NORTH STAR JUNCTION WEST

DETAILED TERRESTRIAL VERTEBRATE FAUNA ASSESSMENT

PREPARED FOR: FORTESCUE

Spectrum ECOLOGY & SPATIAL

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Report Details			
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Prepared For:	Fortescue		
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V2			07/06/2024
V3			20/01/2025

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EXECUTIVE SUMMARY

Fortescue Limited's (Fortescue) decarbonisation pathway to achieve carbon neutrality across existing and future operations by 2030 is focused on addressing Fortescue's largest sources of emissions, which are stationary power and mining fleet. Fortescue is assessing potential renewable energy generation sites as part of Fortescue's commitment to decarbonise its mining operations.

Spectrum Ecology & Spatial (Spectrum) was engaged to undertake a desktop assessment and a two-phase detailed and targeted vertebrate fauna assessment of the North Star Junction Generation Hub (Survey Area) to support environmental approvals for the potential development of the project.

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To provide regional context for the assessment of the terrestrial fauna values within the Survey Area, a desktop assessment was completed. The desktop assessment identified a total of 352 vertebrate fauna consisting of 46 mammals (including nine introduced), 169 bird, 128 reptile, and nine amphibian species that have previously been recorded in the region.

A total of 123 vertebrate fauna species were recorded during both phases of the survey. This included 12 species of native non-volant mammals, eight (or nine due to ambiguous calls) species of bats, five introduced mammals, 54 bird species, 42 reptiles and two amphibians.

Six species of significant fauna were recorded from the Survey Area during the survey:

- Northern Quoll (*Dasyurus hallucatus*, EPBC Act & BC Act; Endangered);
- Bilby (*Macrotis lagotis*, EPBC Act & BC Act; Vulnerable);
- Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*, EPBC Act & BC Act; Vulnerable);
- Grey Falcon (*Falco hypoleucos*, EPBC Act & BC Act; Vulnerable);
- Brush-tailed Mulgara (*Dasycercus blythi*, DBCA; Priority 4); and
- Western Pebble-mound Mouse (*Pseudomys chapmani*, DBCA Priority 4 – secondary evidence only).

One additional species was previously recorded from the Survey Area:

- Ghost Bat (*Macroderma gigas*, EPBC Act & BC Act Vulnerable).

A further seven species (one mammal, four birds, two reptiles) were assessed to have a medium to high likelihood of occurrence based on previous regional records and the habitat types present within the Survey Area.

A total of five fauna habitat types were recorded from the Survey Area, these include (Fortescue habitat names in brackets):

- Spinifex Sand Plain (Plain (sand));
- Spinifex Rocky Plain (Plain (stony/gibber));
- Major Drainage Line (Drainage Line/River/Creek (major));
- Minor Drainage Line (Drainage Line/River/Creek (minor)); and
- Granite Domes and Boulder Piles (Granite Outcrops (boulder piles)).

The most common fauna habitat at the Survey Area is Spinifex Sand Plain habitat (91.5%) followed by Granite Domes and Boulder Piles (2.7%). All habitat types are common in the Pilbara region. The Granite Domes and Boulder Piles, and the Major and Minor Drainage Lines have the highest value for significant fauna (Northern Quoll, Bilby, Pilbara Leaf-nosed Bat, Ghost Bat, Brush-tailed Mulgara, Grey Falcon, Pilbara Olive Python, and Migratory Birds) followed by the Spinifex Sand Plain (Bilby, Brush-tailed Mulgara and Spectacled Hare-wallaby).

1. INTRODUCTION

1.1. Project Background

Fortescue Limited's (Fortescue) decarbonisation pathway to achieve carbon neutrality across existing and future operations by 2030 is focused on addressing Fortescue's largest sources of emissions, which are stationary power and mining fleet. Fortescue is making significant investment in renewable power generation that is supported by battery storage, to replace existing stationary diesel and reducing the amount of gas-fired power generating facilities.

Fortescue is assessing potential renewable energy generation sites as part of Fortescue's commitment to decarbonise its mining operations.

Fortescue is constructing the North Star Junction Generation Hub in the Pilbara region of Western Australia (WA). The North Star Junction West (NSJW) Project is being considered as part of the portfolio of solar projects that will generate renewable energy to power Fortescue's operations and meet their decarbonisation targets by 2027.

Fortescue engaged Spectrum Ecology & Spatial (Spectrum) to undertake a two-phase detailed and targeted vertebrate fauna assessment of the NSJW Project (herein referred to as the Survey Area). The Survey Area covers 4,532.9 hectares (ha) and is located approximately 25 km west of Fortescue's Iron Bridge operation and 120 km south of Port Hedland (Map 1.1).

1.2. Project Scope

The project objective was to undertake a detailed vertebrate fauna assessment of the Survey Area (NSJW Project) to support environmental approvals.

The scope of work for this project included:

- Desktop assessment of the Study Area (Survey Area plus 50 km buffer);
- Detailed terrestrial fauna survey for vertebrates; and
- Targeted terrestrial vertebrate fauna survey for significant species.

Throughout this report, areas will be referred to as per the below:

- Survey Area (NSJW Project; area to be surveyed as provided by Fortescue); and
- Study Area (desktop study area; Survey Area plus 50 km buffer).

1.3. Legislation & Guidelines

Fauna in Western Australia are protected by various legislation, including (see Appendix A):

- *Biodiversity Conservation Act 2016* (WA, BC Act);
- *Environmental Protection Act 1986* (WA, EP Act); and
- *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth, EPBC Act).

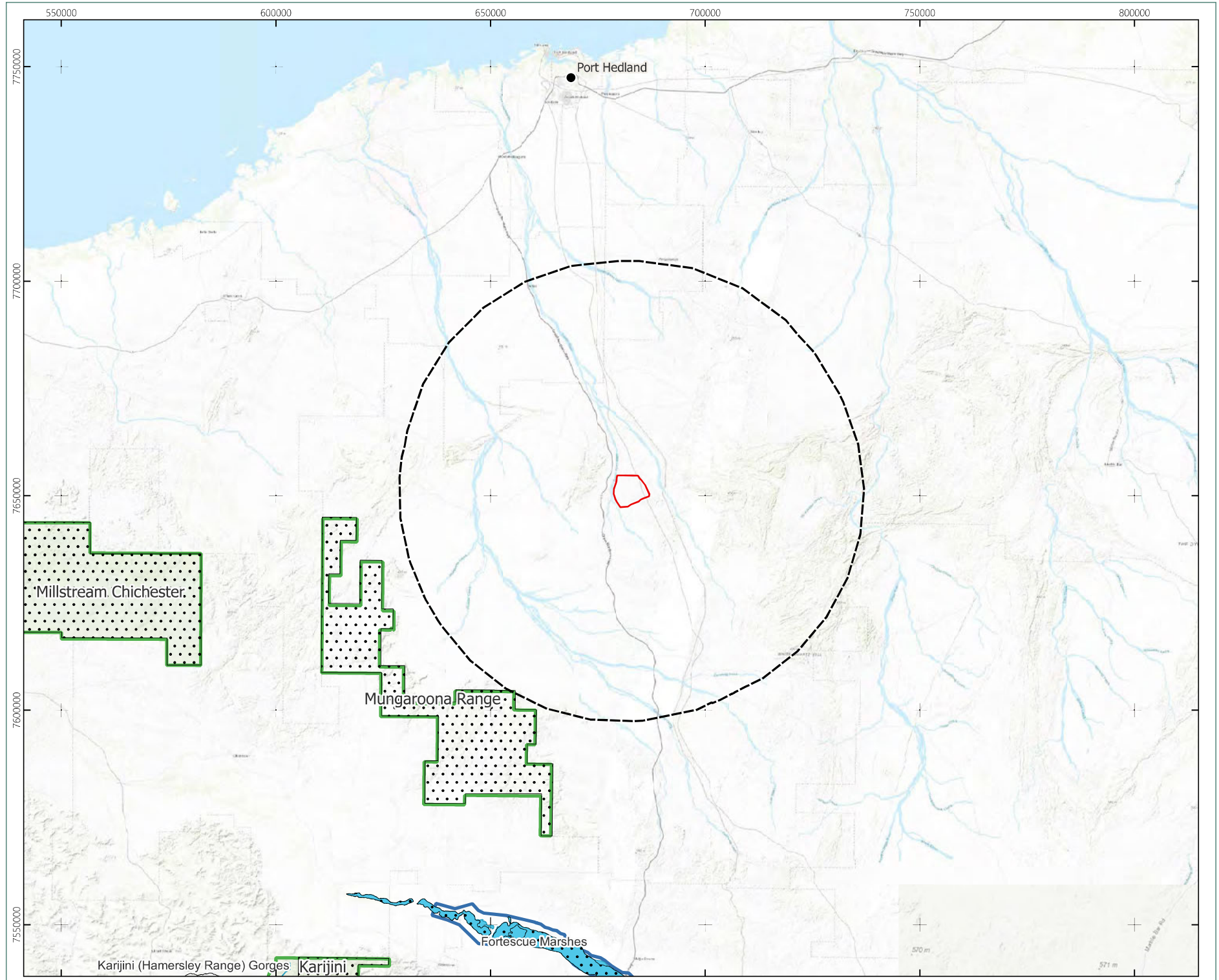
The survey was compliant with survey guidelines, as outlined in:

- Environmental Protection Authority (EPA) – Environmental Factor Guideline. Terrestrial Fauna (EPA, 2016);
- EPA Technical Guidance Technical Guidance – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (EPA, 2020);

- Terrestrial Vertebrate Fauna Assessment Guidelines 100-GU-EN-0006 (Fortescue, 2014); and
- Environmental Datasets – Data Governance 100-GU-EN-0020_Rev1 (Fortescue, 2019); and
- Geographic Information Systems and Raw Data Guidelines 100-GU-EN-0009_Rev2 (Fortescue Metals Group, 2021b).

In addition to the above, species-specific guidelines were also accessed:

- Survey guidelines for Australia's threatened mammals (Department of Sustainability Environment Water Population and Communities (DSEWPaC), 2011a);
- Survey guidelines for Australia's threatened birds (Department of the Environment Water Heritage and the Arts (DEWHA), 2010c);
- Survey guidelines for Australia's threatened bats (DEWHA, 2010a);
- Survey guidelines for Australia's threatened reptiles (DSEWPaC, 2011b);
- EPBC Act referral guideline for the endangered northern quoll *Dasyurus hallucatus* (Department of the Environment (DoE), 2016);
- Guidelines for surveys to detect the presence of bilbies, and assess the importance of habitat in Western Australia (Department of Biodiversity Conservation and Attractions (DBCA), 2017); and
- Interim guideline for preliminary surveys of night parrot (*Pezoporus occidentalis*) in Western Australia (Department of Parks and Wildlife (DPAW), 2017).



Legend

- Survey Area
- NSJW Study Area (50km Buffer)
- Environmentally Sensitive Areas
- Directory of Important Wetlands - Fortescue Marsh
- RAMSAR - Fortescue Marsh - Proposed Addition
- Nature Reserve / National Park Boundary

N

0 10 20 30 km

Scale 1:805,000 @ A3

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum

Author: GF Approved: AH Date: 26-09-2023

Location of the NSJW Survey Area, Study Area and Signifcant Lands

NSJW Fauna Assessment

MAP 1.1

Prepared for Fortescue

1.4. Bioregion

The Interim Biogeographic Regionalisation for Australia (IBRA) classifies Australia into regions based on dominant landscape, climate, lithology, geology, landform and vegetation (Thackway and Cresswell, 1995a).

The Study Area is in the Pilbara Craton IBRA Bioregion (Figure 1.1). The climate is classified semi-desert-tropical with very hot summers and mild or warm winters with 9 to 11 months of dry weather annually and a mean average rainfall of between 250-350 mm each year (Kendrick, 2001a). The bioregion is geologically complex with great mineral wealth and is also biologically special. There are high levels of species endemism and species-rich ecosystems including persisting populations of threatened species (McKenzie, May and McKenna, 2003).

The Pilbara Craton is made up of four sub regions; the Chichester, Fortescue Plains, Hamersley and Roebourne. The Study Area is in the central Pilbara within the Chichester subregion (Figure 1.1). The Chichester subregion is characterised by undulating Archaean granite and basalt plains with significant areas of basaltic ranges (Kendrick, 2001a; McKenzie, May and McKenna, 2003). The plains of this subregion support hummock grasslands characterised by shrub steppe of *Acacia pyrifolia* over *Triodia pungens*. The ranges are dominated by *Eucalyptus leucophloia* tree steppes (Kendrick, 2001a; McKenzie, May and McKenna, 2003).

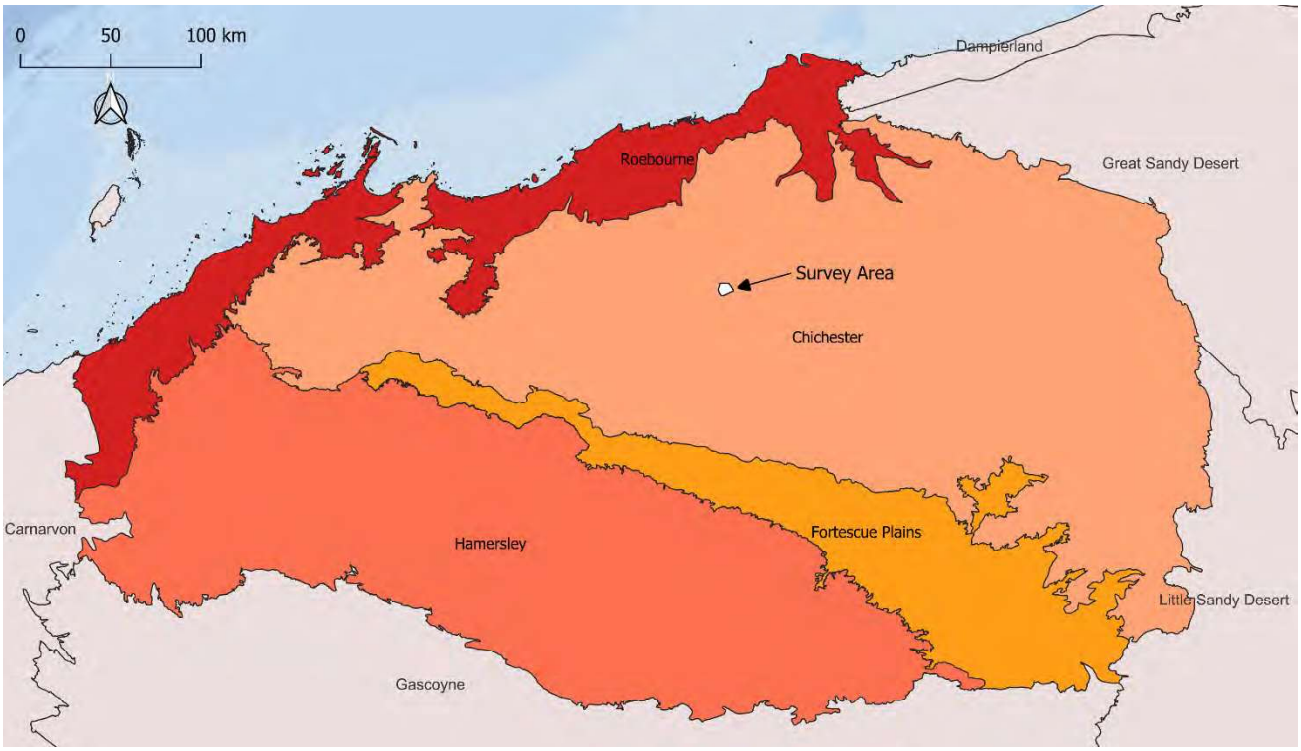


Figure 1.1: IBRA Classification

1.5. Climate

The climate of the Pilbara bioregion is classified as tropical, arid to semi-arid, with a median annual rainfall of 300 mm. Rainfall for the region can be variable, falling mainly in summer cyclonic events from December to February (Thackway and Cresswell, 1995b).

Two broad climatic zones occur across the Pilbara region. Semi-desert tropical climatic conditions occur in coastal areas, as well as some higher-rainfall inland areas, which experience 9-11 months of dry weather, with hot humid summers and warm winters. Dry desert climatic conditions occur across the remaining inland areas, which typically experience higher temperatures and lower rainfall, with hot dry summers and mild winters with up to 12 months of dry weather (Leighton, 2004). The Study Area is located within the dry inland area.

Annual rainfall is highly variable but generally follows an inland-to-coastal and southern-to-northern increasing trend (Leighton, 2004). The driest months are in spring (September to October), with tropical cyclones and local thunderstorms producing much of the summer and early autumn rainfall (Mckenzie, Van Leeuwen and Pinder, 2009). Winter rainfall is also highly variable, generally decreasing from the coast through to inland areas (Leighton, 2004).

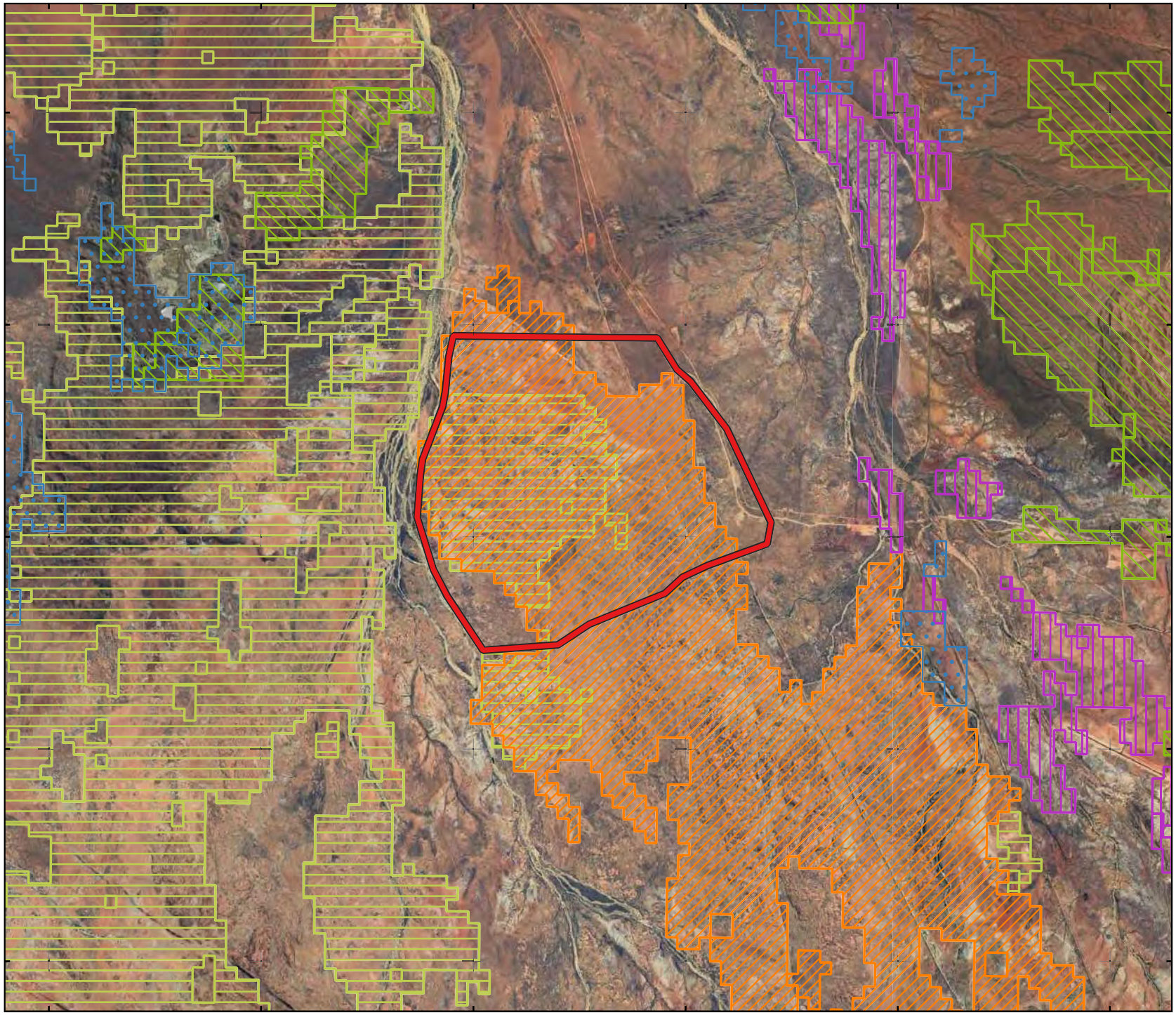
Monthly maximum temperatures in the Pilbara region range from an average of 25°C in July to 37°C in January, while minimum temperatures range between 12°C in July and 25°C in January (Mckenzie, Van Leeuwen and Pinder, 2009). According to the Köppen-Geiger climate classification, the Study Area has a hot desert climate (Class BWh) (Peel, Finlayson and McMahon, 2007). This classification includes arid regions where annual evaporation exceeds annual precipitation, and have a mean annual temperature ≥18°C.

1.6. Disturbance History

The dominant current and historical land uses across the Pilbara region involves grazing of native pasture, conservation, crown reserves, mining leases, and Aboriginal lands and reserves. Historically, pastoralism has been the most significant land use within the Pilbara. Since the 1960's mining, predominantly iron ore, has become a significant land use with much of the Pilbara now under mining tenure (Kendrick, 2001b).

1.7. Fire History

The fire history of the Survey Area for the five years (2018 to 2023) prior to the assessment was assessed using North Australia and Rangelands Fire Information (NAFI) (Charles Darwin University, 2023). Two fires have impacted the Survey Area during this period. In 2021, 37% or 1,656.6 ha of the Survey Area was burnt, while in 2022, 79% (3,589 ha) of the Survey Area was impacted by fire, which also included the same area as the 2021 fire (Charles Darwin University, 2023). However, it is likely the actual burnt area is less as NAFI uses satellite imagery to map fire scars, which has an accuracy of 85-90% (Charles Darwin University, 2023). Map 1.2 displays the fire history over the past five years.



Legend

Survey Area

NAFI Fire History

- 2017
- 2018
- 2019
- 2020
- 2021
- 2022

N

0 1 2 3 4 5 km

Scale 1:125,000 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum Ecology + Spatial

[redacted]

Date: 29-01-2024

Fire History

NSJW Project

MAP 1.2

Prepared for Fortescue

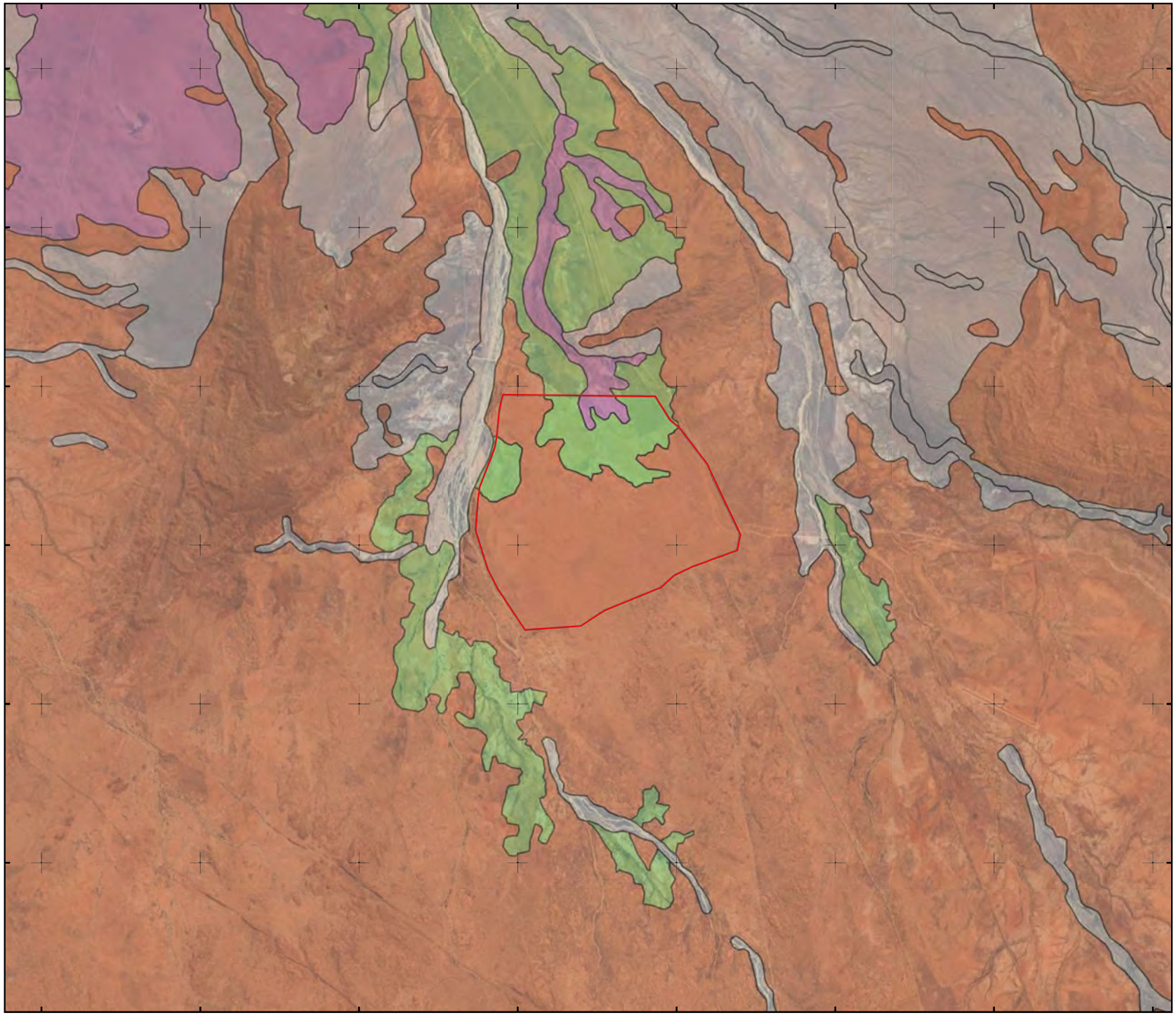
1.8. Geology

The geology of Western Australia has been mapped at a scale of 1:50,000, 1:100,000, 1:250,000, and 1:500,000. The Study Area occurs in the central west of the 1:500,000 scale geological mapping (DMIRS, 2020), which is the finest-scale digital mapping available for the area mapped to the state extent.

Geological mapping was completed within the Survey Area, recording three units, as listed in Table 1.1 and mapped on Map 1.3. Two units cover most of the Survey Area, with X-PIP accounting for 77% and R-PIP representing 21%. All units are well represented elsewhere in WA.

Table 1.1: Surface Geology

Unit Name	Unit Code	Description	Area in Survey Area (ha)	% of Survey Area	Total WA Extent (ha)	Total Pilbara Extent (ha)	% of Pilbara Extent Within Survey Area
X-PIP	Exposed Unit, PIP	Exposed bedrock	3,486.7	76.9	14,267,483	8,412,584	0.04
R-PIP	Residual or relict unit, PIP	Residual or relict unit; undivided	944.4	20.8	355,639	298,866	0.32
W-PIP	Sheetwash unit, PIP	Clay, silt and sand in distal sheetwash fan and slope deposits; local ferruginous pisoliths and gravel	101.8	2.3	3,786,925	1,200,060	0.01
		Total	**4,532.9**	**100**			



Legend

Survey Area

Geological Unit Code

_R-PIP

_W-PIP

_X-PIP

Unit Not in Survey Area

N

0 1 2 3 4 km

Scale 1:167,107.788394 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum

[redacted]

Date: 05-02-2024

Surface Geology (1:500,000)

NSJW Project

MAP 1.3

Prepared for Fortescue

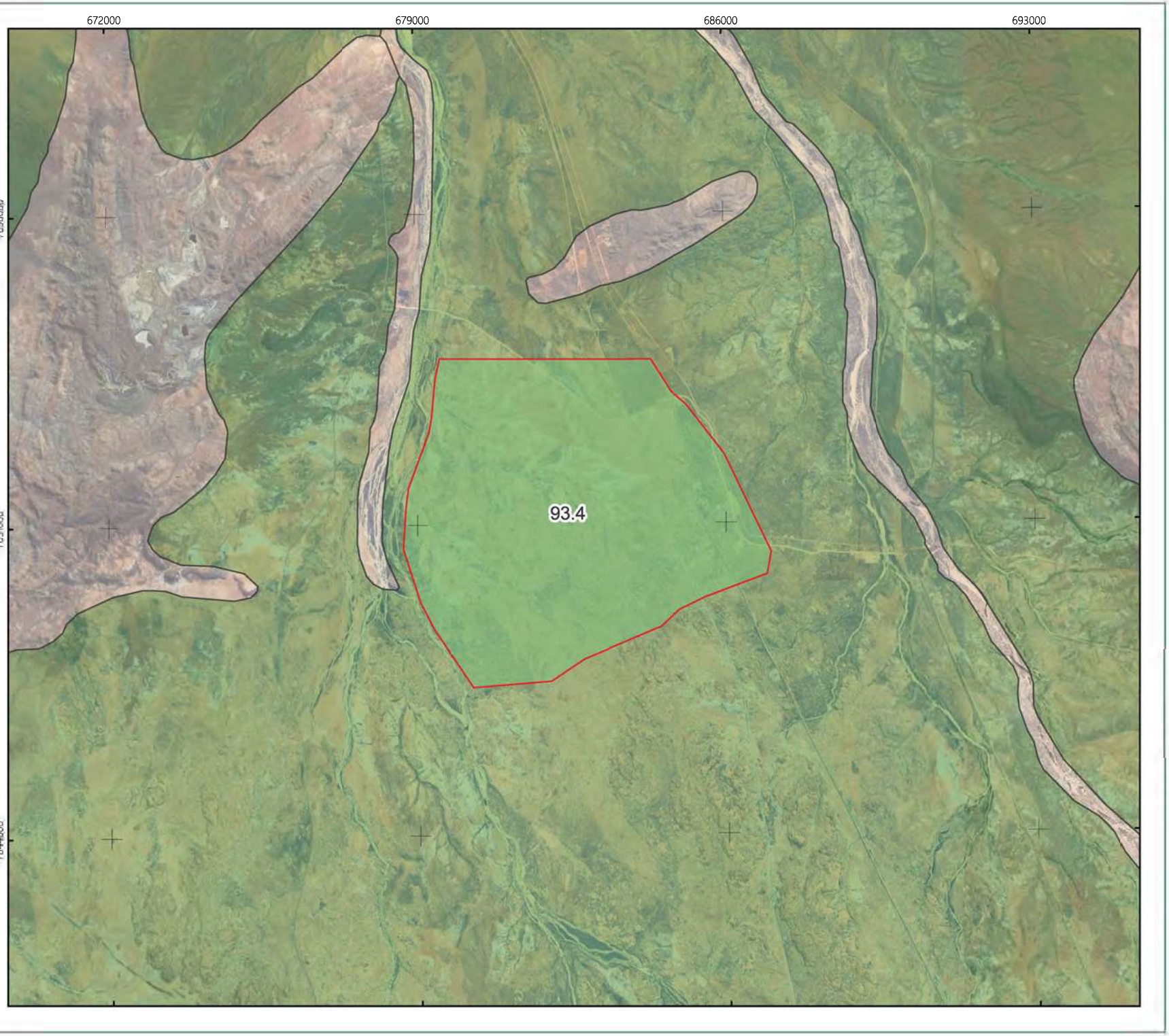
1.9. Beard Vegetation Mapping

Pre-European vegetation mapping was originally undertaken by John Beard (Beard *et al.*, 2013) at various scales across the state and has since been updated to be consistent with the National Vegetation Information System (NVIS) descriptions at a scale of 1:250,000 (Department of Primary Industries and Regional Development, 2019). State-wide vegetation statistics are available from 2018 for these associations, which lists pre-European extent, current extent, area in DBCA managed lands and is a useful tool to determine if a vegetation association is rare or otherwise significant (Department of Biodiversity Conservation and Attractions, 2019a).

One vegetation sub-association (SA) has been mapped within the Survey Area, SA93.4 (Table 1.2, Map 1.4). Over 99% of the pre-European vegetation extent remains for this SA.

Table 1.2: Beard Vegetation Sub-Associations

SA	NVIS Level V Description	Area in Survey Area (ha)	% of Survey Area	Pre-European Extent WA (ha)	Current Extent WA (ha)	Current Pilbara Extent WA (ha)	% Remaining	% of Current WA Extent in Survey Area	% Current Pilbara Extent in Survey Area
93.4	*Grevillea pyramidalis, Hakea lorea, Senna* sp., *Grevillea wickhamii* tall sparse shrubland.	4,532.9	100	2,481,889	2,478,504	2,477,408	99.8	0.2	0.2



Legend

- Survey Area

Beard Vegetation Sub-Associations

- 93.4
- Sub-Association not in Survey Area

N

0 1 2 3 4 km

Scale 1:125,000 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum

[redacted]

Date: 13-06-2023

Beard Vegetation Sub-Associations

NSJW Project

MAP

Prepared for Fortescue

1.4

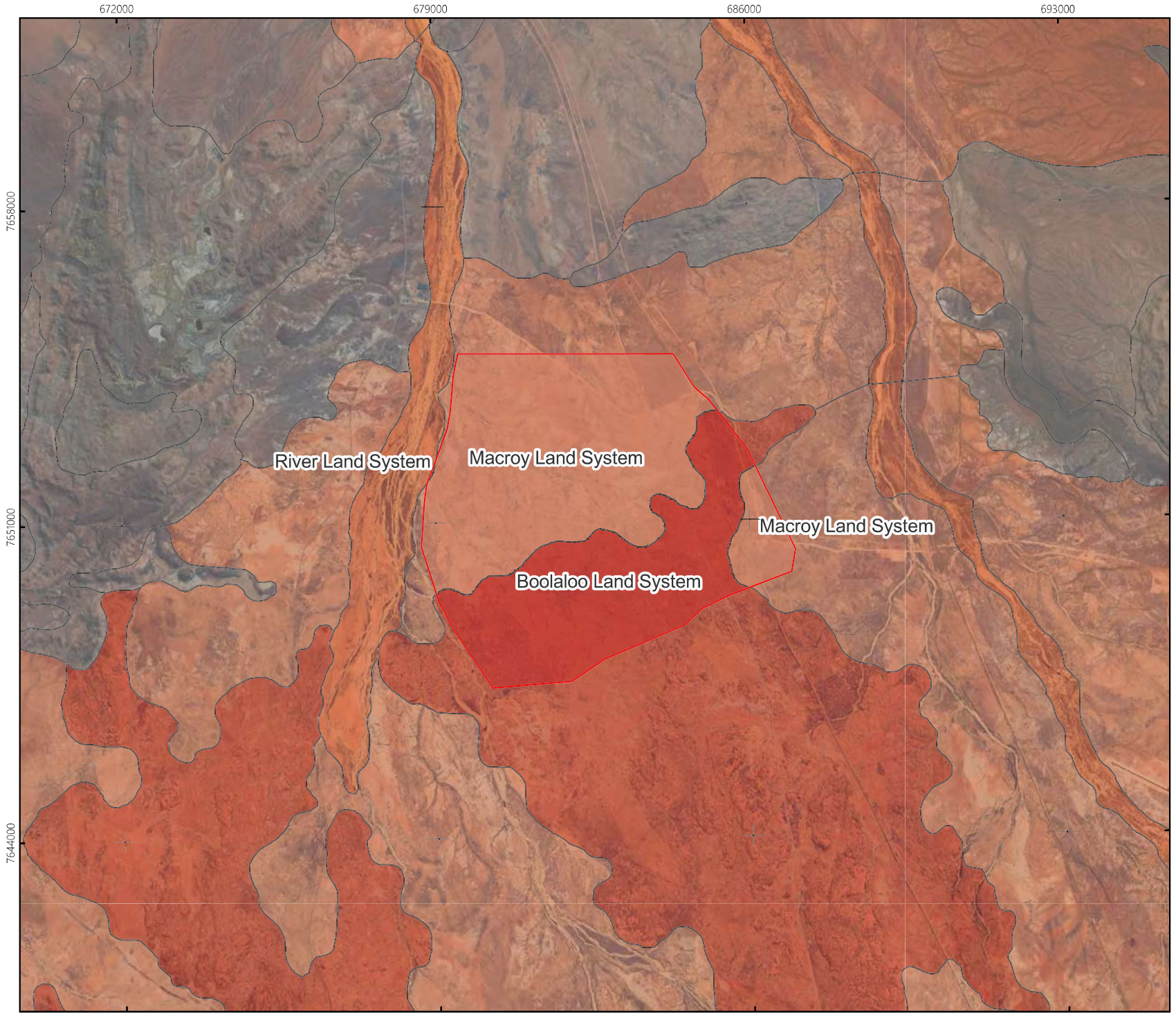
1.10. Land Systems

The land systems of Western Australia have been mapped at a scale of 1:250,000 (DAFWA 2016).

A total of three land systems were mapped across the Survey Area, two of which are dominant: Macroy (60.6%) and Boolaloo (39.3%). The dominant land systems encompass stony plains, granite hills and spinifex grasslands. The remaining River land system encompasses less than 0.1% of the Survey Area. All land systems are well represented in the region with the Survey Area covering less than 1 % of the land systems extent in WA (Table 1.3; Map 1.5).

Table 1.3: Land Systems

Description	Area in Survey Area (ha)	% of Survey Area	Total WA Extent (ha)	% of Total Extent within Survey Area
Boolaloo Land System: Granite hills, domes, tor fields and sandy plains supporting spinifex grasslands with scattered shrubs.	1,783.5	39.3	247,383	0.7
Macroy Land System: Stony plains and occasional tor fields based on granite supporting hard and soft spinifex shrubby grasslands.	2,748.1	60.6	1,330,647	0.2
River Land System: Narrow, seasonally active flood plains and major river channels supporting moderately close, tall shrublands or woodlands of acacias and fringing communities of eucalypts sometimes with tussock grasses or spinifex.	1.3	<0.1	481,994	<0.01
Total	4,532.9	100		



Legend

Survey Area

Land Systems

- Boolaloo Land System
- Macroy Land System
- River Land System
- Land System not in Survey Area

N

0 1 2 3 4 km

Scale 1:125,000 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum Geology + Spatial

[redacted]

Date: 05-02-2024

Land Systems

NSJW Project

MAP 1.5

Prepared for Fortescue

1.11. Significant Lands

Significant lands include conservation estates, Environmentally Sensitive Areas (ESAs) and wetlands listed on the Australian Wetlands Database, with further detailed information in sections 1.11.1 to 1.11.3. One significant land is located in the Study Area: Mungaroona Nature Reserve, located approximately 40 km south-west of the Survey Area. It is listed in Table 1.4, shown on Map 1.1 and described in the following sections.

Table 1.4: Significant Lands within the Study Area

Reserve Name (Protected Area ID)	Distance and Direction from Survey Area
Conservation Estate & ESAs	
Mungaroona Range Nature Reserve	40 km SW

1.11.1. 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 generally managed by the Department of Biodiversity, Conservation and Attractions (DBCA) to protect Western Australia's biodiversity and includes National Parks, Nature Reserves, Conservation Reserves, and other areas managed primarily for biodiversity conservation (DCCEEW, 2022). The Mungaroona Range Nature Reserve occurs within the Study Area (Table 1.4, Map 1.1).

1.11.2. Environmentally Sensitive Areas

Environmentally Sensitive Areas are defined by the Department of Water and Environmental Regulation (DWER, 2019) as:

- A defined wetland and the area within 50 m of a wetland;
- The area covered by vegetation within 50 m of Threatened flora, to the extent to which the vegetation is continuous with the vegetation in which the Threatened flora is located;
- The area covered by a Threatened Ecological Community (TEC);
- A Bush Forever site;
- Areas covered by the Gnangara Mound Crown Land Policy and Western Swamp Tortoise Policy; and
- Areas covered by lakes, wetlands, and fringing vegetation of the Swan Coastal Plain Lakes Policy, including South-west Agricultural Zone Wetlands Policy and Swan and Canning Rivers Policy.

One ESA is located within the Study Area, the Mungaroona Range Nature Reserve (Table 1.4, Map 1.1).

1.11.3. Australian Wetlands Database

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 (DBCA, 2017, 2018; DCCEEW, 2023).

No nationally significant wetlands, including Ramsar wetlands, were mapped within the Study Area. The closest wetland of national significance is the Fortescue Marsh, located approximately 100 km south of the Survey Area (Table 1.4, Map 1.1).

2. METHODS

2.1. Desktop Assessment

A desktop review of relevant and available biological data sources of the Study Area was undertaken prior to the field survey, to assess the fauna likely to occur across the Survey Area. The desktop assessment of the Study Area included searches of biological databases, a literature review of previously conducted assessments and likelihood of occurrence of significant species (Table 2.1, Map 1.1).

2.1.1. Biological Database Searches

The following databases were searched and incorporated into the desktop assessment (Table 2.1).

Table 2.1: Summary of Database Searches

Data Source	Custodian	Details	Buffer
Commonwealth Protected Matters Search Tool (PMST)	Department of Climate Change, Energy, the Environment and Water (DCCEEW)	Date: 04/04/2023	50 km
Threatened Fauna Database	Department of Biodiversity Conservation and Attraction (DBCA)	Date: 4/05/2023 Reference: 7635	50 km
NatureMap	DBCA	Date: 13/06/2023	50 km
Atlas of Living Australia	National Research Infrastructure for Australia (NCRIS) / Commonwealth Scientific and Industrial Research Organisation (CSIRO) / Global Biodiversity Information Facility (GBIF)	Date: 04/04/2023	50 km
Fortescue Internal Database	Fortescue	Date: 14/04/2023	40 km

2.1.2. Literature Review

Previously conducted vertebrate fauna assessments or monitoring programs within the Study Area were reviewed to analyse fauna assemblages and determine occurrence of significant species. Reports were incorporated if they were provided by the client, publicly available, or within our fauna database. The 33 reports incorporated into the desktop assessment are listed in Table 2.2 and shown on Map 2.1.

