



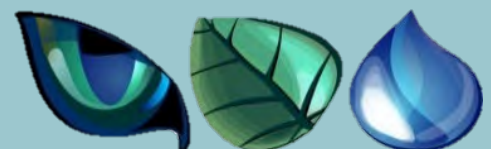
E 45/2287 Infill

Pilgangoora Project

Biological Survey

Pilbara, Western Australia

Prepared for
Pilbara Minerals Limited by
Animal Plant Mineral Pty Ltd.



May 2023

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EXECUTIVE SUMMARY

Animal Plant Mineral Pty Ltd was commissioned by Pilbara Minerals Limited to undertake a Detailed flora and vegetation and Targeted terrestrial vertebrate fauna survey of a previously unsurveyed area within Exploration Licence (E) 45/2287. Tenement E 45/2287 is part of the Pilgangoora Lithium Project, located 84 kilometres (km) south-east of Port Hedland in the Pilbara region of Western Australia (WA). The Infill survey area is 334.6 hectares (ha).

The field survey was conducted in March 2023. The rainfall in the calendar year and the month of January 2023 preceding the survey was above average, however the summer rainfall was below average with a dry December and February. No adverse weather conditions occurred that would impact the results of the survey. The timing of the flora and vegetation survey was within the recommended Primary survey period for the region (EPA 2016), and seasonal conditions were optimal. Survey timing was within that recommended for mammals and reptiles (EPA 2020). The survey was conducted without constraint.

Three vegetation types are described for the Survey Area. Vegetation type 9a occurring on stony rises and outcrops is synonymous with the vegetation type of the same code described for the Lynas Find project area (APM 2022a). Vegetation type 12a occurring on undulating sandy plains is synonymous with the vegetation type of the same code described for the TSF options 2 and 5 project area (APM 2022b). Vegetation type 15a occurring in a sandy bottomed creek is different to those described during other baseline surveys for the Pilgangoora Project. No vegetation of conservation significance was recorded, and current extent of regional vegetation units is close to pre-European extent. Vegetation is predominantly in Very Good condition with the main disturbances being low intensity cattle grazing, vegetation clearing for mining and pastoral activity and a small number of weeds. Completely Degraded areas comprise 10.9 ha or 3.3% of the Survey Area.

No Threatened flora are known to occur in the Survey Area or were recorded during the survey. Two Priority 3 flora – *Triodia chichesterensis* and *Euploca mutica*, were recorded. An additional eight species were determined to be possibly occurring or likely to occur based upon the availability of suitable habitat. One is a perennial shrub and seven are annual herbs or small herbaceous perennials. Seasonal conditions were suitable for these species to be detected if present.

No Declared weeds or Weeds of National Significance were recorded. Two weeds were recorded - *Cenchrus ciliaris* and *Aerva javanica* in small, isolated occurrences of low abundance.

Four fauna habitats are described for the Survey Area:

- FH1 – Rocky outcrops composed of angular, red granite boulders. This habitat is synonymous with the FH1 fauna habitat reported in (APM 2022a) and the Rocky Hill habitat reported in 360 Environmental (2016), however these are small, isolated outcrops, fragmented from the adjoining ranges by plains areas and are therefore comparatively lower habitat quality.
- FH2 – Minor sandy bottomed ephemeral first and second order creeks, and shallow drainage depressions, is synonymous with habitat FH2 described in APM 2022b and Drainage Line habitat described in 360 Environmental (2016), however is of lower quality due to the canopy being composed of smaller trees lacking in hollows, and the absence of River Red Gum.

- FH4 – Sandy Plains, is synonymous with the FH4 fauna habitat reported in APM (2022a) and the Sandy Plain habitat reported in 360 Environmental (2016).
- FH6 – Stony plains and rises, synonymous with the FH6 fauna habitat reported in APM (2022a).

No Threatened or Priority fauna species are previously known to occur in the Survey Area. Database records from the local area indicate that 11 conservation significant fauna may possibly occur or are likely to occur.

Targeted survey for conservation significant fauna identified:

- One call sequence of the Pilbara Leaf-nosed bat was recorded within the Survey Area. The detection of a single short echolocation call sequence away from areas of suitable roosting habitat is indicative of an individual of this species out foraging away from a diurnal roost.
- Western pebble-mound mouse is present, and three mound locations were recorded.
- Foraging habitat suitable for the Grey falcon occurs and may be used by local populations.
- Denning, foraging and dispersal habitat suitable for the Northern quoll occurs, but evidence of presence was limited to one scat, despite critical habitat known to occur 4 km to the east.
- Abandoned burrows, possibly indicating Brush-tailed mulgara was historically present.
- Wallaby scats possibly indicating the presence of Spectacled Hare-wallaby (mainland).
- Possible habitat for the Night parrot, Greater bilby, and Ghost bat, but no evidence of their presence was recorded.

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PROJECT TERMS

Abbreviation	Meaning
The Project	Pilgangoora Lithium Project
Survey Area	The 334.47 ha area predominantly within tenement E 45/2287 that is the subject of this survey

UNITS OF MEASURE

Unit	Measure
%	Percentage
°C	Degrees Celsius
ha	Hectare
km	Kilometre
m	Metre
mm	Millimetre

LIST OF ABBREVIATIONS

Abbreviation	Meaning
APM	Animal Plant Mineral Pty Ltd
BAM Act	<i>Biosecurity and Agriculture Management Act 2007</i>
BC Act	<i>Biodiversity Conservation Act 2016</i>
BoM	Bureau of Meteorology
DBCA	Department of Biological Conservation and Attractions
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DEE	Department of Energy and the Environment
DMIRS	Department of Mines, Industry Regulation and Safety
DWER	Department of Water and Environment Regulation
DPIRD	Department of Primary Industries and Regional Development
EN	Endangered
EPA	Environmental Protection Authority
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
ESA	Environmentally Sensitive Areas
IBRA	Interim Biogeographic Regionalisation for Australia
IBSA	Index of Biodiversity Surveys for Assessment
MI	Migratory
MNES	Matters of National Environmental Significance
OS	Other Specifically Protected
PEC	Priority Ecological Community

Abbreviation	Meaning
P	Priority
PMST	Protected Matters Search Tool
TEC	Threatened Ecological Community
T	Threatened
VU	Vulnerable
WA	Western Australia
WONS	Weeds of National Significance



1 INTRODUCTION

1.1 PROJECT AND LOCATION

Animal Plant Mineral Pty Ltd (**APM**) was commissioned by Pilbara Minerals Limited to undertake a Detailed flora and vegetation and Targeted terrestrial vertebrate fauna survey of a previously unsurveyed area within Exploration Licence (E) 45/2287. Tenement E 45/2287 is part of the Pilgangoora Lithium Project, located 84 kilometres (**km**) south-east of Port Hedland in the Pilbara region of Western Australia (**WA**). The Infill Survey Area is 334.6 ha and is shown in Figure 1-1.


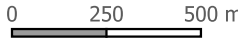


Legend


-  Tenement boundaries
-  E45/2287 Infill Survey Area



Scale: @ A4
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Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator



Author: EH Approved: ML Date: 06/03/2023

Project Location

Prepared for:
 Pilbara Minerals

Figure: 1-1

1.2 SCOPE OF WORK

The scope of work includes a Detailed flora and vegetation and Targeted terrestrial vertebrate fauna survey of the E 45/2287 Infill area, referred to herein as the **Survey Area**.

Survey data accompanies this report in a format suitable for submission to the Index of Biodiversity Surveys for Assessment (**IBSA**) online portal.

1.2.1 Flora and Vegetation

The flora and vegetation survey was conducted in accordance with the Environmental Protection Authority's (**EPA**) *Technical Guidance - Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment* (2016) at a Detailed level of assessment.

The aims of the desktop study were to:

- Establish vegetation associations previously determined for the site;
- Identify threatened (**T**) and priority (**P**) flora and threatened ecological communities (**TECs**) previously recorded on site;
- Identify weed species previously determined as present on site, in particular any Declared weeds; and
- Identify potentially suitable habitat for conservation significant flora known from the region.

The aims of the field survey were to:

- Determine vegetation associations on the site;
- Identify species present on site, including T and P Flora;
- Locate and identify, as far as possible, weed species, in particular any Declared weeds;
- Map the vegetation and locations of T and P species; and
- Identify conservation significant features of the flora and vegetation.

1.2.2 Terrestrial Fauna

The scope of work was to conduct a basic and targeted terrestrial vertebrate survey in accordance with the EPA's fauna guidelines: *Technical Guidance – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (2020).

The aims of the desktop study were to:

- Identify species previously determined as present on-site including T and P Fauna;
- Identify habitat types previously determined as present on site regarded as suitable for T and P fauna; and
- Identify introduced species previously determined as present on site.

The aims of the field survey were to conduct:

- Targeted quoll survey using unbaited camera traps;
- Bat survey using acoustic monitoring devices;
- Night Parrot survey using acoustic recording devices;

- Record incidental fauna observations;
- Conduct spotlight survey, without physical capture/collection of individuals; and
- Record habitats suitable for T and P fauna.

2 BACKGROUND AND SUPPORTING INFORMATION

2.1 RELEVANT LEGISLATION AND GUIDANCE

2.1.1 Commonwealth Government EPBC Act

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (**EPBC Act**) is administered by the Department of Climate Change, Energy, the Environment and Water (**DCCEEW**). It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places, defined in the EPBC Act as Matters of National Environmental Significance (**MNES**).

If a project has the potential to significantly impact on MNES it is to be referred to the DCCEEW for determination on whether the matter is a 'controlled action' and therefore requiring assessment.

The EPBC Act provides for the identification and listing of species under several categories listed in Appendix A. The EPBC Act also provides for the development of conservation advice and recovery plans, development of a register of critical habitat, recognition of key threatening processes and the development of threat abatement plans.

2.1.2 Western Australia BC Act

The *Biodiversity Conservation Act 2016* (**BC Act**) provides a statutory basis for the listing of T species, specially protected species, extinct species, TECs, collapsed ecological communities, critical habitat and key threatening processes in WA. The BC Act provides for the listing of T flora and fauna species and ecological communities under specified conservation categories listed in Appendix A. Species and communities listed under the BC Act are protected and require authorisation by the Minister to take or disturb.

Species may also be listed as being of special conservation interest if they have a naturally low population, restricted natural range, are subject to or recovering from a significant population decline or reduction of range or are of special interest to science. Species of special conservation interest, migratory species and species subject to international agreements are known as Specially Protected Species in the BC Act.

2.1.3 Western Australia Priority species and communities

Flora and fauna species and communities are listed by the Department of Biodiversity, Conservation and Attractions (**DBCA**) as P where they are considered to have a greater level of significance than other native species and communities. This generally occurs where populations are geographically restricted or threatened by local processes, or where there is insufficient information to formally assign them to T species and communities categories. Whilst P species and communities are not specifically listed in the BC Act, all flora and fauna are protected in WA following the provisions in Part 10 of the BC Act. This protection applies even when a species is not listed as T or specially protected. The categories covering P species and communities are listed in Appendix A.

2.1.4 BAM Act

Plants may be 'Declared' by the Agriculture Protection Board under the *Biosecurity and Agriculture Management Act 2007* (WA) (**BAM Act**). Declared Plants are gazetted under three categories (C1-C3) which define the action required. Details of the definitions of these categories are provided in Appendix A. A declaration may apply to the whole State, to districts, individual properties or even to single paddocks. If a plant is 'Declared', landholders are obliged to control that plant on their properties.

2.1.5 Weeds of National Significance

The DCCEEW, along with the State and Territory governments, has endorsed 32 Weeds of National Significance (**WONS**). Four major criteria were used in determining WONS:

- The invasiveness of a weed species;
- A weed's impact;
- The potential for spread of a weed; and
- Socio-economic and environmental values.

Each WONS has a national strategy and a national coordinator, responsible for implementing the strategy. WONS are regarded as the worst weeds in Australia because of their invasiveness, potential for spread, and economic and environmental impacts (DAWE 2020).

2.1.6 Guidelines

The terrestrial biological assessment was conducted in accordance with the above Commonwealth and State legislation, as well as EPA requirements for environmental surveys as outlined below:

- *Technical Guidance: Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (EPA 2020); and
- *Technical Guidance - Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016).

Relevant species-specific survey and assessment guidelines include:

- *Survey Guidelines for Australia's T Bats* (Department of the Environment Water Heritage and the Art (**DEWHA**) 2010).
- *Survey Guidelines for Australia's T Mammals* (Department of Sustainability Environment Water Population and Communities (**DSEWPAC**) 2011); and

Relevant guidance for the preparation of spatial datasets to accompany this report are:

- Guidelines for biological survey and mapped data (Department of the Environment and Energy (**DEE**) 2018); and
- Instructions for the preparation of data packages for IBSA (EPA 2021).

2.2 LAND USE

The Survey Area lies within the Wallareenya pastoral lease (N050365). The current land use is cattle grazing.

Active mining operations occur within the Pilgangoora Lithium project, east of the Survey Area. Mining exploration activities occur within E 45/2287.

2.3 CLIMATE

The Pilbara has very hot summers, mild winters and low and variable rainfall. It is classified as hot desert in northern and inland areas and hot grasslands in the north-west. The climate of the Chichester subregion of the Pilbara is described as semi-desert-tropical, receiving 300 millimetres (mm) of rainfall annually (Kendrick and McKenzie, 2001).

The nearest Bureau of Meteorology (BoM) weather station with a long historical record is at Port Hedland Airport (BoM Site Number: 004032), approximately 75 km northeast of the Survey Area. Port Hedland Airport has recorded rainfall from 1942 (80 years), and temperature from 1948 (74 years). The average climate data recorded for the region over these periods is shown in Figure 2-1. Monthly mean maximum temperature ranges from 36.8°C in March to 27.4°C in July. Monthly mean rainfall ranges from 89.3 mm in February to 0.9 mm in October, with a mean annual rainfall of 316.7 mm (BoM 2023).

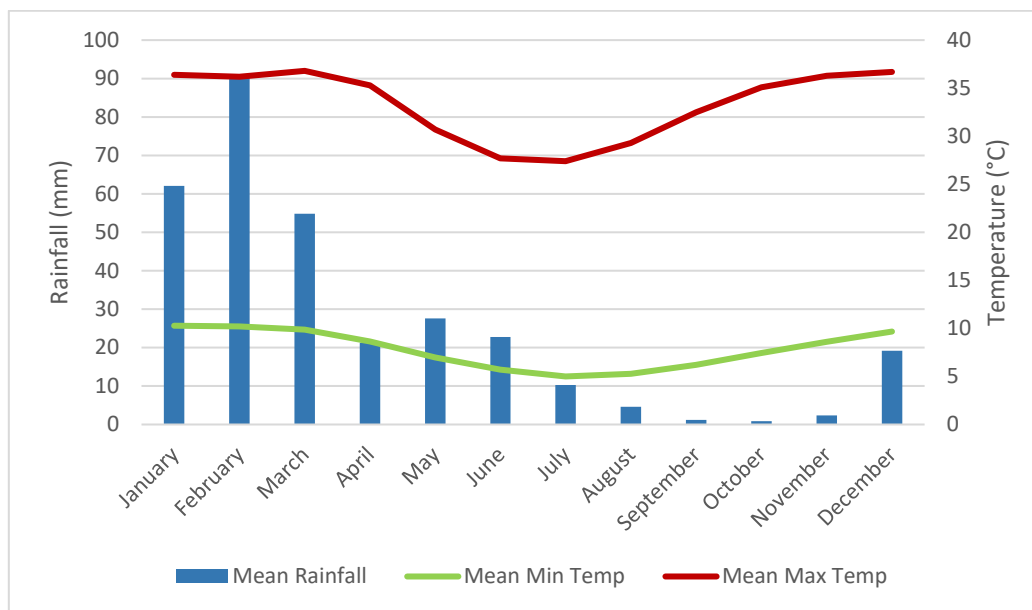


Figure 2-1. Temperature and rainfall averages for Port Hedland Airport weather station (Station No. 004032) (BoM 2023)

2.4 GEOLOGY

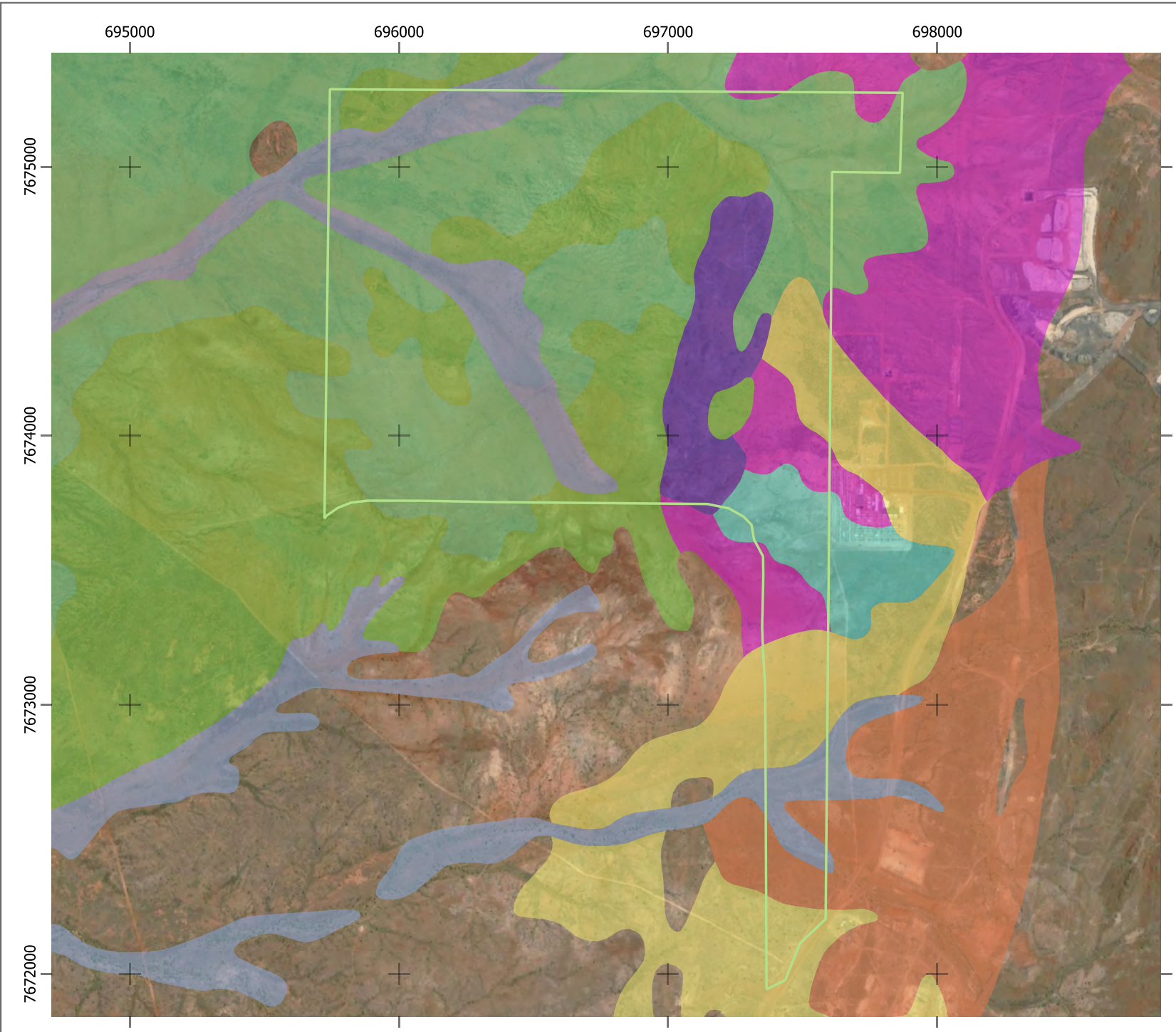
The Pilbara 2014 Geological Information Series dataset (Geological Survey of Western Australia 2014) features a 1:100 000 scale surface geology compilation. The digital layers are based on published maps

from the 1994-2005 Pilbara Craton Mapping Project, carried out by the Geological Survey of Western Australia and Geoscience Australia under the North Pilbara National Geoscience Mapping Accord. The Survey Area is within the Wodgina (2655) map area.

The Infill area contains the following eight geological formations:

- A-KEe-mu; Euro Basalt; Metamorphosed ultramafic rock;
- A-CLmo-xmgm-mgg; Motherin Monzogranite; Interleaved metamonzogranite, metagranodiorite, gneiss, and pegmatite; moderately to strongly foliated; intruded by abundant sheets of massive to weakly foliated muscovite-bearing metamonzogranite and pegmatite;
- A-CLmo-jmgm-mwa; Motherin Monzogranite; Interleaved seriate to porphyritic metamonzogranite, hornblende--biotite metagranodiorite, and pegmatite; strongly foliated and banded, locally gneissic; contains greenstone enclaves and pendants;
- _S1; Sandplain unit; Sandplain deposits; sand of mixed residual, sheetwash, and eolian origin; unconsolidated;
- _R1-g-pg; Residual or relict unit; Residual quartzofeldspathic sand, with quartz and rock fragments; overlying and derived from mass-wasting of granitic rocks; unconsolidated;
- _C1; Colluvial unit; Colluvial sand, silt, and gravel in outwash fans; scree and talus; proximal mass-wasting deposits; unconsolidated;
- _A2-d-k; Alluvial unit; Partly consolidated alluvial gravel, sand, and silt; local carbonate cement; dissected by present-day drainage; and
- _A1c; Alluvial unit; Sand, silt, and gravel in active drainage channels; includes clay, silt, and sand in poorly defined drainage courses on floodplains; unconsolidated.

The geology of the Survey Area is shown in Figure 2-2.



Legend

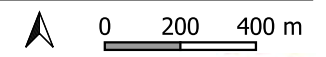
Infill Survey Area

Surface Geology

- _A1c
- _A2-d-k
- _C1
- _R1-g-pg
- _S1
- A-CLmo-jmgm-mwa
- A-CLmo-xmgm-mgg
- A-KEE-mu



Scale: @ A4
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Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator



Author: EH Approved: ML Date: 10/03/2023

Geology of the Survey Area

Prepared for:
 Pilbara Minerals

Figure: 2-2

The soils of the Survey Area were mapped by Tille (2006). The Survey Area is situated in the Fortescue Province, in the western edge of the Nullagine Hills Zone, with influences from the Abydos Plains and Hills Zone.

The Nullagine Hills Zone is characterised by:

“Hills and ranges (with some stony plains) on volcanic and sedimentary rocks of the Pilbara Craton (including the Hamersley Basin). Stony soils with red shallow loams and sands. Spinifex grasslands with kanji and snappy gum. Located in the north-eastern Pilbara around Marble Bar and Nullagine (Tille 2006).”

The Abydos Plains and Hills Zone is characterised by:

“Stony plains (with some hills) on granitic rocks of the Pilbara Craton (East Pilbara Terrane). Red deep sandy duplexes and red shallow loams with stony soils, red sandy earths and red loamy earths. Spinifex grasslands with kanji (and some tussock grasslands). Located in the northern Pilbara between Yandeyarra Community, Bamboo Springs Station, and Marble Bar (Tille 2006).”

2.5 BIOGEOGRAPHIC REGIONALISATION

The Interim Biogeographic Regionalisation for Australia (**IBRA**, version 7) classifies the Australian continent into regions (bioregions) of similar geology, landform, vegetation, fauna, and climate characteristics (Thackway and Cresswell 1995). The mapping completed by Beard (1975) provides the basis for the IBRA bioregions. IBRA mapping (Version 7), places the Project within the Pilbara Bioregion.

The Pilbara Bioregion is characterised by vast coastal plains and inland mountain ranges with cliffs and deep gorges. Vegetation is predominantly mulga low woodlands or snappy gum over bunch and hummock grasses.

The Pilbara Bioregion is further subdivided into the Chichester (PIL1), Fortescue (PIL2), Hamersley (PIL3) and Roebourne (PIL4) Sub-regions. The Project lies entirely within the Chichester Sub-region of the Pilbara Bioregion.

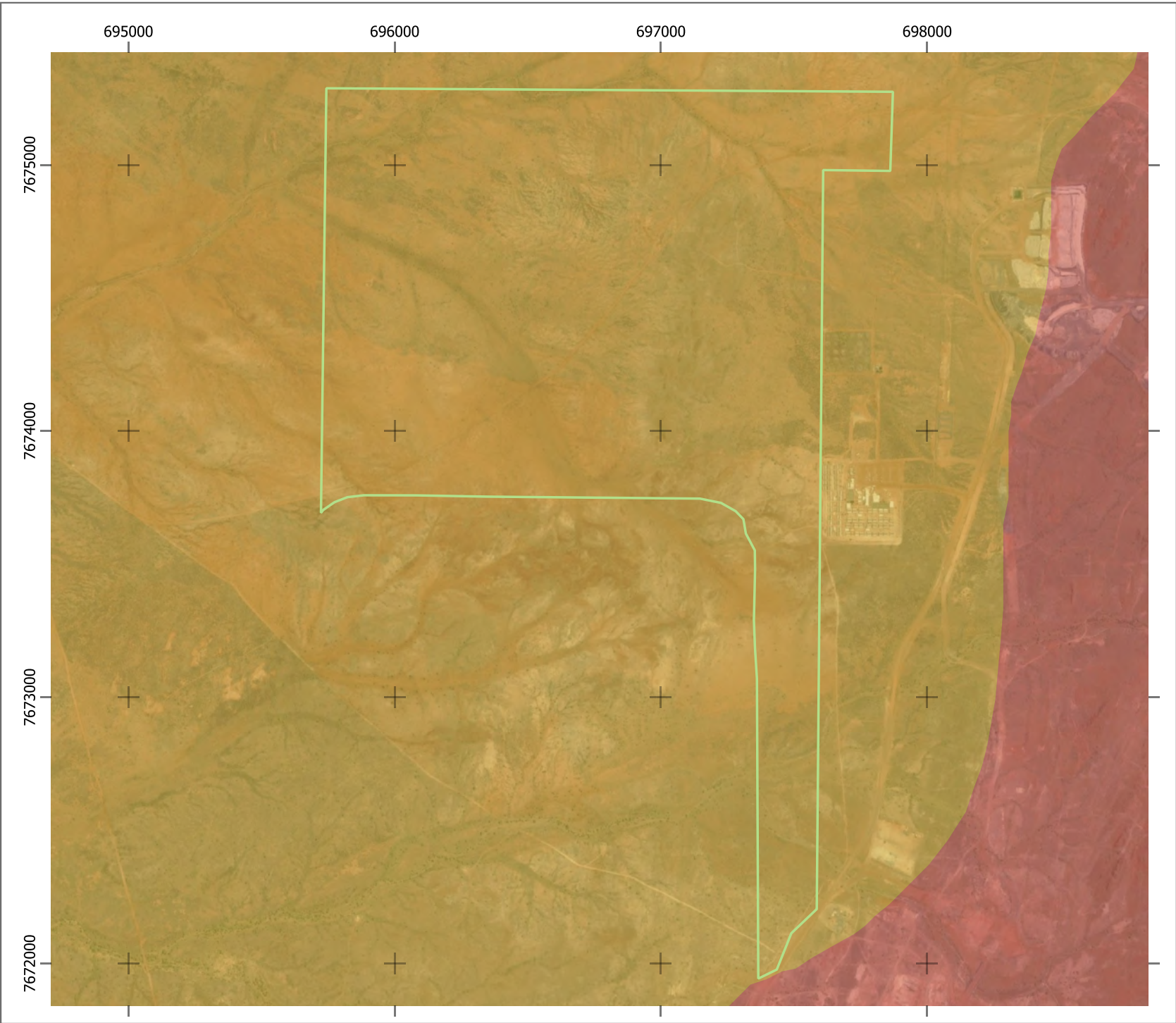
The Chichester Sub-region comprises the northern section of the Pilbara Craton and is comprised of undulating Archaean granite and basalt plains and includes significant areas of basaltic ranges. Plains support a shrub steppe characterised by *Acacia inaequilatera* over *Triodia wiseana* hummock grasslands, while *Eucalyptus leucophloia* tree steppes occur on ranges (Kendrick and McKenzie, 2001).

2.6 LAND SYSTEMS

Land Systems of the Pilbara region are described by van Vreeswyk *et al.* (2004). Mapping of Land Systems is available from Department of Primary Industry and Regional Development (**DPIRD**, 2019a). The Survey Area falls within one soil landscape system, Macroy, as listed in Table 2-1 and illustrated in Figure 2-3. The Talga Land System occurs to the east.

Table 2-1. Land Systems

Land System	Geology	Description
Underlying the Infill Survey Area		
Macroy	Level to gently undulating stony and gritty surfaced plains with occasional granite tor fields and domes and closely to moderately spaced dendritic tributary drainage floors, relief up to 25 metres (m)	Stony plains and occasional tor fields based on granite supporting hard and soft spinifex grasslands
Nearby		
Talga	Hill and ridge tracts of mafic and ultramafic rocks (greenstones), other metamorphics and chert, relief up to 100 m	Hills and ridges of greenstone and chert and stony plains supporting hard and soft spinifex grasslands

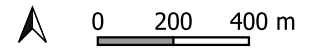


Legend

- Infill Survey Area
- Land Systems**
- Macrocy System
- Talga System



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Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator



Author: EH Approved: ML Date: 10/03/2023

**Land Systems of the
Survey Area**

Prepared for:
 **Pilbara
Minerals**

Figure: 2-3

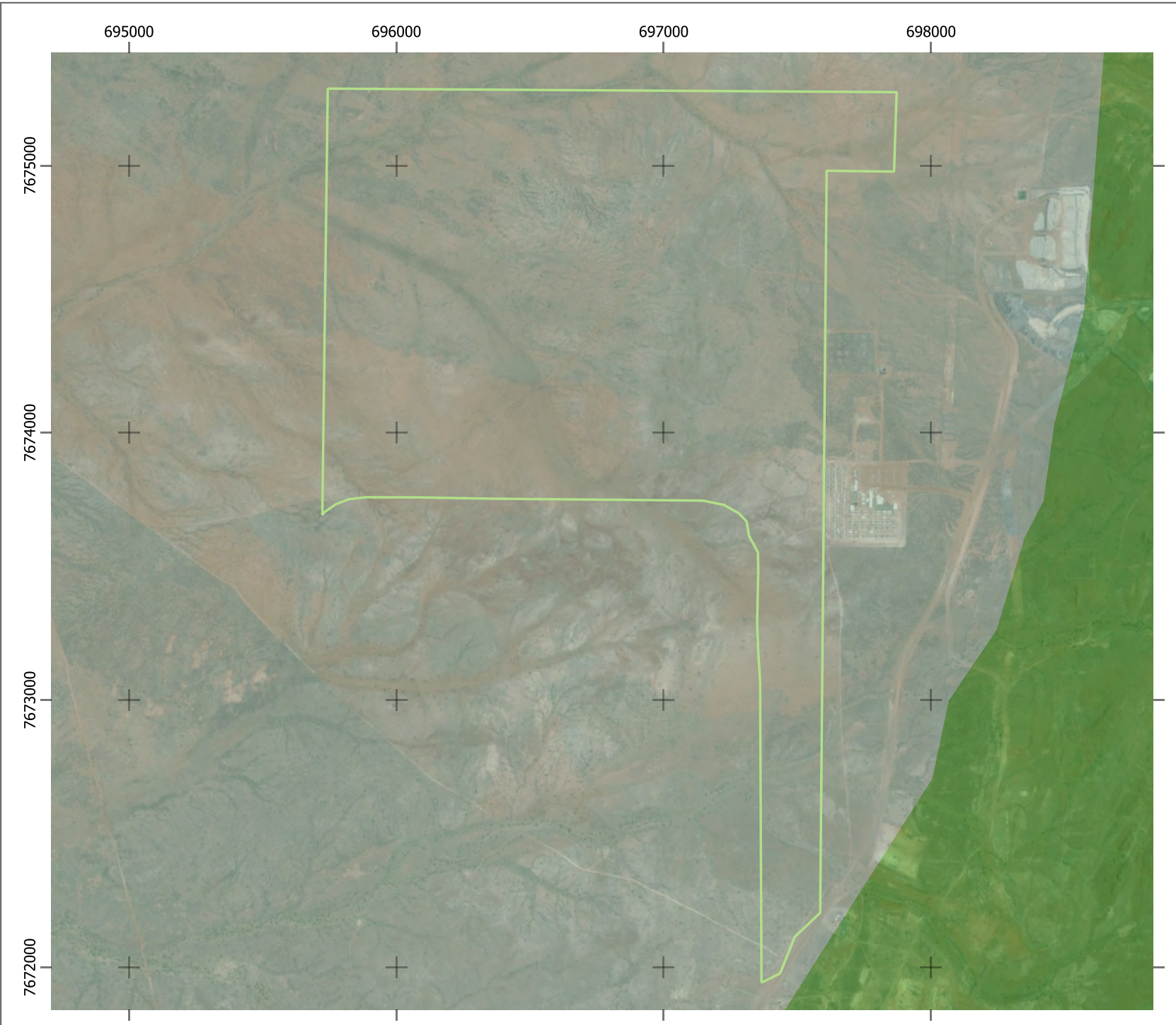
2.7 REGIONAL VEGETATION

The Survey Area is located within the Eremaean Botanical Province and contains one pre-European Beard vegetation association of the Abydos Plain – Chichester System as shown in Figure 2-4 (DPIRD 2019b). One vegetation association of the George Ranges System is nearby. The remaining extent of these vegetation associations is outlined in the most recent DBCA Statewide Vegetation Statistics table dated 2018 and summarised in Table 2-2 below.


Vegetation Associations within and nearby the Survey Area have over 99% pre-European Vegetation extent remaining. Conservation significance ranking of vegetation associations occurring within and nearby the Survey Area are of ‘Least Concern’.

Table 2-2 Pre-European Beard Vegetation Associations


Unit	Vegetation Description	Pre-European Extent (ha)	Current Extent (ha)	Pre-European Extent Remaining (%)	Current Extent within DBCA Managed Lands (%)
Underlying the Infill Survey Area					
93	Hummock grassland with scattered shrubs or mallee <i>Triodia</i> spp. <i>Acacia</i> spp., <i>Grevillea</i> spp. <i>Eucalyptus</i> spp.	3,044,310	3,040,641	99.88	1.96
Nearby					
82	Hummock grassland with scattered bloodwoods and snappy gum <i>Triodia</i> spp., <i>Corymbia dichromophloia</i> , <i>Eucalyptus leucophloia</i>	2,565,901	2,553,206	99.51	11.57




Legend

 Infill Survey Area

Pre-European Vegetation

 82: Hummock grassland with scattered bloodwoods and snappy gum *Triodia* spp. *Corymbia dichromophloia* and *Eucalyptus leucophloia*

 93: Hummock grassland with scattered shrubs or mallee *Triodia* spp. *Acacia* spp. *Grevillea* spp. and *Eucalyptus* spp.



Scale: @ A4
1: 20,000



0 200 400 m

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator



Author: EH Approved: ML Date: 10/03/2023

Pre-European Vegetation of the Survey Area

Prepared for:
 Pilbara
Minerals

Figure: 2-4

2.8 ENVIRONMENTALLY SIGNIFICANT AREAS

2.8.1 Conservation Estate

The Western Australian Conservation Estate includes land and waters vested in the Conservation and Parks Commission under the *Conservation and Land Management Act 1984*. The Conservation Estate is managed by the Parks and Wildlife Service of DBCA to protect WA's biodiversity, and includes National Parks, Nature Reserves, Conservation Reserves, and other areas managed primarily for biodiversity conservation (DEE 2016).

A search of the Collaborative Australian Protected Area Database returned no conservation estates located within 50 km of the Survey Area. The nearest gazetted terrestrial conservation estate is Mungaroon Range, 80 km to the south-west of the Survey Area.

2.8.2 Environmentally Sensitive Areas

Environmentally Sensitive Areas (**ESA**) are areas that are defined by the Department of Water and Environment Regulation (**DWER**) (2019) as:

- A declared World Heritage property as defined in s.13 of the EPBC Act;
- An area that is included on the Register of the National Estate, because of its natural heritage value under the *Australian Heritage Council Act 2003*;
- A defined wetland and the area within 50 m of the wetland;
- The area covered by vegetation within 50 m of T flora, to the extent to which the vegetation is continuous with the vegetation in which the T flora is located;
- The area covered by a TEC;
- A Bush Forever site;
- Areas covered by the Gngarara Mound Crown Land Policy and Western Swamp Tortoise Policy;
- Areas covered by lakes, wetlands, and fringing vegetation of the Swan Coastal Plain Lakes Policy, including Southwest Agricultural Zone Wetlands Policy and Swan and Canning Rivers Policy; and
- Protected wetlands as defined in the *Environmental Protection (Southwest Agricultural Zone Wetlands) Policy 1998*.

Environmentally Sensitive Areas can be viewed on the DWER clearing permit system map viewer. There are no ESAs within the Survey Area.

