



East Ophthalmia and Ninga Detailed Vertebrate Fauna Survey

Biologic Environmental Survey

Report to BHP Western Australian Iron Ore

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EXECUTIVE SUMMARY

BHP Western Australian Iron Ore is investigating the biological values of the East Ophthalmia and Ninga area (hereafter referred to as the Study Area) to provide contextual biological information to inform future environmental approvals within and in the vicinity of the area. The Study Area is located approximately 15 kilometres northeast of Newman and covers an area of approximately 5,859.10 hectares (ha). To support this investigation, Biologic Environmental Survey Pty Ltd was commissioned to undertake a detailed vertebrate fauna assessment of the Study Area. This report documents the findings of this assessment, which consisted of a desktop assessment and a two-season detailed vertebrate fauna field survey.

A comprehensive desktop assessment was conducted prior to the field survey to identify vertebrate fauna species, which have the potential to occur in the Study Area. Phase 1 of the survey was conducted between 12–25 of March 2022, and phase 2 between 5–14 October 2022. The primary objective of the survey was to identify the occurrence of terrestrial vertebrate fauna species and their supporting habitats within the Study Area, with a focus on significant species listed under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act), *Biodiversity Conservation Act 2016* (BC Act) and/or listed as Priority by the Department of Biodiversity, Conservation and Attractions (DBCA). Specific methods included systematic trapping (pitfall, Elliott, funnel and cage trapping), avifauna censuses, spotlighting, camera traps, acoustic bird call recordings, bat echolocation recordings, targeted searches, bilby plots and habitat assessments.

A total of 12 broad fauna habitat types were recorded and mapped across the Study Area, comprising, in decreasing order of extent:

- Hillcrest/ Hillslope (33.54%, 1,965.26 ha);
- Stony Plain (22.17%, 1,299.07 ha);
- Drainage Area/ Floodplain (17.59%, 1,030.66 ha);
- Cleared/ Disturbed (9.03%, 529.09 ha);
- Undulating Low Hills (5.03%, 294.50 ha);
- Major Drainage Line (4.43%, 259.53 ha);
- Gorge/ Gully (3.74%, 219.00 ha);
- Minor Drainage Line (1.66%, 97.00 ha);
- Breakaway/ Cliff (1.56%, 91.65 ha);
- Mulga Woodland (0.76%, 44.61 ha);
- Sand Plain (0.41%, 23.94 ha); and
- Dam (0.08%, 4.79 ha).

All broad fauna habitats within the Study Area have the potential to support significant species to varying extents. With regard to MNES species, Major Drainage, Gorge/ Gully and Breakaway/ Cliff have the potential to provide critical habitat for northern quoll (*Dasyurus hallucatus* – Endangered EPBC/BC Act) and Pilbara olive python (*Liasis olivaceus* subsp. *barroni* – Vulnerable EPBC/BC Act). Although Gorge/ Gully and Breakaway/ Cliff habitats are not classified as critical habitat for ghost bat (*Macroderma gigas* – Vulnerable EPBC/BC Act) or Pilbara leaf-nosed bat (*Rhinonicteris aurantia* – Vulnerable EPBC/BC Act), they have the potential to contain critical habitat in the form of Category 1–3 caves. Drainage Area/ Floodplain, Major Drainage Line, Minor Drainage Line, Mulga Woodland, and to a lesser extent, Stony Plain and Sand Plain, may provide suitable nesting and foraging for southern whiteface (*Aphelocephala leucopsis* Vulnerable EPBC Act). Hillcrest/ Hillslope, Stony Plain, Undulating Low Hills, Mulga Woodland and Drainage Area/ Floodplain habitat have the potential to provide suitable critical and/or supporting foraging and dispersal habitat for all or some of the MNES species. For other significant species, Hillcrest/ Hillslope, Stony Plain, Undulating Low Hills, Major Drainage Line, Gorge/ Gully, Minor Drainage Line, Breakaway Cliff and Sand Plain have the potential to provide critical breeding, nesting, foraging and dispersal habitat. All of the broad fauna habitats occurring within the Study Area, except for Cleared/ Disturbed areas, provide supporting foraging and dispersal habitat of varying extents.

A total of 13 caves are known from within the Study Area, comprising; 11 recorded on previous surveys and two new caves identified and assessed during the current survey. All of the caves occurring within the Study Area were classified primarily as nocturnal refuge (Category 4) caves for Pilbara leaf-nosed bats. For ghost bat usage, one cave was classified as a Category 2 roost (maternity/ diurnal roost caves with regular occupancy for ghost bats and defined as critical habitat), seven as Category 3 roosts (diurnal roost caves with occasional occupancy) and the remaining five as Category 4 roosts (nocturnal roost caves with opportunistic usage). A total of 32 water features have been recorded within the Study Area to date, comprising ten recorded on previous surveys and 22 new water features recorded during the current survey. All of the water features known from within the Study Area are considered to provide supporting foraging features for the northern quoll, Pilbara leaf-nosed bat and Pilbara olive python.

The desktop assessment identified a total of 371 vertebrate fauna species as potentially occurring in the Study Area, comprising 51 mammals (41 native and ten non-native), 200 birds, 111 reptiles and nine amphibians. The desktop assessment identified 41 significant species, 18 of which have previously been recorded within the Study Area, comprising:

- ghost bat (*Macroderma gigas* - Vulnerable EPBC Act and BC Act);
- Pilbara leaf-nosed bat (*Rhinonicteris aurantia* Pilbara form Vulnerable EPBC Act and BC Act);
- grey falcon (*Falco hypoleucos* – Vulnerable EPBC Act and BC Act);
- Pilbara olive python (*Liasis olivaceus barroni* – Vulnerable EPBC Act and BC Act);
- Pilbara flat-headed blind snake (*Anilius ganei* – Priority 1 DBCA);
- brush-tailed mulgara (*Dasycercus blythi* – Priority 4 DBCA);
- western pebble-mound mouse (*Pseudomys chapmani* – Priority 4 DBCA);
- gull-billed tern (*Gelochelidon nilotica* – Migratory EPBC Act and BC Act);
- caspian tern (*Sterna caspia* – Migratory EPBC Act and BC Act);
- common sandpiper (*Actitis hypoleucos* – Migratory EPBC Act and BC Act);

- sharp-tailed sandpiper (*Calidris acuminata* – Migratory EPBC Act and BC Act);
- red-necked stint (*Calidris ruficollis* – Migratory EPBC Act and BC Act);
- black-tailed godwit (*Limosa limosa* – Migratory EPBC Act and BC Act);
- wood sandpiper (*Tringa glareola* – Migratory EPBC Act and BC Act);
- common greenshank (*Tringa nebularia* – Migratory EPBC Act and BC Act);
- marsh sandpiper (*Tringa stagnatilis* – Migratory EPBC Act and BC Act);
- long-toed stint (*Calidris subminuta* – Migratory EPBC Act and BC Act); and,
- glossy ibis (*Plegadis falcinellus* – Migratory EPBC Act and BC Act).

The current survey recorded approximately 58% (217 species) of the 371 species identified in the desktop assessment, comprising 29 mammal species (24 native and five introduced), 125 bird species, 59 reptile species and four amphibian species. The number of species recorded during the current survey was substantially higher than other surveys reviewed as part of the desktop assessment, including those of comparable size and sampling effort, indicating the fauna assemblage was adequately sampled. Of the 41 significant species identified in the desktop assessment, five were recorded within the Study Area during the current survey:

- Pilbara leaf-nosed bat– recorded on 13 occasions from ultrasonic calls within Sand Plain, Major Drainage Line, Gorge/ Gully and Minor Drainage Line habitats;
- western pebble-mound mouse– recorded on 23 occasions from secondary evidence (pebble-mounds; $n = 22$, comprising seven active mounds, three recently inactive and 12 inactive) and a captured individual ($n = 1$) within Hillcrest/ Hillslope and Stony Plain habitats;
- common sandpiper– recorded one individual within Dam habitat;
- fork-tailed swift (*Apus pacificus* – Migratory EPBC Act and BC Act) – recorded three individuals within Drainage Area/ Floodplain habitat; and
- glossy ibis– recorded four individuals within Dam habitat.

Given the habitats present within the Study Area and locations of nearby records identified during the desktop assessment, no significant fauna species were considered Highly Likely to occur. One species, peregrine falcon (*Falco peregrinus* – Specially Protected BC Act) was deemed Likely to occur, and a further 15 species were deemed Possible to occur. The remaining six species were considered Unlikely to occur.

INTRODUCTION

1.1 Project Background

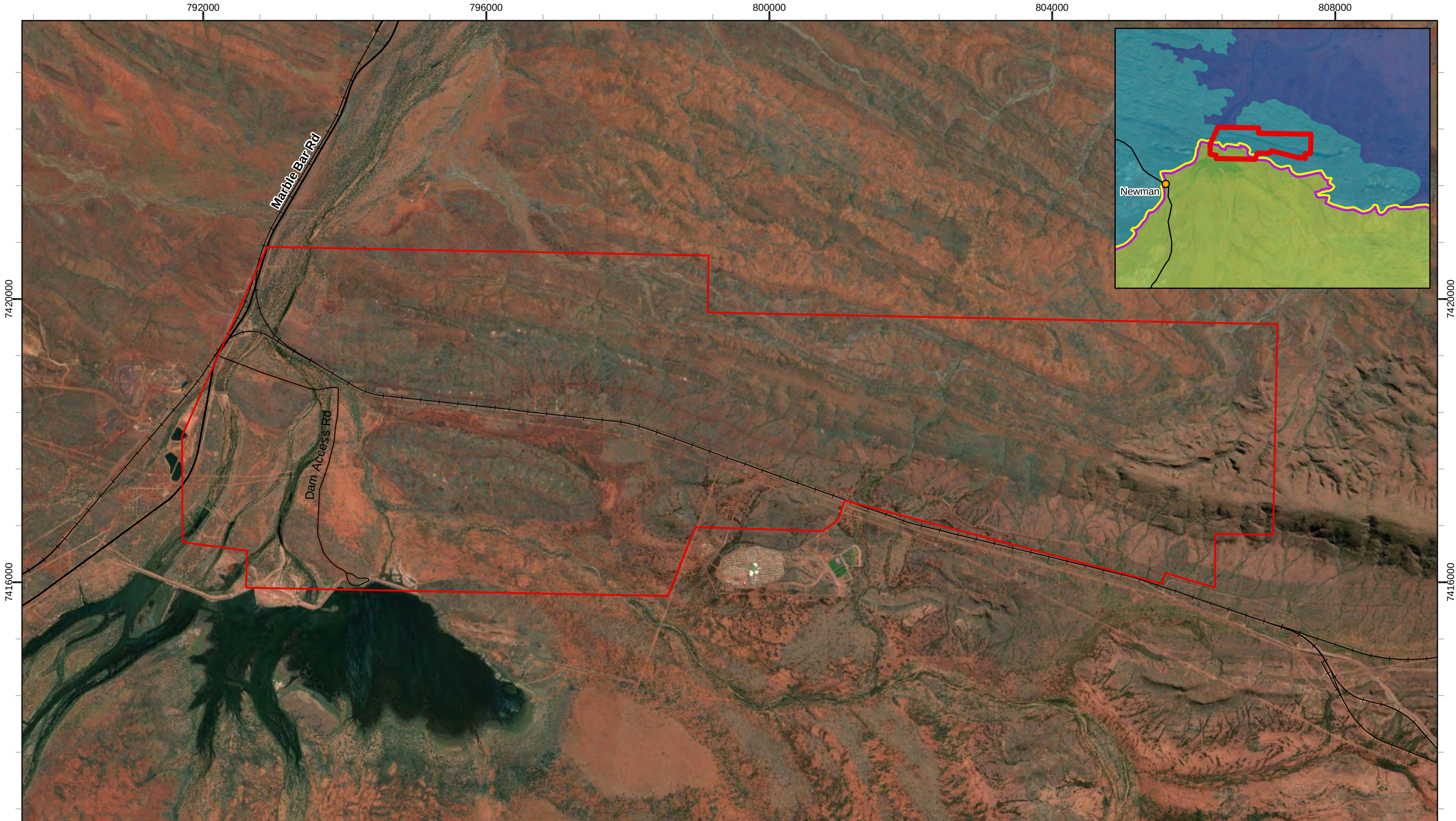
BHP Western Australian Iron Ore (BHP WAIO) is investigating the biological values of the East Ophthalmia and Ninga areas (hereafter referred to as the Study Area) to provide contextual biological information to inform future environmental approvals within and in the vicinity of the area. The Study Area is located approximately 15 kilometres (km) northeast of Newman and encompasses a total area of approximately 5,859 hectares (ha) (Figure 1.1; Figure 1.2).

To support this investigation, BHP WAIO commissioned Biologic Environmental Survey Pty Ltd (Biologic) to undertake a detailed vertebrate fauna assessment of the Study Area. This report documents the findings of this assessment, which consisted of a comprehensive desktop assessment and a two-season detailed vertebrate fauna field survey.

1.2 Scope and Objectives

The overarching objective of this assessment was to identify the occurrence of terrestrial vertebrate fauna species and their habitats within the Study Area, with a focus on significant species (as per Environmental Protection Authority (EPA) technical guidance (EPA (2020))). Specifically, the key objectives of the assessment were to:

- conduct a comprehensive desktop assessment (database searches and literature review) to identify vertebrate fauna species known to or potentially occurring within the Study Area;
- define and delineate broad fauna habitats occurring within the Study Area, and describe their significance to vertebrate fauna, particularly significant species;
- conduct a two-season detailed survey to identify vertebrate fauna species and fauna assemblages occurring within the Study Area; and
- assess the likelihood and distribution of significant vertebrate fauna species occurring within the Study Area and map areas of suitable habitat by use (e.g. foraging, denning, roosting etc.).



- LEGEND
- | | | | |
|------------|------------|-------------|----------------|
| Study Area | Local Road | IBRA Region | IBRA Subregion |
| State Road | Gascoyne | Augustus | Fortescue |
| Rail | Pilbara | Hamersley | |

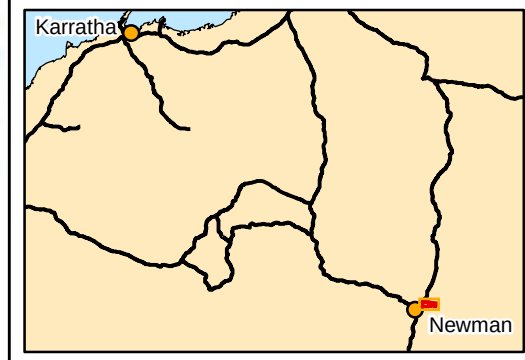
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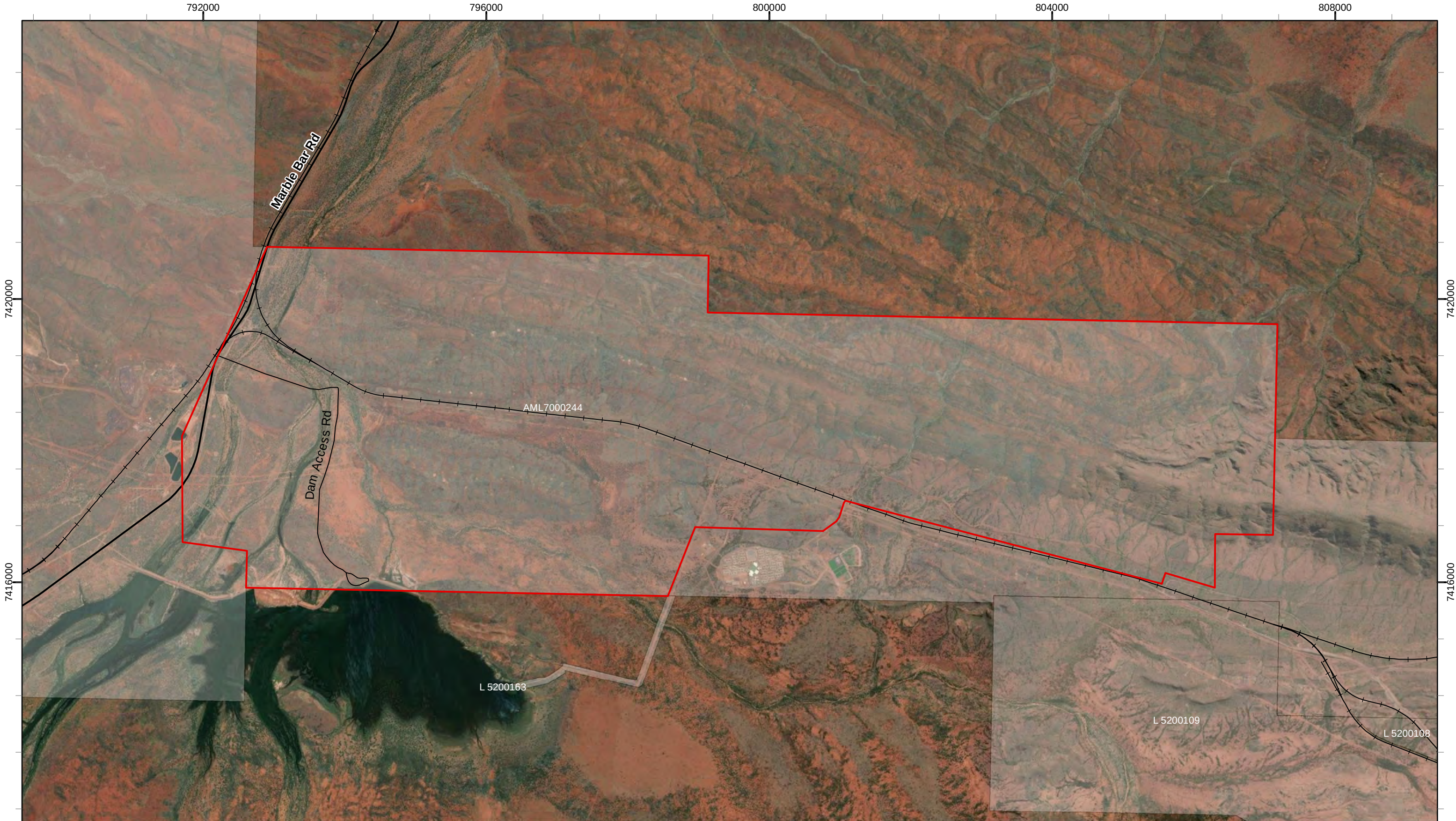
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BHP WAIO
East Ophthalmia and Ninga
Detailed Vertebrate
Fauna Survey

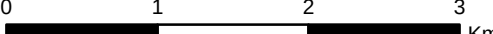
Figure 1.1: Study Area and regional context



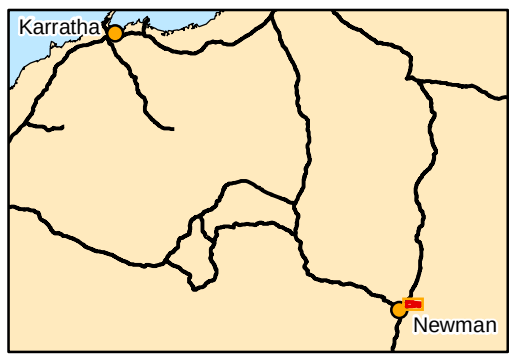
- LEGEND
- | | |
|---|--|
|  Study Area |  Local Road |
|  Live BHP Mining Tenement |  State Road |
| |  Rail |



Scale: 1:50,000

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Coordinate System: GDA2020 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA2020 Created 25/11/2022



BHP WAIO
East Ophthalmia and Ninga
Detailed Vertebrate
Fauna Survey

Figure 1.2: Study Area and
BHP tenure

1.3 Compliance

This assessment was carried out in acknowledgement of the following guidelines and recommendations developed by the relevant state and federal regulatory bodies, relevant survey-specific license conditions and, where relevant, BHP procedures:

- EPA (2016b) Technical guidance: Sampling methods for terrestrial vertebrate fauna;
- EPA (2020) Technical guidance: Terrestrial vertebrate fauna surveys for environmental impact assessment;
- Department of Biodiversity Conservation and Attractions (DBCA) (2017a) Guidelines for surveys to detect the presence of bilbies, and assess the importance of habitat in Western Australia;
- Department of Parks and Wildlife (DPaW) (2017) Interim guidelines for the preliminary surveys of night parrot (*Pezoporus occidentalis*) in Western Australia;
- Department of the Environment, Water, Heritage and the Arts (DEWHA) (2010a) Survey guidelines for Australia's threatened bats;
- DEWHA (2010b) Survey guidelines for Australia's threatened birds;
- Department of the Environment (DoE) (2013) Significant impact guidelines 1.1: Matters of national environmental significance;
- DoE (2016) EPBC Act referral guideline for the endangered northern quoll (*Dasyurus hallucatus*);
- Department of Sustainability, Environment, Water, Population and Communities (DSEWPac) DSEWPac (2011a) Survey guidelines for Australia's threatened mammals;
- DSEWPac (2011b) Survey guidelines for Australia's threatened reptiles;
- BHP WAIO (2020a) Biodiversity survey spatial data requirements procedure (Document number: SPR-IEN-EMS-015) Version: 11.0 or latest revision; and
- BHP WAIO (2020b) Vertebrate fauna surveys in Western Australia procedure (Document Number: SPR-IEN-EMS-012) Version: 9.0 or latest revision.

1.4 Background to Protection of Fauna

Terrestrial fauna may be significant for a range of reasons, including:

- being identified as a threatened or Priority species;
- being a species with restricted distribution;
- enduring a degree of historical impact from threatening processes; or
- providing an important function required to maintain the ecological integrity of a significant ecosystem (EPA, 2016a).