Twelve of the previous surveys or monitoring programs in the region overlap with the Survey Area:

- Fortescue Fauna Monitoring from 2013 to 2023 (ecologia Environment (ecologia), 2014b, 2014a, 2014d, 2015a, 2015b; Ecoscape (Australia, Ecoscape), 2015, 2016c, 2016b, 2017a, 2018; Spectrum, 2019, 2020a, 2021, 2022, 2023a, 2024);
- North Star Junction Renewable Energy Infrastructure Project Vertebrate Fauna (360 Environmental (360), 2023);
- North Star Junction Flora and Fauna Assessments (Ecoscape, 2021);
- Pilbara Transmission Project Targeted Flora and Fauna (Ecoscape, 2020a);

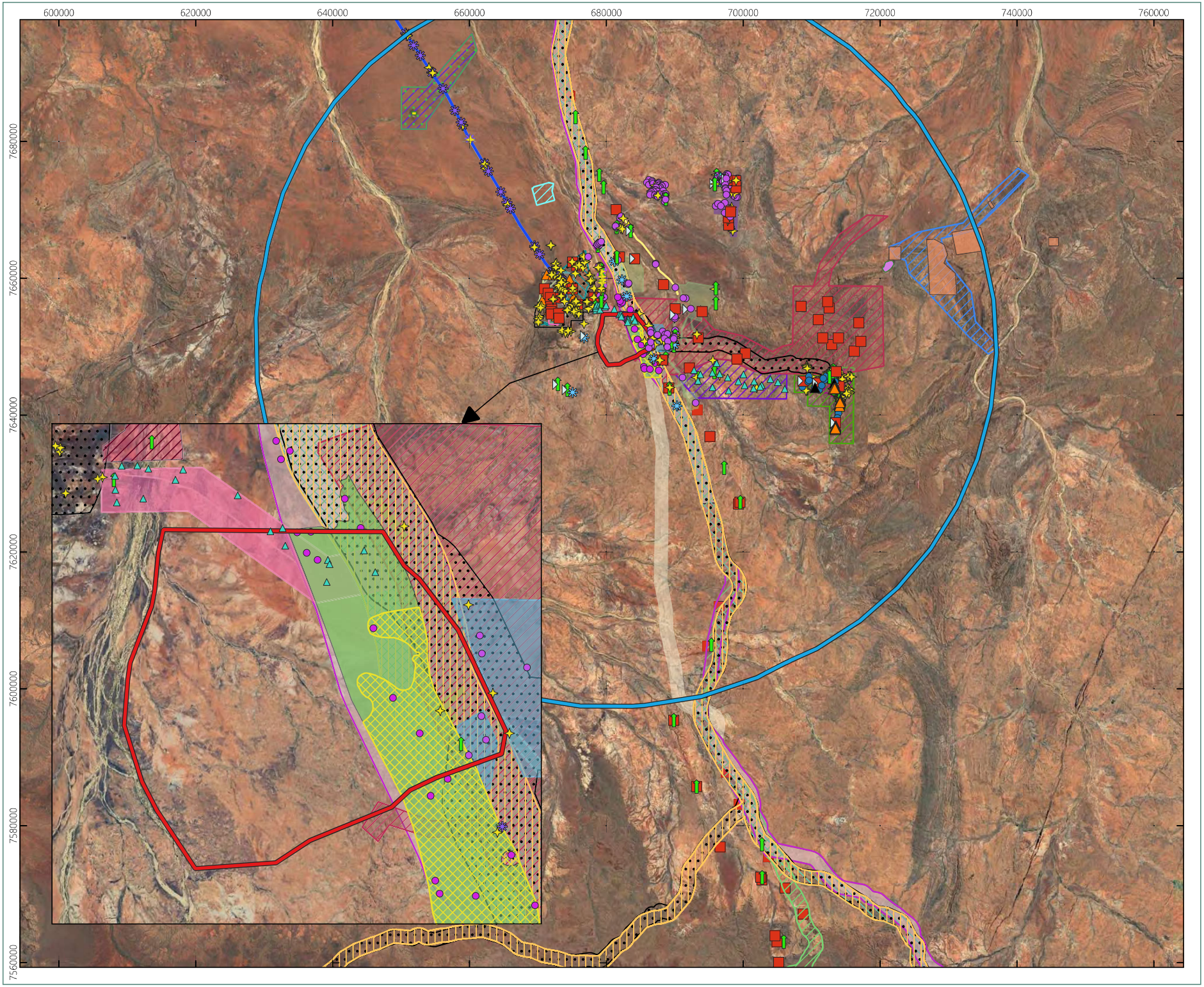
- Pilbara Transmission Project Terrestrial Fauna Desktop (Spectrum, 2018);
- North Star Project Level 2 Vertebrate Fauna (ecologia, 2012a);
- North Star Access Corridor Flora, Vegetation & Vertebrate Fauna (ecologia, 2012b);
- Targeted Fauna Assessment of the Rail Duplication (Bamford Consulting Ecologists (Bamford, 2010);
- Significant Vertebrate Fauna of Roy Hill Infrastructure Corridor (Terrestrial Ecosystems (TE), 2011);
- Targeted Flora and Fauna of Rail Corridor GDP Areas 2449, 2462 & 2515 (Ecoscape, 2009);
- Conservation Significant Vertebrate Fauna – Proposed Rail Corridor and Borrow Pits (ATA Environmental (ATA), 2007); and
- Fortescue Stage A Rail (Biota Environmental Sciences (Biota), 2004).

Table 2.2: Previously Conducted Biological Assessments

Biological Assessment Name	Survey Level	Survey Timing	Distance to Survey Area
Fortescue Fauna Monitoring (ecologia, 2014b, 2014a, 2014d, 2015a, 2015b; Ecoscape, 2015, 2016c, 2016b, 2017a, 2018; Spectrum, 2019, 2020a, 2021; 2022, 2023a, 2024)	Significant fauna monitoring	2013-2023	Partially in Survey Area
North Star Junction Renewable Energy Infrastructure Project Vertebrate Fauna (360 Environmental (360), 2023)	Detailed and targeted – vertebrate fauna & SRE – single phase	March 2022	Partially in Survey Area
North Star Junction Flora and Fauna Assessments (Ecoscape, 2021)	Basic – vertebrate fauna	May 2021	Partially in Survey Area
Pilbara Transmission Project Targeted Flora and Fauna (Ecoscape, 2020a)	Targeted – vertebrate fauna	September 2019	Partially in Survey Area
Pilbara Transmission Project Terrestrial Fauna Desktop (Spectrum, 2018)	Desktop – vertebrate fauna & SRE	October 2018	Partially in Survey Area
North Star Project Level 2 Vertebrate Fauna (ecologia, 2012a)	Detailed and targeted – vertebrate fauna	Mar-Apr, Jul & Oct-Nov 2011	Partially in Survey Area
North Star Access Corridor Flora, Vegetation & Vertebrate Fauna (ecologia, 2012b)	Basic – vertebrate fauna	May 2012	Partially in Survey Area
North Star Aerodrome Flora & Fauna (ecologia, 2015c)	Basic – vertebrate fauna	August 2015	5.3 km W
North Star Filtration Plan Relocation Flora & Fauna (ecologia, 2014c)	Basic – vertebrate fauna	August 2014	1.5 km N
Targeted Fauna Assessment of the Rail Duplication (Bamford, 2010)	Targeted – vertebrate fauna	November 2010	Partially in Survey Area
Conservation Significant Vertebrate Fauna Species Habitat Assessment: Roy Hill Rail (TE, 2011)	Basic & targeted – vertebrate fauna	January – February 2011	Partially in Survey Area
Targeted Flora and Fauna of Rail Corridor GDP Areas 2449, 2462 & 2515 (Ecoscape, 2009)	Targeted – vertebrate fauna	June 2009	Partially in Survey Area
Conservation Significant Vertebrate Fauna – Proposed Rail Corridor and Borrow Pits (ATA, 2007)	Targeted & basic – vertebrate fauna	June to September 2006 (9 phases)	Partially in Survey Area
Fortescue Stage A Rail (Biota, 2004)	Detailed – vertebrate fauna	March – April 2004	Partially in Survey Area
Wodgina Lithium Project: Level 2 Vertebrate Fauna (Western Wildlife (WW), 2020)	Detailed – vertebrate fauna	April 2019 & October 2019	1.6 km W
Pippingarra and Wodgina Roads Flora & Fauna (Ecoscape, 2020b)	Basic – vertebrate fauna	July 2020	2.7 km E

Biological Assessment Name	Survey Level	Survey Timing	Distance to Survey Area
Wodgina Project: Level 1 & Targeted Fauna (Stantec, 2018)	Basic & targeted – vertebrate fauna	July 2018	3.6 km NW
Hercules Project: Terrestrial Fauna (Outback Ecology Services (Outback), 2012)*	Detailed & targeted – vertebrate fauna (single phase only)	March 2011	6.5 km W
Wodgina DSO Project: Terrestrial Fauna (Outback, 2009)	Detailed and targeted vertebrate fauna	April-May 2009 & July-August 2009	5.6 km W
Wodgina DSO Project: Northern Quoll Annual Monitoring (Baseline Survey) (Outback, 2010)	Targeted – vertebrate fauna	February 2010	4.9 km W
Wodgina DSO Project Quarterly Bat Monitoring Program (Outback, 2011a)	Targeted – vertebrate fauna	March 2011	5.5 km W
Wodgina Gas Pipeline Targeted Fauna Survey (360, 2018)	Targeted – vertebrate fauna & SRE	June 2018	7.3 km NW
Pilgangoora Baseline Vertebrate Fauna (360, 2016)	Detailed – vertebrate fauna (single phase only)	March 2016	23.8 km NE
E45/2287 Infill Pilgangoora Project Flora & Fauna (Animal Plant Mineral (APM), 2023)	Targeted – vertebrate fauna	March 2023	29.5 km NE
P1000 Pilgangoora Project Flora & Fauna (APM, 2024)	Targeted – vertebrate fauna	September-October 2023	34.3 km NE
Glacier Valley and South Star Fauna Surveys (GHD, 2020)	Targeted – vertebrate fauna	May 2018 – February 2019	21 km E
Glacier Valley Terrestrial Vertebrate Fauna (Spectrum, 2021b)	Detailed – vertebrate fauna	May – October 2020	21 km E
Abydos DSO Project: Terrestrial Vertebrate Fauna Baseline Survey (Outback, 2011b)	Detailed – vertebrate fauna	May – September 2010	35.2 km E
Conservation Significant Bats Sulphur Springs, Pilbara (Molhar, 2007)	Targeted – vertebrate fauna	June 2007	36.4 km E
Mt Dove DSO Project: Northern Quoll Monitoring (MWH, 2015)	Targeted – vertebrate fauna	July – August 2015	37.4 km NW
Mt Dove DSO Project: Vertebrate Fauna (Outback, 2011c)	Detailed – vertebrate fauna	May – September 2010	37.4 km NW
Mt Dove Drilling Exploration Bat Monitoring (Outback, 2011d)	Targeted – vertebrate fauna	January 2011	39.9 km NW
Panorama Project Area: Baseline Fauna (Bamford, 2001)	Detailed – vertebrate fauna	June – September 2001	37.1 km E

Note: * - these reports were only accessed via Western Wildlife (2020) and Stantec (2018) reports, so have limited information



Legend

Survey Area
Study Area

Previous Surveys Completed in Vicinity

- 360 (2016)
- 360 (2018a)
- 360 (2018b)
- 360 (2023)
- APM (2023)
- APM (2024)
- ATA (2007)
- Bamford (2001)
- Bamford (2010)
- Biota (2004)
- Ecologia (2012a)
- Ecologia (2012b)
- Ecologia (2014c)
- Ecologia (2015c)
- Ecoscape (2009)
- Ecoscape (2020a)
- Ecoscape (2020b)
- Ecoscape (2021)
- GHD (2020)
- Molhar (2007)
- MWH (2015)
- Outback Ecology (2009)
- Outback Ecology (2010)
- Outback Ecology (2011a)
- Outback Ecology (2011b)
- Outback Ecology (2011c)
- Outback Ecology (2011d)
- Outback Ecology (2012)
- Spectrum (2018)
- Spectrum (2021)
- Stantec (2018)
- Terrestrial Ecosystems (2011)
- Western Wildlife (2020)

Survey Site Types

- Systematic trapping
- Bat Recorder
- Motion Camera
- Habitat Assessment
- Targeted Search
- Targeted Bird Survey
- Targeted Bilby Search
- Bilby Monitoring
- Targeted Pilbara Olive Python
- Northern Quoll Trap Location
- Opportunistic Site

Targeted Search Areas

- Terrestrial Ecosystems (2011) - Bilby & Brush-tailed Mulgara
- Terrestrial Ecosystems (2011) - Northern Quoll
- Bamford (2010) - Northern Quoll, Bilby, Pilbara Olive Python

N

0 5 10 15 20 km

Scale 1:500,000 @ A3

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum

Date: 27-11-2024

Previous Surveys in the Vicinity

NSJW Project

MAP 2.1

Prepared for Fortescue

2.1.3. Likelihood of Occurrence of Significant Fauna

The following information was collated for each significant fauna taxon identified during the desktop assessment:

- Conservation status (EPBC Act, BC Act, DBCA listing);
- Description of habitat requirements;
- Description of previous records including age of record (historical database records considered not accurate were excluded if required); and
- Distance of record to the Survey Area.

A likelihood of occurrence assessment was then conducted using the criteria listed in Table 2.3. This included assessing the presence of appropriate habitats within the Survey Area using geology, vegetation mapping, and/or aerial imagery.

Table 2.3: Likelihood of Occurrence Criteria

Likelihood	Fauna
Recorded	Species recorded within the Survey Area within the previous 10 years.
High	Species recorded within the Survey Area, more than 10 years ago; or Species recorded within 20 km of the Survey Area and suitable habitat occurs in the Survey Area. Species is easily detectable using standard survey methods.
Medium	Species recorded within the Survey Area, more than 20 years ago; or Species recorded within 40 km of the Survey Area and suitable habitat occurs; or Suitable habitat exists in the Survey Area, but species records are infrequent, or species is not easily detectable using standard survey methods.
Low	Species rarely or not recorded within 50 km of the Survey Area and suitable habitat does not occur within the Survey Area; or Suitable habitat occurs in the Survey Area, but species has not been recorded for more than 50 years.
Very Low	Species not recorded within 50 km despite multiple recent surveys. Suitable habitat does not occur within the Survey Area. Species considered locally extinct.

Note: The species' biology, detectability and frequency of records are considered in the likelihood assessment (e.g. an elusive species that is very rarely recorded may be rated more likely to occur than a species that is easily detectable).

2.2. Survey Timing & Survey Personnel

2.2.1. Survey Timing

The first phase of surveying was completed from the 15-25 May 2023, with the motion camera set-up survey completed from the 21 to 22 August 2023 and the second phase from the 27 September - 6 October 2023. The Survey Area is located within the Eremaean Botanical Province as described by Beard (1980). Technical Guidance (EPA, 2020a) recommends terrestrial fauna surveys in this region be completed between September to April (the period of highest reptile activity), preferably immediately after rain events (rain season) to coincide with peak amphibian and bird activity. There is no recommendation on survey timing for mammals.

The proposed survey timing for targeted significant fauna followed relevant species-specific guidelines (DBCA, 2017; DSEWPC, 2011b, 2011a; DoE, 2016; DEWHA, 2010a, 2010b) in particular those for EPBC Act listed species such as the Northern Quoll and threatened bat species which are known from the Study Area. The preferred timing for the terrestrial fauna assessments relevant to this project are:

- Surveys for Northern Quoll can be completed any time of the year using non-invasive techniques such as motion cameras.
- Threatened bat species can be surveyed at any time; however, the population contracts to areas around roost caves during the cooler dry season and then expands out during the warmer wet season.
- Pilbara Olive Python can be surveyed at any time; however, they are considered to be more active in the warmer wet season, and move to rocky areas with suitable caves and crevices during the cooler dry season.
- The Bilby can be surveyed at any time of the year using non-invasive techniques such as targeted searches for secondary evidence.

Survey timing is also a significant factor when considering animal welfare. The survey should be completed at a time when the target fauna groups are active and detectable but not during a time of year when extreme weather events are likely. High temperatures and flooding can lead directly to fauna stress and/ or death or indirectly by restricting access to trapping sites. Traps were closed after morning check and reopened in the late afternoon when temperatures to minimise impacts by heat to trapped fauna.

2.2.2. Climatic Conditions

Monthly climate data was sourced from the two nearest Bureau of Meteorology (BOM) stations with data, Indee #4016 and Marble Bar #4106, located approximately 48 km north and 98 km west of the Survey Area, respectively (BOM, 2023). Only monthly and long-term rainfall data was available from Indee which opened in 1909, while Marble Bar station data commenced in 2000. Rainfall recorded 12 months prior to the survey, median monthly rainfall, and temperature are presented in Figure 2.1.

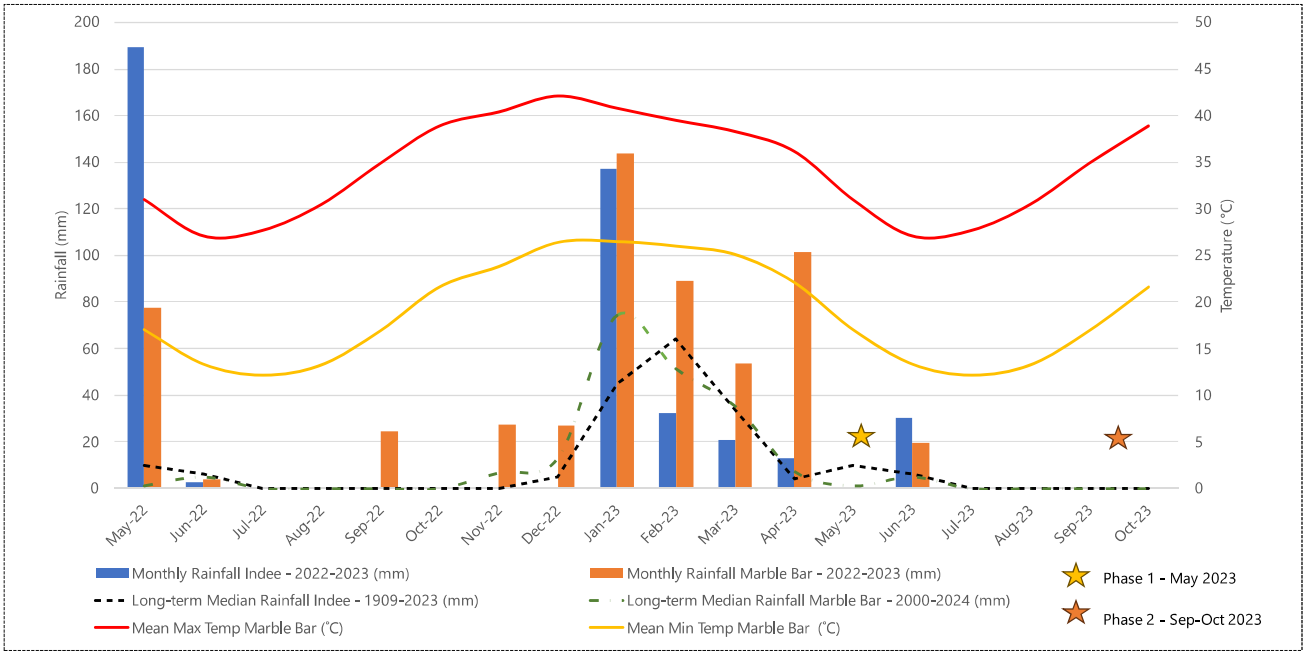


Figure 2.1: Mean Temperature, Rainfall 12 Months Prior to Surveys & Median Long-term Rainfall

The following rainfall was recorded at Indee (#4016) and Marble Bar (#4106) 12 months prior to the survey:

- In the 12 months preceding the Phase 1 survey (May 2022 to April 2023), 395.2 mm of rainfall was recorded at Indee, 227.3 mm higher than the sum of the long-term annual median of 167.9 mm. While, 548.6 mm of rainfall was recorded at Marble Bar, 354.1 mm higher than the sum of the long-term annual median of 194.5 mm. In 2022, the wet season occurred later than usual, with Indee and Marble Bar recording 189.6 mm and 77.6 mm of rainfall in May, respectively. While the 2023 wet season was more typical for the Survey Area with significant rainfall recorded in January 2023 at Indee (137 mm) and Marble Bar (143.6 mm). Additionally, Marble Bar received more than twice Indee's rainfall during the 2023 wet season period (November 2022 to April 2023) with 442.2 mm and 203.1 mm recorded, respectively.
- During the three months preceding the Phase 1 field survey (February 2023 – April 2023), only 66.1 mm of rainfall was recorded from Indee, 35.9 mm lower than the sum of the long-term annual median for the same three months (102 mm). However, significant rainfall occurred one month prior, with January 2023 recording 137 mm. Conversely, for the same period, Marble Bar recorded 244. mm of rainfall, 94.3 mm higher than the sum of the long-term annual median for the same three months (244.4 mm) with similar significant rainfall in January 2023 (143.6 mm).
- Rainfall between the two survey phases (May 2023 to September 2023) was above the long-term median for both stations (Indee: 16.1 mm and Marble Bar: 6.2 mm), with Indee recording 30 mm and Marble Bar receiving less rain with 19.4 mm.

During Phase 1 in May 2023, the maximum daily temperatures were generally below the long-term mean max temperature for Marble Bar in May (31°C), with only day three of the survey reaching slightly above that (31.1°C). The average maximum temperature experienced during the survey was 28.5°C. The minimum temperatures experienced during Phase 1 of the survey were similarly below the long-term mean minimum temperature in May (17°C) with an average of 13.3°C. The lowest minimum temperature was experienced on Day 10 of the survey, where it only reached 9.8°C. However, during Phase 2, the maximum temperatures were well above the long-term mean for both September (30.5°C) and October (34.9°C), with an average of 40.1°C. The lowest temperature experience was 37.5°C, with a high of 41.9°C. Likewise, the minimum

temperatures were also above the long-term mean for both months (13.2°C and 16.9°C, respectively), with an average of 20.8°C. No rainfall was recorded during any of the survey phases.

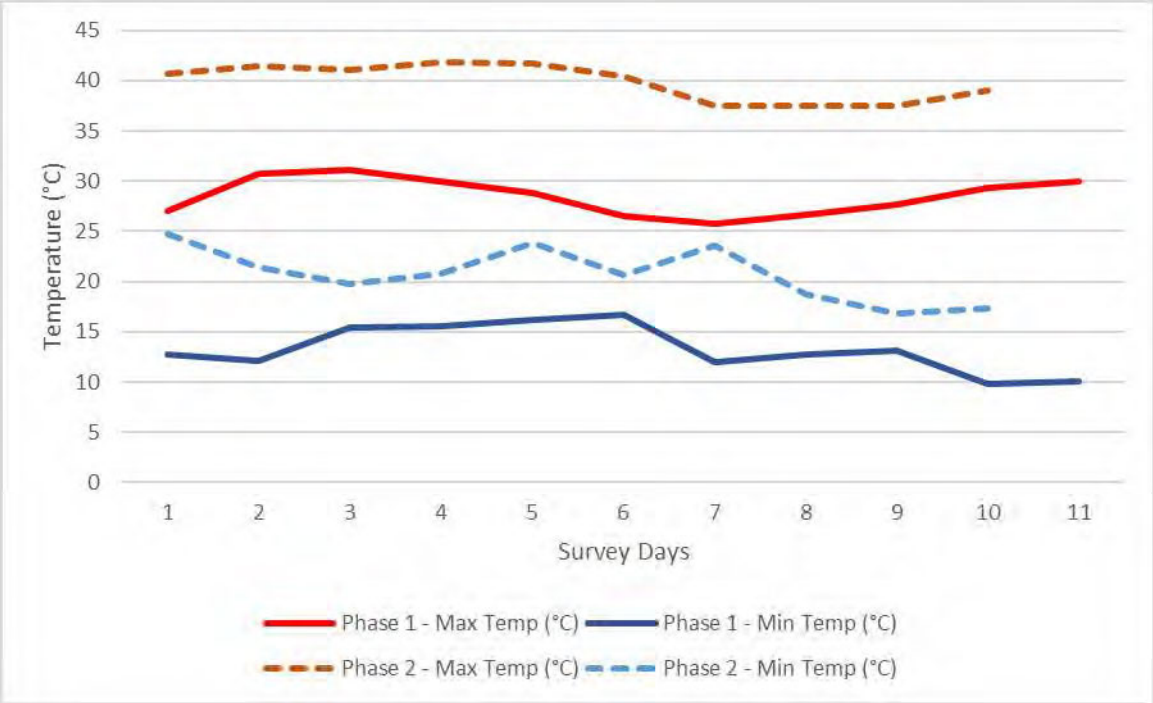


Figure 2.2: Phase 1 & 2 Survey Maximum & Minimum Temperatures

2.2.3. Survey Permits & Personnel

The survey was completed under DBCA Regulation 27 licence number BA27000842 and Section 40 of the BC Act authorisation number TFA2223-0261.

The field personnel details are presented in Table 2.4, along with Dr Kyle Armstrong of Specialised Zoological, who completed the bat call analysis.

Table 2.4: Project Staff

Name	Position	Qualification	Consulting/Relevant Experience*	Tasks
Astrid Heidrich	Principal Zoologist	MSc.	15	Report writing, report review, field survey (phase 1)
Erica MacIntyre	Senior Zoologist	BSc.	10	Report writing, project management, field survey (phase 1 and 2)
Melinda Henderson	Senior Zoologist	B.Sc. Hons	5	Field survey (phase 2)
Georgia Ford	Zoologist	BSc, MSc.	5	Report writing, field survey (phase 1)
Steven Spragg	Zoologist, Ornithologist	BSc.	1 (10 years ornithology)	Field survey (phase 1)
Louise Ridgeway	Zoologist	BSc.	5	Field survey (phase 2)
Karis Waterson	Zoologist	BSc.	<1	Field survey (phase 2)
Joel Wilson	Zoologist	MSc (Res.)	4	Statistical analysis
Kyle Armstrong	Bat Call Analysis	BSc, PhD. Zool.	>20	Bat call analysis

2.3. Field Methods & Sampling Effort

2.3.1. Determination of Survey Design

The desktop assessment identified 33 previous surveys of relevance, which includes the ongoing fauna monitoring for Fortescue. Of these, 12 were completed partly within the Survey Area, nine were within 10 km (Table 2.5) and the remaining 12 were completed in the wider region (60 km or less; section 2.1.2). Following this review and prior to the development of the survey methods, an assessment was undertaken of factors likely to influence the design and intensity of the field survey. This assessment followed the EPA Technical Guidance: Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (EPA, 2020a).

Of the 12 surveys that partially overlap the Survey Area, five were conducted recently, while the remaining seven are over 12 years old. Notably, the three detailed surveys did not include any trap sites within the Survey Area boundary. A recent detailed survey was completed 1.6 km to the west in 2019, although some of the habitats present differed from those in the Survey Area. Consequently, it was determined that a detailed fauna survey and targeted survey for significant fauna was required. These surveys and other factors that may influence survey design are detailed in Table 2.6.

The survey effort of fauna assessments completed within or adjacent to (within 10 km) of the Survey Area are listed in Table 2.5.

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Table 2.5: Previous Survey Effort & Timing within 10 km of the Survey Area

Source^	Survey Type	Survey Timing	Distance from Survey Area	Site Type								
				Trapping Grid	Habitat Assessment (HA)	Opportunistic Observations	Targeted NQ Trapping / Search	Targeted Bilby Search	Targeted POP Search	Bird Survey	Motion Camera	Bat Recorder / Targeted Search
Fortescue Fauna Monitoring 2013-2023 (ecologia, 2014b, 2014a, 2014c, 2015a, 2015b; Ecoscape, 2015, 2016c, 2016b, 2017a, 2018; Spectrum, 2020, 2021, 2022, 2023a, 2024b)	Significant fauna monitoring	2013-2023	Partially in Survey Area		-	-	-	8 x Bilby 2 ha search sites within 10 km	-	4 x transects within 10 km	1 MC in culvert x 30-90 days in Survey Area (annually since 2013) 2 MCs in culvert x 30-90 days within 10 km (annually since 2013)	1 site (85 recorder nights) in Survey Area (annually since 2012) 6 x bat recorders (392 nights) within 10 km (annually since 2012)
North Star Junction Renewable Energy Infrastructure Project Vertebrate Fauna (360, 2023)	Detailed and targeted – vertebrate fauna & SRE – single phase	March 2022	Partially in Survey Area	7 x trapping grids	16	Completed	-	5 x 6 km transects searching for burrows, diggings, scats and tracks	Active searches at each trap site for all significant fauna	One hour at each trapping site Targeted Night Parrot x 2 acoustic recorders (14 nights)	4 sites x 10 cameras (210 trap nights)	6 x recorders (44 nights)
North Star Junction Flora and Fauna Assessments (Ecoscape, 2021)	Basic – vertebrate fauna	May 2021	Partially in Survey Area	-	15	Completed	-	-	-	-	5 motion cameras	1 bat recorder
Pilbara Transmission Project Targeted Flora and Fauna (Ecoscape, 2020a)	Targeted – vertebrate fauna	September 2019	Partially in Survey Area	-	-	Completed	Searches in granite boulder piles	Searches in alluvial plains in association with creek lines	-	-	-	-
North Star Project Level 2 Vertebrate Fauna (ecologia, 2012a)	Detailed and targeted – vertebrate fauna	Mar-Apr, Jul & Oct-Nov 2011	Partially in Survey Area	16 x trapping grids	Completed for habitat mapping	Completed	3825 trap nights 129.5 hours of active searches 52 camera nights	3 hours searching sandy plains	125.5 hours active searches 52 camera nights	6 x 20 min at each trapping site (total 62 hours)	14 sites (total 156 hours)	682.5 hours of recordings and 11 hours of cave searches
North Star Access Corridor Flora, Vegetation & Vertebrate Fauna (ecologia, 2012b)	Basic – vertebrate fauna	May 2012	Partially in Survey Area	-	Completed for habitat mapping	Completed	Active searches at each site for all significant fauna	Active searches at each site for all significant fauna	Active searches at each site for all significant fauna	20 min x 18 sites	-	-
North Star Aerodrome Flora & Fauna (ecologia, 2015c)	Basic – vertebrate fauna	August 2015	5.3 km W	-	Completed for habitat mapping	-	19 hours active searches for all significant fauna	19 hours active searches for all significant fauna	19 hours active searches for all significant fauna	1 hour x 19 sites	13 sites (208 hours total)	-
North Star Filtration Plan Relocation Flora & Fauna (ecologia, 2014c)	Basic – vertebrate fauna	August 2014	1.5 km N	-	10	Completed	Searches in suitable den habitat (rocky habitats)	Searches in sandy spinifex plains	Searches along drainage lines and rocky areas	-	8 x motion cameras at 8 sites (approx.. 40 hours each, total 334 hours & 47 mins	6 bat recorders at 6 sites (12 hrs 47 min effort each site)
Targeted Fauna Assessment of the Rail Duplication (Bamford, 2010)	Targeted – vertebrate fauna	November 2010	Partially in Survey Area	-	-	-	Searches for scats around granite outcrops	Searches for burrows, diggings and tracks in sandy habitats	Searches for individuals, skins, scats around rock outcrops	-	-	-
Conservation Significant Vertebrate Fauna Species Habitat Assessment: Roy Hill Rail (TE, 2011)	Basic & targeted – vertebrate fauna	January – February 2011	Partially in Survey Area	-	7 x in Survey Area, 30 x within 10 km	-	Searches in suitable habitat	Searches suitable habitat, also searches for Brush-tailed Mulgara	-	-	-	-
Targeted Flora and Fauna of Rail Corridor GDP Areas 2449, 2462 & 2515 (Ecoscape, 2009)	Targeted – vertebrate fauna	June 2009	Partially in Survey Area	-	-	Completed	Searches in suitable habitat	Searches in suitable habitat	Searches in suitable habitat	-	-	-
Conservation Significant Vertebrate Fauna – Proposed Rail Corridor and Borrow Pits (ATA, 2007)	Targeted & basic – vertebrate fauna	June to September 2006 (9 phases)	Partially in Survey Area	-	Completed for habitat mapping	Completed	Grid searches in suitable habitat	Grid searches in suitable habitat	Grid searches in suitable habitat	-	-	-

Source^	Survey Type	Survey Timing	Distance from Survey Area	Site Type								
				Trapping Grid	Habitat Assessment (HA)	Opportunistic Observations	Targeted NQ Trapping / Search	Targeted Bilby Search	Targeted POP Search	Bird Survey	Motion Camera	Bat Recorder / Targeted Search
Fortescue Stage A Rail (Biota, 2004)	Detailed – vertebrate fauna	March – April 2004	Partially in Survey Area	3 x trapping grids (Hope Downs)	-	Completed	Active searches in suitable habitat	Active searches in suitable habitat	Active searches in suitable habitat	37 surveys at 18 sites (24.67 hours)	-	1 x within 10 km
Wodgina Lithium Project: Level 2 Vertebrate Fauna (WW, 2020)	Detailed – vertebrate fauna	April 2019 & October 2019	1.6 km W	6 x trapping grids	Completed for habitat mapping	Completed	2 x trap sites (20 Elliott traps) April 2019 only	-	-	6 x 20 min at each site Targeted Night Parrot x 4 acoustic recorders	82 at 40 sites (208 trap nights)	At each trap site plus additional 20 sites
Pippingarra and Wodgina Roads Flora & Fauna (Ecoscape, 2020b)	Basic – vertebrate fauna	July 2020	2.9 km E	-	Completed for habitat mapping	Completed	23 x 30 min searches across 1 ha	23 x 30 min searches across 1 ha	23 x 30 min searches across 1 ha	2 acoustic recorders (8 nights total)	10 cameras	3 bat recorders (12 nights)
Wodgina Project: Level 1 & Targeted Fauna (Stantec, 2018)	Basic & targeted – vertebrate fauna	July 2018	3.6 km NW	-	54	-	Searches in suitable habitat	Searches in suitable habitat	Searches in suitable habitat	-	32	6 x recorders & searches in suitable habitat
Wodgina Hercules Project: Terrestrial Fauna* (Outback, 2012)	Detailed & targeted – vertebrate	March 2011 (1 phase only)	6.5 km W	4 x trapping grids	Completed*	Completed*	Completed*	-	Completed*	Completed*	-	Completed*
Wodgina DSO Project: Terrestrial Fauna* (Outback, 2009)	Detailed and targeted vertebrate fauna	April-May 2009 & July-August 2009	5.6 km W	6 x trapping grids	Completed*	Completed*	Completed*	-	Completed*	Completed*	-	Completed*
Wodgina DSO Project: Northern Quoll Annual Monitoring (Baseline Survey) (Outback, 2010)	Targeted – vertebrate fauna	February 2010	4.9 km W	-	-	-	8 sites x 20 Elliott traps (1,120 trap nights)	-	-	-	-	-
Wodgina DSO Project Quarterly Bat Monitoring Program (Outback, 2011a)	Targeted – vertebrate fauna	March 2011	5.5 km W	-	-	-	-	-	-	-	4 x at 4 cave entrances	9 x bat recorders from 1-4 nights
Wodgina Gas Pipeline Targeted Fauna Survey (360, 2018)	Targeted – vertebrate fauna & SRE	June 2018	6.1 km NW	-	-	-	46 x 2 ha searches total for all significant fauna	46 x 2 ha searches total for all significant fauna (specifically targeting Bilby)	-	-	12 units for 36 trap nights	-

Note: * - these reports were only accessed via Western Wildlife (2020) and Stantec (2018) reports, so have limited information of survey effort for some site types. ^Desktop reports were excluded from table.

Table 2.6: Factors Likely to Influence Survey Design

Factor	Relevance
Bioregion – level of existing survey/knowledge of the region and associated ability to predict accurately.	The Pilbara region has been extensively surveyed over the past decade with a general expansion in the detailed knowledge of the vertebrate faunal assemblages that occur in the region. The data is adequate to predict fauna assemblages and the likelihood of occurrence of significant species.
Landform special characteristics/specific fauna/specific context of the landform characteristics and their distribution and rarity in the region.	The landforms of the Survey Area are typical of the region and consist of sand plains, granite outcropping and drainage lines. All landforms are considered common throughout the surrounding region.
Lifeforms, life cycles, types of assemblages and seasonality (e.g. migration) of species likely to be present.	The Pilbara region is considered arid, and most fauna life cycles are significantly influenced by rainfall. Population increases, the influx of nomadic species and the onset of breeding activity is directly affected by rainfall in many taxa. Temperature also influences activity levels, with reptiles and amphibians being most active during warm wet periods.
Level of existing knowledge and results of previous regional sampling (e.g. species accumulation curves, species/area curves).	The results of 20 vertebrate fauna surveys were available to provide regional context to the current assessment. Four previous surveys have been completed within the Survey Area, with an additional seven within 10 km of the Survey Area, including four detailed vertebrate trapping surveys. A comprehensive detailed survey (2 phases), and targeted significant fauna survey have been completed in 2019, from 1.6 km to the west for Wodgina. Regional and local knowledge for the area is detailed, highly comparable and available for inclusion.
Number of different habitats or degree of similarity between habitats within a study area.	Five fauna habitat types were expected and identified based on staff experience with the region, previous habitat mapping, land systems and vegetation units. Additional areas considered cleared or disturbed were also identified.
Climatic constraints (e.g. temperature or rainfall that preclude certain sampling methods).	The Pilbara region experiences hot summers with occasional cyclonic rain events, followed by warm winters with little rain although rainfall is considered to be highly unpredictable. Field surveys are generally conducted in Autumn (wet/post-wet season) and Spring (dry season) to avoid climatic events that may preclude sampling. Above the median rainfall was recorded prior to the surveys which made conditions optimal. However, there was a large fire that burnt approximately 79% of the Survey Area in 2022 (prior to phase 1), which may have impacted the fauna assemblage of the Survey Area. Phase 2 of the survey experienced high temperatures, so traps were closed during the day and reopened in the afternoon, which may have limited diurnal reptile captures. Nocturnal species captures are not likely impacted. Extensive regional data offset any potential survey gaps experienced.
Sensitivity of the environment to the proposed activities.	The Survey Area contains habitat types which are well represented in the surrounding region. However, granite outcrops provide habitat for a range of significant fauna and other species. Prior assessments completed as part of the Wodgina project, North Star project, Glacier Valley project, and rail infrastructure projects provided broad baseline knowledge of the area.
Size, shape, and location of the proposed activities.	The Survey Area is located approximately 120 km south of Port Hedland and 25 km west of Iron Bridge. The Survey Area encompasses 4,532.9 ha.
Scale and impact of the proposal.	The proposal will include clearing of land for solar panel installation.

2.3.2. Terrestrial Fauna Survey Techniques

Spectrum conducted a two-phase detailed fauna assessment and targeted significant fauna survey. The details of the survey phases including dates, time frame and number of staff is outlined in Table 2.7.

Table 2.7: Survey Phase Details

Survey Phase	Dates	Time Frame (Days)	No. of Zoologists*
Phase 1	15 - 25 May 2023	11	4
Motion Camera Installation	21 - 22 August 2023	2	2
Phase 2	27 September - 6 October 2023	10	4

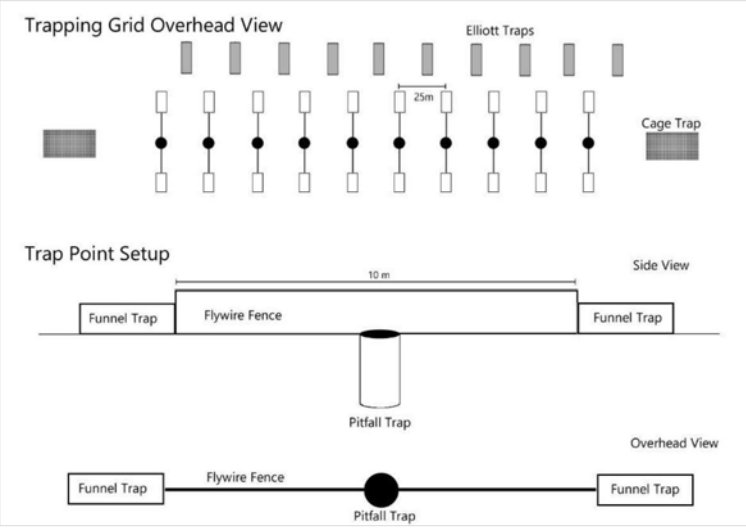
Note: * = See Table 2.4 for staff details

The approach of the survey was to describe and map the terrestrial fauna habitats across the Survey Area and complete systematic trapping and targeted searches to describe the vertebrate fauna assemblages, particularly any significant fauna identified as likely to be present.

Survey techniques used during the survey are outlined in Table 2.8.