The Australian Wetlands Database includes nationally significant wetlands (as listed in the directory of important wetlands), wetlands listed under the Ramsar convention, wetlands that are representative, rare or unique, or wetlands that are considered of international importance (DEE 2019). The nearest wetlands listed in the Directory of Important Wetlands within 150 km of the Survey Area are the Leslie (Port Hedland) Saltfields System, 80 km to the north, the De Grey River System, 85 km to the north-east, and the Fortescue Marshes, 130 km to the south-west.

3 METHODOLOGY

3.1 DESKTOP STUDY

The desktop study provides background information on the known attributes of flora, vegetation, and fauna of the Survey Area, and in the local surrounding area.

3.1.1 Database Searches

A search for EPBC Act MNES was undertaken using the DCCEEW Protected Matters Search Tool (**PMST**). The PMST identifies EPBC listed flora and fauna species and communities based on predicted distributions of the species and/or their habitat, in conjunction with species records. The PMST may predict the occurrence of a species or community in an area where there are no documented records, or documented records are historic. For this search, the Survey Area was imported into the PMST viewer as the feature area and a buffer of 30 km applied.

The conservation codes are described in Appendix A. The results of the PMST search are included in Appendix B.

The DBCA maintains databases for records of T and P species and communities. A request was made for a search of DBCA databases for T and P flora and fauna and the presence of TECs or Priority Ecological Communities (**PECs**). Results were obtained in August 2022. A 30 km buffer was applied to the search results from a central coordinate of 696681, 7674607 (GDA 2020, MGA Zone 50).

Flora and Fauna Inventory, including records for Introduced flora and fauna from within 30 km, were obtained from the Dandjoo Biodiversity Data Repository hosted by the DBCA Biodiversity Office (DBCA 2023).

Table 3-1 lists the database searches conducted for the desktop study.

Table 3-1. Database Searches

Attribute	Search Area	Database	Location
Threatened and Priority Ecological Communities	30 km radius	DBCA	Figure 4-2; Section 4.1.2
	30 km radius	PMST	Appendix B
Threatened Flora	30 km radius	DBCA	Figure 4-1; Section 4.1.1
	30 km radius	PMST	Appendix B
Introduced Flora	30 km radius	Dandjoo	Section 4.1.3
Threatened Fauna	30 km radius	DBCA	Figure 5-1; Section 5.1.1
	30 km radius	PMST	Appendix B
Introduced Fauna	30 km radius	Dandjoo	Section 5.1.2

The DBCA fire history database (DBCA 2022) was consulted to identify local fire history.

3.1.2 Literature Review

Flora, vegetation, and terrestrial vertebrate fauna surveys have been conducted in the local area for the Pilgangoora Project. The following local surveys were reviewed, and the results incorporated into the Desktop Study:

- Baseline Vertebrate Fauna Survey, Pilgangoora. Prepared on behalf of Pilbara Minerals Limited by 360 Environmental. Publication date: May 2016.
- Pilgangoora Project Area – Flora, Vegetation and Fauna Assessment. Prepared on behalf of Pilbara Minerals Limited by MMWC Environmental Pty Ltd. Publication date: July 2016
- Pilgangoora Access Road Borrow Pits - Flora and Vegetation Assessment. Prepared on behalf of Pilbara Minerals Limited by MMWC Environmental Pty Ltd. Publication date: July 2016.
- Pilgangoora Project – Stage 2 Expansion Desktop Environmental Assessment. Prepared on behalf of Pilbara Minerals Limited by Ecologia Environmental. Publication date: 26 October 2018.
- Pilbara Leaf-nosed Bat Survey, Pilgangoora Prepared for Pilbara Minerals Limited by 360 Environmental November 2015
- Pilbara Leaf-nosed Bat Roost Survey, Pilgangoora Prepared for Pilbara Minerals Limited by 360 Environmental February 2016
- Northern Quoll Survey on mining tenement M45/1266. Prepared for Pilbara Minerals Limited by Terrestrial Ecosystems, January 2020.
- Lynas Find Biological Survey - Prepared for Pilbara Minerals Limited by APM, October 2022.
- TSF Option 2 and Option 5 Biological Survey - Prepared for Pilbara Minerals Limited by APM, November 2022.

3.1.3 Likelihood of Occurrence

Threatened and Priority flora, fauna and communities returned from the database searches and literature review were assessed for their likelihood of occurrence within the Survey Area using the likelihood of occurrence criteria listed in Table 3-2.

Table 3-2. Likelihood of occurrence criteria

Likelihood of occurrence	Criteria
Recorded	Identified from database records or field survey as occurring within the Survey Area
Likely	Suitable habitat is present in the Survey Area and the species has previously been recorded within 15 km
Possible	Suitable habitat is present within the Survey Area and the species has previously been recorded between 15 – 30 km of the Survey Area
Unlikely	No suitable habitat is present in the Survey Area

3.2 FIELD SURVEY

3.2.1 Survey Personnel and Timing

The terrestrial vertebrate fauna survey was carried out by Dr Mitchell Ladyman. The flora and vegetation field survey was undertaken by Dr Neil Pettit and Ms Tia Berard, with assistance by Mr Mahes Degebrodt.

Acoustic analysis and bat call identification was conducted by Dr Kyle Armstrong and Yuki Konishi at Specialised Zoological, a scientific consultancy business that specialises in bats, bioacoustics, and genetic identification. Dr Armstrong has 20 years' experience in environmental consultancy specialising in bats.

Table 3-3 lists the personnel involved in the field survey.

Table 3-3. Field Survey Personnel

Survey Date	Personnel	Experience	Description
9 th – 12 th March 2023	Dr Mitchell Ladyman	20+ years	Terrestrial vertebrate fauna survey
27 th – 31 st March 2023	Dr Neil Pettit	25+ years	Flora and vegetation survey
	Ms Tia Berard	2 years	
	Mahes Degebrodt	under instruction	

Autonomous recording devices were installed during the first field survey period and were collected during the second survey period.

3.2.2 Survey Conditions

The total summer rainfall prior to survey (1st December 2022 to 28th February 2023) was below average at 97.4 mm compared to 170.6 mm (BoM 2023). Monthly total rainfall at Port Hedland was below average in December, February and March and slightly above average in January. A few days prior to the flora and vegetation survey, 30 mm of rain was recorded at the Port Hedland weather station.

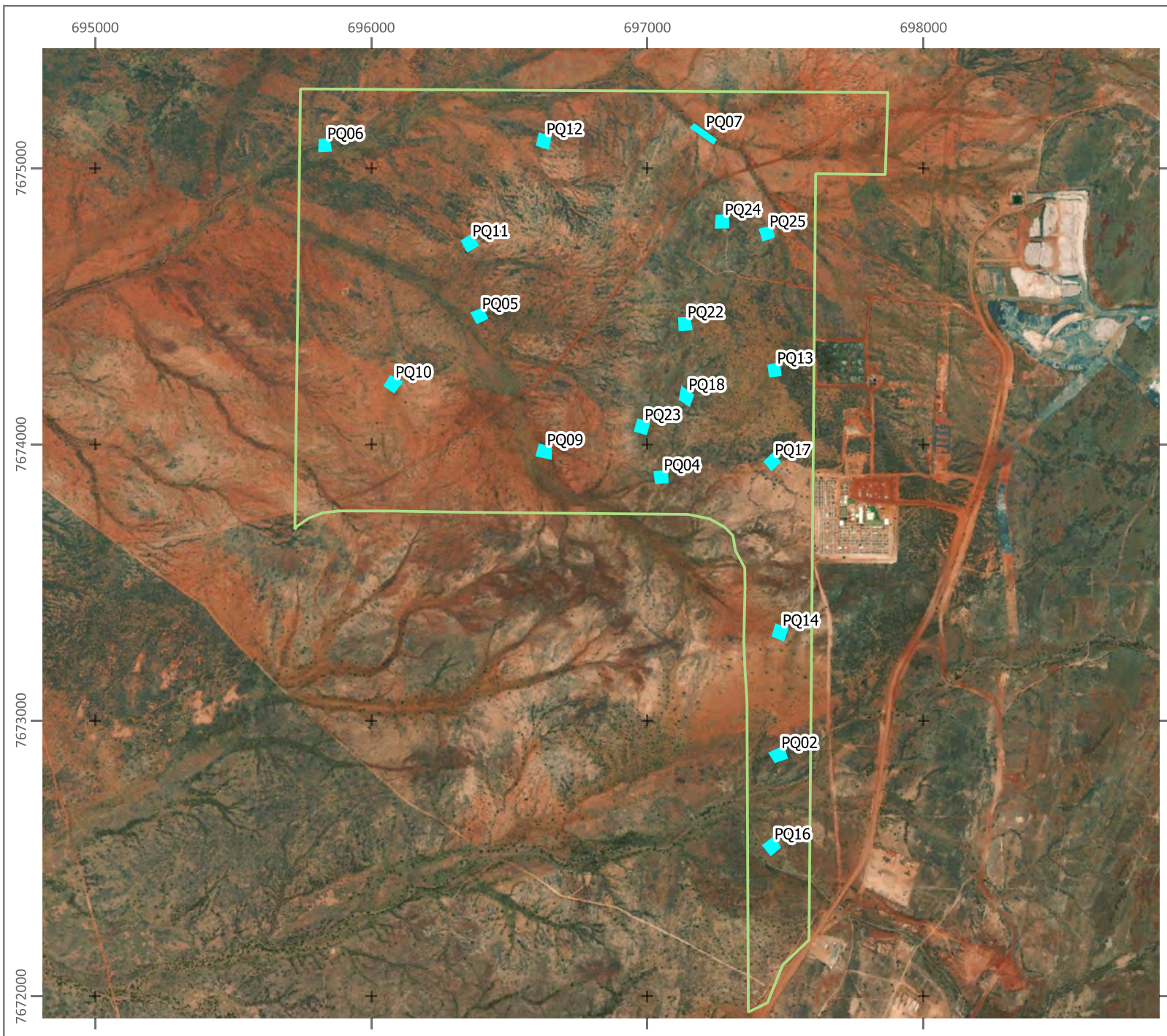
During the survey period, daytime temperatures reached a maximum of between 33.4 and 34.9 °C and a minimum of between 26.4 and 28.1°C overnight, which is typical of the time of year (BoM 2023). No adverse weather conditions occurred that would impact the results of the survey. No rainfall was recorded on the BoM weather station on the 30th March, however at the site a light rainfall was experienced throughout the day with one brief period of moderate intensity.

The Survey Area is within the Eremaean botanical province. Recommended timing for flora and vegetation survey is 6-8 weeks post wet season (March – June) for Primary survey, and a Dry season survey (after winter rainfall if available) for Supplementary survey (EPA 2016). The timing of the field survey was within the recommended Primary survey period for the region. Despite the below average summer rainfall conditions, floristic diversity was high, annual species were present and the vegetation was in a condition suitable for flora inventory and taxonomic determination.

Survey timing was within that recommended for mammals and reptiles (EPA 2020).

3.2.3 Flora and Vegetation

A detailed survey was conducted for flora and vegetation. Vegetation was sampled using 17 quadrats of 50 x 50 m and one quadrat of 25 x 100 m (Figure 3-1). Quadrats are vegetation survey plots which are accurately measured out as 50 x 50 m (or an area equivalent to 2500 m²) and marked at the north-west corner using a handheld Global Positioning System (**GPS**) unit.



Legend

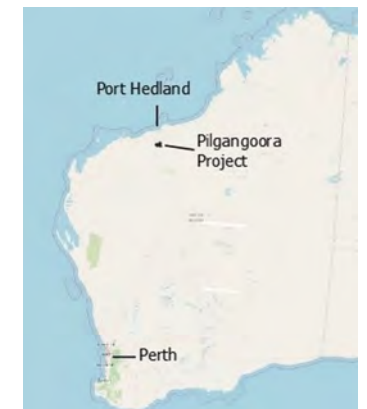
Infill Survey Area

Flora Survey Sites

Excellent

Good

Very Good



Scale: @ A4
1: 20,000



Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator



Author: TB Approved: EH Date: 03/04/2023

Flora Survey Sites

Prepared for:



Figure: 3-1

Field data at each survey site was recorded on a pro-forma data sheet and included the parameters listed in Table 3-4. The attributes of Detailed survey sites are provided in Appendix C.

Table 3-4. Parameters recorded at each Detailed site

Variable	Parameters
Collection attributes	Personnel/recorder; date, quadrat dimensions and marking method, photographs of the quadrat, site code.
Physical features	Landform, slope, aspect, soil attributes, ground surface cover, litter, rock type and physical attributes.
Location	Coordinates recorded in GDA94 datum using a hand-held GPS (Garmin) to accuracy approximately ± 5 m.
Vegetation	Dominant growth form, height, cover, and species for the three traditional strata (upper, mid and ground) compatible with NVIS Level V (ESCAVI 2003).
Vegetation condition	Vegetation condition was assessed using the condition rating scale devised by Trudgen (1988).
Disturbance	Level and nature of disturbances (<i>e.g.</i> weed presence, fire, and time since last fire, impacts from grazing, vegetation clearing, erosion).
Flora	List of all species within the quadrat including weeds and listing species average height, cover, and abundance.

A flora inventory was compiled from taxa listed in Detailed survey sites and from opportunistic floristic collections throughout the Survey Area, with at least one collection made for every taxon encountered. Specimens were identified by an experienced botanical taxonomist in the Western Australia Herbarium (**WAH**) using published reference material. The nomenclature applied is consistent with Florabase (WAH 1998-).

The conservation status of all recorded flora was determined from the DBCA Wildlife Conservation Rare Flora Notice 2022, T and P Flora List 6 October 2022, and the EPBC Act List of T Flora (DCCEEW 2023). The Western Australian Organisms List database was consulted to determine if any are BAM Act Declared Plants (DPIRD 2021), and the Weeds of National Significance list to determine any WONS (DAWE 2020).

The vegetation types were described based on their structure and species composition, as defined by quadrat data, and field observations. Vegetation was mapped in the field using handheld GPS units and aerial photographs, then digitised as map figures using GIS software. Vegetation is described at the association level (ESCAVI 2003) and referred to as Vegetation Types (EPA 2016).

Vegetation Condition was assigned using the scale developed for the Eremaean and Northern Botanical Provinces adapted from Trudgen (1988) as recommended in EPA (2016). Table 3-5 lists the six potential categories.

Table 3-5. Vegetation Condition Scale

Vegetation Condition	Erreanean and Northern Botanical Provinces adapted from Trudgen (1988)
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>i.e.</i> areas that are cleared or 'parkland cleared' with their flora comprising weed or crop species with isolated native trees or shrubs

Conservation significant flora was Targeted searched using traverses on foot and logged using a handheld GPS.

Data analysis was applied using the method recommended by EPA (2016). A species by site matrix was prepared using the complete suite of species recorded. The Primer 7 (Clarke and Gorley, 2015), software was used to perform floristic composition vegetation classification. Data was transformed to presence/absence and a resemblance matrix was constructed using the Bray Curtis similarity measure. A cluster analysis was performed using group averages. The SIMPROF routine was used to test the hypothesis that the species and/or abundances are different at each group of sites using 999 permutations and a significance level of 5%.

The completeness of the survey was tested using a species accumulation curve and applying the Michaelis-Menton model to estimate the species richness of the Survey Area.

3.2.4 Fauna

Fauna habitat assessments were performed at 33 locations. Descriptive data was recorded including soil type, landform, presence of microhabitats, disturbances and images were recorded. Site photos are included in Appendix D.

Targeted search was conducted for direct observation and signs of conservation significant fauna using traverses on foot, with tracklogs recorded on a handheld GPS. Signs include scats, prints, slough skin, scratchings made during foraging and other diggings, burrows and mounds. Traverses were conducted at dawn, dusk and during daylight hours. Table 3-6 lists the transect locations, survey effort and targeted habitats.

Table 3-6. Targeted search transects

Target Fauna Habitat	Transect	Distance (km)	Duration (min)
Shallow Drainage basins and creeks	T02	1.36	26
	T05	2.26	43
	T09	2.89	56
Sandy Plains	T04	1.58	25
	T06	1.93	38
	T07	2.35	42
	T10	1.77	46
	T11	1.28	31
	T12	1.30	36
	T01	1.87	38
Stony Plains	T03	2.31	44
	T08	3.36	57
	T13	2.21	45
	T14	2.60	49
Rocky Outcrops	T15	2.39	85

Sixteen motion-triggered and time lapse cameras were deployed throughout the Survey Area between the 9th and 11th of March 2023. Two cameras (MSC018 and MSC022) failed in the first period and were redeployed from the 26th of March to the 19th of April. Cameras were deployed in pairs with one camera set up as motion-triggered capture (3 photos per trigger with a 5 minute reset period) and one set up as a time lapse capture method (1 photo every 5 minutes). Table 3-7 lists the camera locations and confirmed operational days by target habitat.

Table 3-7. Motion-triggered and time lapse camera setup and duration

Targeted Fauna Habitat	Location (GDA 2020 MGA zone 50)	Camera	Method	Trap nights
Shallow Drainage basins and creeks	696085, 7675102	MSC006	Time lapse	16
Shallow Drainage basins and creeks	696085, 7675102	MSC009	Motion-triggered	16
Shallow Drainage basins and creeks	697546, 7673952	MSC019	Motion-triggered	16
Shallow Drainage basins and creeks	697546, 7673952	MSC013	Time lapse	16
Stony Plain	695899, 7673747	MSC007	Time lapse	17
Stony Plain	695899, 7673747	MSC016	Motion-triggered	17
Sandy Plains	697362, 7674603	MSC020	Time lapse	14
Sandy Plains	697362, 7674603	MSC024	Motion-triggered	14
Low Rocky Outcrop	697072, 7674260	MSC012	Motion-triggered	16

Low Rocky Outcrop	697072, 7674260	MSC014	Time lapse	16
Low Rocky Outcrop	697216, 7674490	MSC018	Time lapse	23
Low Rocky Outcrop	697216, 7674490	MSC022	Motion-triggered	3
Low Rocky Outcrop	697127, 7674470	MSC021	Motion-triggered	15
Low Rocky Outcrop	697127, 7674470	MSC010	Time lapse	15
Low Rocky Outcrop	697151, 7674353	MSC011	Time lapse	14
Low Rocky Outcrop	697151, 7674353	MSC021x	Motion-triggered	14
Total				242

Three Anabat Swift acoustic bat recording devices were deployed for between 8 and 10 nights between the 9th and 30th of March 2023 for a total of 27 trap nights. Table 3-8 lists the acoustic bat recording devices deployed, the habitat type targeted, and the number of trap nights.

Bat call analysis was performed by Dr Kyle Armstrong of Specialised Zoological. A technical report with specifications on the analysis method is included as Appendix E. The scope of the analysis was limited to the detection of the conservation significant species Ghost bat *Macroderma gigas* and Pilbara leaf-nosed bat *Rhinonictoris aurantia*.

Table 3-8. Acoustic bat recording device location and duration

Habitat	Location (GDA 1994 MGA zone 50)	Acoustic Bat Recorder	Trap nights
Shallow Drainage basins and creeks	697547, 7673949	AS450007	9
Shallow Drainage basins and creeks	696101, 7675096	AS450083	8
Stony Plain	695899, 7673747	AS642022	10
Total			27

Four Phillips DVT-7110 Digital Voice-Tracer Sound Recording devices were deployed for recording bird calls in .wav format, with the Night parrot as the target. Devices were deployed for three nights between the 9th to the 12th of March 2023, for a total of twelve trap nights. Locations were selected that provided the highest potential habitat quality. Habitat quality for Night parrot was assessed with reference to habitats described and depicted by the Night Parrot Recovery Team (2022).

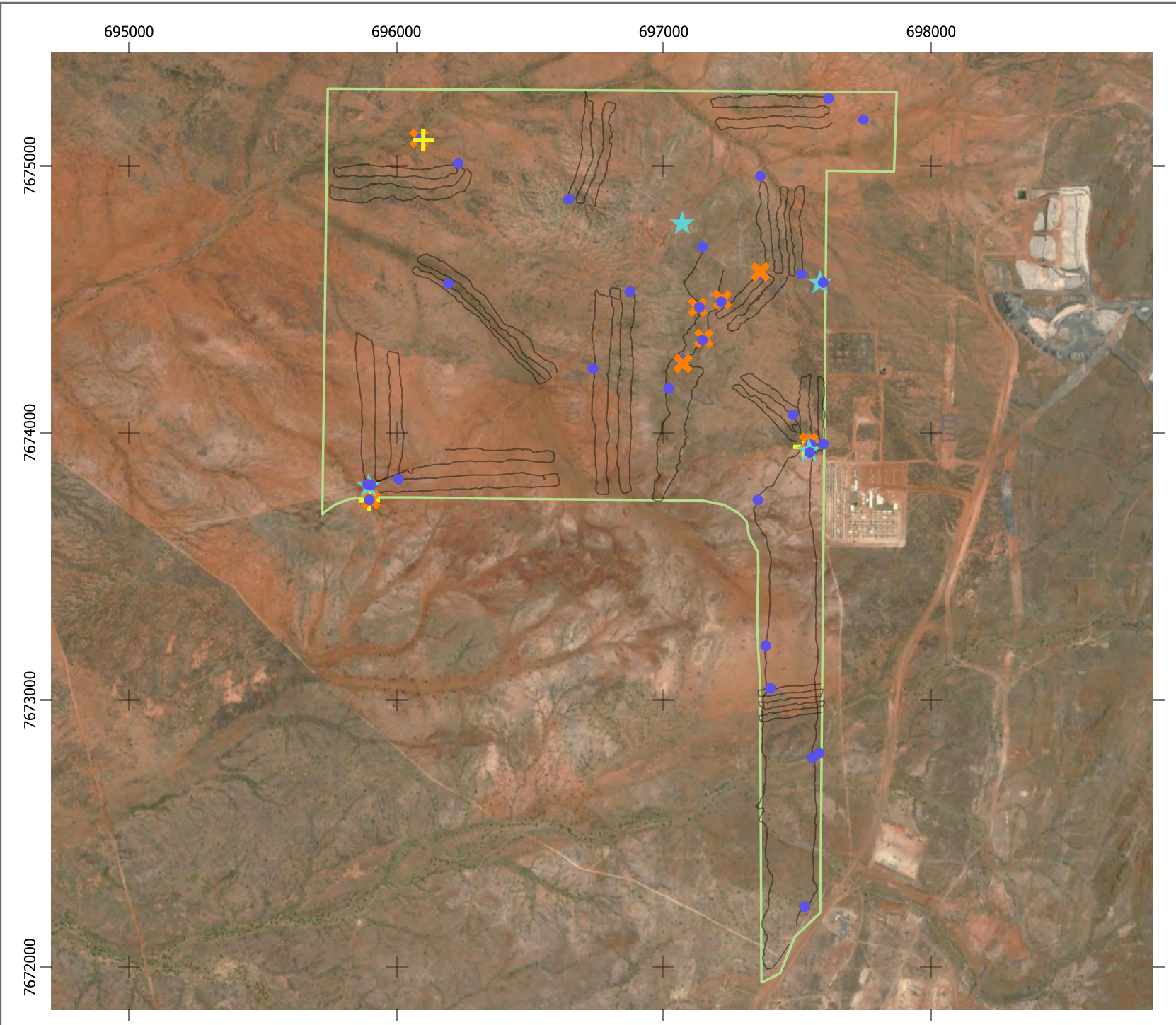
Table 3-9 lists the recording devices deployed in each habitat type, and the number of trap nights.

Table 3-9. Acoustic bird recording devices

Habitat	Location (GDA 2020 MGA zone 50)	Acoustic Bird Recorder	Trap nights
Sandy Plains	697070, 7674783	NP001	3
Shallow Drainage Depression	697585, 7674562	NP002	3
Stony Plain	695897, 7673801	NP003	3
Shallow Drainage Depression	697544, 7673933	NP004	3
Total			12

Acoustic recordings were assessed with reference to the calls available on the Night Parrot Recovery Team (2022) website. Sound files recorded between 18:30 – 20:30 (2 hours post-sunset) and from 03:00 – 05:00 (2 hours pre sunrise) were assessed for Night parrot calls (48 hours total). In addition to listening to call playbacks, a spectrograph of bird calls were viewed using the Audacity® software package. A profile of Night parrot calls was created by playing the calls available on the Night Parrot Recovery Team (2022) website, for comparison with recorded bird calls. The assessments were also made with reference to descriptions of known vocalisations of the Night parrot as published by Leseberg *et al.* (2019).

Nomenclature within this report is applied according to the WA Checklist of Terrestrial Vertebrates (Western Australian Museum 2022). Figure 3-2 shows the location of motion-triggered cameras, bat acoustic recording devices and targeted searches. Detailed fauna habitat assessments were made at the locations where cameras and acoustic recording device were deployed, and during traverses.

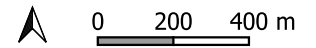


Legend

- Infill Survey Area
- + Acoustic Bat Recorder
- ★ Acoustic Bird Recorder
- Fauna Habitat Assessment
- × Motion Triggered Camera
- Targeted Search Traverses



Scale: @ A4
1: 20,000



Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator



Author: EH Approved: ML Date: 16/03/2023

Fauna Survey Sites

Prepared for:
 Pilbara Minerals

Figure: 3-2

3.3 CONSTRAINTS

Several limitations may arise during field survey EPA (2016 and 2020). These potential survey limitations are listed below in Table 3-10 with comments on the constraint to the outcomes of the survey.

Table 3-10. Survey Constraints

Factor	Impact of survey outcomes
Access Problems	Not a constraint All of the Survey Area was accessed.
Experience levels	Not a constraint The personnel were suitably qualified
Scope: Flora and Vegetation	Not a constraint Survey was carried out at a level of Detailed assessment
Scope: Fauna	Not a constraint The survey was carried out at a level of Targeted and basic assessment, suitable for the size and intensity of the proposed Project and the availability of previous local survey.
Timing, weather, season, cycle	Not a constraint The Survey Area is within the Eremaean Botanical district. Rainfall in the season prior to survey was lower than average. The Flora and Vegetation survey was conducted early in the Primary period recommended by EPA (2016) to ensure the best possible seasonal conditions were captured. No inclement weather occurred during the survey period that would impact the detection of target fauna. Survey timing was within that recommended for mammals and reptiles. Conditions were unsuitable for water birds and amphibians, however the assessment of habitat availability for these groups was possible.
Sources of information	Not a constraint Previous biological reports and database records are available for the locality and region.
Completeness: Flora and vegetation	Not a constraint The scope was completed. One plant specimen (0.8% of the collection) was not able to be determined to the species level due to juvenile status. Modelling indicates the survey captured 87.5% of the floristic richness in the area.
Completeness: Fauna	Not a constraint The scope was completed. The survey resulted in no ambiguous identifications of bat calls or bird calls. Two photos were unable to be determined.

4 FLORA AND VEGETATION RESULTS

4.1 DESKTOP STUDY

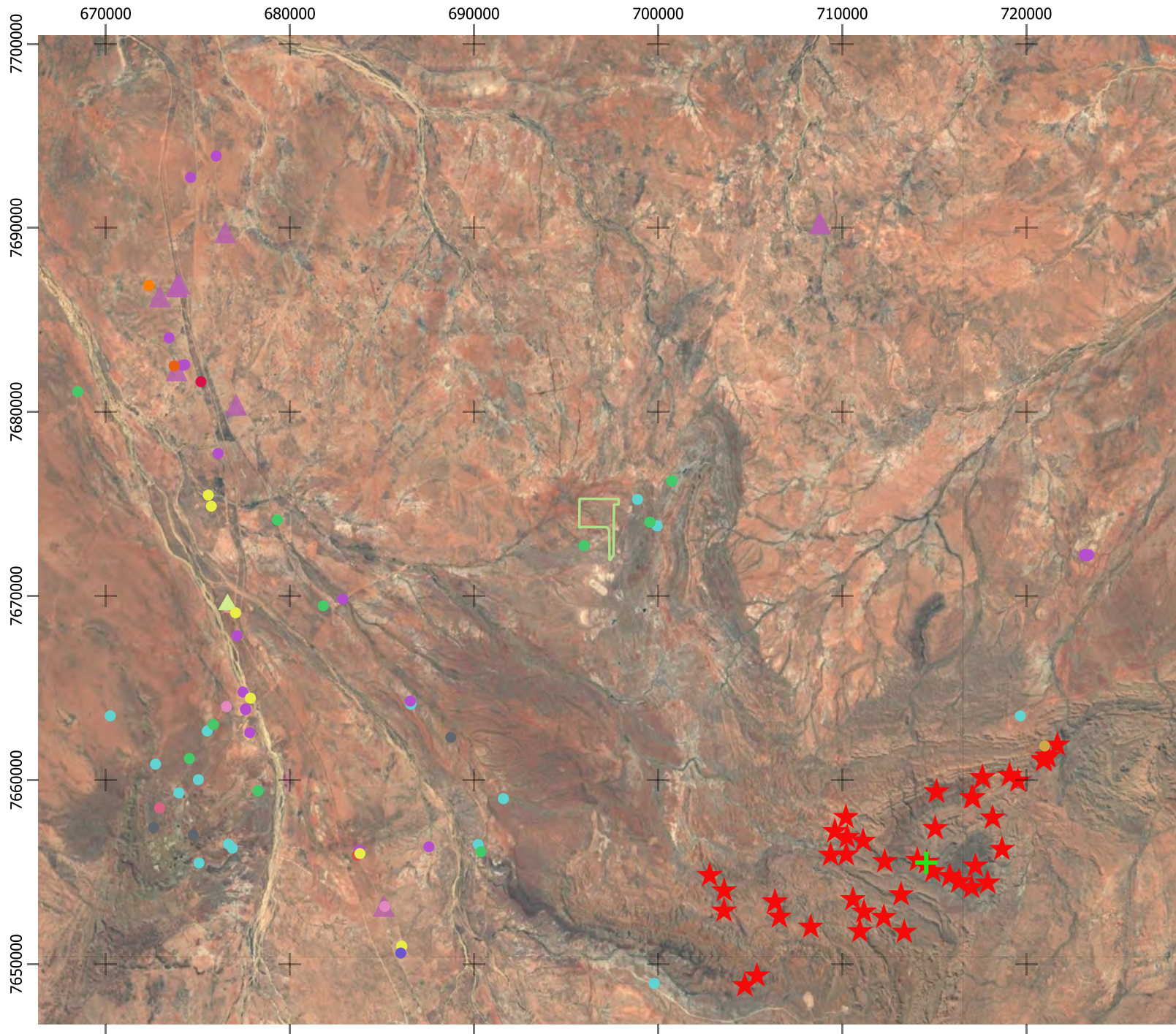
4.1.1 Significant Flora

No T or P Flora listed under the BC Act and/or EPBC Act have been previously recorded within the Survey Area.

One T flora species has been recorded within 30 km, *Quoya zonalis* (formerly *Pityrodia* sp. Marble Bar, listed as Endangered under the EPBC Act and BC Act). One P1, thirteen P3, and two P4 species have records within 30 km of the Survey Area.

No additional T or P species were returned from the PMST or literature review, however a local record of *Rothia indica* subsp. *australis* (APM 2022a) increased the likelihood of occurrence from Possible to Likely.

T and P flora returned from the DBCA database with records within 30 km of the Survey Area are shown in Figure 4-1.



Legend

Infill Survey Area

Endangered

Quoya zonalis

Priority 1

Themeda sp. Panorama
(J. Nelson et al. NS 102)

Priority 3

- Eragrostis crateriformis*
- Euphorbia clementii*
- Euploca mutica*
- Gomphrena leptophylla*
- Gymnanthera cunninghamii*
- Nicotiana umbratica*
- Phyllanthus hebecarpus*
- Rothia indica subsp. australis*
- Stylidium weeliwolli*
- Terminalia supranitifolia*
- Triodia basitricha*
- Triodia chichesterensis*
- Vigna tridiophila*

Priority 4

- Bulbostylis burbidgeae*
- Goodenia nuda*

Scale: @ A4
1: 300,000

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator

Author: EH Approved: ML Date: 16/03/2023

Threatened and Priority Flora Database Records

Prepared for:
 Pilbara Minerals

Figure: 4-1

An assessment of the likelihood of occurrence of these 17 species within the Survey Area was performed using the criteria listed in Table 3-2. The results of the assessment are listed in Table 4-1.

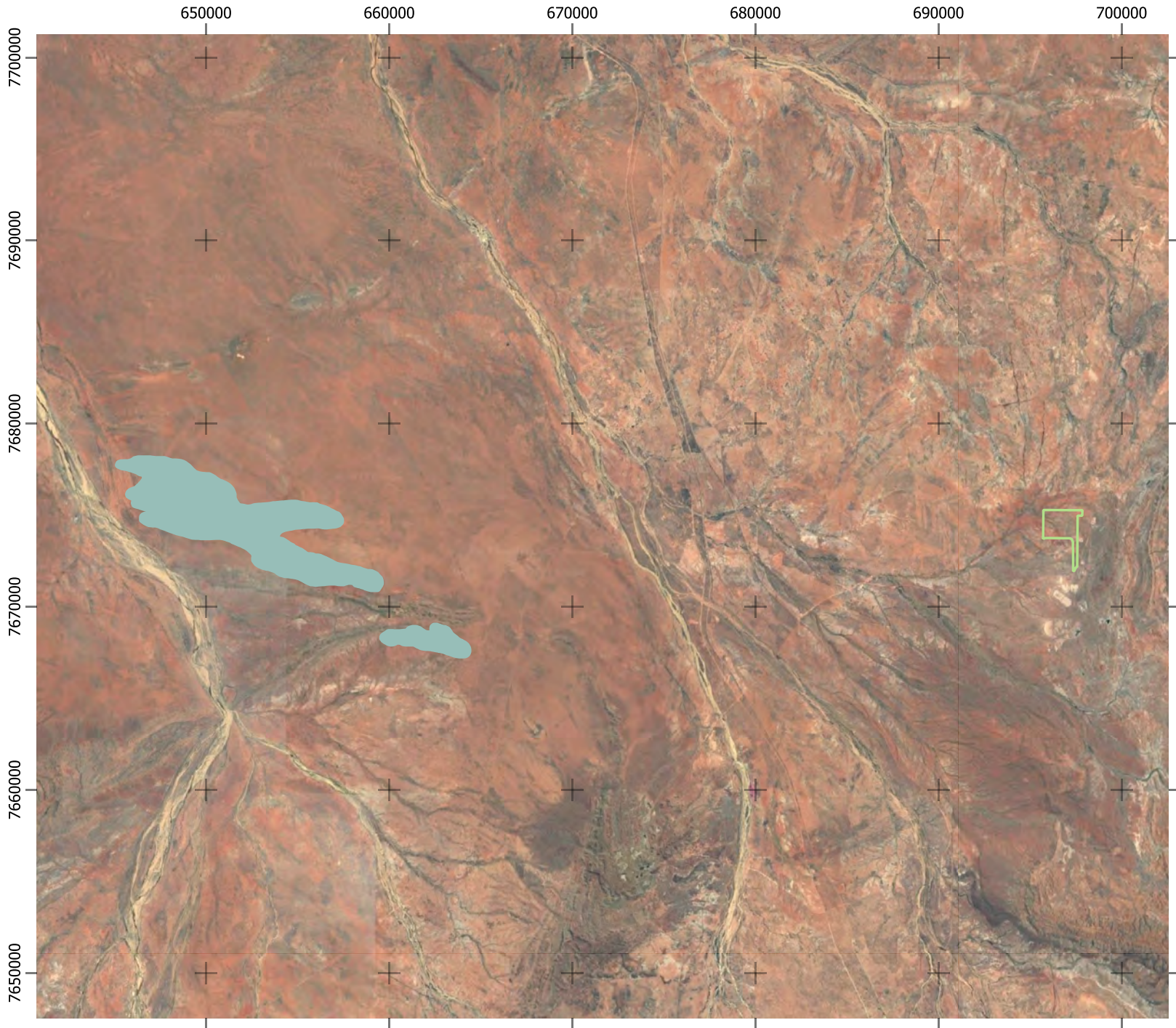
Table 4-1. Threatened and Priority Flora Likelihood of Occurrence

Species	Cons. Code		Preferred Habitat	Likelihood of Occurrence
	BC Act	EPBC Act		
<i>Bulbostylis burbridgeae</i>	P4		Granitic soils. Granite outcrops and cliff bases.	Possible. Suitable habitat in granite outcrop areas.
<i>Eragrostis crateriformis</i>	P3		Clayey loam or clay. Creek banks, depressions.	Unlikely. Soils are sandy, low clay content.
<i>Euphorbia clementii</i>	P3		Gravelly hillsides, stony grounds.	Unlikely. No suitable habitat.
<i>Euploca mutica</i>	P3		Hummock grassland and sandplains.	Present. Suitable habitat in sandplains.
<i>Gomphrena leptophylla</i>	P3		Open flats, sandy creek beds, edges salt pans and marshes, stony hillsides.	Possible. Suitable habitat in the plains and sandy creek beds.
<i>Goodenia nuda</i>	P4		Has been previously found in drainage lines of red-brown loamy sand or sandy loam and in disturbed roadside areas	Possible. Suitable habitat in creeks and roadsides.
<i>Gymnanthera cunninghamii</i>	P3		Sandy soils, creeks.	Possible. Suitable habitat in sandy creeks.
<i>Nicotiana umbratica</i>	P3		Typically grows in shelter of large boulders on rocky outcrops and in shallow soils	Possible. Suitable habitat in granite outcrop areas.
<i>Phyllanthus hebecarpus</i>	P3		Granite boulders/outcropping	Possible. Suitable habitat in granite outcrop areas.
<i>Quoya zonalis</i>	EN	EN	Steep, rocky, sandstone conglomerate and granite slopes in skeletal, brown, sandy loam soils of the Capricorn Land System	Unlikely to occur. No suitable habitat.
<i>Rothia indica</i> subsp. <i>australis</i>	P3		Sandy soils. Seasonally inundated areas, sandhills and flats.	Likely. Suitable habitat in sandplains.
<i>Stylidium weeliwoolli</i>	P3		Gritty sand soil, sandy clay. Edge of watercourses.	Possible. Sandy creek edges.