All native fauna in Western Australia (WA) are protected at a state level under the *Biodiversity Conservation Act 2016* (BC Act) and at a national level under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act). Any action that has the potential to impact native fauna needs to be approved by relevant state and/or federal departments in accordance with the WA *Environmental Protection Act 1986* (EP Act) and the federal EPBC Act.

While all native fauna is protected under these Acts, some species are afforded extra protection. This includes species that are considered threatened under the EPBC Act and/or BC Act, or migratory bird species that are protected under international agreements and subsequently listed as Migratory under the EPBC Act and/or BC Act (Table 0.1). Furthermore, any species that may be threatened but for which there is insufficient information available to allocate a threatened status under the EPBC Act and/or BC Act, can also be listed as Priority species by the WA DBCA (Table 0.1).

For the purposes of this assessment, as per EPA (2020), significant species are those that are afforded protection under the EPBC Act, BC Act and/or listed as Priority by DBCA (Table 0.1). A summary of applicable legislation and status codes is provided in Table 0.1.

Table 0.1: Definitions and terms for fauna of conservation significance

Act, Agreement or List	Status Codes ¹
Federal	
<i>Environment Protection and Biodiversity Conservation Act 1999</i> (EPBC Act) In Australia, native fauna are protected under the EPBC Act. This Act makes provisions for an independent committee (the Threatened Species Scientific Committee [TSSC]), which is charged with maintaining a list of threatened species. Threatened species are listed under one of six categories, depending on their specific conservation status. Migratory bird species are those listed under international agreements and protected under the EPBC Act as a Matter of National Environmental Significance (MNES). Relevant international agreements include the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), China-Australia Migratory Bird Agreement (CAMBA), Japan-Australia Migratory Bird Agreement (JAMBA), and Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA).	Extinct: - EX – Extinct - EW – Extinct in the Wild Threatened: - CR – Critically Endangered - EN – Endangered - VU – Vulnerable - CD – Conservation Dependent Other: - MI – Migratory
State	
<i>Biodiversity Conservation Act 2016</i> (BC Act) In WA, native fauna are protected under the BC Act. Species in special need of protection are listed as being Extinct, Threatened or Specially Protected. Within these groups, species are listed under one of eight categories, depending on their specific conservation status. Migratory bird species are those listed under the Bonn Convention and/or CAMBA, JAMBA and ROKAMBA agreements.	Extinct: - EX – Extinct Threatened: - CR – Critically Endangered - EN – Endangered - VU – Vulnerable Specially Protected: - MI – Migratory - CD – Conservation Dependent - OS – Other specially protected fauna
DBCA Priority List The DBCA maintains a list of Priority species that are considered to be possibly threatened but have not been assigned statutory protection under the BC Act, as not enough information is available for an accurate determination of conservation status. These species are generally in urgent need of survey to determine their distribution and abundance.	Poorly Known: - P1 – Priority 1 - P2 – Priority 2 - P3 – Priority 3 Rare, Near Threatened and other - P4 – Priority

¹See Appendix A for definitions of status codes

2 EXISTING ENVIRONMENT

2.1 Biogeography

The Study Area is located within two bioregions as defined by the Interim Biogeographic Regionalisation of Australia (IBRA; Thackway & Cresswell, 1995), Gascoyne and Pilbara (Figure 1.1). The Study Area primarily occurs within the Hamersley subregion of the Pilbara bioregion, of which approximately 76.35% (4,473.49 ha) occurs (Figure 1.1; Table 2.1). The remaining 23.65% (1,385.61 ha) of the Study Area occurs within the Augustus subregion of the Gascoyne bioregion (Figure 1.1; Table 2.1).

Table 2.1: IBRA bioregion and subregion of the Study Area

Bioregion	Subregion	Extent in Study Area	
		Area (ha)	%
Pilbara Characterised by vast coastal plains and inland mountain ranges with cliffs and deep gorges (Thackway & Cresswell, 1995). Vegetation is predominantly mulga low woodlands or snappy gum over bunch and hummock grasses (Bastin, 2008).	Hamersley (PIL3) Characterised by mountainous areas of Proterozoic sedimentary ranges (ironstone ranges) and plateaux dissected by gullies and gorges (Kendrick, 2001). Mulga low woodland over bunch grasses on fine-textured soils dominates in valley floors, while skeletal soils of the ranges are dominated by snappy gum (<i>Eucalyptus leucophloia</i>) over <i>Triodia brizoides</i> (Kendrick, 2001). Drainage is typically into the Fortescue River to the north, the Ashburton River to the south, or the Robe River to the west (Kendrick, 2001).	4,473.49	76.35%
Gascoyne Characterised by low, rugged ranges that are divided by broad, flat valleys and interspersed with open mulga woodlands on the plains (Bastin, 2008).	Augustus (GAS3) Rugged low Proterozoic sedimentary and granite ranges divided by broad flat valleys and contains extensive areas of alluvial valley-fill deposits (Desmond <i>et al.</i> , 2001). Mulga Woodland with <i>Triodia</i> occurs on shallow stony loam on rises, while the shallow earthy loams over hardpan on the plains are covered by Mulga Woodland (Desmond <i>et al.</i> , 2001). The Gascoyne River System provides the main drainage for the subregion and the headwaters of the Ashburton and Fortescue Rivers (Desmond <i>et al.</i> , 2001).	1,385.61	23.65%
Total		5,859.10	100%

2.2 Climate

The Pilbara bioregion, of which the majority of the Study Area occurs, has a semi-desert to tropical climate, with rainfall occurring sporadically throughout the year, although mostly during summer (Thackway & Cresswell, 1995). Summer rainfall is usually the result of tropical low pressure systems and cyclonic activity in the region (Leighton, 2004). Winter rainfall is generally lighter and often associated with cold fronts moving north easterly across the state (Leighton, 2004). The average annual rainfall ranges from 200–400 mm, although there are significant fluctuations between years, with up to 1,200 mm falling in some locations in some years (Bureau of Meteorology (BoM, 2022; McKenzie *et al.*, 2009)).

The Gascoyne bioregion has an arid climate with summer rainfall in the east, and winter rainfall in the west (Thackway & Cresswell, 1995). Average annual rainfall ranges from 200–290 mm; however, this can significantly fluctuate annually with heavy rainfall events sometimes occurring as a result of tropical cyclones (BoM, 2022; Waddell *et al.*, 2012).

Long-term climatic data is not available for the Study Area itself; however, long term climatic data is available from the BoM weather station at Newman Airport (station 7176), approximately 9 km west of the Study Area (BoM, 2022). This weather station is expected to provide the most accurate dataset for historic and current climatic conditions experienced within the Study Area.

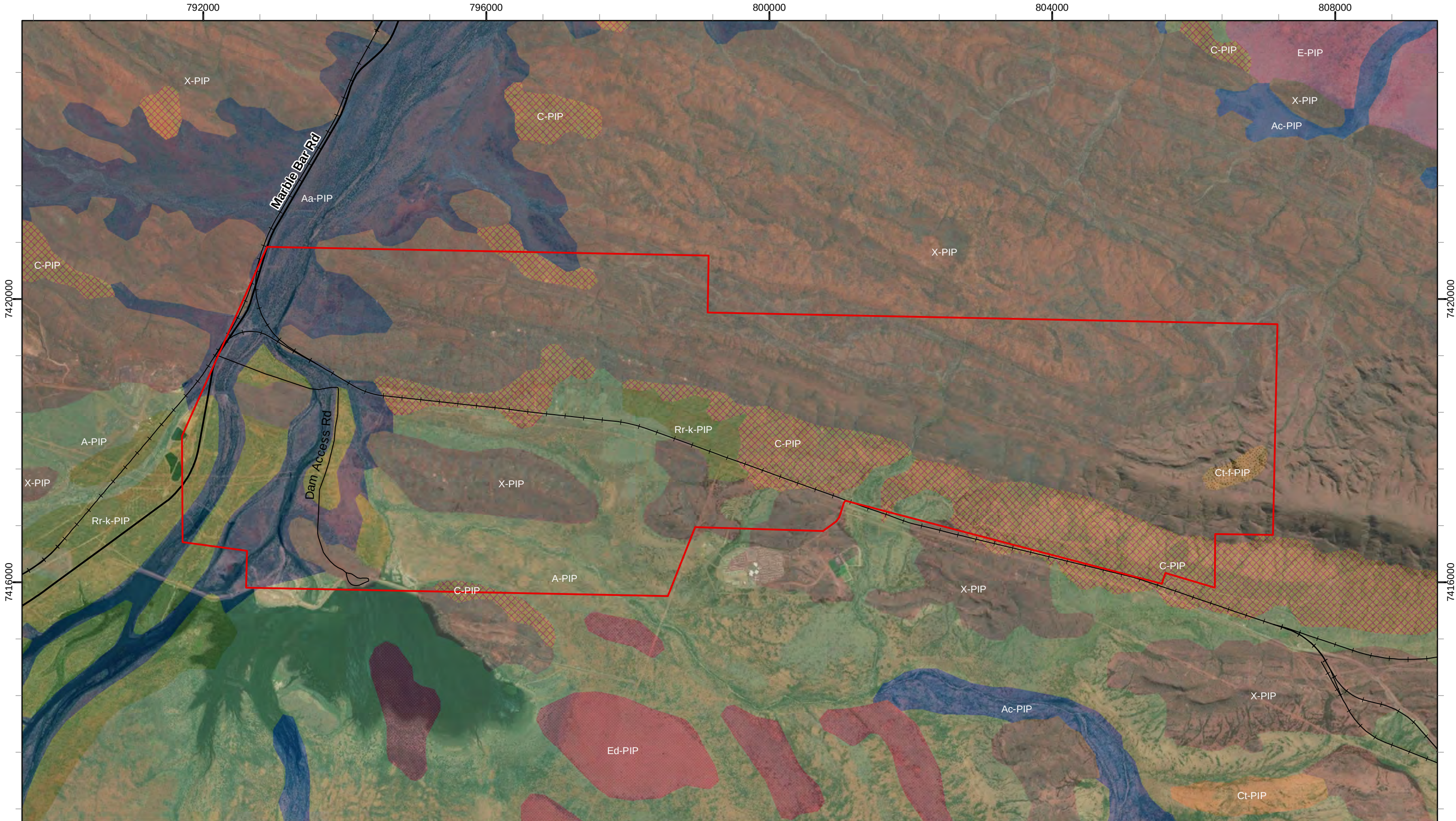
2.3 Geology

The Hamersley Province has a long geological history, broadly comprising Archaean and Proterozoic metamorphic and sedimentary rocks with much younger (Tertiary) sedimentary deposits. Within and in the vicinity of the Study Area, those Tertiary deposits infill older erosion features, either broad valleys with clays and calcretes of groundwater derived origin, or narrow channel-fill deposits (including iron-rich Channel-iron Deposits) (Kendrick, 2001).

The Study Area occurs across four broad (1:500,000) geological units (Table 2.2; Figure 2.1). The dominant geological unit occurring within the Study Area is the Exposed unit, occupying approximately 53.89%, followed by the Alluvial/ fluvial unit (26.30%), the Colluvial unit (13.51%) and the Residual or relict unit (6.30%) (Table 2.2; Figure 2.1).

Table 2.2: Geology units within the Study Area

Geological unit	Description	Extent in Study Area	
		Area (ha)	%
Exposed unit, PIP (X-PIP)	Exposed bedrock.	3,157.52	53.89%
Alluvial/ fluvial unit, PIP (A-PIP, Aa-PIP)	Clay, silt, sand, and gravel in channels and on floodplains. Sand- or clay-rich alluvium on alluvial plain.	1,541.02	26.30%
Colluvial unit, PIP (C-PIP, Ct-f-PIP)	Colluvium derived from different rock types; includes gravel, sand, silt and clay. Talus deposit from iron-rich rocks and iron-rich weathering products; commonly derived from banded iron-formation and ferruginous duricrust.	791.36	13.51%
Residual or relict unit, PIP (Rr-k-PIP)	Deeply weathered rock; protolith undetermined. Ferruginous duricrust, massive to rubbly; includes iron-cemented reworked products. Calcrete duricrust (residual or relict).	369.20	6.30%
Total		5,859.10	100%



LEGEND

Study Area

Local Road

State Road

Rail

1:500k Regolith Geology

A-PIP; Alluvial/fluviol unit, PIP

Aa-PIP; Alluvial/fluviol unit, PIP

Ac-PIP; Alluvial/fluviol unit, PIP

C-PIP; Colluvial unit, PIP

Ct-PIP; Colluvial unit, PIP

Ct-f-PIP; Colluvial unit, PIP

E-PIP; Eolian unit, PIP

Ed-PIP; Eolian unit, PIP

Rr-k-PIP; Residual or relict unit, PIP

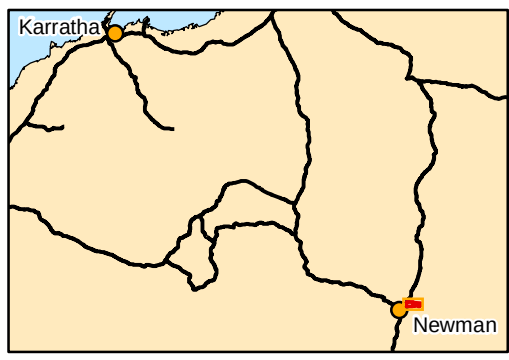
X-PIP; Exposed unit, PIP

biologic
Environmental Survey

Scale: 1:50,000

0 1 2 3 Km

Coordinate System: GDA2020 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA2020
Created 25/11/2022



BHP WAIO
East Ophthalmia and Ninga
Detailed Vertebrate
Fauna Survey

Figure 2.1: Broad geology
of the Study Area

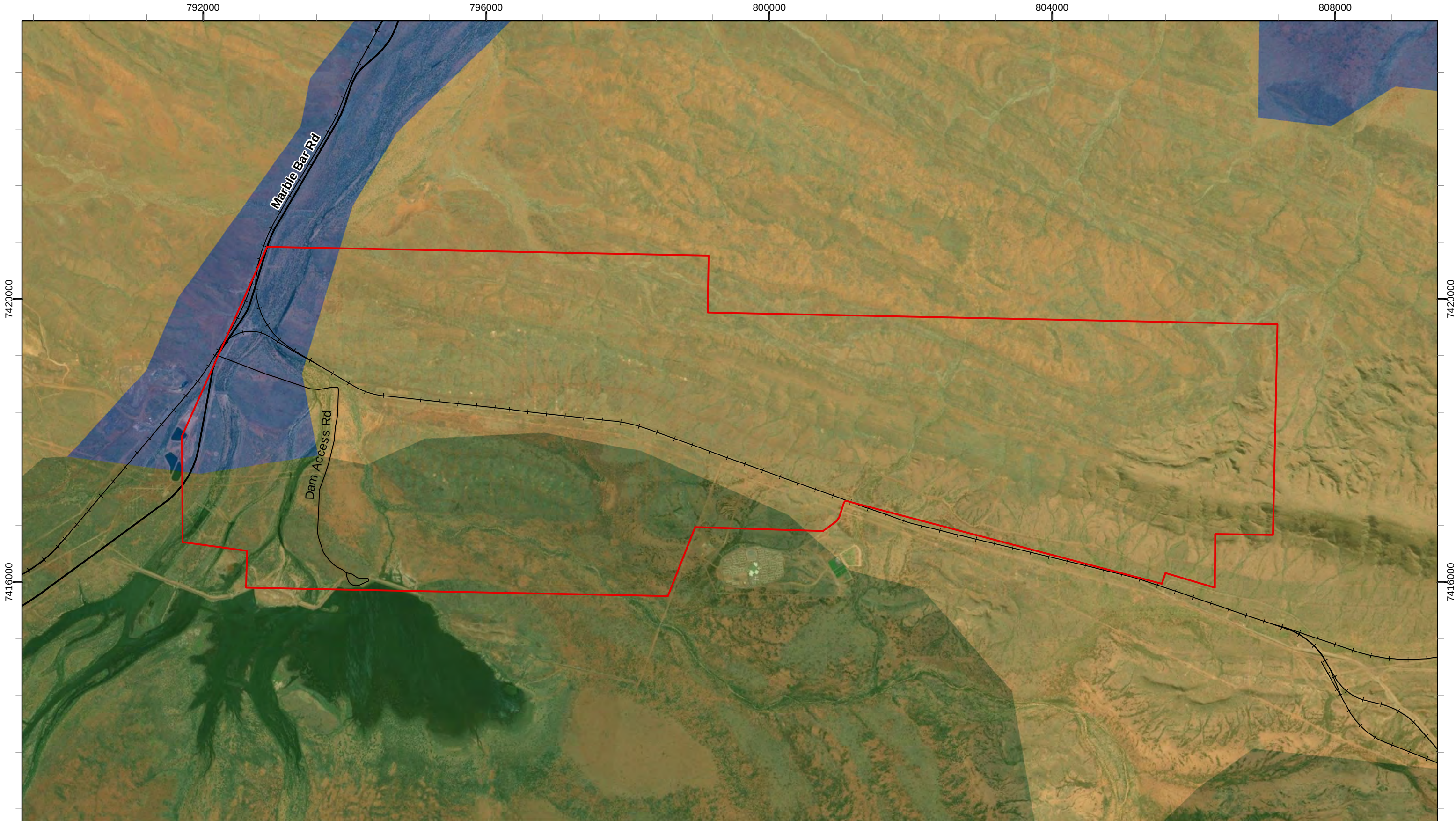
2.4 Soils

The Commonwealth Scientific and Industrial Research Organisation (2009) Atlas of Australian Soils described and mapped the soils of Australia following Bettany *et al.* (1967). The Study Area occurs across three soil units, Fa13, BE6 and Mz25 (Table 2.3; Figure 2.2). The dominant soil unit, covering approximately 68.38% of the Study Area, is FA13, which comprises of ranges of banded jaspilite and chert along with shales, dolomites, and iron ore formations; some areas of ferruginous duricrust as well as occasional narrow winding valley plains and steeply dissected pediments (Table 2.3; Figure 2.2).

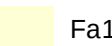
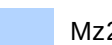
Table 2.3: Soil units within the Study Area

Soil unit	Description	Extent in Study Area	
		Area (ha)	%
Fa13	Ranges of banded jaspilite and chert along with shales, dolomites, and iron ore formations; some areas of ferruginous duricrust as well as occasional narrow winding valley plains and steeply dissected pediments.	4,006.60	68.38%
BE6	Extensive flat and gently sloping plains that sometimes have a surface cover of gravels and on which red-brown hardpan frequently outcrops.	1,426.00	24.34%
Mz25	Plains associated with the Fortescue valley; there is a surface cover of stony gravels close to the ranges and hills: chief soils are acid red earths with some neutral red earths; red-brown hardpan is absent.	426.50	7.28%
Total		5,859.10	100%

At the finer scale of land systems mapping, the Study Area consists primarily of stony soils, red shallow loams and some red shallow sands of the Newman land system, red loamy earths and red shallow loams or red loamy earths of the Boolgeeda land system and deep red/ brown non-cracking clays, red loamy earths, river bed soils, and red deep and shallow sands of the River land system (van Vreeswyk *et al.*, 2004). To a lesser extent the Study Area consists of red deep sandy duplex and red deep loamy duplex soils of the Washplain land system, red/brown non-cracking clays, self-mulching cracking clays of the Elimunna land system, stony soils, red shallow loams, red deep loamy duplex soils, red loamy earths and river bed soils of the McKay land system and stony soils, red shallow loams and calcareous shallow loams of the Rocklea land system (van Vreeswyk *et al.*, 2004).