Table 2.8: Fauna Survey Techniques

Technique	Application & Purpose	Target Group
Opportunistic / Basic Site	Information collected at each site included some, or all of the following: • Site code, date, location, zoologist; • A photograph; • Vegetation condition and disturbances (including fire); • Landform including; slope, soil, rock type, aspect; • Vegetation community type and density; and • Fauna present.	• Habitat Assessment • Mammals • Reptiles • Birds • Amphibians • Significant Fauna
Systematic Trapping Site	• **Pitfall:** 5 x 20 L bucket and 5 x 50 cm PVC pipe pitfall traps, dug into the ground to act as pitfall traps. A 10 m long, 30 cm high fence was also installed, passing across the top of each pit to direct fauna into it. • **Funnel traps**: placed at the ends of each fence to capture fauna that are not readily caught in pitfall traps (20 per trapping grid). All funnel traps were covered with shades to reduce the likelihood of animals suffering from overheating. • **Elliott traps**: aluminium box traps were baited with 'universal bait' to attract and capture smaller mammals (10 per trapping grid) and re-baited as required. All Elliott traps were covered by shades to reduce the likelihood of animals suffering from overheating. • **Cage traps**: larger wire-frame box traps, also baited with 'universal bait', to capture medium-sized mammals (two per trapping grid) and re-baited as required. All cage traps were covered by shades to reduce the likelihood of animals suffering from overheating. Layout of a trap site and a single trap line is shown below. Traps were left open for seven nights.	• Habitat Assessment • Mammals (small sized non-volant) • Reptiles • Amphibians • Significant Fauna

Technique	Application & Purpose	Target Group
	 	
Targeted Trapping Site – Satellite Sites	Two sites (S01 & S03) located in granite outcropping consisted of: • 5 x cage traps (as per above) (Phase 1 & 2); • 5 x motion cameras (Phase 1 only); • One ultrasonic bat recorder (Phase 1 & 2); and • Traps were left open for four trap nights. One site (S02) located in drainage line habitat consisted of: • 5 x motion cameras (Phase 1 & 2); and • One ultrasonic bat recorder (Phase 1 & 2).	• Mammals • Significant Fauna
Systematic Bird Surveys	Area searches (30-minute set-time searches of 2 ha areas) were used to document the bird assemblage present at each of the systematic fauna trapping sites. Four searches per phase were completed (total of eight 30 min surveys). During each area search an ornithologist recorded the number of individuals of each species observed while actively searching similar habitat within a 2 ha area surrounding the trapping site. Survey effort was concentrated within three hours of dawn or dusk, as these times are considered optimal for recording most bird species.	• Birds • Significant Fauna
Mapping Note	Note taken with the location and fauna habitat present. Might have included photographs or descriptions.	• Habitat Assessment
Opportunistic Sampling	Fauna species not recorded through other sampling methods were opportunistically sampled as encountered in the Survey Area. Opportunistic sampling also included recording locations of significant and introduced species.	• Mammals • Reptiles • Birds

Technique	Application & Purpose	Target Group
		• Amphibians • Significant Fauna
Targeted Sampling	Areas likely to support significant fauna were targeted during the survey, using techniques such as motion cameras, bat recorders, and searches for secondary evidence, with further details provided in Table 2.10. Areas were selected based on existing records from previous surveys, database searches, geology, aerial imagery, and vegetation mapping.	• Significant Fauna
Motion Cameras	Motion sensitive cameras capable of recording both normal (day) and infra-red (night) images were deployed in areas of interest, such as near permanent water or in gorges, to record cryptic or targeted species not normally recorded by other survey methods. In addition, suitable habitat for significant fauna likely to occur were targeted to determine their presence or absence. Motion Cameras were baited with non-food reward baits (cotton rope soaked in fish oil).	• Mammals • Reptiles • Birds • Significant Fauna
Passive^ Ultrasonic Recording Units (PUR)	Bat echolocation calls were recorded using Wildlife Acoustics SM4BAT ultrasonic recorders. The PUR devices record the full spectrum of calls allowing greater accuracy and sensitivity when identifying bat species. Each PUR device was programmed to record from 30 minutes pre-dusk to 30 minutes post-dawn for each night and deployed for a minimum of three nights.	• Bats

Note: ^ Passive is the automatic recording of echolocation calls without an observer present.

2.3.2.1. Survey Effort

Five systematic detailed vertebrate fauna trapping sites were surveyed over two phases. Each site was open for seven nights. In addition, two targeted trapping satellite sites were surveyed for four nights during each phase of the survey. A minimum of four 30-minute systematic bird surveys were completed at each of the trapping sites during both phases of the vertebrate fauna survey.

Ultrasonic Acoustic recordings were completed at each trapping site for at least four nights during both phases of the survey. Three additional bat survey sites (satellite sites) were surveyed for a minimum of four nights each during Phase 1, and at least three nights during Phase 2. Five motion cameras were deployed at each of the three satellite sites for four nights during Phase 1.

During Phase 1, a total of 15 motion cameras were deployed at the three satellite sites for four nights, with an additional 15 cameras set up at other areas of interest (e.g. Bilby and Mulgara burrows). This included two long-term motion cameras deployed for 32 days at an active Bilby burrow at site NS01. A separate motion camera installation survey was completed in August 2023, and nine motion cameras sites were set up consisting of five motion cameras each, except for one site with only four. These cameras were deployed for 44-45 days. A further five cameras were deployed during Phase 2 at one satellite site.

A total of 43 habitat assessments were completed at trap and satellite sites, motion camera sites, targeted search sites and an additional four sites.

A summary of the survey effort completed during the current survey at the Survey Area is detailed in Table 2.9.

Table 2.9: Survey Effort Completed

Survey		Phase 1	MC Install	Phase 2	Total
Survey Timing		May 2023	Aug 2023	Sep-Oct 2023	-
Person Days		44	4	40	88
Trap Nights	Pit Trap	350		350	700
	Funnel Trap	700		700	1400
	Elliott Trap	350		350	700
	Cage Trap	70		70	140
	Satellite Site – Cage Traps	40		40	80
Survey Effort (hrs)	Diurnal Searches	76.02		19	95.02
	Bird Surveys	10		10	20
	Bat Recorders	410		370	160
	Motion Cameras	4,200	49,080	600	53,880

Legend

Survey Area

Survey Sites

- Bat recorder
- Grey Falcon Check
- Habitat Assessment
- Motion Camera
- Systematic Trapping
- Targeted Active Search

N

0 0.5 1 1.5 km

Scale 1:50,000 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum

[redacted]

Date: 02-02-2024

Survey Site Locations

NSJW Project

MAP

Prepared for Fortescue

2.2

2.3.2.2. Targeted Survey – Significant Fauna

An initial desktop assessment was completed, which identified 28 species listed under the EPBC Act, gazetted under the BC Act or listed under the DBCA Priority fauna categories. These were specifically targeted using the field survey techniques as listed in Table 2.10 which follow the Threatened Species guidelines (where applicable).

Table 2.10: Significant Species – Targeted Survey Methods

Species	Conservation Status			Survey Method
	EPBC Act	BC Act	DBCA	
Mammals				
Northern Quoll *Dasyurus hallucatus*	EN	EN	-	• Habitat assessment • Searches for secondary evidence (8 hours across 2 sites) • Cages in Granite Outcropping habitat (80 trap nights at 2 sites) • 60 motion cameras at 12 sites from 4 - 45 nights (45,312 hours recording)
Pilbara Leaf-nosed Bat *Rhinonicteris aurantia* Pilbara Form	VU	VU	-	• Habitat assessment • Ultrasonic Recorders (78 nights at 8 sites)
Ghost Bat *Macroderma gigas*	VU	VU	-	• Habitat assessment • Ultrasonic Recorders (78 nights at 8 sites)
Bilby *Macrotis lagotis*	VU	VU	-	• Habitat assessment • Searches for secondary evidence (45.5 hours at 11 sites) • 22 motion cameras at 3 sites from 3 - 45 nights (5,448 hours recording)
Long-tailed Dunnart *Antechinomys longicaudatus*	-	-	P4	• Habitat assessment
Brush-tailed Mulgara *Dasycercus blythi*	-	-	P4	• Habitat assessment • Searches for secondary evidence (45.5 hours at 11 sites) • 21 motion cameras from 3 - 5 nights (2,112 hours recording)
Spectacled Hare-wallaby *Lagorchestes conspicillatus leichardti*	-	-	P4	• Habitat assessment • Searches for secondary evidence (4 hours at 1 site) • seven motion cameras from 3 to 5 nights (600 hours recording)
Short-tailed Mouse *Leggadina lakedownensis*	-	-	P4	• Habitat assessment • Trapping grids in suitable habitat (pitfalls – 700 trap nights and Elliott traps – 700 trap nights, at five sites)
Western Pebble-mound Mouse *Pseudomys chapmani*	-	-	P4	• Habitat assessment • Searches for secondary evidence (5 hours at 2 sites) • eight motion cameras at 1 site for 2 - 45 nights (4,512 hours recording)
Birds				
Night Parrot *Pezoporus occidentalis*	EN	CR	-	• Habitat assessment

Species	Conservation Status			Survey Method
	EPBC Act	BC Act	DBCA	
Grey Falcon *Falco hypoleucos*	VU	VU	-	• Habitat assessment • Bird surveys across variety of habitats (20 hours at 5 sites) • Targeted searches in suitable habitat (30.2 hours at 14 sites)
Pacific Swift *Apus pacificus*	MI	MI	-	• Habitat assessment • Bird surveys across variety of habitats (20 hours at 5 sites) • Opportunistic searches in suitable habitat (30.2 hours at 14 sites)
Peregrine Falcon *Falco peregrinus*		OS	-	• Habitat assessment • Bird surveys in suitable habitat (20 hours at 5 sites) • Targeted searches in suitable habitat (30.2 hours at 14 sites)
Migratory shorebirds	CR, MI	CR, MI	-	• Habitat assessment • Bird surveys in suitable habitat (8 hours at 1 site) • Targeted searches in suitable habitat (5 hours at 2 sites)
Reptiles				
Pilbara Olive Python *Liasis olivaceus barroni*	VU	VU	-	• Habitat assessment • Targeted searches in suitable habitat (26 hours at 6 sites)
Pin-striped Finesnout Ctenotus *Ctenotus nigrilineatus*	-	-	P1	• Habitat assessment • Targeted searches suitable habitat (26 hours at 6 sites) • Trapping grids in suitable habitat (pitfalls – 700 trap nights at five sites)
Gane's Blindsnake *Anilios ganei*		-	P1	• Habitat assessment • Trapping grids in suitable habitat (pitfalls – 700 trap nights at five sites)

2.3.3. Animal Ethics

This survey has approval under the Western Australian Ethics Committee scientific licence number: WAEC-22-07-74. Any disturbance of animals by the various capture or sampling methods involved, followed the state and federal legislations and guidelines listed in section Appendix A. The survey methods also followed the DBCA Standard Operating Procedures (SOPs) listed below (Department of Biodiversity Conservation and Attractions, 2019b):

- Aluminium Box Traps for Capture of Terrestrial Vertebrates;
- Cage Traps for Live Capture of Terrestrial Vertebrates;
- Dry Pitfall Trapping for Vertebrates;
- Funnel Trapping for Terrestrial Fauna;
- Animal Handling and Restraint using Soft Containment;
- Hand Capture of Wildlife;
- Hand Restraint of Wildlife; and
- Transport and Temporary Holding of Wildlife.

Vertebrate fauna taxa were only handled as required for the purposes of species identification.

2.4. Reporting & Data Analysis

2.4.1. Fauna Taxonomy & Nomenclature

Nomenclature for mammals, reptiles and amphibians followed the Western Australian Museum Checklist of the Vertebrates of Western Australia (November 2024). Nomenclature for birds follows the IOC World Bird List (Gill, Donsker and Rasmussen, 2023). Fauna species identifications were completed based on information provided in references listed in Table 2.11.

Table 2.11: Species Identification References

Fauna	Survey Techniques
Mammals	Churchill (2009); Menkhorst and Knight (2010); Van Dyck, Gynther and Baker (2013)
Birds	Menkhorst *et al.* (2019a); Simpson and Day (2017); Gill, Donsker and Rasmussen (2023)
Reptiles & Amphibians	Wilson and Swan (2017a); Cogger (2014); Tyler and Doughty (2009)

2.4.2. Bat Call Analysis

The raw bat call data was recorded in full spectrum WAV format using Wildlife Acoustics Song Meter SM4BAT bat detectors (sampling rate 384 kHz, set to turn on automatically at 30 minutes prior to sunset and off, 30 minutes after sunrise). The data was downloaded and sent to Kyle Armstrong (Specialised Zoological), where it was processed and analysed to identify all bat species present, but with a focus on the two significant bat species; the Ghost Bat (*Macroderma gigas*) and the Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*).

A multi-step acoustic analysis procedure developed to process large full spectrum echolocation recording datasets from insectivorous bats (Armstrong, Broken-Brow, *et al.*, 2021; Armstrong, Clarke, *et al.*, 2021) 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:

- undertook a Discriminant Function Analysis on training data from representative calls from bat species in the Pilbara region;
- 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
- facilitated an inspection in a spectrogram of multiple examples of each call type for each recording night by opening the original WAV files containing pulses of interest in Adobe Audition version 23.1.

Species were identified based on information in Armstrong and Coles (2007), McKenzie and Bullen (2009) and Kyle Armstrong's own unpublished material. Nomenclature in the report and data follows Jackson and Groves (2015).

Pilbara leaf-nosed Bat: Echolocation calls are distinctive, having a CF-FM (constant frequency - frequency modulated) structure, and with a characteristic frequency between 117 and 125 kHz (DAWE 2020a). The mean characteristic frequency of the loudest (second) emitted harmonic is 121 kHz in the Pilbara, which is around 6 kHz higher than in the northern distribution of the species. Each pulse consists of a constant frequency tone of c. 8 milliseconds duration, followed by a very brief broadband downwards sweep through

c. 20 kHz (Armstrong and Coles, 2007). It is possible to identify the species unambiguously from good quality echolocation calls.

Ghost Bat: Ghost Bats make several social calls that are audible to humans ('chirps', 'squabbles' and 'twitters' (Kulzer et al., 1984; Guppy, Coles, and Pettigrew, 1985; Pettigrew et al., 1986)). When free flying, echolocation calls are characterised by steep linear frequency modulated pulses at 45-56 kHz, of low intensity and short duration (0.8-2.3 ms) (Guppy, Coles and Pettigrew, 1985). Echolocation calls have up to four harmonics, but most of the strength is in the 2nd or 3rd harmonic (Guppy, Coles, and Pettigrew, 1985). More recently studies (Hanrahan, 2020; Hanrahan *et al.*, 2021) reviewed and revised the social vocalisations of the species as 'chirp-trill', 'squabble' and 'ultrasonic social'.

2.4.3. Fauna Habitat Mapping

Fauna habitat mapping identifies areas of vegetation and land features that are distinguishable from other areas. Typically, each fauna habitat supports a characteristic fauna assemblage that is adapted to the features of the fauna habitat. Fauna habitat types are identified and mapped based on the following information:

- General vegetation type (Department of Primary Industries and Regional Development, 2019);
- Vegetation types mapped within the Survey Area;
- Previous fauna habitat mapping supplied by Fortescue;
- Vegetation structure;
- Landforms;
- Geological units;
- Soil substrate;
- Aerial imagery;
- Fauna assemblage; and
- Field observations.

The fauna habitat was recorded at each fauna site and also opportunistically while traversing the Survey Area.

2.4.4. Habitat Analysis

Fauna habitat mapping enables the categorisation of each survey site into a specific habitat type, and analysis of this data provides insight into how distinct or similar the fauna assemblages in each habitat type are. One method is non-metric multidimensional scaling (non-metric MDS), which is based on a distance matrix computed with a range of distance measures, whereby an algorithm attempts to place the data points in a theoretical two- or three-dimensional coordinate system whilst preserving the ranked differences in terms of their Euclidean distance from others (Oksanen *et al.*, 2022). In this case, the Bray-Curtis similarity algorithm was used because it appropriately quantifies the compositional similarity/dissimilarity between two sites with abundance data.

2.4.5. Survey Adequacy

Survey adequacy can, in part, be assessed by estimating species richness from sample data. Extrapolating Species Accumulation Curves (SACs), fitting parametric models or relative abundance and using non-parametric estimators (Bunge and Fitzpatrick, 1993; Colwell and Coddington, 1994; Gaston, 1996) are three generally accepted methods that achieve this. Rarefaction Curves were used to interpolate and extrapolate the collected species data and graphically illustrate the species richness against the number of individuals encountered (Hsieh, Ma and Chao, 2016). These curves were generated using abundance data and plotted

with a 95% confidence interval. The point where the horizontal asymptote is estimated to be reached, is interpreted to be when no new species are expected to be present.

2.4.6. Significant Fauna Definitions

Significant fauna (Appendix A) can include (EPA, 2016):

- Being identified as a Threatened or Priority species;
- Species with restricted distribution;
- Degree of historical impact from threatening processes; or
- Providing an important function required to maintain the ecological integrity of a significant ecosystem.

2.5. Limitations & Constraints

Survey specific limitations and constraints for the fauna assessment of the Survey Area are discussed in Table 2.12. Overall, the assessment was not subject to any limitations or constraints.

Table 2.12: Survey Limitations & Constraints

Limitation	Constraint	Comment
Availability of the contextual information at a regional and local scale.	No	Database searches provided detailed information, adequate to guide field survey design and effort for the fauna survey. There were multiple assessments conducted within and in the vicinity of the Survey Area and have been included in the desktop assessment.
Competency/experience of the consultant carrying out the survey including experience in bioregion surveyed.	No	Principal Zoologist Astrid Heidrich and Senior Zoologist Erica MacIntyre have suitable knowledge and experience (over 20 years combined) conducting fauna surveys in the Pilbara region of Western Australia.
Timing/weather/season/cycle.	No	The timing of the two-phase field survey was considered appropriate for a fauna survey conducted in the Pilbara region, where the recommended survey timing is post wet (February to April). The first survey was completed in May 2023 with the second season completed in September/October 2023. Rainfall prior to phase 1 of the survey was above the median rainfall leading to optimal survey conditions. Phase 2 also had above the median rainfall prior to survey, however, temperatures during this survey were above the mean with an average temperature of 41°C experienced.
Disturbances (e.g., fire, flood, accidental human intervention) which affected results of survey.	No	No significant disturbances were recorded at the Survey Area that have affected the results of the fauna assessment. A fire prior to phase 1 of the survey limited the unburnt areas to be surveyed, with approximately 79% of the Survey Area impacted by the fire. This may have offset the optimal survey conditions discussed above. Access tracks were also limited, but the use of the helicopter enable access to all areas, in particular patches of unburnt habitats.
Remoteness and/or access problems.	No	No access restrictions were experienced during the survey. The use of helicopter during both phases enabled full access.
Fauna Specific		
Scope (what faunal groups were sampled and were some sampling methods not able to be employed because of constraints such as weather conditions).	No	Sampling techniques were adequate for all vertebrate fauna species. All fauna groups were sampled, and no survey constraints were experienced.
Proportion of fauna identified, recorded, and/or collected.	No	All vertebrate fauna species encountered were identified in the field by experienced zoologists.

Limitation	Constraint	Comment
The proportion of the task achieved and further work which might be needed.	No	All components of a detailed fauna assessment were completed.
Resources (degree of expertise available in animal identification to taxon level).	No	Fauna resources available were adequate and did not compromise the outcome of the survey.
Intensity (in retrospect, was the intensity adequate).	No	A detailed and targeted fauna assessment was adequate to identify faunal assemblages and fauna habitat present, and significant fauna present or likely to be present within the Survey Area. Targeted searches for significant fauna species were completed within areas of suitable habitat.
Completeness (was the relevant area fully surveyed.	No	All major fauna habitat types were sampled and defined. Habitat types that may host significant fauna species were surveyed.

3. RESULTS & DISCUSSION

3.1. Desktop Assessment

To provide regional context for the assessment of the terrestrial fauna values within the Survey Area, a desktop assessment was completed. The desktop assessment identified a total of 352 vertebrate fauna consisting of 46 mammals (including nine introduced), 169 bird, 128 reptile, and nine amphibian species that have previously been recorded in the region (Table 3.1, Appendix C).

The total of 352 vertebrate fauna species recorded from the regions is significantly higher than the results of any single vertebrate fauna survey completed in the region, including the current survey. This is to be expected, as the desktop draws data from a wide range of sources that were collected over different time periods and seasons. There is also a high likelihood that the desktop assessment will include occurrence data from fauna habitat types that are not present within the Survey Area, such as permanent water sources, rocky gorges/gullies, rocky ridgetops and cracking clays. A suitable example of this is the large number of shorebird and other water bird species reported only by NatureMap. NatureMap also has the potential to record vagrant species and those only present in the region during and/or following significant rainfall events and the resource boom that follows. These records may also come via museum collection trips, public specimen collections/ observations, DBCA surveys, and the DBCA Fauna Survey Returns Database, which includes data from private sources.

The data reported by NatureMap, the DBCA Threatened Fauna Database, Protected Matters Search Tool as well as previous survey reports provide a useful indication of regional vertebrate fauna assemblages. Whilst many species recorded during the desktop assessment have the potential to occur in the Survey Area, the fauna assemblage that typically uses the habitats found within the Survey Area forms a much smaller subset of species. Variations in population distributions and the availability of microhabitats within each area also limit the species that may occur. However, the accumulated data provided by the desktop assessment is invaluable during survey planning to ensure all major fauna assemblages are sampled, and any significant species that may occur are targeted appropriately.

Table 3.1: Total Vertebrate Fauna Species Previously Recorded in the Region

Data Source	Mammals (Native/Introduced)	Birds	Reptiles	Amphibians	Total Vertebrates
Survey Reports					
Fortescue Fauna Monitoring 2019-2023 (Spectrum, 2020, 2021, 2022, 2023a, 2023b)	15/6	22	13	-	56
North Star Junction Renewable Energy Infrastructure Project Vertebrate Fauna (360, 2023)	12/4	37	53	3	109
North Star Junction Flora and Fauna Assessments (Ecoscape, 2021)	9/2	20	7	-	38
North Star Project Level 2 Vertebrate Fauna (ecologia, 2012a)	20/3	80	68	6	177
North Star Access Corridor Flora, Vegetation & Vertebrate Fauna (ecologia, 2012b)	2/4	38	7	-	51
North Star Aerodrome Flora & Fauna (ecologia, 2015c)	5/1	18	12	-	36
North Star Filtration Plan Relocation Flora & Fauna (ecologia, 2014c)	6/3	28	4	-	41
Targeted Fauna Assessment of the Rail Duplication (Bamford, 2010)	5/0	25	2	-	32
Fortescue Stage A Rail (Biota, 2004)	18/6	84	56	6	170
Wodgina Lithium Project: Level 2 Vertebrate Fauna (WW, 2020)	21/4	75	57	5	162
Pippingarra and Wodgina Roads Flora & Fauna (Ecoscape, 2020b)	9/2	29	4	-	44
Wodgina Project: Level 1 & Targeted Fauna (Stantec, 2018)	16/4	33	4	-	57
Wodgina Hercules Project: Terrestrial Fauna (Outback, 2012)	11/1	39	32	3	86
Wodgina DSO Project: Terrestrial Fauna (Outback, 2009)	17/2	46	24	2	91
Wodgina DSO Project: Northern Quoll Annual Monitoring (Baseline Survey) (Outback, 2010)	2/0	-	8	-	10
Pilgangoora Baseline Vertebrate Fauna (360, 2016)	3/0	27	30	-	60
E45/2287 Infill Pilgangoora Project Flora & Fauna (APM, 2023)	4/2	9	9	1	25
P1000 Pilgangoora Project Flora & Fauna (APM, 2024)	3/2	6	12	1	24
Glacier Valley and South Star Fauna Surveys (GHD, 2020)	13/3	70	28	3	117
Glacier Valley Terrestrial Vertebrate Fauna (Spectrum, 2021b)	11/3	37	32	1	84
Abydos DSO Project: Terrestrial Vertebrate Fauna (Outback, 2011b)	15/3	38	41	3	100
Mt Dove DSO Project: Northern Quoll Monitoring (MWH, 2015)	4/3	2	4	-	13
Mt Dove DSO Project: Vertebrate Fauna (Outback, 2011c)	17/6	40	29	1	93
Panorama Project Area: Baseline Fauna (Bamford, 2001)	18/5	79	28	2	132
Public Databases					
EPBC Act Protected Matters (PMST)	4/0	12	1	-	17
DBCA Threatened Fauna Database	9/0	8	2	-	19
NatureMap	35/8	139	99	9	290
Atlas of Living Australia	25/6	142	85	7	265
Fortescue Internal Database	9/0	11	2	-	22
Total Species	**37/9**	**169**	**128**	**9**	**352**

Note: Surveys containing less than 10 species or desktop assessments have been omitted from this table, see Appendix C for further details.

3.1.1.1. Significant Fauna

The desktop assessment identified 28 species of significance (nine mammals, 16 birds and three reptiles) as potentially occurring at the Survey Area based on the database search results (DBCA Threatened Fauna, Fortescue's database, ALA, NatureMap and PMST). Six species have previously been recorded in the Survey Area (Table 3.2):

- Northern Quoll (*Dasyurus hallucatus*, EPBC Act & BC Act Endangered (EN));
- Bilby (*Macrotis lagotis;* EPBC Act & BC Act Vulnerable (VU)) – secondary evidence;
- Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia* Pilbara form; EPBC Act & BC Act VU);
- Ghost Bat (*Macroderma gigas*, EPBC Act & BC Act VU);
- Brush-tailed Mulgara (*Dasycercus blythi*, DBCA Priority 4 (P4)); and
- Western Pebble-mound Mouse (*Pseudomys chapmani*; DBCA P4).

In addition, the Grey Falcon (*Falco hypoleucos;* EPBC Act & BC Act Vulnerable) was previously recorded less than 300 m from the Survey Area.

The DBCA Threatened Fauna Database search results and PMST included records of species that have been excluded from the report as per the below details:

- Great Desert Skink (*Liopholis kintorei;* EPBC Act & BC Act Vulnerable) no known Pilbara distribution;
- Four Migratory species have been deemed unlikely to occur far from the coastline and thus outside the Survey Area:
    - Far Eastern Curlew (*Numenius madagascariensis*, EPBC Act & BC Act Critically Endangered);
    - Barn Swallow (*Hirundo rustica*, EPBC Act & BC Act Migratory);
    - Grey Wagtail (*Motacilla cinerea*, EPBC Act & BC Act Migratory); and
    - Eastern Yellow Wagtail (*Motacilla tschutschensis (flava*), EPBC Act & BC Act Migratory).
- Northern Leaf-nosed Bat (*Hipposideros stenotis*, DBCA Priority 2), no known Pilbara distribution; and
- Spotted Ctenotus *(Ctenotus uber johnstonei;* DBCA Priority 2): single record, however this subspecies is not currently known to occur in the Pilbara region.

The locations of the DBCA Threatened Database and the Fortescue Internal Database (FID) search results are shown on Map 3.1.

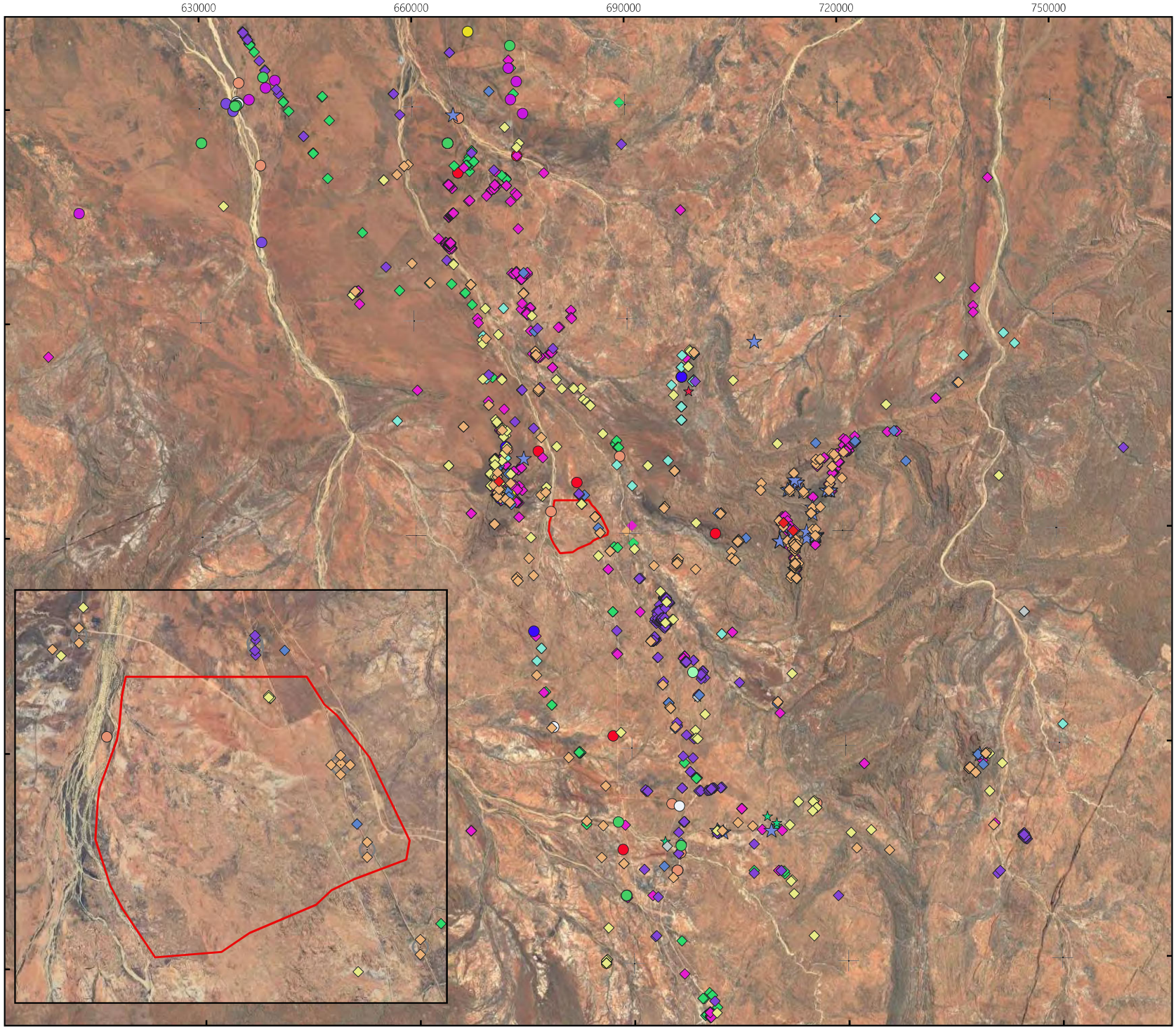
Table 3.2: Significant Fauna Potentially Occurring at the Survey Area

Species	Conservation Status			Database Record				No. Surveys Recorded	Previously Recorded in Survey Area
	EPBC Act	BC Act	DBCA	PMST	DBCA	NatureMap	FID*		
Mammals									
Northern Quoll *Dasyurus hallucatus*	EN	EN	-	✓	✓	✓	✓	18	Y
Bilby *Macrotis lagotis*	VU	VU	-	✓	✓	✓	✓	9	Y
Pilbara Leaf-nosed Bat *Rhinonicteris aurantia* Pilbara form	VU	VU	-	✓	✓	-	✓	18	Y
Ghost Bat *Macroderma gigas*	VU	VU	-	✓	✓	✓	✓	10	Y
Long-tailed Dunnart *Antechinomys longicaudatus*	-	-	P4	-	✓	-	✓	3	N
Brush-tailed Mulgara *Dasycercus blythi*	-	-	P4	-	✓	✓	✓	10	Y
Spectacled Hare-wallaby *Lagorchestes conspicillatus leichardti*	-	-	P4	-	✓	✓	✓	2	N
Short-tailed Mouse *Leggadina lakedownensis*	-	-	P4	-	✓	✓	-	1	N
Western Pebble-mound Mouse *Pseudomys chapmani*	-	-	P4	-	✓	✓	✓	16	Y
Birds									
Curlew Sandpiper *Calidris ferruginea*	CR, MI	CR	-	✓	-	-	-	-	N
Night Parrot *Pezoporus occidentalis*	EN	CR	-	✓	PA	-	-	-	N

Species	Conservation Status			Database Record				No. Surveys Recorded	Previously Recorded in Survey Area
	EPBC Act	BC Act	DBCA	PMST	DBCA	NatureMap	FID*		
Australian Painted Snipe *Rostratula benghalensis australis*	EN	EN	-	✓	-	-	-	-	N
Red Goshawk *Erythrotriorchis radiatus*	VU	VU	-	✓	-	-	-	-	N
Grey Falcon *Falco hypoleucos*	VU	VU	-	✓	✓	✓	✓	4	N
Pacific Swift *Apus pacificus*	MI	MI	-	✓	✓	✓	✓	3	N
Oriental Plover *Charadrius veredus*	MI	MI	-	✓	✓	✓	-	1	N
Sharp-tailed Sandpiper *Calidris acuminata*	MI	MI	-	✓	✓	✓	-	-	N
Red-necked Stint *Calidris ruficollis*	MI	MI	-	-	✓	✓#		-	N
Pectoral Sandpiper *Calidris melanotos*	MI	MI	-	✓	-	-	-	-	N
Common Sandpiper *Tringa hypoleucos*	MI	MI	-	✓	✓	✓	✓	2	N
Wood Sandpiper *Tringa glareola*	MI	MI	-	-	✓	✓	✓	2	N
Common Greenshank *Tringa nebularia*	MI	MI	-	-	✓	✓	-	1	N
Oriental Pratincole *Glareola maldivarum*	MI	MI	-	✓	✓	✓	-	1	N

Species	Conservation Status			Database Record				No. Surveys Recorded	Previously Recorded in Survey Area
	EPBC Act	BC Act	DBCA	PMST	DBCA	NatureMap	FID*		
Osprey *Pandion haliaetus cristatus*	MI	MI	-	-	✓	-	-	-	N
Peregrine Falcon *Falco peregrinus*	OS	OS	-	-	✓	✓	✓	4	N
Reptiles									
Pilbara Olive Python *Liasis olivaceus barroni*	VU	VU	-	✓	✓	✓	✓	8	N
Pin-striped Finesnout Ctenotus *Ctenotus nigrilineatus*	-	-	P1	-	✓	✓	-	-	N
Gane's Blind Snake *Anilios ganei*	-	-	P1	-	✓	✓	✓	-	N

Notes: * - FID = Fortescue Internal Database, PA: within Night Parrot Priority Area; # - from ALA



Legend

Survey Area

Mammals
- Bilby
- Ghost Bat
- Long-tailed Dunnart
- Brush-tailed Mulgara
- Northern Quoll
- Short-tailed Mouse
- Pilbara Leaf-nosed Bat
- Spectacled Hare-wallaby
- Western Pebble-mound Mouse

Birds
- Common Greenshank
- Common Sandpiper
- Pacific Swift
- Grey Falcon
- Oriental Plover
- Oriental Pratincole
- Osprey
- Peregrine Falcon
- Red-necked Stint
- Sharp-tailed Sandpiper
- Wood Sandpiper

Reptiles
- Gane's blind Snake
- Pilbara Olive Python
- Pin-striped Finesnout Ctenotus

N

0 5 10 15 20 25 km

Scale 1:800,000 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum

[redacted]

Date: 02-02-2024

DBCA Threatened Fauna Database Results

NSJW Project

MAP

Prepared for Fortescue

3.1

3.2. Fauna Habitat Types

A total of five broad fauna habitat types were recorded from the Survey Area. The habitat types, including both the Spectrum and Fortescue naming conventions and their extents, are outlined in Table 3.3.

Table 3.3: Broad Fauna Habitat Types and Extents in the Survey Area

Spectrum Habitat Type	Fortescue Habitat Type	Extent in Survey Area (ha)	% of Survey Area
Spinifex Sand Plain	Plain (sand)	4,147.9	91.5
Spinifex Rocky Plain	Plain (stony/gibber)	3.4	0.1
Major Drainage Line	Drainage Line/River/Creek (major)	43.5	1.0
Minor Drainage Line	Drainage Line/River/Creek (minor)	61.2	1.4
Granite Domes and Boulder Piles	Granite Outcrops (boulder piles)	121.1	2.7
Cleared/Disturbed	Cleared	155.8	3.4
	Total	**4,532.9**	**100**

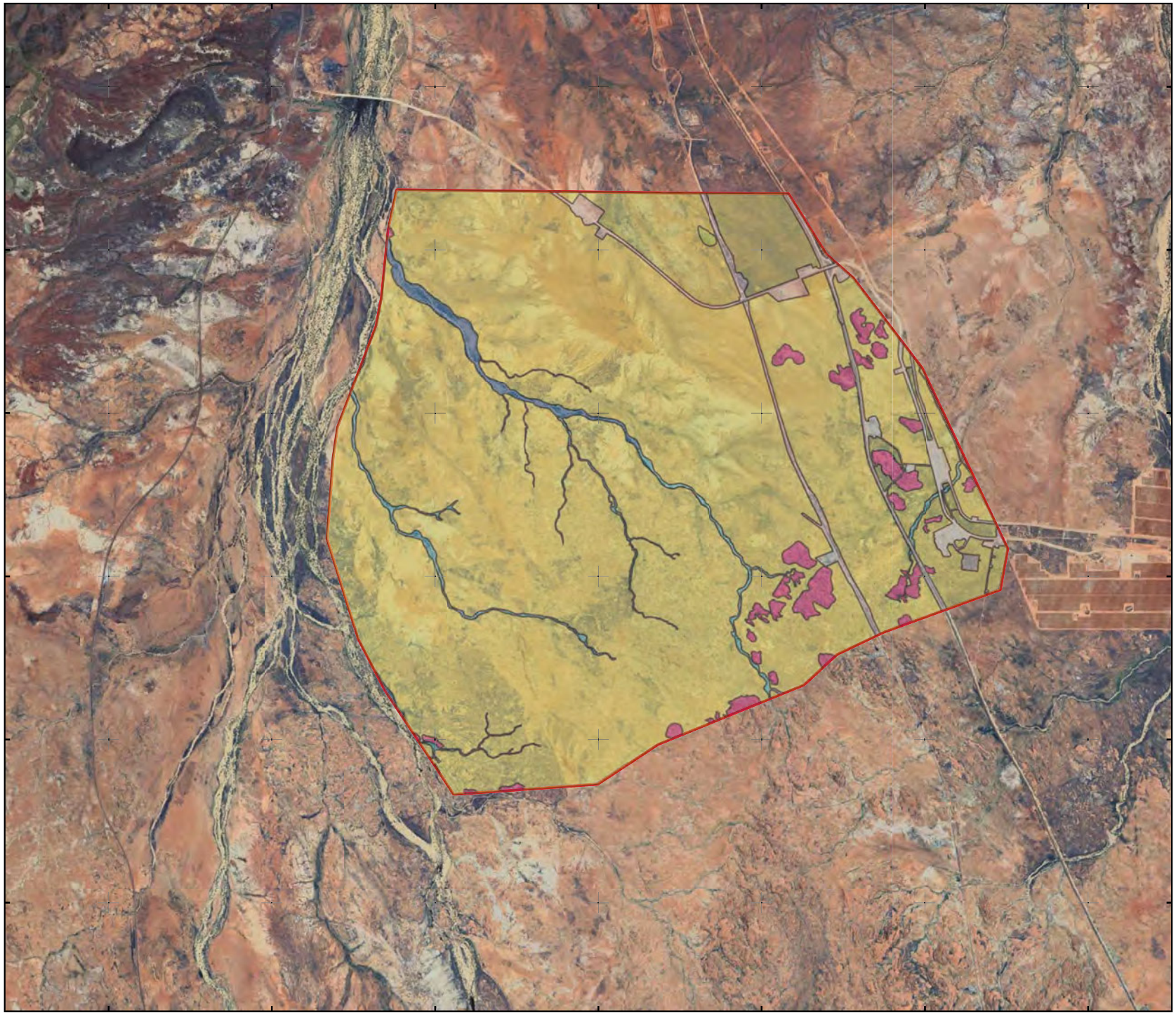
The most common fauna habitat at the Survey Area is the Spinifex Sand Plain habitat (91.5%). The remaining four habitat types (Granite Domes and Boulder Piles, Major and Minor Drainage Lines and Spinifex Rocky Plain), occupy less than 3% of the Survey Area (Table 3.3). The Spinifex Rocky Plain habitat has been distinguished from the surrounding Spinifex Sand Plain due to the accumulation of ironstone pebbles and the presence of the Western Pebble-mound Mouse mounds. The habitat types in the Survey Area also occur in the surrounding region, so they are not restricted to this area. A brief description and potential fauna assemblage (including possible significant fauna) are listed in Table 3.4 and displayed on Map 3.2. Cleared and disturbed areas, covering 155.8 ha (3.4% of the Survey Area), offer no fauna value and have been excluded from Table 3.4.