<i>Terminalia supranitifolia</i>	P3	Sand. Among basalt rocks.	Unlikely to occur.
<i>Themeda</i> sp. Panorama (J. Nelson <i>et al.</i> NS 102)	P1	Has been found growing along watercourses and creeklines and on rocky substrate	Unlikely to occur.
<i>Triodia basitricha</i>	P3	Occurs on rocky and gravelly slopes of mountains or low hills.	Unlikely to occur.
<i>Triodia chichesterensis</i>	P3	Occurs on sand or loam over rocky or gravelly substrates, often with quartzite.	Present. Suitable habitat includes low rises with rocky soils containing quartzite.
<i>Vigna triodiophila</i>	P3	Local record among dolerite boulders on very steep upper slope. Stony red-brown clay loam.	Unlikely to occur.

4.1.2 Significant Vegetation

There are no TECs listed under the BC Act or EPBC Act known to occur within the Survey Area. One Priority 3 Ecological Community is located approximately 30 km west of the Survey Area; the Gregory Land System (Figure 4-2).

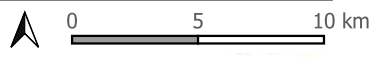


Legend

- Infill Survey Area
- Gregory Land System Priority 3 Ecological Community



Scale: @ A4
1: 300,000



Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator



Author: EH Approved: ML Date: 16/03/2023

Threatened and Priority Ecological Communities

Prepared for:
 Pilbara Minerals

Figure: 4-2

4.1.3 Introduced Flora Species

Dandjoo returned two introduced flora species (*Cenchrus ciliaris* and *Flaveria trinervia*), both categorised under S11-Permitted under the BAM Act. Eleven introduced flora species have been recorded locally by previous surveys (MMWC Environmental 2016a; APM 2022a,b), including two Declared pests also listed as WONS.

Table 4-2 lists the introduced flora species recorded within 30 km of the Survey Area.

Table 4-2. Introduced Flora Records within 30 km of the Survey Area

Species	Common Name	BAM Act Listing	WONS
<i>Aerva javanica</i>	Kapok Bush	Permitted – S11	No
<i>Cenchrus ciliaris</i>	Buffel Grass	Permitted – S11	No
<i>Cenchrus setiger</i>	Birdwood Grass	Permitted – S11	No
<i>Chloris barbata</i>	Purpletop Chloris	Permitted – S11	No
<i>Cynodon dactylon</i>	Couch Grass	Permitted – S11	No
<i>Flaveria trinervia</i>	Speedy Weed	Permitted – S11	No
<i>Malvastrum americanum</i>	Spiked malvastrum	Permitted – S11	No
<i>Opuntia stricta</i>	Common Prickly Pear	Declared Pest – S11(2) (C3 Restricted)	Yes
<i>Passiflora foetida</i> var. <i>hispida</i>	Stinking Passion Flower	Permitted – S11	No
<i>Tamarix aphylla</i>	Athel Pine	Declared Pest – S22(2) (Exempt)	Yes
<i>Triumfetta pentandra</i>	-	Permitted – S11	No

4.2 FIELD SURVEY

4.2.1 Flora

A total of 119 species of flora were recorded within the Survey Area, comprising 117 native species and two introduced species. One specimen in the collection (0.8% of the collection) could not be unambiguously identified beyond genus level due to the lack of flowering parts or fruiting bodies.

The *Poaceae* (grass family, 28 native, one introduced), *Fabaceae* (pea family, 24 native) *Malvaceae* (nine native species), *Convolvulaceae* (eight native species) and *Goodeniaceae* (seven native species) were the most species-rich families recorded. Twenty-five families from 67 genera were recorded across the Survey Area.

The complete list of plant species recorded within the Survey Area is presented in Appendix F. The mean species richness was 32 species per quadrat, higher than other local surveys including the MMWC Environmental (2016a) survey which included 49 detailed sites with an average species richness of 25, the TSF Option 2 and 5 Survey (APM 2022b with 19 detailed sites and an average species richness of

23, and the Lynas Find survey (APM 2022a) with 23 detailed sites and an average species richness of 20. The increased floristic diversity is most likely due to season of survey, seasonal conditions, and the effect of recent fire in the Survey Area.

A species accumulation curve was performed with a modelled Michaelis-Menton species richness of 136, indicating that the floristic survey was approximately 87.5% complete.

The survey recorded 11 species not previously recorded for the Pilgangoora Project area (including the Lynas Find and TSF Option 2 and 5 areas). These species are identified in Appendix F and bring the total richness for the Pilgangoora Project area to 271 including subspecies, and varieties.

Floristic groups identified in the cluster analysis were organised into vegetation types and are discussed in the following section.

The introduced flora species recorded are detailed in Section 4.2.6.

4.2.2 Vegetation Types

The DBCA fire history database identified that some areas within the Survey Area were subject to fire activity as recently as 2018. Recently burned areas were apparent during field survey and time since fire was estimated based upon the level of regeneration with consideration of the good growth conditions following significant rainfall in the 2022 calendar year, followed by good rainfall in January 2023.

Three vegetation types are described for the Survey Area, as summarised in Table 4-3 and detailed below.

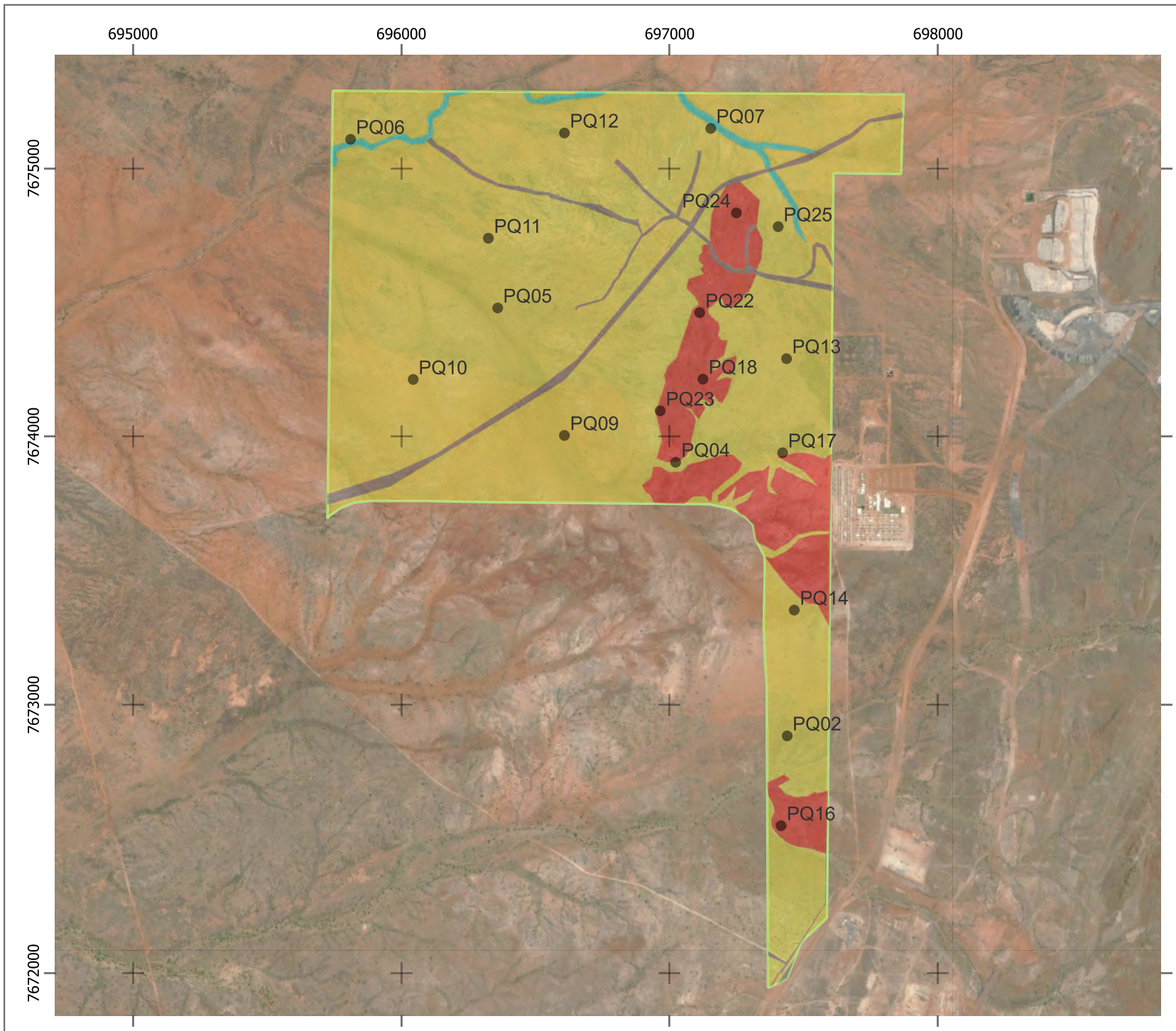
Table 4-3. Vegetation Types

Code	Landform	Vegetation Description	ha	%
9a	Stony rises and outcrops	<i>Isolated low Corymbia hammersleyana</i> over mid to tall <i>Grevillea wickhamii</i> , <i>Acacia inaequilatera</i> and <i>Acacia colei</i> sparse shrubland with <i>Triodia wiseana</i> . <i>Triodia chichesterensis</i> (P3) and <i>Triodia angusta</i> hummock grassland.	38.7	11.6
12a	Undulating sandy plains	Isolated low <i>Corymbia hammersleyana</i> over mid to tall <i>Acacia adsurgens</i> , <i>Acacia cowleana</i> and <i>Acacia colei</i> sparse shrubland with mid hummock grassland of <i>Triodia lanigera</i> , <i>Triodia epactia</i> and <i>Triodia wiseana</i> .	280.6	83.9
15a	Sandy Creek	Low open woodland of <i>Corymbia hammersleyana</i> , over <i>Acacia adsurgens</i> , <i>Acacia cowleana</i> , and <i>Acacia bivenosa</i> open shrubland and <i>Triodia epactia</i> , <i>Triodia lanigera</i> and <i>Triodia wiseana</i> hummock grassland.	4.4	1.3
D	-	Disturbed – clear of vegetation	10.9	3.3
Total			334.6	100

As the Survey Area is continuous with other surveys conducted for the Pilbara Minerals Pilgangoora Project, the vegetation coding system previously used at the site has been retained and extended.

MMWC Environmental (2016a) described vegetation type using the numerals 1 to 6, and the letters a to c, to group sites by landform and floristics respectively. APM (2022a,b) adopted the approach and described vegetation types using the numerals 6 to 14. Vegetation types in Table 4-3 labelled 15 onwards and are different from those recorded previously, those with codes less than 15 are synonymous with previously described vegetation types.

Distribution of vegetation types at a scale of 1: 20,000 is shown in Figure 4-3. The dendrogram resulting from the cluster analysis is shown in Appendix C, followed by the site data sheets and photos.



Legend

- 9a: Isolated low *Corymbia hammersleyana* over mid to tall *Grevillea wickhamii*, *Acacia inaequilatera* and *Acacia colei* sparse shrubland with *Triodia wiseana*. *Triodia chichesterensis* (P3) and *Triodia angusta* hummock grassland.
- 12a: Isolated low *Corymbia hammersleyana* over mid to tall *Acacia adsurgens*, *Acacia cowleana* and *Acacia colei* sparse shrubland with mid hummock grassland of *Triodia lanigera*, *Triodia epactia* and *Triodia wiseana*.
- 15a: Low open woodland of *Corymbia hammersleyana*; over *Acacia adsurgens*, *Acacia cowleana* and *Acacia bivenosa* open shrubland and *Triodia epactia*, *Triodia lanigera* and *Triodia wiseana* hummock grassland.
- Disturbed
- Quadrat

Scale: @ A4
1: 20,000



0 200 400 m

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator



Author: EH Approved: ML Date: 14/05/2023

Vegetation

Prepared for:
 Pilbara Minerals

Figure: 4-3

Landform: Undulating sandy plains

Vegetation Type: 12a

Isolated low *Corymbia hammersleyana* over mid to tall *Acacia adsurgens*, *Acacia cowleana* and *Acacia coleii* sparse shrubland with mid hummock grassland of *Triodia lanigera*, *Triodia epactia* and *Triodia wiseana*.

Other common shrub species included *Acacia bivenosa*, *Acacia inaequilatera*, *Corchorus incanus*, *Goodenia stobbsiana*, *Tephrosia arenicola*, *Grevillea wickhamii*, *Indigofera monophylla*, *Bonamia erecta*, *Hibiscus sturtii*, *Ptilotus obovatus* and *Grevillea pyramidalis*.

Groundcover was diverse, likely because of recent fire (2-5 years) over the majority of this vegetation type followed by good rainfall in 2022 and January 2023. Common species also included *Triodia angusta*, *Chrysopogon fallax*, *Cassytha capillaris*, *Triodia schinzii*, *Aristida holathera*, *Trigastrotheca molluginea*, *Polycarpaea corymbosa*, *Ptilotus calostachyus*, *Goodenia microptera*, *Arivela uncifera*, *Bonamia linearis*, *Eragrostis eriopoda*, *Polymeria ambigua*, *Bulbostylis barbata*, *Rhynchosia minima* and *Trianthema pilosum*.

This community occurs on loamy sand soils of undulating plains, sometimes with small pebbles and stones at the surface. The *Acacia* dominated mid story occurs in higher density in areas where run on occurs such as shallow drainage depressions but is generally a tall and sparse shrub layer. The ground layer is dominated by the hard spinifex species *Triodia lanigera* and *Triodia wiseana*.



Plate 4-1. Quadrat PQ05 (696383, 7674440)

Condition: Impacts from cattle grazing are low. One weed species was recorded. The condition of this vegetation is Very Good. Areas recovering from fire are regenerating rapidly following good rainfall in 2022 and January 2023, with no erosion evident.

Detailed sites: PQ2, PQ04, PQ05, PQ09, PQ10, PQ11, PQ12, PQ13, PQ14, PQ17, PQ25

Total richness: 87 species. Average richness: 30.9 species.

Introduced/exotic taxa: The exotic agricultural grass **Cenchrus ciliaris* was recorded at one site in low abundance.

Conservation significant species: *Euploca mutica* (0.1% cover at PQ09, PQ10, PQ13 and PQ17) and *Triodia chichesterensis* (15% cover at PQ04). Within this vegetation type, the presence of *Triodia chichesterensis* is unique to the PQ04 site due to its position at the base of the stony outcrop area and the differences in soil type/geology in that location.

This vegetation type is synonymous to that described for the TSF survey areas to the south (Vegetation type 12a [APM 2022b]), with very minor changes in the abundances of the common *Triodia* and *Acacia* species present. The sites surveyed in the Infill area have a higher floristic richness compared to those recorded at the TSF sites, due to differences in survey season and the effects of fire frequency in the Infill areas. In hard spinifex grasslands of the Pilbara plains, peak floristic diversity is often recorded at fire intervals of less than 5-10 years (DPIRD 2023).

Landform – Sandy Creek**Vegetation Type: 15a**

Low open woodland of *Corymbia hammersleyana*, over *Acacia adsurgens*, *Acacia cowleana*, and *Acacia bivenosa* open shrubland and *Triodia epactia*, *Triodia lanigera* and *Triodia wiseana* hummock grassland.

Common shrubs also included *Acacia coleii*, *Cajanus cinereus*, *Acacia inaequilatera*, *Grevillea wickhamii*, *indigofera rugosa*, *Afrohybanthus aurantiacus*, *Corchorus incanus*, *Hibiscus sturtii*, *Ptilotus obovatus*, *Senna artimisioides* subsp. *helmsii*, *Tephrosia arenicola* and *Triumfetta appendiculata*.

Common groundcover species also included *Themeda triandra*, *Chrysopogon fallax*, *Heteropogon contortus*, *Cassytha capillaris*, *Dichanthium sericeum*, *Nellica maderaspatensis*, *Polymeria ambigua*, *Aristida holathera*, *Notoleptopus decaisnei*, *Paraneurachne muelleri*, *Paspalidium clementii*, *Ptilotus calostachyus*, *Rhynchosia minima* and *Sporobolus australasicus*.

This community occurs in the sandy creekline along the north of the Survey Area with red sandy to loamy sand soils. Riparian banks are often present with alluvial loamy soils. Creeks are all ephemeral with no permanent pools present. Whilst similar to Vegetation type 12a, there is a denser canopy and mid shrub layer and a more diverse and floristically different groundcover dominated by the soft spinifex *Triodia epactia*. The composition is also different compared to other creek lines mapped for the broader project area.



Plate 4-2. Quadrat PQ07 (697181, 7675148)

Condition: Impacts from cattle grazing are moderate, erosion is present on riparian banks and the agricultural weed *Cenchrus ciliaris* is also present in low density. The condition of this vegetation is Very Good.

Detailed sites: PQ06, PQ07

Total richness: 62 species. Average richness: 43.5 species

Introduced/exotic taxa: The exotic agricultural grass **Cenchrus ciliaris* was recorded at one site in low abundance.

Conservation significant species: None

Landform – Stony rises and outcrops

Vegetation Type: 9a

Isolated low *Corymbia hammersleyana* over mid to tall *Grevillea wickhamii*, *Acacia inaequilatera* and *Acacia colei* sparse shrubland with *Triodia wiseana*. *Triodia chichesterensis* (P3) and *Triodia angusta* hummock grassland.

Common shrubs also included *Acacia adsurgens*, *Indigofera rugosa*, *Goodenia stobbsiana*, *Indigofera monophylla*, *Grevillea pyramidalis*, *Corchorus incanus*, *Abutilon lepidum*, *Ptilotus obovatus*, *Senna notabilis* and *Senna artimisioides* subsp. *helmsii*.

Common groundcover species also included *Cassutha capillaris*, *Triodia epactia*, *Cymbopogon ambiguous*, *Bulbostylis barbata*, **Aerva javanica*, *Bonamia pilbarensis*, *Gomphrena cunninghamii*, *Goodenia lamprosperma*, *Trigastrotheca molluginea*, *Aristida holathera*, *Arivela uncifera*, *Eriachne mucronata*, *Evolvulus alsinoides* var. *villosicalyx*, *Nellica maderaspatensis* and *Ptilotus calostachyus*.

This community occurs on stony rises and outcrops with lower areas having sandy loam soils and higher elevated areas having generally sandier soils with a greater cover of small quartzite and granite stones at the surface. On the highest ground, small outcrops are present.



Plate 4-3. Quadrat PQ23 (696996, 7674040)

Condition: Impacts from cattle grazing are very low, the weed **Aerva javanica* is present surrounding rocky outcrops. The condition of this vegetation is Excellent.

Detailed sites: PQ16, PQ18, PQ22, PQ23, PQ24

Total richness: 76 species. Average richness: 30.2 species.

Introduced/exotic taxa: **Aerva javanica* and **Cenchrus ciliaris* are present in low abundance.

Conservation significant species: *Triodia chichesterensis* was recorded at PQ18 (10% cover) and PQ23 (5% cover).

This vegetation type is synonymous to that described for the Lynas Find survey area to the east (Vegetation type 9a [APM 2022a]), with very minor changes in the abundances of the *Acacia* and sub dominant *Triodia* species present. The sites surveyed in the Infill area have a higher floristic richness compared to those recorded at the TSF sites, due to differences in survey season and lower evidence of grazing pressure.

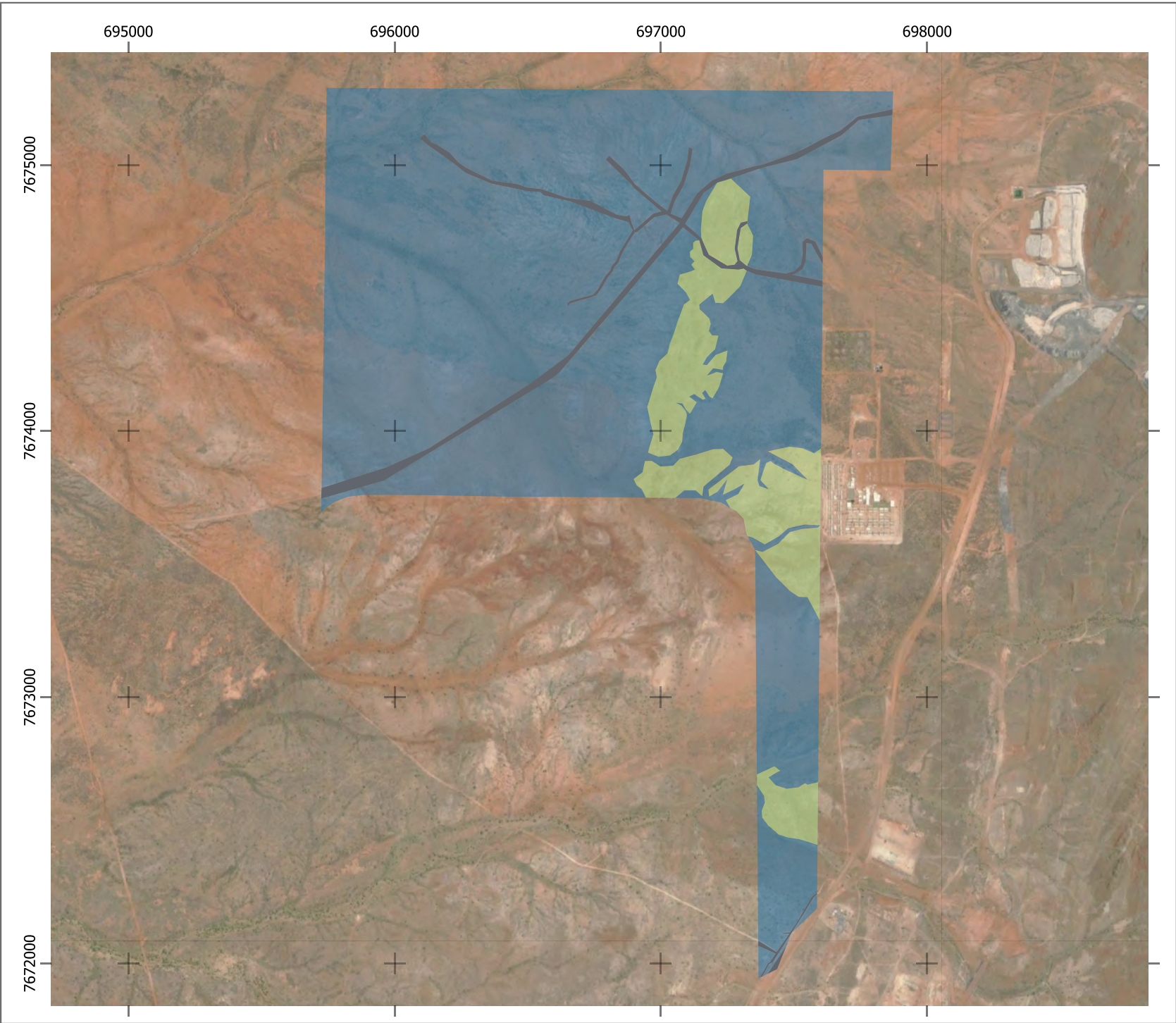
In the cluster analysis, site PQ16 was classified as a separate group. It has been included within this community due to occurring on a similar landform and having similarity in the dominant vegetation strata (i.e. has an isolated *Corymbia hammersleyana* overstory, a mid-layer composed of predominantly *Grevillea wickhamii* and *Acacia inaequilatera* with *Triodia wiseana*, *Triodia epactia* and *Triodia angusta* hummock grasses). The separation within the cluster analysis is due to the presence of *Triodia brizoides*, a common species in the vegetation type 3a (MMWC 2016a), which occurs broadly in the area to the east, but has not otherwise been recorded in the Infill Survey Area.

4.2.3 Vegetation Condition

Vegetation condition across the Survey Area was within the categories Excellent, Very Good and Completely Degraded, with most of the Survey Area in Very Good condition (Table 4-4; Figure 4-4). The primary sources of disturbance on site are recent fire scarring, low to moderate grazing impact from cattle and roads to support the pastoralism activities. Additional tracks are present in support of the nearby mining activity.

Table 4-4. Vegetation condition within the Survey Area

Vegetation Condition	Area (ha)	Area (%)
Excellent	38.7	11.6
Very Good	285.0	85.1
Completely Degraded	10.9	3.3



Legend

- Excellent
- Very Good
- Completely Degraded



Scale: @ A4
 1: 20,000

0 200 400 m

Coordinate System: GDA 1994 MGA Zone 50
 Projection: Transverse Mercator

Author: EH Approved: ML Date: 15/05/2023



Vegetation Condition

Prepared for:
Pilbara Minerals

Figure: 4-4

4.2.4 Significant Flora

No species listed as T under the EPBC Act or BC Act were recorded during the survey.

Two P3 species were recorded during the survey. These were *Euploca mutica* and *Triodia chichesterensis*.

4.2.4.1 *Euploca mutica*

Euploca mutica is a small, perennial herb/shrub that grows to approximately 0.3 m. Atlas of Living Australia collection records for the species identify that flowering specimens are often collected in August, and that habitat includes sandy or calcareous plains, often on granite geology, with a sandy or loamy surface often with ironstone and quartz.

The species was first recorded in the local area during surveys undertaken by MMWC Environmental in 2016a. At the time of the MMWC Environmental (2016) survey the species was known as *Heliotropium muticum* and was considered to be a Priority 1 species. Taxonomic revision for the species has led to the revision of the name to *Euploca mutica* (Frohlich *et al.* 2020) and targeted searches resulting in increased known population size has led to a revision of the status to Priority 3.

Euploca mutica was found at four locations within the Survey Area within the undulating sandy plains in generally low, scattered abundance. Targeted searches were conducted where individuals were found to identify the population size and extent within these areas. Thirty-one individuals were recorded, locations of records are shown in Figure 4-5.

4.2.4.2 *Triodia chichesterensis*

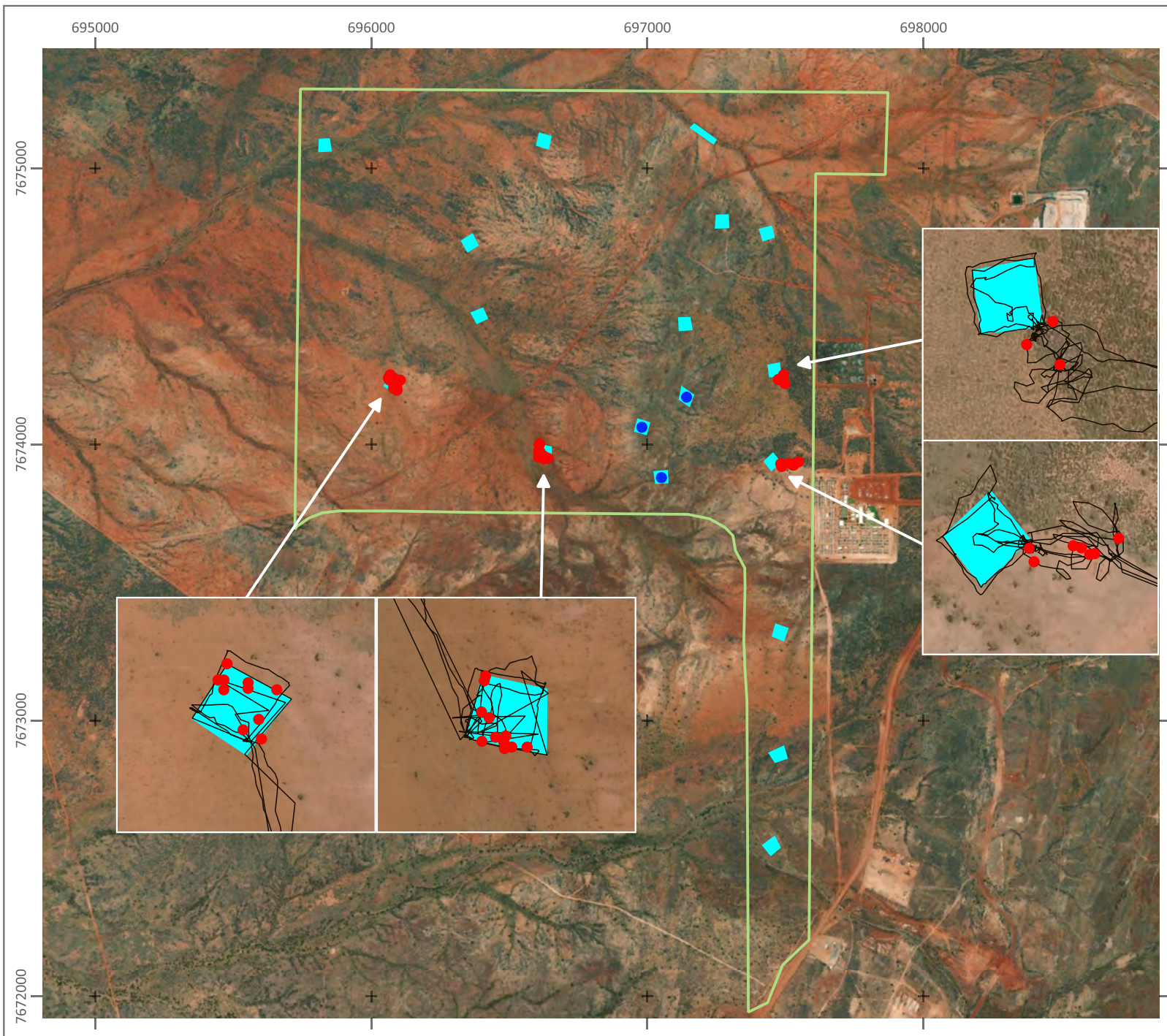
Triodia chichesterensis is described by Anderson *et al.* (2017). It is characterised by being a short-leaved species, distinguished by the combination of diminutive stature, glabrous leaf sheaths, relatively unbranched inflorescence, often short pedicels, and pubescent lemma midlobe. The short pedicels and pubescent lemma midlobe contrast with the typically longer pedicels and glabrous lemma midlobes of other short-leaved species in the complex (*T. nana*, *T. scintillans*, *T. vanleeuwenii*). It is distinguished from the closely related and often co-occurring *Triodia lanigera* by its shorter and less hairy leaves and less branched inflorescence.

The species has a limited distribution and has been found only in a narrow area in the central Chichester region of the Pilbara of WA. The areas immediately to the west and east of its known distribution are poorly explored, but it is likely to be restricted to an area <100 km beyond current collections, given intensive collecting efforts in the Pilbara (Anderson *et al.* 2017).

The Survey Area is in the central part of the range of this species, which is significant from the perspective of determining it from the closely related *Triodia lanigera* (Anderson *et al.* 2017). Where the two co-occur in the south it can be difficult to determine them based on morphological and distributional parameters. Where the two co-occur in the north, there is a subtle but consistent substrate change that marks the shift in species, with *T. lanigera* occurring on sandier soils and *T. chichesterensis* on rockier soils with quartzite pieces. In the northern species range, it can usually be morphologically distinguished from *T. lanigera* by its shorter and less hairy leaves and less branched inflorescences.

The species has been previously found within the Project on rocky soils with quartzite (APM, 2022a,b). Within the Survey Area, the species was also recorded within sandy red soils with a substantial coverage of rocks and pebbles including quartzite. *Triodia lanigera* was common on the sandy soils with minimal surface rock and generally lacking in quartzite.

Collection records indicate that florets are observed between February–April and in August. At the time of the Survey in March, some flowering material was available, and the species was able to be determined using the taxonomic key published by Anderson *et al.* (2017). Observations of the species made within the Survey Area are presented in Figure 4-5.



Legend

Infill Survey Area

Flora Survey Sites

Excellent

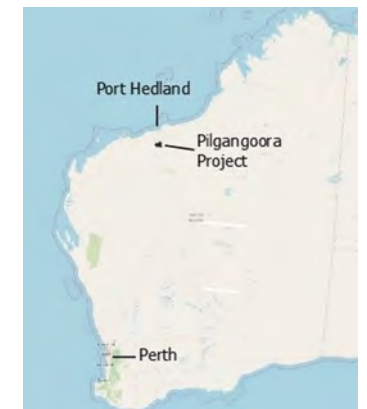
Good

Very Good

Targeted Search Traverses

Euploca mutica (P3)

Triodia chichesterensis (P3)



Scale: @ A4
1: 20,000



Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator



Author: TB Approved: EH Date: 04/04/2023

Priority Flora Records

Prepared for:



Figure: 4-5

4.2.5 Significant Vegetation

No vegetation types occurring within the Survey Area are analogous to any known TEC’s or PEC’s.

4.2.6 Introduced Flora

Two introduced flora species were recorded in the Survey Area and are listed in Table 4-5. No Declared Weeds or WONS were recorded.

Table 4-5. Introduced Flora Recorded within the Survey Area

Species	Common name	Description
BAM Act S11 - Permitted		
<i>Aerva javanica</i>	Kapok	Erect, much-branched perennial herb, 0.4-1.6 m high. Flowers white from January to October. Often found growing on sandy soils and along drainage lines.
<i>Cenchrus ciliaris</i>	Buffel grass	Tufted or sometimes stoloniferous perennial, grass-like or herb. 0.2 - 1.5 m high. Flowers purple from February to October. Grows on white, red, or brown sand, stony red loam, or black cracking clay.

The agricultural weed *Cenchrus ciliaris* was recorded in all vegetation types, occurring only occasionally and in very low abundance. Where found, these weeds were grazed.

The environmental weed *Aerva javanica* was occurring only occasionally and in very low abundance, restricted to the rocky outcrop vegetation type.

5 TERRESTRIAL VERTEBRATE FAUNA RESULTS

5.1 DESKTOP STUDY

5.1.1 Significant Fauna

The DBCA database returned 15 species of significant fauna that have previously been recorded within 30 km of the Survey Area. Of these, three are listed as migratory bird species (**MI**) and one as Other Specifically Protected (**OS**). Record locations of significant fauna in relation to the Survey Area are shown in Figure 5-1.

No T fauna species have previously been recorded within the Survey Area. One Priority 4 species, the spectacled hare-wallaby (mainland) (*Lagorchestes conspicillatus leichardt*) has historically been recorded within the Survey Area.

The PMST returned 12 additional species, four T, six MI and two that are both T and MI. These are species that do not have records within 30 km but where modelling has identified that suitable habitat is known to occur or may occur.

