s):
Aerial Imagery: Landgate
All other data: FMG, 2018

N

0 1 2 3 4
Kilometres

Requested By: O. Hertsted
Drawn By: S. Roestenburg
Revised By: sroestenburg
Approved By:P. Mastalir
Scale: 1:65,000
Coordinate System: GDA 1994 MGA Zone 50
Document Name: R_MP_EN_0049.001_r1

Date: 4/23/2018
Size: A3L
Revision: 1
Confidentiality: 1

INTERNAL USE ONLY

FMG accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose.

Culvert locations within Northern Quoll Habitat Hamersley Rail

Fortescue Metals Group Ltd
The New Force in Iron Ore

595,000 600,000 605,000 610,000 615,000

7,555,000 7,550,000 7,545,000

M47/1549 M47/1473 E47/1447 M47/1546 M47/1413 L47/362 M47/1431 M47/1545 M47/1453 L47/363 E47/3762 M47/1543 M47/1570 M47/1569 M47/1513 L47/367 L47/814 E47/1334 L47/472 M47/1542 M47/1409 L47/813 M47/1550 M47/1474 L47/801 E47/1334 E47/3464 L47/381 L47/294 L47/687 L47/361 L47/606 L15A M47/1481 E47/1398 E47/1399

RANGE ROAD NANUTARRA WITTENOOM Mount King Range Bore (abandoned) Deep Well (abandoned) Tripod Well (abandoned) bore Fortescue River Gorge Rio Tinto Gorge

LOCATION MAP

Auski Roadhouse

Tom Price

LEGEND

- 50k Drainage Pilbara
- FMG Rail Culverts
- FMG Rail Alignments
- Northern Quoll Habitat
- FMG Rail Corridors
- FMG Tenements

Data Source(s):
Aerial Imagery: Landgate
All other data: FMG, 2018

N

0 1 2 3 4
Kilometres

Requested By: O. Hertsted
Drawn By: S. Roestenburg
Revised By: sroestenburg
Approved By:P. Mastalir
Scale: 1:65,000
Coordinate System: GDA 1994 MGA Zone 50
Document Name: R_MP_EN_0049.001_r1