Table 3.4 Fauna Habitat Types at the Survey Area

Habitat Type (Fortescue Habitat Type)	Habitat Description	Habitat Photo	Potential Faunal Group	Potential Species (Examples)
Spinifex Sand Plain (Plain (sand))	Widespread, flat sand plains consisting of varied substrate with mostly sand, or sandy-loam with some patches of quartz or granitic stones and low granitic outcropping scattered throughout. Vegetation consists of sparse *Corymbia hamersleyana over Acacia orthocarpa* and *A. ancistrocarpa* over patches of *A. stellaticeps* over *Triodia epactia* and *T. lanigera* low hummock grasses. Isolated patches of *Corymbia hamersleyana* scattered trees over *Acacia acradenia* over *Triodia schinzii* low hummock grasses occur in some areas associated with the patches of calcrete and quartz stones. Some small patches were recorded that comprised sparse vegetation on clay, however the small size of the area is unlikely to support a distinct fauna assemblage. Leaf and wood litter sparse, and generally restricted to underneath vegetation. Fauna microhabitats: *Triodia* hummocks, *Corymbia* trees (flowers, leaf litter & bark), shrubs, and substrate for burrowing.		Mammals	Desert Mouse (*Pseudomys desertor*), Sandy Inland Mouse (*Pseudomys hermannsburgensis*), Delicate Mouse (*Pseudomys delicatulus*).
			Birds	Painted Finch (*Emblema pictum*), Nankeen Kestrel (*Falco cenchroides*), Whistling Kite (*Haliastur sphenurus*), Little Buttonquail (*Turnix velox*), Australian Bustard (*Ardeotis australis*).
			Herpetofauna	Smooth Knob-tailed Gecko (*Nephrurus levis*), North-western Sandslider (*Lerista bipes*), Narrow-banded Shovel-nosed Snake (*Brachyurophis fasciolatus*), Sand Goanna (*Varanus gouldii*), Pygmy Desert Goanna (*Varanus eremius*).
			Significant	Bilby (*Macrotis lagotis*), Brush-tailed Mulgara (*Dasycercus blythi*), Spectacled Hare-wallaby (*Lagorchestes conspicillatus*), Night Parrot (*Pezoporus occidentalis*) – in proximity to Samphire only, Grey Falcon (*Falco hypoleucos*), Ghost Bat (*Macroderma gigas*), Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia* Pilbara form; lowest Priority), Oriental Plover (*Charadrius veredus*) – bare patches only.
Spinifex Rocky Plain (Plain (stony/gibber))	A small area of flat plain with abundant ironstone stones/pebbles and some quartz. Vegetation consists of *Corymbia hamersleyana*, over *Acacia acradenia*, over *Triodia schinzii* low hummock grasses. Leaf and wood litter generally sparse and restricted to underneath vegetation on loamy clay. Fauna microhabitats: *Triodia* hummocks, *Corymbia* trees (flowers, leaf litter & bark), shrubs, and substrate for burrowing.		Mammals	Pilbara Ningaui (*Ningaui timealeyi*) & Euro (*Osphranter robustus*)
			Birds	Spinifex Pigeon (*Geophaps plumifera*), Little Buttonquail (*Turnix velox*), Weebill (*Smicrornis brevirostris*), Brown Falcon (*Falco berigora*), Whistling Kite (*Haliastur sphenurus*), Pilbara Death Adder (*Acanthophis wellsi*).
			Herpetofauna	Rock Ctenotus (*Ctenotus saxatilis*), Western Ring-tailed Dragon (*Ctenophorus caudicinctus*), Short-tailed Pygmy Monitor (*Varanus brevicauda*), Moon Snake (*Furina ornata*), Southern Phasmid Gecko (*Strophurus jeanae*), Pilbara Ground Gecko (*Lucasium wombeyi*), Pilbara Death Adder (*Acanthophis wellsi*).
			Significant	Western Pebble-mound Mouse (*Pseudomys chapmani*), Night Parrot (*Pezoporus occidentalis*) – in proximity to Samphire only, Grey Falcon (*Falco hypoleucos*), occasionally Ghost Bat (*Macroderma gigas*)

Habitat Type (Fortescue Habitat Type)	Habitat Description	Habitat Photo	Potential Faunal Group	Potential Species (Examples)
Major Drainage Line (Drainage Line/River/Creek (major))	Wide drainage lines with large eucalypts, and sandy, gravel or small creek stone substrate that may fill intermittently during the wet season or during flooding events, or create pools that retain water sporadically. This habitat also includes the immediately adjacent low-lying drainage areas which are predominately sandy or may occasionally contain granite domes or outcropping. These areas typically feature denser vegetation and may be sporadically inundated during heavy rainfall events . The vegetation within the drainage line consists of *Eucalyptus camaldulensis* with scattered *Corymbia hamersleyana* over *Acacia trachycarpa* and *A. tumida* over Buffel grass **Cenchrus ciliaris* and *Triodia epactia* and *T. longiceps*. hummock grasses. The surrounding drainage areas include various *Acacia* species such as *A. trachycarpa* and *A. stellaticeps* over hummock grasses. Leaf Fauna microhabitats: Eucalypt trees (flowers, tree hollows, bark, leaf litter), sandy substrate for digging, woody debris, pools of surface water, sandbanks for construction of burrows and tunnels, increased moisture levels.	 	Mammals	Brushtail Possum (*Trichosurus vulpecula*), Sandy Inland Mouse (*Pseudomys hermannsburgensis*), Various bat species.
			Birds	Blue-winged Kookaburra (*Dacelo leachii*), Collared Sparrowhawk (*Accipiter cirrocephalus*), Pheasant Coucal (*Centropus phasianinus*), Sacred Kingfisher (*Todiramphus sanctus*), White-plumed Honeyeater (*Ptilotula penicillata*). Inland Dotterel (*Peltohyas australis*), Grey Teal (*Anas gracilis*) when inundated.
			Herpetofauna	Pilbara Toadlet (*Uperoleia saxatilis*), Little Red Tree Frog (*Litoria rubella*), Long-nosed Dragon (*Gowidon longirostris*), Shaded-litter Rainbow-skink (*Carlia munda*), Monk Snake (*Parasuta monachus*), Flat-shelled Turtle (*Chelodina steindachneri*).
			Significant	Northern Quoll (*Dasycercus hallucatus*), Pilbara Olive Python (*Liasis olivaceus barroni*), Bilby (*Macrotis lagotis*), Ghost Bat (*Macroderma gigas*), Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia* Pilbara Form), Grey Falcon (*Falco hypoleucos*), Peregrine Falcon (*Falco peregrinus).* When inundated: Common Greenshank (*Tringa nebularia*), Common Sandpiper (*Actitis hypoleucos*), Wood Sandpiper (*Tringa glareola*), Oriental Pratincole (*Glareola maldivarum*), occasionally Osprey (*Pandion haliaetus cristatus*).
Minor Drainage Line (Drainage Line/River/Creek (minor))	Narrow drainage lines dominated by shrubs and a sandy substrate that fills intermittently during the wet season or from flooding events. Occasional pools of water may be retained after large rainfall events. This habitat also includes the immediately adjoining areas of low-lying drainage areas which are predominately sandy or may occasionally contain some granite domes or outcropping. These areas are generally more densely vegetated and may be intermittently flooded during significant rainfall events. The vegetation is characterised by *Acacia* species, such as *A. trachycarpa* and *Acacia tumida* over *Triodia epactia* and *Triodia longiceps* low hummock grasses over mixed herbs and tussock grasses. Some leaf and wood litter present. Fauna microhabitats: woody debris, sandbanks for construction of burrows and tunnels, and intermittent pools of water.		Mammals	Delicate Mouse (*Pseudomys delicatulus*), Sandy Inland Mouse (*Pseudomys hermannsburgensis*), Desert Mouse (*Pseudomys desertor*).
			Birds	Willie Wagtail (*Rhipidura leucophrys*), Chestnut-rumped Thornbill (*Acanthiza uropygialis*), Grey-crowned Babbler (*Pomatostomus temporalis*), White-winged Triller (*Lalage tricolor*), Crested Bellbird (*Oreoica gutturalis*), Brown Honeyeater (*Lichmera indistincta*).
			Herpetofauna	Long-nosed Dragon (*Gowidon longirostris*), Sharp-snouted Delma (*Delma nasuta*), North-western Shovel-nosed Snake (*Brachyurophis approximans*), Common Dwarf Skink (*Menetia greyii*), Variegated Gehyra (*Gehyra variegata*).
			Significant	Northern Quoll (*Dasycercus hallucatus*), Pilbara Olive Python (*Liasis olivaceus barroni*), Bilby (*Macrotis lagotis*), Brush-tailed Mulgara (*Dasycercus blythi*), Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia* Pilbara Form), Ghost Bat (*Macroderma gigas*), Grey Falcon (*Falco hypoleucos*), Peregrine Falcon (*Falco peregrinus).*

Habitat Type (Fortescue Habitat Type)	Habitat Description	Habitat Photo	Potential Faunal Group	Potential Species (Examples)
				When inundated: Common Greenshank (*Tringa nebularia*), Common Sandpiper (*Actitis hypoleucos*), Wood Sandpiper (*Tringa glareola*).
Granite Domes and Boulder Piles (Granite Outcrops (boulder piles))	This habitat is dominated by large, exposed granitic formations, including boulder piles and domes. These granitic formations rise prominently in the landscape, shaped by billions of years of extensive erosion. A sandy substrate occurs between granite piles and domes with very sparse leaf and wood litter. The vegetation is sparse due to the lack of substrate, with *Terminalia circumalata* over *Acacia eriopoda* and *A. tumida* over *Triodia epactia* hummocks. Fauna microhabitats: Cracks and crevices, small caves, overhangs, underside of rocks.		Mammals	Rothschild's Rock Wallaby (*Petrogale rothschildi*), Rock Rat (*Zyzomys argurus*).
			Birds	Willie Wagtail (*Rhipidura leucophrys*), Nankeen Kestrel *(Falco cenchroides*), Brown Falcon (*Falco berigora*), Spinifex Pigeon (*Geophaps plumifera*), Painted Finch (*Emblema pictum*).
			Herpetofauna	Northern Pilbara Rock Monitor (*Varanus pilbarensis*).
			Significant	Northern Quoll (*Dasycercus hallucatus*), Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia* Pilbara Form), Ghost Bat (*Macroderma gigas*), Pilbara Olive Python (*Liasis olivaceus barroni*).



Legend

Survey Area

Fauna Habitats
(Fortescue name in brackets)

- Spinifex Sand Plain (Plain (sand))
- Spinifex Rocky Plain (Plain (stony/gibber))
- Major Drainage Line (Drainage Line/River/Creek (major))
- Minor Drainage Line (Drainage Line/River/Creek (minor))
- Granite Domes & Boulder Piles (Granite Outcrops (boulder piles))
- Cleared/Disturbed (Cleared)

N

0 0.5 1 1.5 2 km

Scale 1:65,000 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum Geology + Spatial

Date: 07-06-2024

Preliminary Fauna Habitats

NSJW Project

MAP 3.2

Prepared for Fortescue

3.2.1. Habitat Analysis

Fauna habitats were analysed in terms non-metric MDS scatter plots, separately for vertebrate fauna species caught in trapping grids and for systematically sampled bird species. In Figure 3.1 and Figure 3.2, the three systematic trapping sites installed in Spinifex Sand Plain (NS01, NS02 and NS03) appear to differ from each other when considering the trappable fauna. This is likely due to the extensive fire that burnt through 79% of the Survey Area (section 1.7) in 2022. This fire impacted site NS03, while NS01 and NS02 were not burnt. Site NS01 was located in the vicinity of Granitic Domes and Boulder Piles and a Minor Drainage Line, which may have influenced the assemblage data. The bird assemblage data indicates that sites NS01 and NS03 were similar and that site NS02 was more like the Major Drainage Line habitat (site NS04, Figure 3.2). Both sites were in fact dominated by tall shrubs and an abundance of *Corymbia hamersleyana* trees, with NS04 including a densely regenerating shrub layer post fire, while NS02 was the most densely unburnt vegetated site. The other two Sand Plain sites were both lacking upper strata of vegetation. NS01 was located in dense spinifex grassland with a lower shrubland dominated by *Acacia stellaticeps*, whereas site NS03 was characterised by open and recently burnt vegetation.

The Minor Drainage Line habitat (site NS05) was distinctly different in both, avian and trappable fauna (Figure 3.1, Figure 3.2).

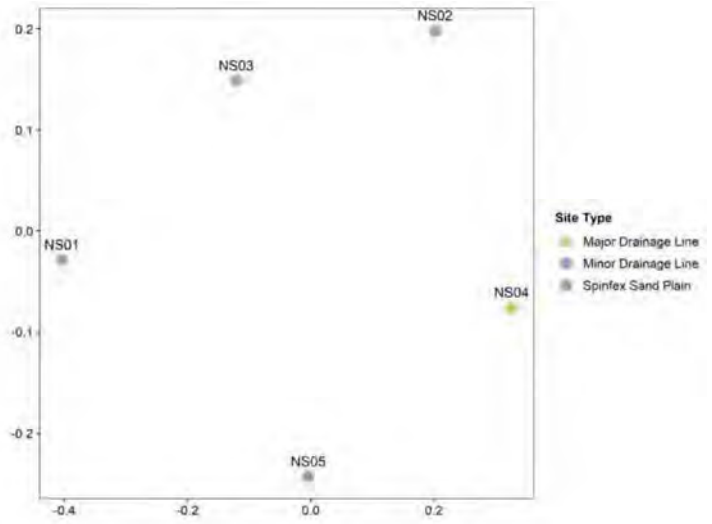


Figure 3.1: Non-metric MDS Scatter Plot of Trapping Grid Vertebrate Fauna Data

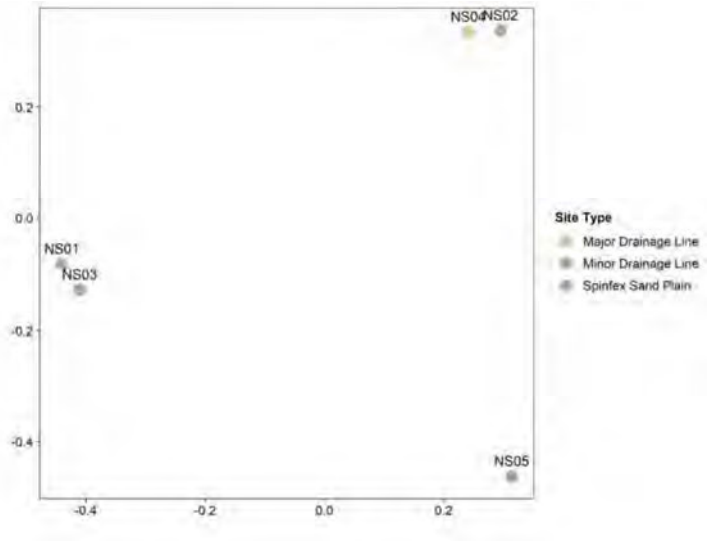


Figure 3.2: Non-metric MDS Scatter Plot of Systematic Bird Survey Data

3.3. Vertebrate Fauna

A total of 123 vertebrate fauna species were recorded during the two phases of surveying: 12 species of native non-volant mammals, eight (or nine due to ambiguous calls) species of bats, five introduced mammals, 54 bird species, 42 reptiles and two amphibians (Appendix D).

The number of mammal species recorded was similar across both survey phases. This consistency suggests that mammal activity was less influenced by the seasonal or environmental differences between the two survey periods.

Bird activity was higher in Phase 1, with 49 species recorded compared to 34 in Phase 2. Notably, 18 bird species, including four birds of prey, were observed exclusively during Phase 1. This increased activity is likely due to Phase 1 being conducted shortly after the wet season, coinciding with peak flowering. Above-median rainfall during this time likely enhanced food resources, attracting more species (section 2.2.2). Conversely, Phase 2 was conducted post dry season, outside the typical flowering period for most plants. Unseasonably high temperatures during Phase 2 may have further reduced bird presence. Additionally, the 2022 fire, which burned 79% of the Survey Area, likely impacted bird diversity by reducing flowering plants and microhabitats.

Reptile activity showed an opposite trend, with 40 species recorded in Phase 2 compared to 23 species in Phase 1. The higher temperatures during Phase 2 likely contributed to this increase, as reptiles are more active in warmer conditions (section 2.2.2). In contrast, the cooler temperatures experienced during Phase 1, conducted just after the wet season, may have limited reptile activity.

Amphibians showed a slight increase in Phase 2, with two species recorded compared to one species in Phase 1. This increase is likely linked to unusual winter rainfall within three months of the Phase 2 survey (June 2023, section 2.2.2). Such rainfall can activate estivating species, like burrowing frogs.

Overall, the above-median rainfall prior to both survey phases created favourable conditions for many fauna groups by enhancing food resources, such as seeds and flowering plants, and stimulating breeding activity. These conditions likely benefited amphibians, birds, and mammals, particularly seed-eating birds and nomadic species. However, the positive effects of the rainfall may have been offset by the 2022 fire, which significantly reduced habitat availability. Additionally, the hot temperatures during Phase 2 may have further mitigated the benefits of the increased rainfall. Weather data from the Marble Bar station (#4106), presented in Figure 2.2, highlight these seasonal variations.

3.3.1. Survey Adequacy

Analyses of both the vertebrate trapping grid and bird data produced Rarefaction Curves which approached the horizontal asymptote. The graphs below display two data sets, trappable fauna at systematic trapping sites and bird census at systematic sites (Figure 3.3). A comparison of these two curves shows that approximately 80 % of the estimated total number of combined mammal, reptile, and amphibian species and 78 % of the potential bird species were recorded (Figure 3.3). The estimators indicate that with further trapping effort an additional 12 trappable species (mammal, reptile or amphibian species) and another 13 bird species may have been detected (estimator = 57 birds and 61 trappable fauna). After adding the opportunistic observations made during the survey, a total of 54 birds were recorded which represents 96 % of the species estimated to occur. Opportunistic observations (including motion cameras) also recorded an additional 12 species of native mammal (total of 58 species) which represents 95 % of the estimated number of species present at the Survey Area.

It is important to consider the influence of the survey methods on the data collected, as all methods have inherent biases that can favour the detection of certain species over others. Some species are more easily

trapped, while others are considered trap-shy and rarely captured, if at all. Additionally, other species may be too large to fit into traps, easily escape or be temporarily absent from a site due to their irruptive, migratory or nomadic nature. Species distributions might be scattered within suitable habitats and may be influenced by the resources present during the survey period. The large fire that impacted the Survey Area in 2022, may have negatively impacted the fauna assemblage.

Therefore, the results from the surveys are considered to be an adequate representation of the fauna present.

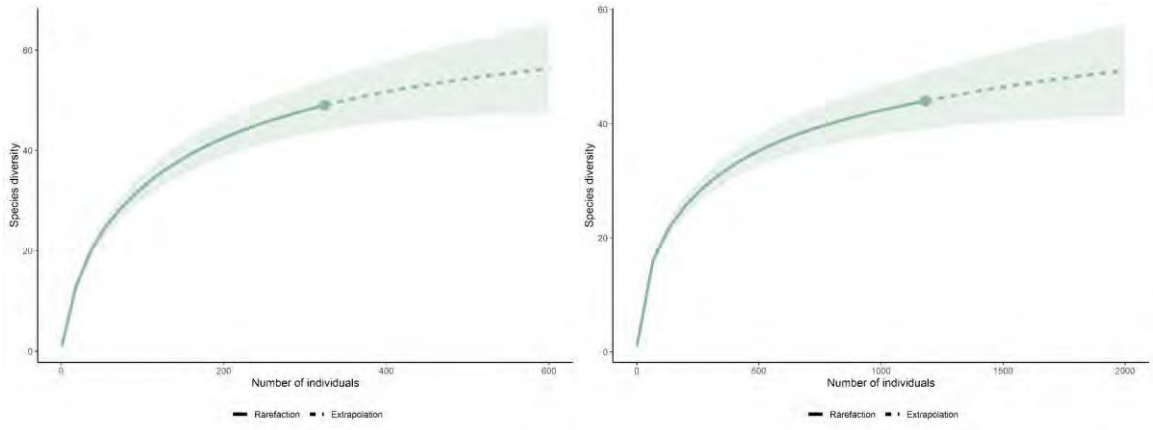


Figure 3.3: Rarefaction Curves for Mammal, Reptile & Amphibian (Left) and Birds (Right)

3.4. Significant Vertebrate Fauna

The literature review, database searches and survey results indicate that 28 species of significant vertebrate fauna have the potential to occur in the Survey Area or surrounding region: nine mammals, 16 bird species, three reptile species (see Table 3.2 and Table 3.5). The seven species that have been recorded within the Survey Area or immediate surrounding vicinity (<300 m) during previous and/or current surveys include six mammals (four non-volant and two bat species), and one bird species (3.1.1.1, Table 3.2). A further seven species (one mammal, four birds, two reptiles) were assessed to have a medium to high likelihood of occurrence based on previous regional records and the habitat types present within the Survey Area. The remaining 14 species have a low to very low likelihood to occur (based on the criteria listed in section 2.1.3).

Six species of significance were recorded from the Survey Area from both phases of this survey and include:

- Northern Quoll (*Dasyurus hallucatus*):
- Bilby (*Macrotis lagotis)*;
- Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia* Pilbara Form);
- Brush-tailed Mulgara (*Dasycercus blythi*);
- Western Pebble-mound Mouse (*Pseudomys chapmani*); and
- Grey Falcon (*Falco hypoleucos*).

All the species are listed in Table 3.5, while recorded species and those with a medium to high likelihood of occurrence are discussed in further detail in the following sections 3.4.1 to 3.4.3.

Table 3.5: Significant Fauna Species Likely to Occur

Species	Conservation Status			Preferred Habitats	Previous Records	Likelihood of Occurrence
	EPBC Act	BC Act	DBCA			
Mammals						
Northern Quoll *Dasyurus hallucatus*	EN	EN		Most common on dissected rocky escarpments, gorges and boulder piles. Typically prefers rocky areas with suitable denning sites and access to surface water. Major drainage lines and treed creek lines may be used for movement and dispersal (Department of the Environment, 2016).	Numerous DBCA database (225) records from 2009-2018 within 10 km of the Survey Area. The majority of these records are from Wodgina to the west, within rocky escarpments and gorges. Other records located to the north and south of the Survey Area are from granite outcropping and drainage lines. Numerous other records exist at Iron Bridge/North Star to the east, in rocky escarpments and gorges.	**Recorded** This species was recorded during both phases of the survey (trapping and motion camera). Suitable habitat is present for this species and numerous records exist near the Survey Area. **Critical habitat:** Granite Domes and Boulder Piles **Supporting habitat:** Major Drainage Line & Minor Drainage Lines
Bilby *Macrotis lagotis*	VU	VU		A variety of habitats with suitable soil substrates and plant species that are fed on directly or host insect larvae. Habitats can include spinifex hummock grassland, acacia shrubland, open woodland and cracking clays (Dziminski and Carpenter, 2016, 2018).	Fortescue's internal database returned one record from within the Survey Area from 2009 from secondary evidence, and two additional records are less than 100 m outside, from 2019 and 2021. Four recent records from 2013 (DBCA) are located 1 km to the north of the Survey Area. Numerous other records exist to the north and south of the Survey Area in suitable sandy plain habitat. Most records are from secondary evidence such as tracks, scats, and diggings.	**Recorded** This species was recorded during both phases of the survey (trapping, motion camera and confirmed secondary evidence). Suitable habitat exists with numerous other records in the vicinity. **Critical habitat:** Spinifex Sand Plain, Major Drainage Line & Minor Drainage Line **Supporting habitat:** Spinifex Rocky Plain and sandy patches of Granite Domes and Boulder Piles only in the vicinity of critical habitat.

Species	Conservation Status			Preferred Habitats	Previous Records	Likelihood of Occurrence
	EPBC Act	BC Act	DBCA			
Pilbara Leaf-nosed Bat *Rhinonicteris aurantia* Pilbara form	VU	VU		Dissected rocky escarpments with suitable roost caves with high humidity (85 - 100% RH) and stable temperatures (28 - 32°C). Forages in a variety of habitats, particularly along water bodies and riparian vegetation (Armstrong, 2001a; Cramer *et al.*, 2016).	Previously recorded in 2013-2014, 2016 and 2019 in the Survey Area from Fortescue's fauna monitoring program. Numerous other recent records located to the west at Wodgina and at Iron Bridge to the east, with both sites containing preferred rocky escarpment habitat. Both areas contain known roost sites.	**Recorded** The Pilbara Leaf-nosed Bat was previously recorded within the Survey Area. In addition, this species was recorded at 7 sites during the current survey. None of these records were close to sunset/sunrise, indicating there are no roosts nearby. Suitable foraging habitat exists. **Critical habitat:** N/A **Supporting habitat:** Granite Domes and Boulder Piles, Major & Minor Drainage Line.
Ghost Bat *Macroderma gigas*	VU	VU		A variety of habitats including caves, rock piles and abandoned mines may be utilised as transient roosts. Maternity/ breeding roosts require dark, warm and humid (>80% RH) microclimates (Armstrong and Anstee, 2000). Will travel up to 2 km from a roost to hunt and will utilise other structures such as culverts, rock overhangs and trees for feeding roosts (Tidemann *et al.*, 1985).	One record from 2014 occurs within the Survey Area, with one additional record located <1 km north. Numerous recent records to the west at Wodgina and further records to the east at Iron Bridge, with both areas containing known roost sites and preferred rocky escarpment habitat.	**Recorded** One previous record in the Survey Area. No suitable roosts were recorded during the survey. This species likely uses the Survey Area for foraging only, with potential use of Granite Domes and Boulder Piles habitat and/or culverts as intermittent transient roosts. **Critical habitat:** N/A **Supporting habitat:** Granite Domes and Boulder Piles, Major Drainage Line, Minor Drainage Line, Spinifex Sand Plain & Spinifex Rocky Plain.
Long-tailed Dunnart *Antechinomys longicaudatus*			P4	Rocky hills, ranges and escarpments with open woodland and/or shrubland over spinifex (Pavey, 2006b).	Three records from 2011-12, 8-26 km east and west of the Survey Area in rocky habitat.	**Low** Records within 50 km but no suitable habitat is present within the Survey Area.

Species	Conservation Status			Preferred Habitats	Previous Records	Likelihood of Occurrence
	EPBC Act	BC Act	DBCA			
Brush-tailed Mulgara *Dasycercus blythi*			P4	Sandy, loamy and sometimes stony/ gibber plains and dunes vegetated with spinifex and/ or tussock grasses (Pavey *et al.*, 2011; Newman-Martin *et al.*, 2023)	12 records within the last 20 years <10 km from the Survey Area in suitable burrowing habitat (sand plains), with numerous more within 50 km.	**Recorded** This species was recorded during Phase 1 (one individual captured, records on camera traps and secondary evidence observed throughout the Survey Area). **Critical habitat:** Spinifex Sand Plain, Minor Drainage Lines. **Supporting habitat:** Major Drainage Line, Spinifex Rocky Plain and potential use of lower areas of Granite Domes and Boulder Piles in the vicinity of preferred habitat.
Spectacled Hare-wallaby *Lagorchestes conspicillatus leichardti*			P4	Acacia shrubland and spinifex in Tanami Desert and tropical grasslands, open forests and woodlands, shrublands with tussock grasses as well as inland areas of hummock grassland (Van Dyck and Strahan, 2008a).	No records within the Survey Area, however recorded on motion camera <500 m away in 2022. In addition, four DBCA records within 10 km mostly to the north-east, with two from 2018.	**High** Four records within 10 km and some suitable habitat was present within the Survey Area. **Critical habitat:** Spinifex Sand Plain & Spinifex Rocky Plain. **Supporting habitat:** Major Drainage Line & Minor Drainage Line.
Short-tailed Mouse *Leggadina lakedownensis*			P4	Spinifex and tussock grassland on cracking clays. Also, acacia shrubland, samphire, woodlands and stony ranges in Northern Australia (Kutt and Kemp, 2005).	Two records within 50 km of the Survey Area from 2001 in the Chichester range.	**Low** Records not recent and only marginal suitable habitat is present. This species prefers cracking clays in the Pilbara.

Species	Conservation Status			Preferred Habitats	Previous Records	Likelihood of Occurrence
	EPBC Act	BC Act	DBCA			
Western Pebble-mound Mouse *Pseudomys chapmani*			P4	Rocky ranges and hills where suitably sized pebbles are available for mound construction. Most common on the lower slopes of ridges vegetated with spinifex hummock grassland (Dunlop and Pound, 1981).	Many historical and contemporary records from DBCA database search within the vicinity and recorded within the Survey Area in 2012 from secondary evidence (mounds).	**Recorded** This species was previously recorded in 2012 from four mounds. The mounds were visited during Phase 1 and appeared to be recently active. **Critical habitat:** Spinifex Rocky Plain & Spinifex Sand Plain in vicinity of Granite Domes and Boulder Piles, where suitable substrate occurs. **Supporting habitat:** N/A
Birds						
Curlew Sandpiper *Calidris ferruginea*	CR & MI	CR		Tidal flat systems and freshwater to brackish wetlands. Ephemeral and permanent lakes, dams and waterholes, usually with bare edges, mud and sand.	No DBCA Records. Returned in the PMST search as species or species habitat may occur in the area.	**Very Low** Based on satellite imagery, as well as field survey, optimal habitat for this species is not present within the Survey Area.
Night Parrot *Pezoporus occidentalis*	EN	CR		Recorded from long unburnt, ring forming Triodia grasslands in association with low lying saline lakes and drainages hosting chenopods/samphire (N.A. Jackett *et al.*, 2017).	The Night Parrot is rare and elusive, resulting in very few confirmed records of this species. These include: • A population is known to occur at Fortescue Marsh with records between 2005 and 2023 (Davis and Metcalf, 2008; Fortescue Metals Group, 2021a); • Near Lake Disappointment, about 285 km east of Newman in 2017-2018 (Harewood, 2018); • Martu country, Great Sandy and Little Sandy deserts in 2020 (Australian Geographic, 2020); • Lake Mackay, border of WA and NT in 2020 (Stantec, 2021); • East Murchison (Hamilton *et al.*, 2017; Nigel A. Jackett *et al.*, 2017);	**Low** There are no records within the Survey Area or surrounding area. This species is unlikely to be present as suitable *Triodia* hummocks that form rings of hummock grassland are sparse. Especially after the 2022 fire that impacted 79% of the Survey Area. The Survey Area also lacks drainage areas/saline wetlands that support foraging activity for this species.

Species	Conservation Status			Preferred Habitats	Previous Records	Likelihood of Occurrence
	EPBC Act	BC Act	DBCA			
					• Near Lake Gregory in the Great Sandy Desert in the Kimberley region in 2018 (Kimberley Land Council, 2018); and • Ngururrpa Indigenous Protected Area population in the Great Sandy Desert (Ngururrpa Rangers *et al.*, 2024).	
Australian Painted Snipe *Rostratula benghalensis australis*	EN	EN		Shallow terrestrial freshwater wetlands, lakes, and swamps, typically with low, dense fringing vegetation. Favours sites with shallow water and exposed mud (Menkhorst *et al.*, 2019a).	No DBCA Records. Returned in the PMST search as species or species habitat may occur in the area.	**Very Low** Based on satellite imagery, as well as field survey, optimal habitat for this species is not present within the Survey Area.
Red Goshawk *Erythrotriorchis radiatus*	VU	VU		Open forest and woodland with mixed vegetation, particularly along streams, swamps and wetlands, mostly along coastal fringes (Morcombe, 2003a; Menkhorst *et al.*, 2019a).	No DBCA Records. Returned in the PMST search as species or species habitat may occur in the area.	**Low** This species was not known to occur in the Pilbara. However, recent reliable observations have recorded both adults and juveniles in the region, representing a 500 km south range extension. It is unknown if individuals are just passing through or breeding (MacColl *et al.*, 2023).
Grey Falcon *Falco hypoleucos*	VU	VU		Arid and semi-arid grasslands, plains and timbered watercourses (Olson and Olson, 1986; Schoenjahn, 2013).	One bird was recorded close to the Survey Area in 2012. A further 11 records from both north and south of the Survey Area were within 50 km.	**Recorded** This species was recorded during Phase 1 and suitable habitat for breeding and foraging exists within the Survey Area. The species is rare but widespread throughout the semi-arid interior of Australia (Morcombe and Stewart, 2013). **Critical habitat:** Major Drainage Line **Supporting habitat:** Spinifex Sand Plain, Spinifex Rocky Plain & Minor Drainage Line
Pacific Swift *Apus pacificus*	MI	MI		Nomadic, almost entirely aerial lifestyle over a variety of habitats; associated with storm fronts (Australian Government &	Two previous DBCA records from 2011-14, located >10 km north and east of the Survey Area.	**Medium** No records of this species within the Survey Area; however, its almost entirely ariel lifestyle and wide

Species	Conservation Status			Preferred Habitats	Previous Records	Likelihood of Occurrence
	EPBC Act	BC Act	DBCA			
				Department of Agriculture Water and the Environment, 2020).		range of suitable habitats means it has the potential to fly over the Survey Area. **Critical habitat:** N/A **Supporting habitat:** N/A
Oriental Plover *Charadrius veredus*	MI	MI		Open grasslands and sparsely vegetated plains. During hottest parts of the day collects in large flocks on wet ground associated with wetlands though often found far from water (Pizzey and Knight, 2012).	One DBCA record 21 km north-east of the Survey Area in 1999. Returned in the PMST search as species or species habitat may occur in the area.	**Medium** No recent, nearby records however the species can occur sporadically in a variety of habitats including those found within the Survey Area. **Critical habitat:** N/A **Supporting habitat:** Spinifex Sand Plain and Major Drainage Line, particularly after rainfall events.
Sharp-tailed Sandpiper *Calidris acuminata*	MI	MI		Inland lakes, and coastal, along brackish and freshwater wetlands, saltmarsh, lakes and pools (Morcombe, 2003a).	No DBCA Records. This species only appeared in the PMST (species or species habitat may occur in the area), and ALA database searches.	**Very Low** No recent, nearby records and no suitable habitat occurs within the Survey Area.
Red-necked Stint *Calidris ruficollis*	MI	MI		Inhabit coastal areas, particularly tidal flats. Some species may also inhabit mangroves, ocean beaches and rocky shorelines. Also known to inhabit inland temporary waters and sewage dams (Menkhorst *et al.*, 2019a).	No DBCA Records. This species only appeared in the ALA database searches.	**Low** Only marginal habitat is present when drainage lines or other low areas are inundated.
Pectoral Sandpiper *Calidris melanotos*	MI	MI		Coastal wetland, both fresh and saline but also inland on permanent and temporary wetlands. Prefers sites with mudflats, fringing vegetation or swamps with heavy vegetation (Morcombe, 2003a).	No DBCA Records. Returned in the PMST search as species or species habitat may occur in the area.	**Very Low** No recent, nearby records and no suitable habitat occurs within the Survey Area.
Common Sandpiper	MI	MI		Coastal and inland ephemeral wetland habitat types. Sheltered, narrow and	Two DBCA Records approximately 20km to the North. This species appeared in the PMST	**Low**

Species	Conservation Status			Preferred Habitats	Previous Records	Likelihood of Occurrence
	EPBC Act	BC Act	DBCA			
Actitis hypoleucos				steep shorelines. Mangrove-lined creeks and varied wetland habitats including areas of mud with outcropping rocks, sewage ponds and dams (Morcombe, 2003a; Menkhorst *et al.*, 2019a).	(species or species habitat may occur in the area), and ALA database searches.	Marginal suitable habitat occurs within the Survey Area. It may occasionally fly over and use Major Drainage Line habitat or the small claypan located in the Spinifex Sand Plainonly when inundated.
Wood Sandpiper *Tringa glareola*	MI	MI		Well-vegetated, shallow freshwater wetlands, lakes, pools and swamps. Usually near shorelines either on mud or in shallow water (Morcombe, 2003a; Menkhorst *et al.*, 2019a).	Two DBCA records from 2005 and 2007, <50 km south of the Survey Area in Coonarie Creek.	**Low** Two recent records <50 km from Survey Area. It may occasionally fly over and use Major Drainage Line habitat or the small claypan located in the Spinifex Sand Plain, only when inundated.
Common Greenshank *Tringa nebularia*	MI	MI		Variety of coastal to inland permanent and ephemeral wetlands, swamps, lakes, waterholes and well as open mudflats (Morcombe and Stewart, 2013; Menkhorst *et al.*, 2019a).	Three DBCA records <50 km south of Survey Area (2004, 2005 & 2012) in drainage line habitat (Yule River and Coonarie Creek).	**Medium** Majority of records are <20 km from Survey Area some marginally suitable habitat under wet conditions is present within the Survey Area. **Critical habitat:** N/A **Supporting habitat:** Spinifex Sand Plain - small claypan and Major Drainage Line , only when inundated
Oriental Pratincole *Glareola maldivarum*	MI	MI		Often found at wetlands with an abundance of insects or in open areas near tidal flats and beach lands (Morcombe, 2003a). Known to congregate in large flocks (Menkhorst *et al.*, 2019a).	No previous records returned from DBCA database search within 50km. Included in PMST results only (Species or species habitat may occur within area).	**Very Low** Suitable habitat does not occur within the Survey Area, and there are no previous records from the region.
Osprey *Pandion haliaetus*	MI	MI		Coastal and terrestrial wetlands of tropical and temperate Australia and offshore islands, occasionally ranging inland along rivers (Menkhorst *et al.*, 2019a).	Two records from DBCA from 2013. Two records are >24-38 km from the Survey Area at Chichester Gorge.	**Low** No records of this species within the Survey Area. Marginal suitable habitat within Survey Area and species occurs inland only occasionally. Existing records are >20 km from the Survey Area.

Species	Conservation Status			Preferred Habitats	Previous Records	Likelihood of Occurrence
	EPBC Act	BC Act	DBCA			
Peregrine Falcon *Falco peregrinus*	OS	OS		Widespread but uncommon; variety of habitats including open woodlands, grasslands with trees, lakes, timbered watercourses and urban areas (Pizzey and Knight, 2012). Cliff faces are preferred nesting sites (Morcombe, 2003b; Menkhorst *et al.*, 2019b).	Four DBCA records within 25 km of the Survey Area from 2000-2013.	**High** Species occupies a diverse range of habitats and therefore has the potential to utilise the Survey Area predominately for foraging. **Critical habitat:** N/A **Supporting habitat:** Major Drainage Line, Minor Drainage Line, Spinifex Sand Plain & Spinifex Rocky Plain
Reptiles						
Pilbara Olive Python *Liasis olivaceus barroni*	VU	VU		Inhabits gorges, gullies, stony ranges, rock piles and along watercourses. Often associated with permanent and temporary water bodies though is not restricted to them (DSEWPaC 2011b).	Sixteen DBCA records within 25 km, mostly to the east of the Survey Area (2011, 2014-2017). One record from 2011 within 7.2 km to NE of Survey Area.	**Medium** Some marginal suitable habitat is present for this species in Turner River East that runs adjacent to the western border of the Survey Area. This species may occasionally use the Major/Minor Drainage Lines for movement. Known sites are nearby <25km at Iron Bridge Mine site where more favourable habitat is present. **Critical habitat:** N/A **Supporting habitat:** Major Drainage Line & Minor Drainage Line, & Granite Domes and Boulder Piles (especially near Major Drainage Line habitat, for dispersal and foraging.
Pin-striped Finesnout Ctenotus *Ctenotus nigrilineatus*			P1	Spinifex plains adjacent to granite outcrops and watercourses at hilly interior of Pilbara near Woodstock, Meentheena and Nullagine (Wilson and Swan, 2021).	One DBCA record 25 km S of Survey Area in 2012. Four other records to the south within 50 km.	**Medium** Recorded 25 km south of Survey Area in 2001. Survey Area contains suitable habitat for this species. **Critical habitat:** Spinifex Sand Plain

Species	Conservation Status			Preferred Habitats	Previous Records	Likelihood of Occurrence
	EPBC Act	BC Act	DBCA			
						Supporting habitat: Major Drainage Line & Minor Drainage Line, & Granite Domes and Boulder Piles
Gane's Blindsnake *Anilios ganei*			P1	A variety of habitats; thought to prefer moist gorges though habitat data is limited (Aplin, 1998). Its cryptic nature and predominantly subterranean lifestyle reduce the likelihood of recording the species during fauna assessments.	Three DBCA records <30 km E of the Survey Area from 2005 to 2018.	**Low** Recorded in vicinity of Survey Area. Previous records indicate a preference for rocky gorges, which are absent within the Survey Area.

3.4.1. Mammals

3.4.1.1. Northern Quoll (*Dasyurus hallucatus*)

Conservation Status: EPBC Act & BC Act: Endangered.

Distribution, Habitat and Ecology: The Northern Quoll is the smallest of the four quoll species occurring in Australia (Oakwood, 2008). The species formerly occurred across the northern parts of Australia. Since the arrival of the Cane Toad (*Rhinella marina*) the Northern Quolls' distribution has declined significantly, especially in the more arid parts of its range (DotEE 2018a). The Pilbara population typically find refuge in rocky habitats during the day in crevices, cracks and small caves. These critical denning habitats include rocky gorges, basalt hills, escarpments, mesas, plateaux, granite boulder piles, caves and adjacent cliff faces but also along coastal fringes and beaches (DoE, 2018b). Foraging occurs across any adjacent habitat that provides suitable cover and food resources. Drainage lines and rivers are used for dispersal and as foraging habitat. The species is adaptable and has also been recorded in artificial habitat such as rock armour underneath bridges, in quarries, camp sites and along breakwaters (ecologia, 2012; DMP, 2013; Ecoscape, 2016a). The Northern Quoll is an omnivorous, opportunistic feeder that mostly consumes insects, fruits, vegetation, molluscs but also a large number of vertebrate species including mammals, birds, reptiles and frogs (Dunlop et al., 2017).

Occurrence in the Survey Area: The Northern Quoll was previously recorded in the Survey Area from Fortescue's Internal Database, with a record from the fauna monitoring program in 2019 as outlined in Table 3.6. This record was captured by a motion camera in a culvert situated in a minor drainage line, mapped as part of the broader fauna habitat of Spinifex Sand Plain. This culvert is also in the vicinity of Granite Domes and Boulder Piles habitat. The individual was recorded using the culvert three times, with two sightings on the 19 July 2019 (2:01 am and 6:14 pm) and one on the 3 July 2019 from 5:38 am.

An additional 225 records from the DBCA database are located within 10 km of the Survey Area, with the majority located to the west at Wodgina, where rocky escarpments and gorges are present. Other records occur to the north and south of the Survey Area, where the Northern Quoll has been recorded from granite outcropping and drainage lines. Further to the east, there are also numerous records at Iron Bridge, within rocky escarpments and gorges habitat, where they are frequently observed.

The species was recorded 12 times during both phases of the current survey within Granite Domes and Boulder Piles habitat. The records included:

- Trapping of three individuals (Plate 3.1):
  - Two females at satellite sites S01 and S03; and
  - One male at S01.
- Capture on motion camera at:
  - Satellite sites S01 and S03 (possibly same individuals as trapped); and
  - Motion camera site NSMC02, located in the south-east of the Survey Area.

All records from the Survey Area are detailed in Table 3.6 and displayed on Map 3.3.

Table 3.6: Northern Quolls Records within the Survey Area and 2 km Buffer

Survey Phase or Date	Site / Location	Type of Record	Fauna Habitat	Habitat Definition	Easting	Northing
Previous Records – Fortescue Internal Database – Fauna Monitoring						
19/06/2019 03/07/2019	R_F_P_MR_CU_02	Recorded 3 times on motion camera (Spectrum, 2021)	Spinifex Sand Plain – this camera is in a culvert for a very minor drainage, that has not been pulled out of the surrounding habitat.	Supporting / Critical	685589	7650772
This Survey						
Phase 1	S03	Scat	Granite Domes and Boulder Piles	Critical	685249	7653038
Phase 1	S03-MC01	One individual recorded on motion camera over two days. Could be two different individuals	Granite Domes and Boulder Piles	Critical	685249	7653004
Phase 1	S03-MC05	One individual recorded on camera	Granite Domes and Boulder Piles	Critical	685249	7653004
Phase 1	S03-MC01	One individual recorded on motion camera over two days. Could be two different individuals	Granite Domes and Boulder Piles	Critical	685246	7653039
Phase 1	S03-MC143	One individual recorded on motion camera	Granite Domes and Boulder Piles	Critical	685230	7653051
Phase 1	S01-MC134	One individual recorded on camera	Granite Domes and Boulder Piles	Critical	683786	7648419
Phase 1	S01-MC135	One individual recorded on motion camera	Granite Domes and Boulder Piles	Critical	683848	7648397
Phase 1	S01	Male in cage	Granite Domes and Boulder Piles	Critical	683847	7648455
Phase 1	S03	Female in cage, undeveloped pouch	Granite Domes and Boulder Piles	Critical	685248	7653003
Phase 1	S01	Female in cage, undeveloped pouch	Granite Domes and Boulder Piles	Critical	683829	7648523
Phase 2	NSMC02-MC110	One individual recorded on camera	Granite Domes and Boulder Piles	Critical	685766	7649828
Phase 2	NSMC02-MC27	One individual recorded on camera	Granite Domes and Boulder Piles	Critical	685767	7649797

Critical habitat in Survey Area: Granite Domes and Boulder Piles (2.7%).