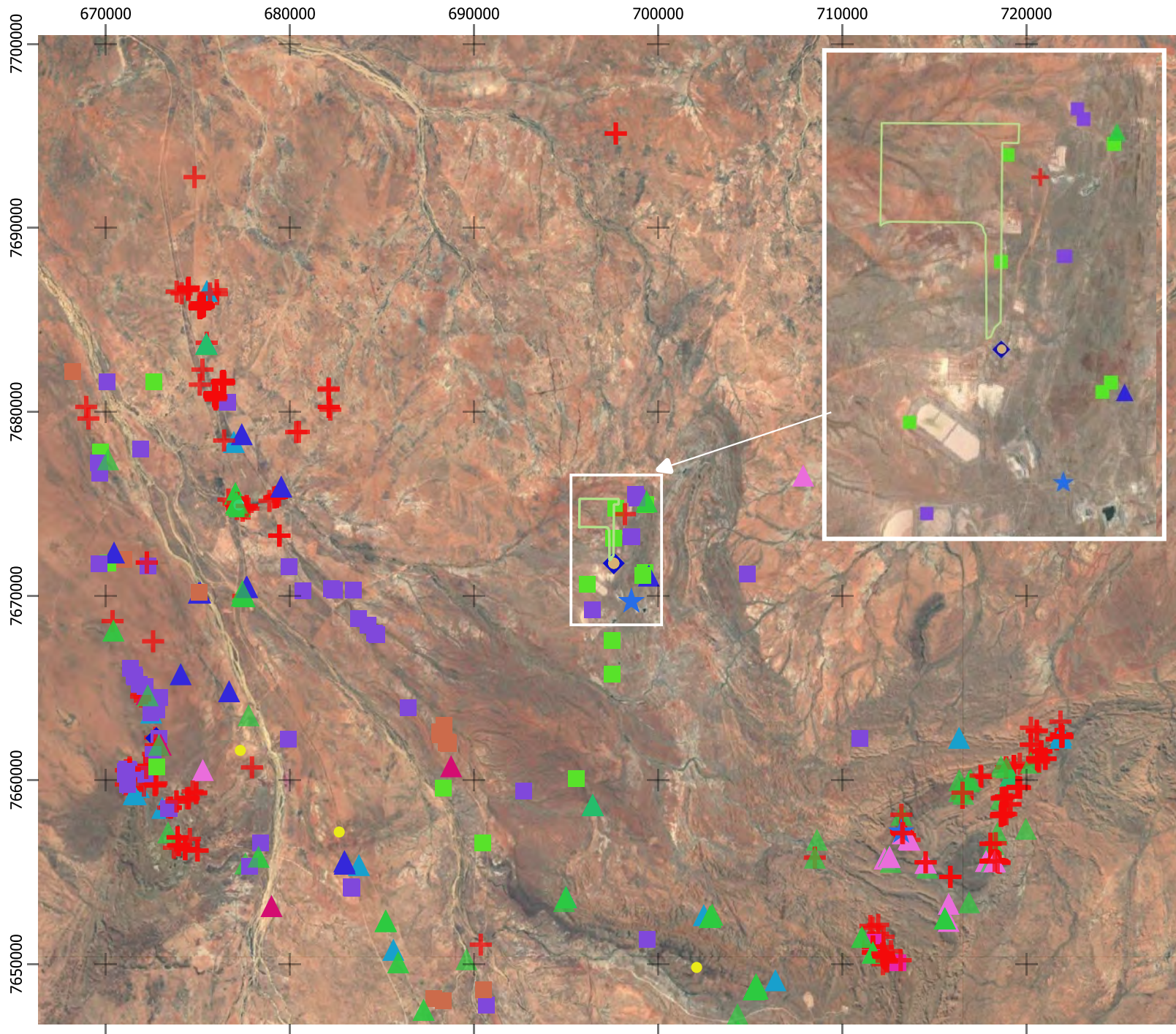
The literature review returned additional information about the locations and abundance of Pilbara leaf-nosed bat and Northern quoll records.

Database search results of T, P and MI fauna within 30 km of the Survey Area are listed in Table 5-1, with the outcome of the likelihood of occurrence assessment. The complete assessment including the preferred habitat relative to those available in the Survey Area and a summary of records in the local area is included in Appendix G.

5.1.2 Introduced Fauna

Dandjoo database records did not return any introduced fauna. A search of the superseded NatureMap database in September 2022 for a nearby area returned records for eight introduced fauna as listed below:

- Camel (*Camelus dromedarius*);
- Cat (*Felis catus*);
- Cattle (*Bos taurus*);
- Dog (*Canis lupus*);
- Donkey (*Equus asinus*)
- Fox (*Vulpes vulpes*)
- Horse (*Equus caballus*); and
- House mouse (*Mus musculus*).



Legend

- Infill Survey Area
- Endangered**
- + *Dasyurus hallucatus*
- Vulnerable**
- ▲ *Falco hypoleucos*
- ▲ *Liasis olivaceus barroni*
- ▲ *Macroderma gigas*
- ▲ *Macrotis lagotis*
- ▲ *Rhinonictes aurantia (Pilbara)*
- Priority 1**
- ★ *Anilius ganeii*
- Priority 4**
- *Dasyercus blythi*
- *Lagorchestes conspicillatus leichardti*
- *Pseudomys chapmani*
- *Sminthopsis longicaudata*
- Migratory**
- *Actitis hypoleucos*
- *Apus pacificus*
- *Charadrius veredus*
- Other Specially Protected**
- ◆ *Falco peregrinus*

Scale: @ A4
 1: 300,000

Coordinate System: GDA 1994 MGA Zone 50
 Projection: Transverse Mercator

Author: EH Approved: ML Date: 20/03/2023

**Significant Fauna Database
 Records**

Table 5-1. Significant fauna database records and likelihood of occurrence

Species	Common Name	Conservation Code		Assessment of Occurrence
		BC Act	EPBC Act	
<i>Actitis hypoleucos</i>	Common sandpiper	MI	MI	
<i>Calidris acuminata</i>	Sharp-tailed sandpiper	MI	MI	
<i>Calidris ferruginea</i>	Curlew sandpiper	CR	CR, MI	
<i>Calidris melanotos</i>	Pectoral sandpiper	-	MI	Unlikely. No saline or coastal habitats available.
<i>Numenius madagascariensis</i>	Eastern curlew	CR	CR, MI	Freshwater habitats are likely to be seasonally present in the drainage lines, however there are no permanent or semi-permanent pools and the surface substrates are sandy and therefore likely to be well draining.
<i>Glareola maldivarum</i>	Oriental pranticole	MI	MI	The Survey Area contains no areas where seasonal inundation is expected to occur.
<i>Hirundo rustica</i>	Barn swallow	MI	MI	
<i>Motacilla cinerea</i>	Grey wagtail	MI	MI	
<i>Motacilla flava</i>	Yellow wagtail	MI	MI	
<i>Apus pacificus</i>	Fork-tailed swift	MI	MI	Possible. Utilises a broad array of habitats.
<i>Charadrius veredus</i>	Oriental plover	MI	MI	Likely. Suitable habitat in the open plains.
<i>Erythroriorchis radiatus</i>	Red goshawk	VU	VU	Unlikely. Not within the known range of the species distribution.
<i>Falco hypoleucos</i>	Grey falcon	VU	VU	Likely. All areas are suitable for foraging. No suitable nesting habitat.
<i>Falco peregrinus</i>	Peregrine falcon	OS	-	Likely. All areas are suitable for foraging. No suitable nesting habitat.
<i>Pezoporus occidentalis</i>	Night parrot	CR	EN	Possible. No local records. Habitat modelling includes the Survey Area at the extremity of the species potential extent. Foraging resources are limited.

Species	Common Name	Conservation Code		Assessment of Occurrence
		BC Act	EPBC Act	
<i>Rostratula australis</i>	Australian painted-snipe	EN	EN	Unlikely. No habitat occurs in the Survey Area. Vegetation too open to provide well vegetated shallows.
<i>Dasyercus blythi</i>	Brush-tailed mulgara	P4	-	Likely. Sandy plains habitat is suitable.
<i>Dasyurus hallucatus</i>	Northern quoll	EN	EN	Likely. Suitable foraging habitat in the creeks but of low quality. Limited suitable denning and foraging habitat available in the larger outcrops.
<i>Lagorchestes conspicillatus leichardti</i>	Spectacled hare-wallaby	P4	-	Likely. Historic records nearby and suitable habitat is present in the denser shrub covered areas.
<i>Macroderma gigas</i>	Ghost bat	VU	VU	Likely. Foraging habitat available. No roosting habitat available.
<i>Macrotis lagotis</i>	Greater bilby	VU	VU	Possible. All habitats are suitable.
<i>Pseudomys chapmani</i>	Western pebble-mound mouse	P4	-	Present. Mounds located in the plains where suitable pebbles occur.
<i>Rhinonicteris aurantia</i>	Pilbara leaf-nosed bat	VU	VU	Present. No roosting habitat available, foraging quality of habitats is Low.
<i>Sminthopsis longicaudata</i>	Long-tailed dunnart	P4	-	Unlikely. No suitable habitat.
<i>Anilius ganei</i>	Gane's blind snake (Pilbara)	P1	-	Unlikely. No suitable habitat.
<i>Liasis olivaceus</i> subsp. <i>baronni</i>	Pilbara olive python	VU	VU	Unlikely. No suitable habitat.
<i>Liopholis kintorei</i>	Great desert skink	VU	VU	Unlikely. No records in the local area. May occur 10 km to the east.

5.2 FIELD SURVEY

5.2.1 Fauna Habitats


The Survey Area is characterised by sandy undulating plains with first and second order ephemeral creeks and shallow drainage basins. A low rocky rise occurs in the eastern half of the Survey Area, with some minor outcropping running north to south spanning approximately 800 m. There are higher ranges to the east and water sheds from these into the Survey Area through the minor drainages that continue to the west. The presence of water is ephemeral, and no permanent or semi-permanent water is available. There are no areas where seasonal inundation is expected to occur. Vegetation is sparse on the rocky rises and plains, and densest in the shallow drainage basins.


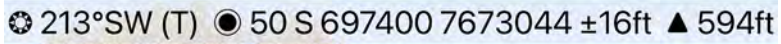

The Survey Area has Moderate (burnt 2-5 years previously) to Very Old fire age. Recent fires recorded on the DBCA (2022) database indicate approximately 123 ha burned in 2015, five ha burned in 2016 and 37 ha burned in 2017, totalling 49% of the Survey Area. Evidence of more recent fire was apparent from the field survey, with southern sections of the plains showing evidence of burning within the past 2 years.


Four fauna habitats are described for the Survey Area and are summarised in Table 5-2 below. Codes used in previous surveys for the Pilgangoora Project (APM 2022a,b) have been retained where appropriate and comparisons made to other existing survey (360 Environmental 2016).

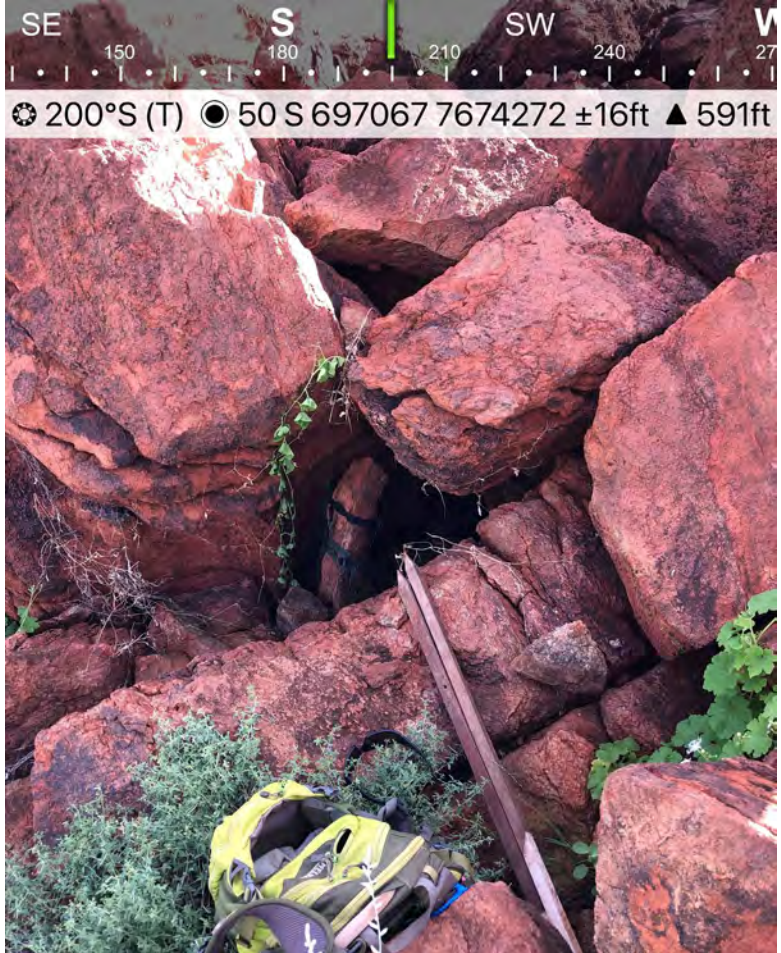
The distribution of fauna habitats is shown in Figure 5-2. Photos of the habitat assessment locations are shown in Appendix D.

Table 5-2. Fauna Habitats within the Survey Area

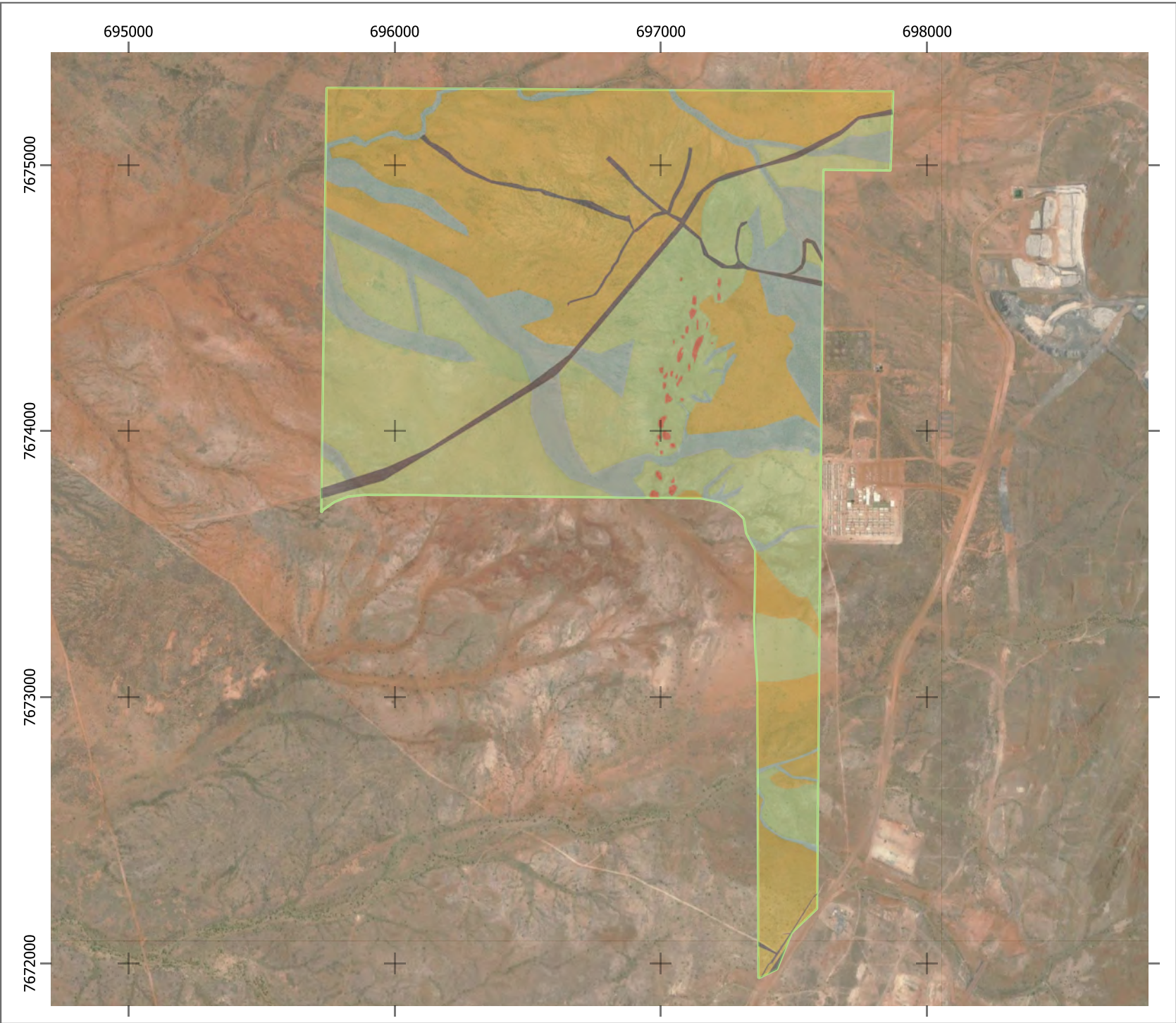
Code/Name/Sites	Description	Photo
<p>Shallow Drainage basins and creeks</p>	<p>Minor sandy bottomed ephemeral first and second order creeks, and shallow drainage depressions. The densest vegetation of the Survey Area occurs in this habitat type, with thick Acacia shrubs found in the drainage depressions, and less densely along the creek banks.</p>	
<p>Habitat Code: FH2</p>	<p>The sandy substrate indicates that water pooling is unlikely to occur, and no evidence of water pooling was observed.</p>	
<p>Survey Sites: MSC006, MSC009, MSC013, MSC019 AS450083 AS450007 NP2, NP4 T05, T02, T09</p>	<p>Sand in the stream beds is suitable for burrowing species. Occasional trees occur but generally of insufficient size to have hollows and no fallen hollow branches observed. Small amounts of litter were present. The dense vegetation provides cover for species sensitive to predation. This habitat may act as a wildlife corridor for birds, bats, mammals, and reptiles. The habitat value is high.</p> <p>Cattle impacts were low, the weedy and fire prone introduced fodder grass genus <i>Cenchrus</i> is present in low frequency and density.</p> <p>The vegetation consists of Low open woodland of <i>Corymbia hammersleyana</i>, over <i>Acacia adsurgens</i>, <i>Acacia cowleana</i>, and <i>Acacia bivenosa</i> open shrubland and <i>Triodia epactia</i>, <i>Triodia lanigera</i> and <i>Triodia wiseana</i> hummock grassland.</p>	
<p>Extent in Survey Area: 59.05 ha (17.6%)</p>	<p>This habitat type is synonymous with habitat FH2 described in APM 2022b and Drainage Line habitat described in 360 Environmental (2016), however is of lower quality due to the canopy being composed of smaller trees lacking in hollows, and the absence of River Red Gum.</p>	

Code/Name/Sites	Description	Photo
<p>Sandy Plains</p>	<p>This habitat type is characterised by its red sandy loam soils with low surface rock/pebble cover. The sandy substrate is suitable for burrowing species and in some places the spinifex hummocks are large, which can provide shelter for fauna. A sparse Eucalypt overstory is present, however trees are mature and sometimes large, offering perching opportunities and the potential for future hollow development.</p>	
<p>Habitat Code: FH4</p>	<p>Availability of microhabitats in a sparse canopy, and in the groundcover of spinifex and soft substrate mean the habitat value is moderate.</p>	
<p>Survey Sites: MSC020, MSC024 NP1 T04, T06, T07, T10, T11, T12</p>	<p>Approximately half of this habitat type was burned in a low intensity fire in the past 2 years.</p> <p>Cattle grazing intensity was moderate to high. Cat tracks were also recorded within this habitat type.</p>	
<p>Extent in Survey Area: 137.01 ha (40.9%)</p>	<p>The vegetation consists of Isolated low <i>Corymbia hammersleyana</i> over mid to tall <i>Acacia adsurgens</i>, <i>Acacia cowleana</i> and <i>Acacia colei</i> sparse shrubland with mid hummock grassland of <i>Triodia lanigera</i>, <i>Triodia epactia</i> and <i>Triodia wiseana</i>.</p> <p>This fauna habitat is synonymous with the FH4 fauna habitat reported in APM (2022a) and the Sandy Plain habitat reported in 360 Environmental (2016).</p>	

Code/Name/Sites	Description	Photo
<p>Stony Plains and Rises</p>	<p>Gently undulating stony surfaces of quartzite or granite on red sandy loam soils. This habitat is suitable for small species that construct shelters from small stones. This habitat type contains limited microhabitats providing limited vegetation with sparse midstory, very few, small trees lacking hollows, few to no logs and limited leaf litter. This habitat provides limited value to fauna and given the lack of structure and microhabitats, is considered to have a low habitat value.</p>	
<p>Habitat Code: FH6</p>	<p>Approximately half of this habitat type was burned in a low intensity fire in the past 2 years.</p>	
<p>Survey Sites: MSC07, MSC016 AS642022 NP3 T01, T03, T08, T13, T14</p>	<p>No evidence of cattle grazing is present in the habitat type.</p> <p>Vegetation is Isolated low <i>Corymbia hammersleyana</i> over mid to tall <i>Grevillea wickhamii</i>, <i>Acacia inaequilatera</i> and <i>Acacia colei</i> sparse shrubland with <i>Triodia wiseana</i>, <i>Triodia angusta</i> and <i>Triodia epactia</i> hummock grassland.</p>	
<p>Extent in Survey Area: 126.58 ha (37.8%)</p>	<p>This fauna habitat is synonymous with the FH6 fauna habitat reported in APM (2022a).</p>	

Code/Name/Sites	Description	Photo
Rock Outcrop	<p>Rocky outcrops composed of angular, red granite boulders. Exposed bedrock provided cracks and crevices as important shelter sites for small and large reptiles such as goannas and snakes, and mammals such as the Northern Quoll. Soils are shallow and occur in small pockets between rocks and are unsuitable for burrowing species. The shallow soil pockets support a good cover of grasses and herbs, however tree species are absent and shrub species are sparse. This habitat type is considered to have the highest habitat value relative to the others in the Survey Area.</p>	
FH1	<p>The parent rock is close to the surface over an 800 m linear distance orientated north-south in the eastern half of the Survey Area. There are however only small outcrops where the material is exposed and arranged in a manner that supports fauna shelter.</p>	
<p>Survey Sites: MSC10, MSC11, MSC12, MSC14, MSC18, MSC22 T15</p>	<p>The vegetation consists of mid to tall <i>Grevillea wickhamii</i>, <i>Acacia inaequilatera</i> and <i>Acacia colei</i> sparse shrubland with <i>Triodia wiseana</i>, <i>Triodia chichesterensis</i> and <i>Triodia angusta</i> hummock grassland.</p> <p>This fauna habitat is synonymous with the FH1 fauna habitat reported in (APM 2022a) and the Rocky Hill habitat reported in 360 Environmental (2016), however these are small, isolated outcrops, fragmented from the adjoining ranges by plains areas, and do not support <i>Ficus</i> (a known preferred food of the Northern quoll). They are therefore of lower carrying capacity and habitat value than the FH1 and Rocky Hill habitats where a continuous supply of refuges is available across an extended area. The habitat is valuable locally due to the lack of similar nearby habitats, however is of low quality compared to the ranges to the east.</p>	
Extent in Survey: 1.38 ha (0.4%)		

Code/Name/Sites	Description	Photo
D Disturbed Extent in Survey: 10.76 ha (3.2%)	Completely Degraded – cleared land.	



Legend

- FH1 Rocky Outcrops
- FH2 Shallow Drainage Basins and Creeks
- FH4 Sandy Plains
- FH6 Stony Plains
- Disturbed



Scale: @ A4
 1: 20,000

0 200 400 m

Coordinate System: GDA 2020 MGA Zone 50
 Projection: Transverse Mercator

Author: EH Approved: ML Date: 15/05/2023



Fauna Habitats

Prepared for:
 Pilbara Minerals

5.2.2 Acoustic bat recorders

The recording dataset comprised a total of 27 recording nights from three bat detector units.

Acoustic processing of the bat detector recordings was conducted separately for each of Ghost bat and Pilbara leaf-nosed bat using methods optimised for the detection of their unique echolocation call types.

One call sequence of the target species Pilbara leaf-nosed bat was detected and is discussed further in Section 5.2.6.2. No calls of the Ghost Bat were observed in the recordings.

5.2.3 Motion triggered and time lapse cameras

Motion-triggered cameras returned 46,086 captures of which 1417 images contained fauna. No targeted fauna were captured on camera. Non-target captures returned a diversity of species, including Introduced fauna. Table 5-3 lists the non-target records from cameras.

Table 5-3. Non-target captures from motion triggered and time lapse cameras

Common name	Species	# captures	Common name	Species	# captures
Bar-shouldered ctenotus	<i>Ctenotus inornatus</i>	42	Pogona	<i>Pogona</i> sp.	5
Black Headed Python	<i>Aspidites melanocephalus</i>	1	Python		3
Bungarra	<i>Varanus gouldii</i>	13	Quail		1
Bush Stone Curlew	<i>Burhinus grallarius</i>	1	Rat Unidentifie		1
Butcherbird	<i>Cracticus</i> sp.	482	Rock Rat	<i>Zyomys</i> sp.	1
Button Quail	<i>Coturnix pectoralis</i>	10	Rufous Grasswren	<i>Amytornis striatus</i>	3
Cat	<i>Felis catus</i>	7	Rufous Whipsnake	<i>Demansia rufescens</i>	1
Cow	<i>Bos taurus</i>	1	Skink	<i>Egernia depressa</i>	5
Leopard Ctenotus	<i>Ctenotus pantherinus</i>	3	Snake		20
Ctenotus sp. 1	<i>Ctenotus</i> sp.	4	Snake Sp. 1		2
Ctenotus sp. 2	<i>Ctenotus</i> sp.	2	Snake Sp. 3		1
Desert spadefoot toad	<i>Notaden nichollsi</i>	89	Songlark	<i>Cincloramphus cruralis</i>	2
Diamond Dove	<i>Geopelia cuneata</i>	23	Spinifex Pigeon	<i>Geophaps plumifera</i>	22
Dragon	<i>Diporiphora</i> sp.	41	Spiny-tailed Goanna	<i>Varanus acanthurus</i>	5
Dragon	<i>Lophognathus</i> sp.	13	Stimsons Python	<i>Antaresia stimsoni</i>	38
Euro	<i>Macropus robustus</i>	2	Torresian Crow	<i>Corvus orru</i>	2
Gecko	<i>Diplodactylus</i> sp.	1	Woolley's Pseudantechinus	<i>Pseudantechinus woolleyae</i>	1
Gekko	Gehyra sp.	707	Yellow-throated Minor	<i>Manorina flavigula</i>	2
Indeterminate		2	Zebra Finch	<i>Taeniopygia guttata castanotis</i>	2
Perentie	<i>Varanus giganteus</i>	7			

Identifications were only made as far as necessary to rule out target species. Two captures were of poor image quality and were unable to be identified.

One capture was of cattle, which is expected as the land is within a station and pastoralism is the active land use within all the surveyed areas, however low grazing impact had been observed in vegetation and fauna habitats and therefore low numbers of cattle were expected.

Seven captures of cats were made, indicating the feral predator is frequently present in the locality.

5.2.4 Acoustic bird recording devices

No Night parrot calls were recorded in the 48 hours of assessed recordings.

5.2.5 Traverses

During traverses, the following fauna signs were identified:

- A scat that is from a small carnivore in the Sandy Plains near the Outcrop habitats, consistent with Northern Quoll scat type,
- Two Wallaby scats in the Sandy Plans near the Outcrop habitats that cannot be excluded as Spectacled hare-wallaby in origin;
- Conical diggings in two locations, one in Sandy Plains and one in Drainage Depression habitats;
- Diggings in the Drainage Depression habitat; and
- 3 Western pebble mouse mounds (two active, one intermediate).

No signs of Night parrot or were observed.

No T or MI bird species were observed, however seasonal conditions were unsuitable.

Notes were taken on habitat quality, disturbances, and the availability/unavailability of habitat micro-niches.

5.2.6 Conservation Significant Fauna






5.2.6.1 Northern Quoll

Northern quoll has been recorded on several occasions within the Pilgangoora Project area (DBCA Database record, Ecologia Environmental 2018; Terrestrial Ecosystems 2020, APM 2022a, APM unpublished data [Figure 5-3]). Locally this species seems to be most encountered in the boulder hill tops habitat of the north/south tending ridgeline running along the eastern half of the Pilgangoora Project area. This is the most rugged landform in the local area, at the highest elevations. Boulders on the ridge tops form a mosaic of cracks and crevices large enough to provide denning habitat for the quoll. In some locations the habitat is able to support fig trees – a favoured food of Northern quoll.

Within 30 km of the Survey Area, species records are predominantly occurring within rocky outcrop habitats, but also occur in the Turner River and larger tributaries of the Turner River, 16 km to the west of the Survey Area. Quoll have been recorded near to mine infrastructure of the Pilgangoora Project on three occasions.




Legend

-  E45/2287 Infill Survey Area
-  Northern quoll scat in Infill Survey Area
-  Pilbara Minerals Quoll Records (Terrestrial Ecosystems 2020 APM 2022a APM unpublished data)
-  Rocky Outcrop habitat
-  1 km buffer

Scale: @ A4
1: 50,000



Coordinate System: GDA 2020 MGA Zone 50
Projection: Transverse Mercator



Author: EH Approved: ML Date: 16/05/2023

Northern Quoll

Prepared for:
 Pilbara Minerals

Figure: 5-3

Habitat critical to the survival of the Northern quoll and populations important for the long-term survival of the Northern quoll are defined in CoA (2016) and are present in the Pilgangoora Project area. Habitat critical to the survival of the Northern quoll previously recorded at the Pilgangoora Project area includes:

- Rocky outcrop habitat 2 km to the east of the Survey Area;
- areas of native vegetation within 1 km of Rocky outcrop habitat; and
- dispersal and foraging habitat associated with or connecting the population within the Rocky outcrop habitat to other nearby populations or foraging habitats.

Evidence of habitat usage within the Infill Survey Area includes one scat collected in the Sandy plains near to the FH1 habitat (Plate 5-1) consistent with Northern quoll, being cigar shaped and composed of insect remains and with very little sand present. No captures of Northern quoll were made from camera traps, and no quoll scats were recorded in the rocky outcrop habitat, where potential denning sites are present. No quoll records or signs were recorded in creeks. Whilst in other environs creek lines would be a dispersal and foraging habitat for Northern quoll, in the Survey Area this habitat type does not appear to be frequented by the species. It is unknown whether the population inhabiting the rocky hills to the east are connected with the Turner River population, but it would be expected that connectivity between the two populations would occur via the creeks and channels which provide greater cover and forage potential over the 16 km separation. However, there is currently no evidence of such usage and the lack of large trees with hollows may be a limiting factor.

All habitats occurring within the Survey Area may be utilised by the species, at some time, to forage and or during dispersal activities; however, their significance to the species will vary depending on resource availability and connectivity. At the time of survey there is little evidence of consistent use of the Infill area by Northern quoll. The Survey Area is outside of the 1 km Critical Habitat buffer zones surrounding the previous local records of the species (Figure 5-3).

Within the Survey Area, the FH1 fauna habitat may be suitable for Northern quoll denning. The FH1 fauna habitat is synonymous with the FH1 fauna habitat reported in (APM 2022a) and the Rocky Hill habitat reported in 360 Environmental (2016). Within the Survey Area these are small, isolated outcrops, fragmented from the adjoining ranges by plains areas, and do not support *Ficus* (a known preferred food of the Northern quoll). They are therefore of lower carrying capacity and habitat value than the FH1 and Rocky Hill habitats where a continuous supply of refuges is available across an extended area. The habitat is valuable locally due to the lack of similar nearby habitats, however, is of low quality compared to the ranges to the east.

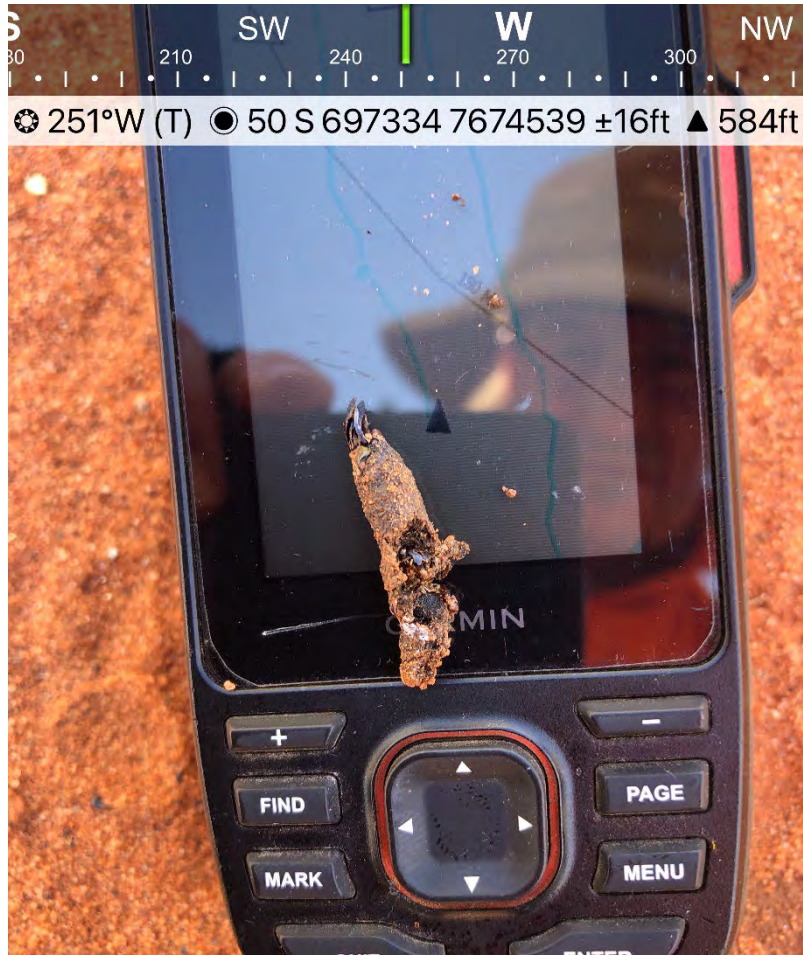


Plate 5-1. Scat collected in the Sandy Plains near to the FH1 habitat

(GDA 1994, MGA Zone 50 697339, 7674537)

5.2.6.2 Ghost Bat

A recent review of Ghost bat (Bat Call WA 2021a) updates the knowledge base on ecology, threats, and survey requirements for the species.

Ghost bats move between a number of caves seasonally or as dictated by weather conditions and/or foraging opportunities, so they require a range of cave sites (Richards *et al.* 2008). They disperse widely when not breeding but may concentrate in relatively few roost sites when breeding. In the Pilbara, except for the large, abandoned mine colonies, ghost bats are often present either singly or in small groups (usually less than 15). These have been shown to move periodically, either seasonally or as dictated by prey availability. Their vagrant foraging strategy relates to patchy, locally unreliable rainfall events (and prey biomass) across much of its foraging habitat in the Pilbara and elsewhere in other semi-arid parts of its broader Australian range. Hence the relatively small groups that must move from roost to roost to access their ephemeral patchy food resource.

Extensive survey activity in the last decade has led to the proposal of 4 categories of roosting habitat used by ghost bats in the Pilbara region (Bullen 2021):

- Category 1 maternity/diurnal roost sites with permanent ghost bat occupancy;
- Category 2 maternity/diurnal roost caves with regular occupancy;
- Category 3 diurnal roost caves with occasional occupancy; and
- Category 4 nocturnal roost caves with opportunistic usage.

Within the Survey Area there are no Category 1, 2, 3 or 4 sites/caves available to this species.

In the Pilbara, Ghost bats prefer to forage on productive plain areas with thin mature woodland over patchy or clumped tussock or hummock grass (*Triodia spp.*) on sand or stony ground. Isolated trees and trees on the edge of thin thickets on the plains, or trees along the edges of watercourse woodlands, appear to be preferred vantage points (Bullen unpublished data). In the Survey Area there are scattered *Corymbia hamersleyana* trees available for perching.

No Ghost bats were recorded during the acoustic survey, however acoustic recorders are not suited to Ghost bat detection during foraging as the species seldom uses its echolocation away from caves.

The Ghost bat is listed in the PMST as known to occur within the local area and the DBCA database has records for the species within a 30 km radius. Ghost bats are known to travel up to 15 km from a roost site for foraging and up to 30 km in one night to alternative roosting sites, indicating the Survey Area may be within range of Category 1, 2 or 3 roosts.

It is possible that the Survey Area offers foraging habitat to Ghost bat across all habitat types.

5.2.6.3 Pilbara Leaf-Nosed Bat

A recent review of Pilbara leaf-nosed bat (Bat Call WA 2022b) updates the knowledge base on ecology, threats, and survey requirements for the species. It is generally encountered in rocky areas that provide opportunity for roosting, in particular the ironstone Hamersley Range, the ridgelines granite boulder piles and disused mines of the eastern Pilbara, and along medium and major drainage lines that radiate away from rocky uplands.

Pilbara leaf-nosed bat roost during the day beyond the twilight zone in caves and underground mines with stable, warm and humid microclimates because of its poor ability to maintain its heat and water balance (Churchill *et al.* 1988; Jolly 1988; Churchill 1991; Baudinette *et al.* 2000; Armstrong 2001). There is a possibility that some roosts exist in the deeper spaces amongst granite tor rockpiles in the eastern Pilbara, (Armstrong and Anstee 2000; Armstrong 2001) although recent survey work is yet to identify any (Bat Call WA 2022b). The Pilbara leaf-nosed bat does not roost in overhangs (shallow structures where the rear wall can be observed from the entrance), as these do not support warm, humid microclimates (TSSC, 2016). A suggestion that this species becomes 'forest dwelling' in the wet season of the monsoonal northern areas (Churchill 1991, 1995) has not been supported, and is very unlikely in the Pilbara region (Armstrong 2001).