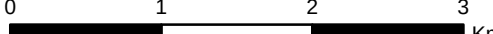


LEGEND

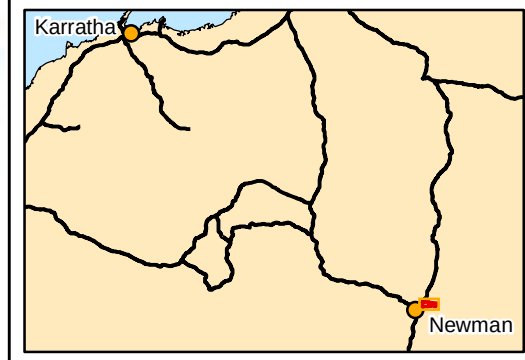
 Study Area	 Local Road	Soil Unit
 State Road	 BE6	
 Rail	 Fa13	
	 Mz25	



Scale: 1:50,000

 0 1 2 3 Km

Coordinate System: GDA2020 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA2020 Created 25/11/2022



BHP WAIO
East Ophthalmia and Ninga
Detailed Vertebrate
Fauna Survey

Figure 2.2: Soils of the
Study Area

2.5 Land Systems

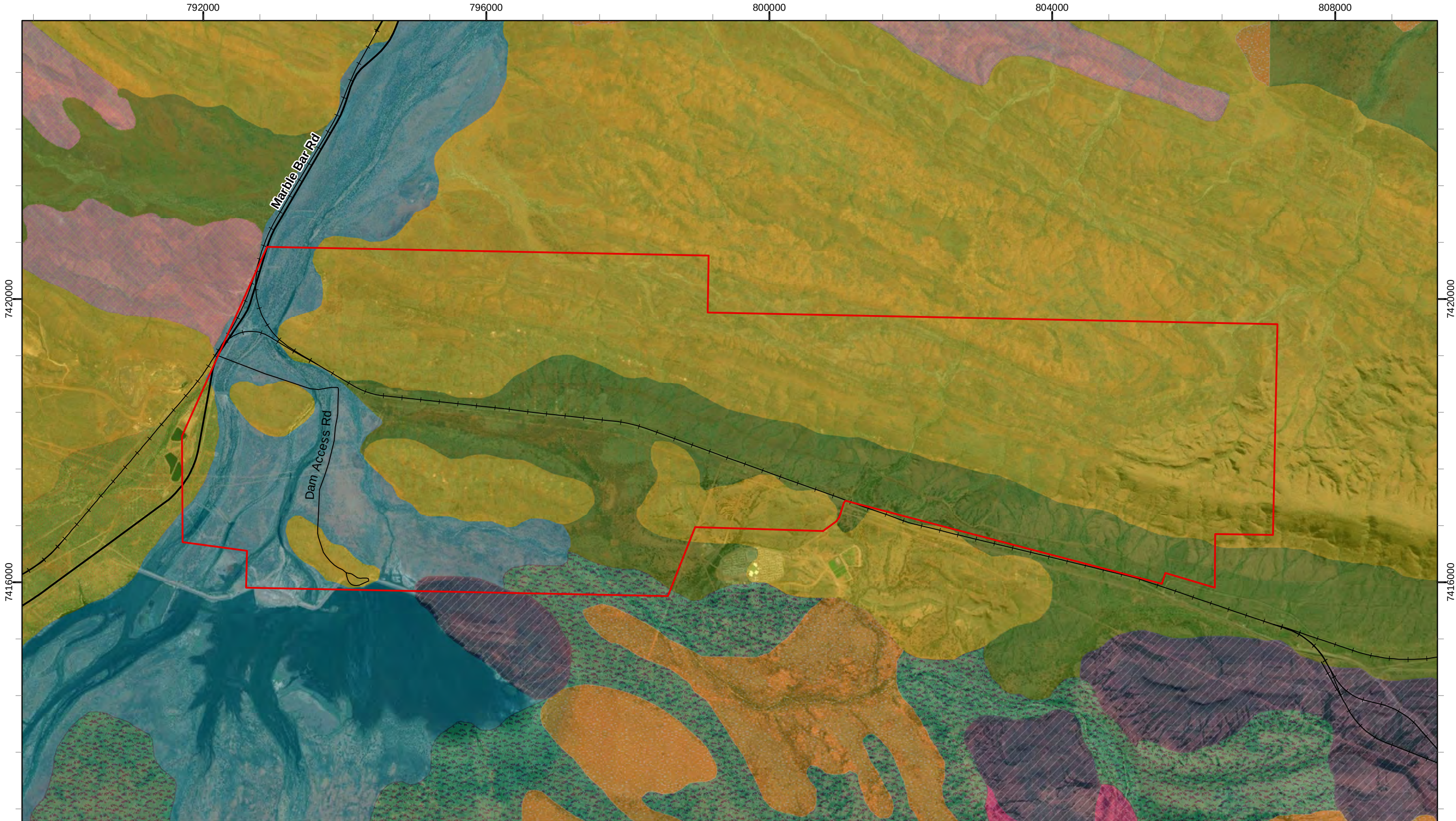
Van Vreeswyk *et al.* (2004) and Payne *et al.* (1988) classified and mapped the land systems of the Pilbara and Gascoyne bioregions according to similarities in landform, soil, vegetation, geology and geomorphology. An assessment of land systems provides an indication of the diversity and distribution of fauna habitats present within the Study Area.

The Study Area intercepts seven land systems, none of which are limited in extent or protected as Threatened Ecological Communities (TECs) or Priority Ecological Communities (PECs) (DBCA, 2019) (Figure 2.3; Table 2.4). The dominant land system is the Newman land system, covering approximately 58.57% of the Study Area (Figure 2.3; Table 2.4). The Newman land system is defined as “Rugged jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands” (van Vreeswyk *et al.*, 2004). The next most dominant are the Boolgeeda and River land systems, covering approximately 22.23% and 16.25% of the Study Area respectively (Figure 2.3; Table 2.4). The four remaining land systems, Washplain, Elimunna, McKay and Rocklea, occupy only 1.54%, 0.99%, 0.40% and 0.02% of the Study Area respectively (Figure 2.3; Table 2.4).

Of the seven land systems occurring within the Study Area, the Newman, McKay and Rocklea land systems provide suitable habitats for many of the Matters of National Environmental Significance (MNES) species, in the form of rocky ridges, mesas, plateaux, ranges and mountains associated with these land systems, which may support important refugia and foraging habitats for Pilbara leaf-nosed bat, ghost bat, northern quoll and Pilbara olive python.

Table 2.4: Land systems of the Study Area

Land system	Land type	Description	Extent in Study Area	
			Area (ha)	%
Newman	Hills and ranges with spinifex grasslands	Rugged jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands.	3,431.74	58.57%
Boolgeeda	Stony plains with spinifex grasslands	Stony lower slopes and plains below hill systems supporting hard and soft spinifex grasslands or mulga shrublands.	1,302.23	22.23%
River	River plains with grassy woodlands and tussock grasslands	Active flood plains, major rivers and banks supporting grassy eucalypt woodlands, tussock grasslands and soft spinifex grasslands	952.09	16.25%
Washplain	Wash plains on hardpan with mulga shrublands	Hardpan plains supporting groved mulga shrublands	90.04	1.54%
Elimunna	Stony plains with acacia shrublands	Stony plains on basalt supporting sparse acacia and cassia shrublands and patchy tussock grasslands.	58.08	0.99%
McKay	Hills and ranges with spinifex grasslands	Hills, ridges, plateaux remnants and breakaways of meta sedimentary and sedimentary rocks supporting hard spinifex grasslands with acacias and occasional eucalypts.	23.46	0.40%
Rocklea	Hills and ranges with spinifex grasslands	Basalt hills, plateaux, lower slopes and minor stony plains supporting hard spinifex (and occasionally soft spinifex) grasslands.	1.46	0.02%
Total			5,859.10	100%



LEGEND

Study Area

Local Road

State Road

Rail

Land System

Boolgeeda System

Divide System

Elimunna System

McKay System

Newman System

River System

Rocklea System

Sylvania System

Washplain System

N

biologic

Environmental Survey

0

1

2

3

Km

Scale: 1:50,000

Coordinate System: GDA2020 MGA Zone 50

Projection: Transverse Mercator

Datum: GDA2020

Created 25/11/2022

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East Ophthalmia and Ninga
Detailed Vertebrate
Fauna Survey

Figure 2.3: Land systems
of the Study Area

2.6 Hydrology and Surface Drainage

The Fortescue River and Warrawandu Creek are the only major watercourses to intersect the Study Area (Figure 2.4). The Fortescue River and Warrawandu Creek both flow in a north-easterly direction, with water from the watercourses getting captured at Ophthalmia Dam, located immediately southwest of the Study Area. A small section of the dam intersects the Study Area on the southern border. Additionally, Shovelanna Creek and several smaller un-named drainage lines and tributaries intersect the Study Area and connect with the Fortescue River or Warrawandu Creek (Figure 2.4). Most of these watercourses and drainage lines are ephemeral and often only flow during and/or following large rainfall events.

2.7 Pre-European Vegetation

Beard (1975) broadly (1:1,000,000) mapped the major structural vegetation types of Western Australia. Shepherd *et al.* (2002) reinterpreted and updated the vegetation association mapping to reflect the National Vegetation Information System (NVIS) standards (ESCAVI, 2003). This update also accounts for extensive clearing since Beard (1975) mapping.

Five vegetation associations occur within the Study Area (Table 2.5; Figure 2.5). The dominant vegetation association is Fortescue Valley 82, which is defined as “*Eucalyptus leucophloia* over *Triodia wiseana* hummock grasslands/ low tree steppe” and covers approximately 47.34% (2,773.98 ha) of the Study Area. The next largest vegetation associations consist of Fortescue Valley 216 and Kumarina Hills, covering approximately 27.70% (1,622.92 ha) and 21.34% (1,250.32 ha) of the Study Area respectively. The remaining vegetation associations comprise Hammersley 82 and Fortescue Valley 29, covering approximately 3.61% and 0.01% of the Study Area respectively.

Table 2.5: Vegetation associations within the Study Area

Vegetation Association (System Association Code)	IBRA Subregion	Description	Extent in Study Area	
			Area (ha)	%
Fortescue Valley 82 (82)	PIL3 (majority) and GAS3	<i>Eucalyptus leucophloia</i> over <i>Triodia wiseana</i> hummock grasslands/ low tree steppe	2,773.98	47.34%
Fortescue Valley 216 (216)	PIL3	Low woodland, mulga (with spinifex) on rises	1,622.92	27.70%
Kumarina Hills 29 (29)	PIL3 and GAS3 (majority)	Sparse low mulga (<i>Acacia aneura</i>) woodland, discontinuous in scattered groups	1,250.32	21.34%
Hammersley 82 (82.3)	PIL3	<i>E. leucophloia</i> over <i>T. wiseana</i> hummock grasslands/ low tree steppe	211.78	3.61%
Fortescue Valley 29 (29)	PIL3	Sparse low mulga (<i>A. aneura</i>) woodland, discontinuous in scattered groups	0.10	0.01%
Total			5,859.10	100%



LEGEND

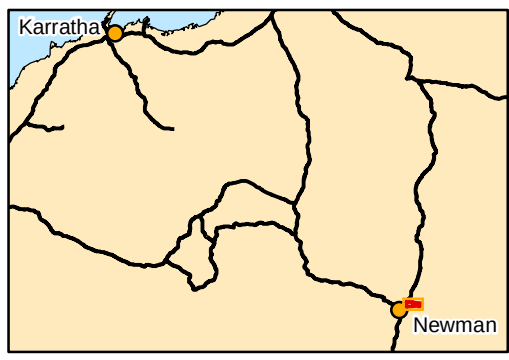
 Study Area	 Local Road	Surface Hydrology
 State Road	 Minor	
 Rail	 Major	
 Ophthalmia Dam		



Scale: 1:50,000

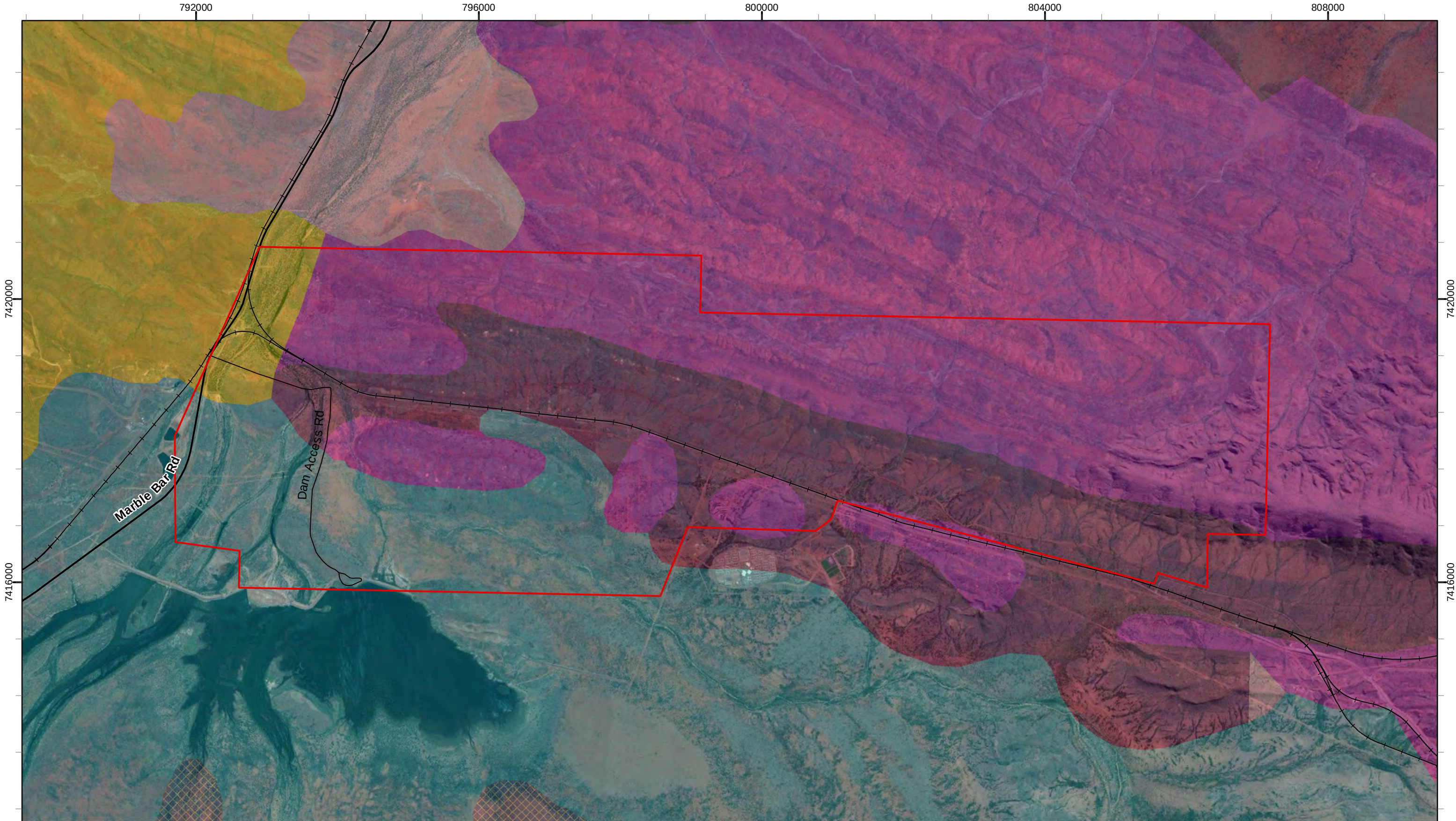
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Coordinate System: GDA2020 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA2020 Created 25/11/2022



BHP WAIO
East Ophthalmia and Ninga
Detailed Vertebrate
Fauna Survey

Figure 2.4: Hydrology
of the Study Area



LEGEND

Study Area

Local Road

State Road

Rail

Label

Fortescue Valley 29

Fortescue Valley 82

Fortescue Valley 216

Hammersley 82

Kumarina Hills 29

Kumarina Hills 216

N

biologic

Environmental Survey

0

1

2

3

Km

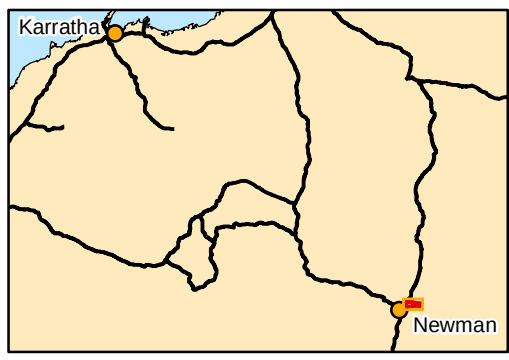
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Coordinate System: GDA2020 MGA Zone 50

Projection: Transverse Mercator

Datum: GDA2020

Created 25/11/2022



BHP WAIO
East Ophthalmia and Ninga
Detailed Vertebrate
Fauna Survey

Figure 2.5: Vegetation
associations of the
Study Area

2.8 Land Use and Tenure

No pastoral leases intersect the Study Area (Figure 1.2), and land use within the Study Area includes extensive exploration activities throughout, with the majority of exploration activities occurring within the central portion of the Study Area. A small portion of the Study Area directly adjacent to Ophthalmia Dam is used for public recreation activities.

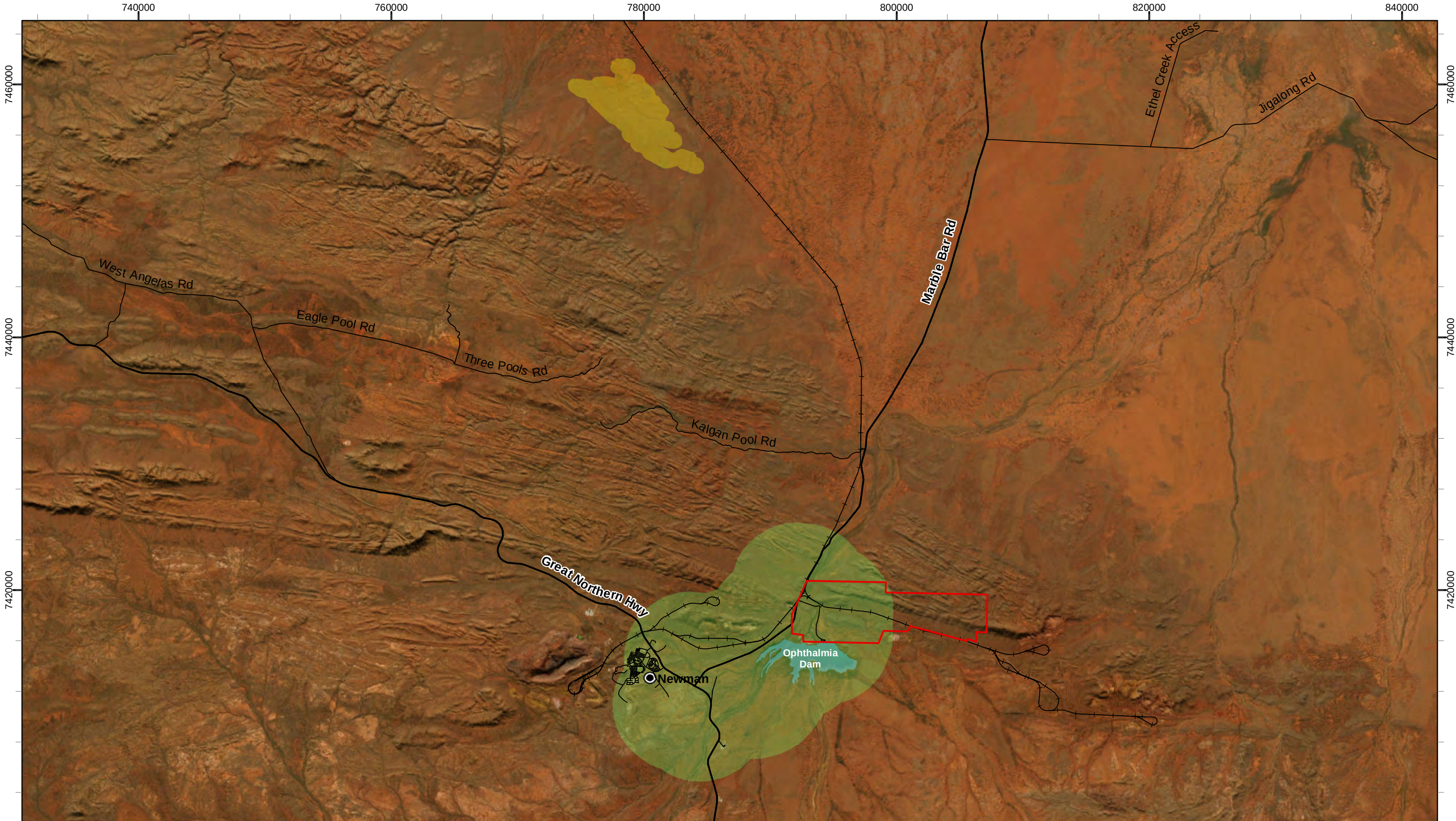
Tenure within the Study Area comprises one live mining lease (AML7000244) (Figure 1.2), which includes BHP WAIO's operating Jimblebar iron ore mine located directly east of the Study Area.

2.9 Threatened and Priority Ecological Communities

One TEC overlaps the western portion of the Study Area (Figure 2.6; Table 2.6). Additionally, one PEC occurs within 50 km of the Study Area (Figure 2.6; Table 2.6). Neither the TEC or PEC have conservation values related to terrestrial vertebrate fauna.

Table 2.6: Threatened and Priority Ecological Communities within 50 km of the Study Area

Name	Status	Description	Distance from Study Area	Applied Buffer
TEC				
Ethel Gorge Aquifer Stygobiont Community	Critically Endangered (BC Act)	Stygofauna communities of the Ethel Gorge Aquifer	Overlaps to the west	2 km
PEC				
Vegetation of Sand Dunes of the Hamersley Range/Fortescue Valley	Priority 3 (DBCA)	Vegetation of sand dunes of the Hamersley Range/ Fortescue Valley	41 km northwest	500 m

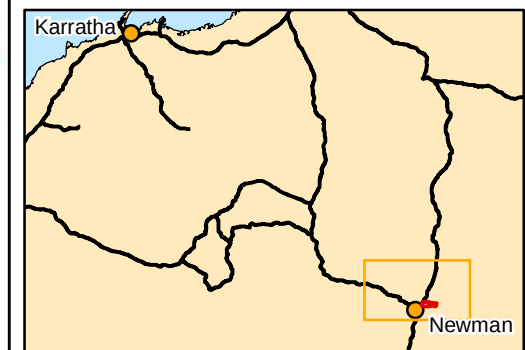


- LEGEND**
- | | | |
|---|--|--|
|  Study Area | Local Road | Community - State Category |
|  Ophthalmia Dam | State Road |  Ethel Gorge - Endangered |
| | Rail |  Fortescue Valley Sand Dunes - Priority 3 |


biologic
Environmental Survey


Scale: 1:280,000
0 8 16 Km

Coordinate System: GDA2020 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA2020 Created 28/04/2023



BHP WAIO
East Ophthalmia and Ninga
Detailed Vertebrate
Fauna Survey

Figure 2.6: Threatened and Priority
Ecological Communities identified
in the desktop assessment

3 DESKTOP ASSESSMENT

A desktop assessment, comprising database searches and a literature review of the Study Area was undertaken prior to the field survey. The purpose of the desktop assessment was to identify vertebrate fauna previously recorded or potentially occurring within the Study Area, with a focus on significant species.