Two females were recorded at both satellite sites in this habitat. It is likely that the Northern Quoll is using this habitat for breeding and foraging.

Supporting habitat in Survey Area: Major Drainage Line (1.0%) and Minor Drainage Line (1.4%).

The Northern Quoll is likely using the Major Drainage Line habitat in the Survey Area and surrounding Turner River West & East, along with the Minor Drainage Lines, for foraging and dispersal.

Potential habitat within the Survey Area and details of species records are displayed on Map 3.3.

Plate 3.1: Northern Quoll Female Captured During the Survey

Legend

Survey Area

Northern Quoll Records

This Survey

Capture

Motion camera

Scat

Fortescue Internal Database - Fauna Monitoring

Northern Quoll (Spectrum, 2021)

Fauna Habitats

Critical Habitat

Granite Domes & Boulder Piles

Supporting Habitats

Major Drainage Line

Minor Drainage Line

N

0 0.5 1 1.5 2 km

Scale 1:50,000 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum

[redacted]

Date: 08-01-2025

Northern Quoll Records & Habitat

NSJW Project

MAP 3.3

Prepared for Fortescue

3.4.1.2. Bilby (*Macrotis lagotis*)

Conservation Status: EPBC Act & BC Act: Vulnerable.

Distribution, Habitat and Ecology: The Bilby is a medium-sized marsupial that formerly inhabited the arid and semi-arid zones of 70% of Australia (Department of Environment and Conservation [DEC], 2012). The distribution of this species has contracted to less than 20% of their former range, and the distribution is thought to have further decreased to the north, due to threatening processes (DCCEEW, 2023a). The remaining populations occur in the Northern Territory, some isolated areas in south-west Queensland and within central and northern WA (DEC, 2012; Dziminski et al., 2020; Northover et al., 2023).

Within WA, the Bilby populations are limited to the Pilbara, Kimberley and the central desert and rangelands regions. The current Bilby distribution within the Pilbara region encompasses the eastern portion or around 48%. The western boundary of this distribution extends south-east from around 50 km west of Port Hedland to approximately 350 km past Newman (Dziminski, Carpenter and Morris, 2020). However, there are historic or unreliable records in areas to the west and south-west of their current distribution in the Pilbara. These areas require further survey work to confirm the Bilby is absent (Dziminski, Carpenter and Morris, 2020).

The Bilby inhabits a variety of substrate and vegetation types in northern WA from sand plains with low *Acacia* spp. over hummock grasses to Mulga shrubland on loamy-clay soils, and can broadly fit into three landscape types as per the Cramer et al. (2017) conceptual model (Cramer *et al.*, 2017; Northover *et al.*, 2023) which is detailed in Table 3.7.

Table 3.7: Suitable Habitat Characteristics of the Bilby in the North of WA

Landform	Substrate	Vegetation
Fluvial, includes a variety of drainage lines: • creek lines including upland systems • broad paleodrainage, low-lying and perched systems • calcrete	• sandy to sandy loam soils • alluvial and calcrete • salt channels and lakes	• Low shrubs of *Acacia* spp. and *Melaleuca* spp. over *Cyperus bulbosus. and* hummock grasslands usually with *Triodia basedowii, T. pungens and T. schinzii*
Residual, includes: • Laterite • Silcrete • Stony rises • Uplands • Breakaways • Plateaus • Granitic hills	• sandy to sandy loam soils • red earths usually with lateritic, small gravel, stony matrix	• Low shrubs of *Acacia* spp., including Mulga shrubland (*A. aneura*), over hummock and tussock grasslands
Sand plain and sand dune, includes: • Flat to gently undulating plains • Dune fields • Isolated dunes	• Soil texture ranges from coarse sand to light medium clay • Non-calcareous gradational soils • Duplex soils – red sand, loamy sand plains and dune fields	• Low woodland (<10 m) of *Eucalyptus* and *Acacia* spp. over shrub-steppe communities over *Triodia* hummock grasslands, occasionally with rich understorey; or • Pindan woodland over hummock and tussock grassland (Kimberley)

Where rainfall is higher in northern WA, the Bilby tends to occupy all three landforms, while in the south of WA, they are more restricted to fluvial and residual landforms (Cramer *et al.*, 2017). It is uncertain why the residual landforms are so important, as the substrate tends to be harder and includes less inundated run-off areas. They also include shrub species such as *Acacia hilliana* that support root-dwelling larvae that the

Bilby use for food, so it appears these areas are more suitable for foraging (Cramer *et al.*, 2017). Additionally, it appears that fire may influence the type and availability of food resources and may assist in improving habitat favourability in parts of the Bilby's range (Cramer *et al.*, 2017; Northover *et al.*, 2023).

Within the Pilbara, some preliminary distribution modelling undertaken by Dziminski and Carpenter (2017) showed that the habitat variables of soil type, depth and elevation are the major variables predicting preferred Bilby habitat. Observations have also shown that in addition to the species requiring a substrate that is suitable for burrowing, such as sand, sandy clay or sandy gravel, the Bilby also has an association with certain stands of *Acacia* species (and other plants) that provide a key food resource as they host root-dwelling larvae (RDL) (Cramer *et al.*, 2017; Northover *et al.*, 2023). In particular, the Cossidae (moth) larvae appears to be a major food resource for the Bilby (Dziminski and Carpenter, 2017; Southgate *et al.*, 2019). Within the Pilbara, these plant species include:

- *Acacia bivenosa;*
- *A. colei;*
- *A. dictyophleba;*
- *A. hilliana*^
- *A. melleodora;*
- *A. rhodophloia*^
- *A. stellaticeps;*
- *A. trachycarpa* including dwarf variant; and
- *Senna notabilis*.

Note: ^- species occurs in the Pilbara, but observations of Bilby diggings for RDL only in Tanami Desert (NT), Central Desert or Gibson Desert IBRA regions (Southgate *et al.*, 2019).

The larvae are extracted from the root systems by the Bilby which is the only known species in the arid and semi-arid areas of Australia that opens the root system in this specific way (Southgate *et al.*, 2019).

The Bilby also consumes a variety of invertebrates such as spiders, beetles, and termites, along with plant materials such as seeds and bulbs. The majority of the food resources for the Bilby are either acquired from the soil surface or by digging (Southgate *et al.*, 2019).

The Bilby is a nocturnal species that shelters during the day in an extensive burrow system of up to 4.5 m in length and 2 m deep, which could spiral down, have side branches, or blocked tunnel entrances (freshly dug soil). Most burrows have a single entrance; however, some can have multiple entrances like rabbit warrens. A single individual may use up to 18 burrows (Moseby et al., 2003; DEC, 2012).

Bilbies are exceedingly mobile and can cover vast distances while foraging (DCCEEW, 2023a). The size of the Bilby's home range is estimated to be between 0.18 km^2 and 3.16 km^2 (from Arid Recovery in SA) and is dependent on the location and availability of foraging habitat supporting insects, fungi and vegetation (Pavey, 2006; DCCEEW, 2023). However, their home range in many areas is still not well understood (DCCEEW, 2023a). Sudden shifts in spatial distribution can occur, particularly in sandy deserts, in response to changing food availability. Females can display long-term site fidelity whereas males display a roaming behaviour allowing them to mate with multiple females (Pavey, 2006a).

Occurrence in the Survey Area:

The Fortescue Internal Database has a previous record for the Bilby in the Survey Area approximately 150 m from the Bilby recorded during this assessment (Table 3.8, Map 3.4). This record was from a burrow located between two granite boulders within Spinifex Sand Plain habitat, and was not noted as active (Ecoscape, 2009). Two further secondary evidence records are located less than 100 m away from the Survey Area in 2019 and 2021. The record from 2019 was from an old burrow (27 m east), while the 2021 record included three potential Bilby diggings (84 m east). Additional records up to 2 km from the Survey Area have been included in Table 3.8, which includes further records from fauna monitoring (three 1.4 km south) and four records from the DBCA Database, including two motion camera records (confirmed presence) from 2013, located up to 900 m north near the Roy Hill Rail Line. Numerous additional records surround the Survey Area, generally to the north and south, where suitable habitat occurs.

During this assessment, the female Bilby was recorded several times during both phases of the assessment and included a capture in a cage, scats, active burrows, and confirmed diggings, scratchings, and tracks. These records and other potential evidence are outlined in Table 3.8 and displayed on Map 3.4, whilst dubious and inaccurate records have been removed. This individual is shown on Plate 3.2 with two active burrows displayed on Plate 3.3.

Table 3.8: Bilby Records within the Survey Area and 2 km Buffer

Survey Phase or Date	Site / Location / Distance	Type of Record / Reference	Fauna Habitat	Habitat Definition	Easting^	Northing^
Previous Records – Fortescue Internal Database – Previous Surveys & Fauna Monitoring						
22/07/2009	GDP2449	Old burrow (Ecoscape, 2009)	Spinifex Sand Plain	Critical	686333	7650954
Previous Records – Fortescue Internal Database – Previous Surveys & Fauna Monitoring (up to 2 km outside)						
22/09/2019	HV1905 27 m E	Old burrow (Ecoscape, 2020a)	Was Spinifex Sand Plain, now Cleared/Disturbed	N/A	686974	7650492
27/05/2021	NSJ_FN_P_FS04 84 m E	Potential diggings (x3) (Ecoscape, 2021)	Spinifex Sand Plain	Critical	686880	7650825
16/05/2019	R_F_P_MR GB OS15 1.4 km S	Two potential old diggings (Spectrum, 2020b)	Spinifex Sand Plain	Critical	686904	7648294
11/07/2020	R_F_P_MR GB OS15 1.4 km S	Potential tracks (gait pattern only) (Spectrum, 2021)	Spinifex Sand Plain	Critical	686904	7648294
22/07/2022	R_F_P_MR GB OS15 1.4 km S	Scats (Spectrum, 2023)	Spinifex Sand Plain	Critical	686904	7648294
Previous Records – DBCA Database – Previous Survey (up to 2 km outside)						
4/12/2013	Roy Hill Rail Line 767 m	Motion camera recording	Spinifex Sand Plain	Critical	682989	7655465
4/12/2013	Roy Hill Rail Line 776 m	Unknown	Spinifex Sand Plain	Critical	682991	7655474
4/12/2013	Roy Hill Rail Line 889 m	Motion camera recording	Spinifex Sand Plain	Critical	682971	7655587
4/12/2013	Roy Hill Rail Line 898 m	Unknown	Spinifex Sand Plain	Critical	682971	7655596
This Survey						
Phase 1	NS01	Female in cage	Spinifex Sand Plain	Critical	685937	7650777
Phase 1 & Phase 2	NS01	Active burrow	Spinifex Sand Plain	Critical	685937	7650778
Phase 1 & Phase 2	NS01	Old burrow recorded during Phase 1, active in Phase 2	Spinifex Sand Plain	Critical	685904	7650708

Survey Phase or Date	Site / Location / Distance	Type of Record / Reference	Fauna Habitat	Habitat Definition	Easting^	Northing^
Phase 1 & Phase 2	NS01	Inactive burrow	Spinifex Sand Plain	Critical	685906	7650707
Phase 2	NS01	Active burrow	Minor Drainage Line	Critical	685960	7650764
Phase 2	NS01	Active Bilby burrow	Spinifex Sand Plain	Critical	685858	7650640
Phase 2	NS01	Lots of confirmed diggings, scratchings and scat piles within the general area	Spinifex Sand Plain	Critical	685843	7650632
Phase 1	NS01-TS	Confirmed tracks	Minor Drainage Line	Critical	686045	7650915
Phase 1	NS01-TS	Confirmed tracks	Spinifex Sand Plain	Critical	686078	7650998
Phase 1	NS01-TS	Confirmed tracks	Spinifex Sand Plain	Critical	686173	7651006
Phase 1	NS01-MC30-LT	39 video records of the female Bilby coming and going from her burrow between 24/05/23 to 29/06/23	Spinifex Sand Plain	Critical	685942	7650774
Phase 1 & Phase 2	NS01-MC33-LT	Three photos of the female Bilby at her burrow over three days on 4/06/23, 16/06/23 & 7/09/23	Spinifex Sand Plain	Critical	685943	7650777
Phase 1 & Phase 2	NS01-MC57	Two photos of Bilby at burrow on 1/09/23 & 21/09/23	Spinifex Sand Plain	Critical	685944	7650775
Phase 1 & Phase 2	NS01-MC63	Five photos of Bilby at burrow between 26/08/23 to 21/09/23	Spinifex Sand Plain	Critical	685944	7650776
Phase 1	NSOPP06	Potential, old burrow	Spinifex Sand Plain	Critical	685739	7652040
Phase 1	NSOPP08	Potential old disused burrow	Spinifex Sand Plain	Critical	679715	7650593
Phase 2	NSOPP12	Potential old digging	Spinifex Sand Plain	Critical	682368	7649956
Phase 2	NSOPP13	Potential old digging	Spinifex Sand Plain	Critical	679770	7654577
Phase 2	BD01	Potential old digging	Spinifex Sand Plain	Critical	686420	7651188

^ = Coordinate reference system – GDA94, MGA94, Zone 50

Critical habitat in Survey Area: Spinifex Sand Plain (91.5%), Major Drainage Line (1.0%) and Minor Drainage Line (1.4%).

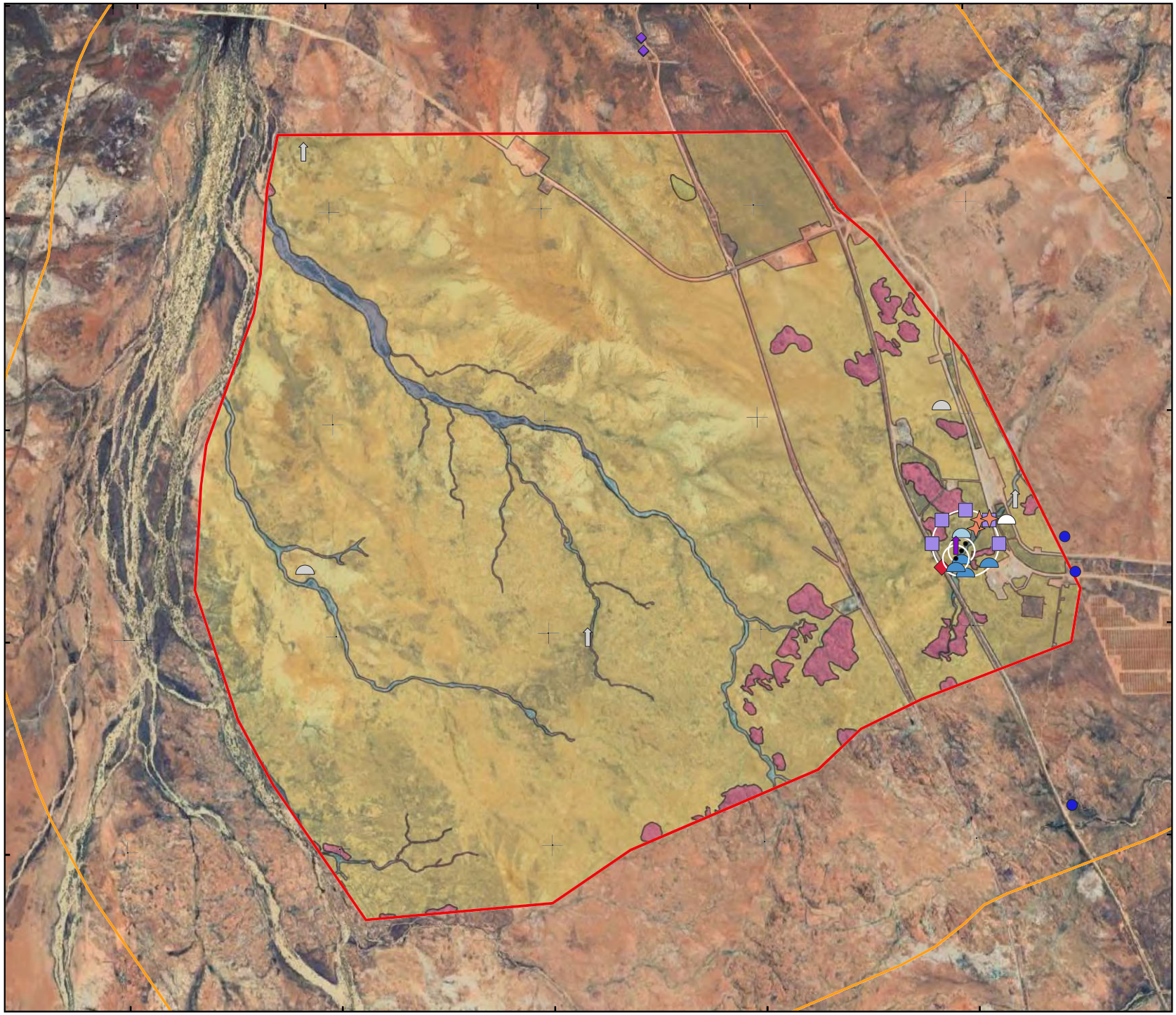
The majority of the Spinifex Sand Plain habitat in the Survey Area is considered potential habitat; however, the Bilby is typically found in the vicinity of Minor (and Major) Drainage Lines, in particular, in areas where *Acacia bivenosa*, *A. colei*, *A. dictyophleba*, *A. melleodora*, *A. stellaticeps* and *A. trachycarpa* occurs (Southgate *et al.*, 2019; Northover *et al.*, 2023). However, it is likely that the recent fires in 2021-2022 have impacted the suitability of some of these habitats, especially in the south-western portion of the Survey Area. The Bilby find suitable breeding conditions within the Spinifex Sand Plain and Minor Drainage Line habitats and uses all three habitats for foraging (Map 3.4).

Supporting habitat in Survey Area: Spinifex Rocky Plain (0.1%) and possibly Granite Domes and Boulder Piles (2.7%).

Due to the surrounding critical habitat, the Bilby may use these two habitats within the Survey Area infrequently (particularly the latter), especially when foraging and dispersing.

Plate 3.2: Motion Camera Image of Bilby Recorded During the Survey

Plate 3.3: Active Bilby Burrows Recorded from Site NS01 (left is from Phase 1, right from Phase 2)



Legend

Survey Area

Bilby Records

This Survey

- Capture
- Motion camera
- Confirmed active burrow
- Confirmed digging
- Confirmed tracks
- Potential old burrow
- Inactive burrow
- Potential old digging

Fortescue Internal Database - Previous Survey

- Bilby (Ecoscape, 2009)

Outside Survey Area (<2 km)

- Fortescue Internal Database
- DBCA Database

Fauna Habitats

Critical Habitats

- Spinifex Sand Plain
- Major Drainage Line
- Minor Drainage Line

Supporting Habitats

- Spinifex Rocky Plain
- Granite Domes & Boulder Piles

N

0 0.5 1 1.5 2 km

Scale 1:50,000 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum

[redacted]

Date: 08-01-2025

Bilby Records & Habitat

NSJW Project

MAP 3.4

Prepared for Fortescue

3.4.1.3. Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia* Pilbara form)

Conservation Status: EPBC Act & BC Act: Vulnerable.

Distribution, Habitat and Ecology: The Pilbara Leaf-nosed Bat is the Pilbara form of the Orange Leaf-nosed Bat, a small orange coloured bat that occurs across northern Australia (K.N. Armstrong, 2006). There are two populations of Orange Leaf-nosed Bat, one in the Pilbara and the other in the Kimberley region. They differ genetically, morphologically and in the frequency of their echolocation calls (Armstrong, 2001b, 2003; Kyle N Armstrong, 2006).

The Pilbara Leaf-nosed Bat requires two different habitats, suitable caves or mine adits for roosting during the day, and an external habitat for foraging at night. These habitats are defined in the Conservation Advice for this species (Threatened Species Scientific Committee (TSSC), 2016). Roosting occurs in deep, warm and humid caves and adits (horizontal tunnels). Some caves are used all year around, whereas others are visited for a variety of purposes including specific maternity roost caves (Churchill, 2009; TSSC, 2016; Department of the Environment, 2018c). A standardised nomenclature for the different roost types has been established and include four types of roosts:

- Permanent diurnal roost;
- Non-permanent breeding roost;
- Transitory diurnal roosts; and
- Nocturnal refuge.

Permanent diurnal roosts are occupied all year and are utilised for breeding and rearing of young. Non-permanent breeding roosts are also used for mating and transitory diurnal roosts facilitate long-distance dispersal. These roost types are considered critical habitat for the survival of the species. Nocturnal refuge roosts are used for shelter and feeding, and while not classified as critical habitat, they are important for the species persistence in the local area (Churchill, 2009; Department of the Environment, 2018c).

The Conservation Advice for the Pilbara Leaf-nosed Bat has categorised critical foraging habitat based on number of encounters at night and the theory that the conditions of these habitats are important for supporting a neighbouring colony (Threatened Species Scientific Committee (TSSC), 2016). These habitats and priorities include:

- Priority 1 – rocky gorges with waterpools;
- Priority 2 – gullies;
- Priority 3 – rocky outcrops;
- Priority 4 – major watercourses; and
- Priority 5 – open grassland and woodland (TSSC 2016).

Pilbara Leaf-nosed Bats are insectivorous, with a large proportion of their diet consisting of moths, termites and beetles. The bats emerge from their nocturnal roost after dusk and forage along rock faces, rocky gullies, gorges, and creek lines and water holes (Churchill, 2009; Department of the Environment, 2018c). The Pilbara Leaf-nosed Bat is vulnerable to the loss of body heat and moisture, and therefore requires a stable warm microclimate. Their breeding cycle stretches over a 9-month period, with mating taking place in July and the dispersal of independent young in February/March (Churchill, 2009; Department of the Environment, 2018c).

Occurrence in the Survey Area: The Pilbara Leaf-nosed Bat was previously recorded in the Survey Area, along Fortescue's Main Line Rail in 2013-2014, 2016 and 2019 (Table 3.9). All records are from Fortescue's on-going fauna monitoring program. The older records from 2013-2014 were recorded on both the DBCA

database and Fortescue's internal database, while the more recent records were only on Fortescue's. Additional monitoring records from the Survey Area in 2015 (on both databases) have been removed due to discrepancies with the locational information. Further records exist from 1.5 km NW of the Survey Area at another monitoring site in 2018 and 2019.

Numerous additional records for this species are located to the west at Wodgina and to the east at Iron Bridge. Both areas feature rocky escarpments, the preferred habitat for this species, and include known roosting locations.

The Pilbara Leaf-nosed Bat was recorded during both phases of the current survey from seven of the eight trapping/satellite sites across the Survey Area. Call patterns from the sites were well after sunset and well before sunrise, indicating foraging activity within the Survey Area (Appendix E). It is unclear if all records represent foraging individuals or if they just pass through whilst travelling between suitable habitats.

All records from the Survey Area and surrounds (up to 2 km) are summarised in Table 3.9 with locations shown on Map 3.5. The bat call analysis report is included in Appendix E.

Table 3.9: Pilbara Leaf-nosed Bat Records within the Survey Area and 2 km Buffer

Survey Phase or Date	Site / Location Distance	Type of Record	Fauna Habitat	Habitat Definition (Fortescue & TSSC)	Easting	Northing
Previous Records – Fortescue's Internal Database – Fauna Monitoring						
22-23/12/2016	MR Bat I3.1	2 nights, 3 call passes between 21:59 to 23:02 (Ecoscape, 2017a)	Granite Domes and Boulder Piles	Supporting (Priority 3)	685891	7650102
16-17/11/2019 19/11/2019	R_F_P_ML_Bat_I3	3 nights, 3 call passes between 21:09 to 1:19 (Spectrum, 2020a)	Granite Domes and Boulder Piles	Supporting (Priority 3)	686046	7650043
Previous Records – DBCA Database & Fortescue's Internal Database – Fauna Monitoring						
22/05/2013	J-ML-FA_SM2 4699 21/5	1 night, 2 call passes, one at 19:12 (ecologia, 2014a)	Spinifex Sand Plain – edge of granites	Supporting (Priority 5)	685224	7652369
30/08/2013-02/09/2013	J-ML-FA-MLPLNBIS3	4 nights, 4 call passes between 19:40 to 12:04 (ecologia, 2014a)	Spinifex Sand Plain – edge of granites	Supporting (Priority 5)	685212	7652338
23-25/08/2014	J-ML-FA-MLPLNBIS3	3 nights, 7 call passes between 19:40 to 00:50 (ecologia, 2015b)	Spinifex Sand Plain – edge of granites	Supporting (Priority 5)	685212	7652338
Previous Records – DBCA Database & Fortescue's Internal Database – Fauna Monitoring (up to 2 km outside)						
27/11/2018	R_F_P_MR_BAT_C6 1.5 km NW	1 night, 1 call pass at 23:13 (Spectrum, 2019)	Minor Drainage Line	Supporting (Priority 5)	678448	7655829
17/12/2019, 19-20/12/2019	R_F_P_MR_BAT_C6 1.5 km NW	3 nights, 1 call pass from 20:00 to 4:08 (Spectrum, 2020b)	Minor Drainage Line	Supporting (Priority 5)	678448	7655829
This Survey						
Phase 1	NS01	1 night; 1 call pass at 19:35	Minor Drainage Line	Supporting (Priority 5)	685958	7650763
Phase 2	NS01	1 night; 1 call pass at 22:03	Minor Drainage Line	Supporting (Priority 5)	685953	7650760
Phase 1	NS02	4 nights; 15 call passes between 21:02 to 02:38	Spinifex Sand Plain	Supporting* (Priority 5)	683945	7653596
Phase 2	NS02	4 nights; 4 call passes between 20:02 to 22:26	Spinifex Sand Plain	Supporting* (Priority 5)	683945	7653596

Survey Phase or Date	Site / Location Distance	Type of Record	Fauna Habitat	Habitat Definition (Fortescue & TSSC)	Easting	Northing
Phase 1	NS03	1 night; 3 call passes between 21:44 to 23:52	Spinifex Sand Plain	Supporting* (Priority 5)	682171	7653959
Phase 2	NS03	3 nights; 5 call passes between 19:50 to 4:14	Spinifex Sand Plain	Supporting* (Priority 5)	682174	7653956
Phase 1	NS04	1 night; 2 call passes between 22:12 to 2:24	Major Drainage Line	Supporting (Priority 4)	680038	7653289
Phase 2	NS04	3 nights; 7 call passes between 20:43 to 00:26	Major Drainage Line	Supporting (Priority 4)	680006	7653287
Phase 1	S01	1 night, 1 call pass at 23:08 (Phase 1)	Granite Domes and Boulder Piles	Supporting (Priority 3)	683834	7648480
Phase 1	S02	2 nights; 2 call passes between 19:33 to 22:13	Major Drainage Line	Supporting (Priority 4)	681530	7652069
Phase 2	S02	1 night; 4 call passes between 1:10 to 1:26	Major Drainage Line	Supporting (Priority 4)	681518	7652073
Phase 1	S03	1 night; 3 call passes between - 19:48 to 3:01	Granite Domes and Boulder Piles	Supporting (Priority 3)	685299	7652927

*records are likely individuals passing through and not utilising the habitat. Area is likely used as fly path.

Critical habitat in Survey Area: Not applicable.

No critical habitat was identified within the Survey Area.

Supporting habitat in Survey Area: Granite Domes and Boulder Piles (2.7%), Major Drainage Line (1.0%) and Minor Drainage Line (1.4%)

Spinifex Sand Plain (91.5%) and Spinifex Rocky Plain (0.1%) have been discounted for the Survey Area despite 'open grasslands and woodlands' being listed in the species advice (TSSC 2016). The open plains in the Survey Area may be crossed or overflown to access habitats in the area, but they are unlikely to provide suitable conditions. Habitats present in the Survey Area are likely used for foraging (supporting) only and provide connectivity to the known roost locations to the east and west. The Granite Domes and Boulder Piles may be suitable for infrequent and temporary nocturnal roosting during the wet season, provided suitable shelters exist. However, the absence of deep crevices and humid caves likely restricts this activity to humid weather conditions.

Based on the TSSC (2016), the fauna habitats present within the Survey Area, form supporting (foraging) habitat only, and fit into the following categories (see Map 3.5):

- Priority 3:
    - Granite Domes and Boulder Piles (121.1 ha / 2.7 % of the Survey Area).
- Priority 4:
    - Major and Minor Drainage Lines (104.5 ha / 2.4 % of the Survey Area).

3.4.1.4. Ghost Bat (*Macroderma gigas*)

Conservation Status: EPBC Act & BC Act: Vulnerable.

Distribution, Habitat and Ecology: The Ghost Bat is a large, specialist carnivorous bat and is the sole member of its genus (Hoyle, Pople and Toop, 2001; Worthington Wilmer *et al.*, 2008). The species once occurred across of much of Australia but is now only known from isolated locations in northern Australia (Armstrong and Anstee, 2000; Bat Call WA, 2021).

Ghost Bats use a range of cave structures for short-term transient feeding roosts, long-term roosts and maternity roots (DoE 2023b). Short-term transient roosts can include overhangs, small shallow caves, granite boulders, and rail culverts. These sites have microclimates close to ambient conditions (Armstrong and Anstee, 2000; Ecoscape 2017b, 2018). Maternity roosts require a stable, warm, and humid climate with a relative humidity over 80%. They are usually deep, complex, or large domed caves or mine adits with an ideal isothermal zone (23-26°C) and a cavern size large enough for the species to manoeuvre in (Pettigrew *et al.*, 1986; Hall *et al.*, 1997). Medium-sized caves with suitable microclimates are used for a variety of activities such as foraging and long-term roosting. Caves that provide complete darkness are reported to be preferred for roosting (Schulz and Menkhorst, 1986).

Female Ghost Bats exhibit long-term philopatry, using the same roost caves, resulting in low mitochondrial DNA diversity (Worthington Wilmer *et al.*, 2008). Tracking studies have shown that up to 75% of the population disperse in winter with the remaining individuals (possibly pregnant females) occupying the warm caves over winter (Toop, 1985). The dispersing parties typically consist of small groups of paired Ghost Bats which can utilise smaller caves than those used during the breeding season. Females and males aggregate for breeding purposes at the end of the wet season (Pettigrew *et al.*, 1986) and females give birth to young between late August and November. The young are nursed in large maternity caves over the wet season (Toop, 1985).

The Ghost Bat is a carnivorous predator, feeding on other bats, rodents, invertebrates, and birds (Pettigrew *et al.*, 1986; Boles, 1999; Ecoscape 2018). Prey detection is through a combination of passive listening, vision, and echolocation. Detection through movement is thought to be the primary stimulus (Pettigrew *et al.*, 1988).

Occurrence in the Survey Area: The Ghost Bat was previously recorded from the Survey Area in 2014 from a motion camera image within a culvert during Fortescue's fauna monitoring program, as outlined in Table 3.10 (ecologia, 2015b). This species has been recorded using other culverts along the Main Line Rail for foraging and/or temporary nocturnal roosts, with remains and scats recorded over multiple years (Ecoscape, 2017a; Spectrum, 2020). Additionally, this species was also recorded in 2011, less than 1 km north of the Survey Area, from a survey along the Roy Hill rail line. Numerous additional records exist for this species to the west at Wodgina and to the east at Iron Bridge. Both areas have preferred roosting habitat for this species (rocky escarpments) and contain known maternity roost locations. Further infrequent records exist to the south and north from culverts and other foraging areas.

The species was not recorded during the survey; however, survey methods current at the time of survey area were inadequate to detect the Ghost Bat reliably. Recent developments have improved detection probabilities (Ruykys, Hanrahan and Stokeld, 2023, K. Armstrong, pers. comms, 2023).

The record from the Survey Area is outlined in Table 3.10 and shown on Map 3.5.

Table 3.10: Ghost Bat Records within the Survey Area and 2 km Buffer

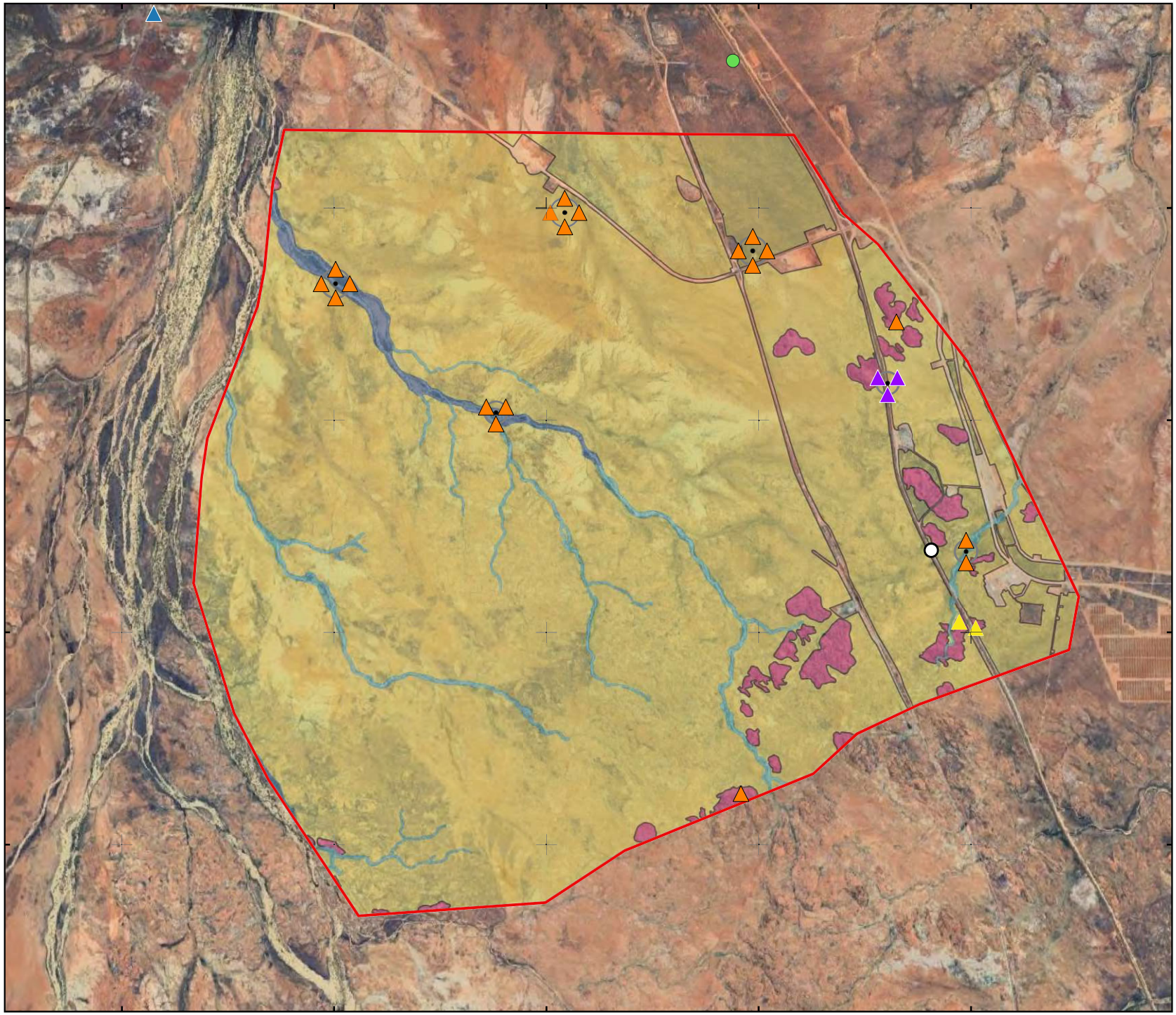
Survey Phase or Date	Site / Location	Type of Record	Fauna Habitat	Habitat Definition (Fortescue)	Easting	Northing
Previous Records – DBCA Database & Fortescue's Internal Database – Fauna Monitoring						
29/11/2014	J-ML-FA-MLCM8 (now known as R_F_P_MR CU02)	On motion camera in culvert (ecologia, 2015b)	Spinifex Sand Plain – this camera is in a culvert within minor drainage line habitat.	Supporting	685627	7650774
Previous Records – DBCA Database – Previous Survey						
21/03/2011	Roy Hill Railway 695 m N	Likely call recorded on bat recorder	Spinifex Sand Plain	Supporting	683758	7655388

Critical habitat in Survey Area: Not applicable.

No critical habitat was identified in the Survey Area for the Ghost Bat.

Supporting habitat in Survey Area: Granite Domes and Boulder Piles (2.7%), Spinifex Sand Plain (91.5%), Major Drainage Line (1.0%) and Minor Drainage Line (1.4%) and Spinifex Rocky Plain (0.1%).

The Major Drainage Line, Minor Drainage Line, Granite Dome and Boulder Piles and possibly the Spinifex Sand Plain habitats in the Survey Area are likely used by the Ghost Bat for foraging on an occasional basis (Map 3.5). These habitats provide connectivity to the known roost locations to the east and west of the Survey Area (Iron Bridge and Wodgina). The habitats are unlikely to be utilised for roosting due to the lack of deep, humid crevices or caves in the Granite Dome and Boulder Piles and the absence of suitable roost sites in the remaining habitat types. However, any suitable shelters present in the Granite Dome and Boulder Piles habitat could potentially be used intermittently as a transient roost. Additionally, the culverts present in the Survey Area may also be used for foraging and/or temporary nocturnal roosts on an occasional basis.



Legend

Survey Area

Pilbara Leaf-nosed Bat & Ghost Bat Records

This Survey

Pilbara Leaf-nosed Bat

Previous Records - Fauna Monitoring

Ghost Bat - DBCA Database

Pilbara Leaf-nosed Bat - both databases

Pilbara Leaf-nosed Bat - Fortescue Internal Database

Outside Survey Area (<2 km)

Ghost Bat - both databases

Pilbara Leaf-nosed Bat - both databases

Fauna Habitats

Supporting Habitats - TSSC Priorty

Granite Domes & Boulder Piles - Priority 3

Major Drainage Line - Priority 4

Minor Drainage Line - Priority 4

Spinifex Sand Plain - Ghost Bat only

Spinifex Rocky Plain - Ghost Bat only

N

0 0.5 1 1.5 2 km

Scale 1:50,000 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum

[redacted]

Date: 20-01-2025

Significant Bat Records & Habitat

NSJW Project

MAP

Prepared for Fortescue

3.5

3.4.1.5. Brush-tailed Mulgara (*Dasycercus blythi*)

Conservation Status: DBCA: Priority 4.

Distribution, Habitat and Ecology: The Brush-tailed Mulgara is a medium sized carnivorous marsupial belonging to the family Dasyuridae. It occupies the arid and semi-arid interior of Australia with records from Western Australia, the Northern Territory, and Queensland (Woolley et al, 2013; Newman-Martin et al., 2023). Preferred habitats include sandy and loamy flats and dunes vegetated with hummock and/ or tussock grasses. Brush-tailed Mulgara have also been recorded from stony gibber plains where wind-blown soil or sand has accumulated and allowed burrowing (Pavey *et al.*, 2011).

The Brush-tailed Mulgara excavates single entrance burrows (often at the edges of *Triodia* spp. hummocks) with multiple side tunnels that may terminate at surface 'pop-holes'. It is a nocturnal hunter, predating upon rodents, reptiles, and arthropods. Breeding takes place during the winter months with females recorded carrying young in September (Van Dyck and Strahan, 2008). They are solitary, seasonal breeders with low dispersal once a home range has been established (Masters, 2003).

Occurrence in the Survey Area: The Brush-tailed Mulgara was previously recorded from secondary evidence at five locations in the Survey Area from three surveys conducted in 2009, 2019 and 2021, as detailed in Table 3.11 and shown on Map 3.6. An additional six previous records are within 2 km, with further records within 2 km to 10 km of the Survey Area.

This species was recorded during both phases of the survey from sites NS01, NS05, NSOPP08 and NSOPP10. Sites NS01 and NS05 both recorded captures and secondary evidence (Table 3.11, Map 3.6). The Brush-tailed Mulgara is likely a resident of the Survey Area.