Roosts have been categorised according to importance to the survival of the species into four categories (TSSC 2016):

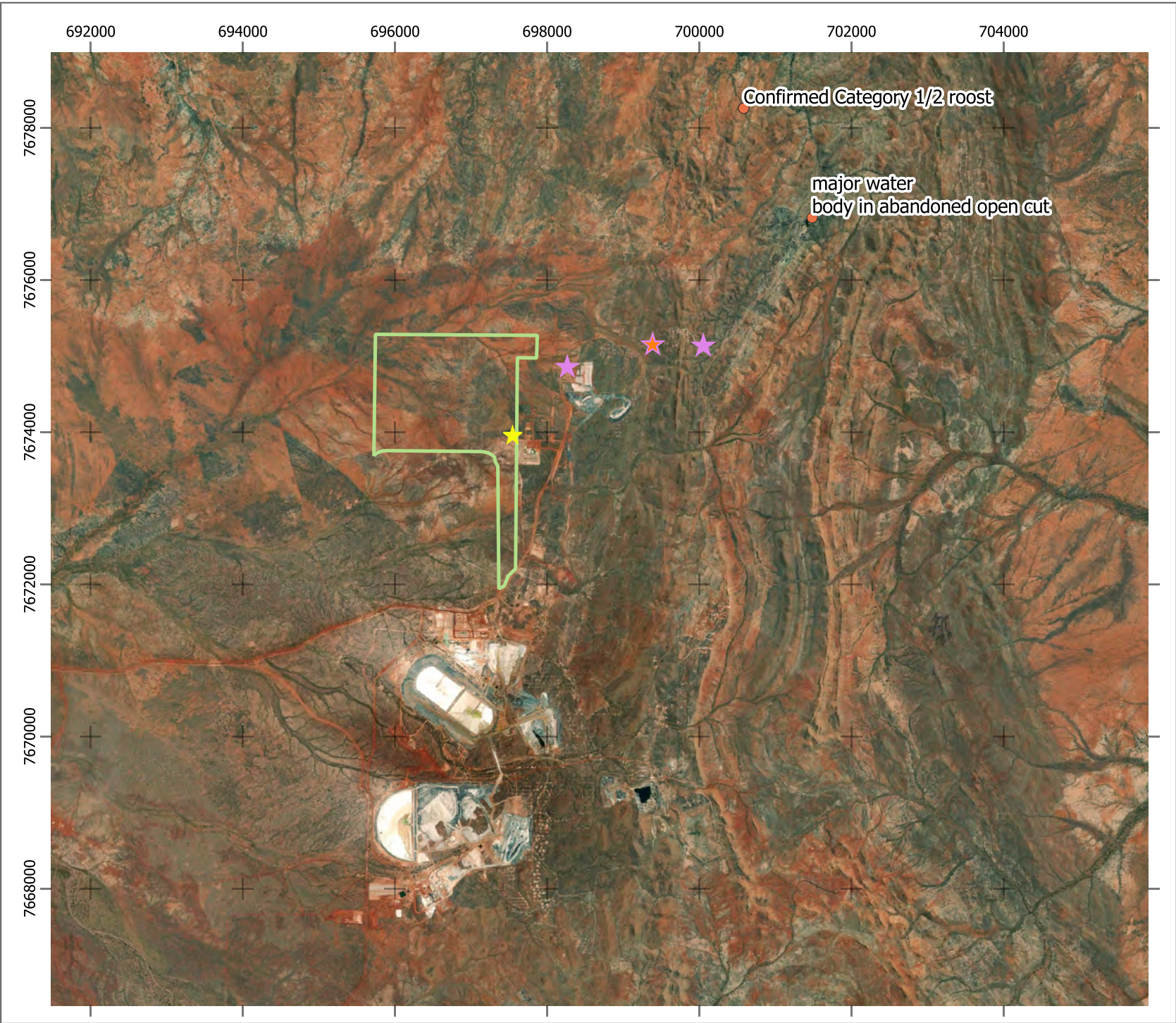
- Category 1 - Permanent diurnal maternity roosts where seasonal presence of young is proven;
- Category 2 - Permanent diurnal roosts where presence of young is unproven;
- Category 3 - Semi-permanent diurnal roosts; and
- Category 4 - Nocturnal refuge.

The Pilbara leaf-nosed bat was recorded locally during Targeted survey for individuals and roosts for the Pilgangoora Project (360 Environmental 2015, 2016). A Category 1 or 2 roost was located, and high-quality foraging habitat was identified at a major water body in an abandoned open cut pit. The roost site and confirmed foraging habitat are 4 km from the Survey Area to the northeast and are shown in Figure 5-4. An estimate of the number of Pilbara leaf-nosed bat at the roost based on ultrasonic calls and video counts ranged between 25-50. There are additional known permanent diurnal category 1 or 2 Pilbara leaf-nosed bat roosts approximately 20 km to the southwest and southeast of the Survey Area (Bat Call WA 2022b). The Survey Area does not contain any roosts described as Category 1, 2, 3 or 4. The Survey Area is within range of three Category 1/2 roosts.





Generally, the Pilbara leaf-nosed bat is most encountered within 20 km of its permanent diurnal roosts (Bullen 2013), but in the months where climatic conditions are least challenging for the species (April-May) they have been recorded further afield (Bat Call WA 2022b). Echolocation based records indicate that it can complete round trips of 50 km or longer in a night under favourable conditions (Bat Call WA 2022b).

One call sequence of the Pilbara leaf-nosed bat was recorded within the Survey Area at AS450007. The detection of a single short echolocation call sequence away from areas of suitable roosting habitat is indicative of an individual of this species out foraging away from a diurnal roost.

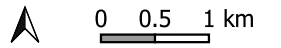
Habitat types found in the Pilbara have been scaled and a foraging habitat rating applied (Bat Call WA 2022b). Habitats FH1, FH4 and FH6 in the Survey Area best fit the foraging habitat description of *Open plain with two layer, not complex, vegetation structure (excluding scattered trees)*. These are of low habitat rating. Pilbara leaf-nosed bat are unlikely to forage in these habitats but may traverse while crossing to more productive areas. Habitat FH2 can be described as *two layer, not complex, vegetation structure (excluding scattered trees). Includes ephemeral watercourse*. This habitat is of moderate foraging value and Pilbara leaf-nosed bat may occasionally forage in this area due to the presence of suitable vegetation and seasonal water, and may also use the area as a flyway.



Legend

-  E45/2287 Infill Survey Area
-  Pilbara Leaf-nosed bat database record
-  Pilbara Leaf-nosed bat acoustic records Infill Survey
-  Pilbara Leaf-nosed bat acoustic records APM (2022a)

Scale: @ A4
1: 70,000



Coordinate System: GDA 2020 MGA Zone 50
Projection: Transverse Mercator



Author: EH Approved: ML Date: 16/05/2023

Pilbara leaf-nosed bat

Prepared for:
 Pilbara Minerals

Figure: 5-4

5.2.6.4 Grey Falcon

The Grey falcon occurs in most of the drier parts of Australia (Schoenjahn 2018). Its distribution is centred on inland drainage systems where there is an average annual rainfall of less than 500 mm. Its main habitat is timbered lowland plains, particularly Acacia shrublands that are crossed by tree-lined watercourses. It generally occurs at low densities across inland Australia (BirdLife International 2019).

The Grey falcon hunts far out into tussock grassland and open woodland. It nests in old nests made by other birds, usually nests in the tallest trees along watercourses, particularly river red gum (TSSC 2020). Prey species include doves, pigeons, small parrots and cockatoos, and finches, but a variety of other bird prey species has been recorded, as well as mammals and lizards (TSSC 2020).

Local records are centred on the Turner River and major tributaries. The closest record is 10 km from the Survey Area to the southeast. The Survey Area is suitable foraging habitat for this species, and within range of the population likely to be nesting in the Turner River riparian zone.

5.2.6.5 Night Parrot

The Survey Area is within the area where Night parrot is modelled as *may occur*. Very limited information is available on the Night parrot, however some information on habitat characteristics where the species has persisted is available.

DBCAs (2017) summarises habitat characteristics. Night parrot roosting and nesting sites are in clumps of dense vegetation, primarily old and large spinifex (*Triodia*) clumps, but sometimes other vegetation types. Often the vegetation in these habitats will be naturally fragmented and therefore well protected from fire. Little is known about foraging sites, but favoured sites are likely to vary across the range of the species. In Queensland, Night parrots have been shown to feed in areas rich in herbs including forbs, grasses and grass-like plants, and it is likely that such areas may also be important in WA. *Triodia* is likely also to provide a good food resource for Night parrot, in times of mass flowering and seeding, but they also rely heavily on a range of other food species. *Sclerolaena* has been shown to be a source of food and moisture.

The species and growth pattern of the spinifex in some of the plains habitat in the Survey Area may be suitable for the Night parrot. There are no samphire or chenopod habitats proximal to the Survey Area, however the Drainage Depressions may seasonally support a diversity of herbs and other potential forage species. Night parrots have been known to fly up to 40 km or more in a night during foraging expeditions, so foraging habitat is not necessarily within or adjacent to roosting areas.

An interim guideline for preliminary surveys of Night parrot in WA (DPAW 2017b) identifies when and where Night parrot surveys may be required. The Survey Area is on the north-western edge of the area classed as a high priority for survey. Due to the inclusion of the site in the high priority survey area and the presence of potentially suitable spinifex habitat, passive acoustic survey was conducted at locations where the best spinifex habitat was found. Four devices were deployed for a total of 12 trap nights. No Night parrot calls were recorded. Foot traverses did not encounter any signs or individuals of Night parrot.

While the habitat is potentially suitable, there are no historic records of Night parrot in the area and very few records of extant individuals. While it remains possible that the species could colonise in the future, there is no evidence that they are currently present.

5.2.6.6 Greater Bilby

Extant populations of bilby occur in a variety of habitats, usually on landforms with level to low slope topography and light to medium soils (typically sandy for burrow excavation). Bilby occupies three major vegetation types; open tussock grassland on uplands and hills, mulga woodland/shrubland growing on ridges and rises, and hummock grassland in plains and alluvial areas (Southgate 1990). Laterite and rock feature substrates are an important part of Greater bilby habitat, which support shrub species such as Acacia, and spinifex hummocks which are quite uniform and discrete, providing runways between hummocks, enabling easier movement and foraging (Southgate *et al.* 2007).

The species is identified by the PMST as known to occur within 30 km of the Survey Area. Database results returned 14 records within a 30 km radius of the Survey Area, the closest being one record to the east of Pilgangoora made in 1979. Recent records (2012-2016; 16 to 25 km west) are from surveys conducted for the rail and road corridors to the west. These records are surrounding the Turner River. The DBCA has a long-term bilby abundance monitoring program at the Turner River (DPAW 2017a).

Suitable habitat in the Survey Area includes the plains habitats and the shallow drainage depressions. Extensive foot transects were walked across all habitats. No burrows were located. Indeterminate signs were recorded in three locations. Diggings/scratchings were recorded as shown in Plate 5-2. The diggings/scratchings lacked attributes common to digging lizards and other species expected to occur, however they were out in the open, shallow and not fresh.

Department of Parks and Wildlife (2017a) provides a protocol for using signs to determine the presence of Bilby. Under the protocol, diggings in the open can be used to flag potential bilby activity or potential past presence, but not to verify current presence with certainty. Additional searching was conducted to identify the presence of further signs, but no diggings near shrubs known to host root-dwelling larvae, scats or burrows were observed. Under the protocol the significance of the observed signs is *Potential bilby activity - Presence not confirmed*.

This species has the potential to occupy the Survey Area as bilbies can be relatively transient across their distribution. No burrows were observed suggesting any recent use may be for foraging only and transitory in nature.



Plate 5-2. Conical digging

5.2.6.7 Western Pebble Mount Mouse

The Western pebble-mound mouse is endemic to the Pilbara where it is found on stony hillsides with hummock grassland (Menkhorst and Knight, 2010). This species builds pebble mounds from small stones, which typically cover areas from 0.5-9.0 m². The mounds are characteristic of the species. Pebble mounds are restricted to areas with suitable class stones and are usually found on gentle slopes and spurs that are often vegetated by hard spinifex (Van Dyck and Strahan 2008). Active mounds are characterised by the conical shape of the mound with clear, distinct entrance holes (Anstee 1996). Mounds are often sited close to narrow ribbons of Acacia dominated scrub that grow along incised drainage lines (Van Dyck and Strahan 2008).

Targeted searches were performed using foot transects in suitable habitat. Three mounds were recorded. The status of mounds was assessed according to the method published in Anstee (1996). The Anstee (1996) index is most accurate at predicting the status of mounds with very high (classed as active) or very low (classed as inactive) scores. Mounds with intermediate activity could be either active or inactive, depending on whether they are in the process of being activated or degrading following abandonment. Mound locations and status are listed in Table 5-3, an example of an active mound is shown in Plate 5-3.

Table 5-4. Western Pebble-mound Mouse mound status and location

Status	Location (GDA 1994; MGA zone 50)
Active	697350, 7673750
Active	697363, 7673640
Intermediate	695919, 7673938



Plate 5-3. An active Pilbara Pebble Mound Mouse Mound

5.2.6.8 Brush-tailed Mulgara

Brush-tailed mulgara is widespread, but patchily distributed in sandy regions of arid central Australia and WA. It inhabits hummock grass plains, sand ridges, and mulga shrubland on loamy soils (Menkhorst and Knight, 2010). It uses the open space between vegetation, a microhabitat that is known to support important prey species and may forage in termite mounds (Molyneux *et al.* 2018).

The Brush-tailed mulgara constructs burrows or utilises those of other species. Burrows may provide access to prey items, protection from predators and have thermoregulation benefits (Molyneux *et al.* 2018).

Local records are to the west of the Survey Area with the closest records 13 km to the southwest. Records originate from biological surveys assessing the impact of rail lines servicing the Pilbara region.

Suitable habitat occurs in the Sandy Plains habitat, however the preferred sand dune habitat is not present.

Targeted searches were conducted in suitable habitat for signs (tracks and burrow entrances) of the Mulgara. Three locations were marked where connected burrows appeared to be present, one included nearby scats (Plates 5-4 to 5-6). These were highly degraded and collapsed, indicating they are not currently in use, but may have once been occupied by Mulgara. Cats were captured on seven occasions in the camera survey and may be a contributing factor to the decline of the Mulgara in the local area. Whilst the habitat is suitable, there is no evidence that Mulgara are currently present in the Survey Area.

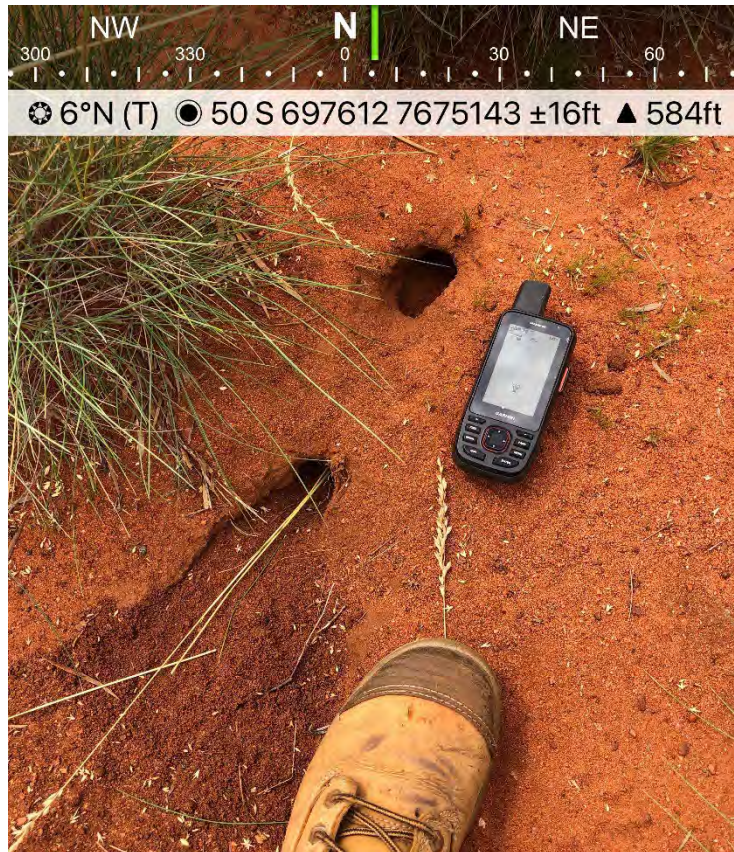


Plate 5-4. Collapsed Mulgara burrow entrance and tunnel

5.2.6.9 Spectacled Hare-wallaby (mainland)

The Spectacled hare-wallaby inhabits tropical tussock or hummock grassland with mid-dense or sparse tree and shrub cover (Menkhorst and Knight, 2010). In the Pilbara this species has declined drastically, possibly due to fox predation and because frequent burning of spinifex grassland has prevented the development of the large hummocks required for shelter (Van Dyck and Strahan 2008).

There are many local records, in the surrounding foothills and plains habitats. These records are from the early 1990's.

Signs in the Survey Area recorded during targeted searches that may be attributable to Spectacled hare-wallaby include:

- Scats (Plate 5-5); and
- Foot and tail prints of a small macropod.

The species was not recorded during the detailed and reconnaissance fauna surveys for the Pilgangoora Project (360 Environmental 2016a), the Lynas Find or TSF options (APM 2022a,b) surveys, with the absence of the species attributed to the broader regional decline. The habitats available in the Survey Area, particularly in the Drainage Depressions, offer a denser cover of vegetation that may be providing sufficient shelter from predation for the species to persist locally. The signs were recorded in the Sandy Plains close to Drainage Depressions. The species may be foraging in the Sandy Plains and sheltering in the Shallow Drainage Depressions.

It is not possible from the available evidence to comprehensively determine the presence of Spectacled hare-wallaby in the Survey Area. A Rothschild Rock Wallaby (*Petrogale rothschildi*) was recently recorded at the project and is of similar size to the Spectacled hare-wallaby, however the species is known to stay close to suitable shelter habitat (DPAW 2013) that is not present in or near the Survey Area.

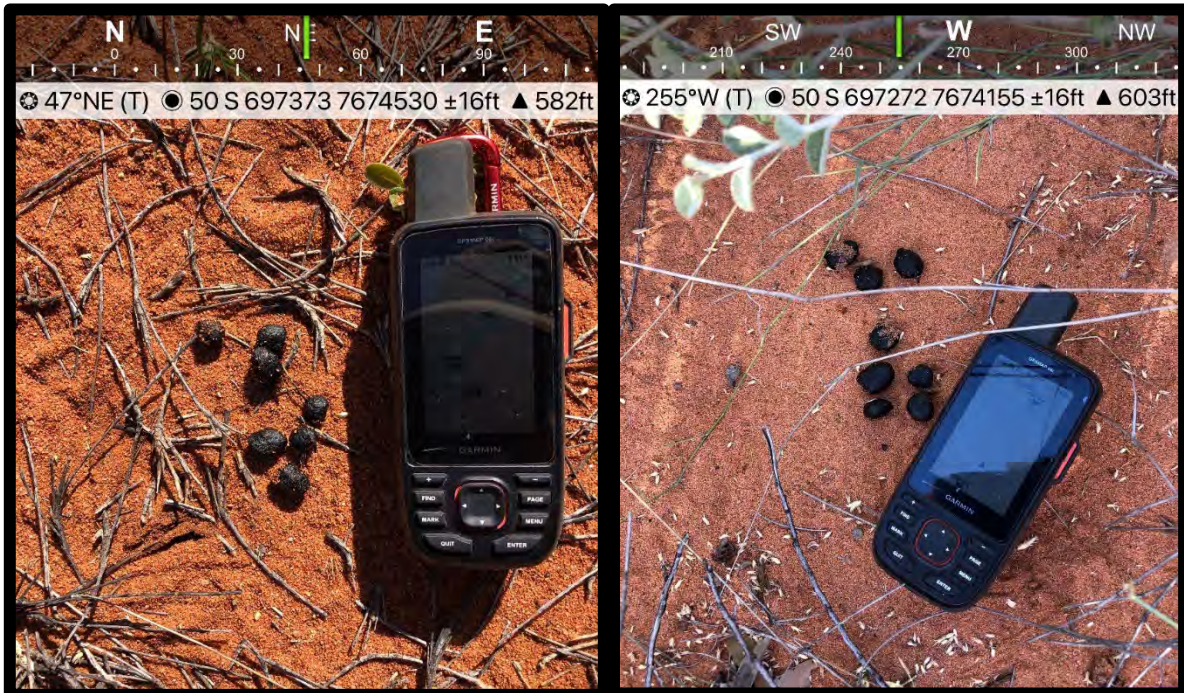


Plate 5-5. Wallaby scats

5.2.7 Introduced Fauna

The field survey identified the presence of 3 introduced fauna species. Camera captures and signs such as footprints and scats of Cat (*Felis catus*), Cattle (*Bos taurus*) were recorded. Feral goat scats were also recorded (Plate 5-6).

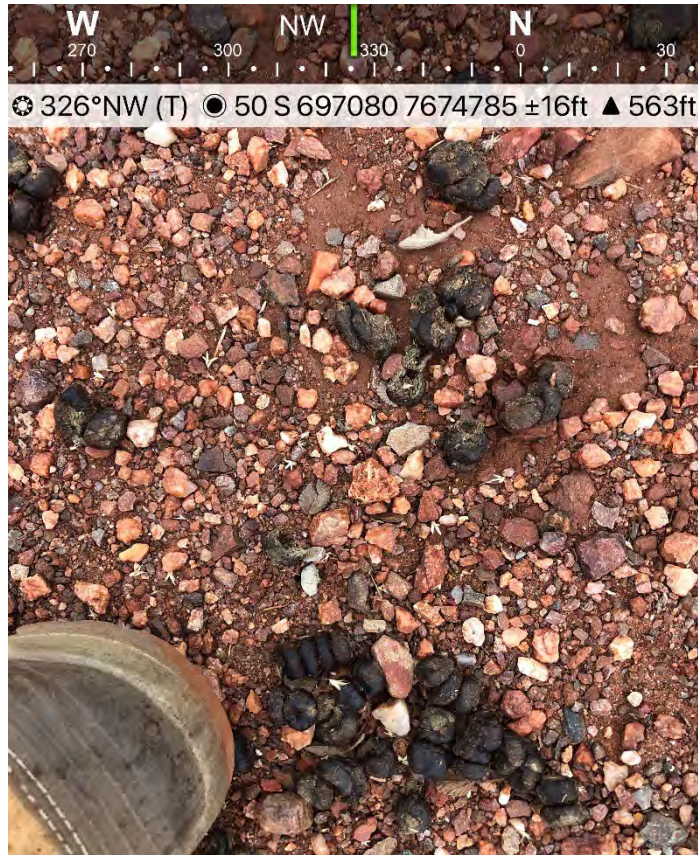


Plate 5-6. Goat scats

6 CONCLUSIONS

6.1 FLORA

The flora and vegetation survey recorded a total of 119 taxa within the Survey Area which is comparable to the number of taxa recorded in other previous local surveys: 116 taxa (63 genera from 26 families) recorded by APM (2022a) at the Lynas Find Deposit; 195 taxa (101 genera and 39 families) recorded by MMWC Environmental (2016a) at the Pilgangoora Project, and 122 taxa (67 genera and 38 families) recorded by Outback Ecology (2009) at Wodgina.

The flora and vegetation of the Survey Area is generally typical of the Pilbara, and of the adjacent lands surrounding the Survey Area.

6.2 FLORA OF CONSERVATION SIGNIFICANCE

No T flora was recorded in the Survey Area. Two P3 species were recorded.

One P3 species *Triodia chichesterensis* was recorded within the Stony rises and outcrops vegetation. It co-occurs with the closely related *Triodia lanigera* and as is common in the northern part of the species range, the distribution of the two species is substrate based. *Triodia lanigera* was common in the Survey Area in the sandy plains and *Triodia chichesterensis* was restricted to the Stony rise and outcrops with quartzite commonly found at the surface.

Euploca mutica was found at four locations within the Survey Area within the undulating sandy plains in generally low, scattered abundance. Targeted searches were conducted where individuals were found to identify the population size and extent within these areas. Thirty-one individuals were recorded.

An additional eight species were determined to be possibly occurring or likely to occur based upon the availability of suitable habitat. One is a perennial shrub and seven are annual herbs or small herbaceous perennials. Seasonal conditions were suitable for the presence of these species to be detected.

6.3 INTRODUCED FLORA

No weeds Declared under the BAM Act or classed as WoNS were recorded in the Survey Area. Two weeds were recorded, one species of agricultural grass *Cenchrus ciliaris* and the environmental weed Kapok. Occurrence was infrequent and where present, they occurred in low numbers.

6.4 VEGETATION OF CONSERVATION SIGNIFICANCE

There are no recognised TECs or PECs located within or adjacent to the Survey Area.

None of the vegetation types described for the Survey Area are analogous to any known TECs or PECs. The nearest record of a TEC or PEC to the Survey Area is the Gregory Land System (P3 PEC), approximately 50 km away.

The Chichester Subregion includes seven Ecosystems at Risk which are subject to a range of threatening processes (Kendrick and McKenzie 2001). None of these ecosystems are relevant to the Survey Area.

No species that have been associated with Groundwater Dependent Ecosystems were recorded.

Regional Vegetation Associations within and nearby the Survey Area as described by Beard have over 99% pre-European Vegetation extent remaining. Conservation significance ranking of vegetation associations occurring within the Survey Area are of 'Least Concern'.

6.5 FAUNA OF CONSERVATION SIGNIFICANCE

The survey recorded two active Pebble mound mouse mounds. The Pebble mound mouse is known to occur in the area and its presence within the Survey Area is confirmed. The suitability of mound building habitat is confined by the availability of suitable size pebbles, which occur on the Stony plains and rises habitat.

The Northern quoll is known to occur in the local area and critical habitat has been identified in the ridgeline to the east of the Survey Area. The Survey Area is more than 1 km from this critical habitat. The Survey Area contains habitats that are of possible value to the Northern quoll for denning, foraging and dispersal however, they are of low quality. Signs of the Northern quoll were limited to one scat, but no captures on cameras were obtained. It is possible the Northern quoll occasionally uses the Survey Area however, it does not constitute critical habitat at this time.

The Pilbara leaf-nosed bat is known to occur in the local area and diurnal roosts occur within the range of the Survey Area. The quality of habitat for the Pilbara leaf-nosed bat is limited to low to moderate quality foraging– the species may occasionally use the site for foraging or in transit to other more productive areas.

The Ghost bat is known to occur in the local area and diurnal roosts are known to occur within range of the Survey Area. The Survey Area is suitable foraging habitat for the Ghost bat. The Ghost bat was not recorded during the acoustic survey however the method has limitation with detection of the species. The species is likely to occur within the Survey Area at some time, for foraging purposes only.

The Grey falcon is known to occur in the local area and the Survey Area is within foraging range of the species. Grey falcon nesting in the Turner River area are likely to visit the Survey Area at some times for the purpose of foraging.

There are no areas that would be subject to inundation in the Survey Area or that are likely to sustain habitat suitable for migratory shorebirds. There are no nationally or internationally significant aggregations of migratory species known to occur within or near the Survey Area.

Abandoned burrows that may once have hosted Brush-tailed mulgara were recorded. Burrows were collapsed, however there were indications of a multi-entranced burrow system as used by the Brush-tailed mulgara. Suitable habitat is limited to the sandy plains. Whilst the Survey Area is likely to contain suitable habitat, there is no evidence of the species being currently present.

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APPENDICES

APPENDIX A: CONSERVATION AND DECLARED CATEGORIES

Conservation categories for threatened species and communities protected under Federal legislation are defined under the *Environment Protection and Biodiversity Conservation Act 1999* and the *Environment Protection and Biodiversity Conservation Regulations 2000* are listed in Tables A.1. and A.2.

Table A.1: Categories and definitions for threatened flora and fauna species listed under the *Environment Protection and Biodiversity Conservation Act 1999*.

Conservation Category	Definition
Extinct	Taxa with no reasonable doubt that the last member of the species has died.
Extinct in the wild	Taxa known to survive only in cultivation, in captivity or as a naturalised population well outside its past range; or it has not been recorded in its known and/or expected habitat, at appropriated seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
Critically Endangered (CR)	Taxa facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
Endangered (E)	Taxa are not critically endangered; and are facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
Vulnerable (V)	Taxa are not critically endangered or endangered; and are facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.
Conservation dependent (CD)	Taxa are the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered or critically endangered; or the following subparagraphs are satisfied: <ul style="list-style-type: none"> i) the taxa is a species of fish; ii) the taxa is the focus of a management plan that provides management actions necessary to stop the decline of, and support the recovery of, the taxa so that its chances of long term survival in nature are maximized; iii) the management plan is in force under a law of the Commonwealth or of a State or Territory; and iv) Cessation of the management plan would adversely affect the conservation status of the taxa. Fish includes all taxa of bony fish, sharks, rays, crustaceans, molluscs and other marine organisms, but does not include marine mammals/reptiles.

Table A.2: Definitions for Threatened Ecological Communities under the *Environment Protection and Biodiversity Conservation Act 1999*.

Conservation Category	Definition
Critically endangered	If, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
Endangered	If, at that time, it is not critically endangered and is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
Vulnerable	If, at that time, it is not critically endangered or endangered, and is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.

For Section 182 of the EPBC Act and 179 of the EPBC Act Threatened Ecological Communities and Native species are in the Critically Endangered, Endangered or Vulnerable category if they meet any of the criteria for the category mentioned in Table A.3:

Table A.3: Criteria for listing Threatened Species and Threatened Ecological Communities under the *Environment Protection and Biodiversity Conservation Regulations 2000*

Threatened Species				
Item	Criterion	Category		
		Critically Endangered	Endangered	Vulnerable
1	It has undergone, is suspected to have undergone, or is likely to undergo in the immediate future:	A very severe reduction in numbers	A severe reduction in numbers	A substantial reduction in numbers
2	Its geographic distribution is precarious for the survival of the species and is:	Very restricted	Restricted	limited
3	The estimated total number of mature individuals is: And: (a) Evidence suggests that the number will continue to decline at: or (b) The number is likely to continue to decline and its geographic distribution is:	Very low	Low	limited
		A very high rate	A high rate	A substantial rate
		Precarious for its survival	Precarious for its survival	Precarious for its survival
4	The estimated total number of mature individuals is:	Extremely low	Very low	low
5	The probability of its extinction in the wild is at least:	50% in the immediate future	20% in the near future	10% in the medium term future
Threatened Ecological Communities				
Item	Criterion	Category		
		Critically Endangered	Endangered	Vulnerable
1	Its decline in geographic distribution is:	Very severe	Severe	substantial
2	Its geographic distribution is: And the nature of its distribution makes it likely that the action of a threatening process could cause it to be lost in:	Very restricted	restricted	limited
		The immediate future	The near future	The medium term future
3	For a population of a native species that is likely to play a major role in the community, there is a: To the extent that restoration of the community is not likely to be possible in:	Very severe decline	Severe decline	Substantial decline
		The immediate future	The near future	The medium term future
4	The reduction in its integrity across most of its geographic distribution is: As indicated by degradation of the community or its habitat, or disruption of important community processes, that is:	Very severe	severe	substantial
		Very severe	severe	substantial
5	The rate of continuing detrimental change is: As indicated by	Very severe	severe	substantial

	(a) A rate of continuing decline in its geographic distribution, or a population of a native species that is believed to play a major role in the community, that is: or	Very severe	severe	serious
	(b) Intensification, across most of its geographic distribution, in degradation, or disruption of important community processes, that is:	Very severe	severe	serious
6	A quantitative analysis shows that its probability of extinction, or extreme degradation over all its geographic distribution, is:	At least 50% in the immediate future	At least 20% in the near future	At least 10% in the medium term future

In Western Australia, the *Biodiversity Conservation Act 2016* (BC Act) provides for the statutory listing of Threatened Ecological Communities, under the categories listed in Table A.4.

Table A.4: Definitions and criteria for Presumed Totally Destroyed, Critically Endangered, Endangered and Vulnerable Ecological Communities. Department of Environment and Conservation (2013).

PD : Presumed Totally Destroyed
<p>An ecological community that has been adequately searched for but for which no representative occurrences have been located. The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future.</p> <p>An ecological community will be listed as presumed totally destroyed if there are no recent records of the community being extant and either of the following applies (A or B):</p> <p>A) Records within the last 50 years have not been confirmed despite thorough searches of known or likely habitats or</p> <p>B) All occurrences recorded within the last 50 years have since been destroyed.</p>
CR : Critically Endangered
<p>An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated.</p> <p>An ecological community will be listed as Critically Endangered when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future. This will be determined on the basis of the best available information, by it meeting any one or more of the following criteria (A, B or C):</p> <p>A) The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 90% and either or both of the following apply (i or ii):</p> <ul style="list-style-type: none"> i) geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is imminent (within approximately 10 years); ii) modification throughout its range is continuing such that in the immediate future (within approximately 10 years) the community is unlikely to be capable of being substantially rehabilitated. <p>B) Current distribution is limited, and one or more of the following apply (i, ii or iii):</p> <ul style="list-style-type: none"> i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the immediate future (within approximately 10 years); ii) there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes; iii) there may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes. <p>C) The ecological community exists only as highly modified occurrences that may be capable of being rehabilitated if such work begins in the immediate future (within approximately 10 years).</p>
En : Endangered
<p>An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future.</p> <p>An ecological community will be listed as Endangered when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria (A, B, or C):</p> <p>A) The geographic range, and/or total area occupied, and/or number of discrete occurrences have been reduced by at least 70% since European settlement and either or both of the following apply (i or ii):</p> <ul style="list-style-type: none"> i) the estimated geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is likely in the short term future (within approximately 20 years); ii) modification throughout its range is continuing such that in the short term future (within approximately

20 years) the community is unlikely to be capable of being substantially restored or rehabilitated.
B) Current distribution is limited, and one or more of the following apply (i, ii or iii):
i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the short term future (within approximately 20 years);
ii) there are few occurrences, each of which is small and/or isolated and all or most occurrences are very vulnerable to known threatening processes;
iii) there may be many occurrences but total area is small and all or most occurrences are small and/or isolated and very vulnerable to known threatening processes.
C) The ecological community exists only as very modified occurrences that may be capable of being substantially restored or rehabilitated if such work begins in the short-term future (within approximately 20 years).

VU : Vulnerable

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

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

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

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

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

In Western Australia, possible Threatened Ecological Communities that do not meet survey criteria or that are not adequately defined are added to the Priority Ecological Community Lists under Priorities 1, 2 and 3. Ecological communities that are adequately known, and are rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list, are placed in Priority 4. These ecological communities require regular monitoring. Conservation Dependent ecological communities are placed in Priority 5 (Table A.4).

Table A.5: Definitions and criteria for Priority Ecological Communities Department of Environment and Conservation (2013).

<p>P1: Priority One – Poorly-known ecological communities</p> <p>Ecological communities that are known from very few occurrences with a very restricted distribution (generally ≤ 5 occurrences or a total area of ≤ 100 ha). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist. May include communities with occurrences on protected lands. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.</p>
<p>P2: Priority Two – Poorly-known ecological communities</p> <p>Communities that are known from few occurrences with a restricted distribution (generally ≤ 10 occurrences or a total area of ≤ 200 ha). At least some occurrences are not believed to be under immediate threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.</p>
<p>P3: Priority Three – Poorly-known ecological communities</p> <p>(i) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or: (ii) communities known from a few widespread occurrences, which are either large or within significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or; (iii) communities made up of large, and/or widespread occurrences, that may or not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes. Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.</p>
<p>P4: Priority Four</p> <p>Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring.</p> <p>(i) Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands. (ii) Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. (iii) Ecological communities that have been removed from the list of threatened communities during the past five years.</p>
<p>P5: Priority Five – Conservation dependent ecological communities</p> <p>Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.</p>

In Western Australia, the Wildlife Conservation (Specially Protected Fauna) Notice 2018 and the Wildlife Conservation (Rare Flora) Notice 2018 have been transitioned under regulations 170, 171 and 172 of the Biodiversity Conservation Regulations 2018 to be the lists of Threatened, Extinct and Specially Protected species under Part 2 of the *Biodiversity Conservation Act 2016*.

Categories of Threatened, Extinct and Specially Protected fauna and flora are listed in Table A.6.

The definition of flora includes algae, fungi and lichens. The definition of Species includes all taxa (plural of taxon - a classificatory group of any taxonomic rank, e.g. a family, genus, species or any infraspecific category i.e. subspecies or variety, or a distinct population).

Table A.6: Conservation codes for Western Australian flora and fauna under the *Biodiversity Conservation Act 2016* (DBCA 2019).

Code	Conservation Category	Definition
Threatened species		
Listed by order of the Minister as Threatened in the category of critically endangered, endangered or vulnerable under section 19(1), or is a rediscovered species to be regarded as threatened species under section 26(2) of the Biodiversity Conservation Act 2016 (BC Act). Threatened fauna is that subset of 'Specially Protected Fauna' listed under schedules 1 to 3 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for Threatened Fauna. Threatened flora is that subset of 'Rare Flora' listed under schedules 1 to 3 of the Wildlife Conservation (Rare Flora) Notice 2018 for Threatened Flora. The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria as detailed below.		
CR	Critically Endangered	Threatened species considered to be "facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as critically endangered under section 19(1)(a) of the BC Act in accordance with the criteria set out in section 20 and the ministerial guidelines. Published under schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for critically endangered fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for critically endangered flora.
EN	Endangered	Threatened species considered to be "facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as endangered under section 19(1)(b) of the BC Act in accordance with the criteria set out in section 21 and the ministerial guidelines. Published under schedule 2 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for endangered fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for endangered flora
VU	Vulnerable	Threatened species considered to be "facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as vulnerable under section 19(1)(c) of the BC Act in accordance with the criteria set out in section 22 and the ministerial guidelines. Published under schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for vulnerable fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for vulnerable flora.
Extinct species		
Listed by order of the Minister as extinct under section 23(1) of the BC Act as extinct or extinct in the wild.		