3.1 Methodology

3.1.1 Database Searches

Five fauna databases were searched, three to obtain information on all species previously recorded (NatureMap, Birddata and BHP WAIO Fauna Records Database), one to identify significant species previously recorded (DBCA Threatened and Priority Fauna Database), and one to identify significant species known or with the potential to occur within the desktop search area (Protected Matters Search Tool) (Table 3.1).

Table 3.1: Details of database searches conducted

Database	Data Access/ Receival Date	Search Area
DBCA (2022a) NatureMap	01/03/2022	Study Area with a 50 km buffer
DBCA (2022b) Threatened and Priority Fauna Database	14/01/2022	
BirdLife Australia (2022) Birddata	14/01/2022	
DoE (2022) Protected Matters Search Tool	14/01/2022	
BHP WAIO (2022a) BHP WAIO Fauna Records Database	17/02/2022	Study Area with 20 km buffer. Includes any biological surveys completed for BHP WAIO within search area.

3.1.2 Literature Review

A review of available literature relevant to the Study Area was undertaken to compile a list of fauna habitats and vertebrate fauna species with the potential to occur within the Study Area. A total of 39 assessments were reviewed, comprising 15 detailed surveys, 19 basic surveys (including two targeted level 1 surveys), four targeted surveys and one avifauna survey (Appendix B).

3.2 Results

The literature review and database searches identified a total of 371 vertebrate fauna species and subspecies which have previously been recorded and/or have the potential to occur within the Study Area. This comprised 51 mammals (including 41 native and ten non-native), 200 birds, 111 reptiles and nine amphibians (Table 3.2; Appendix C). Due to the size of the desktop assessment search area, and likelihood of encompassing habitats which may not occur within the Study Area, results of the desktop review are likely to include species which may not occur within the Study Area. Additionally, many species tend to be patchily distributed even where appropriate habitats are present, and many species of birds can occur as regular migrants, occasional visitors or vagrants.

Of the 371 species of vertebrate fauna identified by the desktop assessment, 41 species are of significance, comprising ten mammals, 27 birds and four reptiles (Table 3.3). Of the 41 significant species identified, 18 species have previously been recorded within the Study Area, comprising; four mammals (brush-tailed mulgara, ghost bat, western pebble-mound mouse and Pilbara leaf-nosed bat), twelve bird species (grey falcon, gull-billed tern, caspian tern, common sandpiper, sharp-tailed sandpiper, red-necked stint, black-tailed godwit, wood sandpiper, common greenshank, marsh sandpiper, long-toed stint and glossy ibis) and two reptile species (Pilbara olive python and Pilbara flat-headed blind snake) (Figure 3.1).

Table 3.2: Summary of fauna species recorded within and in the vicinity of the Study Area in the desktop assessment

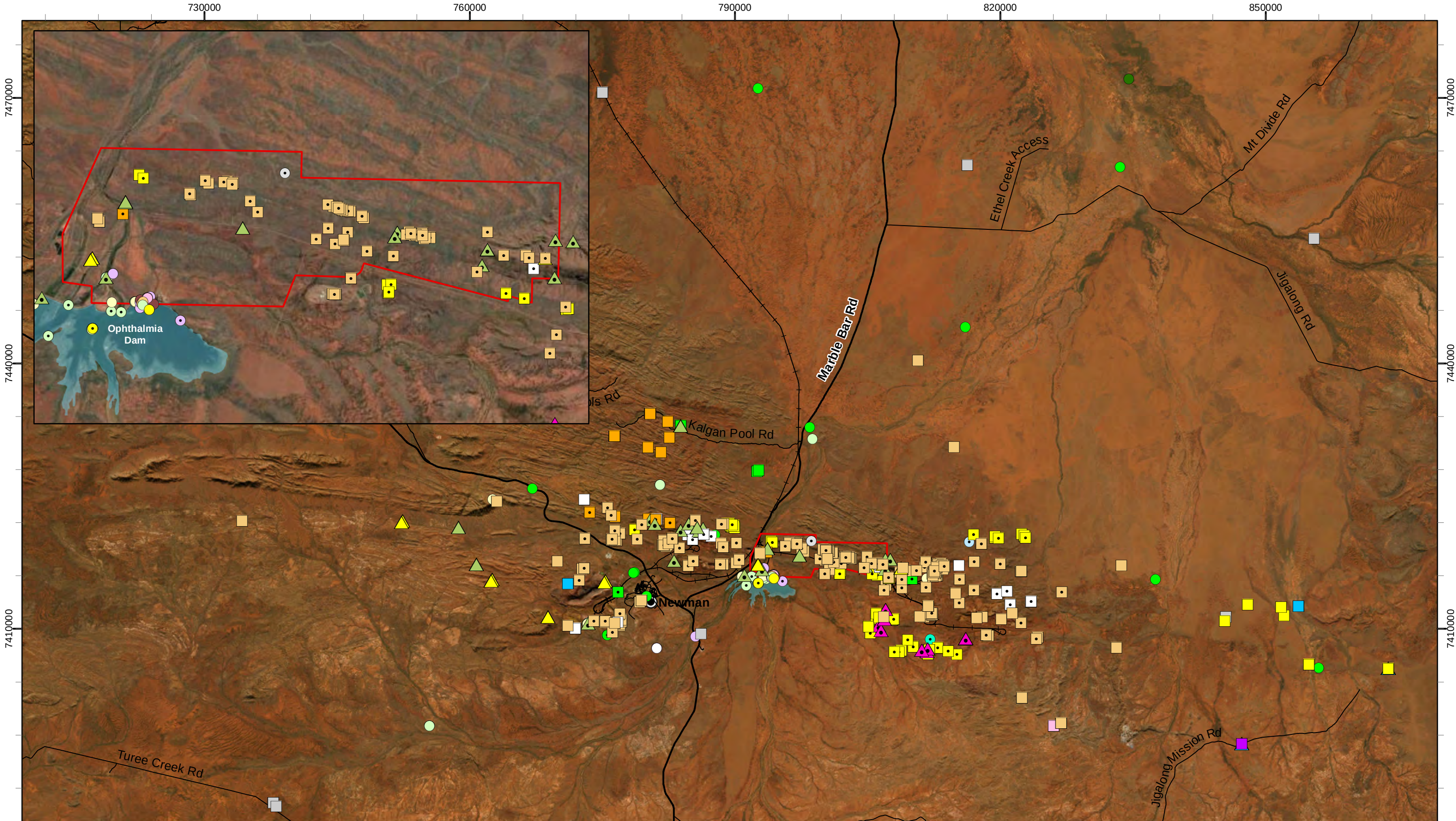
Source	Reference	Mammals (native)	Mammals (introduced)	Birds	Reptiles	Amphibians	Total
Literature Sources							
Biologic (2014a) Orebody 19 level 2 vertebrate fauna survey	1	20	3	62	48	1	134
Eco Logical (2013) Ninga level 1 vertebrate fauna assessment	2	5	4	41	16	1	67
ENV (2011c) Orebody 42/43 flora, vegetation and fauna assessment	3	2	3	36	0	0	41
Outback Ecology (2009b) Jimblebar Linear Development terrestrial vertebrate fauna assessment	4	7	2	80	47	4	140
Ecologia (1996) Jimblebar Rail Spur biological assessment survey	5	3	1	59	7	2	72
MWH (2015) Ophthalmia Dam avian fauna survey	6	0	0	123	0	0	123
Ecologia (2008) RGP5 fauna survey Newman to Jimblebar Junction	7	2	3	39	9	0	53
ENV (2006) OB24 flora and fauna assessment phase II	8	7	2	63	31	3	106
Eco Logical (2012) Orebody 37 level 1 vertebrate fauna assessment	9	10	5	64	11	1	91
ENV (2011a) Eastern Ridge (OB23/24/25) fauna assessment	10	10	0	46	11	2	69
Biologic (2013a) Ore Body 24 targeted vertebrate fauna survey	11	18	0	44	18	1	81
Biologic (2021c) Western Ridge Pipelines vertebrate fauna survey	12	12	3	66	12	2	95
ENV (2007b) West Jimblebar Lease fauna assessment	13	4	5	73	27	0	109
Ecologia (2004c) Orebody 24 Expansion biological survey	14	4	2	62	22	0	90
Biologic (2014b) Orebody 25 targeted vertebrate fauna survey	15	11	2	28	6	0	47
Onshore and Biologic (2009b) Biological survey Myopic Exploration Leases	16	7	3	48	7	0	65
GHD (2008) Report for Myopic Project Area Newman flora and fauna assessment	17	3	3	32	3	0	41

Source	Reference	Mammals (native)	Mammals (introduced)	Birds	Reptiles	Amphibians	Total
Biologic (2014c) Orebody 31 vertebrate fauna survey	18	16	6	39	42	0	103
Outback Ecology (2009a) Jimblebar Iron Ore Project terrestrial vertebrate fauna assessment	19	11	6	47	29	2	95
Biologic (2021a) Western Ridge Creeks targeted MNES species survey	20	2	5	60	13	2	82
Ecologia (2004b) Jimblebar-Wheelarra Hill biological survey	21	8	1	57	29	4	99
GHD (2019b) North Jimblebar fauna survey	22	17	5	62	45	0	129
Biologic (2016) Cathedral Gorge level 1 and targeted vertebrate fauna survey	23	13	3	46	10	0	72
ENV (2011b) Mt Whaleback East flora, vegetation and fauna assessment	24	2	1	29	7	0	39
Onshore and Biologic (2009a) Mt Whaleback flora & vegetation survey and fauna assessment	25	4	3	51	7	0	65
Biologic (2020a) Coomabanbunna Well level 2 vertebrate fauna survey	26	20	5	75	50	2	152
Onshore (2014) Western Ridge biological survey	27	13	3	36	8	0	60
Ecologia (2006a) Jimblebar Marra Mamba Exploration biological survey	28	7	3	64	24	1	99
Biologic (2013b) South West Jimblebar vertebrate fauna survey	29	15	6	55	39	2	117
Astron (2010) BHP Billiton Iron Ore Mt Whaleback TSF flora, vegetation and fauna assessment	30	2	0	1	0	0	3
Biologic (2020c) Western Ridge targeted vertebrate fauna survey	31	6	2	41	4	2	55
GHD (2019a) Jimblebar East and Caramulla fauna survey	32	23	5	66	46	0	140
Biologic (2011) Orebody 35 and Western Ridge vertebrate fauna survey	33	19	6	82	54	2	163
Ecologia (2005b) Western Ridge Exploration Project biological survey	34	3	3	50	15	0	71
Ecologia (2006b) BHPBIO Western Ridge Exploration Project biological survey	35	10	7	25	8	0	50
Ecologia (2005a) East Jimblebar Exploration Project biological survey	36	8	2	40	19	1	70
ENV (2010) Ophthalmia flora, vegetation and fauna assessment	37	11	5	34	7	0	57
ENV (2007a) Ophthalmia Exploration Lease fauna assessment	38	7	5	84	22	2	120
Database Searches							
DBCA (2022a) NatureMap		32	5	171	94	9	311
DBCA (2022b) Threatened and Priority Fauna Database		9	-	15	4	0	28
BirdLife Australia (2022) Birddata		-	-	175	-	-	175
DoE (2022) Protected Matters Search Tool		4	-	14	2	0	20
BHP WAIO (2022a) BHP WAIO Fauna Records Database		32	8	170	86	5	225
Total species recorded		41	10	200	111	9	371
Significant species		10	-	27	4	-	41

Table 3.3: Significant species identified and their conservation status

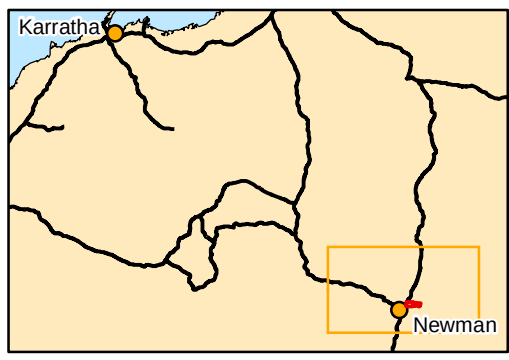
Scientific Name	Common Name	EPBC Act	BC Act	DBCA	IUCN
MAMMALS					
DASYURIDAE					
<i>Dasyercus blythi</i>	brush-tailed mulgara			P4	
<i>Dasyurus hallucatus</i>	northern quoll	EN	EN		EN
<i>Antechinomys longicaudata</i>	long-tailed dunnart			P4	
MACROPODIDAE					
<i>Lagorchestes conspicillatus</i> subsp. <i>leichardti</i>	spectacled hare-wallaby			P4	
<i>Petrogale lateralis</i> subsp. <i>lateralis</i>	black-flanked rock-wallaby	EN	EN		VU
MEGADERMATIDAE					
<i>Macroderma gigas</i>	ghost bat	VU	VU		VU
MURIDAE					
<i>Pseudomys chapmani</i>	western pebble-mound mouse			P4	
NOTORYCTIDAE					
<i>Notoryctes caurinus</i>	northern marsupial mole			P4	
RHINONYCTERIDAE					
<i>Rhinonictes aurantia</i>	Pilbara leaf-nosed bat	VU	VU		
THYLACOMYIDAE					
<i>Macrotis lagotis</i>	greater bilby	VU	VU		VU
AVES					
ACANTHIZIDAE					
<i>Aphelocephala leucopsis</i>	Southern whiteface	VU			
ANATIDAE					
<i>Anas querquedula</i>	garganey	MI	MI		
APODIDAE					
<i>Apus pacificus</i>	fork-tailed swift	MI	MI		
CHARADRIIDAE					
<i>Charadrius dubius</i>	little ringed plover	MI	MI		
<i>Charadrius veredus</i>	oriental plover	MI	MI		
CICONIIDAE					
<i>Ephippiorhynchus asiaticus</i>	black-necked stork				NT
FALCONIDAE					
<i>Falco hypoleucos</i>	grey falcon	VU	VU		VU
<i>Falco peregrinus</i>	peregrine falcon		OS		
HIRUNDINIDAE					
<i>Hirundo rustica</i>	barn swallow	MI	MI		
LARIDAE					
<i>Gelochelidon nilotica</i>	gull-billed tern	MI	MI		
<i>Sterna caspia</i>	caspian tern	MI	MI		
MOTACILLIDAE					
<i>Motacilla flava</i>	yellow wagtail	MI	MI		

Scientific Name	Common Name	EPBC Act	BC Act	DBCA	IUCN
PSITTACIDAE					
<i>Pezoporus occidentalis</i>	night parrot	EN	CR		EN
ROSTRATULIDAE					
<i>Rostratula australis</i>	Australian painted snipe	EN	EN		EN
SCOLOPACIDAE					
<i>Calidris acuminata</i>	sharp-tailed sandpiper	MI	MI		
<i>Calidris ferruginea</i>	curlew sandpiper	CR/MI	CR/MI		NT
<i>Calidris melanotos</i>	pectoral sandpiper	MI	MI		
<i>Calidris ruficollis</i>	red-necked stint	MI	MI		NT
<i>Calidris subminuta</i>	long-toed stint	MI	MI		
<i>Limosa limosa</i>	black-tailed godwit	MI	MI		NT
<i>Philomachus pugnax</i>	ruff	MI	MI		
<i>Tringa glareola</i>	wood sandpiper	MI	MI		
<i>Actitis hypoleucos</i>	common sandpiper	MI	MI		
<i>Tringa nebularia</i>	common greenshank	MI	MI		
<i>Tringa stagnatilis</i>	marsh sandpiper	MI	MI		
<i>Tringa totanus</i>	common redshank	MI	MI		
THRESKIORNITHIDAE					
<i>Plegadis falcinellus</i>	glossy ibis	MI	MI		
REPTILES					
PYTHONIDAE					
<i>Aspidites ramsayi</i>	woma				EN
<i>Liasis olivaceus</i> subsp. <i>barroni</i>	Pilbara olive python	VU	VU		
SCINCIDAE					
<i>Ctenotus uber</i> subsp. <i>johnstonei</i>	spotted ctenotus			P2	
<i>Liopholis kintorei</i>	great desert skink	VU	VU		VU
TYPHLOPIDAE					
<i>Anilius ganei</i>	Pilbara flat-headed blind-snake			P1	



- LEGEND**
- Study Area
 - Ophthalmia Dam
 - Local Road
 - State Road
 - Rail


Scale: 1:400,000
0 10 20 Km
Coordinate System: GDA2020 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA2020
Created 28/04/2023



BHP WAIO
East Ophthalmia and Ninga
Detailed Vertebrate
Fauna Survey

Figure 3.1: Significant
species identified in the
desktop assessment

BHP Database

Bird

-  Curlew sandpiper - CR
-  Grey falcon - VU
-  Peregrine falcon - OS
-  Barn swallow - MI
-  Black-tailed godwit - MI
-  Common greenshank, greenshank - MI
-  Common redshank, redshank - MI
-  Common sandpiper - MI
-  Fork-tailed swift - MI
-  Garganey - MI
-  Glossy ibis - MI
-  Little ringed plover - MI
-  Long-toed stint - MI

-  Marsh sandpiper, little greenshank - MI
-  Pectoral sandpiper - MI
-  Ruff - MI
-  Sharp-tailed sandpiper - MI
-  Wood sandpiper - MI

Mammal

-  Ghost bat - VU
-  Pilbara leaf-nosed bat - VU
-  Northern quoll - EN
-  Brush-tailed mulgara - P4
-  Western pebble-mound mouse, ngadji - P4

Reptile

-  Pilbara olive python - VU
-  Pilbara flat-headed blind-snake - P1
-  Spotted ctenotus (northeast) - P2

DBCA Database

Bird

-  Curlew sandpiper - CR
-  Peregrine falcon - OS
-  Caspian tern - MI
-  Common greenshank, greenshank - MI
-  Common redshank, redshank - MI
-  Common sandpiper - MI
-  Glossy ibis - MI
-  Gull-billed tern - MI
-  Long-toed stint - MI
-  Marsh sandpiper, little greenshank - MI
-  Oriental plover - MI
-  Pectoral sandpiper - MI
-  Red-necked stint - MI
-  Sharp-tailed sandpiper - MI

-  Wood sandpiper - MI

Mammal

-  Black-flanked rock-wallaby, black-footed rock-wallaby - EN
-  Bilby, dalgyte, ninu - VU
-  Ghost bat - VU
-  Pilbara leaf-nosed bat - VU
-  Brush-tailed mulgara - P4
-  Long-tailed dunnart - P4
-  Marsupial mole - P4
-  Spectacled hare-wallaby (mainland) - P4
-  Western pebble-mound mouse, ngadji - P4

Reptile

-  Great desert skink - VU
-  Pilbara olive python - VU
-  Pilbara flat-headed blind-snake - P1
-  Spotted ctenotus (northeast) - P2

4 FIELD SURVEY METHODS

4.1 Survey Timing and Weather

A two-phase detailed vertebrate fauna survey was undertaken from 14–25 March 2022 (phase 1, wet season), and from 4–14 October 2022 (phase 2, dry season). Observed weather conditions prior to and during all surveys are shown in Figure 4.1, alongside long-term climatic data for Newman Airport (station 007176).

In the 12 months prior to the surveys, mean minimum and maximum temperatures recorded at Newman Airport were similar to or slightly higher than long-term averages for most months (Figure 4.1). Rainfall in the 12 months prior to the surveys was variable (Figure 4.1). Well above average rainfall was recorded during both May and September 2022 (Figure 4.1).

Observed temperatures at Newman Airport during the surveys were comparable to long-term averages; however, numerous days above long-term averages were recorded during both surveys. During the phase 1 survey, minimum daily temperatures ranged between 23.4–28.8°C and maximum temperatures ranged between 34.3–41.0°C, compared to long-term minimum averages of 22.2°C and maximum averages of 35.6°C for March (Table 4.1; Figure 4.1). Minimum daily temperatures during the phase 2 survey ranged between 8.2°C–18.9°C and maximum temperature between 26.1–36.3°C, compared to long-term minimum averages of 17.7°C and maximum averages of 35.1°C for October (Table 4.1; Figure 4.1). Rainfall recorded during the surveys was well below long-term averages, with a total of 0.2 mm rainfall recorded at Newman Airport during both phase 1 and phase 2 (Table 4.1).