Table 3.11: Brush-tailed Mulgara Records within the Survey Area and 2 km Buffer

Survey Phase or Date	Site / Location	Type of Record	Fauna Habitat	Habitat Definition (Fortescue)	Easting	Northing
Fortescue's Internal Database – Previous Surveys						
10/06/2009	GDP 2449	Inactive burrow (Ecoscape, 2009)	Spinifex Sand Plain	Critical	685937	7650658
10/06/2009	GDP 2449	Active burrow (Ecoscape, 2009)	Spinifex Sand Plain	Critical	6861556	7650862
22/09/2019	HV1909	Digging or burrow (Ecoscape, 2020a)	Was Spinifex Sand Plain, now Cleared/Disturbed	N/A	686927	7650507
27/05/2021	NSJ_FN_P_FS08	Digging (Ecoscape, 2021)	Was Spinifex Sand Plain, now Cleared/Disturbed	N/A	686222	7650310
27/05/2021	NSJ_FN_P_FS09	Digging (Ecoscape, 2021)	Was Spinifex Sand Plain, now Cleared/Disturbed	N/A	686382	7650388
DBCA Database – Previous Survey (up to 2 km outside)						
01/07/2001	Proposed Hope Downs Rail – HAE9b 1.9km S	Capture	Spinifex Sand Plain	Critical	687826	7648131
Fortescue's Internal Database – Previous Surveys (up to 2 km outside)						
09/06/2009	P4D 287 m E	Inactive burrow (Ecoscape, 2009)	Spinifex Sand Plain	Critical	685071	7654089
09/06/2009	P4D 313 m E	Active burrow (Ecoscape, 2009)	Was Spinifex Sand Plain, now Cleared/Disturbed	N/A	684675	7654731
09/06/2009	P4D 422 m E	Inactive burrow (Ecoscape, 2009)	Spinifex Sand Plain	Critical	684974	7648294
27/05/2021	NSJ_FN_P_FS06 99 m E	Digging or burrow (Ecoscape, 2021)	Spinifex Sand Plain	Critical	686902	7650813

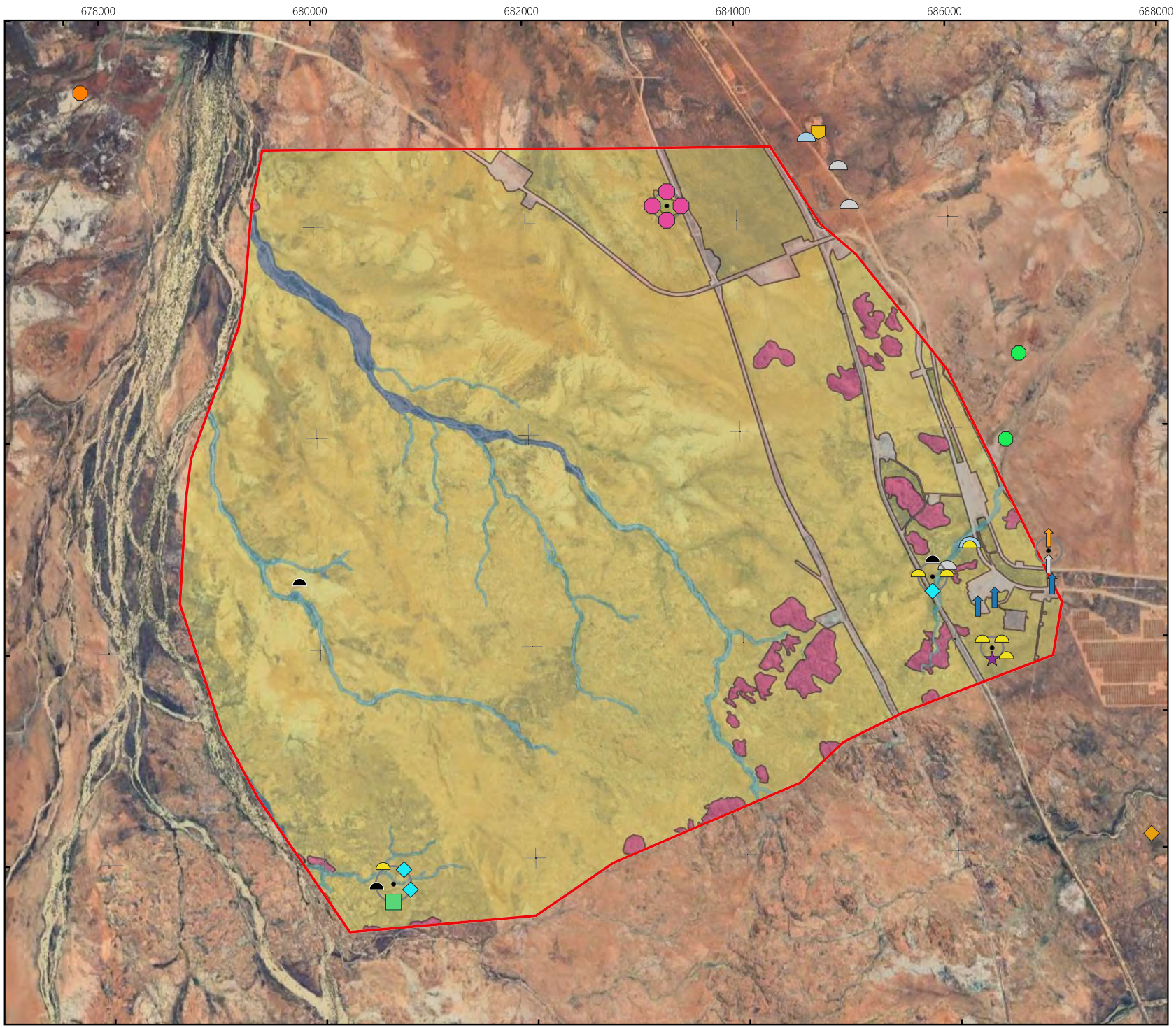
Survey Phase or Date	Site / Location	Type of Record	Fauna Habitat	Habitat Definition (Fortescue)	Easting	Northing
27/05/2021	NSJ_FN_P_FS07 101 m E	Digging (Ecoscape, 2021)	Spinifex Sand Plain	Critical	686897	7650828
This Survey						
Phase 1	NS05	Burrow	Minor Drainage Line	Critical	680657	7647798
Phase 1	NS01-TS	Inactive burrow	Spinifex Sand Plain	Critical	686153	7650861
Phase 1	NS05-MC105	Individual on motion camera	Spinifex Sand Plain	Critical	680683	7647779
Phase 1	NS05	Female captured in pitfall	Spinifex Sand Plain	Critical	680624	7647777
Phase 1	NSOPP08	Inactive burrow	Spinifex Sand Plain	Critical	679811	7650612
Phase 2	NS01	Female with pouch young captured in Elliott	Spinifex Sand Plain	Critical	685777	7650594
Phase 2	NS05	Male captured in Elliott	Spinifex Sand Plain	Critical	680630	7647758
Phase 2	NS01	Burrow	Spinifex Sand Plain	Critical	685753	7650614
Phase 2	NS01	Burrow	Spinifex Sand Plain	Critical	685813	7650557
Phase 2	NS01	Burrow & pophole	Spinifex Sand Plain	Critical	685851	7650611
Phase 2	NS05	Inactive burrow	Minor Drainage Line	Critical	680661	7647762
Phase 2	NSOPP10	Burrow & diggings	Spinifex Sand Plain	Critical	686330	7649879
Phase 2	NSOPP10	Burrow	Spinifex Sand Plain	Critical	686365	7649910
Phase 2	NSOPP10	Burrow	Spinifex Sand Plain	Critical	686352	7649944
Phase 2	NSOPP10	Pophole	Spinifex Sand Plain	Critical	686484	7649804

Critical habitat in Survey Area: Spinifex Sand Plain (91.5%) and Minor Drainage Line (1.4%).

The majority of the Spinifex Sand Plain habitat in the Survey Area is considered potential habitat, as are Minor Drainage Lines. These habitats are suitable for breeding, as the sandy substrate provides optimal conditions for burrow construction (Map 3.6).

Supporting habitat in Survey Area: Spinifex Rocky Plain (0.1%), Major Drainage Line (1.0%) and Granite Domes and Boulder Piles (2.7%).

The Spinifex Rocky Plain (0.1%) could be used for foraging and dispersal and may also be used for breeding depending on the suitability of the substrate. The Major Drainage Line (1.0%) and Granite Domes and Boulder Piles (2.7%) habitat surrounding the preferred habitat, may infrequently be used, especially when foraging and dispersing.



Legend

Survey Area

Other Significant Fauna Records

This Survey

- Brush-tailed Mulgara - capture
- Brush-tailed Mulgara - motion camera
- Brush-tailed Mulgara - active burrow
- Brush-tailed Mulgara - inactive burrow
- Brush-tailed Mulgara - camera recording
- Brush-tailed Mulgara - burrow & diggings
- Western Pebble-mound Mouse - active mound

DBCA Database - Other Surveys

- Brush-tailed Mulgara - capture
- Western Pebble-mound Mouse - likely mound

Fortescue Internal Database - Other Surveys

- Brush-tailed Mulgara - active burrow
- Brush-Tailed Mulgara - digging
- Brush-Tailed Mulgara - digging or burrow
- Brush-tailed Mulgara - inactive burrow
- Western Pebble-mound Mouse - mound

Fortescue's Fauna Monitoring Program

- Spectacled Hare-wallaby

Fauna Habitats

- Spinifex Sand Plain
- Spinifex Rocky Plain
- Major Drainage Line
- Minor Drainage Line
- Granite Domes & Boulder Piles
- Cleared/Disturbed

N

0 0.5 1 1.5 2 km

Scale 1:50,000 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum

[redacted]

Date: 13-01-2025

Other Significant Fauna Records & Habitat

NSJW Project

MAP

Prepared for Fortescue

3.6

3.4.1.6. Spectacled Hare-wallaby (*Lagorchestes conspicillatus*)

Conservation Status: DBCA: Priority 4.

Distribution, Habitat and Ecology: The Spectacled Hare-wallaby (*Lagorchestes conspicillatus leichardti*) is listed as Priority 4 by the DBCA due to the limited knowledge about the species' distribution and ecology. In some areas, the species was presumed extinct (Kimberley region) until 2004, when a specimen was recorded as roadkill (Wysong *et al.*, 2022). Further sightings have been recorded in the Kimberley and Pilbara regions in recent years (Wysong *et al.*, 2022; Spectrum Ecology & Spatial, 2023).

The Spectacled Hare-wallaby is an elusive species that is rarely recorded, and if so, it is mostly found through only secondary evidence (scats). The Spectacled Hare-wallaby are known to inhabit hummock grasslands with a mid-dense or sparse overstory and shelters under long, unburnt spinifex to evade predation and temperature extremes (Menkhorst and Knight, 2001; Van Dyck and Strahan, 2008). The Spectacled Hare-wallaby is solitary and well adapted to arid habitats, with a home range (of up to 177 ha). Their diet of grasses and herbs is dependent on climatic changes and individuals are expected to be nomadic in response to local environmental conditions. (Burbidge and Johnson, 2008).

Occurrence in the Survey Area: The Spectacled Hare-wallaby was recorded within 500 m of the Survey Area in 2022 as detailed in Table 3.12 and shown on Map 3.6 (Spectrum, 2024). Four records were also listed by DBCA from within 10 km of the Survey Area, of which two records were from 2018. The frequency of records in the last 10 years indicates that the species has a high likelihood to occur on an infrequent basis. In September 2024, a video recording was made of an individual crossing the road approx. 4.5 km to the east of the Survey Area (Fortescue internal database) on Spinifex Sand Plain.

Table 3.12: Spectacled Hare-wallaby Records within the Survey Area and 2 km Buffer

Survey Phase or Date	Site / Location	Type of Record	Fauna Habitat	Habitat Definition (Fortescue)	Easting	Northing
Fortescue's Fauna Monitoring Program- (up to 2 km outside)						
07/07/2022	R_F_P_MR_RE_01 455 m E	Motion camera recording	rehabbed area (Spinifex Sand Plain)	N/A / Critical	684791	7654814

Critical habitat in Survey Area: Spinifex Sand Plain (91.5%) and Spinifex Rocky Plain (0.1%).

The Spinifex Sand Plain and Spinifex Rocky Plain habitats are suitable and provides optimal conditions, especially in longer unburnt areas such as in the north-east of the Survey Area. The remainder of the Spinifex Sand Plain habitat was recently burnt, limiting the shelter and suitability for the immediate future (Map 3.6).

Supporting habitat in Survey Area: Major Drainage Line (1.0%) and Minor Drainage Line (1.4%).

Not much is known about this species habitat preferences, but it's likely this species uses both these habitats on an occasional basis for foraging and dispersal.

3.4.1.7. Western Pebble-mound Mouse (*Pseudomys chapmani*)

Conservation Status: DBCA Priority 4.

Distribution, Habitat and Ecology: The Western Pebble-mound Mouse is endemic to the Pilbara region of Western Australia. Distribution extends from southern and central Pilbara to the Little Sandy Desert (Van Dyck and Strahan, 2008) It is one of three species of Australian rodent that constructs an underground burrow system with a permanent arrangement of stones above ground at the entrances (Anstee, Roberts and Shea, 1997). They are found on pebbled soil in arid tussock grassland and acacia woodland on gentle slopes of rocky ranges, with hard spinifex and scattered shrubs. The mice have a complex social structure and are known to occur in groups of up to 12 animals, who may utilise several burrow structures (Anstee, Roberts and Shea, 1997). Male home ranges were found to be considerably larger than those of females, particularly during breeding season (Anstee, Roberts and Shea, 1997).

Occurrence in the Survey Area: Four active mounds of the Western Pebble-mound Mouse were previously recorded from the Survey Area (ecologia, 2012), with an additional three records within 2 km of the Survey Area (Table 3.13, Map 3.6). The mounds within the Survey Area were revisited during the survey and assessed as recently active (Table 3.13, Plate 3.4).

Table 3.13: Western Pebble-mound Mouse Records within the Survey Area and 2 km Buffer

Survey Phase or Date	Site / Location	Type of Record / Reference	Fauna Habitat	Habitat Definition (Fortescue)	Easting	Northing
This Survey & DBCA Database & Fortescue's Internal Database – Previous Survey						
Phase 1/2 & 17/05/2012	PMM01	Recently active mound (ecologia, 2012)	Spinifex Rocky Plain	Critical	683363	7654119
Phase 1/2 & 17/05/2012	PMM02	Recently active mound (ecologia, 2012)	Spinifex Rocky Plain	Critical	683373	7654134
Phase 1/2 & 17/05/2012	PMM03	Recently active mound (ecologia, 2012)	Spinifex Rocky Plain	Critical	683323	7654184
Phase 1/2 & 17/05/2012	PMM04	Recently active mound (ecologia, 2012)	Spinifex Rocky Plain	Critical	683322	7654144
DBCA Database – Previous Survey (up to 2 km outside)						
01/04/2013	1.8 km WNW	Uknown – likely mound	Likely Spinifex Rocky Plain	Critical	677818	7655310
Fortescue's Internal Database – Previous Survey (up to 2 km outside)						
26/05/2021	NSJ_FN_P_FS01 204 m E	Mound – status unknown (Ecoscape, 2021)	Likely Spinifex Rocky Plain	Critical	686512	7651884
26/05/2021	NSJ_FN_P_FS02 675 m E	Mound – status unknown (Ecoscape, 2021)	Likely Spinifex Rocky Plain	Critical	686649	7652696

Critical habitat in Survey Area: Spinifex Rocky Plain (0.1%), with further less optimal habitat in the Spinifex Sandy Plain (91.5%), in areas close to the Granite Domes and Boulders Piles, where suitable rocky substrate occurs (Map 3.6).

Supporting habitat in Survey Area: Not present.

Plate 3.4: Recently Active Western Pebble-mound Mouse Mounds in the Survey Area

3.4.2. Birds

3.4.2.1. Grey Falcon (*Falco hypoleucos*)

Conservation Status: EPBC Act & BC Act: Vulnerable.

Distribution, Habitat and Ecology: The Grey Falcon is the rarest falcon in Australia with an estimated population size of <1000 individuals (Schoenjahn, 2013). They occur sparsely in a wide variety of arid and semi-arid zones across an area of about 5 million km^2 (Schoenjahn, Pavey and Walter, 2020). They have not been found to be associated with any particular vegetation types; however, climate characteristics such as temperature and rainfall appear to strongly influence the distribution of the species (Schoenjahn et al, 2020). This species movements, including their home range size, are poorly understood (Schoenjahn et al, 2020). It is likely their home ranges are large, with the species travelling long distances. However, the Grey Falcon may also be considered, to some extent nomadic, moving to where conditions are more favourable (Schoenjahn, Pavey and Walter, 2020).

The Grey Falcon breeding period is from June to November, with a clutch size varying between 1 to 4 eggs (Olson and Olson, 1986; Garnett et al, 2011; Schoenjahn, 2013). Breeding habitat appears to be localised in zones with the highest annual average temperatures, and areas with persistently dry and winter drought climatic conditions (Schoenjahn, 2013). Grey Falcons typically use the nests of other large birds (corvids and raptors), generally in tall trees such as River Red Gums (*Eucalyptus camaldulensis*) along drainage lines or on man-made infrastructure such as repeater towers or power-line pylons (Olson and Olson, 1986). Nests are often used over several years and can be near nests of other falcons or raptor species (Schoenjahn, 2013).

The Grey Falcon forages in open landscapes such as rocky plains with hummock grasslands, lower shrublands, open woodland and small drainage lines where they predominantly prey on birds, mainly pigeons and parrots (Olson and Olson, 1986; Schoenjahn, 2013).

Occurrence in the Survey Area: The Grey Falcon was previously recorded just outside the Survey Area in 2012 as outlined in Table 3.14 and shown on Map 3.7. It's likely three individuals were recorded during the survey, with at least one individual sighted twice. The individual was soaring above the Major Drainage Line habitat in the north-west, and a pair was recorded perched on powerlines, 1.1 km south of the Survey Area (Table 3.14, Map 3.7). The pair moved along the powerlines adjacent to the Fortescue Main Line Rail in a northwards direction from Rail Camp 145 towards the Survey Area over the duration of the Phase 1 survey

which coincided with the pre-breeding season (June to November, Plate 3.5). It is likely that the pair was in search of a suitable nesting site.

Table 3.14: Grey Falcon Records within the Survey Area and 2 km Buffer

Survey Phase or Date	Site / Location	Type of Record	Fauna Habitat	Habitat Definition (Fortescue)	Easting	Northing
DBCA Database – Previous Survey (up to 2 km outside)						
17/08/2012	281 m W	Unknown but likely an observation	Major Drainage Line	Critical	679009	7653160
This Survey						
Phase 1	NS04	Soaring	Major Drainage Line / Spinifex Sand Plain	Critical / Supporting	680159	7653231
Phase 1	GFC01 (NSOPP02)	Soaring	Major Drainage Line / Spinifex Sand Plain	Critical / Supporting	679467	7653875
Phase 1	GF06 1.1 km S	Pair perched on powerlines, south of the Survey Area	Likely Spinifex Sand Plain	Supporting	686724	7648572

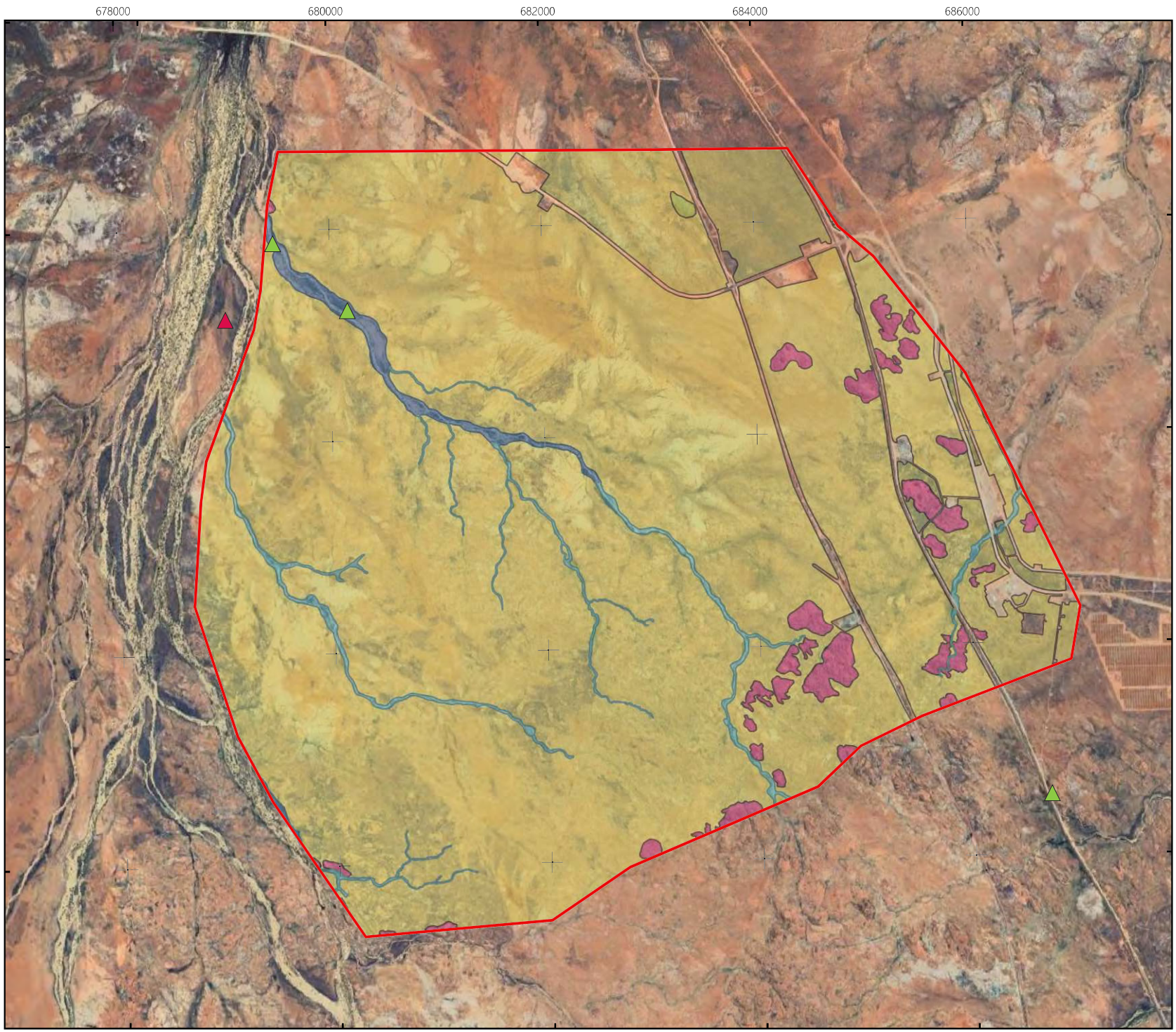
Critical habitat in Survey Area: Major Drainage Line (1.0% of Survey Area).

Suitable breeding habitat is present within the Survey Area in the Major Drainage Line, where tall, large trees such as River Red Gum (*Eucalyptus camaldulensis)* are present. The species may use the Major Drainage Line habitat in the Survey Area and surrounding vicinity (Turner River East) for breeding. Additionally, structures such as repeater towers and powerlines may be used for breeding. These are present in the Survey Area, along the Main Line Rail and vicinity, Junction Camp, and Roy Hill Rail Line.

Supporting habitat in Survey Area: Minor Drainage Line, Spinifex Sand Plain and Spinifex Rocky Plain.

These habitats are likely used for foraging and dispersal on a regular or occasional basis depending on if climatic conditions are favourable and if breeding is occurring in the vicinity (Map 3.7).

Plate 3.5: Pair of Grey Falcons Recorded South of the Survey Area



Legend

Survey Area

Grey Falcon Records

This Survey

Sighting

Outside Survey Area (<2 km)

DBCA Database

Fauna Habitats

Critical Habitats

Major Drainage Line

Supporting Habitats

Minor Drainage Line

Spinifex Sand Plain

Spinifex Rocky Plain

N

0 0.5 1 1.5 2 km

Scale 1:50,000 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum

Date: 14-01-2025

Grey Falcon Records & Habitat

NSJW Project

MAP 3.7

Prepared for Fortescue

3.4.2.2. Pacific Swift (*Apus pacificus*)

Conservation Status: EPBC Act & BC Act: Migratory.

Distribution, Habitat and Ecology: The Pacific Swift is a migratory, non-breeding visitor to Australia. Within Western Australia, records are most abundant in coastal areas of the, southwest, Pilbara, and Kimberley regions (DAWE 2020). This medium sized swift is characterised by its forked tail and white rump, with back swept wings that taper to a fine point (Menkhorst et al., 2019). The species is known to be highly nomadic, rarely landing, spending much of their time foraging in large flocks high above the canopy. The species is known to be insectivorous, but its food source is relatively unknown within Australia (Menkhorst et al., 2019). Large flocks are often associated with low pressure storm systems (DAWE 2020).

Occurrence in the Survey Area: Two records were made from <10 km north and east of the Survey Area (Map 3.1). The Pacific Swift has an almost entirely aerial lifestyle and can occur anywhere when thunderstorms move through the area.

Critical habitat in Survey Area: Not present.

No critical habitat was identified in the Survey Area for the Pacific Swift.

Supporting habitat in Survey Area: Not present.

No supporting habitat was identified in the Survey Area for the Pacific Swift as this species is unlikely to land due to its aerial lifestyle and utilise any habitats on site.

3.4.2.3. Oriental Plover (*Charadrius veredus*)

Conservation Status: EPBC Act & BC Act: Migratory.

Distribution, Habitat and Ecology: The Oriental Plover has been recorded within all states In Australia but is most common in in coastal areas of Northern Australia, notably many thousands gather on Eighty-mile Beach from August onwards (Menkhorst *et al.*, 2019b). The species is migratory to Australia from breeding grounds in China. It is easily identifiable by its dark underparts and long pale legs. When in flight it is the only plover with a dark rump, no wing bar, and a distinctly grey-brown underwing. The species is generally found inland within arid and semi-arid zones. They are known to prefer open areas such as grasslands and sparsely vegetated plains including burnt and heavily grazed areas. Feeding in flocks in the morning, evening and after dark they forage in loose flocks for insects. During the hottest parts of the day they can collect in large flocks on wet ground associated with wetlands.

Occurrence in the Survey Area: The Oriental Plover has only been recorded once from within 21 km north-east of the Survey Area (Map 3.1). The Survey Area may be visited occasionally when conditions are optimal (after rainfall events), so this species has been given a medium likelihood to occur.

Critical habitat in Survey Area: Not present.

No critical habitat was identified in the Survey Area for the Oriental Plover.

Supporting habitat in Survey Area: Spinifex Sand Plain (91.5%) and Major Drainage Line (1.0%).

The species can occur sporadically in a variety of habitats, particularly after rainfall events, so the Spinifex Sand Plain and possibly the Major Drainage Line habitats may be visited infrequently for foraging (Map 3.6).

3.4.2.4. Common Greenshank (*Tringa nebularia*)

Conservation Status: EBPC & BC Act: Migratory

Distribution, Habitat and Ecology: This Common Greenshank is a migratory visitor to Australia, with breeding occurring in Eurasia, Palearctic regions, Asia, India, and Africa. They are common throughout the northern and western areas of Australia, particularly along the coastline in Autumn and Spring when migration occurs (Department of the Environment and Energy, 2018a, 2018b).

The Common Greenshank inhabits well-vegetated, wetlands, swamps, floodplains, water holes, artificial wetlands, channels, clay pans, inland lakes, estuaries and coastal areas, particularly in north-west Australia. They wade through shallow waters, feeding on a wide variety of prey including; molluscs, crustaceans, insects, fish frogs, lizards, rodents, and annelids. (Department of the Environment and Energy, 2018c, 2018a, 2018b).

Occurrence in the Survey Area: The Common Greenshank has been recorded three times in the past 20 years from within 50 km of the Survey Area (Map 3.1).

Critical habitat in Survey Area: Not present.

No critical habitat was identified in the Survey Area for the Common Greenshank.

Supporting habitat in Survey Area: Major Drainage Line (1.0%) and Spinifex Sand Plain (91.5%).

It can be found sporadically after rainfall events in areas of inundation, such as the vicinity of the Turner River (Major Drainage Line (1.0%)) and nearby Spinifex Sand Plain habitat where clay dominated areas retain surface water (Map 3.6). Visits are for foraging purposes only.

3.4.2.5. Peregrine Falcon (*Falco peregrinus*)

Conservation Status: BC Act: Other Specially Protected Fauna (OS).

Distribution, Habitat and Ecology: The Peregrine Falcon is one of the most widespread birds in the world, breeding on all continents except Antarctica. It occurs across most of Australia, although it is an uncommon species and is rare across all states and territories (Birdlife Australia, 2012). They are known to be both a nomadic and sedentary species. They inhabit cliffs, coastal habitats, rivers, wooded water courses and lakes, as well as urban environments. Peregrine Falcons usually nest by making a scrape on a high cliff-edge but will also use stick nests of other large birds and tree hollows in some areas (Olsen *et al.*, 2006). Hunting is mainly done during the day and feeding is primarily on small- to medium-sized birds caught in flight, often above drainage lines and rivers with favoured species reflecting the local prey profile (Birdlife Australia, 2012; Palmer, Rose and Debus, 2019).

Occurrence in the Survey Area: The Peregrine Falcon is a sporadic bird of prey in the Pilbara region with four records within 25 km of the Survey Area between 2000-2013 (Map 3.1).

Critical habitat in Survey Area: Not present.

There was no nesting or roosting habitat (cliff faces) for this species in the Survey Area.

Supporting habitat in Survey Area: Major Drainage Line (1.0%), Minor Drainage Line (1.4%), Spinifex Sand Plain (91.5%) and Spinifex Rocky Plain (0.1%).

Foraging could occur along the Major and Minor Drainage Lines and possibly within the Spinifex Sand Plain and Rocky Plain habitats (Map 3.6).

3.4.3. Reptiles

3.4.3.1. Pilbara Olive Python (*Liasis olivaceus barroni*)

Conservation Status: EPBC Act & BC Act: Vulnerable.

Distribution, Habitat and Ecology: The Pilbara Olive Python is a subspecies of Olive Python which is geographically separated from populations in the Kimberley, Northern Territory and Queensland (Wilson and Swan, 2017). They are one of the largest python species in Australia, growing up to 4.5 m in length (Wilson and Swan, 2017) and are often seen near water or in pools where they ambush prey such as birds, rodents, bats and wallabies (Pearson, 2003; Ellis, 2010; Wilson and Swan, 2021). Male Pilbara Olive Pythons travel up to 4 km during the winter months in search of females to mate with, with home ranges thought to be up to 450 ha (Pearson, 2003). Habitat requirements of the Pilbara Olive Python are thought to vary throughout the year due to changes in temperature and breeding activities. Dispersal during the wet season occurs across rocky habitats supporting water sources and drainage lines (Pearson, 2003). Pools of surface water are utilised for hunting whilst nearby caves, crevices and sometimes debris or tree hollows are used for shelter. During the cooler months, the pythons will shelter in caves and rock crevices, away from water (DEWHA 2008).

Reproduction is dependent upon environmental factors attributing to body condition. Where conditions are optimal, eggs are laid in Spring with young hatching at the start of the wet season (Dec-Jan). Once hatched, the young will disperse whilst foraging conditions for reptiles are ideal (Pearson, 2003).

Occurrence in the Survey Area: The species has been sighted 16 times within 25 km of the Survey Area between 2011 – 2017. The closest record is 7.5 km north-west of the Survey Area. This species may use the Survey Area infrequently and has a medium likelihood of occurrence.

Critical habitat in Survey Area: Not present.

No critical habitat was identified for the Pilbara Olive Python.

Supporting habitat in Survey Area: Major Drainage Line (1.0%), Minor Drainage Line (1.4%), and Granite Domes and Boulder Piles (2.7%).

Habitat use within the Survey Area is likely limited to foraging and dispersal only. The Major Drainage Line habitat is suitable for foraging and dispersal, while the Minor Drainage Line habitat may also be used sporadically. The Granite Domes and Boulders Piles habitat in the vicinity of the Major Drainage Line habitat is likely also used for foraging and potentially for breeding (Map 3.8).

3.4.3.2. Pin-striped Finesnout Ctenotus (*Ctenotus nigrilineatus*)

Conservation Status: DBCA Priority 1.

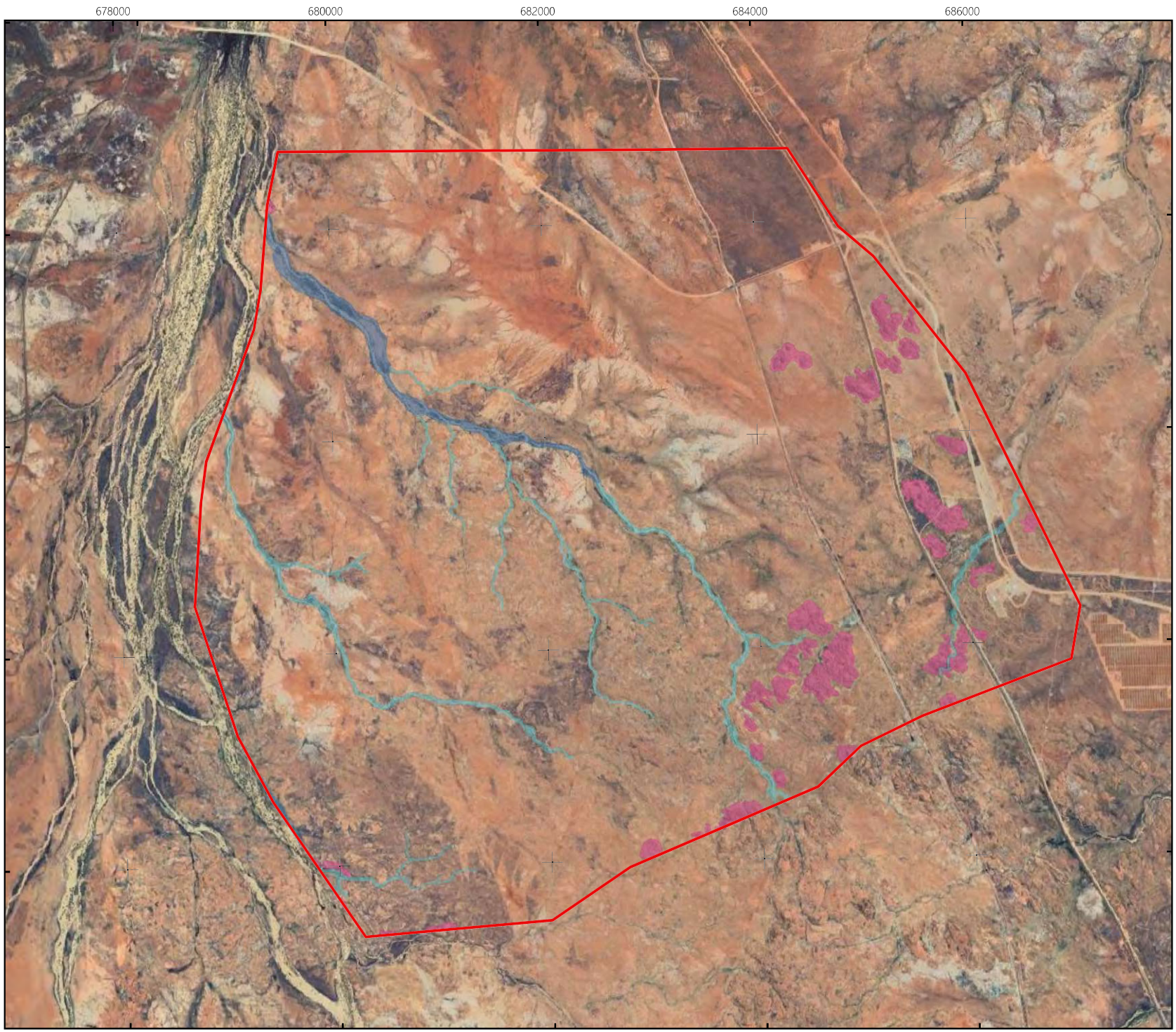
Distribution, Habitat and Ecology: The Pin-striped Ctenotus is a swift and diurnal slender skink with a pattern of eight pale stripes down its back. Most Ctenotus skinks forage as invertebrate generalists feeding on exposed terrain or along vegetation edges (Wilson and Swan, 2017). It is endemic to the Pilbara region and records are isolated and limited to Nullagine, Meentheena and Marble Bar (DPaW 2018). The Pin-striped Ctenotus is known to occur on Spinifex plains adjacent to granite outcrops and watercourses (Wilson and Swan, 2017). Very little information is known about this species due to the small number of records made to date.

Occurrence in the Survey Area: The Pin-striped Finesnout Ctenotus is only known from few records and therefore this species has a medium likelihood to occur. One record is known from 2012 within 25 km of the Survey Area, with an additional four records within 50 km (Map 3.1). However, extensive survey effort inside and surrounding the Survey Area (Table 2.2) has failed to record the species to date.

Critical habitat in Survey Area: Spinifex Sand Plain (91.5%).

The Spinifex Sand Plain habitat in areas where this habitat intersects the Granite Domes and Boulder Piles (2.7%) and Major/Minor Drainage Lines (1.0% and 1.4%) could be considered critical as this appears to be their preferential habitat (Map 3.6).

Supporting habitat in Survey Area: Major Drainage Line (1.0%), Minor Drainage Line (1.4%), and Granite Domes and Boulder Piles (2.7%), however the habitat preference of this species is large unknown and based on very few records.



Legend

Survey Area

Supporting Habitats

- Major Drainage Line
- Minor Drainage Line
- Granite Domes & Boulder Piles

N

0 0.5 1 1.5 2 km

Scale 1:50,000 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum

Date: 14-01-2025

Pilbara Olive Python Habitat

NSJW Project

MAP

Prepared for Fortescue

3.8

4. CONCLUSION

A total of five fauna habitat types were recorded from the Survey Area, these include: Spinifex Sand Plain; Spinifex Rocky Plain; Major Drainage Line; Minor Drainage Line; and Granite Domes and Boulder Piles. The most common fauna habitat at the Survey Area is Spinifex Sand Plain habitat (91.5%) followed by Granite Domes and Boulder Piles (2.7%). All habitat types are common in the Pilbara region, however the Granite Domes and Boulder Piles, and the Major and Minor Drainage Lines have the highest value for significant fauna (Northern Quoll, Bilby, Pilbara Leaf-nosed Bat, Ghost Bat, Brush-tailed Mulgara, Grey Falcon, Pilbara Olive Python, and Migratory Birds) followed by the Spinifex Sand Plain (Bilby, Brush-tailed Mulgara and Spectacled Hare-wallaby).

The majority of species potentially occurring at the Survey Area were recorded during the survey with 95% of trappable fauna (mammals, reptiles and amphibians) and 96% of the potential bird species.

Seven species of significance were recorded from the Survey Area during the current or previous surveys:

- Northern Quoll (*Dasyurus hallucatus*, EPBC Act & BC Act EN);
- Bilby (*Macrotis lagotis*, EPBC Act & BC Act VU);
- Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*, EPBC Act & BC Act VU);
- Grey Falcon (*Falco hypoleucos*, EPBC Act & BC Act VU);
- Brush-tailed Mulgara (*Dasycercus blythi*, DBCA P4);
- Western Pebble-mound Mouse (*Pseudomys chapmani*, DBCA P4, secondary evidence only); and
- Ghost Bat (*Macroderma gigas*; EPBC Act & BC Act VU, previously recorded).

A further seven species (one mammal, four birds, two reptiles) were assessed to have a medium to high likelihood of occurrence based on previous regional records and the habitat types present within the Survey Area.

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APPENDIX A: CONSERVATION CODES

Appendix A1: Definitions of Conservation Categories under the EPBC Act 1999.

Category	Definition
Extinct	The last member of the species has died.
Extinct in the Wild	Species known to survive only in cultivation or in captivity, or as a naturalised population well outside its past range.
Critically Endangered	Species facing an extremely high risk of extinction in the wild in the immediate future.
Endangered	Species facing a very high risk of extinction in the wild in the near future.
Vulnerable	Species facing a high risk of extinction in the wild in the medium-term future.
Conservation Dependent	Species the focus of a specific conservation program without which the species would become vulnerable, endangered, or critically endangered within five years.
Migratory	The EPBC Act provides for protection of migratory species as a matter of national environmental significance. Migratory species are those animals that migrate to Australia and its external territories or pass though or over Australian waters during their annual migrations (DotE 2013). Migratory species are listed under the following international conventions: • Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention); • China-Australia Migratory Bird Agreement (CAMBA); • Japan-Australia Migratory Bird Agreement (JAMBA); and, Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA).

Appendix A2: Definitions of Conservation Categories Under the BC Act 2016

Category (Code)	Definition
Threatened Species Protected under the Biodiversity Conservation Act and listed under the most recent Wildlife Conservation (Specially Protected Fauna Notice) or Wildlife Conservation (Rare Flora Notice). Species are listed as threatened when they face a high to very high risk of extinction in the wild.	
Critically Endangered (CR)	Species facing an extremely high risk of extinction in the wild in the immediate future.
Endangered (EN)	Species facing a very high risk of extinction in the wild in the near future.
Vulnerable (VU)	Species considered to be "facing a high risk of extinction in the wild in the medium-term future.
Extinct species	
Extinct species (EX)	The last member of the species has died.
Extinct in the wild species (EW)	Species known to survive only in cultivation or in captivity, or as a naturalised population well outside its past range.
Specially protected species Species of special conservation interest; migratory species; cetaceans; species subject to international agreement; or species otherwise in need of special protection.	
Migratory species (MI)	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. 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.
Conservation Dependent (CD)	Fauna or flora of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened.
Other specially protected species (OS)	Fauna otherwise in need of special protection to ensure their conservation.