Date: 4/23/2018
Size: A3L
Revision: 1
Confidentiality: 1

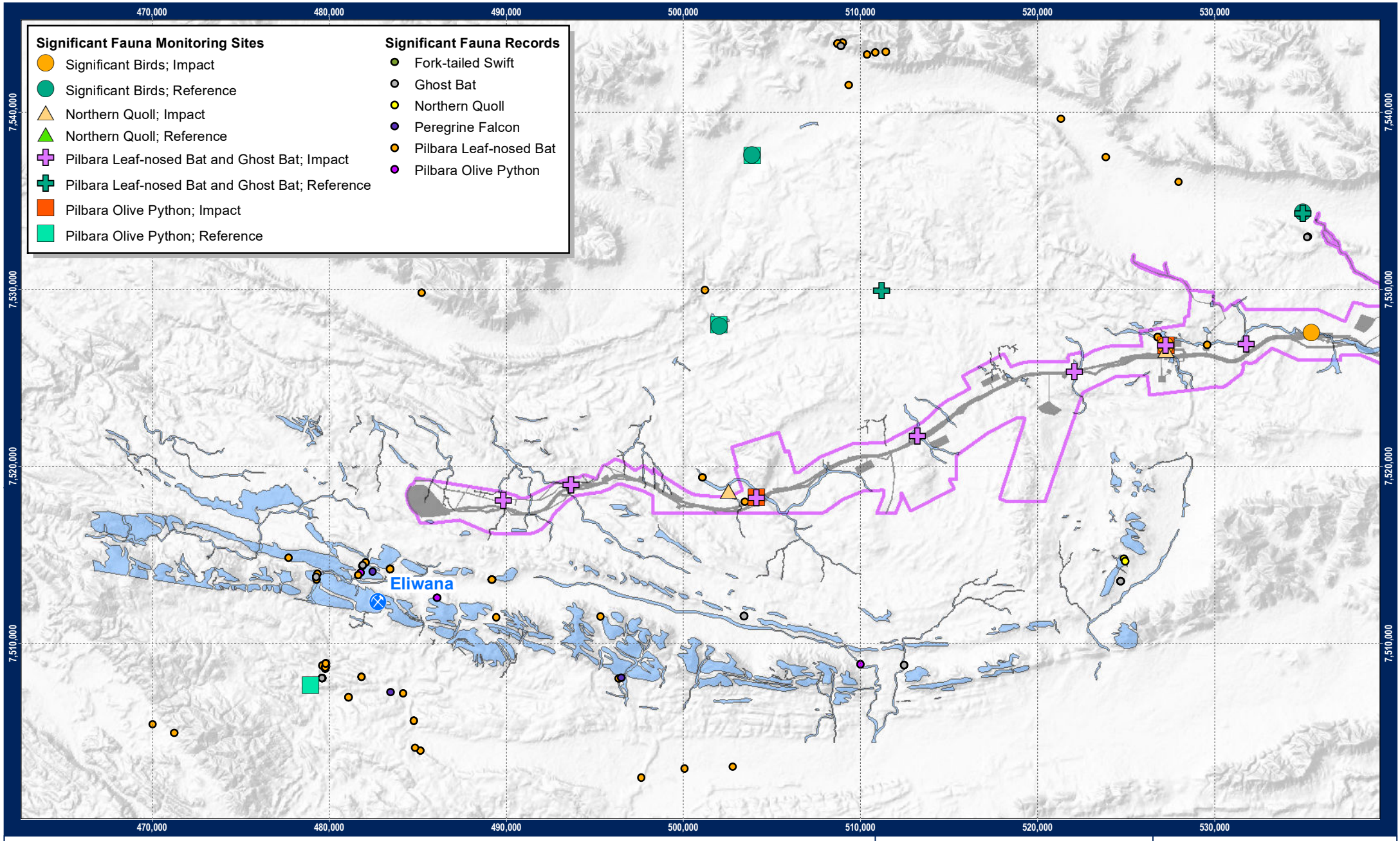
INTERNAL USE ONLY

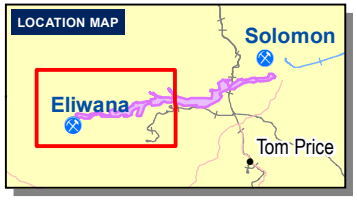
FMG accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose.

Culvert locations within Northern Quoll Habitat Hamersley Rail

Fortescue Metals Group Ltd
The New Force in Iron Ore

FIGURE 33 CONSERVATION SIGNIFICANT FAUNA MONITORING SITES – ELIWANA RAIL





LEGEND

- Fortescue Projects
- Rail Development Envelope
- Eliwana Rail Indicative Footprint
- Significant Fauna Habitat

Data Source(s):
SRTM, GA
All other data, FMG, 2020

N

0 2 4 6 8 10
Kilometres

Requested By: O. Hertsted
Drawn By: P. Kulkarni
Revised By: sanli
Approved By: P. Masalir
Scale: 1:275,000
Coordinate System: GDA 1994 MGA Zone 50
Document Name: 751ES_MP_EN_0009.001_r3