EX	Extinct	<p>Species where “there is no reasonable doubt that the last member of the species has died”, and listing is otherwise in accordance with the ministerial guidelines (section 24 of the BC Act).</p> <p>Published as presumed extinct under schedule 4 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for extinct fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for extinct flora.</p>
EW	Extinct in the Wild	<p>Species that “is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; and it has not been recorded in its known habitat or expected habitat, at appropriate seasons, anywhere in its past range, despite surveys over a time frame appropriate to its life cycle and form”, and listing is otherwise in accordance with the ministerial guidelines (section 25 of the BC Act).</p> <p>Currently there are no threatened fauna or threatened flora species listed as extinct in the wild. If listing of a species as extinct in the wild occurs, then a schedule will be added to the applicable notice.</p>
Specially protected species		
<p>Listed by order of the Minister as specially protected under section 13(1) of the BC Act. Meeting one or more of the following categories: species of special conservation interest; migratory species; cetaceans; species subject to international agreement; or species otherwise in need of special protection.</p> <p>Species that are listed as threatened species (critically endangered, endangered or vulnerable) or extinct species under the BC Act cannot also be listed as Specially Protected species.</p>		
MI	Migratory Species	<p>Fauna that periodically or occasionally visit Australia or an external Territory or the exclusive economic zone; or the species is subject of an international agreement that relates to the protection of migratory species and that binds the Commonwealth; and listing is otherwise in accordance with the ministerial guidelines (section 15 of the BC Act).</p> <p>Includes birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and fauna subject to the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), an environmental treaty under the United Nations Environment Program. Migratory species listed under the BC Act are a subset of the migratory animals, that are known to visit Western Australia, protected under the international agreements or treaties, excluding species that are listed as Threatened species.</p> <p>Published as migratory birds protected under an international agreement under schedule 5 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018.</p>
CD	Species of special conservation interest (conservation dependent fauna)	<p>Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened, and listing is otherwise in accordance with the ministerial guidelines (section 14 of the BC Act).</p> <p>Published as conservation dependent fauna under schedule 6 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018.</p>
OS	Other Specially protected species	<p>Fauna otherwise in need of special protection to ensure their conservation, and listing is otherwise in accordance with the ministerial guidelines (section 18 of the BC Act).</p> <p>Published as other specially protected fauna under schedule 7 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018.</p>

Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened fauna or flora.

Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring.

Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.

Table A.7: Priority species under Western Australian *Biodiversity Conservation Act 2016*.

P1: Priority One – Poorly known taxa
Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.
P2: Priority Two – Poorly known taxa
Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.
P3: Priority Three – Poorly known taxa
Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.
P4: Priority Four: Rare, near threatened and other taxa in need of monitoring
<p>((a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands.</p> <p>(b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for vulnerable but are not listed as Conservation Dependent.</p> <p>(c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.</p>

The management of introduced species in Western Australia is regulated through the *Biosecurity and Agriculture Management Act 2007* (BAM Act). The BAM Act seeks to establish a biosecurity regulatory scheme to prevent serious animal and plant pests from entering the State and becoming established, and to minimise the spread and impact of any that are already present within the State.

The list of declared pests is provided under the BAM Act. Declared animal and plant pests fall into three categories as Gazetted under the *Biosecurity and Agriculture Management Regulations 2013*. These categories are outlined in Table A.7.

Table A.8: Declared pests control categories as gazetted under the *Biosecurity and Agriculture Management Regulations 2013*.

Category	Description
C1 (Exclusion)	Pests will be assigned to this category if they are not established in Western Australia and control measures are to be taken, including border checks, in order to prevent them entering and establishing in the State.
C2 (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 a possibility.
C3 (Management)	Pests will be assigned to this category if they are established in Western Australia but it 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.

References

Department of Biodiversity Conservation and Attractions (2019) Conservation Codes for Western Australian Flora and Fauna. Last updated 3 January 2019. Accessed 25/04/20.

<https://www.dpaw.wa.gov.au/images/documents/plants-animals/threatened-species/Listings/Conservation%20code%20definitions.pdf>

Department of Environment and Conservation (2013). Definitions, categories and criteria for threatened and priority ecological communities. Accessed 25/04/20

https://www.dpaw.wa.gov.au/images/plants-animals/threatened-species/definitions_categories_and_criteria_for_threatened_and_priority_ecological_communities.pdf

APPENDIX B: PMST SEARCH RESULTS



Australian Government

Department of Climate Change, Energy,
the Environment and Water

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: 14-Mar-2023

[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:	11

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:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	16
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:	None
EPBC Act Referrals:	20
Key Ecological Features (Marine):	None
Biologically Important Areas:	1
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	Buffer Status
BIRD			
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area	In feature area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat may occur within area	In feature area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat known to occur within area	In feature area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area	In feature area
Pezoporus occidentalis Night Parrot [59350]	Endangered	Species or species habitat may occur within area	In feature area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area	In feature area
MAMMAL			
Dasyurus hallucatus Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat known to occur within area	In feature area
Macroderma gigas Ghost Bat [174]	Vulnerable	Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Macrotis lagotis Greater Bilby [282]	Vulnerable	Species or species habitat known to occur within area	In feature area
Rhinonicteris aurantia (Pilbara form) Pilbara Leaf-nosed Bat [82790]	Vulnerable	Species or species habitat known to occur within area	In feature area

PLANT

Quoya zonalis listed as Pityrodia sp. Marble Bar (G.Woodman & D.Coultas GWDC Opp 4) Pilbara Foxglove [91588]	Endangered (listed as Pityrodia sp. Marble Bar)	Species or species habitat known to occur within area	In buffer area only
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REPTILE

Liasis olivaceus barroni Olive Python (Pilbara subspecies) [66699]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Liopholis kintorei Great Desert Skink, Tjakura, Warrarna, Mulyamiji [83160]	Vulnerable	Species or species habitat may occur within area	In buffer area only

Listed Migratory Species

[[Resource Information](#)]

Scientific Name	Threatened Category	Presence Text	Buffer Status
Migratory Marine Birds			
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area	In feature area

Migratory Terrestrial Species

Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area	In feature area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area	In feature area
Motacilla flava Yellow Wagtail [644]		Species or species habitat likely to occur within area	In feature area

Migratory Wetlands Species

Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area	In feature area
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Scientific Name	Threatened Category	Presence Text	Buffer Status
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area	In feature area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area	In feature area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area	In feature area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area	In feature area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area	In feature area

Other Matters Protected by the EPBC Act

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

Scientific Name	Threatened Category	Presence Text	Buffer Status
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area overfly marine area	In feature area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area overfly marine area	In feature area
Chalcites osculans as Chrysococcyx osculans Black-eared Cuckoo [83425]		Species or species habitat known to occur within area overfly marine area	In feature area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area overfly marine area	In feature area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area overfly marine area	In feature area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area	In feature area
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area overfly marine area	In feature area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area	In feature area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area overfly marine area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Motacilla flava Yellow Wagtail [644]		Species or species habitat likely to occur within area overfly marine area	In feature area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area	In feature area
Rostratula australis as Rostratula benghalensis (sensu lato) Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area overfly marine area	In feature area

Extra Information

EPBC Act Referrals				[Resource Information]
Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Controlled action				
Abydos Direct Shipping Ore (DSO) Project, Stage 2	2013/6985	Controlled Action	Post-Approval	In buffer area only
Abydos Direct Shipping Ore Project	2012/6345	Controlled Action	Post-Approval	In buffer area only
Additional Rail Infrastructure between Herb Elliott Port Facility and Cloudbreak Mine Site	2010/5513	Controlled Action	Post-Approval	In buffer area only
Development of the Wodgina Direct Shipping Ore Project, Stage 2	2011/5975	Controlled Action	Post-Approval	In buffer area only
North Star Hematite Project	2012/6530	Controlled Action	Post-Approval	In buffer area only
North Star Magnetite Project	2012/6689	Controlled Action	Post-Approval	In buffer area only
Roy Hill to Port Hedland Rail Line and Associated Infrastructure	2010/5424	Controlled Action	Post-Approval	In buffer area only
Wodgina Direct Shipping Ore Project	2009/5167	Controlled Action	Post-Approval	In buffer area only
Not controlled action				
Development of iron ore resources in eastern Pilbara region, including port at P	2004/1562	Not Controlled Action	Completed	In buffer area only

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action				
Expansion of the Talison Minerals Storage Facility, Wodgina Mine	2008/4675	Not Controlled Action	Completed	In buffer area only
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed	In feature area
Pilbara Bulk Ore Transport System Project, WA	2016/7637	Not Controlled Action	Completed	In buffer area only
Pilbara Transmission Project, Pilbara, WA	2018/8349	Not Controlled Action	Completed	In buffer area only
Rail and Port Facilities	2001/474	Not Controlled Action	Completed	In buffer area only
Sulphur Springs Copper-Zinc Mining Project, Pilbara Region, WA	2013/6899	Not Controlled Action	Completed	In buffer area only
Wodgina Lithium Mine Expansion, Pilbara, NT	2018/8194	Not Controlled Action	Completed	In buffer area only
Not controlled action (particular manner)				
Additional Rail Infrastructure	2012/6314	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Atlas Boodarie Link Project, WA	2012/6506	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Mine the Hercules Deposit under the Wodgina Direct Shipping Ore Project Stage 3	2013/6789	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Referral decision				
Mine the Hercules Deposit under the Wodgina Direct Shipping Ore Project ??? Stage 3	2013/6777	Referral Decision	Completed	In buffer area only
Biologically Important Areas				
Scientific Name		Behaviour	Presence	Buffer Status
Seabirds				
Ardena pacifica				
Wedge-tailed Shearwater [84292]		Breeding	Known to occur	In buffer area only

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.

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APPENDIX C: DETAILED FLORA AND VEGETATION SURVEY SITES

E45/2287 Infill Biological Survey - Appendix C
Detailed Flora and Vegetation Sites

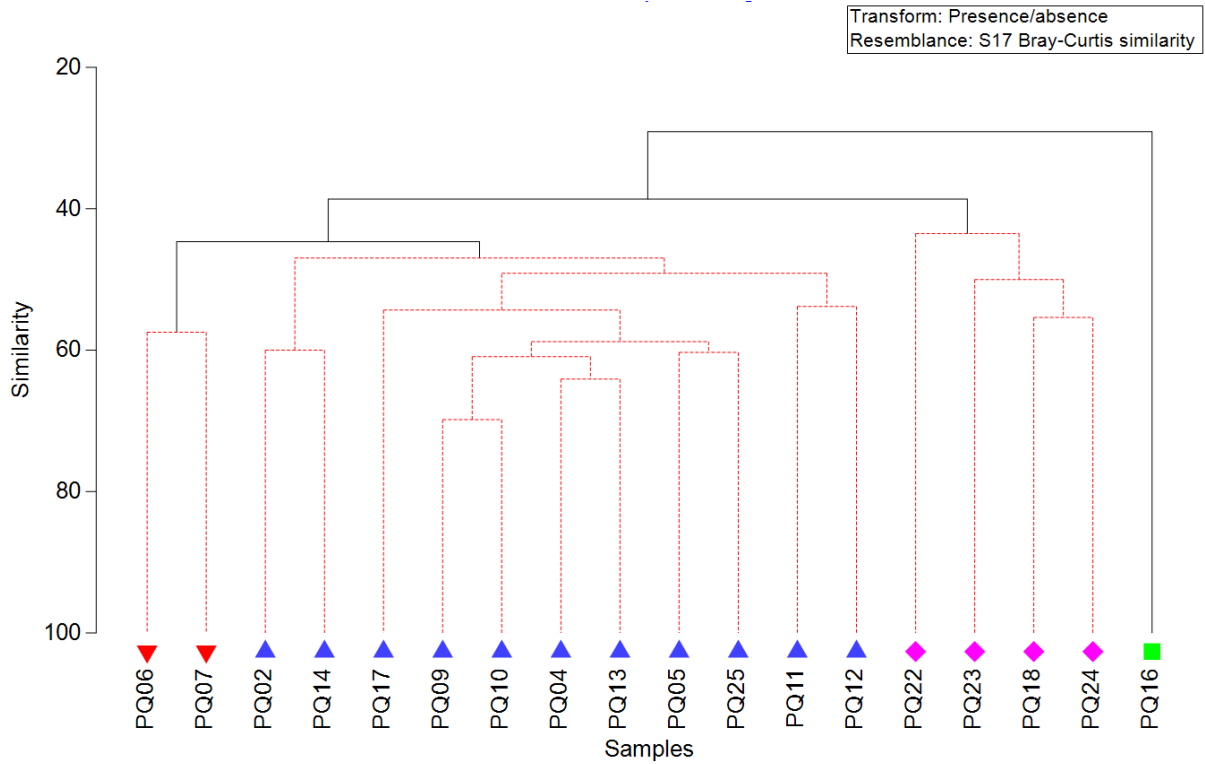


Figure C-1. Dendrogram resulting from the cluster analysis of detailed vegetation sites

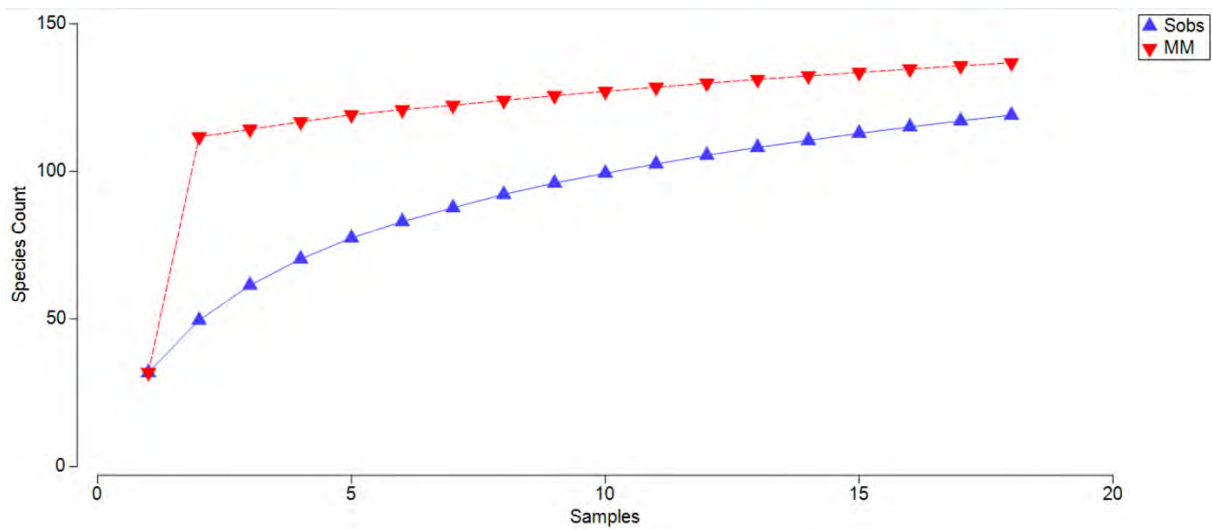
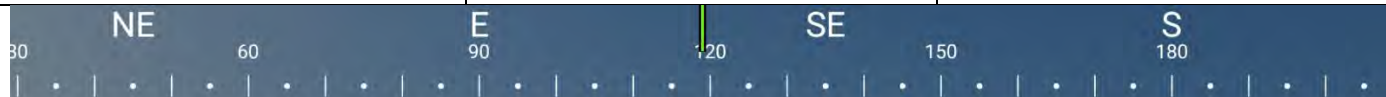


Figure C-2. Species accumulation curve of detailed vegetation sites

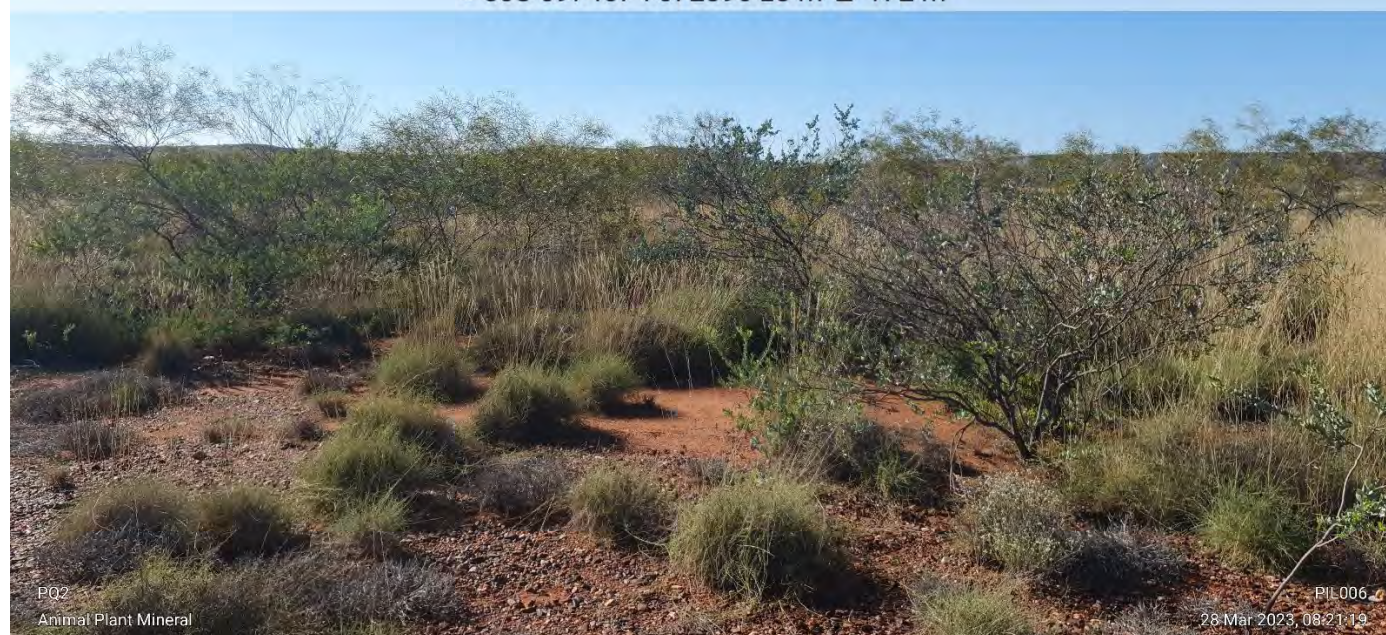
Sobs : Sample observations randomly permuted 999 times; MM : Michaelis Menton model results.

E45/2287 Infill Biological Survey - Appendix C
Detailed Flora and Vegetation Sites

Site: PQ02 **Date:** 28/03/2023 **Botanist(s):** Neil Pettit / Tia Berard



● 50S 697457 7672896 ±8 m ▲ 172 m



PQ02
Animal Plant Mineral

PIL006
28. Mär 2023, 08:21:19

WP-NW: 697437, 7672883		WP-NE: 697496, 7672910		WP-SE: 697509, 7672862		WP-SW: 697463, 7672845	
Site Type / Size:		50 x 50 m Quadrat					
Age since fire:		> 5 years					
Seasonal Conditions:		Dry to moist soil					
Rock Type:		Granite					
Soil Type:		Sandy Loam		Soil Colour:		Red	
Surface Rocks Size/Shape:		0.5-5 cm Angular		Surface Rocks Cover (%):		5	
Landform		Stony flat plain					
Slope aspect		Flat					
Vegetation Description		Hummock grasslands with sparse <i>Acacia</i> spp shrubland and emergent <i>Corymbia hamersleyana</i> ,					
Condition		Excellent					
Strata	Cover (%)	Height (m)	Species				
Overstorey	0.5	3	<i>Corymbia hamersleyana</i> ,				
Midstorey	15	2-3	<i>Acacia inaequilatera</i> , <i>A. bivenosa</i> , <i>A. adsurgens</i>				
Understorey	60	1.2	<i>Triodia lanigera</i> , <i>T. wiseana</i> , <i>T. epactia</i> , <i>T. angusta</i>				

E45/2287 Infill Biological Survey - Appendix C
Detailed Flora and Vegetation Sites

Site: PQ04		Date: 29/03/2023		Botanist(s): Neil Pettit / Tia Berard	
WP-NW: 697022, 7673903		WP-NE: 697075, 7673908		WP-SE: 697077, 7673859	
WP-SW: 697028, 7673857					
Site Type / Size:		50 x 50 m Quadrat			
Age since fire:		> 5 years			
Seasonal Conditions:		Dry. Moist subsoil			
Rock Type:		Granite / quartzite			
Soil Type:		Loamy sand		Soil Colour: Brown	
Surface Rocks Size/Shape:		0.1-15 cm		Surface Rocks Cover (%): 20	
Landform		Shallow drainage line between rocky hills			
Slope aspect		Very slight slope to west			
Vegetation Description		Open scattered woodland with hummock grass understorey			
Condition		Excellent			
Strata	Cover (%)	Height (m)	Species		
Overstorey	2	4	<i>Corymbia hamersleyana</i> ,		
Midstorey	4	2	<i>Acacia inaequilatera</i> , <i>A. adsurgens</i> , <i>A. coliei</i>		
Understorey	60	1.6	<i>Triodia epactia</i> , <i>T. chichesterensis</i>		

E45/2287 Infill Biological Survey - Appendix C
Detailed Flora and Vegetation Sites

Site: PQ05		Date: 30/03/2023		Botanist(s): Neil Pettit / Tia Berard	
WP-NW: 696359, 7674478		WP-NE: 696406, 7674497		WP-SE: 696424, 7674455	
WP-SW: 696382, 7674436					
Site Type / Size:		50 x 50 m Quadrat			
Age since fire:		> 5 years			
Seasonal Conditions:		Dry. Subsoil moist.			
Rock Type:		Quartz / granite			
Soil Type:		Loamy Sand		Soil Colour: Red	
Surface Rocks Size/Shape:		0.1-3 cm, Angular		Surface Rocks Cover (%): 5	
Landform		Flat open sandy plain			
Slope aspect		Flat			
Vegetation Description		Hummock grassland with scattered emergent small trees			
Condition		Excellent			
Strata	Cover (%)	Height (m)	Species		
Overstorey	1	3.5	<i>Corymbia hamersleyana</i>		
Midstorey	15	1.6	<i>Acacia adsurgens</i> , <i>A. coleii</i> , <i>A. bivenosa</i>		
Groundcover	60	1.3	<i>Triodia lanigera</i> , <i>T. schinzii</i> .		

E45/2287 Infill Biological Survey - Appendix C
Detailed Flora and Vegetation Sites

Site: PQ06		Date: 30/03/2023		Botanist(s): Neil Pettit / Tia Berard	
WP-NW: 695810, 7675107		WP-NE: 695850, 7675110		WP-SE: 695858, 7675061	
WP-SW: 695808, 7675059					
Site Type / Size:		50 x 50 m Quadrat			
Age since fire:		> 5 years			
Seasonal Conditions:		Dry. Subsoil moist.			
Rock Type:		Quartz / granite			
Soil Type:		Sand		Soil Colour: Red	
Surface Rocks Size/Shape:		0.1-3 cm, Angular		Surface Rocks Cover (%): 10	
Landform		Shallow drainage area with small channel (3 m wide)			
Slope aspect		Very slight gradient, stream flowing west			
Vegetation Description		Hummock grassland with <i>Corymbia</i> and <i>Acacia</i> lining the stream			
Condition		Excellent			
Strata	Cover (%)	Height (m)	Species		
Overstorey	2	4	<i>Corymbia hamersleyana</i>		
Midstorey	11	2	<i>Acacia adsurgens</i> , <i>A. cowleana</i> , <i>A. bivenosa</i> .		
Groundcover	45	1.5	<i>Triodia lanigera</i> , <i>T. epactia</i> , <i>Chrysopogon fallax</i> .		
Notes: Cattle tracks and scats evident					

E45/2287 Infill Biological Survey - Appendix C
Detailed Flora and Vegetation Sites

Site: PQ07		Date: 29/03/2023		Botanist(s): Neil Pettit / Tia Berard	
WP-NW: 697170, 7675165		WP-NE: 697252, 7675105		WP-SE: 697241, 7675086	
WP-SW: 697153, 7675148					
Site Type / Size:		25 x 100 m Quadrat			
Age since fire:		> 5 years			
Seasonal Conditions:		Dry. Moist subsoil.			
Rock Type:		Conglomerate granite, quartz			
Soil Type:		Sand		Soil Colour: Red	
Surface Rocks Size/Shape:		0.1 – 20 cm, Angular.		Surface Rocks Cover (%): 10	
Landform		Riparian drainage line low order (3) (channel width 5m), very low slope.			
Slope aspect		Flow is westward.			
Vegetation Description		Low open woodland with mixed grassland understorey.			
Condition		Very good			
Strata	Cover (%)	Height (m)	Species		
Overstorey	10	3.5	<i>Corymbia hamersleyana</i>		
Midstorey	15	1.8	<i>Acacia adsurgens</i> , <i>A. cowleana</i> , <i>A. colei</i> , <i>A. bivenosa</i>		
Groundcover	40	1.6	<i>Triodia wiseana</i> , <i>Triodia epactia</i> , <i>Themeda triandra</i> .		
Notes:					
Cattle scats and tracks evident					

E45/2287 Infill Biological Survey - Appendix C
Detailed Flora and Vegetation Sites

Site: PQ09		Date: 30/03/2023		Botanist(s): Neil Pettit / Tia Berard	
WP-NW: 696607, 7674003		WP-NE: 696654, 7673993		WP-SE: 696654, 7673944	
WP-SW: 696595, 7673957					
Site Type / Size:		50 x 50 m Quadrat			
Age since fire:		2 years			
Seasonal Conditions:		Moist soil from recent rain			
Rock Type:		N/A			
Soil Type:		Sandy loam		Soil Colour: Dark brown	
Surface Rocks Size/Shape:		N/A		Surface Rocks Cover (%): 0	
Landform		Broad flat plain at base of low hills, broad drainage area			
Slope aspect		Flat			
Vegetation Description		Hummock grassland with very occasional emergent trees			
Condition		Good (recently burnt)			
Strata	Cover (%)	Height (m)	Species		
Overstorey	2	4	<i>Corymbia hamersleyana,</i>		
Midstorey	12		<i>Acacia inaequilatera, A. coleii, A. adsurgens</i>		
Understorey	40	1.4	<i>Triodia epactia, Triodia lanigera</i>		

E45/2287 Infill Biological Survey - Appendix C
Detailed Flora and Vegetation Sites

Site: PQ10 **Date:** 30/03/2023 **Botanist(s):** Neil Pettit / Tia Berard



WP-NW: 696069, 7674252		WP-NE: 696116, 7674227		WP-SE: 696083, 7674185		WP-SW: 696044, 7674212	
Site Type / Size:		50 x 50 m Quadrat					
Age since fire:		2 years					
Seasonal Conditions:		Dry. Moist subsoil.					
Rock Type:		N/A					
Soil Type:		Loamy sand		Soil Colour:		Red	
Surface Rocks Size/Shape:		N/A		Surface Rocks Cover (%):		0	
Landform		Flat sandy plain					
Slope aspect		Flat					
Vegetation Description		Hummock grassland with scattered emergent trees					
Condition		Good (recently burnt)					
Strata	Cover (%)	Height (m)	Species				
Overstorey	0.5	3	<i>Corymbia hamersleyana</i> ,				
Midstorey	3	1.5	<i>Acacia inaequilatera</i> , <i>A. adsurgens</i> , <i>A. colei</i>				
Understorey	40	1.3	<i>Triodia lanigera</i>				

E45/2287 Infill Biological Survey - Appendix C
Detailed Flora and Vegetation Sites

Site: PQ11		Date: 30/03/2023		Botanist(s): Neil Pettit / Tia Berard	
WP-NW: 696324, 7674738		WP-NE: 696367, 7674766		WP-SE: 696390, 7674721	
WP-SW: 696349, 7674695					
Site Type / Size:		50 x 50 m Quadrat			
Age since fire:		> 5 years			
Seasonal Conditions:		Dry. Subsoil moist.			
Rock Type:		Quartzite			
Soil Type:		Loamy sand		Soil Colour: Red	
Surface Rocks Size/Shape:		0.1 – 5 cm, Angular		Surface Rocks Cover (%): 30	
Landform		Flat stony plain			
Slope aspect		Flat plain			
Vegetation Description		Sparse open woodland with hummock grass understorey			
Condition		Excellent			
Strata	Cover (%)	Height (m)	Species		
Midstorey	5	4	<i>Acacia bivenosa</i> , <i>Acacia inaequilatera</i> , <i>Acacia adsurgens</i>		
Understorey	50	1.3	<i>Triodia lanigera</i>		

E45/2287 Infill Biological Survey - Appendix C
Detailed Flora and Vegetation Sites

Site: PQ12		Date: 30/03/2023		Botanist(s): Neil Pettit / Tia Berard	
WP-NW: 696607, 7675131		WP-NE: 696654, 7675117		WP-SE: 696643, 7675068	
WP-SW: 696596, 7675082					
Site Type / Size:		50 x 50 m Quadrat			
Age since fire:		> 5 years			
Seasonal Conditions:		Dry with subsurface moisture			
Rock Type:		Quartz			
Soil Type:		Loamy sand		Soil Colour: Red	
Surface Rocks Size/Shape:		0.2 – 5 cm, Angular		Surface Rocks Cover (%): 30	
Landform		Broad flat stony plain			
Slope aspect		Flat			
Vegetation Description		Hummock grassland with scattered emerged trees and shrubs			
Condition		Very good			
Strata	Cover (%)	Height (m)	Species		
Overstorey	0.5	4	<i>Acacia inaequilatera</i>		
Understorey	12	1.8	<i>Acacia adsurgens, A. colei, A. inaequilatera.</i>		
Groundcover	35	1.2	<i>Triodia angusta, T. lanigera, Themeda triandra.</i>		

E45/2287 Infill Biological Survey - Appendix C
Detailed Flora and Vegetation Sites

Site: PQ13		Date: 28/03/2023		Botanist(s): Neil Pettit / Tia Berard	
WP-NW: 697435, 7674289		WP-NE: 697480, 7674298		WP-SE: 697487, 7674248	
WP-SW: 697441, 7674243					
Site Type / Size:		50 x 50 m Quadrat			
Age since fire:		> 5 years			
Seasonal Conditions:		Dry with moist subsoil			
Rock Type:		N/A			
Soil Type:		Loamy sand		Soil Colour: Red	
Surface Rocks Size/Shape:		N/A		Surface Rocks Cover (%): 0	
Landform		Low diffuse drainage line			
Slope aspect		Low, flat			
Vegetation Description		Low very open woodland and hummock grassland			
Condition		Very good			
Strata	Cover (%)	Height (m)	Species		
Midstorey	10	2.5	<i>Acacia adsurgens</i> , <i>Acacia colei</i> , <i>A. cowleana</i> , <i>A. inaequilatera</i> .		
Understorey	30	1.6	<i>Triodia epactia</i> , <i>Chrysopogon fallax</i> , <i>Indigofera monophylla</i> .		

E45/2287 Infill Biological Survey - Appendix C
Detailed Flora and Vegetation Sites

Site: PQ14		Date: 28/03/2023		Botanist(s): Neil Pettit / Tia Berard	
WP-NW: 697464, 7673352		WP-NE: 697512, 7673335		WP-SE: 697496, 7673286	
WP-SW: 697450, 7673305					
Site Type / Size:		50 x 50 m Quadrat			
Age since fire:		2 years			
Seasonal Conditions:		Dry with moist subsoil			
Rock Type:		Granite, quartz and basalt			
Soil Type:		Sandy loam		Soil Colour: Red	
Surface Rocks Size/Shape:		0.1 – 4 cm, Angular		Surface Rocks Cover (%): 25	
Landform		Undulating stony plain			
Slope aspect		Flat			
Vegetation Description		Open hummock grassland with occasional emergent trees			
Condition		Good / Poor			
Strata	Cover (%)	Height (m)	Species		
Overstorey	0.1	0.4	<i>Corymbia hamersleyana</i>		
Midstorey	3	3	<i>Acacia inaequilatera</i> , <i>A. adsurgens</i> , <i>A. coleii</i>		
Understorey	20	1.2	<i>Triodia wiseana</i> , <i>T. epactia</i> , <i>T. lanigera</i> , <i>T. angusta</i> .		

E45/2287 Infill Biological Survey - Appendix C
Detailed Flora and Vegetation Sites

Site: PQ16		Date: 28/03/2023		Botanist(s): Neil Pettit / Tia Berard	
WP-NW: 697415, 7672548		WP-NE: 697462, 7672583		WP-SE: 697484, 7672539	
WP-SW: 697447, 7672508					
Site Type / Size:		50 x 50 m Quadrat			
Age since fire:		> 5 years			
Seasonal Conditions:		Dry with moist subsoil			
Rock Type:		Granite and quartzite			
Soil Type:		Sandy loam		Soil Colour: Red	
Surface Rocks Size/Shape:		0.5 – 5 cm, Angular		Surface Rocks Cover (%): 50	
Landform		Flat plain 150 m from Haul Road			
Slope aspect		Flat with drainage line at north end			
Vegetation Description		Open tussock grassland with occasional trees			
Condition		Very good			
Strata	Cover (%)	Height (m)	Species		
Overstorey	0.1	3	<i>Corymbia hamersleyana</i>		
Midstorey	2	2	<i>Acacia inaequilatera</i> , <i>A. orthocarpa</i> , <i>Grevillea wickhamii</i>		
Understorey	40	1	<i>Triodia wiseana</i> , <i>T. epactia</i> , <i>T. angusta</i> , <i>T. brizoides</i> .		

E45/2287 Infill Biological Survey - Appendix C
Detailed Flora and Vegetation Sites

Site: PQ17		Date: 28/03/2023		Botanist(s): Neil Pettit / Tia Berard	
WP-NW: 697421, 7673938		WP-NE: 697456, 7673972		WP-SE: 697485, 7673936	
WP-SW: 697449, 7673902					
Site Type / Size:		50 x 50 m Quadrat			
Age since fire:		> 5 years			
Seasonal Conditions:		Dry with moist subsoil			
Rock Type:		Quartzite / granite			
Soil Type:		Loamy sand		Soil Colour: Red	
Surface Rocks Size/Shape:		0.1 – 5 cm, Angular		Surface Rocks Cover (%): 5	
Landform		Shallow drainage line			
Slope aspect		Very low incline sloping north			
Vegetation Description		Low open woodland with hummock grass understorey			
Condition		Excellent			
Strata	Cover (%)	Height (m)	Species		
Overstorey	2	3	<i>Corymbia hamersleyana</i> ,		
Midstorey	15	2	<i>Acacia cowleana</i> , <i>Grevillea wickhamii</i> , <i>Acacia cowleana</i>		
Understorey	40	1.2	<i>Triodia epactia</i> , <i>Chrysopogon fallax</i> .		