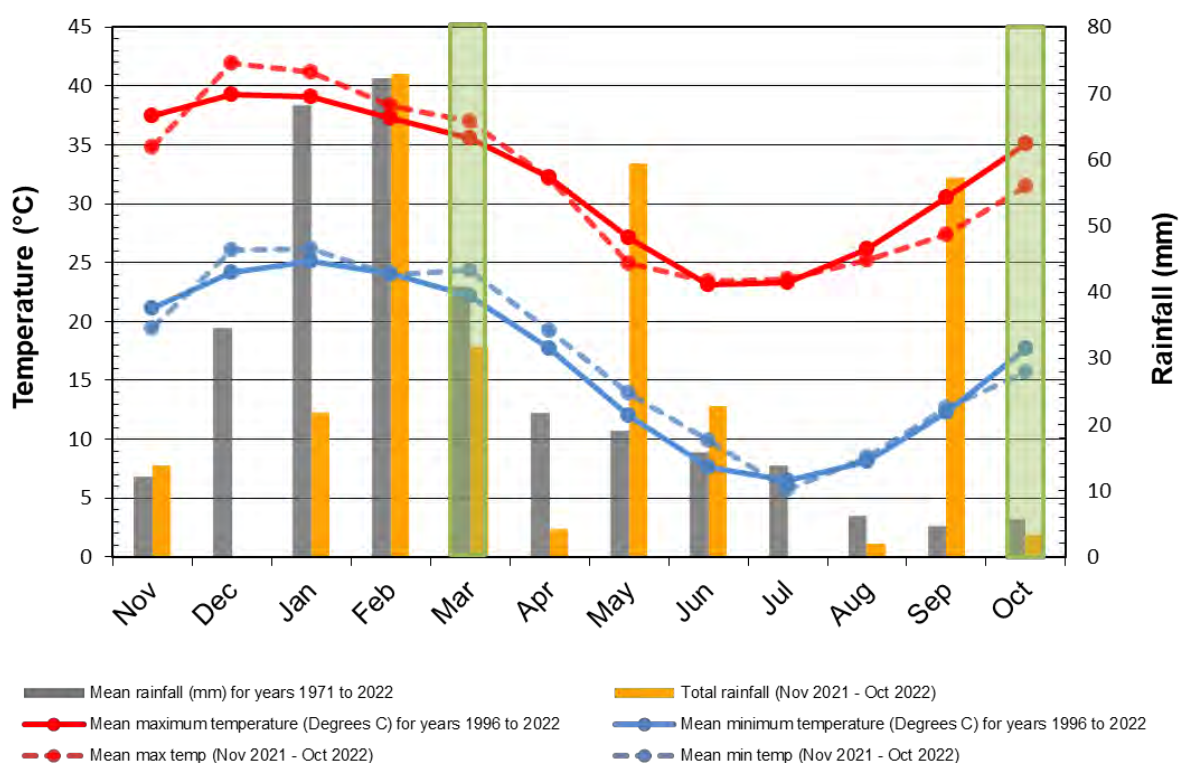


Figure 4.1: Long-term and current climatic data for Newman Airport (station 007176) (BoM, 2022) with approximate survey timing shown in shaded boxes

Table 4.1: Daily climate data recorded during the field surveys

Date	Temperature (°C)		Rainfall (mm)
	Minimum	Maximum	
Phase 1			
14/03/2022	29.0	40.0	0
15/03/2022	28.8	40.6	0.2
16/03/2022	23.4	39.8	0
17/03/2022	24.6	40.5	0
18/03/2022	25.7	39.7	0
19/03/2022	24.7	41.0	0
20/03/2022	23.8	40.0	0
21/03/2022	25.5	40.1	0
22/03/2022	27.5	39.7	0
23/03/2022	28.5	35.0	0
24/03/2022	26.1	34.3	0
25/03/2022	24.8	35.6	0
Average/Total	26.0	38.9	0.2
Phase 2			
4/10/2022	11.6	28.1	0.2
5/10/2022	17.4	32.0	0
6/10/2022	16.5	28.6	0
7/10/2022	14.1	30.3	0
8/10/2022	15.8	31.4	0
9/10/2022	15.7	34.3	0
10/10/2022	15.0	36.3	0
11/10/2022	18.9	32.0	0
12/10/2022	18.0	26.9	0
13/10/2022	13.5	26.1	0
14/10/2022	8.2	27.3	0
Average/Total	15.0	30.3	0.2

4.2 Survey Personnel and Licensing

The field surveys were completed by zoologists with extensive experience undertaking vertebrate fauna surveys in the Pilbara region. Personnel involved in the field survey are shown in Table 4.2.

Table 4.2: Survey personnel and experience

Personnel	Position and Role	Qualification	Experience
Ryan Ellis	Principal Zoologist - project management - field survey team lead (phase 1 & phase 2)	BESc Wildlife and Conservation Biology Dip (Conservation and Land Management)	12 years' Environmental Impact Assessment (EIA) (consulting) 16 years' field survey 16 years' vertebrate zoology/ ecology
Mark Gresser	Senior Zoologist field survey (phase 1)	BSc (Hons) Biological Sciences, Conservation and Wildlife Biology, Animal Biology	6 years' EIA (consulting) 8 years' field survey 8 years' vertebrate zoology/ ecology
Anders Zimney	Senior Zoologist field survey (phase 2)	BSc Biological Science	4 years' EIA (consulting) 12 years' field survey 12 years' vertebrate zoology/ ecology
Ray Lloyd	Senior Zoologist field survey (phase 2)	BSc Zoology	13 years' EIA (consulting) 21 years' field survey 21 years' vertebrate zoology/ ecology
Louis Masarei	Senior Zoologist field survey (phase 1)	BSc Conservation Biology & Marine and Coastal Management	7 years' EIA (consulting) 7 years' field survey 7 years' vertebrate zoology/ ecology
Courtney Proctor	Zoologist field survey (phase 1)	BSc Animal Behaviour	3 years' EIA (consulting) 5 years' field survey 5 years' vertebrate zoology/ ecology
Aleesha Turner	Zoologist field survey (phase 1)	BSc Applied Science (Wildlife Biology) (Hons)	2 years' EIA (consulting) 3 years' field survey 3 years' vertebrate zoology/ ecology
Courtney Wilkins	Zoologist field survey (phase 1)	BSc Conservation & Wildlife Biology	2 years' EIA (consulting) 5 years' field survey 2 years' vertebrate zoology/ ecology
Ashleigh Jenkins	Zoologist field survey (phase 2)	BSc Zoology; Pathology and Laboratory Medicine MBSc Conservation Biology	3 years' EIA (consulting) 5 years' field survey 5 years' vertebrate zoology/ ecology
Georgina Mattner	Graduate Zoologist field survey (phase 1)	BSc Animal Ecology	1 years' EIA (consulting) 5 years' field survey 1 years' vertebrate zoology/ ecology

The fauna sampling for this survey was conducted under a DBCA Regulation 27 "Fauna Taking (Biological Assessment) License" (BA27000588) issued to Christopher George Knuckey. In accordance with Section 40 of the BC Act, threatened species sampling was completed under a DBCA "Authorisation to Take or Disturb Threatened Species" (authorisation number TFA 2022-0004) issued to Christopher George Knuckey. Biologic holds a current license to use animals for scientific purposes (License No. U244/ 2022-2024), administered through the Department of Primary Industries and Regional Development (DPIRD). This is enabled through Biologic's chosen animal ethics committee (AEC), Murdoch University. An application (RW3354/21) that covers the work conducted during this assessment has been submitted and approved by Murdoch University's AEC.

4.3 Sampling and Survey Methods

4.3.1 Habitat Assessments and Mapping

Habitat assessments were undertaken throughout the Study Area to characterise and define habitats and their suitability for significant species (Appendix E; Appendix E). Habitat assessments were undertaken at 112 locations across the Study Area, including all sampling sites (Figure 4.3). The assessments were conducted using methodology and terminology prescribed by BHP WAIO (2022b), which have been modified from the *Australian Soil and Land Survey Field Handbook* (National Committee on Soil and Terrain, 2009). The characteristics recorded during the habitat assessments were:

- site information: location and photo;
- habitat: broad habitat type, landform, aspect, slope, soil type and availability, rocky outcropping presence and type;
- ground cover: rock size, vegetation litter and woody debris;
- vegetation: broad vegetation type, structure and dominant species;
- microhabitat: rocky cracks/ crevices, burrowing suitability, hollow presence and abundance, water presence; and
- condition: time since fire, disturbance and overall habitat condition.

Fauna habitat mapping was completed for the Study Area using the vertebrate fauna habitat assessments completed during the field surveys, as well as high-resolution aerial imagery, vegetation, topographical, geology and soil mapping. Habitats were delineated and mapped across the Study Area at a scale of approximately 1:20,000.

4.3.2 Cave Assessments

Cave assessments were completed for any new caves recorded within the Study Area ($n = 2$) to document the physical characteristics and assist the classification of significance to Pilbara leaf-nosed bat and ghost bat. Information recorded during each cave assessment was consistent with those attributes required by BHP WAIO (2020a), and included:

- entrance location and photograph;
- entrance shape, dimensions, position in the landscape, aspect and level of sun exposure;
- internal structure and dimensions including depth, floor slope, number and size of chambers;
- presence of water either within the cave or near its entrance; and
- presence or signs of bat use (such as remains, scats or feeding signs).

Each cave was categorised based on data from the cave assessments, including the presence of any target bat species via primary or secondary evidence (i.e. calls, scats and individual remains). The categories of cave significance for ghost bats followed the classifications defined by Bat Call (2021a):

- **Category 1** (maternity/ diurnal roost with permanent occupancy): Permanently occupied roost tending to have large fluctuating populations. Due to permanent presence maternity usage is assumed. Structurally, caves are often deep and dark with one or more elevated roosting

chambers that provide a stable microhabitat. Critical for the ongoing presence of ghost bat in the area.

- **Category 2** (maternity/ diurnal roost with regular occupancy): Ghost bat presence regular, but not permanent/ continuous over long periods. Pregnant or pup-carrying individuals may be present. Similar to Category 1 caves, but often less complex, with only a single inner chamber and are often in less productive areas only used by the species periodically. Bats present for 25% to 75% but may be abandoned for weeks or months. Typically have several other caves, shelters and overhangs within a few hundred meters, which together make up an 'apartment block' grouping that supports the ongoing presence of the species. Critical for the ongoing presence of the species in the area.
- **Category 3** (diurnal roost with occasional occupancy): Diurnal roosts where the species roosts occasionally, or rarely. Structurally, less well-developed and often used as feeding sites (as evidenced by middens with food scraps) or temporary refuges. Scats and/or small food middens present but may be no evidence of roosting bats or observations of roosting not consistent. May facilitate long-distance movements of individuals more broadly across the landscape. When adjacent to Category 2 roosts, Category 3 caves are considered part of an 'apartment block' and therefore critical habitat for the ongoing presence of the species in the area. Where occurring in isolation, Category 3 caves are not considered critical habitat essential for the long-term viability of a local population.
- **Category 4** (nocturnal roost with opportunistic usage): Roosts used in at least an opportunistic manner by itinerant individuals and may comprise single visitations to longer periods including periods of rest or feeding during foraging. Includes majority of shallow caves, shelters and deep overhangs in the Pilbara. Not considered critical habitat.

For Pilbara leaf-nosed bats, cave significance followed the classifications defined by Bat Call (2021b):

- **Category 1** (permanent diurnal/ maternity roost): Maternity roosts where seasonal presence of young is proven. Often supporting presence of a large colony. Critical habitat for the daily and long-term survival of the species.
- **Category 2** (permanent diurnal roost): Diurnal roosts occupied year-round, often by smaller colonies to Category 1 roosts, without confirmed maternity usage (presence of young). Critical habitat for the daily and long-term survival of the species.
- **Category 3** (semi-permanent diurnal roost): Diurnal roost with occasional/ intermittent occupancy, not occupied year-round. May be used during the breeding cycle and may also facilitate long distant distance dispersal, particularly around autumn. Often occurring as a 'satellite' roost associated with nearby Category 1 and/or Category 2 roosts. Critical habitat for the long-term survival of the species.
- **Category 4** (nocturnal refuge): Roosts occupied or entered at night for resting, feeding or other purposes, with perching not a requirement. Not considered critical habitat for the species; however, important for persistence in a local area.

4.3.3 Water Feature Assessments

Water feature assessments were conducted for any water features that were found within the Study Area ($n = 22$). The assessments were aimed to define and characterise the water features and identify their likelihood of supporting significant species (i.e. critical habitat for Pilbara olive python or water sources for Pilbara leaf-nosed bat). Water feature assessments were conducted and attributes assessed using attribute terminology prescribed by BHP WAIO (2020a). The characteristics recorded during the habitat assessments were:

- site information, photo and location;
- dimensions: length, width, depth;
- water presence: above the surface, in the intermediate zone; and
- vegetation: obligate phreatophytes, emergent macrophytes.

Water features were assessed, and their persistence classified into three categories, comprising:

- permanent – fed by ground water and/or surface drainage, persisting year-round;
- ephemeral – fed by rainfall/ surface drainage following rainfall, persisting for long periods (i.e. several months) after rainfall; and
- temporary ephemeral – fed by rainfall/ surface drainage following rainfall, persisting for short periods (i.e weeks) after rainfall.

4.3.4 Systematic Trapping Sites

A total of eight systematic trapping sites were established and sampled during the phase 1 and phase 2 field surveys, with sites representing most broad fauna habitats present within the Study Area (Figure 4.2; Figure 4.3; Table 4.8). The sites were setup to sample the most widespread and significant habitats, while ensuring adequate coverage across the entire Study Area. Each trapping site was open for seven consecutive nights each phase and checked daily within three hours of sunrise. Each site comprised the following (Figure 4.2):

- Pit traps – Ten pit traps, comprising five 20 Litre buckets and five PVC pipes (16 centimetres (cm) diameter and 50 cm deep), were installed at all sites except VOPN-008, where rocky substrates did not permit installation of pit traps. Traps were installed approximately 10–20 metres (m) apart along a single transect with a 7.5 m long by 0.3 m high aluminium drift fence bisecting each pit trap. Traps were placed in locations deemed most likely to catch fauna (i.e. areas with dense ground cover, litter, rocks etc.) and most representative of the broad fauna habitat occurring at the site. Styrofoam trays were placed within all pits to provide refuge for any captured fauna from exposure to environmental conditions (i.e. temperature, wind and rainfall) and predators.
- Funnel traps – One funnel trap was placed at each end of the drift fence bisecting each pit trap. A total of 20 funnel traps were deployed at each systematic trapping site.

- Elliott traps – Twenty medium (Type B) Elliott style box traps were placed at each site. Traps were placed along two parallel transects adjacent to pit traps and positioned approximately 10–20 m apart. Each trap was positioned in habitat niches likely to be attractive to small non-volant mammals and reptiles (i.e. areas of cover and shade).
- Cage Traps – Two cage traps (20 x 20 x 56 cm) were located at each site, with one placed at each end of the trap site transect.
- Camera Traps – Two camera traps were placed at each site with inaccessible bait tubes to survey for larger and/or cryptic species (i.e. significant species and/or larger species) which may not typically be recorded by other sampling methods.

Shade covers for funnel, cage and Elliot traps were used to reduce exposure to environmental elements (i.e. direct sunlight and heat, rainfall and wind). Elliot and cage traps were baited with a universal bait mix comprising oats, peanut butter and sardines, and rebaited every 2–3 days. Owing to high temperatures recorded during the phase 1 survey ($>35^{\circ}\text{C}$; Table 4.1), trap sites were closed after the morning trap check and reopened in the late afternoon to reduce exposure to environmental elements.

Survey effort across all eight trapping sites during each phase totalled 2,954 trap nights (comprising 490 pit trap nights, 1,120 funnel trap nights, 1,120 Elliot trap nights, 112 cage trap nights and 112 camera trap nights; Table 4.8). Overall, across both survey phases, a total of 5,908 trap nights of survey effort was completed at trapping sites (comprising 980 pit trap nights, 2,240 funnel trap nights, 2,240 Elliot trap nights, 224 cage trap nights and 224 camera trap nights; Table 4.8).

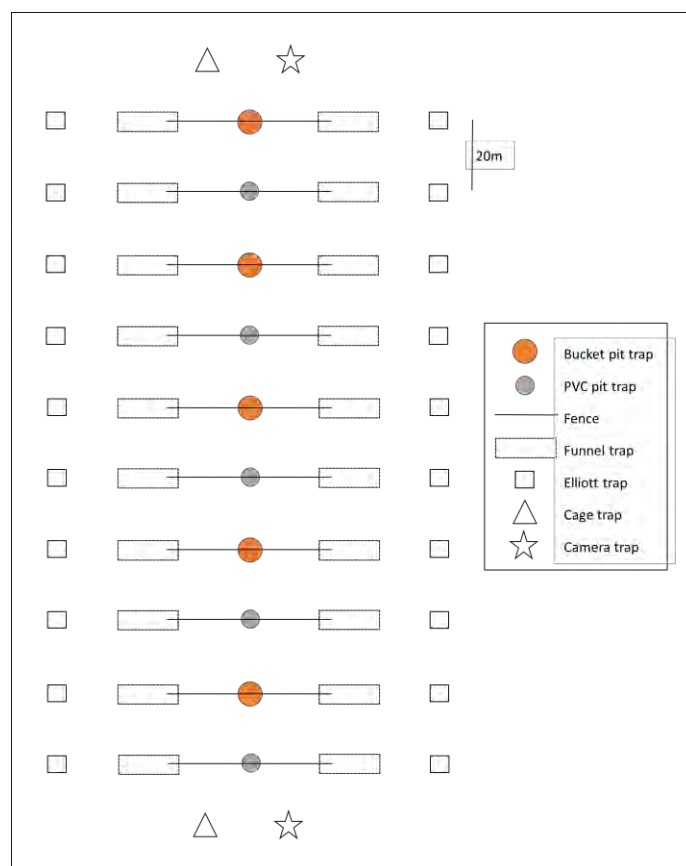


Figure 4.2: Layout of traps at a systematic sampling site

4.3.5 Avifauna Sampling

A daily 20 to 30-minute avifauna census was undertaken at each systematic trapping site during the phase 1 and phase 2 surveys. Each census was undertaken within an area of approximately 2 ha and confined to the habitat type represented by each trapping site in order to collect assemblage data for each habitat. While each avifauna census were completed to obtain information on broad species assemblages, consideration was also given during each census for any significant species potentially occurring within the Study Area, in particular southern whiteface, grey falcon, peregrine falcon, fork-tailed swift and various migratory shorebirds and waterbirds. Each census was conducted between 0630 and 1030 whilst undertaking trap clearing and avifauna were recorded from either direct observation, call and/or secondary evidence (e.g. nests, feathers and/or tracks). The order of site visitation was staggered to reduce bias due to timing of arrival at sites and the recorders were rotated where possible to reduce observers' bias (Lindenmayer *et al.*, 2009). Additional sampling was undertaken during different periods of likely activity, including evening sampling during nocturnal searches. A total of seven 20 to 30-minute avifauna surveys were undertaken at each systematic trapping site, totalling 2.5 hours during each phase, for a total of 40 hours at all sites across both phases (Table 4.8). Additional opportunistic avifauna sampling was undertaken at selected habitat assessment sites (three sites), for a total of 2.75 hours across both phases (Table 4.8; Figure 4.3).

4.3.6 Active Foraging

Active foraging comprised searches of any observable microhabitats likely to support vertebrate fauna species. Searches aimed to record any species, from direct observation or secondary evidence of species occurrence, including tracks, scats, diggings, nests, fur or sloughs (shed skins), predation or feeding sites, and fauna constructed structures (i.e. pebble mounds). Techniques incorporated in active foraging included raking leaf litter and spoil heaps, overturning rocks and logs, investigating dead trees and logs, burrows, rock piles and identification of secondary evidence. Active foraging was undertaken at all eight trapping site locations for a total of one person hour during each survey phase (eight person hours total), equating to a total of 16 person hours over both survey phases (Table 4.8; Figure 4.3).

4.3.7 Nocturnal Surveys

Spotlighting was undertaken to detect the presence of any nocturnal fauna species within the Study Area. Nocturnal surveys were undertaken between sunset (approximately 1830) and 2230 when activity levels were highest for most nocturnal species. Each survey consisted of searches using head torches and, where possible, road spotting to detect fauna from movement, eye shine and other evidence of species' presence. A total of 16 person hours of spotlighting was completed across all eight trapping sites over four evenings during the phase 1 and phase 2 surveys, with additional opportunistic spotlighting undertaken while traversing the Study Area between sampling sites (Table 4.8; Figure 4.3).

4.3.8 Ultrasonic Bat Recording

SongMeter (SM; Wildlife Acoustics Inc.) ultrasonic bat recorders were deployed at 22 locations representative of all habitats occurring within the Study Area during the phase 1 and phase 2 surveys, including all systematic trapping sites (Table 4.3; Table 4.8; Figure 4.3). At each location, recorders were placed in or in the vicinity of areas of prospective foraging habitat, dispersal corridors and/or roosting habitats and features such as natural or artificial waterbodies and caves most likely to be

utilised by bats, particularly Pilbara leaf-nosed bat and ghost bat. Recorders were deployed between three and five nights at each location for a total of 94 recording nights (Table 4.3; Table 4.8). Bat calls were analysed by Robert Bullen of Bat Call WA.