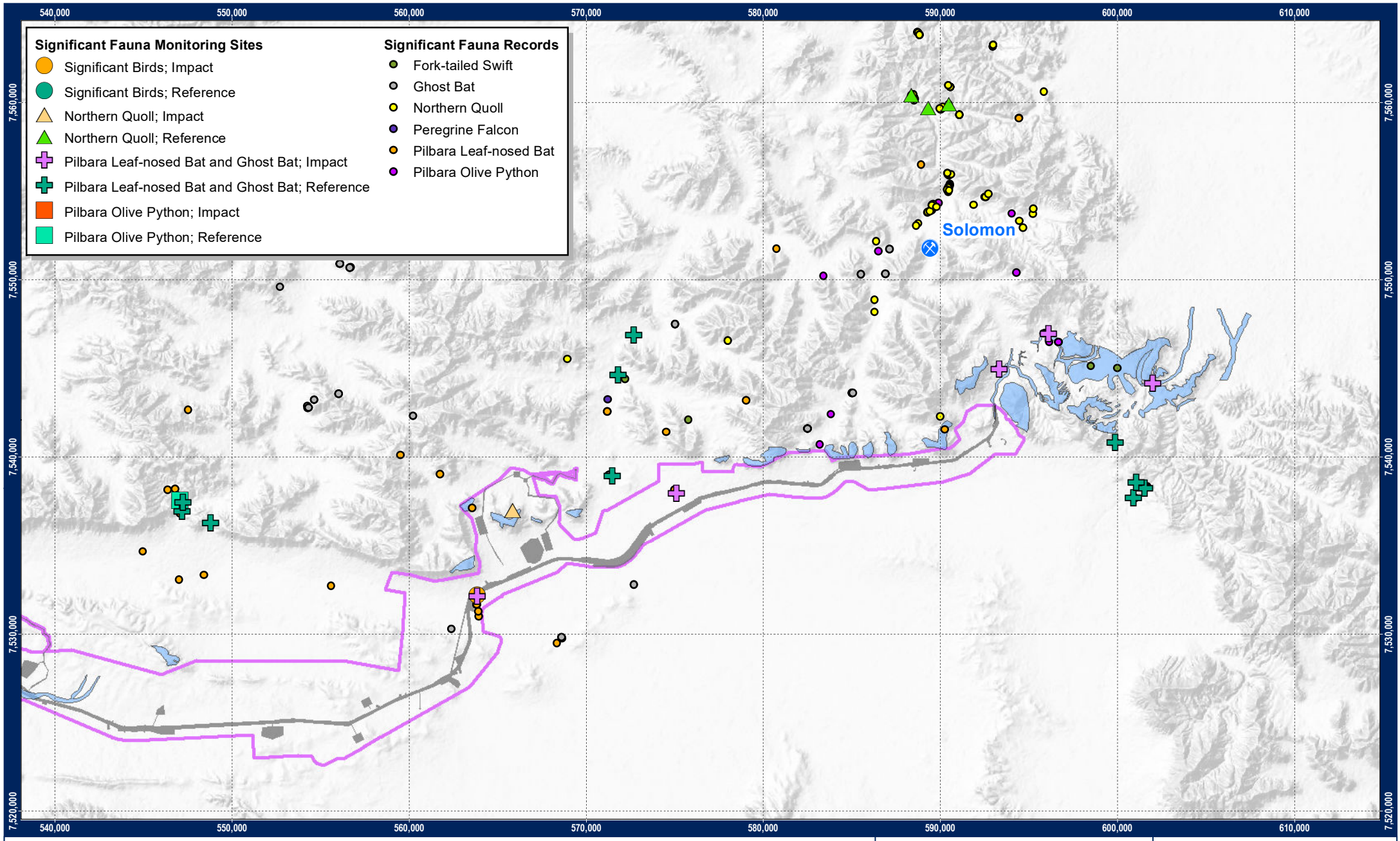
Date: 5/05/2020
Size: A4L
Revision: 3
Confidentiality: 1

FMG accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose.

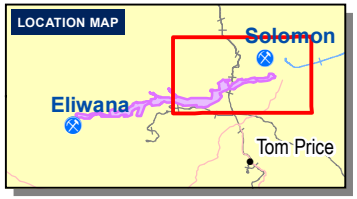
Conservation Significant Fauna Monitoring Sites Eliwana Rail

Map 1

Fortescue



LOCATION MAP



LEGEND

- Fortescue Projects
- Rail Development Envelope
- Eliwana Rail Indicative Footprint
- Significant Fauna Habitat

Data Source(s):
SRTM, GA
All other data, FMG, 2020

N

0 2 4 6 8 10
Kilometres

Requested By: O. Hertsted
Drawn By: P. Kulkarni
Revised By: sanli
Approved By: P. Masalir
Scale: 1:275,000
Coordinate System: GDA 1994 MGA Zone 50
Document Name: 751ES_MP_EN_0009.002_r3

Date: 5/05/2020
Size: A4L
Revision: 3
Confidentiality: 1

FMG accepts no liability and gives no representation or warranty, express or implied, as to the information provided including its accuracy, completeness, merchantability or fitness for purpose.