E45/2287 Infill Biological Survey - Appendix C
Detailed Flora and Vegetation Sites

Site: PQ18		Date: 29/03/2023		Botanist(s): Neil Pettit / Tia Berard	
WP-NW: 697123, 7674213		WP-NE: 697170, 7674181		WP-SE: 697154, 7674135	
WP-SW: 697114, 7674162					
Site Type / Size:		50 x 50 m Quadrat			
Age since fire:		> 5 years			
Seasonal Conditions:		Dry			
Rock Type:		Granite / ironstone			
Soil Type:		Sand		Soil Colour: Red	
Surface Rocks Size/Shape:		0.5 – 60 cm, Angular		Surface Rocks Cover (%): 85	
Landform		Low rocky outcrop			
Slope aspect		Moderate slope all aspects			
Vegetation Description		Low hummock grassland with scattered emergent trees			
Condition		Excellent			
Strata	Cover (%)	Height (m)	Species		
Midstorey	4	3	<i>Acacia inaequilatera</i> , <i>Grevillea pyramidalis</i> , <i>G. wickhamii</i>		
Understorey	50	1.6	<i>Triodia wiseana</i> , <i>Triodia chichesterensis</i>		

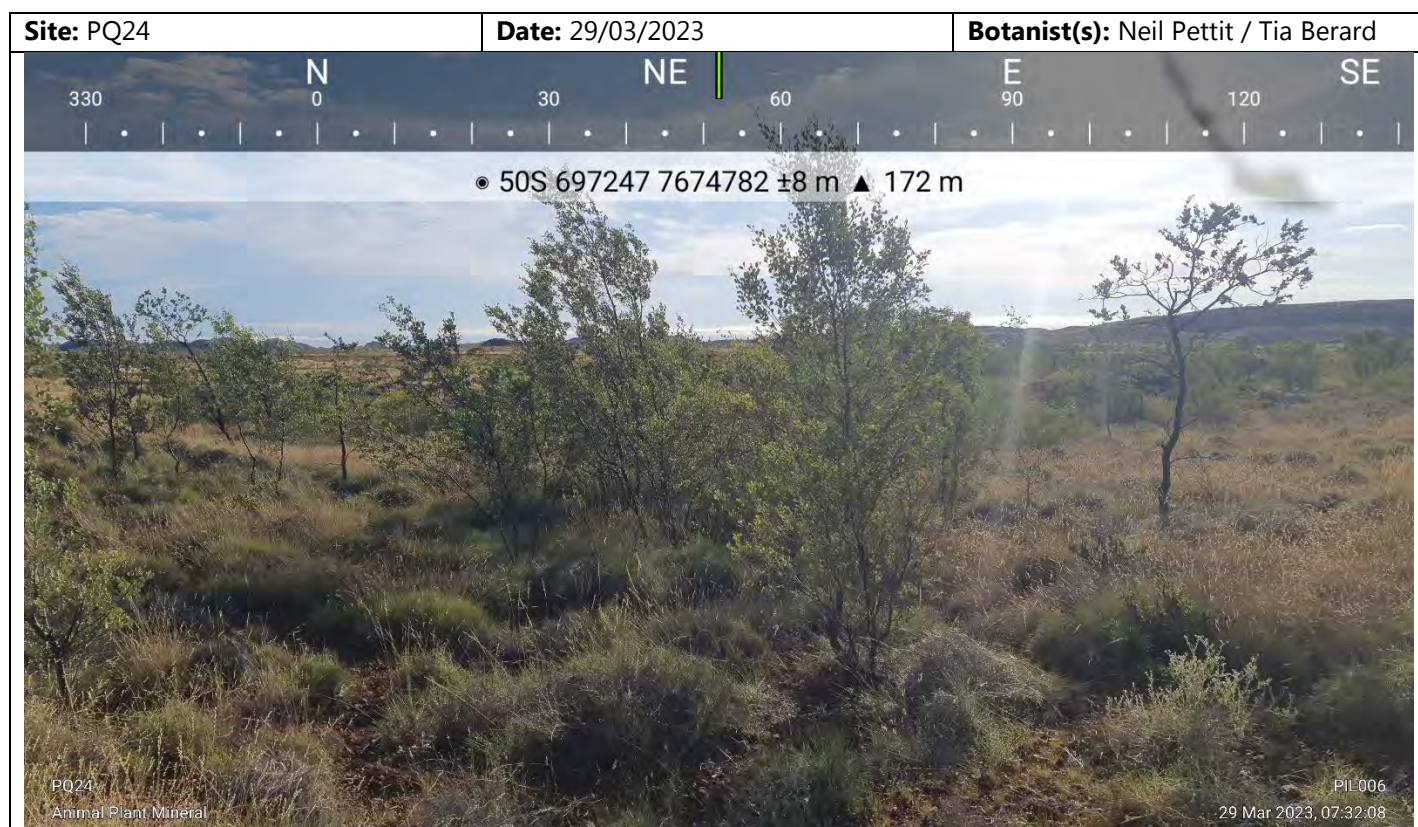
E45/2287 Infill Biological Survey - Appendix C
Detailed Flora and Vegetation Sites

Site: PQ22		Date: 29/03/2023		Botanist(s): Neil Pettit / Tia Berard	
WP-NW: 697111, 7674461		WP-NE: 697156, 7674462		WP-SE: 697165, 7674414	
WP-SW: 697114, 7674410					
Site Type / Size:		50 x 50 m Quadrat			
Age since fire:		> 5 years			
Seasonal Conditions:		Dry with moist subsurface soil			
Rock Type:		Granite			
Soil Type:		Fine sand		Soil Colour: Red	
Surface Rocks Size/Shape:		2 – 30 cm, Angular		Surface Rocks Cover (%): 80	
Landform		Low granite / ironstone outcrop			
Slope aspect		Hilltop covering all aspects			
Vegetation Description		Hummock grassland with scattered trees			
Condition		Excellent			
Strata	Cover (%)	Height (m)	Species		
Midstorey	0.5	3	<i>Acacia inaequilatera</i>		
Understorey	65	1.6	<i>Triodia wiseana, Cymbopogon ambiguous.</i>		

E45/2287 Infill Biological Survey - Appendix C
Detailed Flora and Vegetation Sites

Site: PQ23		Date: 29/03/2023		Botanist(s): Neil Pettit / Tia Berard	
WP-NW: 696964, 7674095		WP-NE: 697011, 7674080		WP-SE: 696998, 7674033	
WP-SW: 696951, 7674047					
Site Type / Size:		50 x 50 m Quadrat			
Age since fire:		> 5 years			
Seasonal Conditions:		Dry			
Rock Type:		Granite / quartzite			
Soil Type:		Sand		Soil Colour: Red	
Surface Rocks Size/Shape:		1 – 50 cm, Angular		Surface Rocks Cover (%): 75	
Landform		Rocky hillslope			
Slope aspect		Moderate slope facing west			
Vegetation Description		Hummock grassland with scattered trees			
Condition		Excellent			
Strata	Cover (%)	Height (m)	Species		
Midstorey	5	3	<i>Acacia inaequilatera</i> , <i>Grevillea wickhamii</i>		
Understorey	60	1.5	<i>Triodia angusta</i> , <i>T. wiseana</i> , <i>T. chichesterensis</i>		

E45/2287 Infill Biological Survey - Appendix C
Detailed Flora and Vegetation Sites



WP-NW: 697248, 7674833		WP-NE: 697296, 7674834		WP-SE: 697297, 7674784		WP-SW: 697245, 7674782	
Site Type / Size:		50 x 50 m Quadrat					
Age since fire:		> 5 years					
Seasonal Conditions:		Dry with moist subsurface soil					
Rock Type:		Granite / ironstone					
Soil Type:		Loamy sand		Soil Colour:		Brown	
Surface Rocks Size/Shape:		0.5 – 10 cm, Angular		Surface Rocks Cover (%):		80	
Landform		Low rocky outcrop and gully					
Slope aspect		Moderate slope east					
Vegetation Description		Hummock grassland with scattered emergent trees					
Condition		Excellent					
Strata	Cover (%)	Height (m)	Species				
Overstorey	2	3	<i>Corymbia hammersleyana</i>				
Midstorey	15	3.5	<i>Acacia inaequilatera</i> , <i>A. coleii</i> , <i>A. adsurgens</i> , <i>Grevillea wickhamii</i>				
Understorey	45	1.2	<i>Triodia angusta</i> , <i>T. epactia</i>				

E45/2287 Infill Biological Survey - Appendix C
Detailed Flora and Vegetation Sites

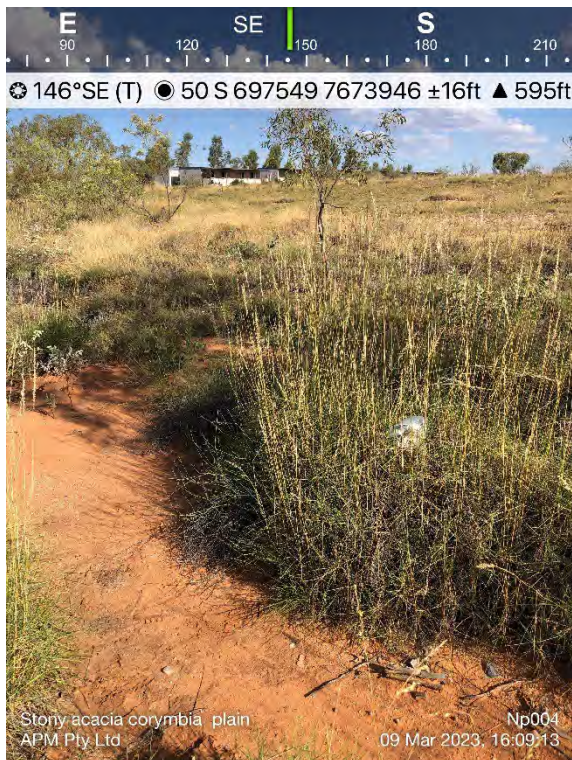
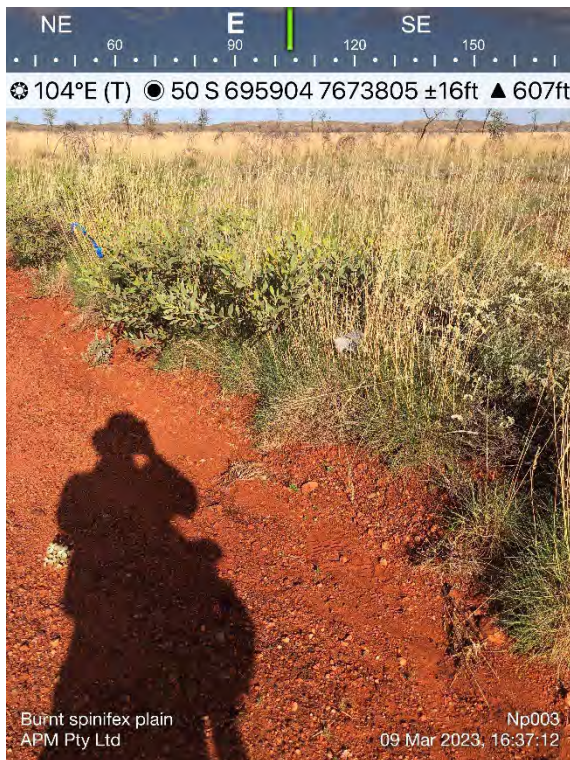
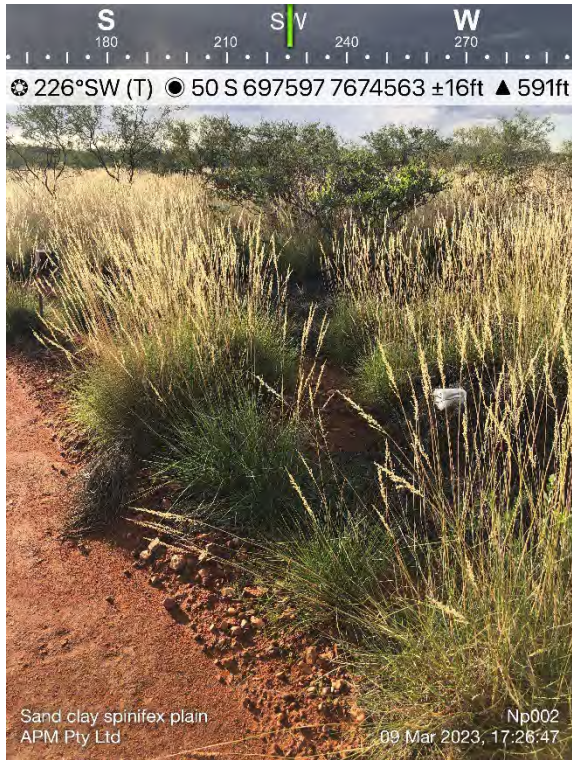
Site: PQ25 **Date:** 29/03/2023 **Botanist(s):** Neil Pettit / Tia Berard



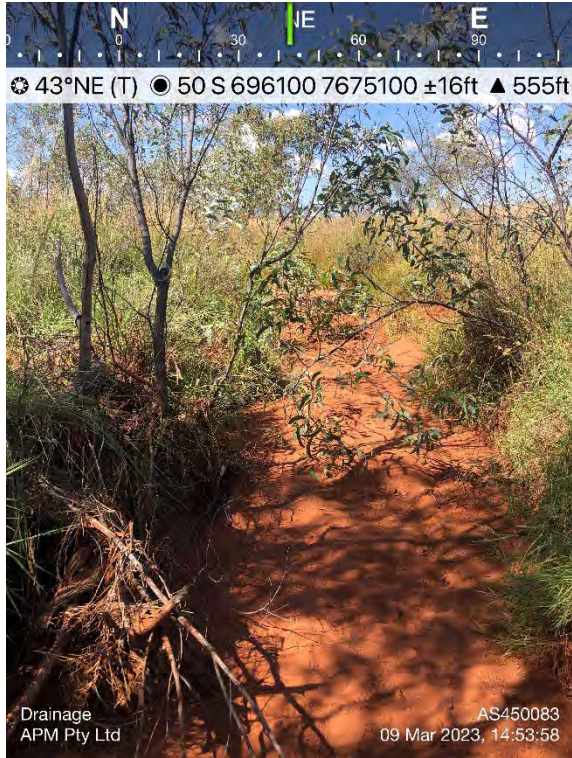
WP-NW: 697404, 7674781		WP-NE: 697451, 7674793		WP-SE: 697462, 7674750		WP-SW: 697418, 7674735	
Site Type / Size:		50 x 50 m Quadrat					
Age since fire:		> 5 years					
Seasonal Conditions:		Dry with a moist subsurface					
Rock Type:		Quartzite / granite					
Soil Type:		Sandy loam		Soil Colour:		Brown	
Surface Rocks Size/Shape:		0.5 – 5 cm, Angular		Surface Rocks Cover (%):		10	
Landform		Sandy undulating plain					
Slope aspect		Flat					
Vegetation Description		Hummock grassland with some emergent trees					
Condition		Excellent					
Strata	Cover (%)	Height (m)	Species				
Overstorey	2	3.5	<i>Acacia inaequilatera</i> , <i>A. colei</i>				
Understorey	60	1.8	<i>Triodia wiseana</i> , <i>T. epactia</i>				

APPENDIX D: FAUNA HABITAT PHOTOS

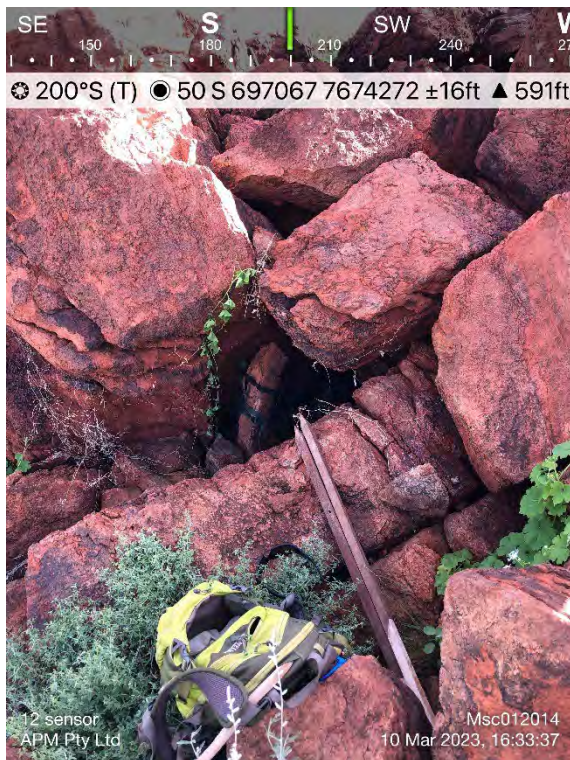
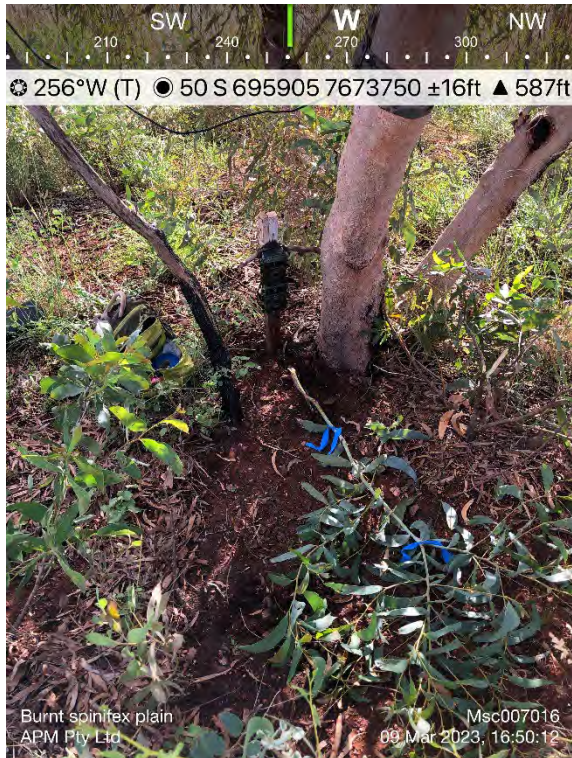
TSF Options 2 and 5 – Biological Survey
Appendix D – Fauna Habitat Site Photos



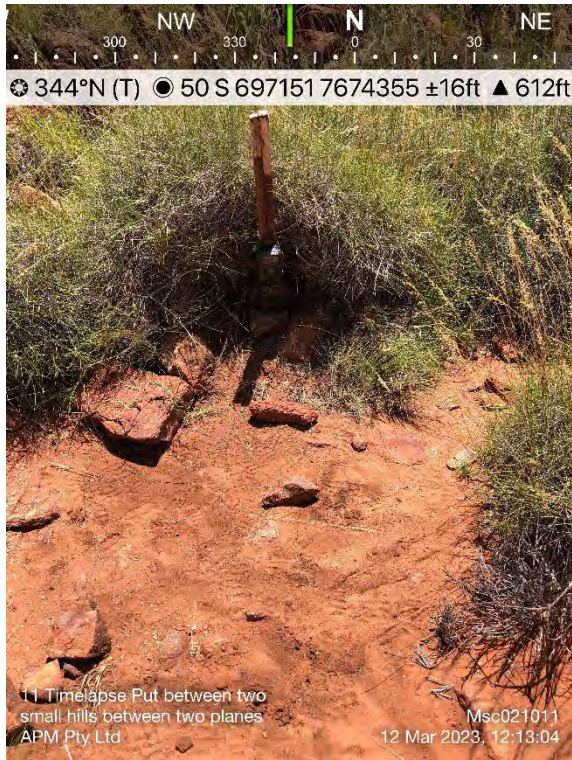
TSF Options 2 and 5 – Biological Survey
 Appendix D – Fauna Habitat Site Photos



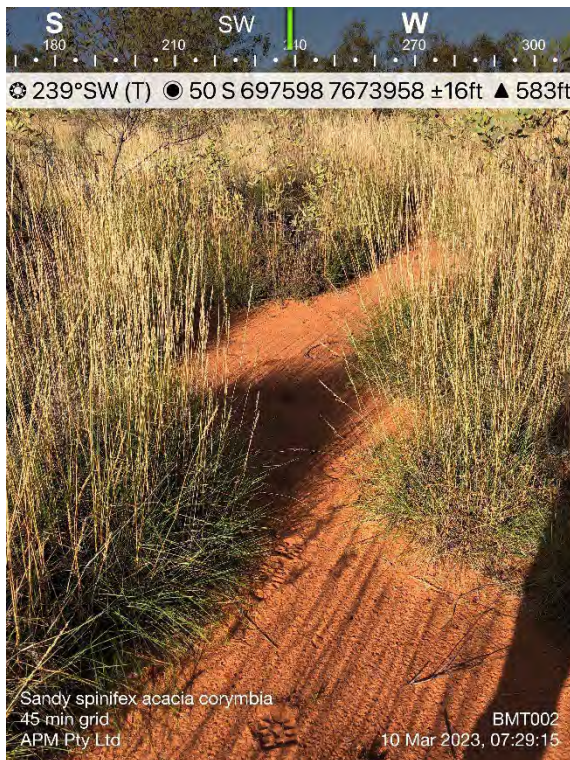
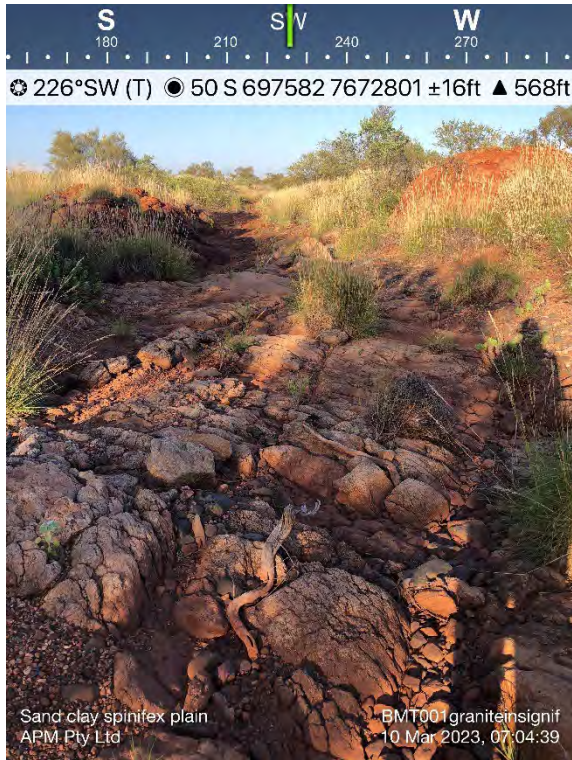
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Appendix D – Fauna Habitat Site Photos



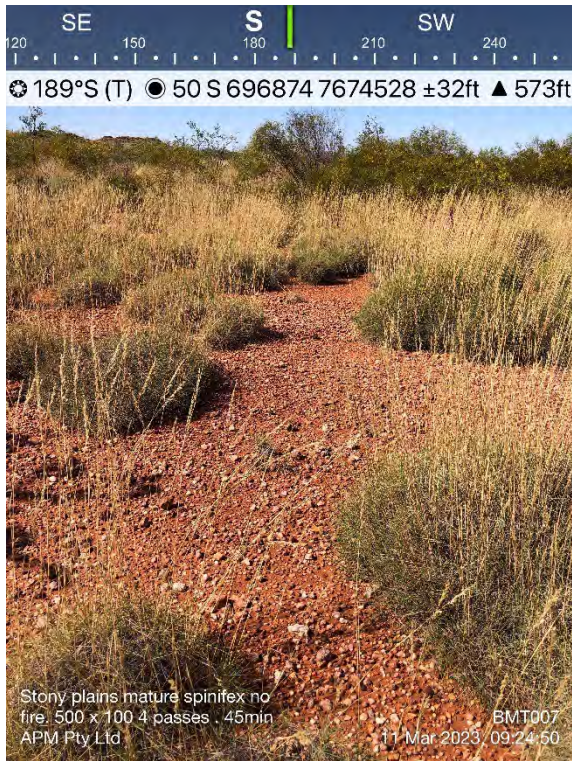
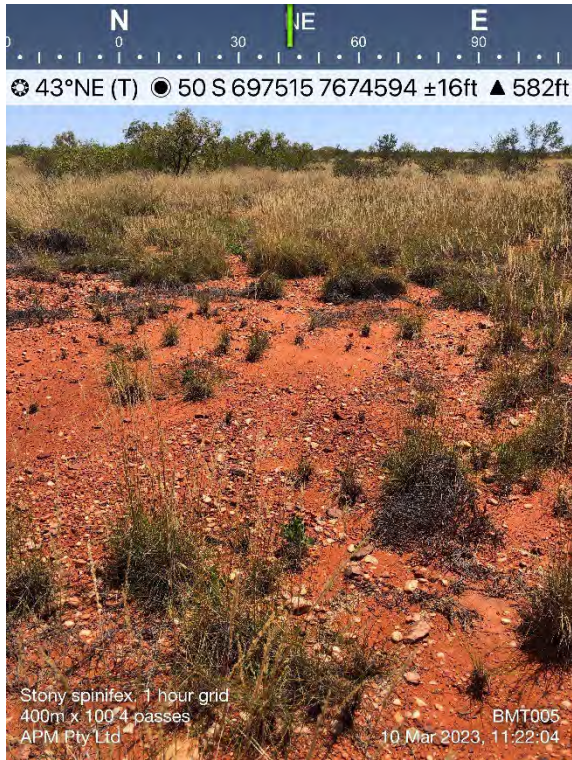
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 Appendix D – Fauna Habitat Site Photos



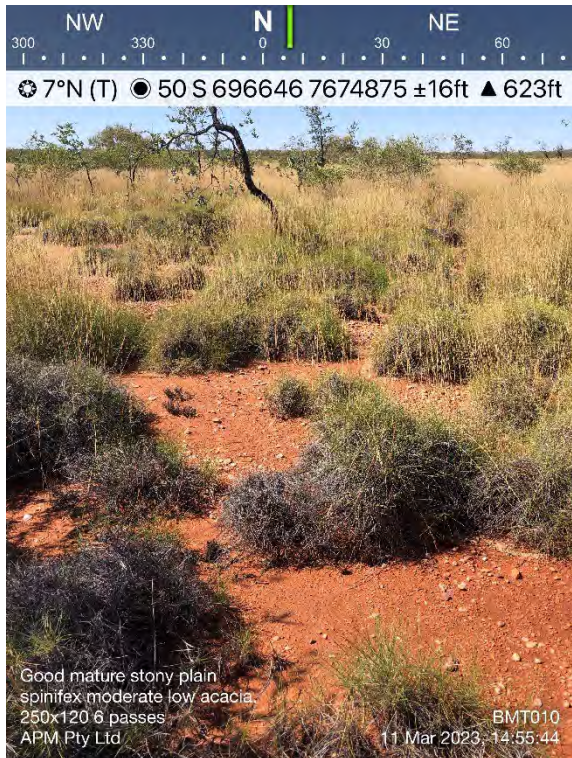
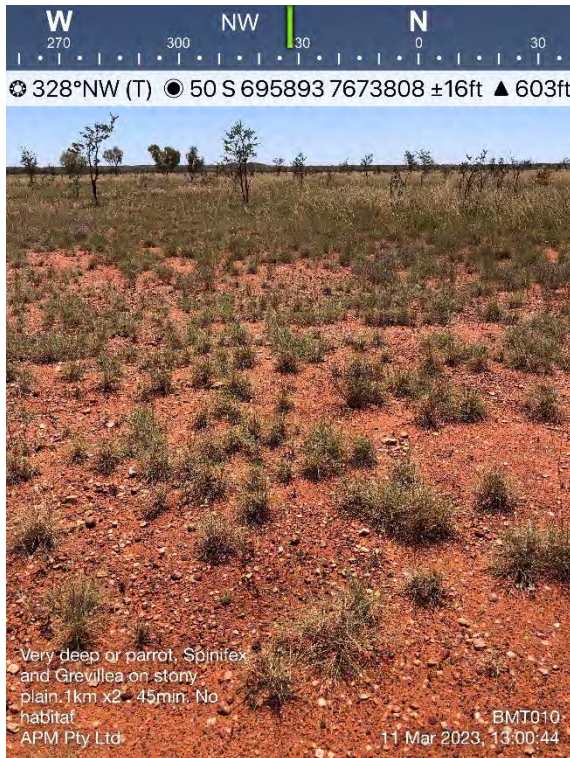
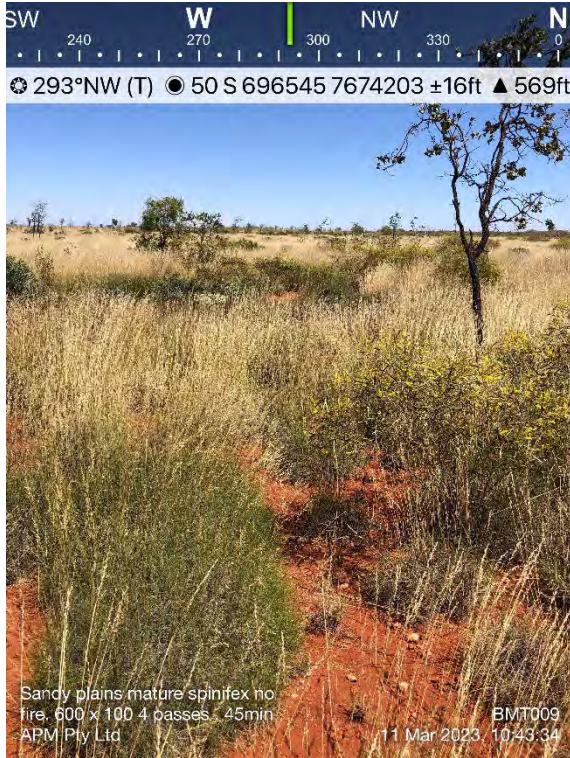
TSF Options 2 and 5 – Biological Survey
 Appendix D – Fauna Habitat Site Photos



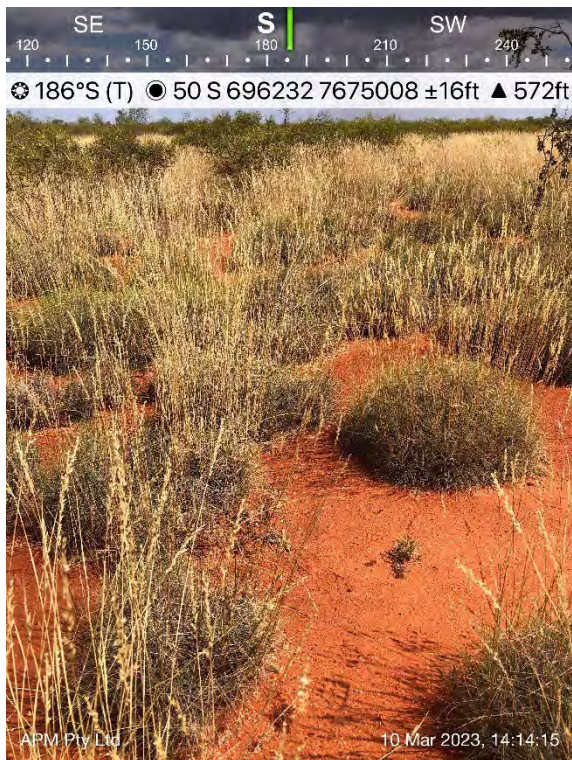
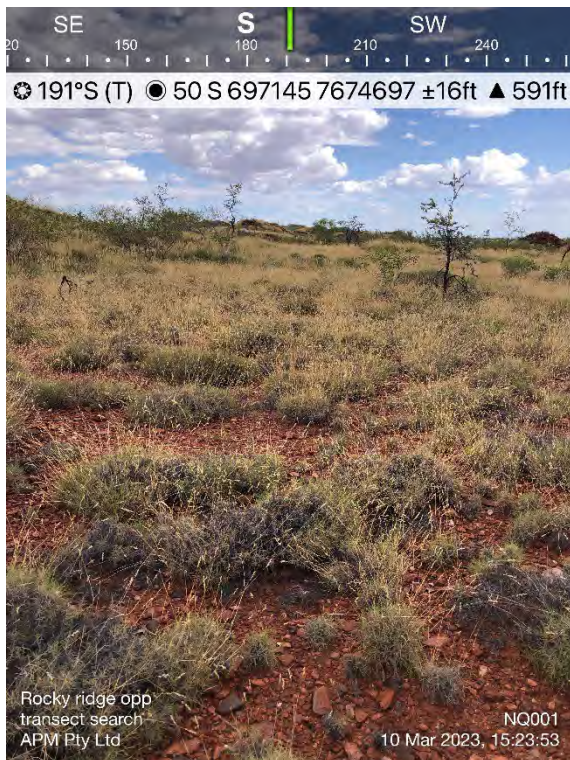
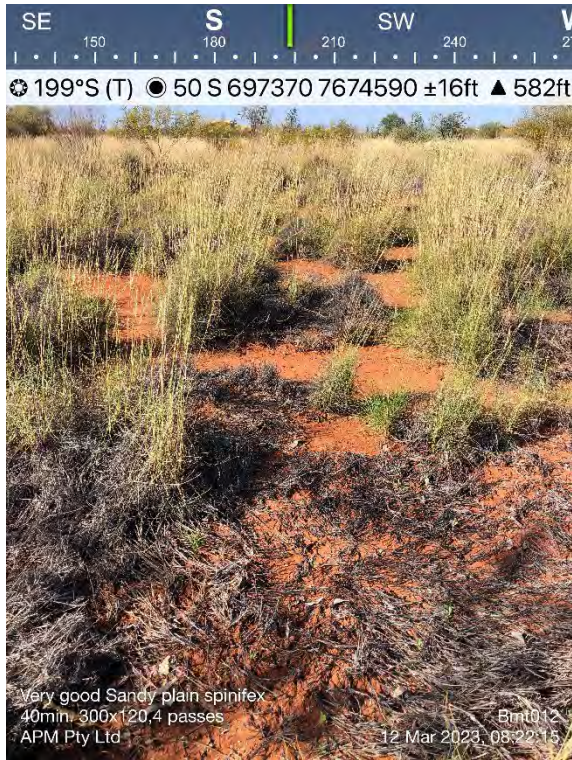
TSF Options 2 and 5 – Biological Survey
 Appendix D – Fauna Habitat Site Photos



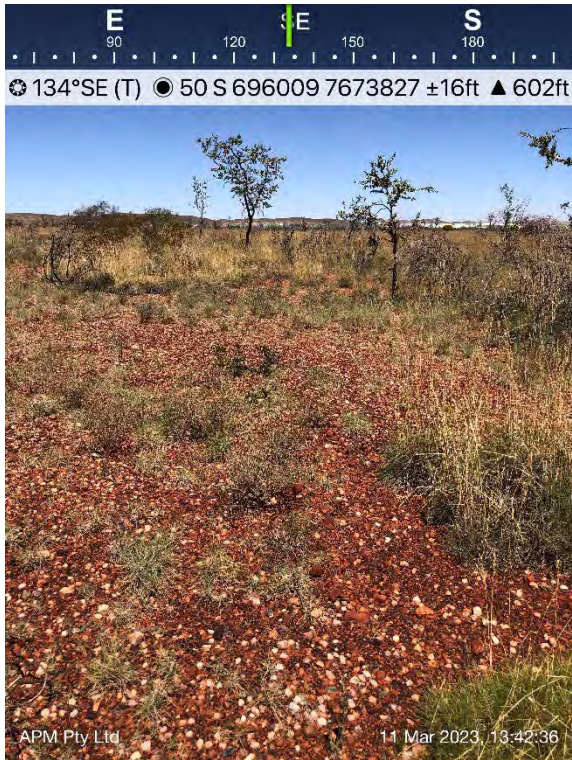
TSF Options 2 and 5 – Biological Survey
 Appendix D – Fauna Habitat Site Photos



TSF Options 2 and 5 – Biological Survey
 Appendix D – Fauna Habitat Site Photos



TSF Options 2 and 5 – Biological Survey
Appendix D – Fauna Habitat Site Photos



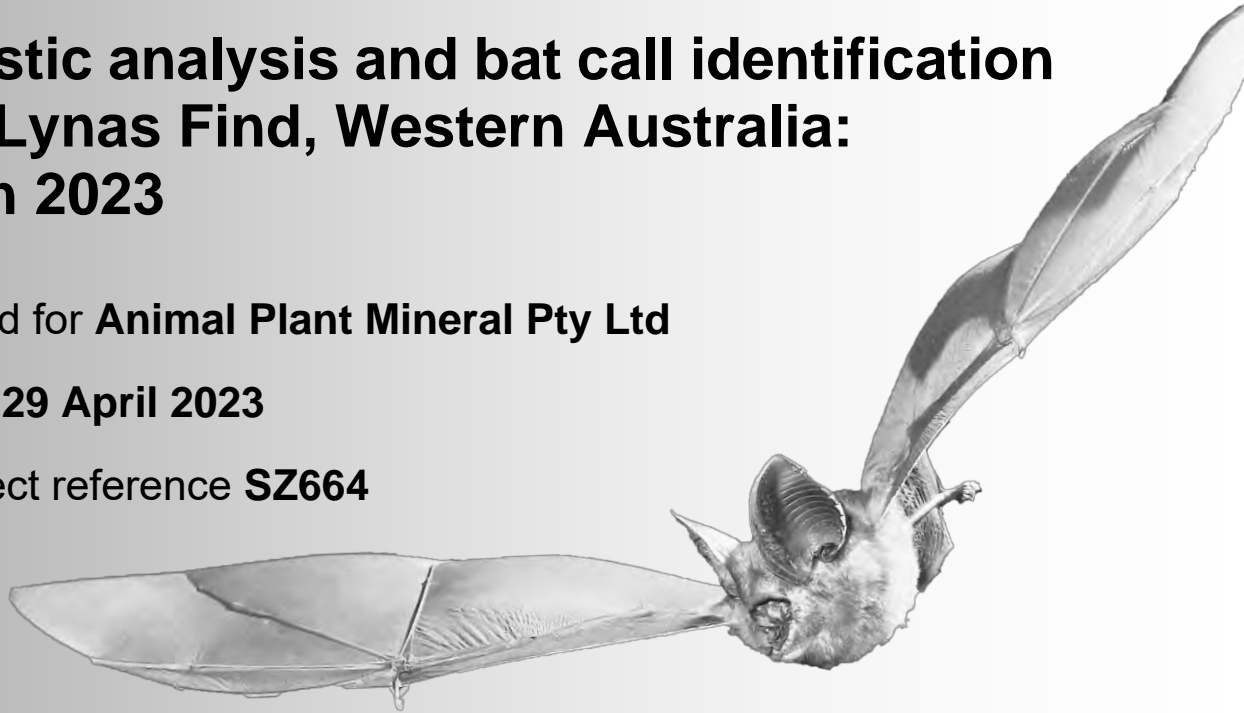
APPENDIX E: SPECIALISED ZOOLOGICAL TECHNICAL REPORT

Acoustic analysis and bat call identification from Lynas Find, Western Australia: March 2023

Prepared for **Animal Plant Mineral Pty Ltd**

Version **29 April 2023**

SZ project reference **SZ664**



Prepared by **Dr Kyle Armstrong and Yuki Konishi**

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Specialised Zoological (2023). Acoustic analysis and bat call identification from Lynas Find, Western Australia: March 2023. Unpublished report by Specialised Zoological for Animal Plant Mineral Pty Ltd, 29 April 2023, project reference SZ664.