Table 4.3: Ultrasonic sampling locations within the Study Area

Site	Habitat Feature-ID	Habitat	Latitude	Longitude	Deployment	Retrieval	Sampling Nights
VOPN-001	-	Sand Plain	-23.3335	119.9100	15/03/2022	18/03/2022	3
					5/10/2022	8/10/2022	3
VOPN-002	-	Stony Plain	-23.3274	119.8898	15/03/2022	18/03/2022	3
					5/10/2022	8/10/2022	3
VOPN-003	-	Major Drainage Line	-23.3166	119.8715	15/03/2022	18/03/2022	3
					5/10/2022	8/10/2022	3
VOPN-004	-	Stony Plain	-23.3163	119.9228	16/03/2022	19/03/2022	3
					6/10/2022	9/10/2022	3
VOPN-005	WOPN-002	Gorge/ Gully	-23.3197	119.9535	16/03/2022	19/03/2022	3
					6/10/2022	9/10/2022	3
VOPN-006	-	Hillcrest/ Hillslope	-23.3258	119.991	19/03/2022	22/03/2022	3
					6/10/2022	9/10/2022	3
VOPN-007	-	Drainage Area/ Floodplain	-23.3364	119.8865	18/03/2022	21/03/2022	3
					5/10/2022	8/10/2022	3
VOPN-008	-	Breakaway/ Cliff	-23.3061	119.8983	18/03/2022	21/03/2022	3
					6/10/2022	9/10/2022	3
VOPN-012	-	Major Drainage Line	-23.3296	119.8803	21/03/2022	24/03/2022	3
VOPN-015	-	Gorge/ Gully	-23.3015	119.8777	9/10/2022	13/10/2022	4
VOPN-027	-	Breakaway/ Cliff	-23.3079	119.9094	20/03/2022	23/03/2022	3
VOPN-033	-	Hillcrest/ Hillslope	-23.32	119.973	20/03/2022	23/03/2022	3
VOPN-044	-	Major Drainage Line	-23.3297	119.856	8/10/2022	11/10/2022	3
VOPN-069	-	Gorge/ Gully	-23.3221	119.995	8/10/2022	13/10/2022	5
VOPN-071	-	Breakaway/ Cliff	-23.3141	119.9561	7/10/2022	10/10/2022	3
VOPN-077	-	Hillcrest/ Hillslope	-23.3049	119.9204	8/10/2022	12/10/2022	4
VOPN-083	-	Minor Drainage Line	-23.3101	119.9982	10/10/2022	13/10/2022	3
VOPN-084	-	Major Drainage Line	-23.3338	119.8664	11/10/2022	14/10/2022	3
VOPN-090	-	Minor Drainage Line	-23.3024	119.9091	10/10/2022	13/10/2022	3
VOPN-095	-	Minor Drainage Line	-23.309	119.9363	11/10/2022	14/10/2022	3

Site	Habitat Feature-ID	Habitat	Latitude	Longitude	Deployment	Retrieval	Sampling Nights
VOPN-097	-	Major Drainage Line	-23.3005	119.8673	7/10/2022	10/10/2022	3
VOPN-099	-	Stony Plain	-23.3324	119.9696	11/10/2022	14/10/2022	3
Total							94

4.3.9 Targeted Searches

Targeted searches were undertaken within areas considered to provide suitable habitat for significant species identified in the desktop assessment, particularly: northern quoll, ghost bat, Pilbara leaf-nosed bat and Pilbara olive python. Searches primarily focused on recording species from direct observation, secondary evidence (i.e. tracks, scats, sloughs and pebble-mounds) and/or habitat features of importance (i.e. den sites, roost caves and/or water features) likely to be utilised by particular species. Targeted search time for individual species is outlined in Table 4.8; however, in total targeted searches were conducted at 35 locations for a total of 71 person hours over the duration of the phase 1 and phase 2 surveys (Table 4.4; Figure 4.3).

Table 4.4: Targeted searches conducted within the Study Area

Transect	Site	Habitat	Latitude	Longitude	Date	Start time (hrs)	End time (hrs)	Person hours
TOPN-003	VOPN-003	Major Drainage Line	-23.3166	119.8715	11/10/2022	923	959	1
TOPN-005	VOPN-005	Gorge/ Gully	-23.3197	119.9535	16/03/2022	1115	1215	2
TOPN-015	VOPN-015	Gorge/ Gully	-23.3015	119.8777	9/10/2022	1427	1531	2
TOPN-021	VOPN-021	Minor Drainage Line	-23.3001	119.8967	6/10/2022	1305	1335	1
TOPN-027	VOPN-027	Breakaway/ Cliff	-23.3079	119.9094	20/03/2022	0830	0930	2
TOPN-035	VOPN-035	Gorge/ Gully	-23.3269	119.9935	21/03/2022	1020	1100	1.5
TOPN-036	VOPN-036	Hillcrest/ Hillslope	-23.3146	119.8926	20/03/2022	1014	1114	2
TOPN-045	VOPN-045	Gorge/ Gully	-23.3122	119.9274	24/03/2022	0940	1040	2
TOPN-046	VOPN-046	Major Drainage Line	-23.3319	119.8592	8/10/2022	947	1057	2
TOPN-047	VOPN-047	Gorge/ Gully	-23.3286	119.9869	24/03/2022	1055	1110	0.5
TOPN-050	VOPN-050	Gorge/ Gully	-23.3247	119.9819	22/03/2022	1134	1238	3
TOPN-052	VOPN-052	Gorge/ Gully	-23.3255	119.9838	22/03/2022	1214	1250	1
TOPN-067	VOPN-067	Gorge/ Gully	-23.3301	119.9989	8/10/2022	1111	1211	2
TOPN-068	VOPN-068	Gorge/ Gully	-23.33	120.0021	8/10/2022	1212	1312	2

Transect	Site	Habitat	Latitude	Longitude	Date	Start time (hrs)	End time (hrs)	Person hours
TOPN-069	VOPN-069	Gorge/ Gully	-23.3221	119.995	13/10/2022	1100	1130	1
TOPN-071	VOPN-071	Breakaway/ Cliff	-23.3141	119.9561	7/10/2022	1203	1333	3
TOPN-073	VOPN-073	Breakaway/ Cliff	-23.3067	119.8931	9/10/2022	1354	1555	3.5
TOPN-074	VOPN-074	Breakaway/ Cliff	-23.3021	119.9042	10/10/2022	1130	1200	1
TOPN-075	VOPN-075	Gorge/ Gully	-23.3204	119.966	9/10/2022	1345	1506	3
TOPN-078	VOPN-078	Breakaway/ Cliff	-23.3039	119.9197	8/10/2022	1200	1500	6
TOPN-079	VOPN-079	Gorge/ Gully	-23.3026	119.9007	10/10/2022	1030	1130	2
TOPN-080	VOPN-080	Breakaway/ Cliff	-23.3217	119.9920	8/10/2022	1430	1601	4
TOPN-081	VOPN-081	Gorge/ Gully	-23.3208	120.0013	10/10/2022	930	1030	2
TOPN-082	VOPN-082	Breakaway/ Cliff	-23.3141	120.0018	10/10/2022	1054	1155	1
TOPN-087	VOPN-087	Gorge/ Gully	-23.3116	119.8917	11/10/2022	1404	1500	2
TOPN-088	VOPN-088	Breakaway/ Cliff	-23.3104	119.9155	11/10/2022	1528	1603	1
TOPN-089	VOPN-089	Breakaway/ Cliff	-23.3094	119.9132	11/10/2022	1607	1652	1
TOPN-091	VOPN-091	Gorge/ Gully	-23.3047	119.9123	10/10/2022	1200	1230	1
TOPN-093	VOPN-093	Breakaway/ Cliff	-23.3191	119.9469	11/10/2022	915	1030	2.5
TOPN-094	VOPN-094	Gorge/ Gully	-23.3176	119.9423	11/10/2022	1030	1130	2
TOPN-095	VOPN-095	Minor Drainage Line	-23.309	119.9363	11/10/2022	1335	1535	4
TOPN-097	VOPN-097	Major Drainage Line	-23.3005	119.8673	7/10/2022	1206	1341	2
TOPN-103	VOPN-103	Gorge/ Gully	-23.3093	119.9951	13/10/2022	1243	1339	2
TOPN-106	VOPN-106	Hillcrest/ Hillslope	-23.3112	119.9906	13/10/2022	1359	1450	1.5
TOPN-108	VOPN-108	Gorge/ Gully	-23.3215	119.9974	13/10/2022	1145	1230	1.5
Total								71

4.3.10 Targeted Sampling – Northern Quoll Camera Trap Transects

Sampling for northern quoll was undertaken by deploying camera trap transects within suitable habitat in the Study Area. In line with methods recommended by DoE (2016), each transect comprised ten camera traps placed 50–100 m apart and baited with a universal bait mix (a mixture of oats, peanut butter and sardines) within a non-reward receptacle (perforated and capped PVC pipe). Cameras were deployed between four and six consecutive nights at six sites for a total of 270 camera trap nights over the duration of both survey phases (Table 4.5; Table 4.8; Figure 4.3).

Table 4.5: Camera transects sampled for northern quoll within the Study Area

Site	Habitat	Latitude	Longitude	Deployment	Retrieval	Sampling Nights	Total Trap Nights
VOPN-027	Breakaway/Cliff	-23.3079	119.9094	20/03/2022	24/03/2022	4	40
VOPN-036	Hillcrest/Hillslope	-23.3146	119.8926	20/03/2022	24/03/2022	4	40
VOPN-071	Breakaway/Cliff	-23.3141	119.9561	7/10/2022	13/10/2022	6	60
VOPN-078	Breakaway/Cliff	-23.3039	119.9197	8/10/2022	12/10/2022	4	40
VOPN-080	Breakaway/Cliff	-23.3217	119.992	8/10/2022	13/10/2022	5	50
VOPN-097	Major Drainage Line	-23.3005	119.8673	7/10/2022	11/10/2022	4	40
Total							270

4.3.11 Targeted Sampling – Greater Bilby Plot Searches

Greater bilby sampling within the Study Area comprised 2 ha survey plots (bilby plots) distributed within areas of suitable habitat across the Study Area, in accordance with DBCA survey guidelines for the species (DBCA, 2017a) (Table 4.6; Table 4.8; Figure 4.3). Each bilby plot was subjected to targeted searches for a minimum of 25 minutes and comprised searches for secondary evidence for the species, i.e. burrows, diggings, tracks and scats, as described by Southgate *et al.* (2019). Overall, a total of three bilby plots were sampled for greater bilby within the Study Area during the Phase 1 survey and seven during the Phase 2 survey, with each searched for 0.5 person hours, totalling five person hours over the two survey phases (Table 4.6; Table 4.8).

Table 4.6: Targeted greater bilby sampling conducted within the Study Area

Site	Habitat	Latitude	Longitude	Date	Person Hours
VOPN-009	Drainage Area/ Floodplain	-23.3323	119.8836	14/10/2022	0.5
VOPN-018	Drainage Area/ Floodplain	-23.3383	119.9087	19/03/2022	0.5
VOPN-057	Drainage Area/ Floodplain	-23.3374	119.8981	24/03/2022	0.5
VOPN-063	Drainage Area/ Floodplain	-23.3365	119.8842	24/03/2022	0.5

Site	Habitat	Latitude	Longitude	Date	Person Hours
VOPN-066	Drainage Area/ Floodplain	-23.3344	119.8861	7/10/2022	0.5
VOPN-085	Drainage Area/ Floodplain	-23.3046	119.8692	11/10/2022	0.5
VOPN-100	Sand Plain	-23.3346	119.9080	12/10/2022	0.5
VOPN-101	Drainage Area/ Floodplain	-23.3370	119.8934	14/10/2022	0.5
VOPN-102	Drainage Area/ Floodplain	-23.3379	119.9039	14/10/2022	0.5
VOPN-112	Drainage Area/ Floodplain	-23.3336	119.8929	13/10/2022	0.5
Total					5

4.3.12 Targeted Sampling – Night Parrot Acoustic Recording

SongMeter acoustic recorders were deployed at ten locations over both phases of the field survey, including three at systematic trapping sites where suitable habitat was present (Table 4.7; Table 4.8; Figure 4.3). In an effort to target night parrot, the SM4 acoustic recorders were deployed in potential habitat recommended within the *Interim guideline for preliminary surveys of night parrot (Pezoporus occidentalis) in Western Australia* (DPaW, 2017) – “stands of large, old clumps of spinifex (*Triodia*)... especially so if the identified area is part of a paleo-drainage system or contains healthy stands of samphire.” SongMeters were deployed for six consecutive nights for a total of 60 recording nights (Table 4.7; Table 4.8). Acoustic recordings were analysed for night parrot calls by ornithologist Nigel Jackett. A list of non-target species recorded at each acoustic recorder site was also compiled and incorporated into the results for each site.

Table 4.7: Acoustic sampling locations within the Study Area

Site	Habitat	Latitude	Longitude	Deployment	Retrieval	Sampling Nights
VOPN-002	Stony Plain	-23.3274	119.8898	5/10/2022	11/10/2022	6
VOPN-004	Stony Plain	-23.3163	119.9228	6/10/2022	12/10/2022	6
VOPN-007	Drainage Area/ Floodplain	-23.3364	119.8865	18/03/2022	24/03/2022	6
				5/10/2022	11/10/2022	6
VOPN-024	Undulating Low Hills	-23.3308	119.9226	19/03/2022	25/03/2022	6
VOPN-065	Stony Plain	-23.3224	119.9148	6/10/2022	12/10/2022	6
VOPN-070	Drainage Area/ Floodplain	-23.3122	119.9572	7/10/2022	13/10/2022	6
VOPN-072	Stony Plain	-23.3299	119.9648	7/10/2022	13/10/2022	6
VOPN-076	Hillcrest/ Hillslope	-23.2977	119.899	8/10/2022	14/10/2022	6
VOPN-096	Drainage Area/ Floodplain	-23.3264	119.8618	7/10/2022	13/10/2022	6
Total						60

4.3.13 Opportunistic Records

At all times while surveying, all records pertaining to species not previously recorded during the survey, rare species, significant species or other fauna of interest were documented. These records include those from primary (i.e. direct observation of species) or secondary (e.g. burrows, scratching's, diggings and scats) evidence. Efforts were made to target likely microhabitats by turning rocks, logs and anthropogenic debris where present.

4.4 Taxonomy and Nomenclature

The latest checklist of mammal, reptile and amphibian taxa published by the Western Australian Museum (WAM) (2022) was used as a guide to the current taxonomy and nomenclature of these groups, with the exception of taxonomic changes published subsequent to the checklist. For birds, the current checklist of the Australian Faunal Directory (ABRS, 2021) was used in conjunction with the WAM (2022) species list. While compiling a list of fauna potentially occurring in the Study Area, all records were checked to ensure the latest taxonomy using recent publications and authorities.

4.5 Animal Welfare and Ethics

All sampling and survey methods implemented during the field survey were undertaken in accordance with relevant survey-specific license conditions, EPA (2016b) technical guidance for sampling terrestrial vertebrate fauna and DBCA Standard Operating Procedures (SOPs), and complied with the Western Australian *Animal Welfare Act* 2002 and the *Australian Code for the Care and Use of Animals for Scientific Purposes* (NHMRC, 2013) where applicable.

Relevant DBCA SOPs applicable to this survey include:

- DBCA (2018a) Aluminium Box Traps for Capture of Terrestrial Vertebrates;
- DBCA (2018b) Cage Traps for Live Capture of Terrestrial Vertebrates;
- DBCA (2018c) Dry Pitfall Trapping of Vertebrates;
- DBCA (2018d) Funnel Trapping for Terrestrial Fauna;
- DBCA (2018e) Hand Capture of Wildlife;
- DBCA (2018f) Managing Disease Risk in Wildlife Management;
- DBCA (2018g) Vouchering Vertebrate Fauna Specimens;
- DBCA (2017d) Hand Restraint of Wildlife;
- DBCA (2017e) Tissue Sample Collection and Storage for Mammals;
- DBCA (2017b) Animal Handling and Restraint Using Soft Containment;
- DBCA (2017c) First Aid for Animals; and
- DBCA (2017f) Transport and Temporary Holding of Wildlife.

Table 4.8: Survey effort by vertebrate sampling sites

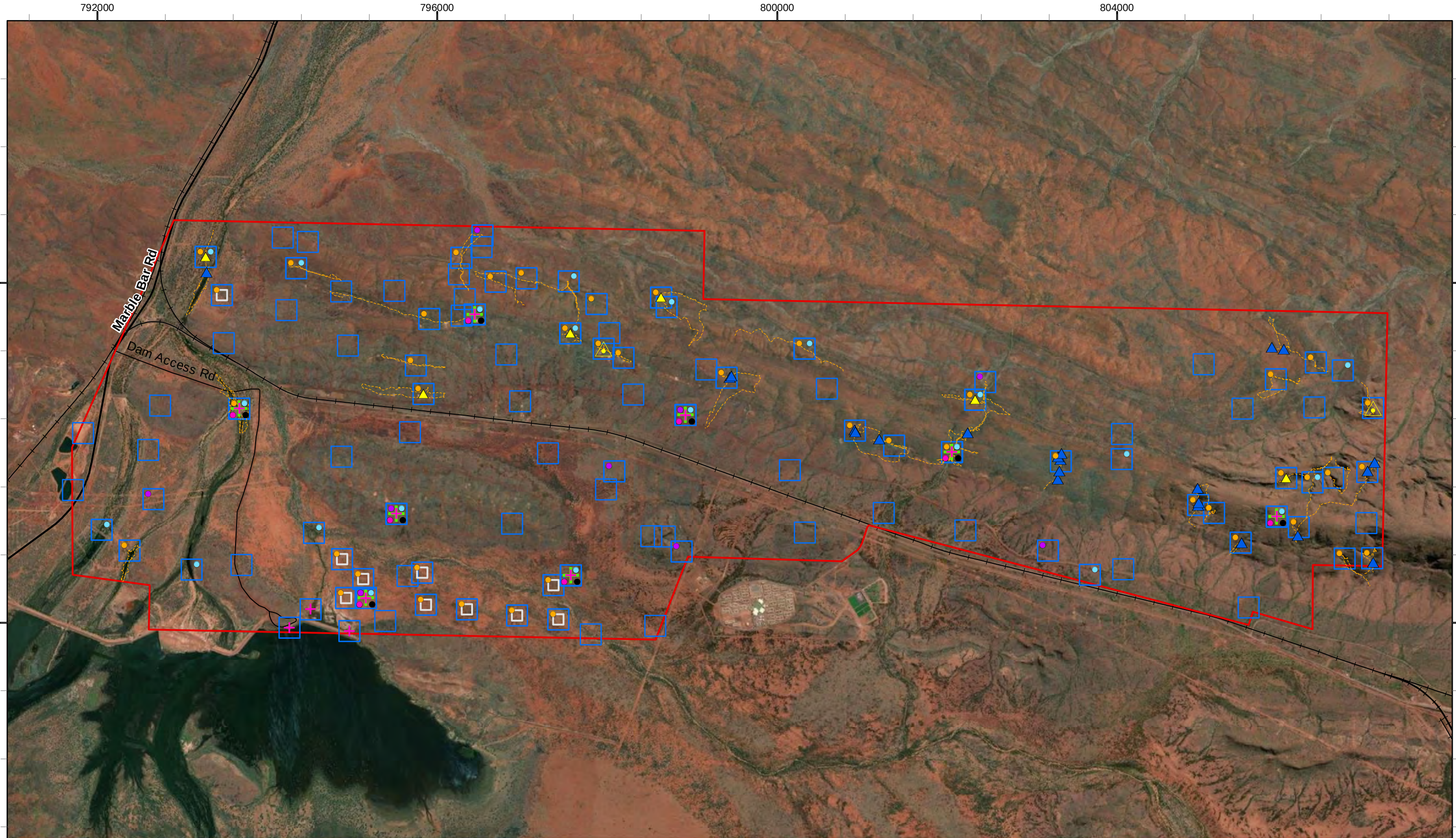
Site	Site type	Pits (nights)	Funnels (nights)	Elliotts (nights)	Cages (nights)	Motion cameras (nights)	Total trap nights	Bird census (hrs)	Active foraging (person hrs)	Nocturnal searches (person hrs)	SongMeter (ultrasonic) (nights)	SongMeter (acoustic) (nights)	Targeted searches (person hrs)
Phase 1													
VOPN-001	Systematic	70	140	140	14	14	378	2.5	1	1	3	-	-
VOPN-002	Systematic	70	140	140	14	14	378	2.5	1	1	3	-	-
VOPN-003	Systematic	70	140	140	14	14	378	2.5	1	1	3	-	-
VOPN-004	Systematic	70	140	140	14	14	378	2.5	1	1	3	-	-
VOPN-005	Systematic	70	140	140	14	14	378	2.5	1	1	3	-	2 (ghost bat, Pilbara leaf-nosed bat, Pilbara olive python & northern quoll)
VOPN-006	Systematic	70	140	140	14	14	378	2.5	1	1	3	-	-
VOPN-007	Systematic	70	140	140	14	14	378	2.5	1	1	3	6	-
VOPN-008	Systematic	-	140	140	14	14	308	2.5	1	1	3	-	-
VOPN-010	Bird Census	-	-	-	-	-	-	0.5	-	-	-	-	-
VOPN-012	SongMeter (ultrasonic)	-	-	-	-	-	-	-	-	-	3	-	-
VOPN-018	Targeted searches	-	-	-	-	-	-	-	-	-	-	-	0.5 (greater bilby, mulgara)
VOPN-024	SongMeter (acoustic)	-	-	-	-	-	-	-	-	-	-	6	-
VOPN-027	Camera trap transect, targeted searches and SongMeter (ultrasonic)	-	-	-	-	40	-	-	-	-	3	-	2 (ghost bat, Pilbara leaf-nosed bat, Pilbara olive python & northern quoll)
VOPN-033	SongMeter (ultrasonic)	-	-	-	-	-	-	-	-	-	3	-	-
VOPN-035	Targeted searches	-	-	-	-	-	-	-	-	-	-	-	1.5 (ghost bat, Pilbara leaf-nosed bat, Pilbara olive python & northern quoll)
VOPN-036	Camera trap transect and targeted searches	-	-	-	-	40	-	-	-	-	-	-	2 (ghost bat, Pilbara leaf-nosed bat, Pilbara olive python & northern quoll)
VOPN-040	Bird census	-	-	-	-	-	-	0.25	-	-	-	-	-