Conservation Significant Fauna Monitoring Sites Eliwana Rail

Map 2

Fortescue

Appendix 8: Ground Disturbance and Topsoil Management (IO-PR-EN-0010)

Procedure

Ground Disturbance and Topsoil Management

Environment

6/02/2023

IO-PR-EN-0010

Revision 0

This document is protected by copyright, no part of this document may be reproduced or adapted without the consent of the originator/company owner, all rights are reserved.

Table of contents

1 PURPOSE 3
1.1 Background 3
1.2 Application 3
2 PROCEDURE 4
3 GUIDELINES 5
3.1 Mine planning 5
3.2 Marking out areas to be cleared 5
3.3 Clearing requirements 5
3.4 Stockpiling of cleared materials 6
3.5 Stockpile management 7
4 MONITORING AND REVIEW 8
5 REFERENCES 9
APPENDIX A LEGISLATIVE CONTEXT 11

List of tables

Table 1: Procedure 4
Table 2: Programmes and Schedules 8
Table 3: Legislation 11

1 Purpose

The procedure provides detail on the process to undertake ground disturbance to ensure topsoil and cleared vegetation is effectively managed as a resource to be used during rehabilitation and mine closure activities.

1.1 Background

Progressive rehabilitation activities need to be integrated into daily mining operations to ensure availability and volumes of key materials (e.g. topsoil, subsoil and cleared vegetation) required for rehabilitation. These materials should be respread over disturbed areas in order to aid in regrowth and habitat establishment.

Topsoil refers to the biologically active upper layer of soil depths typically between 0 to 200 mm. Subsoil refers to soil depths between 200 – 1500 mm. Cleared vegetation that is required to be stockpiled include trees and shrubs at heights greater than 2 metres.

Fortescue employees and contractors are obliged to comply with all relevant environmental Commonwealth and State legislation. Legislation directly relevant to ground disturbance and topsoil management in Western Australia is provided in Appendix A.

Definitions of terms and acronyms used throughout this procedure are provided in the *Definitions and Acronyms Guideline* (IO-GU-EN-0002).

1.2 Application

This procedure is required to be followed for ground disturbance and topsoil management that occurs at all Fortescue Iron Ore (WA) Project and Operational Sites.

Exclusions to the procedure are:

- Ground disturbance and topsoil management activities undertaken for exploration purposes. Refer to the *Exploration Environmental Management Plan* (E-PL-EN-0002).

2 Procedure

The procedure below is to be followed to ensure that only essential ground disturbance is undertaken and all available topsoil material is harvested and stockpiled for use during rehabilitation and mine closure activities.