Appendix A2: Department of Biodiversity, Conservation and Attractions Priority Listing

Category	Definition
Priority species (P) Species that do not have statutory protection under the Biodiversity Conservation Act 2016, but are identified as conservation priorities due to insufficient information to assess their conservation status or they are deemed rare but not threatened, necessitating ongoing monitoring. A register of priority species is managed by the Department of Biodiversity Conservation and Attractions (DBCA).	
Priority 1	Poorly known species that are known from one or a few locations which are potentially at risk.
Priority 2	Poorly known species that are known from one or a few locations, some of which are on managed.
Priority 3	Poorly known species that are known from several locations, and the species does not appear to be under imminent threat.
Priority 4	(a) Rare. Species 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. (b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for vulnerable but are not listed as Conservation Dependent. (c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

APPENDIX B: FAUNA SITE LOCATIONS

Site Name	Coordinates		Survey Type/Effort
	Eastings	Northing	
NS01	685842	7650675	Vertebrate Trap site for 7 nights over 2 phases, 2 bat recorders, systematic bird site
NS02	683888	7653684	Vertebrate Trap site for 7 nights over 2 phases, 2 bat recorders, systematic bird site
NS03	682231	7653978	Vertebrate Trap site for 7 nights over 2 phases, 2 bat recorders, systematic bird site
NS04	680038	7653289	Vertebrate Trap site for 7 nights over 2 phases, 2 bat recorders, systematic bird site
NS05	680769	7647789	Vertebrate Trap site for 7 nights over 2 phases, 2 bat recorders, systematic bird site
S01	683793	7648471	Targeted Trap site (5 cages, 5 motion cameras & 1 bat recorder for 4 nights)
S02	681530	7652069	Targeted Trap site (5 cages, 5 motion cameras & 1 bat recorder for 4 nights)
S03	685260	7652993	Targeted Trap site (5 cages, 5 motion cameras & 1 bat recorder for 4 nights)
GFC01	679475	7653869	Grey Falcon Targeted Search Sites/nest assessment
GFC02	679008	7652245	Grey Falcon Targeted Search Sites/nest assessment
GFC03	682324	7651818	Grey Falcon Targeted Search Sites/nest assessment
GFC04	685901	7651886	Grey Falcon Targeted Search Sites/nest assessment
GFC05	681560	7652124	Grey Falcon Targeted Search Sites/nest assessment
GFC06	686725	7648572	Grey Falcon Targeted Search Sites/nest assessment
GFC07	685290	7651654	Grey Falcon Targeted Search Sites/nest assessment
GFC08	684889	7653535	Grey Falcon Targeted Search Sites/nest assessment
GFC09	684738	7653943	Grey Falcon Targeted Search Sites/nest assessment
GFC10	686485	7649807	Grey Falcon Targeted Search Sites/nest assessment
HAB01	681760	7652226	Habitat Assessment
HAB02	684435	7649958	Habitat Assessment
HAB03	683368	7651716	Habitat Assessment
HAB04	681020	7653687	Habitat Assessment
MC01	684460	7652657	Motion Camera site (5 cameras for 6 weeks)
MC02	685770	7649769	Motion Camera site (5 cameras for 6 weeks)
MC03	684802	7649768	Motion Camera site (5 cameras for 6 weeks)
MC04	680949	7647409	Motion Camera site (5 cameras for 6 weeks)
MC05	683345	7654139	Motion Camera site (5 cameras for 6 weeks)
MC06	679906	7647965	Motion Camera site (5 cameras for 6 weeks)
MC07	682656	7651824	Motion Camera site (5 cameras for 6 weeks)
MC08	686560	7651163	Motion Camera site (5 cameras for 6 weeks)
MC09	681634	7650525	Motion Camera site (5 cameras for 6 weeks)
NSOPP01	683917	7654282	Opportunistic Site
NSOPP02	679476	7653867	Opportunistic Site
NSOPP03	683917	7654282	Opportunistic Site
NSOPP04	680163	7647485	Opportunistic Site
NSOPP05	682394	7651684	Opportunistic Site
NSOPP06	683343	7654197	Opportunistic Site
NSOPP07	685620	7651974	Opportunistic Site
NSOPP08	679809	7650462	Opportunistic Site

Site Name	Coordinates		Survey Type/Effort
	Eastings	Northing	
NSOPP09	679761	7650594	Opportunistic Site
NSOPP10	682414	7650375	Opportunistic Site
NSOPP11	686318	7649938	Opportunistic Site
NSOPP12	682599	7651835	Opportunistic Site
NSOPP13	682450	7650299	Opportunistic Site
NSOPP14	679771	7654599	Opportunistic Site
NSOPP15	679918	7649903	Opportunistic Site
NSOPP16	682054	7652391	Opportunistic Site

Datum: GDA94, zone 50K

APPENDIX C: REGIONAL FAUNA APPENDIX

Family & Species Name	Common name	Conservation Status			Database Searches				Literature Review																																		Current Survey
		EPBC Act	BC Act	DBCA	NatureMap	DBCA	PMST	ALA	Fortescue Internal Database	Fauna Monitoring 2019-2023	North Star Junction (360, 2023)	North Star Junction (Ecoscape, 2021)	Pilbara Transmission Project (Ecoscape, 2020)	Pilbara Transmission Project (Spectrum Ecology, 2018)	North Star Project (Ecologia, 2012a)	North Star Access Corridor (Ecologia, 2012b)	North Star Aerodrome (Ecologia, 2015c)	North Star Filtration Plan (Ecologia, 2014c)	Targeted Fauna Assessment (Bamford, 2010)	Roy Hill (TE, 2011)	Rail Corridor GDP (Ecoscape, 2009)	Proposed Rail Corridor and Borrow Pits (ATA, 2007)	FMG Stage A (Biota, 2004)	Wodgina Lithium (Western Wildlife, 2020)	Pippingarra and Wodgina Roads (Ecoscape, 2020)	Wodgina Project (Stantec, 2018)	Wodgina Hercules (Outback Ecology, 2011)	Wodgina DSO (Outback Ecology, 2009)	Wodgina NQ (Outback Ecology, 2012)	Wodgina Bat (Outback Ecology, 2011)	Wodgina Gas Pipeline (360, 2018)	Pilgangoora (360, 2016)	E45/2287 Infill Pilgangoora (APM, 2023)	P1000 Pilgangoora (APM, 2024)	FMG Glacier (GHD, 2020)	Glacier Valley (Spectrum, 2021)	Abydos DSO (Outback Ecology, 2011)	(Molhar, 2007)	(MWH, 2015)	Mt Dove DSO (Outback Ecology, 2011)	Mt Dove Bat (Outback Ecology, 2011)	Panorama (Bamford, 2001)	
Mammals																																											
TACHYGLOSSIDAE																																											
Tachyglossus aculeatus	Echidna				✓			✓		✓													✓	✓		✓									✓		✓			✓		✓	
DASYURIDAE																																											
Dasycercus blythi	Brush-tailed Mulgara			P4	✓	✓		✓	✓	✓		✓	S	✓					✓		S	✓									✓			✓								✓	✓
Dasykaluta rosamondae	Little Red Kaluta				✓			✓	✓						✓								✓	✓		✓					✓					✓				✓			✓
Dasyurus hallucatus	Northern Quoll	EN	EN		✓	✓	✓	✓	✓	✓	✓			✓	✓		S					✓	✓	✓		✓	✓	✓	✓						✓	✓	✓		✓	✓		✓	✓
Ningaui ridei	Wongai Ningaui																						✓																				
Ningaui timealeyi	Pilbara Ningaui				✓			✓		✓	✓				✓								✓	✓																		✓	
Planigale tealei	Cracking-clay Pilbara Planigale														Δ								Δ				Δ	Δ				Δ			✓		Δ			Δ		Δ	
Planigale kendricki	Orange-headed Pilbara Planigale				✓					✓					Δ								Δ	✓			Δ	Δ				Δ				✓	Δ			Δ		Δ	✓
Pseudantechinus macdonnellensis	Fat-tailed Pseudantechinus				✓			✓		Δ																																✓	Δ
Pseudantechinus woolleyae	Woolley's Pseudantechinus				✓			✓		Δ							✓							✓				✓					✓				✓						Δ
Antechinomys longicaudatus	Long-tailed Dunnart			P4	✓	✓			✓						✓													✓							✓								
Sminthopsis macroura	Stripe-faced Dunnart				✓			✓															✓			✓														✓			
Sminthopsis ooldea	Ooldea Dunnart				✓																																						
Sminthopsis youngsoni	Lesser Hairy-footed Dunnart				✓			✓							✓								✓																				✓
THYLACOMYIDAE																																											
Macrotis lagotis	Bilby	VU	VU		✓	✓	✓	✓	✓	✓		S	S	✓					S	S	S	✓									✓												✓
MACROPODIDAE																																											
Lagorchestes conspicillatus leichardti	Spectacled Hare-wallaby			P4	✓	✓		✓	✓	✓																																✓	
Osphranter robustus	Euro				✓			✓		✓		✓			✓	✓	✓	✓	S				✓	✓	✓	✓	✓	✓				✓	✓		✓	✓	✓		✓	✓		✓	✓
Osphranter rufus	Red Kangaroo				✓			✓		✓	✓								✓																					✓			✓
Petrogale rothschildi	Rothschild's Rock-wallaby				✓			✓		✓					✓								✓	✓		✓		✓							✓	✓	✓		✓			✓	
MURIDAE																																											
Leggadina lakedownensis	Short-tailed Mouse			P4	✓	✓								✓									✓																				
Notomys alexis alexis	Spinifex Hopping-mouse				✓			✓		✓	✓													✓		✓					✓									✓			
Pseudomys chapmani	Western Pebble-mound Mouse			P4	✓	✓		✓	✓		✓	✓		✓	✓	✓	✓		S	S	S			S	✓	S	S	S												S		S	S
Pseudomys delicatulus	Delicate Mouse				✓			✓							✓								✓													✓						✓	
Pseudomys desertor	Desert Mouse				✓			✓							✓								✓	✓										✓		✓						✓	
Pseudomys hermannsburgensis	Sandy Inland Mouse				✓			✓			✓				✓								✓	✓								✓				✓	✓			✓			✓
Zyzomys argurus	Common Rock-rat				✓			✓		✓	✓				✓		✓						✓	✓		✓		✓	✓				✓	✓		✓	✓		✓			✓	✓
RHINONYCTERIDAE																																											
Rhinonicteris aurantia (Pilbara Form)	Pilbara Leaf-nosed Bat	VU	VU		✓	✓	✓		✓	✓	✓			✓	✓			✓						✓		✓	✓	✓		✓	✓		✓		✓		✓	✓		✓	✓	✓	✓
MEGADERMATIDAE																																											
Macroderma gigas	Ghost Bat	VU	VU		✓	✓	✓	✓	✓	✓				✓												✓	✓	✓		✓					✓		✓			✓		✓	
EMBALLONURIDAE																																											
Saccolaimus flaviventris	Yellow-bellied Sheathtail Bat				✓													✓						✓	✓		✓	✓		✓							✓			✓	✓		✓
Taphozous georgianus	Common Sheathtail Bat				✓			✓				✓			✓									✓	✓	✓	✓	✓		✓					✓	✓	✓			✓	✓	✓	✓
MOLOSSIDAE																																											
Austronomus australis	White-striped Free-tailed Bat				✓			✓																✓	✓	✓		✓							✓							✓	
Chaerephon jobensis	Greater Northern Free-tailed Bat				✓						✓	✓						✓						✓	✓			✓							✓								✓
Ozimops lumsdenae	Northern Free-tailed Bat				✓																																						
VESPERTILIONIDAE																																											
Chalinolobus gouldii	Gould's Wattled Bat				✓						✓	✓			✓			✓					✓	✓	✓	✓	✓	✓		✓							✓			✓	✓		✓
Nyctophilus daedalus	Pallid Long-eared Bat																																										Δ
Nyctophilus geoffroyi	Lesser Long-eared Bat				✓										✓																												Δ
Scotorepens greyii	Little Broad-nosed Bat				✓			✓			✓	✓			✓								✓	✓	✓	✓	✓	✓		✓					✓		✓			✓	✓		✓
Vespadelus finlaysoni	Finlayson's Cave Bat				✓			✓			✓	✓			✓			✓					✓	✓	✓	✓	✓	✓		✓					✓	✓	✓			✓	✓	✓	✓
INTRODUCED MAMMALS																																											
**Mus musculus*	House Mouse				✓			✓		✓													✓	✓																		✓	
**Oryctolagus cuniculus*	Rabbit									✓																																	
**Canis familiaris*	Dog/Dingo				✓			✓		✓	✓	✓				✓		✓					✓	✓	✓	✓									✓	✓	✓			✓		✓	✓
**Vulpes vulpes*	Red Fox				✓			✓		✓																✓									✓				✓	✓			
**Felis catus*	Cat				✓			✓		✓	✓	✓			✓	✓		✓					✓	✓		✓		✓			✓		✓	✓		✓	✓		✓	✓		✓	✓
**Equus asinus*	Donkey				✓			✓								✓							✓		✓															✓		✓	✓
**Equus ferus caballus*	Horse				✓						✓																																✓
**Camelus dromedarius*	Camel				✓			✓							✓								✓												✓					✓		✓	
**Bos primigenius taurus*	European Cattle				✓					✓	✓				✓	✓	✓	✓					✓	✓		✓	✓	✓					✓	✓		✓	✓		✓	✓			✓
Birds																																											
CASUARIIDAE																																											
Dromaius novaehollandiae	Emu				✓			✓											✓				✓																	✓			✓
ANATIDAE																																											
Dendrocygna eytoni	Plumed Whistling-Duck				✓																																						
Cygnus atratus	Black Swan				✓			✓							✓																												
Stictonetta naevosa	Freckled duck							✓																																			
Chenonetta jubata	Australian Wood Duck				✓			✓																																			
Malacorhynchus membranaceus	Pink-eared Duck				✓			✓																																			
Anas superciliosa	Pacific Black Duck				✓			✓							✓								✓	✓																		✓	
Anas gracilis	Grey Teal				✓			✓			✓				✓									✓																			
Aythya australis	Hardhead				✓			✓																✓																			
PHASIANIDAE																																											
Coturnix pectoralis	Stubble Quail																						✓																				
Coturnix ypsilophora	Brown Quail				✓			✓							✓	✓																✓				✓				✓		✓	✓
CAPRIMULGIDAE																																											
Eurostopodus argus	Spotted Nightjar				✓			✓			✓				✓		✓						✓	✓		✓	✓	✓							✓	✓	✓			✓		✓	
PODARGIDAE																																											
Podargus strigoides	Tawny Frogmouth				✓			✓							✓								✓	✓								✓					✓					✓	
AEGOTHELIDAE																																											
Aegotheles cristatus	Australian Owlet-nightjar				✓			✓							✓								✓	✓				✓							✓							✓	
APODIDAE																																											
Apus pacificus	Pacific Swift	MI	MI		✓	✓	✓	✓	✓					✓	✓								✓																				
OTIDIDAE																																											
Ardeotis australis	Australian Bustard				✓			✓			✓				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓															✓		✓	✓
CUCULIDAE																																											
Centropus phasianinus	Pheasant Coucal				✓			✓							✓			✓																								✓	
Chalcites basalis	Horsfield's Bronze-Cuckoo				✓			✓							✓								✓	✓																✓		✓	
Chalcites osculans	Black-eared Cuckoo							✓																																			
Cacomantis pallidus	Pallid Cuckoo				✓			✓							✓								✓					✓							✓							✓	✓
COLUMBIDAE																																											
Phaps chalcoptera	Common Bronzewing				✓			✓							✓	✓		✓						✓	✓							✓			✓	✓	✓			✓		✓	
Phaps histrionica	Flock Bronzewing				✓			✓																																			
Ocyphaps lophotes	Crested Pigeon				✓			✓			✓	✓			✓	✓			✓				✓	✓	✓	✓	✓					✓			✓	✓				✓		✓	✓
Geophaps plumifera	Spinifex Pigeon				✓			✓			✓	✓			✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓				✓	✓		✓	✓	✓			✓		✓	✓
Geopelia cuneata	Diamond Dove				✓			✓			✓				✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓				✓	✓		✓	✓						✓	✓
Geopelia placida	Peaceful Dove				✓			✓							✓									✓											✓		✓					✓	✓
Geopelia humeralis	Bar-shouldered Dove							✓																																			
RALLIDAE																																											
Hypotaenidia philippensis	Buff-banded Rail				✓										✓																												
Tribonyx ventralis	Black-tailed Nativehen				✓			✓																																			
Fulica atra	Eurasian Coot				✓			✓																✓																			
Porphyrio melanotus	Australasian Swamphen																							✓																			
PODICIPEDIDAE																																											
Tachybaptus novaehollandiae	Australasian Grebe				✓			✓																✓			✓								✓								
Poliocephalus poliocephalus	Hoary-headed Grebe				✓			✓																																			
TURNICIDAE																																											
Turnix velox	Little Button-quail				✓			✓				✓			✓	✓	✓						✓	✓		✓	✓	✓					✓		✓							✓	✓
BURHINIDAE																																											
Burhinus grallarius	Bush Stone-curlew				✓			✓							✓			✓		✓		✓	✓	✓									✓									✓	✓

Family & Species Name	Common name	Conservation Status			Database Searches				Literature Review																																			Current Survey
		EPBC Act	BC Act	DBCA	NatureMap	DBCA	PMST	ALA	Fortescue Internal Database	Fauna Monitoring 2019-2023	North Star Junction (360, 2023)	North Star Junction (Ecoscape, 2021)	Pilbara Transmission Project (Ecoscape, 2020)	Pilbara Transmission Project (Spectrum Ecology, 2018)	North Star Project (Ecologia, 2012a)	North Star Access Corridor (Ecologia, 2012b)	North Star Aerodrome (Ecologia, 2015c)	North Star Filtration Plan (Ecologia, 2014c)	Targeted Fauna Assessment (Bamford, 2010)	Roy Hill (TE, 2011)	Rail Corridor GDP (Ecoscape, 2009)	Proposed Rail Corridor and Borrow Pits (ATA, 2007)	FMG Stage A (Biota, 2004)	Wodgina Lithium (Western Wildlife, 2020)	Pippingarra and Wodgina Roads (Ecoscape, 2020)	Wodgina Project (Stantec, 2018)	Wodgina Hercules (Outback Ecology, 2011)	Wodgina DSO (Outback Ecology, 2009)	Wodgina NQ (Outback Ecology, 2012)	Wodgina Bat (Outback Ecology, 2011)	Wodgina Gas Pipeline (360, 2018)	Pilgangoora (360, 2016)	E45/2287 Infill Pilgangoora (APM, 2023)	P1000 Pilgangoora (APM, 2024)	FMG Glacier (GHD, 2020)	Glacier Valley (Spectrum, 2021)	Abydos DSO (Outback Ecology, 2011)	(Molhar, 2007)	(MWH, 2015)	Mt Dove DSO (Outback Ecology, 2011)	Mt Dove Bat (Outback Ecology, 2011)	Panorama (Bamford, 2001)	
HAEMATOPODIDAE																																											
Haematopus longirostris	Pied Oystercatcher							✓																																			
RECURVIROSTRIDAE																																											
Himantopus himantopus	Black-winged Stilt			✓			✓														✓																				
Himantopus leucocephalus	Pied Stilt							✓																																			
CHARADRIIDAE																																											
Vanellus tricolor	Banded Lapwing			✓																																						
Erythrogonys cinctus	Red-kneed Dotterel			✓			✓													✓																					
Charadrius veredus	Oriental Plover	MI	MI		✓	✓	✓	✓																																			
Elseyornis melanops	Black-fronted Dotterel			✓			✓		✓	✓				✓								✓	✓			✓	✓														✓	
ROSTRATULIDAE																																											
Rostratula australis	Australian Painted Snipe	EN	EN				✓																																					
SCOLOPACIDAE																																											
Calidris acuminata	Sharp-tailed Sandpiper	MI	MI				✓	✓																																			
Calidris ferruginea	Curlew Sandpiper	CR & MI	CR				✓																																					
Calidris ruficollis	Red-necked Stint	MI	MI					✓																																			
Calidris melanotos	Pectoral Sandpiper	MI	MI				✓																																					
Actitis hypoleucos	Common Sandpiper	MI	MI		✓	✓	✓	✓	✓					✓										✓																			
Tringa glareola	Wood Sandpiper	MI	MI		✓	✓		✓	✓					✓										✓																			
Tringa nebularia	Common Greenshank	MI	MI		✓	✓		✓						✓																													
GLAREOLIDAE																																											
Glareola maldivarum	Oriental Pratincole	MI	MI				✓	✓						✓																													
LARIDAE																																											
Chlidonias hybrida	Whiskered Tern														✓																												
CICONIIDAE																																											
Ephippiorhynchus asiaticus	Black-necked Stork			✓			✓														✓					✓														✓	
ANHINGIDAE																																											
Anhinga novaehollandiae	Australasian Darter			✓			✓							✓								✓																			✓	
PHALACROCORACIDAE																																											
Microcarbo melanoleucos	Little Pied Cormorant			✓			✓																																			✓	
Phalacrocorax varius	Pied Cormorant			✓																																						
Phalacrocorax sulcirostris	Little Black Cormorant			✓			✓																✓																	✓	
Phalacrocorax carbo	Great Cormorant			✓			✓																																			
THRESKIORNITHIDAE																																											
Threskiornis molucca	Australian white Ibis			✓			✓																																			
Threskiornis spinicollis	Straw-necked Ibis			✓			✓																																			✓	
Plegadis falcinellus	Glossy Ibis																																											
Platalea regia	Royal Spoonbill			✓			✓						✓																													
Platalea flavipes	Yellow-billed Spoonbill							✓																																			
ARDEIDAE																																											
Nycticorax caledonicus	Nankeen Night-Heron			✓			✓																										✓							✓	
Ardea pacifica	White-necked Heron			✓			✓								✓							✓	✓	✓									✓							✓	
Ardea alba modesta	Eastern Great Egret			✓			✓	✓																✓																	✓	
Egretta novaehollandiae	White-faced Heron			✓			✓							✓								✓		✓									✓								✓	
Egretta garzetta	Little Egret			✓			✓																																			
PELECANIDAE																																											
Pelecanus conspicillatus	Australian Pelican			✓			✓																✓																	✓	
PANFIONIDAE																																											
Pandion haliaetus cristatus	Osprey	MI	MI		✓	✓	✓																																					
ACCIPITRIDAE																																											
Elanus axillaris	Black-shouldered Kite			✓			✓										✓	✓				✓	✓											✓							✓	
Lophoictinia isura	Square-tailed Kite							✓							✓								✓																				
Hamirostra melanosternon	Black-breasted Buzzard			✓																			✓			✓									✓								
Hieraaetus morphnoides	Little Eagle			✓			✓			✓												✓												✓							✓	✓
Aquila audax	Wedge-tailed Eagle			✓			✓							✓				✓				✓	✓		✓									✓	✓	✓			✓		✓	✓
Erythrotriorchis radiatus	Red Goshawk	VU	VU				✓																																					
Accipiter fasciatus	Brown Goshawk			✓			✓								✓							✓	✓				✓							✓		✓					✓	
Accipiter cirrocephalus	Collared Sparrowhawk			✓			✓			✓				✓								✓												✓							✓	
Circus approximans	Swamp Harrier																						✓		✓																		
Circus assimilis	Spotted Harrier			✓			✓				✓				✓		✓					✓	✓											✓	✓						✓	✓
Milvus migrans	Black Kite			✓			✓							✓								✓	✓		✓		✓							✓	✓						✓	✓
Haliastur sphenurus	Whistling Kite			✓			✓	✓		✓				✓	✓			✓				✓	✓	✓	✓	✓								✓					✓		✓	✓
Haliaeetus leucogaster	White-bellied Sea-Eagle			✓			✓																																			
TYTONIDAE																																											
Tyto javanica	Eastern Barn Owl			✓			✓																																			
STRIGIDAE																																											
Ninox connivens	Barking Owl			✓			✓																																			
Ninox boobook	Boobook Owl			✓			✓							✓	✓							✓	✓		✓									✓					✓		✓	✓
ALCEDINIDAE																																											
Dacelo leachii	Blue-winged Kookaburra			✓			✓			✓	✓			✓			✓					✓	✓		✓									✓		✓					✓	
Todiramphus sanctus	Sacred Kingfisher			✓			✓	✓						✓		✓						✓					✓							✓		✓					✓	
Todiramphus pyrrhopygius	Red-backed Kingfisher			✓			✓			✓				✓	✓							✓	✓		✓									✓	✓	✓			✓		✓	
MEROPIDAE																																											
Merops ornatus	Rainbow Bee-eater			✓			✓	✓		✓				✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓				✓			✓	✓	✓			✓		✓	✓
FALCONIDAE																																											
Falco cenchroides	Australian Kestrel			✓			✓	✓		✓	✓			✓	✓			✓				✓	✓		✓	✓	✓							✓	✓	✓			✓		✓	✓
Falco longipennis	Australian Hobby			✓			✓															✓	✓	✓			✓							✓								✓
Falco berigora	Brown Falcon			✓			✓			✓	✓			✓	✓	✓	✓	✓				✓	✓	✓			✓				✓			✓	✓	✓			✓		✓	✓
Falco hypoleucos	Grey Falcon	VU	VU		✓	✓	✓	✓	✓					✓	✓							✓	✓																				✓
Falco subniger	Black Falcon			✓			✓																				✓															
Falco peregrinus	Peregrine Falcon		OS		✓	✓		✓	✓					✓								✓	✓												✓								
CACATUIDAE																																											
Nymphicus hollandicus	Cockatiel			✓			✓			✓				✓	✓		✓					✓	✓	✓		✓	✓				✓			✓	✓	✓					✓	✓
Eolophus roseicapilla	Galah			✓			✓			✓				✓	✓	✓	✓	✓				✓	✓		✓	✓	✓				✓			✓	✓	✓			✓		✓	✓
Cacatua sanguinea	Little Corella			✓			✓			✓				✓				✓				✓	✓	✓	✓		✓							✓		✓			✓		✓	✓
PSITTACIDAE																																											
Barnardius zonarius	Australian Ringneck			✓			✓			✓				✓			✓						✓													✓			✓		✓	
Pezoporus occidentalis	Night Parrot	EN	CR				✓																																					
Neophema elegans	Elegant Parrot			✓																																						
Melopsittacus undulatus	Budgerigar			✓			✓			✓	✓			✓	✓	✓	✓					✓	✓		✓	✓	✓							✓	✓						✓	✓
PTILONORHYNCHIDAE																																											
Chlamydera guttata	Western Bowerbird			✓			✓							✓									✓			✓	✓							✓	✓	✓			✓		✓	
CLIMACTERIDAE																																											
Climacteris melanurus	Black-tailed Treecreeper			✓			✓																																			
MALURIDAE																																											
Malurus assimilis	Purple-backed Fairywren			✓			✓			✓				✓	✓							✓	✓			✓	✓				✓		✓	✓	✓	✓			✓		✓	✓
Malurus leucopterus	White-winged Fairywren			✓			✓			✓	✓			✓	✓			✓				✓		✓															✓			✓
Stipiturus ruficeps	Rufous-crowned Emu-wren			✓			✓																																			✓	
Amytornis whitei whitei	Pilbara Grasswren										✓				✓									✓			✓	✓				✓	✓										
MELIPHAGIDAE																																											
Epthianura tricolor	Crimson Chat			✓			✓							✓	✓	✓						✓	✓											✓					✓		✓	
Lacustroica whitei	Grey Honeyeater			✓																							✓									✓						
Certhionyx variegatus	Pied Honeyeater			✓			✓																✓	✓			✓							✓		✓					✓	
Sugomel niger	Black Honeyeater			✓			✓								✓							✓					✓							✓								
Lichmera indistincta	Brown Honeyeater			✓			✓							✓	✓							✓	✓		✓	✓	✓				✓			✓	✓							✓
Melithreptus gularis	Black-chinned Honeyeater			✓			✓							✓																						✓					✓	
Gavicalis virescens	Singing Honeyeater			✓			✓			✓				✓	✓			✓				✓	✓	✓	✓	✓	✓						✓	✓		✓			✓		✓	✓
Ptilotula keartlandi	Grey-headed Honeyeater			✓			✓			✓				✓									✓		✓	✓	✓				✓			✓	✓	✓		✓			✓	✓
Ptilotula plumula	Grey-fronted Honeyeater			✓			✓																			✓	✓							✓					✓			

Family & Species Name	Common name	Conservation Status			Database Searches				Literature Review																																		
		EPBC Act	BC Act	DBCA	NatureMap	DBCA	PMST	ALA	Fortescue Internal Database	Fauna Monitoring 2019-2023	North Star Junction (360, 2023)	North Star Junction (Ecoscape, 2021)	Pilbara Transmission Project (Ecoscape, 2020)	Pilbara Transmission Project (Spectrum Ecology, 2018)	North Star Project (Ecologia, 2012a)	North Star Access Corridor (Ecologia, 2012b)	North Star Aerodrome (Ecologia, 2015c)	North Star Filtration Plan (Ecologia, 2014c)	Targeted Fauna Assessment (Bamford, 2010)	Roy Hill (TE, 2011)	Rail Corridor GDP (Ecoscape, 2009)	Proposed Rail Corridor and Borrow Pits (ATA, 2007)	FMG Stage A (Biota, 2004)	Wodgina Lithium (Western Wildlife, 2020)	Pippingarra and Wodgina Roads (Ecoscape, 2020)	Wodgina Project (Stantec, 2018)	Wodgina Hercules (Outback Ecology, 2011)	Wodgina DSO (Outback Ecology, 2009)	Wodgina NQ (Outback Ecology, 2012)	Wodgina Bat (Outback Ecology, 2011)	Wodgina Gas Pipeline (360, 2018)	Pilgangoora (360, 2016)	E45/2287 Infill Pilgangoora (APM, 2023)	P1000 Pilgangoora (APM, 2024)	FMG Glacier (GHD, 2020)	Glacier Valley (Spectrum, 2021)	Abydos DSO (Outback Ecology, 2011)	(Molhar, 2007)	(MWH, 2015)	Mt Dove DSO (Outback Ecology, 2011)	Mt Dove Bat (Outback Ecology, 2011)	Panorama (Bamford, 2001)	Current Survey
Ptilotula penicillata	White-plumed Honeyeater				✓			✓			✓	✓			✓	✓		✓					✓	✓		✓						✓			✓		✓			✓		✓	✓
Acanthagenys rufogularis	Spiny-cheeked Honeyeater				✓			✓							✓								✓	✓								✓											✓
Manorina flavigula	Yellow-throated Miner				✓			✓			✓				✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓				✓	✓		✓	✓	✓			✓		✓	✓
PARDALOTIDAE																																											
Pardalotus rubricatus	Red-browed Pardalote				✓			✓			✓				✓								✓	✓											✓	✓						✓	✓
Pardalotus striatus	Striated Pardalote				✓			✓																				✓														✓	
ACANTHIZIDAE																																											
Smicrornis brevirostris	Weebill				✓			✓							✓								✓												✓		✓					✓	
Pyrrholaemus brunneus	Redthroat							✓																																			
Gerygone fusca	Western Gerygone				✓			✓																																		✓	
Acanthiza uropygialis	Chestnut-rumped Thornbill																						✓																				
Acanthiza chrysorrhoa	Yellow-rumped Thornbill				✓																																						
Acanthiza robustirostris	Slaty-backed Thornbill																						✓																				
POMATOSTOMIDAE																																											
Pomatostomus temporalis	Grey-crowned Babbler				✓			✓							✓	✓		✓						✓		✓									✓								✓
Pomatostomus superciliosus	White-browed Babbler																						✓																				
PSOPHODIDAE																																											
Psophodes occidentalis	Western Wedgebill							✓																																			
CINCLOSOMATIDAE																																											
Cinclosoma marginatum	Western Quail-thrush																						✓																				
ARTAMIDAE																																											
Artamus leucorynchus	White-breasted Woodswallow				✓																				✓										✓								
Artamus personatus	Masked Woodswallow				✓			✓							✓	✓							✓												✓								✓
Artamus cinereus	Black-faced Woodswallow				✓			✓			✓	✓			✓	✓			✓				✓	✓		✓	✓	✓				✓			✓		✓			✓		✓	✓
Artamus minor	Little Woodswallow				✓			✓							✓									✓			✓	✓							✓	✓						✓	
Gymnorhina tibicen	Australian Magpie				✓			✓							✓		✓						✓		✓		✓								✓							✓	✓
Cracticus torquatus	Grey Butcherbird				✓			✓							✓								✓	✓	✓							✓			✓					✓			
Cracticus nigrogularis	Pied Butcherbird				✓			✓			✓	✓			✓	✓		✓	✓				✓	✓			✓	✓						✓	✓	✓	✓			✓		✓	✓
CAMPEPHAGIDAE																																											
Coracina maxima	Ground Cuckoo-shrike				✓			✓																												✓							
Coracina novaehollandiae	Black-faced Cuckoo-shrike				✓			✓			✓	✓			✓	✓		✓	✓				✓	✓		✓	✓	✓				✓			✓	✓	✓			✓		✓	✓
Lalage tricolor	White-winged Triller				✓			✓				✓			✓			✓					✓	✓				✓							✓	✓						✓	✓
NEOSITTIDAE																																											
Daphoenositta chrysoptera	Varied Sittella							✓															✓																				
OREOICIDAE																																											
Oreoica gutturalis	Crested Bellbird				✓			✓							✓								✓	✓											✓	✓	✓			✓		✓	
PACHYCEPHALIDAE																																											
Pachycephala rufiventris	Rufous Whistler				✓			✓							✓								✓	✓								✓			✓	✓				✓		✓	✓
Colluricincla harmonica	Grey Shrike-thrush				✓			✓			✓				✓									✓			✓	✓							✓	✓	✓					✓	
RHIPIDURIDAE																																											
Rhipidura leucophrys	Willie Wagtail				✓			✓				✓			✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓				✓			✓	✓	✓			✓		✓	✓
Rhipidura albiscapa	Grey Fantail				✓																																						
MONARCHIDAE																																											
Grallina cyanoleuca	Magpie-lark				✓			✓	✓		✓	✓			✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓				✓		✓	✓	✓	✓			✓		✓	✓
CORVIDAE																																											
Corvus orru	Torresian Crow				✓			✓			✓				✓		✓		✓				✓	✓		✓	✓	✓				✓	✓		✓	✓	✓		✓	✓		✓	✓
Corvus bennetti	Little Crow				✓			✓			✓	✓				✓		✓						✓	✓																		
PETROICIDAE																																											
Melanodryas cucullata	Hooded Robin				✓			✓															✓													✓							
Petroica goodenovii	Red-capped Robin				✓			✓															✓																				
ALAUDIDAE																																											
Mirafra javanica	Horsfield's Bushlark				✓			✓							✓								✓																				✓
HIRUNDINIDAE																																											
Cheramoeca leucosterna	White-backed Swallow																																										✓
Hirundo neoxena	Welcome Swallow				✓			✓				✓															✓																
Petrochelidon ariel	Fairy Martin				✓			✓			✓				✓								✓	✓			✓	✓								✓							✓
Petrochelidon nigricans	Tree Martin				✓			✓							✓			✓						✓			✓	✓							✓							✓	✓
ACROCEPHALIDAE																																											
Acrocephalus australis	Australian Reed-Warbler				✓			✓																			✓																
LOCUSTELLIDAE																																											
Poodytes carteri	Spinifexbird				✓			✓							✓	✓			✓				✓	✓	✓	✓	✓	✓				✓			✓	✓	✓			✓		✓	✓
Cincloramphus cruralis	Brown Songlark				✓			✓							✓								✓	✓									✓		✓					✓		✓	
Cincloramphus mathewsi	Rufous Songlark				✓			✓							✓			✓					✓	✓		✓	✓								✓							✓	✓
CISTICOLIDAE																																											
Cisticola exilis	Golden-headed Cisticola							✓																																			
DICAEIDAE																																											
Dicaeum hirundinaceum	Mistletoebird				✓			✓															✓																			✓	
ESTRILDIDAE																																											
Neochmia ruficauda	Star Finch				✓			✓																✓																			
Emblema pictum	Painted Finch				✓			✓				✓			✓	✓		✓					✓	✓		✓	✓	✓				✓		✓	✓	✓	✓			✓		✓	✓
Taeniopygia castanotis	Australian Zebra Finch				✓			✓			✓	✓			✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓				✓	✓		✓		✓			✓		✓	✓
MOTACILLIDAE																																											
Anthus australis	Australian Pipit				✓			✓							✓	✓			✓				✓	✓			✓								✓					✓			✓
Reptiles																																											
CHELUIDAE																																											
Chelodina steindachneri	Flat-shelled Turtle				✓			✓							✓								✓																				
CARPHODACTYLIDAE																																											
Nephrurus levis	Smooth Knob-tailed Gecko				✓			✓			✓				✓								✓	✓																			✓
Nephrurus cinctus	Southern Banded Knob-tailed Gecko				✓																																						
DIPLODACTYLIDAE																																											
Crenadactylus ocellatus	Clawless Gecko														✓																	✓											
Diplodactylus bilybara	Western Fat-tailed Gecko							✓			✓													✓																			
Diplodactylus conspicillatus	Variable Fat-tailed Gecko				✓			✓							✓								✓	✓			✓					✓			✓					✓			
Diplodactylus galaxias	Northern Pilbara Beak-faced Gecko				✓			✓							✓									✓																			
Diplodactylus laevis	Desert Fat-tailed Gecko							✓																✓																			✓
Diplodactylus savagei	Southern Pilbara Beak-faced Gecko				✓			✓							✓												✓	✓				✓				✓	✓					✓	
Lucasium wombeyi	Pilbara Ground Gecko				✓			✓							✓								✓	✓			✓									✓	✓						
Lucasium woodwardi	Pilbara Ground Gecko				✓			✓			✓	✓			✓								✓	✓			✓	✓				✓		✓		✓	✓			✓			✓
Oedura fimbria	Western Marbled Velvet Gecko				✓										✓												✓								✓		✓			✓			
Rhynchoedura ornata	Western Beaked Gecko				✓			✓							✓									✓																✓			✓
Strophurus elderi	Jewelled Gecko				✓			✓			✓				✓								✓	✓			✓					✓				✓						✓	✓
Strophurus jeanae	Southen Phasmid Gecko				✓			✓															✓																				
Strophurus wellingtonae	Western-shield Spiny-tailed Gecko																						✓																				
GEKKONIDAE																																											
Crenadactylus pilbarensis	Pilbara Clawless Gecko				✓			✓																																		✓	
Gehyra kimberleyi	Robust Termitaria Gecko																							✓																			
Gehyra media	Medium Pilbara Spotted Rock Gehyra							✓																												✓							
Gehyra micra	Small Pilbara Spotted Rock Gehyra							✓																																			
Gehyra pilbara	Pilbara Dtella				✓			✓			✓																✓										✓			✓		✓	
Gehyra punctata	Spotted Pilbara Rock Dtella				✓			✓			✓				✓		✓							✓			✓					✓			✓		✓		✓			✓	
Gehyra purpurascens	Purple Dtella																																							✓			
Gehyra variegata	Variegated Dtella				✓			✓		✓	✓	✓			✓								✓	✓			✓	✓	✓			✓		✓	✓		✓			✓		✓	✓
Heteronotia binoei	Bynoe's Gecko				✓			✓			✓				✓								✓	✓			✓	✓				✓			✓	✓	✓			✓		✓	✓
Heteronotia spelea	Desert Cave Gecko				✓			✓							✓									✓			✓	✓							✓		✓						
PYGOPODIDAE																																											
Delma butleri	Unbanded Delma				✓			✓																				✓															
Delma elegans	Pilbara Delma				✓			✓							✓								✓												✓	✓	✓					✓	
Delma nasuta	Sharp-snouted Delma				✓			✓							✓								✓	✓			✓	✓									✓					✓	
Delma pax	Peace Delma				✓			✓			✓				✓								✓	✓			✓	✓				✓			✓	✓	✓					✓	✓