Summary

The outcome is provided of the analysis of acoustic (bat detector) recordings made in March 2023 in the Lynas Find project area, located in the Pilbara region of Western Australia.

The scope of the analysis was limited to the detection of the Threatened-listed Ghost Bat *Macroderma gigas* (Megadermatidae) and Pilbara Leaf-nosed Bat *Rhinonycteris aurantia* (Rhinonycteridae).

The recording dataset comprised a total of 27 recording nights from three bat detector units placed at three recording sites (**Table 1; Figure 1**).

Acoustic processing of the bat detector recordings was conducted separately for each of the two target bat species using methods optimised for the detection of their unique echolocation call types.

One echolocation call sequence of the Pilbara Leaf-nosed Bat was detected (**Figures 1 and 2**).

The detection of a single short echolocation call sequence away from areas of rocky outcrop is indicative of an individual of this species out foraging away from a diurnal roost.

No calls of the Ghost Bat were observed in the recordings.

Further information is available should verification be required.

Methods

The data provided were recorded in full spectrum WAV format with Titley Scientific Anabat Swift bat detectors (sampling rate 500 kHz, set to record continuously over a 24-hour period because of issues with batteries).

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 datasets from representative echolocation calls of Pilbara cave-roosting bat species;
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 of each call type for each recording night by opening the original WAV files containing pulses of interest in Adobe Audition version 22.1.

Species were identified based on information in Armstrong and Coles (2007) and the author's own unpublished material.

References

- Armstrong, K.N. and Coles, R.B. (2007). Echolocation call frequency differences between geographic isolates of *Rhinonictis aurantia* (Chiroptera: Hipposideridae): implications of nasal chamber size. *Journal of Mammalogy* 88: 94–104. <http://dx.doi.org/10.1644/06-MAMM-A-115R1.1>
- Armstrong K.N., Broken-Brow J., Hoyer 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>

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 two target bat species 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 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.

Table 1. Summary of bat detector recordings analysed (Mg: Ghost Bat *Macroderma gigas*; Ra: Pilbara Leaf-nosed Bat *Rhinonictoris aurantia*). [Note that there were issues with the units (beyond the responsibility of Animal Plant Mineral Pty Ltd) that lead to loss of date and time information. The units were deployed between 15 and 30 March 2023.]

Swift Serial	Latitude	Longitude	No. recording nights	Mg calls	Ra calls
450007	-21.024507	118.900828	9	0	1
450083	-21.014218	118.886952	8	0	0
642022	-21.026715	118.885018	10	0	0

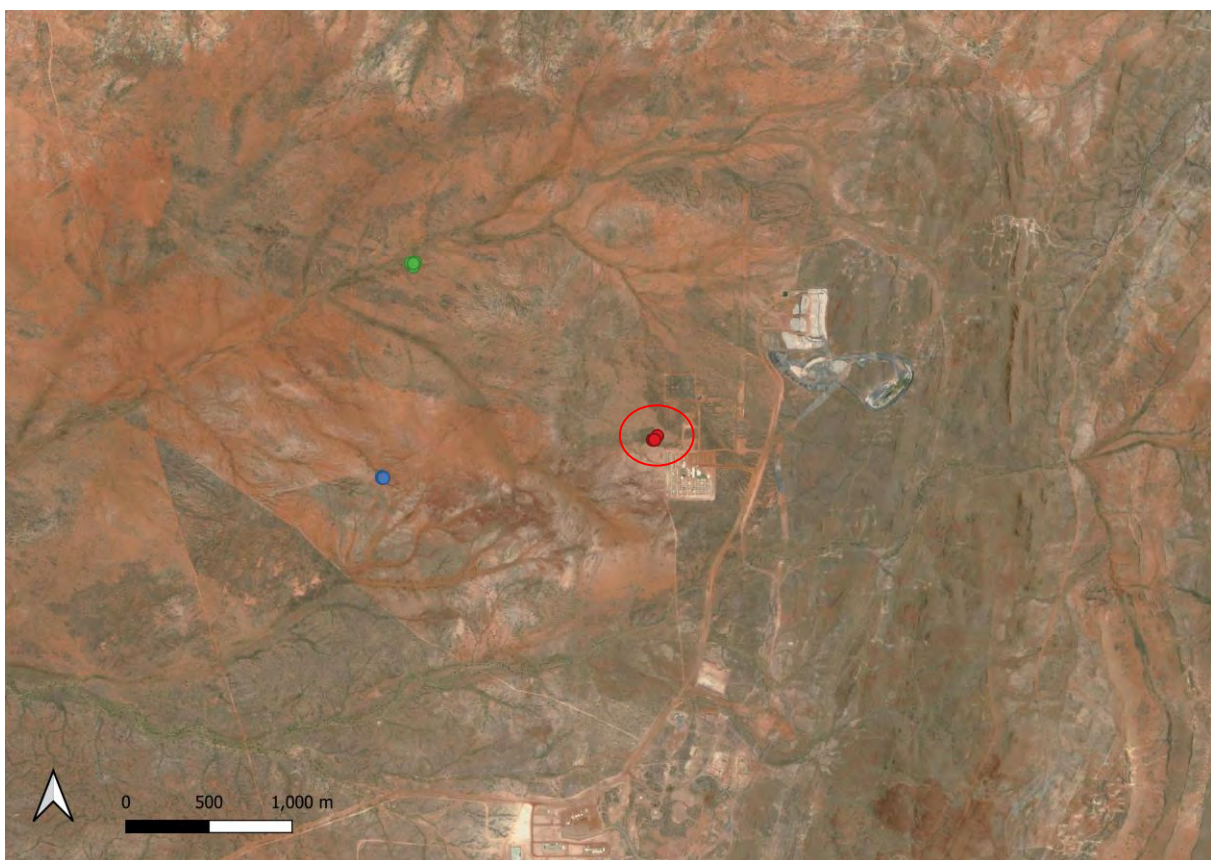


Figure 1. The location of the bat detector recording sites in the lowland drainage area to the west of existing mining infrastructure. The Pilbara Leaf-nosed Bat was detected at the site with the red dots (circled).

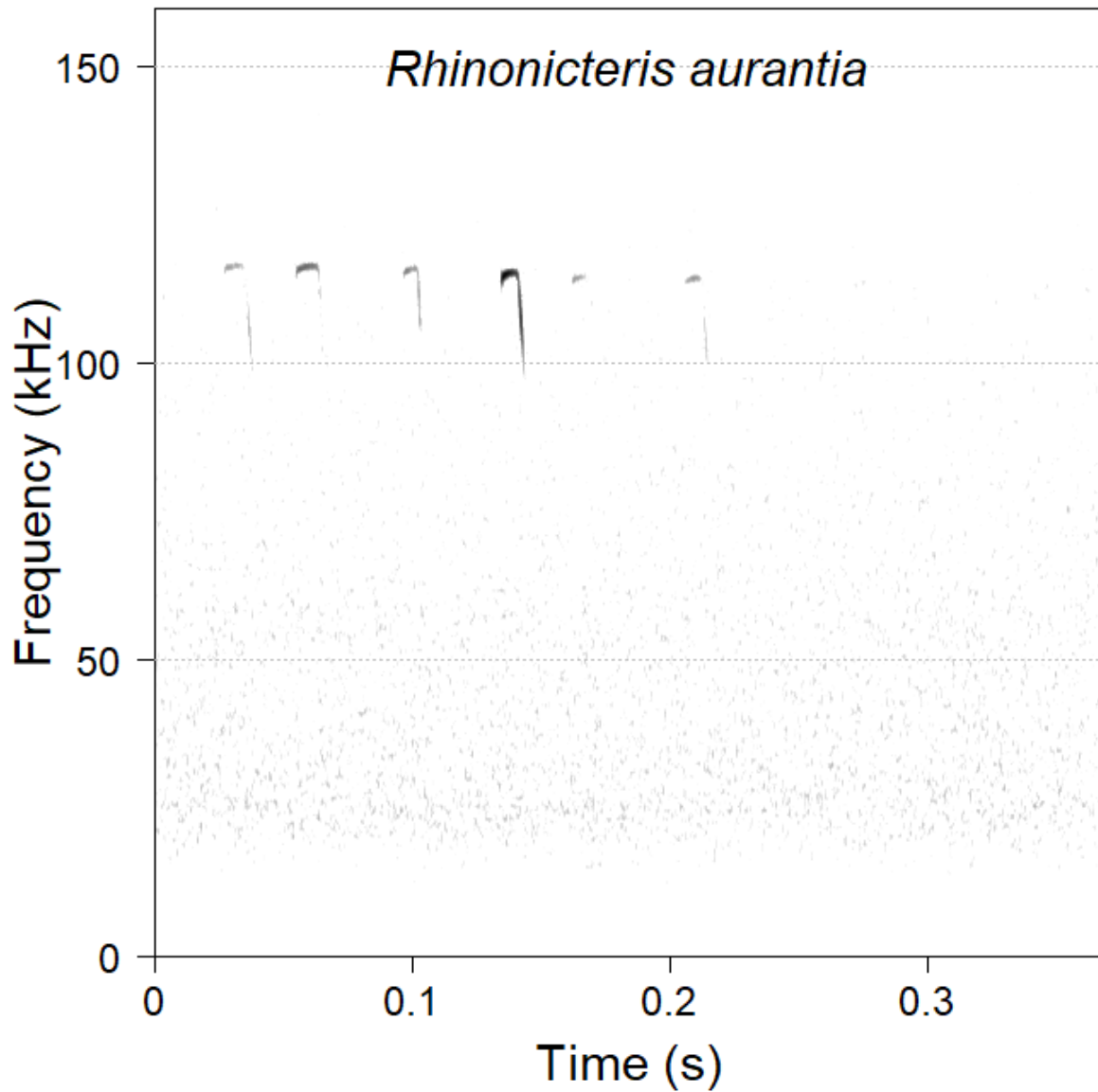


Figure 2. The echolocation call sequence of the Pilbara Leaf-nosed Bat detected (file 450007_2003-07-27_03-41-49.wav; cropped; note the date and time are incorrect in the filename).

APPENDIX F: SPECIES BY SITE MATRIX - FLORA

Appendix F
Flora Species by Site Matrix

Name	Status	PQ02	PQ04	PQ05	PQ06	PQ07	PQ09	PQ10	PQ11	PQ12	PQ13	PQ14	PQ16	PQ17	PQ18	PQ22	PQ23	PQ24	PQ25
Aizoaceae																			
<i>Trianthema pilosum</i>			0.1				0.1	0.1			0.1			0.1		0.1		0.1	0.1
Amaranthaceae																			
<i>Aerva javanica</i>	Int.												0.1			0.1	0.5		
<i>Amaranthus cuspidifolius</i>																0.1			
<i>Gomphrena cunninghamii</i>			0.1					0.1					0.1		0.1	0.1	0.1	0.1	
<i>Ptilotus axillaris</i>			0.1				0.1		0.1					0.1		0.1			
<i>Ptilotus calostachyus</i>		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1		0.1	0.1		0.1	0.1		0.1	0.1
<i>Ptilotus clementii</i>																0.1			
<i>Ptilotus obovatus</i>		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1		0.1	0.1	0.1			0.1	0.1
Asteraceae																			
<i>Pluchea tetranthera</i>																			0.1
<i>Pterocaulon sphacelatum</i>					0.1														
<i>Streptoglossa decurrens</i>		0.1																	
<i>Streptoglossa odora</i>					0.1														
Boraginaceae																			
<i>Euploca chrysocarpa</i>		0.1										0.1						0.1	
<i>Euploca diversifolia</i>										0.1						0.1			
<i>Euploca mutica</i>	P3						0.1												
Caryophyllaceae																			
<i>Polycarpaea corymbosa</i>		0.1	0.1	0.1			0.1	0.1	0.1	0.1	0.1				0.1				0.1
<i>Polycarpaea longiflora</i>																0.1		0.1	
Cleomaceae																			
<i>Arivela uncifera</i>			0.1	0.1			0.1	0.1	0.1					0.1	0.1	0.1		0.1	0.1
<i>Arivela viscosa</i>			0.1	0.1							0.1	0.1		0.1		0.1	0.1		
Convolvulaceae																			
<i>Bonamia erecta</i>		0.1	0.1	0.5	0.1	0.1	0.1	0.1	0.1	0.1	0.1			0.1					0.1
<i>Bonamia linearis</i>			0.1		0.1		0.1	0.1			0.1	0.1		0.1		0.1			0.1
<i>Bonamia media</i>								0.1					0.5						
<i>Bonamia pilbarensis</i>			0.1					0.1	0.1			0.1			0.1	0.1	0.1	0.1	
<i>Bonamia rosea</i>										0.1				0.1					0.1
<i>Evolvulus alsinoides var villosicalyx</i>										0.1					0.1	0.1		0.1	

Appendix F
Flora Species by Site Matrix

<i>Operculina aequisejala</i>					0.1														
<i>Polymeria ambigua</i>			0.1	0.1	0.2	0.2	0.1			0.1	0.1		0.2		0.1		0.1		
Cucurbitaceae																			
<i>Cucumis argenteus</i>			0.1		0.1	0.1			0.1	0.1								0.1	
Cyperaceae																			
<i>Bulbostylis barbata</i>			0.1	0.1	0.1		0.1		0.1	0.1				0.1	0.1	0.1	0.5	0.1	
<i>Cyperus cunninghamii</i>														0.1					
Euphorbiaceae																			
<i>Euphorbia tannensis</i>															0.1		0.1		
<i>Euphorbia careyi</i>			0.1		0.1					0.1							0.1	0.1	
Fabaceae																			
<i>Acacia adsurgens</i>		10	0.5	8	5	5	5	0.5	1	10	5	2						5	0.1
<i>Acacia bivenosa</i>		2.5		4	2	1.5		0.1	2		0.1		0.1	0.5					0.1
<i>Acacia colei</i>			0.5	1		1.5	5	0.5		1	2	0.1			0.5			5	0.5
<i>Acacia cowleana</i>					2	5	0.5				0.5			10					
<i>Acacia inaequilatera</i>		0.5	1	0.1	0.5		0.5	0.5	1	0.5	0.1	1	0.5		0.5	0.1	4	1	0.1
<i>Acacia maitlandii</i>									0.1										
<i>Acacia orthocarpa</i>		0.5											0.5						
<i>Acacia sphaerostachya</i>										0.1									
<i>Acacia acradenia</i>													0.1						
<i>Alysicarpus muelleri</i>											0.1			0.1					
<i>Cajanus cinereus</i>						1													
<i>Crotalaria medicaginea</i>					0.1												0.1		
<i>Indigofera hirsuta</i>			0.1							0.1	0.1								0.1
<i>Indigofera monophylla</i>			0.1	0.1	0.1		0.1	0.1			0.5	0.1		0.5	0.5		0.1	0.1	0.1
<i>Indigofera rugosa</i>		0.1				0.5	0.1					0.1	0.1		1	0.1			
<i>Indigofera trita</i>																0.1	0.1		
<i>Petalostylis labicheoides</i>						0.1													
<i>Rhynchosia minima</i>			0.1	0.5	0.1	0.1										0.1			
<i>Senna artemisioides</i> subsp. <i>helmsii</i>					0.1	0.1		0.1								0.1		0.1	0.1
<i>Senna glutinosa</i>				0.1					0.1	0.1			0.1						
<i>Senna notabilis</i>						0.1					0.1			0.1		0.1		0.1	
<i>Tephrosia arenicola</i>		0.1	0.1	0.1	0.1	0.1	0.1	0.5		0.1	0.1	0.1		0.5					0.1

Appendix F
Flora Species by Site Matrix

<i>Tephrosia clementii</i>					0.1		0.2						0.1		0.1				
<i>Tephrosia rosea</i>			0.1									0.1							
Goodeniaceae																			
? <i>Goodenia microptera</i>					0.1					0.1									
<i>Dampiera candidans</i>			0.1			0.1													
<i>Goodenia forrestii</i>				0.1	0.1														
<i>Goodenia lamprosperma</i>													0.1	0.2			0.2		
<i>Goodenia microptera</i>		0.1	0.1		0.1		0.1	0.2		0.1	0.1	0.1							
<i>Goodenia scaevolina</i>		0.1																	
<i>Goodenia stobbsiana</i>		1	0.5		0.1		0.1	0.1	0.1	0.1		0.1	0.5	0.1		0.1	0.5		
<i>Scaevola amblyanthera</i>		0.1	0.1			0.1											0.1		
Lauraceae																			
<i>Cassytha capillaris</i>		1	0.5	0.1	0.5	0.5	0.5		0.5	0.5	0.5			1	0.5	0.5	0.5	2	0.5
Malvaceae																			
<i>Abutilon lepidum</i>													0.1				0.1	0.1	
<i>Corchorus incanus</i>		0.1	0.1	0.5	0.1	0.1		0.1	0.5	0.1	1	0.1		1	0.1	0.1	0.1	0.1	0.5
<i>Hibiscus leptocladus</i>													0.1						
<i>Hibiscus sturtii</i>			0.1	0.1		0.2	0.1	0.1		0.1	0.5								
<i>Sida arenicola</i>					0.1														
<i>Sida cardiophylla</i>				0.1							0.1								
<i>Sida clementii</i>				0.1									0.1	0.1					
<i>Sida</i> sp. Pilbara (A.A. Mitchell PRP 1543)					0.1						0.1				0.1				
<i>Triumfetta appendiculata</i>		0.1			0.1	0.1					0.5			0.1					
Molluginaceae																			
<i>Trigastrotheca molluginea</i>		0.1	0.1	0.1			0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Myrtaceae																			
<i>Corymbia hamersleyana</i>		0.5	2	1	2	10	2	0.5				0.1	0.1	2			2		
Nyctaginaceae																			
<i>Boerhavia coccinea</i>	Mixed																0.1		
<i>Boerhavia gardneri</i>			0.1	0.1									0.1	0.1	0.1		0.1	0.1	
Onagraceae																			
<i>Ludwigia perennis</i>					0.1														
Phyllanthaceae																			

Appendix F
Flora Species by Site Matrix

<i>Nellica maderaspatensis</i>				0.2	0.2										0.1	0.1	0.1
<i>Notoleptopus decaisnei</i>				0.2													
Poaceae																	
<i>Aristida holathera</i>		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1		0.5	0.1	0.1		0.1	0.1
<i>Aristida inaequiglumis</i>										0.5							
<i>Bothriochloa ewartiana</i>				0.1													
<i>Cenchrus ciliaris</i>	Int.		0.5	0.1								1		0.1			
<i>Chrysopogon fallax</i>			0.1	1	1		0.1			2.5		0.1	2.5				
<i>Cymbopogon ambiguus</i>														0.5		0.5	
<i>Cymbopogon obtectus</i>			0.1														
<i>Dichanthium sericeum</i>				0.1	0.5												
<i>Enneapogon lindleyanus</i>																0.1	
<i>Eragrostis cumingii</i>				0.1													
<i>Eragrostis eriopoda</i>			0.1		0.1	0.1	0.1	0.1	0.1	0.1		0.1	0.1				0.2
<i>Eriachne aristidea</i>		0.1								0.1					0.1		
<i>Eriachne mucronata</i>		0.1							0.1			0.1			0.1	0.2	0.1
<i>Eriachne pulchella</i>								0.1	0.1					0.1		0.1	
<i>Eulalia aurea</i>				0.1													
<i>Heteropogon contortus</i>					2												
<i>Paraneurachne muelleri</i>			0.1	0.1	0.1	0.1	0.1		0.1	0.1							
<i>Paspalidium clementii</i>			0.1	0.1	0.1	0.1		0.1		0.1					0.1		0.1
<i>Perotis rara</i>				0.1													
<i>Sorghum plumosum</i>						0.1											
<i>Sporobolus australasicus</i>		0.1		0.1	0.1				0.1								
<i>Themeda triandra</i>				0.5	5				0.1								
<i>Triodia angusta</i>		2							10		2	2				2	10
<i>Triodia brizoides</i>											2						
<i>Triodia chichesterensis</i>	P3		15										10		5		
<i>Triodia epactia</i>		5	45		10	20	5			25	2	5	30			3	5
<i>Triodia lanigera</i>		15		50	10		35	40	45	25	2						
<i>Triodia schinzii</i>				5													
<i>Triodia wiseana</i>		30				10					15	25		40	60	55	55
Polygalaceae																	

APPENDIX G: FAUNA LIKELIHOOD OF OCCURRENCE ASSESSMENT - FAUNA

Species	Common Name	Conservation Code		Relevant Habitat Preference	Assessment of Occurrence
		BC Act	EPBC Act		
-- Birds --					
<i>Actitis hypoleucos</i>	Common Sandpiper	MI	MI	<p>Edge of sheltered waters salt or fresh (<i>e.g.</i> estuaries, mangrove creeks, rocky coasts, near-coastal saltlakes (including saltwork ponds), river pools, lagoons, claypans, drying swamps, flood waters, dams and sewage ponds. Preferring situations where low perches are available (Johnstone and Storr, 1998).</p> <p>Shallow, pebbly, muddy or sandy edges of rivers and streams coastal to far inland; dams, lakes, sewage ponds; margins of tidal rivers, waterways in mangroves or saltmarshes; mudflats: rocky or sand beaches; causeways, riverside lawns, drains, street gutters. (Pizzey and Knight, 2012).</p>	<p>Unlikely. Perching opportunities available in the creeks however water pooling is limited by the well-drained sandy substrate.</p> <p>Two records 20 km to the west from a semi-permanent pool in a tributary of the Turner River.</p>
<i>Apus pacificus</i>	Fork-tailed Swift	MI	MI	<p>Broadly distributed aerial species that is not specifically limited to any particular habitat type.</p> <p>Aerial: over open country, from semi-arid deserts to coasts, islands; sometimes over forests, cities. (Pizzey and Knight, 2012).</p> <p>Occurs over dry or open habitats comprising of riparian woodland, low scrub, heathland, or saltmarsh, also grasslands and sandplains with spinifex. (Morcombe, 2011).</p>	<p>Possible.</p> <p>Listed by the PMST as Likely to occur. Seven records are reported from 1998 – 2014 over a wide variety of habitats.</p> <p>This species is distributed across Australia. It is an aerial species that rarely comes to land. Individuals would not be specifically dependant on any habitats present in the Survey Area.</p>

Species	Common Name	Conservation Code		Relevant Habitat Preference	Assessment of Occurrence
		BC Act	EPBC Act		
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	MI	MI	<p>Scarce to moderately common (much more plentiful near coasts than in interior). (Johnstone and Storr, 1998).</p> <p>Tidal mudflats, saltmarshes, mangroves; shallow fresh, brackish or saline inland wetlands; floodwaters, irrigated pastures and crops; sewage ponds, saltfields. Widespread summer migrant to coastal and inland Australia. (Pizzey and Knight, 2012).</p>	<p>Unlikely. Limited pooling of water in the ephemeral drainage lines. No Permanent pools. No seasonally inundated areas.</p> <p>No records in the local area. PMST considers the species May occur.</p>
<i>Calidris ferruginea</i>	Curlew Sandpiper	CR	CR, MI	<p>Mainly shallows of estuaries and near-coastal saltlakes (including saltwork ponds) and drying near-coastal freshwater lakes and swamps. Also beaches and near-coastal sewage ponds. (Johnstone and Storr, 1998)</p> <p>Tidal mudflats; saltmarsh, saltfields; fresh, brackish or saline wetlands; sewage ponds. (Pizzey and Knight, 2012)</p>	<p>Unlikely. Limited pooling of water in the ephemeral drainage lines. No Permanent pools. No seasonally inundated areas.</p> <p>No records in the local area. PMST considers the species May occur.</p>
<i>Calidris melanotos</i>	Pectoral Sandpiper		MI	<p>Mainly fresh waters (swamps, lagoons, river pools, irrigation channels and sewage ponds); also, samphire flats around estuaries and saltlakes. (Johnstone and Storr, 1998)</p> <p>Shallow fresh waters, often with low grass or other herbage; swamp margins, flooded pastures, sewage ponds, occasionally tidal areas, saltmarshes. (Pizzey and Knight, 2012)</p>	<p>Unlikely. Limited pooling of water in the ephemeral drainage lines. No Permanent pools. No seasonally inundated areas.</p> <p>No records in the local area. PMST considers the species May occur.</p>
<i>Charadrius veredus</i>	Oriental Plover	MI	MI	<p>Open plains; bare, rolling country, often far from water; ploughed land; muddy or sandy wastes near inland swamps or tidal mudflats; bare claypans; margins of coastal marshes; grassy fields and lawns. (Pizzey and Knight, 2012).</p>	<p>Possible. Limited pooling of water in the ephemeral drainage lines. No Permanent pools. No seasonally inundated areas.</p> <p>One local historic record from an area that is now cleared.</p>

Species	Common Name	Conservation Code		Relevant Habitat Preference	Assessment of Occurrence
		BC Act	EPBC Act		
<i>Erythrotriorchis radiatus</i>	Red Goshawk	VU	VU	Well-wooded country. (Johnstone and Storr, 1998) Open forests, woodlands, especially near rivers, wetlands; rainforest fringes. (Pizzezy and Knight, 2012)	Unlikely. No records are known from the Pilbara and not within the range of the species known distribution (BirdLife International 2022, TSSC 2015).
<i>Falco hypoleucos</i>	Grey Falcon	VU	VU	Mainly lightly wooded and coastal riverine flats. (Johnstone and Storr, 1998) Lightly treed and inland plains; gibber deserts, sandridges, pastoral lands, timbered watercourses; seldom in driest deserts (Pizzezy and Knight, 2012).	Likely. The Survey Area is potentially suitable foraging habitat. Listed by EPBC as Known to Occur in the feature area and five records since 2012 occur near the Turner River and larger tributaries. The closest record is 10 km south west of the Survey Area. All habitats in the Survey Area are suitable foraging habitat for this species.
<i>Falco peregrinus</i>	Peregrine Falcon	OS	-	Mainly about cliffs along coasts, rivers and ranges, and about wooded watercourses and lakes (Johnstone and Storr, 1998). Cliffs, gorges, timbered watercourses, environs of rivers, wetlands, plains, open woodlands, pylons, spires, buildings. (Pizzezy and Knight, 2012)	Likely. All habitats are suitable. One record from 2002 is 250 m from the Survey Area. This location is now the site of the Pilgangoora mine.
<i>Glareola maldivarum</i>	Oriental pratincole	MI	MI	Feeding in air and roosting on bare ground beside water, e.g. tidal flats and floodwaters (Johnstone and Storr, 1998). Plains; shallow wet and dry edges of open bare wetlands; tidal mudflats, beaches (Pizzezy and Knight, 2012).	Unlikely. Limited pooling of water in the ephemeral drainage lines. No Permanent pools. No seasonally inundated areas. No records in the local area. PMST considers the species May occur.

Species	Common Name	Conservation Code		Relevant Habitat Preference	Assessment of Occurrence
		BC Act	EPBC Act		
<i>Hirundo rustica</i>	Barn swallow	MI	MI	<p>Mainly towns and wetlands (sewage and saltworks ponds, river pools, swamps, tidal creeks and reservoirs). (Johnstone and Storr, 2004)</p> <p>Open country; agricultural land, especially near water; railyards, towns, overhead wires. (Pizzey and Knight, 2012)</p>	<p>Unlikely. Limited pooling of water in the ephemeral drainage lines. No Permanent pools. No seasonally inundated areas.</p> <p>No records in the local area. PMST considers the species May occur.</p>
<i>Motacilla cinerea</i>	Grey Wagtail	MI	MI	<p>Mainly banks and rocks in fast-running fresh water habitats; rivers, creeks, streams and around waterfalls, both in forest and open country; but occurs almost anywhere during migration. Flits from rock to rock, and often enters water after insects (or performs flycatcher sallies after them). (Johnstone and Storr, 2004)</p> <p>In Australia, near running water in disused quarries; sandy, rocky streams in escarpments and rainforests; sewage ponds, ploughed fields, airfields. (Pizzey and Knight, 2012)</p>	<p>Unlikely. The drainage lines in the Survey Area are highly ephemeral and would only flow for brief period of time. Drainage lines are in plains habitat where fast running channel flow is limited. There are no previous records in the local area and the species is uncommonly recorded in Australia.</p> <p>No records in the local area. PMST considers the species May occur.</p>
<i>Motacilla flava</i>	Yellow Wagtail	MI	MI	<p>Damp short-grass flats: rice stubbles and edge of swamps, sewage ponds, bore overflows, grazed or mowed grass and irrigated areas. (Johnstone and Storr, 2004)</p>	<p>Unlikely. Limited pooling of water in the ephemeral drainage lines. No Permanent pools. No seasonally inundated areas.</p> <p>No records in the local area. PMST considers the species Likely to occur.</p>
<i>Numenius madagascariensis</i>	Eastern Curlew	CR	CR, MI	<p>Mainly tidal mudflats; also reef flats, sandy beaches and rarely near-coastal lakes (including saltwork ponds). (Johnstone and Storr, 1998)</p>	<p>Unlikely, prefers saline habitats and no areas of shallow seasonal inundation are expected to occur. Listed in the PMST as suitable habitat may occur. No local database records.</p>

Species	Common Name	Conservation Code		Relevant Habitat Preference	Assessment of Occurrence
		BC Act	EPBC Act		
				Estuaries, tidal mudflats, sandspits, saltmarshes, mangroves; occasionally fresh or brackish lakes; bare grasslands near water. (Pizzey and Knight, 2012)	
<i>Pezoporus occidentalis</i>	Night Parrot	CR	EN	Treeless or sparsely wooded spinifex <i>Triodia</i> spp. near water (including artesian bores) (Johnstone and Storr, 1998). Seeding spinifex on stony rises, breakaway country, sandy lowlands; shrubby glasswort, chenopods; succulents on flats around salt lakes; flooded claypans saltbush, bluebush, bassia associations (Pizzey and Knight, 2012).	Possible. No local records. Habitat modelling includes the Survey Area at the extremity of the species potential extent. Foraging resources are limited.
<i>Rostratula australis</i>	Australian Painted-Snipe	EN	EN	Common in south and north-east Kimberley swampy plains before their degradation by cattle, but only five records since 1909. Rare summer visitor to North-west, single birds recorded at man-made ponds in the Hamersley and Ophthalmia Ranges in December and January and a male collected at Carnarvon in November. In arid interior a female about to lay collected at Brockman Creek in August 1896 (Johnstone and Storr, 1998). Well-vegetated shallows and margins of wetlands, dams, sewage ponds; wet pastures, marshy areas, irrigation systems, lignum, tea-tree scrub, open timber. (Pizzey and Knight, 2012)	Unlikely. No habitat occurs in the Survey Area, no areas of seasonal shallow inundation are likely to occur. Vegetation fringing creeks is too open to provide suitable cover. No records in the local area. PMST considers the species May occur.
-- Mammals --					
<i>Dasyercus blythi</i>	Brush-tailed Mulgara	P4	-	Inhabits spinifex grasslands and burrows on the flats between low sand dunes (Van Dyck and Strahan, 2008).	Likely. Sandy Plains habitat is suitable. Multiple database records from 2012 are less than 15 km to the southwest.

Species	Common Name	Conservation Code		Relevant Habitat Preference	Assessment of Occurrence
		BC Act	EPBC Act		
<i>Dasyurus hallucatus</i>	Northern Quoll	EN	EN	The Northern Quoll will usually den in hollow tree trunks (Hill and Ward, 2010) or in small caves and crevices in rocky outcrops.	Likely. Denning habitat in the better developed boulder piles, however this is limited to a small area. Foraging habitat available in the creek lines, however is likely to be poor quality as lacking in litter. Trees too small to provide hollows suitable for denning. Confirmed to occur in the rocky range 4 km to the east. One database record 0.6 km to the east. One scat recorded during survey.
<i>Lagorchestes conspicillatus leichardti</i>	Spectacled Hare-Wallaby	P4	-	Open <i>Acacia</i> forests, open woodlands and tall shrubland over tussock or hummock grasslands (Van Dyck and Strahan, 2008).	Likely. Multiple historic records nearby. Suitable shelter habitat in the denser shrubland in creeks and drainage depressions. Wallaby scats and small macropod footprints recorded during survey.
<i>Macroderma gigas</i>	Ghost Bat	VU	VU	Their distribution is influenced by the availability of suitable caves and mines for roost sites (Churchill 2008). In the Pilbara, ghost bats prefer to forage on productive plain areas with thin mature woodland over patchy or clumped tussock or hummock grass (<i>Triodia</i> spp.) on sand or stony ground (Bat Call WA 2021a).	Likely. Foraging habitat available across the Survey Area. No roosting habitat available. The Survey Area is within foraging range of database record locations.
<i>Macrotis lagotis</i>	Bilby	VU	VU	Occupy a variety of inland habitats including grass and stony downs country on cracking clays, desert sandplains and dune fields of laterite with hummock grassland and massive red earths with <i>Acacia</i> shrubland (Van Dyck and Strahan, 2008).	Possible. Suitable habitat includes the undulating plains habitats. Historic record nearby, recent records 16 km to the west.

Species	Common Name	Conservation Code		Relevant Habitat Preference	Assessment of Occurrence
		BC Act	EPBC Act		
<i>Pseudomys chapmani</i>	Western Pebble-mound Mouse	P4	-	Found on stony hillsides with hummock grassland (Menkhorst and Knight, 2009)	Present. Mounds located stony plains and rises habitat.
<i>Rhinonicteris aurantia</i>	Pilbara Leaf-Nosed Bat	VU	VU	Dependant on deep and complex cave systems. Roosting and foraging habitats defined by TSSC (2016) and Bat Call WA (2021b)	Present. No roosting habitat available, foraging quality of habitats in the Survey Area is Low. Recorded on acoustic device during survey, possibly in flight over the area to reach more productive foraging habitat.
<i>Sminthopsis longicaudata</i>	Long-tailed Dunnart	P4		A specialist rock dwelling species (Freeland <i>et al.</i> 1988). It prefers exposed rock and stony soils with hummock grasses and shrubs, on flat-topped hills, lateritic plateaus, sandstone ranges and breakaways.	Unlikely. No suitable habitat.
-- Reptiles --					
<i>Anilius ganeii</i>	Gane's blind snake (Pilbara)	P1		Known from widely separated areas between Newman and Pannawonica. Possibly associated with moist gorges and gullies (Wilson and Swan 2008).	Unlikely. Suitable habitat unlikely to be present as drainage lines are small and highly ephemeral. No termite mounds present for foraging resource.
<i>Liasis olivaceus</i> subsp. <i>baronni</i>	Pilbara Olive Python	VU	VU	Recorded in areas with gorges and escarpments in close proximity to water holes (Doughty <i>et al.</i> 2011). During the cooler months they will typically hide in caves, crevices and fissures away from water sources. However, in the warmer months they become active and tend to stay near rocky outcrops and water.	Unlikely. No suitable habitat. There are no gorges or significant water filled gullies in the Survey Area. No permanent or semi-permanent pools in the creeks. Caves, crevices or fissures are limited to a small area that has no proximity to permanent pools.

Species	Common Name	Conservation Code		Relevant Habitat Preference	Assessment of Occurrence
		BC Act	EPBC Act		
<i>Liopholis kintorei</i>	Great Desert Skink		VU	<p>A nocturnal burrowing and social lizard, living in family groups and creating extensive burrows that are typically 1 m deep and up to 10 m in diameter with multiple entrances (McAplin 2001).</p> <p>Typically occupy hummock grass sandplains and some adjacent dunefield swales, though they can occur in a variety of habitats (McAplin 2001). Vegetation usually consists of hummock grassland (<i>Triodia basedowii</i>, <i>T. pungens</i> and <i>T. schinzi</i>), with some scattered shrubs and occasional trees (e.g. <i>Acacia</i> spp., <i>Eucalyptus</i> spp., <i>Hakea</i> spp., <i>Grevillea</i> spp. and <i>Allocasuarina decaisneana</i>) (McAlpin 2001). Tend to utilise areas of habitat that have been burnt within the previous 2-15 years (McAplin 2001; Morre <i>et al.</i> 2015).</p>	<p>Unlikely.</p> <p>No records in the local area. PMST considers the species May occur in the buffer area only. The area where suitable habitat may occur is 10 km to the east of the Survey Area and separated by a rocky range.</p>

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