Site	Site type	Pits (nights)	Funnels (nights)	Elliotts (nights)	Cages (nights)	Motion cameras (nights)	Total trap nights	Bird census (hrs)	Active foraging (person hrs)	Nocturnal searches (person hrs)	SongMeter (ultrasonic) (nights)	SongMeter (acoustic) (nights)	Targeted searches (person hrs)
VOPN-042	Bird census	-	-	-	-	-	-	2	-	-	-	-	-
VOPN-045	Targeted searches	-	-	-	-	-	-	-	-	-	-	-	2 (ghost bat, Pilbara leaf-nosed bat, Pilbara olive python & northern quoll)
VOPN-047	Targeted searches	-	-	-	-	-	-	-	-	-	-	-	0.5 (ghost bat, Pilbara leaf-nosed bat, Pilbara olive python & northern quoll)
VOPN-050	Targeted searches	-	-	-	-	-	-	-	-	-	-	-	3 (ghost bat, Pilbara leaf-nosed bat, Pilbara olive python & northern quoll)
VOPN-052	Targeted searches	-	-	-	-	-	-	-	-	-	-	-	1 (ghost bat, Pilbara leaf-nosed bat, Pilbara olive python & northern quoll)
VOPN-057	Targeted searches	-	-	-	-	-	-	-	-	-	-	-	0.5 (greater bilby, mulgara)
VOPN-063	Targeted searches	-	-	-	-	-	-	-	-	-	-	-	0.5 (greater bilby, mulgara)
Phase 1 total		490	1,120	1,120	112	192	2,954	22.75	8	8	33	12	12
greater bilby, mulgara													
ghost bat, Pilbara leaf-nosed bat, Pilbara olive python & northern quoll													14
Phase 2													
VOPN-001	Systematic	70	140	140	14	14	364	2.5	1	1	3	-	-
VOPN-002	Systematic	70	140	140	14	14	364	2.5	1	1	3	6	-
VOPN-003	Systematic	70	140	140	14	14	364	2.5	1	1	3	-	1 (northern quoll, Pilbara olive python)
VOPN-004	Systematic	70	140	140	14	14	364	2.5	1	1	3	6	-
VOPN-005	Systematic	70	140	140	14	14	364	2.5	1	1	3	-	-
VOPN-006	Systematic	70	140	140	14	14	364	2.5	1	1	3	-	-
VOPN-007	Systematic	70	140	140	14	14	364	2.5	1	1	3	6	-
VOPN-008	Systematic	-	140	140	14	14	294	2.5	1	1	3	-	-
VOPN-009	Targeted Searches	-	-	-	-	-	-	-	-	-	-	-	0.5 (greater bilby, mulgara)

Site	Site type	Pits (nights)	Funnels (nights)	Elliotts (nights)	Cages (nights)	Motion cameras (nights)	Total trap nights	Bird census (hrs)	Active foraging (person hrs)	Nocturnal searches (person hrs)	SongMeter (ultrasonic) (nights)	SongMeter (acoustic) (nights)	Targeted searches (person hrs)
VOPN-015	Targeted searches and SongMeter (ultrasonic)	-	-	-	-	-	-	-	-	-	4	-	2 (ghost bat, Pilbara leaf-nosed bat, Pilbara olive python & northern quoll)
VOPN-021	Targeted searches	-	-	-	-	-	-	-	-	-	-	-	1 (northern quoll, Pilbara olive python)
VOPN-044	SongMeter (ultrasonic)	-	-	-	-	-	-	-	-	-	3	-	-
VOPN-046	Targeted searches	-	-	-	-	-	-	-	-	-	-	-	2 (northern quoll, Pilbara olive python)
VOPN-065	SongMeter (acoustic)	-	-	-	-	-	-	-	-	-	-	6	-
VOPN-066	Targeted searches	-	-	-	-	-	-	-	-	-	-	-	0.5 (greater bilby, mulgara)
VOPN-067	Targeted searches	-	-	-	-	-	-	-	-	-	-	-	2 (ghost bat, Pilbara leaf-nosed bat, Pilbara olive python & northern quoll)
VOPN-068	Targeted searches	-	-	-	-	-	-	-	-	-	-	-	2 (ghost bat, Pilbara leaf-nosed bat, Pilbara olive python & northern quoll)
VOPN-069	SongMeter (ultrasonic) and targeted searches	-	-	-	-	-	-	-	-	-	5	-	1 (ghost bat, Pilbara leaf-nosed bat, Pilbara olive python & northern quoll)
VOPN-070	SongMeter (acoustic)	-	-	-	-	-	-	-	-	-	-	6	-
VOPN-071	SongMeter (ultrasonic), camera trap transect and targeted searches	-	-	-	-	60	-	-	-	-	3	-	3 (ghost bat, Pilbara leaf-nosed bat, Pilbara olive python & northern quoll)
VOPN-072	SongMeter (acoustic)	-	-	-	-	-	-	-	-	-	-	6	-
VOPN-073	Targeted searches	-	-	-	-	-	-	-	-	-	-	-	3.5 (ghost bat, Pilbara leaf-nosed bat, Pilbara olive python & northern quoll)
VOPN-074	Targeted searches	-	-	-	-	-	-	-	-	-	-	-	1 (ghost bat, Pilbara leaf-nosed bat, Pilbara olive python & northern quoll)
VOPN-075	Targeted searches	-	-	-	-	-	-	-	-	-	-	-	3 (ghost bat, Pilbara leaf-nosed bat, Pilbara olive python & northern quoll)
VOPN-076	SongMeter (acoustic)	-	-	-	-	-	-	-	-	-	-	6	-

Site	Site type	Pits (nights)	Funnels (nights)	Elliotts (nights)	Cages (nights)	Motion cameras (nights)	Total trap nights	Bird census (hrs)	Active foraging (person hrs)	Nocturnal searches (person hrs)	SongMeter (ultrasonic) (nights)	SongMeter (acoustic) (nights)	Targeted searches (person hrs)
VOPN-077	SongMeter (ultrasonic)	-	-	-	-	-	-	-	-	-	4	-	-
VOPN-078	Camera trap transect and targeted searches	-	-	-	-	40	-	-	-	-	-	-	6 (ghost bat, Pilbara leaf-nosed bat, Pilbara olive python & northern quoll)
VOPN-079	Targeted searches	-	-	-	-	-	-	-	-	-	-	-	2 (ghost bat, Pilbara leaf-nosed bat, Pilbara olive python & northern quoll)
VOPN-080	Camera trap transect and targeted searches	-	-	-	-	50	-	-	-	-	-	-	4 (ghost bat, Pilbara leaf-nosed bat, Pilbara olive python & northern quoll)
VOPN-081	Targeted searches	-	-	-	-	-	-	-	-	-	-	-	2 (ghost bat, Pilbara leaf-nosed bat, Pilbara olive python & northern quoll)
VOPN-082	Targeted searches	-	-	-	-	-	-	-	-	-	-	-	1 (ghost bat, Pilbara leaf-nosed bat, Pilbara olive python & northern quoll)
VOPN-083	SongMeter (ultrasonic)	-	-	-	-	-	-	-	-	-	3	-	-
VOPN-084	SongMeter (ultrasonic)	-	-	-	-	-	-	-	-	-	3	-	-
VOPN-085	Targeted searches	-	-	-	-	-	-	-	-	-	-	-	0.5 (greater bilby, mulgara)
VOPN-087	Targeted searches	-	-	-	-	-	-	-	-	-	-	-	2 (ghost bat, Pilbara leaf-nosed bat, Pilbara olive python & northern quoll)
VOPN-088	Targeted searches	-	-	-	-	-	-	-	-	-	-	-	1 (ghost bat, Pilbara leaf-nosed bat, Pilbara olive python & northern quoll)
VOPN-089	Targeted searches	-	-	-	-	-	-	-	-	-	-	-	1 (ghost bat, Pilbara leaf-nosed bat, Pilbara olive python & northern quoll)
VOPN-090	SongMeter (ultrasonic)	-	-	-	-	-	-	-	-	-	3	-	-
VOPN-091	Targeted searches	-	-	-	-	-	-	-	-	-	-	-	1 (ghost bat, Pilbara leaf-nosed bat, Pilbara olive python & northern quoll)
VOPN-093	Targeted searches	-	-	-	-	-	-	-	-	-	-	-	2.5 (ghost bat, Pilbara leaf-nosed bat, Pilbara olive python & northern quoll)
VOPN-094	Targeted searches	-	-	-	-	-	-	-	-	-	-	-	2 (ghost bat, Pilbara leaf-nosed bat, Pilbara olive python & northern quoll)

Site	Site type	Pits (nights)	Funnels (nights)	Elliotts (nights)	Cages (nights)	Motion cameras (nights)	Total trap nights	Bird census (hrs)	Active foraging (person hrs)	Nocturnal searches (person hrs)	SongMeter (ultrasonic) (nights)	SongMeter (acoustic) (nights)	Targeted searches (person hrs)
VOPN-095	SongMeter (ultrasonic) and Targeted searches	-	-	-	-	-	-	-	-	-	3	-	4 (northern quoll, Pilbara olive python)
VOPN-096	SongMeter (acoustic)	-	-	-	-	-	-	-	-	-	-	6	-
VOPN-097	Camera trap transect, SongMeter (ultrasonic) and Targeted searches	-	-	-	-	40	-	-	-	-	3	-	2 (northern quoll, Pilbara olive python)
VOPN-099	SongMeter (ultrasonic)	-	-	-	-	-	-	-	-	-	3	-	-
VOPN-100	Targeted searches	-	-	-	-	-	-	-	-	-	-	-	0.5 (greater bilby, mulgara)
VOPN-101	Targeted searches	-	-	-	-	-	-	-	-	-	-	-	0.5 (greater bilby, mulgara)
VOPN-102	Targeted searches	-	-	-	-	-	-	-	-	-	-	-	0.5 (greater bilby, mulgara)
VOPN-103	Targeted searches	-	-	-	-	-	-	-	-	-	-	-	2 (ghost bat, Pilbara leaf-nosed bat, Pilbara olive python & northern quoll)
VOPN-106	Targeted searches	-	-	-	-	-	-	-	-	-	-	-	1.5 (ghost bat, Pilbara leaf-nosed bat, Pilbara olive python & northern quoll)
VOPN-108	Targeted searches	-	-	-	-	-	-	-	-	-	-	-	1.5 (ghost bat, Pilbara leaf-nosed bat, Pilbara olive python & northern quoll)
VOPN-112	Targeted searches	-	-	-	-	-	-	-	-	-	-	-	0.5 (greater bilby, mulgara)
Phase 2 total		490	1,120	1,120	112	302	2,954	20	8	8	61	48	3.5
greater bilby, mulgara													
ghost bat & Pilbara leaf-nosed bat													
Pilbara olive python & northern quoll													
Survey total		980	2,240	2,240	224	494	5,908	42.75	16	16	94	60	5
greater bilby, mulgara													
ghost bat & Pilbara leaf-nosed bat													
Pilbara olive python & northern quoll													



LEGEND

Study Area	Site Type	Cave Assessment	Targeted Search
Local Road	Acoustic Recorder	Foraging	Targeted Search
State Road	Avifauna Census	Habitat Assessment	Ultrasonic Recorder
Rail	Bilby Plot	Nocturnal Search	Water Feature Assessment
	Camera Trap Transect	Systematic Trapping	

Scale: 1:42,500

0 1 2 Km

Coordinate System: GDA2020 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA2020
Created 28/04/2023

BHP WAIO

**East Ophthalmia and Ninga
Detailed Vertebrate
Fauna Survey**

**Figure 4.3: Vertebrate fauna
sample sites and traverses**

4.6 Data Analysis

To estimate the adequacy and effectiveness of sampling during the survey, the cumulative number of species encountered from systematic sampling (i.e. trapping sites) was plotted against survey effort in terms of cumulative individuals or trap days/ nights to develop a species accumulation curve for the survey, following EPA (2020). The species accumulation curve assists in estimating total species richness and the proportion of species caught during the survey, with well-sampled species assemblages showing a distinct plateau following the initial rapid increase in the plotted data of species recorded, while under-sampled assemblages continuing to show a continual or slowly decreasing rise in species diversity. When a curve approaches a plateau, it suggests that sampling effort has been sufficient to adequately collect the majority of species comprising the faunal assemblage at the locations sampled (Thompson & Withers, 2003). The value at which the curve asymptotes can also be used as an approximate measure of the total size of the species diversity at the sampled location (Thompson *et al.*, 2003).

Species accumulation curves were created for each faunal group (mammals, birds and herpetofauna). Accumulation curves and estimators were run using EstimateS v9.1.0 (Colorado, USA) and included the estimated number of species based on observed data recorded (S(est), formerly Sobs Mao Tau) and species richness estimators Chao 1, Chao 2, Jackknife 1 and Michaelis-Menten, to predict the total number of species that could potentially be recorded using the same techniques.

Species accumulation curves and richness estimators for this survey were calculated using avifauna census data for birds and systematic trapping data for mammals, reptiles and amphibians at systematic trapping sites only. It should be noted that additional species were recorded from other techniques (i.e. opportunistic and targeted sampling methods) which are not included in the analysis as the survey effort and data are not statistically valid (i.e. not standardised or comparable).

4.1 Assessment of Significance

4.1.1 Habitats

For the purposes of this assessment, definition of 'critical habitat' for MNES species followed that of DoE (2013), being areas necessary "for activities such as foraging, breeding, roosting, or dispersal". For non-MNES species, these habitats were classified as important habitat for the species. For each species, suitable habitat was categorised as providing critical/ important foraging, breeding, roosting, or dispersal habitat (as per the definition above), or supporting foraging, breeding, roosting or dispersal, for habitat types where the species may occur, but it is not necessary for such activities. Critical habitat for ghost bat and Pilbara leaf-nosed bat was classified following (Bat Call, 2021a) and Bat Call (2021b) for each species respectively. Due to differing habitat preferences of significant species (including habitat features and/or microhabitats), habitat significance was assessed on a species-by-species basis. For MNES species, classification of critical and supporting habitat broadly followed criteria defined in BHP WAIO (2020b). Unsuitable habitat was defined by habitat which is unlikely to support the species and impact upon its presence – note individuals may be recorded in these habitats intermittently, though are not expected to be reliant on them.

It should be noted that assessment of habitat significance applies only to habitat occurring within the Study Area, and therefore may not be representative of significance applied to the same habitat in other areas outside the Study Area.

For example, a habitat within the Study Area may be deemed unsuitable due to the absence of certain habitat features which are required for the species persistence, despite the same habitat occurring outside the Study Area being considered of greater significance. The significance of a habitats within the Study Area may also be influenced by other habitats occurring within the Study Area and more broadly, including areas adjacent to the Study Area, particularly if representative of primary habitat.

4.1.2 Likelihood of Significant Species Occurrence

Significant species identified by the desktop assessment were assessed for their likelihood of occurrence within the Study Area using a decision matrix which considers the suitability of habitat within the Study Area and the proximity, date and validity of previous records. Based on this decision matrix, each species was assigned to one of six categories of likelihood: Confirmed, Highly Likely, Likely, Possible, Unlikely, or Highly Unlikely (Table 4.9).

The decision matrix is intended to be an indicative guide only, and the way in which it is interpreted may vary between species, depending on a given species' habitat preferences and ability to disperse, as well as the reliability and availability of contextual information. For example, considering species which have been previously recorded close to the Study Area, a species with a limited dispersal capability will have a reduced likelihood of occurring in the Study Area compared with a species with greater dispersal capability. It is also recognised that a lack of records in the vicinity of the Study Area may indicate limited sampling effort rather than species' absence, and that previous records may include historic or presumed erroneous information which may misrepresent a species' current distribution. Where the determination of a species' likelihood of occurrence within the Study Area deviates from the decision matrix, detailed justification for any variation is provided.

Table 4.9: Species likelihood of occurrence decision matrix

		Habitat suitability of Study Area			
		Breeding habitat present	Foraging and dispersal habitat present	Marginally suitable habitat ² present	No suitable habitat present
Species Records ¹	Recorded in Study Area	Confirmed	Confirmed	Confirmed	Confirmed
	Recorded within 10 km of Study Area	Highly Likely	Likely	Possible	Possible
	Recorded within 10–50km of Study Area	Likely	Possible	Possible	Unlikely
	Recorded within 50–100 km of Study Area	Possible	Possible	Unlikely	Unlikely
	Recorded >100 km of Study Area	Possible	Unlikely	Unlikely	Highly Unlikely
	Species considered locally/regionally extinct	Unlikely	Unlikely	Highly Unlikely	Highly Unlikely

¹ Only records within the previous 50 years are considered.

² Marginally suitable habitat is habitat which is possibly used by a species but is unlikely to be depended upon; for example, it may be used only when in proximity to critical breeding, foraging or dispersal habitat.

5 FIELD SURVEY RESULTS AND DISCUSSION

5.1 Fauna Habitats

A total of 12 broad fauna habitat types were recorded and mapped across the Study Area, comprising, in decreasing order of extent (Table 5.1; Figure 5.1):

- Hillcrest/ Hillslope (33.54%, 1,965.26 ha);
- Stony Plain (22.17%, 1,299.07 ha);
- Drainage Area/ Floodplain (17.59%, 1,030.66 ha);
- Cleared/ Disturbed (9.03%, 529.09 ha);
- Undulating Low Hills (5.03%, 294.50 ha);
- Major Drainage Line (4.43%, 259.53 ha);
- Gorge/ Gully (3.74%, 219.00 ha);
- Minor Drainage Line (1.66%, 97.00 ha);
- Breakaway/ Cliff (1.56%, 91.65 ha);
- Mulga Woodland (0.76%, 44.61 ha);
- Sand Plain (0.41%, 23.94 ha); and
- Dam (0.08%, 4.79 ha).

Descriptions of the distinguishing characteristics and the occurrence within the Study Area for each of these habitat types are presented in Table 5.1, and the data from on-site habitat assessments are presented in Appendix E.

Of the 12 broad fauna habitats occurring within the Study Area, Major Drainage Line, Gorge/ Gully and Breakaway/ Cliff habitats provide critical habitat for MNES species, including northern quoll and Pilbara olive python (Table 5.1). Within this habitat, potential critical breeding (Pilbara olive python), denning (northern quoll), foraging and dispersal habitat for the species occurs, particularly in areas with caves and overhangs (i.e. Gorge/ Gully and Breakaway/ Cliff) and where pooling water remains for prolonged periods following rainfall events (i.e. Major Drainage Line). Although Gorge/ Gully and Breakaway/ Cliff habitats are not classified as critical habitat for ghost bat or Pilbara leaf-nosed bat, they have the potential to contain critical habitat in the form of Category 1–2 and Category 3 (when found in an apartment block with Category 2 caves) caves (ghost bat) or Category 1–3 caves (Pilbara leaf-nosed bat).

Critical foraging and dispersal habitat for ghost bat within the Study Area is provided by Stony Plain, Drainage Area/ Floodplain, Major Drainage Line, Minor Drainage Line and Mulga Woodland habitats where proximal (<12 km) to Category 1–2 and Category 3 caves when in an apartment block with Category 2 caves. As a Category 2 roost is known to occur in the eastern extent the Study Area (CNIM-03), most of the occurrence of the aforementioned habitats within the Study Area provides critical foraging habitat for the species (i.e. occurs within 12 km of CNIM-03).

Drainage Area/ Floodplain, Major Drainage Line, Minor Drainage Line, Mulga Woodland, and to a lesser extent, Stony Plain and Sand Plain, may provide suitable nesting and foraging for southern whiteface (Table 5.1). The species occurrence, however, is likely to be dependent on the presence of suitable vegetation structure and cover, which is variable throughout all habitats occurring within the Study Area.

Suitable supporting habitat for the northern quoll, Pilbara leaf-nosed bat and Pilbara olive python is provided by Hillcrest/ Hillslope and Minor Drainage Line habitat, particularly when occurring near suitable denning/ roosting habitat (i.e. Gorge/ Gully and Breakaway/ Cliff habitats). Other supporting foraging and dispersal habitat for Pilbara leaf-nosed bat within the Study Area is provided by Stony Plain, Drainage Area/ Floodplain, Major Drainage Line, Undulating Low Hills, Gorge/ Gully and Breakaway/ Cliff habitat.

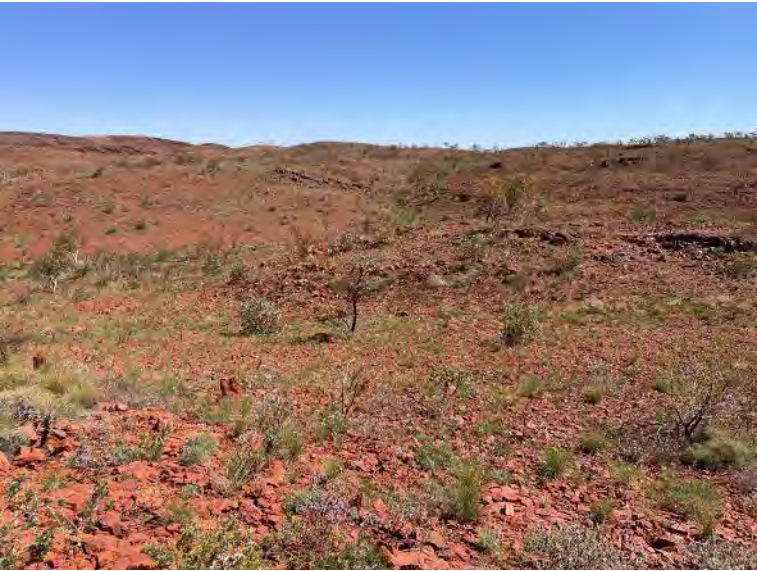
For brush-tailed mulgara, western pebble-mound mouse, long-tailed dunnart, grey falcon, peregrine falcon, spotted Ctenotus and Pilbara flat-headed blind snake, the habitats Hillcrest/ Hillslope, Stony Plain, Undulating Low Hills, Major Drainage Line, Gorge/ Gully, Minor Drainage Line, Breakaway Cliff and Sand Plain all provide important habitat for breeding, nesting, foraging and dispersal functions for some or all of the species to different extents (Table 5.1).