Table 1: Procedure

Responsibility	Steps (tasks)	Refer guideline
LUC Applicant	*1.* Obtain a LUC prior to ground disturbance in accordance with the *Land Use Certificate Procedure (*100-PR-TA-0001).	-
Site Environment team	2. Assess the LUC for approval in accordance with the *Environmental Approval of Land Use Certificates* (100-PR-EN-1058) and condition the LUC with clearing and topsoil requirements.	-
Mine Planning	3. Where the ground disturbance activity is on a mine site, factor in ground disturbance and topsoil management requirements into the 3 Month Mine Plan.	3.1
Area Supervisor	4. Ensure areas to be cleared are clearly marked by either: • Machinery fitted with GPS Machine Guidance System (i.e. EEMIS, Mine Star, Jigsaw), or if unavailable, • Engage a Mine Surveyor to physically mark out the LUC boundary with designated flagging tape.	3.2
Area Supervisor	5. Ensure ground disturbance is undertaken in accordance with the specified clearing requirements.	3.3
	6. Ensure cleared materials are stockpiled in accordance with the specified stockpiling requirements.	3.4
LUC Applicant	7. When ground disturbance is complete, undertake the LUC close out process in accordance with the *Land Use Certification Procedure* (100-PR-TA-0001).	-
Environment Operations team	8. Undertake onsite monitoring and maintenance of existing stockpiles for site specific criteria in accordance with *Undertaking Environmental Inspections* (100-PR-EN-1067).	3.5
	9. Assess ongoing compliance with environmental obligations related to ground disturbance and topsoil management in accordance with *Environmental Approval Compliance* (IO-PR-EN-0004).	-
Area Supervisor	10. Report incidents within BMS in accordance with the *Incident Event Management Procedure* (45-PR-SA-0080).	-

3 Guidelines

3.1 Mine planning

Where the ground disturbance activity is on a mine site the Mine Planning team must:

- Include soil movement and storage locations in the 3 Month Mine Plan (3MMP).
- Where practicable, plan to return stripped topsoil directly to a rehabilitation area. Where the topsoil must be stockpiled, plan to store the soil for the shortest possible time.
- Define where subsoil is available (detailed within the relevant Mine Closure Plan) and required to be stockpiled separately for use during rehabilitation activities.
- Define where rock is available (detailed in the relevant Mine Closure Plan) and required to be stockpiled separately for use during rehabilitation activities as landform armouring material within the Mine Plan.

3.2 Marking out areas to be cleared

- Areas to be cleared shall be clearly marked by ground disturbance machinery fitted with GPS Machine Guidance System (i.e. EEMIS, Mine Star, Jigsaw).
- Ensure any heritage and/or environmental constraints (including conditional mark-ups) shown on the LUC map are identified in the machines guidance system files. If the GPS file does not include all of the relevant constraints or there are further queries on the identified constraints, contact the heritage and/or environmental approver listed on the LUC.
- Where ground disturbance is undertaken by machinery without GPS Machine Guidance System, a Mine Surveyor must be engaged to physically mark out the LUC boundary. Designated flagging tape must be used (e.g. pink flagging to designate the LUC boundary, white flagging to designate the clearing extents inside the LUC).
- Mark out any areas inside the LUC boundary known to have populations of priority weed species with green and white environment tape to avoid the spread of weeds.

3.3 Clearing requirements

- The person undertaking the ground disturbing activity must have a printed copy of the LUC available whilst undertaking the clearing, or must have access to a digital version of the LUC.
- Ground disturbance must be minimised as much as practical. Mature (habitat) trees and termite mounds must be avoided where possible.
- A minimum of 100 mm of topsoil shall be cleared for use in rehabilitation activities. This includes any areas where plant growth is observed, including rocky soils. Only areas that are entirely comprised of rock with no plant material are exempt from clearing. Alternatively, rocks may be stockpiled where required. Where a site

procedure or contract specifies a clearing depth greater than the minimum standard, the site or contract requirement should be adhered to.

- Where the ground disturbance activity includes clearing vegetation that is greater than 2 metres in height, the vegetation should be cleared and stored separately to topsoil.

- Vegetation and soil from weed affected areas should be cleared separately and buried to minimise the occurrence of re-emergence. Where the soil is unable to be buried, it should be managed to minimise the potential spread of weeds.

- If the area to be cleared is on a steep incline and unable to be safely accessed by machinery, clearing should not be undertaken. As general guidance from the DMIRS Mines Safety Directorate (Our Ref: 661MI-EN-0063), slopes greater than 45° are considered unsafe. When slopes are less than 45°, clearing should be planned to be undertaken unless site specific conditions, such as sandy, slippery soil are assessed as unsafe. The justification and any evidence for not undertaking the clearing activity must be provided to the site Environment team prior to completion of clearing and must also be uploaded in the LUC record when undertaking the LUC close out process.