		Conservation Status			Database Searches				Literature Review																																		
Family & Species Name	Common name	EPBC Act	BC Act	DBCA	NaturaMap	DBCA	PMST	ALA	Fortescue Internal Database	Fauna Monitoring 2019-2023	North Star Junction (360, 2023)	North Star Junction (Ecosapce, 2021)	Pilbara Transmission Project (Ecosapce, 2020)	Pilbara Transmission Project (Spectrum Ecology, 2018)	North Star Project (Ecologia, 2012a)	North Star Access Corridor (Ecologia, 2012b)	North Star Aerodrome (Ecologia, 2015c)	North Star Filtration Plan (Ecologia, 2014c)	Targeted Fauna Assessment (Bamford, 2013)	Roy Hill (TE, 2011)	Rail Corridor GDP (Ecosapce, 2009)	Proposed Rail Corridor and Borrow Pits (ATA, 2007)	FMG Stage A (Biota, 2004)	Wodgina Lithium (Western Wildlife, 2020)	Pippingarra and Wodgina Roads (Ecosapce, 2020)	Wodgina Project (Stantec, 2018)	Wodgina Hercules (Outback Ecology, 2011)	Wodgina DSO (Outback Ecology, 2009)	Wodgina NQ (Outback Ecology, 2012)	Wodgina Bat (Outback Ecology, 2011)	Wodgina Gas Pipeline (360, 2018)	Pilgangoora (360, 2016)	E45/2387 Infill Pilgangoora (APM, 2023)	P1200 Pilgangoora (APM, 2024)	FMG Glacier (GHD, 2020)	Glacier Valley (Spectrum, 2021)	Atydon DSO (Outback Ecology, 2011)	(Mattiar, 2007)	(MWH, 2015)	Mt Dove DSO (Outback Ecology, 2011)	Mt Dove Bat (Outback Ecology, 2011)	Panorama (Bamford, 2001)	Current Survey
Delma tincta	Black-necked Delma				✓			✓			✓				✓								✓	✓									✓										
Lialis burtonis	Burton's Snake Lizard				✓			✓			✓				✓								✓	✓								✓							✓		✓	
Pygopus nigriceps	Western Hooded Scaly-foot				✓			✓			✓				✓																			✓								
AGAMIDAE																																											
Ctenophorus caudicinctus	Western Ring-tailed Dragon				✓			✓		✓	✓	✓				✓	✓						✓	✓	✓	✓	✓	✓	✓					✓	✓			✓			✓	✓
Ctenophorus isolepis	Central Military Dragon				✓			✓			✓	✓				✓			✓				✓	✓	✓	✓	✓	✓					✓		✓				✓		✓
Ctenophorus nuchalis	Central Netted Dragon				✓			✓			✓																	✓											✓		✓
Ctenophorus reticulatus	Western Netted Dragon				✓											✓																									
Diporiphora amphiboluroides	Mulga Dragon																						✓																			
Diporiphora valens	Southern Pilbara Tree Dragon				✓																																				✓
Diporiphora vescus	Northern Pilbara Tree Dragon				✓			✓			✓																															
Gowidon longirostris	Long-nosed Dragon				✓			✓			✓	✓					✓	✓					✓	✓			✓					✓	✓							✓	✓
Pogona minor	Dwarf Bearded Dragon				✓			✓			✓													✓																		✓
Tympanocryptis cephalus	Coastal Pebble-mimic Dragon				✓																		✓																		
Tympanocryptis diabolicus	Hamersley Pebble-mimic Dragon																																								
SCINCIDAE																																										
Carlia munda	Striped Rainbow Skink				✓			✓		✓	✓				✓		✓						✓	✓			✓	✓			✓		✓	✓	✓			✓		✓	✓
Carlia triacantha	Desert Rainbow Skink				✓			✓							✓								✓	✓			✓	✓					✓					✓			
Cryptoblepharus buchananii	Buchanan's Snake-eyed Skink				✓										✓																										
Cryptoblepharus ustulatus	Russet Snake-eyed Skink				✓			✓							✓																			✓	✓	✓					✓	
Ctenotus ariadnae	Ariadna's Ctenotus																						✓																		
Ctenotus brooksi	Wedgesnout Ctenotus							✓																																	
Ctenotus duricola	Eastern Pilbara Lined Ctenotus				✓			✓			✓				✓								✓	✓								✓		✓					✓		✓
Ctenotus grandis	Giant Desert Ctenotus				✓			✓			✓				✓								✓	✓			✓		✓			✓		✓					✓		✓
Ctenotus hanloni	Nimbleb Ctenotus				✓																			✓																	
Ctenotus helenae	Dusky Ctenotus				✓			✓			✓				✓								✓	✓																✓		✓
Ctenotus inornatus	Plain Ctenotus				✓			✓									✓																				✓				
Ctenotus leonhardii	Leonhardi's Ctenotus				✓																																			
Ctenotus nigrilineatus	Pin-striped Finasnout Ctenotus			P1	✓	✓		✓						✓																											
Ctenotus pantherinus	Leopard Ctenotus				✓			✓			✓				✓	✓	✓	✓					✓	✓								✓	✓	✓				✓	✓		✓
Ctenotus pianka	Pianka's Ctenotus				✓										✓																										
Ctenotus robustus																																									✓
Ctenotus rubicundus	Ruddy Ctenotus				✓										✓								✓					✓				✓							✓		
Ctenotus saxatilis	Rock Ctenotus				✓			✓			✓				✓								✓	✓	✓		✓	✓	✓			✓	✓	✓				✓	✓		✓
Ctenotus schomburgkii	Barred Wedge-snouted Ctenotus				✓			✓							✓								✓																		
Ctenotus serventyi	North-western Sandy-loam Ctenotus				✓			✓																																	
Ctenotus superciliaris	Sharp-browed Ctenotus				✓																																			
Ctenotus uber uber																																									✓
Cyclodomorphus melanops	Spinifex Slender Blue-tongue				✓			✓			✓				✓		✓						✓	✓				✓				✓						✓		✓	✓
Egernia cyanitos	Western Pilbara Spiny-tailed Skink				✓																			✓							✓										
Egernia epsisolus	Eastern Pilbara Spiny-tailed Skink				✓			✓			✓				✓	✓							✓																		
Egernia formosa	Goldfields Crevice-skink				✓			✓							✓								✓									✓							✓		
Eremiascincus pallidus	Western Narrow-banded Skink																																								✓
Eremiascincus richardsoni	Broad-banded Sand Swimmer				✓			✓									✓															✓	✓								
Lerista bipes	Western Two-toed Slider				✓			✓			✓				✓								✓	✓															✓		✓
Lerista chalybura	Pilbara Blue-tailed Slider																						✓																		
Lerista clara	Sharp-lined Three-toed Slider				✓						✓																					✓								
Lerista jacksoni	Jackson's Three-toed Slider				✓			✓			✓				✓									✓				✓				✓	✓								✓
Lerista muelleri	Meuller's Three-toed Slider				✓			✓			✓				✓								✓					✓	✓			✓								✓	
Lerista verhmens	Powerful Three-toed Slider				✓			✓			✓				✓																	✓									
Liopholis striata	Night Skink				✓			✓																																	
Menetia arevi	Common Dwarf Skink				✓			✓			✓				✓								✓	✓								✓									
Menetia surda	Western Dwarf Skink				✓			✓																✓																✓	
Morethia ruficauda	Fine-tailed Skink				✓			✓		✓	✓				✓		✓							✓		✓		✓	✓	✓		✓	✓	✓				✓	✓		✓
Notoscincus ornatus	Ornate Snake-eyed Skink				✓			✓			✓				✓								✓									✓	✓						✓		✓
Proablepharus reginae	Spinifex Snake-eyed Skink				✓			✓			✓				✓								✓										✓						✓		✓
Tiliqua multifasciata	Central Blue-tongue				✓			✓			✓				✓								✓	✓				✓		✓		✓									
VARANIDAE																																										
Varanus acanthurus	Spiny-tailed Monitor				✓			✓		✓	✓				✓		✓						✓	✓			✓	✓	✓	✓	✓	✓	✓		✓			✓		✓	✓
Varanus brevicauda	Short-tailed Pygmy Monitor				✓			✓			✓				✓								✓	✓				✓				✓									✓
Varanus bushi	Bush's Monitor							✓																																	
Varanus caudolineatus	Stripe-tailed Monitor							✓																																	
Varanus eremius	Pygmy Desert Monitor				✓			✓			✓				✓								✓	✓															✓		✓
Varanus giganteus	Perentie				✓			✓		✓	✓				✓									✓		✓		✓	✓	✓	✓	✓	✓	✓		✓			✓		✓	✓
Varanus gouldii	Sand Monitor				✓			✓			✓	✓			✓				✓	✓			✓					✓	✓										✓		✓	✓
Varanus panoptes	Yellow-spotted Monitor				✓			✓		✓	✓				✓	✓			✓	✓			✓	✓				✓													✓
Varanus pilbarensis	Pilbara Rock Monitor				✓			✓		✓					✓													✓	✓	✓											✓
Varanus tristis	Black-headed Monitor				✓			✓		✓	✓				✓		✓											✓	✓	✓											
TYPHLOPIDAE																																									
Anilios ammodytes	Sand-Diving Blind Snake				✓			✓			✓				✓								✓	✓															✓		✓
Anilios ganei	Ganei's Blind Snake			P1	✓	✓		✓	✓																															
Anilios grypus	Lorn-beaked Blind Snake				✓			✓			✓				✓								✓	✓								✓	✓						✓		✓
Anilios pilbarensis	Pilbara Blind Snake				✓			✓																								✓							✓		✓
PYTHONIDAE																																									
Antaresia childreni	Children's Python				✓			✓		✓	✓				✓								✓	✓				✓	✓			✓									
Antaresia perthensis	Pygmy Python				✓			✓		✓					✓								✓	✓			✓					✓	✓							✓	
Aspidites melanocephalus	Black-headed Python				✓					✓													✓	✓			✓	✓													
Liasis olivaceus barroni	Pilbara Olive Python	VU	VU		✓	✓	✓	✓	✓	✓	✓			✓	✓												✓	✓	✓	✓	✓										
ELAPIDAE																																									
Acanthophis wellsi	Pilbara Death Adder				✓			✓							✓																										
Brachyurophis fasciolatus	Narrow-banded shovel-nosed snake				✓													✓																							
Brachyurophis approximans	North-western Shovel-nosed Snake				✓			✓			✓				✓								✓	✓								✓									
Demansia psammophis reticulata	Reticulated Whipsnake				✓			✓			✓				✓								✓	✓																	
Demansia rufescens	Rufous Whipsnake				✓						✓				✓								✓	✓				✓				✓	✓							✓	
Furina ornata	Moon Snake				✓			✓			✓				✓								✓	✓								✓							✓		✓
Pseudechis australis	Mulga Snake				✓			✓			✓				✓	✓							✓	✓	✓			✓	✓			✓									✓
Pseudonaja mengdeni	Western Brown Snake				✓			✓			✓				✓		✓						✓	✓																	
Pseudonaja modesta	Ringed Brown Snake				✓			✓			✓				✓																								✓		
Pseudonaja nuchalis	Gwardar											✓																													
Suta fasciata	Rosen's Snake				✓										✓								✓																	
Suta monachus	Dillind Hooded Snake				✓										✓																									
Suta punctata	Little Spotted Snake				✓			✓															✓																	
Vermicella snelli	Pilbara Bandy Bandy				✓			✓																															✓		
Amphibians																																									
PELODRYADIDAE																																									
Cyclorana australis	Giant Frog				✓			✓							✓								✓																✓		
Cyclorana maini	Sheep Frog				✓			✓			✓				✓								✓	✓				✓	✓			✓									✓
Litoria rubella	Little Red Tree Frog				✓			✓			✓				✓								✓	✓			✓	✓	✓	✓	✓								✓		
LIMNODYNASTIDAE																																									
Neobatrachus aquilonius	Northern Burrowing Frog				✓																			Δ																	
Neobatrachus sutor	Shoemaker Frog				✓																			Δ																	
Notaden nichollsi	Desert Spadefoot				✓			✓							✓								✓	✓																	
Platyplectrum spenceri	Central Jain Burrowing Frog				✓			✓							✓								✓																		✓
MYOBATRACHIDAE																																									
Uperoleia glandulosa	Glandular Toadlet				✓			✓																																	
Uperoleia saxatilis	Pilbara Toadlet				✓			✓			✓				✓								✓	✓				✓				✓								✓	

APPENDIX D: VERTEBRATE FAUNA SPECIES RECORDED

Family & Species Name	Common name	EPBC Act	BC Act	DBCA	NS01		NS02		NS03		NS04		NS05		NS MC01	NS MC02	NS MC03	NS MC04	NS MC05	NS MC06	NS MC07	NS MC08	NS MC09	S01		S02		S03		Opp	
					Phase 1	Pahse 2	Phase 1	Pahse 2	Phase 1	Pahse 2	Phase 1	Pahse 2	Phase 1	Pahse 2	Pahse 2	Pahse 2	Pahse 2	Pahse 2	Pahse 2	Pahse 2	Pahse 2	Pahse 2	Pahse 2	Phase 1	Pahse 2	Phase 1	Pahse 2	Phase 1	Pahse 2	Phase 1	Pahse 2
Mammals																																
DASYURIDAE																																
Dasycercus blythi	Brush-tailed Mulgara			P4	1	4							3	2																	1	4
Dasykaluta rosamondae	Little Red Kaluta								2	1			1	1																		
Dasyurus hallucatus	Northern Quoll	EN	EN													2								4				6				
Planigale kendricki	Orange-headed Pilbara Planigale				1																											
Pseudantechinus macdonnellensis	Fat-tailed Pseudantenchinus															Δ	Δ				Δ											
Pseudantechinus woolleyae	Woolley's Pseudantechinus															Δ	Δ				Δ											
Sminthopsis youngsoni	Lesser Hairy-footed Dunnart							2	2																							
THYLACOMYIDAE																																
Macrotis lagotis	Bilby	VU	VU		1	1																									2	3
MACROPODIDAE																																
Osphranter robustus	Euro															1	1	1		1	1	4	2							1	1
Osphranter rufus	Red Kangaroo												1										2							2	1
MURIDAE																																
Pseudomys chapmani	Western Pebble-mound Mouse			P4																											S	
Pseudomys hermannsburgensis	Sandy Inland Mouse				3	3		1			8	4	1	4																		
Zyzomys argurus	Common Rock-rat																3	2		1	1		2		1			2			
RHINONYCTERIDAE																																
Rhinonicteris aurantia (Pilbara Form)	Pilbara Leaf-nosed Bat	VU	VU		R	R	R	R	R	R	R	R												R		R	R	R			
EMBALLONURIDAE																																
Saccolaimus flaviventris	Yellow-bellied Sheathtail Bat						R		R	R		R																				
Taphozous georgianus	Common Sheathtail Bat				R	R	R	R	R	R	R	R	R	R										R	R	R	R	R	R			
MOLOSSIDAE																																
Chaerephon jobensis	Greater Northern Free-tailed Bat				R	R	R	R	R	R	R	R	R	R											R	R	R	R				
VESPERTILIONIDAE																																
Chalinolobus gouldii	Gould's Wattled Bat				R	R	R	R	R	R	R	R	R	R										R	R	R	R	R	R			
Nyctophilus daedalus	Pallid Long-eared Bat											Δ																				
Nyctophilus geoffroyi	Lesser Long-eared Bat											Δ																				
Scotorepens greyii	Little Broad-nosed Bat				R	R		R		R	R	R															R					
Vespadelus finlaysoni	Finlayson's Cave Bat				R	R	R	R	R	R	R	R	R	R										R	R	R	R	R	R			
INTRODUCED MAMMALS																																
**Canis familiaris*	Dog/Dingo										1	1			2	2	2					2				1	1			2	
**Felis catus*	Cat					1					1		1			3	1	4		1			1			1				2	2
**Equus asinus*	Donkey				1						1													1						2	
**Equus ferus caballus*	Horse											1	1																	1	2
**Bos primigenius taurus*	European Cattle										2									2						1				3	2
Birds																																
CASUARIIDAE																																
Dromaius novaehollandiae	Emu																									1				1		
PHASIANIDAE																																
Cotumix ypsilophora	Brown Quail																			1										2		
OTIDIDAE																																
Ardeotis australis	Australian Bustard				1				1	1	2		1						1												2	2
CUCULIDAE																																
Cacomantis pallidus	Pallid Cuckoo																									1						
COLUMBIDAE																																
Ocyphaps lophotes	Crested Pigeon						1				1																					1
Geophaps plumifera	Spinifex Pigeon				1	1		1					1		2	2		2		1		1	2							1	
Geopelia cuneata	Diamond Dove				4		1	3	2		3	2														1				5	1
Geopelia placida	Peaceful Dove							1												1												
TURNICIDAE																																
Turnix velox	Little Button-quail						2				3		1							1										2	1
BURHINIDAE																																
Burhinus grallarius	Bush Stone-curlew										2																					
ACCIPITRIDAE																																
Hieraaetus morphnoides	Little Eagle								1																						1	
Aquila audax	Wedge-tailed Eagle				1																					1		1				
Circus assimilis	Spotted Harrier				1																											
Milvus migrans	Black Kite																													1		
Haliastur sphenurus	Whistling Kite													1																	2	
STRIGIDAE																																
Ninox boobook	Boobook Owl											1																				
MEROPIDAE																																
Merops ornatus	Rainbow Bee-eater					1					4	1														2				4	2
FALCONIDAE																																
Falco cenchroides	Australian Kestrel				2				1	1																2		1		5	
Falco longipennis	Australian Hobby								2																							
Falco berigora	Brown Falcon				1				4			1																				
Falco hypoleucos	Grey Falcon	VU	VU								1																				2	
CACATUIDAE																																
Nymphicus hollandicus	Cockatiel						1		1		2		1													1				2	
Eolophus roseicapilla	Galah				2				3		2		1																			
Cacatua sanguinea	Little Corella					2																										
PSITTACIDAE																																
Melopsittacus undulatus	Budgerigar				4		4	1	4		4		1													1				3	1
MALURIDAE																																
Malurus assimilis	Purple-backed Fairywren										4	2						1													1	

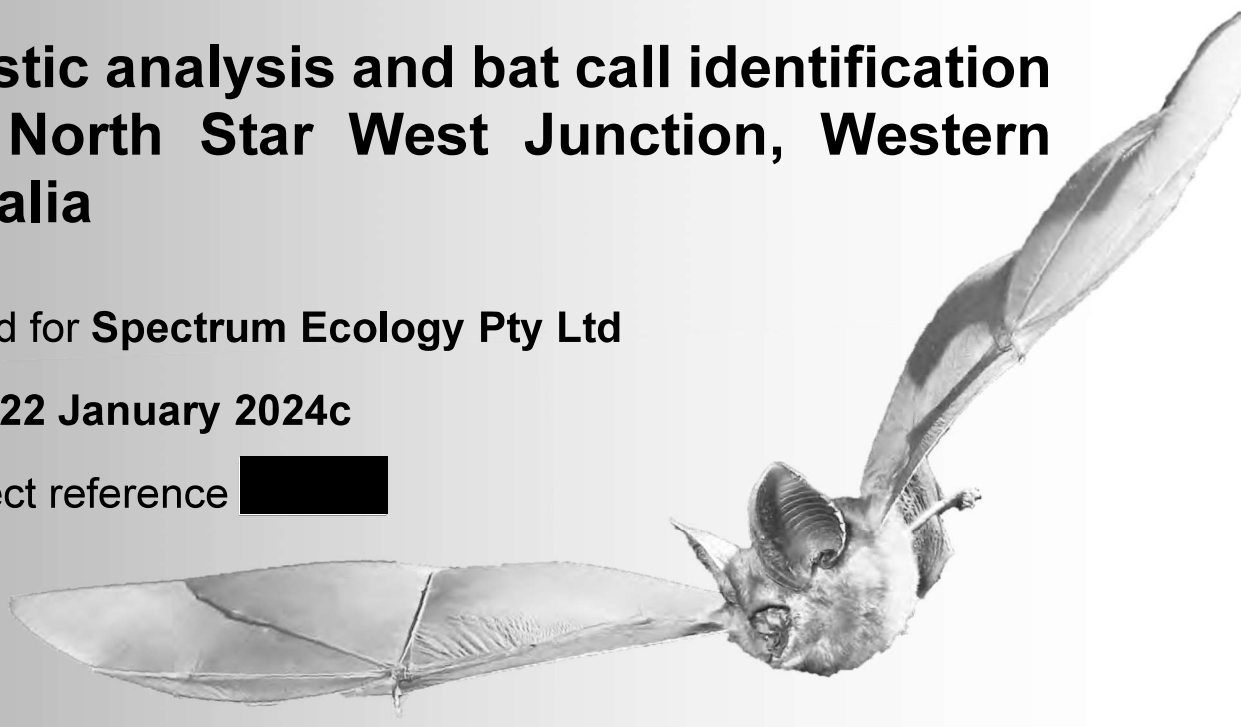
Family & Species Name	Common name	EPBC Act	BC Act	DBCA	NS01		NS02		NS03		NS04		NS05		NS MC01	NS MC02	NS MC03	NS MC04	NS MC05	NS MC06	NS MC07	NS MC08	NS MC09	S01		S02		S03		Opp	
					Phase 1	Pahse 2	Phase 1	Pahse 2	Phase 1	Pahse 2	Phase 1	Pahse 2	Phase 1	Pahse 2	Pahse 2	Pahse 2	Pahse 2	Pahse 2	Pahse 2	Pahse 2	Pahse 2	Pahse 2	Pahse 2	Phase 1	Pahse 2	Phase 1	Pahse 2	Phase 1	Pahse 2	Phase 1	Pahse 2
Malurus leucopterus	White-winged Fairywren					2																								1	
MELIPHAGIDAE																																
Lichmera indistincta	Brown Honeyeater						2				4		2													1				4	
Gavicalis virescens	Singing Honeyeater				5	2	4	4	3	1	4	4	2																	4	
Ptilotula keartlandi	Grey-headed Honeyeater						1		1		1	2														1				3	1
Ptilotula penicillata	White-plumed Honeyeater				1				1		4	3														1				2	
Acanthagenys rufogularis	Spiny-cheeked Honeyeater												1																		
Manorina flavigula	Yellow-throated Miner						1					2				1						1				1					
PARDALOTIDAE																																
Pardalotus rubricatus	Red-browed Pardalote									1	4	2														2					
POMATOSTOMIDAE																																
Pomatostomus temporalis	Grey-crowned Babbler											1																			
ARTAMIDAE																																
Artamus personatus	Masked Woodswallow								1																							
Artamus cinereus	Black-faced Woodswallow									2																1					1
Gymnorhina tibicen	Australian Magpie																									1	3				
Cracticus nigrogularis	Pied Butcherbird				3	3	4		2	1		4	2	1	1	4	1					3	3			1				1	
CAMPEPHAGIDAE																																
Coracina novaehollandiae	Black-faced Cuckoo-shrike					2						1									1					1					1
Lalage tricolor	White-winged Triller										1															1					
PACHYCEPHALIDAE																																
Pachycephala rufiventris	Rufous Whistler										1															1				2	
RHIPIDURIDAE																																
Rhipidura leucophrys	Willie Wagtail				2		2				3															2				3	
MONARCHIDAE																																
Grallina cyanoleuca	Magpie-lark					1					1	2											1				1				2	
CORVIDAE																																
Corvus orru	Torresian Crow				4	3	2		4	1		1	1	1								1				3				1	2
ALAUDIDAE																																
Mirafra javanica	Horsfield's Bushlark				1				1												2									1	1
HIRUNDINIDAE																																
Cheramoeca leucosterna	White-backed Swallow																													1	
Petrochelidon ariel	Fairy Martin				1				1																					1	
Petrochelidon nigricans	Tree Martin																													1	
LOCUSTELLIDAE																																
Poodytes carteri	Spinifexbird					1							1	1																		
Cinclorhamphus mathewsi	Rufous Songlark										1																					
ESTRILDIDAE																																
Emblema pictum	Painted Finch				4	1			1			1	1	1								2								3	1
Taeniopygia castanotis	Australian Zebra Finch				3	4	4	1	5	1	4		2													2				5	1
MOTACILLIDAE																																
Anthus australis	Australian Pipit														1			1			1									1	1
Reptiles																																
CARPHODACTYLIDAE																																
Nephrurus levis	Smooth Knob-tailed Gecko					2				2																						
DIPLODACTYLIDAE																																
Diplodactylus laevis	Desert Fat-tailed Gecko					3		1		1		2																				
Lucasium woodwardi	Western Sandplain Gecko					1		1	2	7	1	2																				
Rhynchoedura ornata	Western Beaked Gecko							1																								
Strophurus elderi	Jewelled Gecko							2		1		1																				
GEKKONIDAE																																
Gehyra variegata	Variegated Dtella					2				1		3		1																		
Heteronotia binoei	Bynoe's Gecko							2		2		1	2	6																		
PYGOPODIDAE																																
Delma pax	Peace Delma						1				2	1																				
Lialis burtonis	Burton's Snake Lizard							1																								
AGAMIDAE																																
Ctenophorus caudicinctus	Western Ring-tailed Dragon				1						1		1							1	1										
Ctenophorus isolepis	Central Military Dragon				4	2		1	7	1			5	4																	1	2
Ctenophorus nuchalis	Central Netted Dragon					1			1	1																						
Diporiphora valens	Southern Pilbara Tree Dragon						1				8																					
Gowidon longirostris	Long-nosed Dragon																														1	
Pogona minor	Dwarf Bearded Dragon										2			1																		
SCINCIDAE																																
Carlia munda	Striped Rainbow Skink							3																								
Ctenotus duricola	Eastern Pilbara Lined Ctenotus				1			1	3	2			2	1																		
Ctenotus grandis	Giant Desert Ctenotus				6	1	5	4	2		4	2	1	1																		
Ctenotus helenae	Dusky Ctenotus					3	8	1	2	1	1	5								1												
Ctenotus pantherinus	Leopard Ctenotus				7				5				2						1													
Ctenotus robustus						1																										
Ctenotus saxatilis	Rock Ctenotus				1		2				5		3							1		1										
Ctenotus uber uber						1																										
Cyclodomorphus melanops	Spinifex Slender Blue-tongue							1																								
Eremiascincus pallidus	Western Narrow-banded Skink											2																				
Lerista bipes	Western Two-toed Slider					2		2		5		2	4	3																		
Lerista jacksoni	Jackson's Three-toed Slider											1		1																		
Morethia ruficauda	Fire-tailed Skink													1										1								
Notoscincus ornatus	Ornate Snake-eyed Skink											1	1																			

Family & Species Name	Common name	EPBC Act	BC Act	DBCA	NS01		NS02		NS03		NS04		NS05		NS MC01	NS MC02	NS MC03	NS MC04	NS MC05	NS MC06	NS MC07	NS MC08	NS MC09	S01		S02		S03		Opp	
					Phase 1	Pahse 2	Phase 1	Pahse 2	Phase 1	Pahse 2	Phase 1	Pahse 2	Phase 1	Pahse 2	Pahse 2	Pahse 2	Pahse 2	Pahse 2	Pahse 2	Pahse 2	Pahse 2	Pahse 2	Pahse 2	Phase 1	Pahse 2	Phase 1	Pahse 2	Phase 1	Pahse 2	Phase 1	Pahse 2
Proablepharus reginae	Spinifex Snake-eyed Skink				1																											
VARANIDAE																																
Varanus acanthurus	Spiny-tailed Monitor														2	1		2		2		2	2									
Varanus brevicauda	Short-tailed Pygmy Monitor				1	1							1	1																		
Varanus eremius	Pygmy Desert Monitor				3				1										1													
Varanus giganteus	Perentie														1		1	2		2		2	1					2				
Varanus gouldii	Sand Monitor					1																										
Varanus panoptes	Yellow-spotted Monitor																											1				
Varanus pilbarensis	Pilbara Rock Monitor															1		2			1	5	1									
TYPHLOPIDAE																																
Anilios ammodytes	Sand-Diving Blind Snake							1						1																		
Anilios grypus	Long-beaked Blind Snake					1																										
Anilios pilbarensis	Pilbara Blind Snake					1																										
ELAPIDAE																																
Furina ornata	Moon Snake				1																											
Pseudechis australis	Mulga Snake				2															1												
Amphibians																																
PELODRYADIDAE																																
Cyclorana maini	Sheep Frog				5	1																										
LIMNODYNASTIDAE																																
Platyplectrum spenceri	Centralian Burrowing Frog											5																				

S Species recorded via secondary sign
R Species recorded via ultrasonic bar recorder
Δ Species level cannot be determined

APPENDIX E: BAT CALL ANALYSIS

Acoustic analysis and bat call identification from North Star West Junction, Western Australia



Prepared for **Spectrum Ecology Pty Ltd**

Version **22 January 2024c**

SZ project reference [redacted]

Prepared by [redacted]

Specialised Zoological ABN 92 265 437 422

[redacted]

This report should be included as an appendix in any larger submission to Government, and cited as:

Specialised Zoological (2024). Acoustic analysis and bat call identification from North Star West Junction, Western Australia. Unpublished report by Specialised Zoological for Spectrum Ecology Pty Ltd, 22 January 2024c, project reference SZ680.

Summary

Bat identifications from acoustic recordings are provided from the North Star West Junction project area, in the Pilbara region of Western Australia. The identification of bat species from full spectrum WAV-format recordings of their echolocation calls was based on measurements of characteristic frequency, observation of pulse shape, and the pattern of harmonics.

The recording dataset comprised 83 recording nights from 16 recording sites in two separate survey phases.

The scope of the analysis included the identification of all bat species present, but with a particular focus on species of conservation significance—Ghost Bat *Macroderma gigas* (Megadermatidae) and Pilbara Leaf-nosed Bat *Rhinonicteris aurantia* (Rhinonycteridae).

Additional acoustic processing of the bat detector recordings was conducted separately for each of the two bat species of conservation significance using methods optimised for the detection of their unique echolocation call types.

A total of eight bat species was detected (**Tables 1 – 2**). Representative echolocation calls for each identification are illustrated (**Figure 1**), as recommended by the Australasian Bat Society (ABS 2006).

No calls of the Ghost Bat were observed.

A total of 48 echolocation call sequences of the Pilbara Leaf-nosed Bat was detected at 12 separate recording sites (23 total recording nights over all sites; **Tables 3 – 4**). The detection of echolocation call sequences well after sunset and well before sunrise, and away from areas of rocky outcrop containing deep caves, is indicative of individuals of this species out foraging away from a diurnal roost.

Further details are available should verification be required.

Methods

The data provided were recorded in full spectrum WAV format with Wildlife Acoustics Song Meter SM4BAT bat detectors (sampling rate 384 kHz, set to turn on automatically at sunset and off at sunrise).

A multi-step acoustic analysis procedure developed to process large full spectrum echolocation recording datasets from insectivorous bats (Armstrong et al. 2021a,b) was applied to the recordings made on the survey. Firstly, the WAV files were scanned for bat echolocation calls using several parameter sets in the software SCAN'R version 1.8.3 (Binary Acoustic Technology), which also provides measurements (SCAN'R parameters) from each putative bat pulse. The outputs were then used to determine if putative bat pulses measured in SCAN'R could be identified to species. This was done using a custom [R] language application that performed three tasks:

1. undertook a Discriminant Function Analysis on training data from representative calls from bat species in the Pilbara region;

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;

3. facilitated an inspection in a spectrogram of multiple examples of each call type for each recording night by opening the original WAV files containing pulses of interest in Adobe Audition version 23.1.

Species were identified based on information in Armstrong and Coles (2007), McKenzie and Bullen (2009) and the author's own unpublished material. Nomenclature follows Jackson and Groves (2015).

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 all 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 not set up and supplied by Specialised Zoological. The equipment was operated by the third party during the survey.
4. Other than the general location of the study area, Specialised Zoological has not been provided with detailed information of the survey area, has not made a visit to observe the habitats available for bats, nor have we visited the specific project area 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, the application of other bat survey methods could help to resolve the presence of the possibilities in the project area.
9. The most reliable way of detecting the Ghost Bat with bat detectors is to place the equipment with the microphone facing into a potential cave roosting site. The echolocation calls of this species are of low amplitude, and therefore most detectable when a Ghost Bat flies close to the bat detector as it exits the underground structure. If there is uncertainty about whether Ghost Bats are present in a cave, then video recordings can be a useful addition to the survey. The detection of Ghost Bats with bat detectors away from cave entrances is less reliable, unless an approach based on an acoustic lure is used (e.g. see the new method described in recent papers by Ruykys et al. 2023 and Hanrahan et al. 2023).
10. This version of the document supersedes any previous version. Previous drafts are not authorised by us for submission to the regulator or the public domain.

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Table 1. Species identified from all sites combined.

RHINONYCTERIDAE	
Pilbara Leaf-nosed Bat	*Rhinonicteris aurantia*
EMBALLONURIDAE	
Yellow-bellied Sheath-tailed Bat	*Saccolaimus flaviventris*
Common Sheath-tailed Bat	*Taphozous georgianus*
VESPERTILIONIDAE	
Gould's Wattled Bat	*Chalinolobus gouldii*
Little Broad-nosed Bat	*Scotorepens greyii*
Finlayson's Cave Bat	*Vespadelus finlaysoni*
Ambiguous identifications	
Pallid Long-eared Bat / **and/or** Lesser Long-eared Bat	*Nyctophilus daedalus* / **and/or** *Nyctophilus geoffroyi*
MOLOSSIDAE	
Greater Northern Free-tailed Bat	*Chaerephon jobensis*

Table 2. Species identifications from each recording site (see *Table 1* for full species names).

Serial	Site	Coordinates	First night	Last night	Nights	*C. gouldii*	*C. jobensis*	*Nyctophilus* sp.	*R. aurantia*	*S. flaviventris*	*S. greyii*	*T. georgianus*	*V. finlaysoni*
S4U06081	**S3**	-21.215772, 118.785306	20/05/2023	23/05/2023	4	X	.	.	X	.	.	X	X
S4U06186	**NS05**	-21.262612, 118.742230	18/05/2023	23/05/2023	6	X	X	.	.	.	.	X	X
S4U06252	**NS02**	-21.209877, 118.772174	19/05/2023	24/05/2023	6	X	X	.	X	X	.	X	X
S4U06253	**S1**	-21.256064, 118.771685	19/05/2023	22/05/2023	4	X	.	.	X	.	.	X	X
S4U06256	**NS03**	-21.206750, 118.755078	17/05/2023	22/05/2023	6	X	X	.	X	X	.	X	X
S4U06269	**NS01**	-21.235248, 118.791889	19/05/2023	22/05/2023	4	X	X	.	X	.	X	X	X
S4U06272	**S2**	-21.223883, 118.749096	20/05/2023	23/05/2023	4	X	X	.	X	.	.	X	X
S4U06285	**NS04**	-21.213013, 118.734606	17/05/2023	23/05/2023	7	X	X	.	X	.	X	X	X
S4U06081	**S2**	-21.223883, 118.749096	30/09/2023	4/10/2023	5	X	X	.	X	.	X	X	X
S4U06174	**NS02**	-21.209877, 118.772174	30/09/2023	4/10/2023	5	X	X	.	X	.	X	X	X
S4U06270	**NS03**	-21.206750, 118.755078	30/09/2023	5/10/2023	6	X	X	.	X	X	X	X	X
S4U06285	**S1**	-21.256064, 118.771685	30/09/2023	4/10/2023	5	X	X	.	.	.	.	X	X
SM4 6266 / WONBAT6	**NS01**	-21.235248, 118.791889	30/09/2023	4/10/2023	5	X	X	.	X	.	X	X	X
SM4 6253 / WONBAT8	**S3**	-21.215772, 118.785306	30/09/2023	4/10/2023	5	X	X	.	.	.	.	X	X
SM4 6186 / WONBAT9	**NS05**	-21.262612, 118.742230	30/09/2023	4/10/2023	5	X	X	.	.	.	.	X	X
SM4 6257 / WONBAT10	**NS04**	-21.213013, 118.734606	30/09/2023	5/10/2023	6	X	X	X	X	X	X	X	X
16 sites					**83**								

Table 3. Summary of detections of the Pilbara Leaf-nosed Bat from May 2023 (alternating blue highlight distinguishes different sites).

Site	Serial	Night of	Passes	Sunset	Dusk	Dawn	Sunrise	Time first detection	Time last detection	Time since sunset	Time until sunrise
NS01	S4U06269	21/05/2023	1	21/05/2023 17:33	21/05/2023 17:56	22/05/2023 6:09	22/05/2023 6:33	19:34:45	19:34:45	2H 1M 42S	10H 58M 35S
NS02	S4U06252	19/05/2023	1	19/05/2023 17:33	19/05/2023 17:57	20/05/2023 6:09	20/05/2023 6:32	0:48:35	0:48:35	7H 15M 13S	5H 44M 19S
NS02	S4U06252	20/05/2023	8	20/05/2023 17:33	20/05/2023 17:57	21/05/2023 6:09	21/05/2023 6:32	23:38:16	1:55:04	6H 4M 54S	4H 37M 50S
NS02	S4U06252	21/05/2023	3	21/05/2023 17:33	21/05/2023 17:56	22/05/2023 6:09	22/05/2023 6:33	21:19:01	2:38:25	3H 45M 58S	3H 54M 55S
NS02	S4U06252	23/05/2023	3	23/05/2023 17:32	23/05/2023 17:56	24/05/2023 6:10	24/05/2023 6:34	21:02:23	22:54:42	3H 29M 55S	7H 39M 31S
NS03	S4U06256	18/05/2023	3	18/05/2023 17:34	18/05/2023 17:57	19/05/2023 6:08	19/05/2023 6:32	21:44:34	23:51:40	4H 10M 31S	6H 40M 20S
NS04	S4U06285	17/05/2023	2	17/05/2023 17:34	17/05/2023 17:58	18/05/2023 6:07	18/05/2023 6:31	22:12:16	2:24:02	4H 37M 51S	4H 7M 32S
S1	S4U06253	22/05/2023	1	22/05/2023 17:32	22/05/2023 17:56	23/05/2023 6:09	23/05/2023 6:33	23:08:02	23:08:02	5H 35M 17S	7H 25M 45S
S2	S4U06272	20/05/2023	1	20/05/2023 17:33	20/05/2023 17:57	21/05/2023 6:09	21/05/2023 6:32	22:12:57	22:12:57	4H 39M 35S	8H 19M 57S
S2	S4U06272	21/05/2023	1	21/05/2023 17:33	21/05/2023 17:56	22/05/2023 6:09	22/05/2023 6:33	19:32:36	19:32:36	1H 59M 33S	11H 0M 44S
S3	S4U06081	23/05/2023	3	23/05/2023 17:32	23/05/2023 17:56	24/05/2023 6:10	24/05/2023 6:34	19:47:36	3:01:01	2H 15M 8S	3H 33M 12S
7 sites		**11 nights**	**27**								

Table 4. Summary of detections of the Pilbara Leaf-nosed Bat from October 2023 (alternating blue highlight distinguishes different sites).

Site	Serial	Night of	Passes	Sunset	Dusk	Dawn	Sunrise	Time first detection	Time last detection	Time since sunset	Time until sunrise
S2	S4U06081	4/10/2023	4	4/10/2023 18:02	4/10/2023 18:25	5/10/2023 5:17	5/10/2023 5:40	1:09:43	1:26:20	7H 7M 3S	4H 14M 7S
NS02	S4U06174	30/09/2023	1	30/09/2023 18:01	30/09/2023 18:23	1/10/2023 5:21	1/10/2023 5:44	20:02:28	20:02:28	2H 1M 9S	9H 41M 58S
NS02	S4U06174	1/10/2023	1	1/10/2023 18:01	1/10/2023 18:24	2/10/2023 5:20	2/10/2023 5:43	22:26:14	22:26:14	4H 24M 35S	7H 17M 11S
NS02	S4U06174	3/10/2023	1	3/10/2023 18:02	3/10/2023 18:24	4/10/2023 5:18	4/10/2023 5:41	21:59:33	21:59:33	3H 57M 14S	7H 41M 53S
NS02	S4U06174	4/10/2023	1	4/10/2023 18:02	4/10/2023 18:25	5/10/2023 5:17	5/10/2023 5:40	20:37:00	20:37:00	2H 34M 20S	9H 3M 27S
NS03	S4U06270	3/10/2023	1	3/10/2023 18:02	3/10/2023 18:24	4/10/2023 5:18	4/10/2023 5:41	21:52:26	21:52:26	3H 50M 7S	7H 49M 0S
NS03	S4U06270	4/10/2023	1	4/10/2023 18:02	4/10/2023 18:25	5/10/2023 5:17	5/10/2023 5:40	0:44:47	0:44:47	6H 42M 7S	4H 55M 40S
NS03	S4U06270	5/10/2023	3	5/10/2023 18:03	5/10/2023 18:25	6/10/2023 5:16	6/10/2023 5:39	19:49:43	4:14:09	1H 46M 42S	1H 25M 19S
NS01	S4U06266	4/10/2023	1	4/10/2023 18:02	4/10/2023 18:25	5/10/2023 5:17	5/10/2023 5:40	22:03:06	22:03:06	4H 0M 26S	7H 37M 21S
NS04	S4U06257	30/09/2023	1	30/09/2023 18:01	30/09/2023 18:23	1/10/2023 5:21	1/10/2023 5:44	21:02:45	21:02:45	3H 1M 26S	8H 41M 41S
NS04	S4U06257	4/10/2023	5	4/10/2023 18:02	4/10/2023 18:25	5/10/2023 5:17	5/10/2023 5:40	22:10:19	0:25:30	4H 7M 39S	5H 14M 57S
NS04	S4U06257	5/10/2023	1	5/10/2023 18:03	5/10/2023 18:25	6/10/2023 5:16	6/10/2023 5:39	20:42:38	20:42:38	2H 39M 37S	8H 56M 50S
5 sites		**12 nights**	**21**								

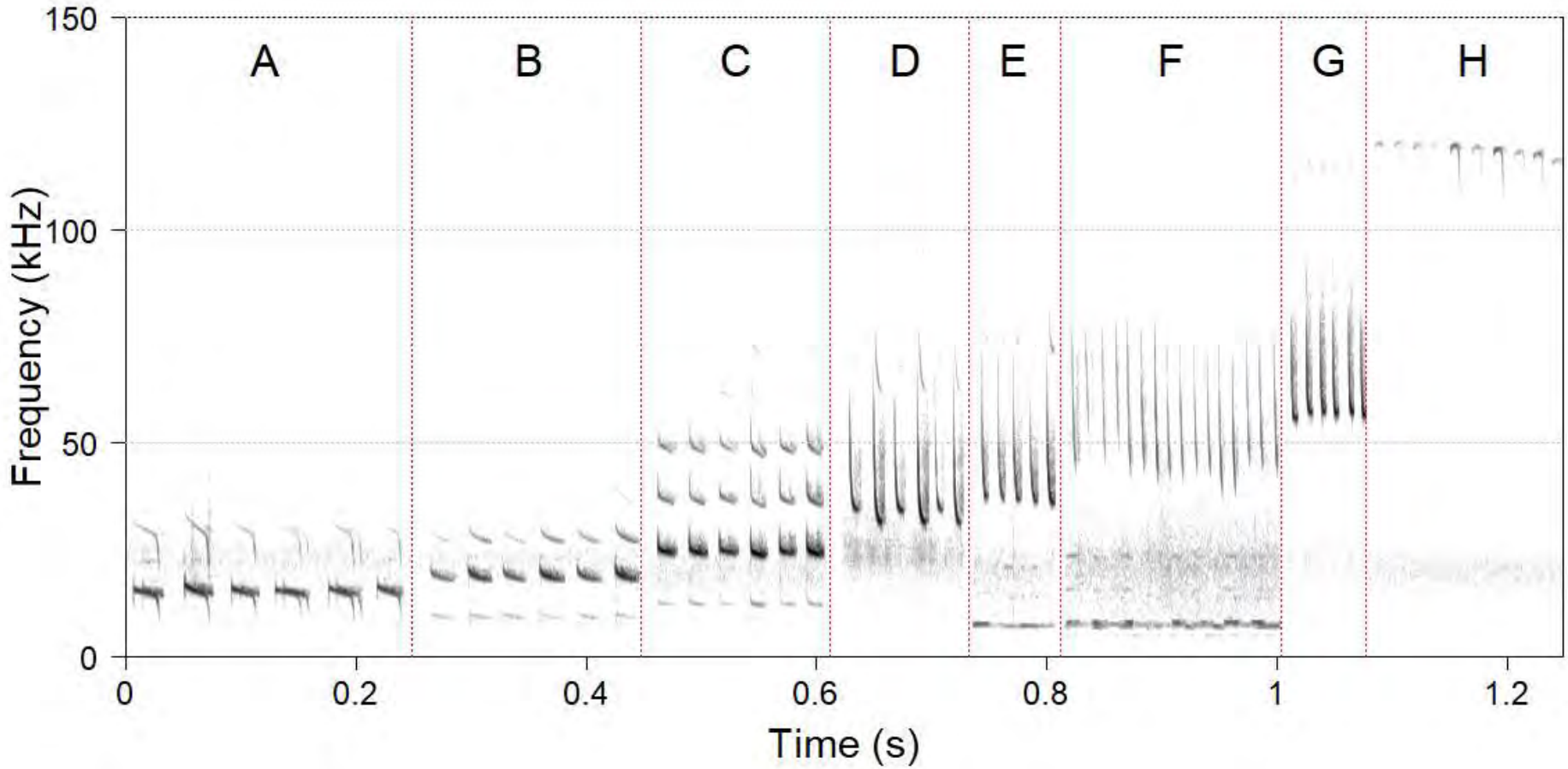

Figure 1. Representative echolocation call sequence portions of the species identified (**A**: *Chaerephon jobensis*; **B**: *Saccolaimus flaviventris*; **C**: *Taphozous georgianus*; **D**: *Chalinolobus gouldii*; **E**: *Scotorepens greyii*; **F**: *Nyctophilus* sp.; **G**: *Vespadelus finlaysoni*; **H**: *Rhinonicteris aurantia*; time between pulses has been compressed).