- Where topsoil is unable to be safely collected, update the Scope of Works attached to the LUC and select 'No topsoil will be disturbed' in the LUC application.

- Ground disturbance shall not be undertaken where adverse weather conditions would result in significant soil losses due to wind, rain or erosion.

- Conduct pre and post clearing inspections to ensure compliance with conditions of the LUC.

3.4 Stockpiling of cleared materials

- During ground disturbance, soil and cleared vegetation shall be stockpiled separately on designated cleared areas inside the LUC boundary.

- Following the clearing activity, any material that is required to be stockpiled, must be stored in designated storage locations covered by an active LUC.

- Topsoil stockpiles should be stored at heights less than 2 metres. Cleared vegetation can be stored on top of topsoil stockpiles for use in rehabilitation activities.

- Where ground disturbance activities include the collection of subsoil (soil depths between 200 – 1500 mm), this should be stockpiled separately to topsoil. Subsoil stockpiles may be stored at heights up to 10 metres.

- Where rock is required for landform armouring materials, it shall be stockpiled separately to cleared vegetation, topsoil and subsoil.
- A buffer zone of at least 8 metres wide should be maintained between topsoil/subsoil/vegetation stockpiles and mined areas to allow access to soil and vegetation stockpiles.
- Soil and/or cleared vegetation shall not be stored in creeks or drainage lines.
- Stockpiles shall be clearly sign-posted to identify the material in the stockpile.
- Topsoil stockpiles must not be compacted. Vehicles and machinery must not drive over topsoil stockpiles.

3.5 Stockpile management

The onsite monitoring and maintenance of existing stockpiles shall be undertaken in accordance with site specific inspection criteria including:

- Stockpile heights
- Erosion and soil stability
- Signage
- Weed populations
- Stockpile volume calculations
- Spatial data of topsoil stockpiles within Fortescue's GIS systems

4 Monitoring and review

Table 2: Programmes and Schedules

Monitor (Audit) and Review	Frequency	Responsibility
Procedure Review	Triennially (or as and when required)	Manager Environment Governance

5 References

This procedure and all internal supporting documents will be managed as per Fortescue Document Governance Standards. These may be read in conjunction with this procedure.

[1] *Conservation Significant Fauna Management Plan* (100-PL-EN-0022)

[2] *Exploration Environmental Management Plan* (E-PL-EN-0002)

[3] *Environmental Approval of Land Use Certificates* (100-PR-EN-1058)

[4] *Environmental Approval Compliance* (IO-PR-EN-0004)

[5] *Incident Event Management Procedure* (45-PR-SA-0080)

[6] *Land Use Certification* (100-PR-TA-0001)

[7] *Undertaking Environmental Inspections* (100-PR-EN-1067)

[8] *Vegetation Health Monitoring and Management Plan* (100-PL-EN-1020)

[9] *Iron Bridge Vegetation Health Monitoring and Management Plan* (662NS-0000-PL-EN-0004)

[10] *Weed Management Plan* (100-PL-EN-1017)

[11] *Iron Bridge Weed Management Plan* (IB-0000-PL-EN-0002)

[12] *Weed Hygiene Procedure* (100-PR-EN-1055)

Document control

Ground Disturbance and Topsoil Management		
Status	IFU - Issued for Use	6/02/2023
Summary of Changes	This procedure supersedes *Ground Disturbance and Topsoil Management* (100-PR-EN-1042)	
Author	Bethany Walker	Signature
Checked or Squad Review# (if applicable)	Squad Check	Signature
Approved	Marlene Lootz	Signature
Next Review Date (if applicable)	6/02/2026	

Appendix A Legislative Context

Table 3: Legislation

Act / Regulation / Standards
Environmental Protection Action 1986
Environment Protection and Biodiversity Conservation Act 1999
Mining Act 1978
Biodiversity Conservation Act 2016
Statutory Guidelines for Mine Closure Plans (Department of Mines, Industry Regulation and Safety, 2020)