All of the broad fauna habitats within the Study Area, except for Cleared/ Disturbed, provide supporting foraging and dispersal habitat in various extents for night parrot, peregrine falcon, long-tailed dunnart, fork-tailed swift, migratory water birds, spotted Ctenotus and Pilbara flat-headed blind snake. For many of these species, usage of supporting habitat is dependent on the proximity of the habitat to other areas of important habitat, particularly breeding/ roosting habitat.

Although critical and/or supporting habitat for numerous significant species was identified within the Study Area, the occurrence of suitable habitat doesn't necessarily indicate species presence. The actual occurrence of species, or their likelihood of occurrence if not recorded previously, in the Study Area, is therefore a primary indicator in the usage of crucial and/or supporting habitats identified within the Study Area for respective species. For example, while potential denning habitat for northern quoll was identified within the Study Area, the absence of any previous records within and scarcity of plausible records in the broader vicinity of the Study Area, indicates critical and/or supporting habitat identified within the Study Area may not necessarily be representative of species actual occurrence.

All fauna habitats mapped that provide supporting habitat are broadly distributed and well represented across the Pilbara bioregion and surrounding regions, and therefore support fauna assemblages which are generally common and widespread. The condition of habitats within the Study Area ranged from High to Excellent. The greatest disturbance was caused by tracks and cleared areas, as a result of mining and exploration activity throughout parts of the Study Area.

Table 5.1: Broad fauna habitats occurring within the Study Area

Habitat	Distinguishing habitat characteristics	Extent of the habitat	Significant Species	Photo
Hillcrest/ Hillslope 1,965.26 ha 33.54%	The Hillcrest/ Hillslope habitat comprised a rocky substrate, often with exposed bedrock, on moderate to steep slopes leading into lower footslopes. This habitat was characterised by steep slopes with a high proportion of coarse fragments dominated by ironstone. These can contain cracks and crevices. Instances of Gorge/ Gully is contained within this habitat. This habitat is usually dominated by open <i>Eucalyptus</i> woodlands, <i>Acacia</i> and <i>Grevillea</i> scrublands and <i>Triodia</i> low hummock grasslands.	Hillcrest/ Hillslope habitat occurs throughout a large portion of the Study Area, with the majority of habitat occurring in the northern section in the elevated parts of the Study Area. Hillcrest/ Hillslope habitat is a characteristic habitat type of the Pilbara region. Its occurrence throughout the region is widespread and common.	Supporting habitat for MNES species: • northern quoll — foraging and dispersal, where proximal to denning/ breeding habitat • Pilbara leaf-nosed bat — foraging (*HR=2) and dispersal • Pilbara olive python — foraging and dispersal • fork-tailed swift — foraging and dispersal Important habitat for non-MNES species: • western pebble-mound mouse — breeding, foraging and dispersal • peregrine falcon — foraging and dispersal • long-tailed dunnart — breeding, foraging and dispersal • spotted Ctenotus — breeding, foraging and dispersal • Pilbara flat-headed blind snake — breeding, foraging and dispersal	
Stony Plain 1,299.07 ha 22.17%	Stony Plain comprise low-lying open plains and the rolling hills below upland areas, with very slight to no gradient. The substrate consists of gravel and pebbles, with vegetation dominated by <i>Triodia</i>, although scattered trees also occur. Vegetation within this habitat varied in composition but was generally dominated by scattered Mulga and <i>Acacia</i> forming an over-storey, with patches of various small to medium shrub species, over low hummock grasslands of <i>Triodia</i>. Scattered <i>Corymbia</i> and <i>Eucalyptus</i> are usually present.	Stony Plain habitat occurs throughout a large portion of the Study Area, often occurring as the intervening area between other habitats. Stony Plain is one of the most common and widespread habitat types within the Pilbara region. The vegetation and substrate which make up this habitat type are characteristic features of the region.	Critical habitat for MNES species: • ghost bat — foraging, where proximal (<12 km) to Category 1–2 caves and Category 3 caves when in an apartment block with Category 2 caves Supporting habitat for MNES species: • ghost bat — foraging and dispersal, where >12 km from Category 1–2 caves and Category 3 caves when in an apartment block with Category 2 caves • Pilbara leaf-nosed bat — foraging (HR=2) and dispersal • night parrot — foraging, where <i>Triodia</i> is suitably sized • fork-tailed swift — foraging and dispersal Important habitat for non-MNES species: • western pebble-mound mouse — breeding, foraging and dispersal • brush-tailed mulgara — breeding, foraging and dispersal • peregrine falcon — foraging • long-tailed dunnart — foraging and dispersal • spotted Ctenotus — foraging and dispersal	

Habitat	Distinguishing habitat characteristics	Extent of the habitat	Significant Species	Photo
Drainage Area/ Floodplain 1,030.66 ha 17.59%	Lower lying plain often subjected to sheet flow following large rainfall events. Vegetation and substrates of this habitat was variable, often comprising scattered <i>Eucalyptus</i> over <i>Acacia</i> and/or <i>Grevillea</i> shrubs with an understorey dominated by <i>Triodia</i> hummock grasses and/or mixed tussock grasses on alluvial substrates, often comprising heavy clays and gravel. Tussock grasses can be dominant within Drainage Area/ Floodplain habitat as a result of high rainfall events.	Drainage Area/ Floodplain habitat occurs across large areas within the Study Area, particularly in the southern lower lying areas of the Study Area. This fauna habitat is common throughout the Pilbara bioregion. Across the region its structure and condition is variable as a result of rainfall events and disturbance (i.e. fire and cattle grazing).	Critical habitat for MNES species: - ghost bat — foraging and dispersal, where proximal (<12 km) to Category 1–2 caves and Category 3 caves when in an apartment block with Category 2 caves - southern whiteface – breeding, foraging and dispersal Supporting habitat for MNES species: - ghost bat — foraging and dispersal, where >12 km from Category 1–2 caves and Category 3 caves when in an apartment block with Category 2 caves - Pilbara leaf-nosed bat — foraging (HR=2) and dispersal - migratory water bird species — foraging (habitat usage would be seasonal and only used when water present) - fork-tailed swift — foraging and dispersal Important habitat for non-MNES species: - brush-tailed mulgara — foraging and dispersal - peregrine falcon — foraging - spotted Ctenotus — foraging and dispersal	
Undulating Low Hills 294.50 ha 5.03%	The Undulating Low Hills habitat comprises low hills and undulating stony plains of higher elevation than Stony Plain. The habitat supports hard spinifex with a mantle of gravel and larger rocks with occasional outcropping or minor breakaway. Vegetation is dominated by hard <i>Triodia</i> hummock grasslands with scattered <i>Eucalyptus</i> trees and <i>Acacia</i>, <i>Eremophila</i> and/or <i>Grevillea</i> shrubs.	Undulating Low Hills habitat occurs in patches throughout the Study Area, the largest is in the centre of the Study Area. Undulating low hills is also one of the most common and widespread habitats within the Pilbara region.	Supporting habitat for MNES species: - Pilbara leaf-nosed bat — foraging (HR=2) and dispersal, where proximal (<20 km) to roosting habitat - fork-tailed swift — foraging and dispersal Important habitat for non-MNES species: - western pebble-mound mouse — breeding, foraging and dispersal - peregrine falcon — foraging	

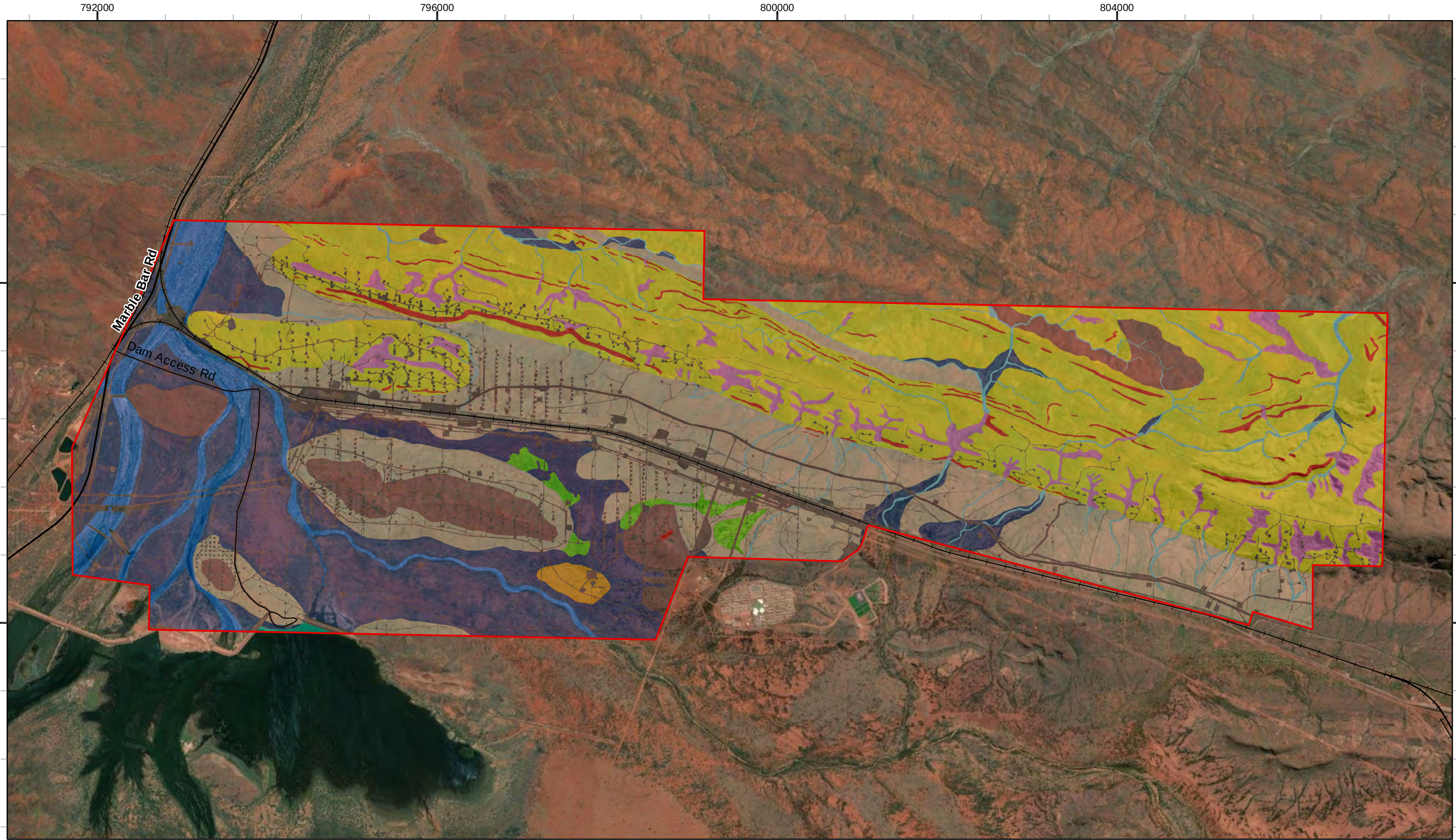
Habitat	Distinguishing habitat characteristics	Extent of the habitat	Significant Species	Photo
Major Drainage Line 259.53 ha 4.43%	Major Drainage Line habitat is prone to flooding and is more likely to retain water when inundated. The structure and condition of vegetation often varies seasonally, particularly following rainfall events. This habitat supports an upper story of relatively tall <i>Eucalyptus</i> .	The Major Drainage Line habitat flows through the west of the Study Area. This fauna habitat is widespread throughout the Pilbara bioregion, though its structure and condition is variable as a result of rainfall events and susceptible to degradation from cattle grazing.	Critical habitat for MNES species: • northern quoll — denning, foraging and dispersal • ghost bat — foraging and dispersal, where proximal (<12 km) to Category 1–2 caves and Category 3 caves when in an apartment block with Category 2 caves • Pilbara olive python — breeding, foraging and dispersal • Southern whiteface – breeding, foraging and dispersal • grey falcon —breeding, foraging and dispersal Supporting habitat for MNES species: • ghost bat — foraging and dispersal, where >12 km from Category 1–2 caves and Category 3 caves when in an apartment block with Category 2 caves • Pilbara leaf-nosed bat — foraging (HR=4) and dispersal • migratory water bird species — foraging and dispersal • fork-tailed swift — foraging and dispersal	
Gorge/ Gully 219.00 ha 3.74%	Gorge/ Gully habitat was characterised by rugged, steep-sided valleys incised into the surrounding landscape. Gorges tend to be deeply incised, with vertical cliff faces, while gullies are more open (but not as open as Minor Drainage Lines). Caves and rock pools are most often encountered in this habitat type. Vegetation can be dense and complex in areas of soil deposition or sparse and simple where erosion has occurred.	The Gorge/Gully habitat is found in patches to the north of the Study Area, within Hillcrest/ Hillslope habitat A reasonably common habitat in the Pilbara, usually associated with ranges, however, because this habitat type is narrow and linear, they only represent a small proportion of the total land area.	Critical habitat for MNES species: • northern quoll — breeding, denning, foraging and dispersal • ghost bat — only Category 1,2 and 3 (when found in an apartment block) caves associated with this habitat type are considered critical; the broad habitat itself is not critical • Pilbara olive python — breeding, foraging and dispersal Supporting habitat for MNES species: • Pilbara leaf-nosed bat — foraging (HR=4) and dispersal. Only Category 1-3 caves associated with this habitat type are consider critical; the broad habitat itself is not considered critical • fork-tailed swift — foraging and dispersal Important habitat for non-MNES species: • peregrine falcon — potential nesting and foraging • Pilbara flat-headed blind snake — breeding, foraging and dispersal	

Habitat	Distinguishing habitat characteristics	Extent of the habitat	Significant Species	Photo
Minor Drainage Line 97.00 ha 1.66%	Minor Drainage Line habitat usually lacked a tall dense upper story but with a dense mid story, including sparse <i>Eucalyptus</i> sp. and <i>Acacia</i> sp. over tussock grasses and <i>Triodia</i> sp. hummock grasses. Does not include the minor drainage depressions that flow off high ground features. It is less likely to support surface water for long after rainfall.	Minor drainage line habitat occurs throughout the Study Area, associated with major drainage lines or surrounding areas of higher elevation. This fauna habitat is widespread throughout the Pilbara bioregion, though its structure and condition is variable as a result of rainfall events and susceptible to degradation from cattle grazing.	Critical habitat for MNES species: - ghost bat — foraging and dispersal, where proximal (<12 km) to Category 1–2 caves and Category 3 caves when in an apartment block with Category 2 caves - southern whiteface – breeding, foraging and dispersal Supporting habitat for MNES species: - northern quoll — dispersal, where proximal to breeding habitat - ghost bat — foraging and dispersal, where >12 km from Category 1–2 caves and Category 3 caves when in an apartment block with Category 2 caves - Pilbara leaf-nosed bat — foraging (HR=2) and dispersal - grey falcon — foraging, where proximal to breeding habitat - Pilbara olive python — foraging and dispersal, where proximal to breeding habitat - fork-tailed swift — foraging and dispersal	
Breakaway/ Cliff 91.65 ha 1.56%	Breakaway/ Cliffs are rugged, incised rocky hills and ranges. They tend to contain large rock fragments and more rock outcropping than other fauna habitats. Significant habitat features such as caves are sometimes encountered in this habitat type. Vegetation can be dense and complex in areas of soil deposition or sparse and simple where erosion has occurred.	Within the Study Area, Breakaway/ Cliff habitat is limited to small sections in the north of the Study Area. Its occurrence is confined to more elevated parts of the Study Area within Hillcrest/ Hillslope habitat. Breakaway/ Cliff habitat is a characteristic habitat type of the Pilbara region. Its occurrence throughout the region is widespread and common.	Critical habitat for MNES species: - northern quoll —breeding, denning, foraging and dispersal - ghost bat — only Category 1, 2 and 3 (when found in an apartment block) caves associated with this habitat type are considered critical; the broad habitat itself is not considered critical - Pilbara olive python — breeding, foraging and dispersal Supporting habitat for MNES species: - Pilbara leaf-nosed bat — foraging (HR=4) and dispersal. Only Category 1-3 caves associated with this habitat type are considered critical; the broad habitat itself is not considered critical - fork-tailed swift — foraging and dispersal Important habitat for non-MNES species: - long-tailed dunnart — breeding, foraging and dispersal - peregrine falcon —breeding and foraging - Pilbara flat-headed blind snake — breeding, foraging and dispersal	

Habitat	Distinguishing habitat characteristics	Extent of the habitat	Significant Species	Photo
Mulga Woodland 44.61 ha 0.76%	Mulga woodland of varying density, often associated with minor Drainage Area/ Floodplain landforms or minor drainage systems subject to sheet flow following rainfall. Vegetation dominated by open Mulga with sparse to no understorey of mixed small shrubs and tussock grasses.	This habitat type is located in a few isolated patches within the southern portion of the Study Area. It often occurs within broader areas of Stony Plain and/or Drainage Area/ Floodplain habitats. Extent within the Study Area and more broadly in the vicinity of the Study Area is limited, with little to no connectivity between small areas of habitat. This habitat is relatively common throughout the Pilbara region, usually occurring in areas of drainage or sheet flow.	Supporting habitat for MNES species: • ghost bat — foraging and dispersal, where proximal (<12 km) to roosting habitat • Pilbara leaf-nosed bat — foraging (HR=2) and dispersal • Southern whiteface – foraging and dispersal • fork-tailed swift — foraging and dispersal Important habitat for non-MNES species: • spotted Ctenotus — breeding, foraging and dispersal	
Sand Plain 23.94 ha 0.41%	Low-lying or elevated sandy areas with accumulated loose sandy substrate. Often supporting an open vegetation cover, dominated by scattered <i>Acacia</i> shrubs over <i>Triodia</i> hummock grasses of various life stages.	Within the Study Area, Sand Plain habitat is restricted to one small occurrence in the southern portion of the Study Area surrounded by Drainage Area/ Floodplain habitat. Extent within the Study Area and more broadly in the vicinity of the Study Area is limited, with little to no connectivity between small areas of habitat. Sand plain is a common and widespread habitat throughout the Pilbara region.	Supporting habitat for MNES species: • fork-tailed swift — foraging and dispersal Important habitat for non-MNES species: • brush-tailed mulgara — breeding, foraging and dispersal	
Dam 4.79 ha 0.08%	Habitat is Ophthalmia Dam, created by the excess water from surrounding man-made infrastructure. Vegetation at edges and some aquatic vegetation within the body of water.	Habitat is unique within the Study Area, occurring on the southern border, and of limited extent within the broader region.	Supporting habitat for MNES species: • grey falcon — foraging, where proximal to breeding habitat • migratory water bird species — foraging • fork-tailed swift — foraging and dispersal	

Habitat	Distinguishing habitat characteristics	Extent of the habitat	Significant Species	Photo
Cleared/ Disturbed 529.09 ha 9.03%	Disturbed areas include where the natural vegetation and microhabitats have been disrupted, usually devoid of native vegetation. This includes tracks, laydown areas, camps, major roads/highways and historic, large-scale clearing.	The Disturbed areas occur throughout the Study Area, primarily associated with drilling activity (drill lines, drill pads and access tracks).	Nil	

*HR = Habitat Rating as defined by Bat Call (2021b)



LEGEND

Study Area	Fauna Habitat	Gorge/ Gully	Mulga Woodland
Local Road	Breakaway/ Cliff	Hillcrest/ Hillslope	Sand Plain
State Road	Cleared/ Disturbed	Major Drainage Line	Stony Plain
Rail	Dam	Minor Drainage Line	Undulating Low Hills
	Drainage Area/ Floodplain		

Scale: 1:42,500

0 1 2 Km

Coordinate System: GDA2020 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA2020
Created 13/12/2022

BHP WAIO
East Ophthalmia and Ninga
Detailed Vertebrate
Fauna Survey

Figure 5.1: Broad fauna
habitats in the Study Area

5.2 Fauna Habitat Features

Caves

Caves can be important features within a landscape, particularly in arid zone systems, often providing stable microclimates, shelter and protection (Medellin *et al.*, 2017). A total of 13 caves are known from within the Study Area, comprising; 11 recorded during previous surveys (Biologic, 2013a, 2014a, 2023a, 2023b; GHD, 2021) and two new caves identified and assessed during the current survey for suitability for Pilbara leaf-nosed bat and ghost bat (Table 5.2; Figure 5.2; Appendix F). Four of the seven previously recorded caves are currently subject to long-term monitoring for ghost bat activity as part of the Jimblebar ghost bat monitoring program (Biologic, 2023b).

Underground refuges used by Pilbara leaf-nosed bat were classified by Bat Call (2021b) into four categories, as detailed further in Section 4.3.2. Category 1–3 caves are classified as critical habitat for the species. All of the caves occurring within the Study Area were classified primarily as nocturnal refuge (Category 4) caves for Pilbara leaf-nosed bats, and none were assessed as likely or potentially suitable as Category 1, 2 or 3 (permanent or semi-permanent diurnal) roosts (Table 5.2).

Caves and roosts used by ghost bats can be classified into four categories (Bat Call, 2021a), as detailed further in Section 4.3.2. Category 1–2, and 3 (when found in an apartment block with Category 2 caves), caves are classified as critical habitat for the species. Of the 13 caves occurring within the Study Area, one (CNIN-03) was identified as a Category 2 roost (maternity/ diurnal roost caves with regular occupancy for ghost bats) (Table 5.2). Seven caves in the Study Area (CNIN-01, CNIN-07, CNIN-09, CNIN-10, CNIN-11, CNIN-12 and CNIN-13) were identified as Category 3 (diurnal roost caves with occasional occupancy) and the remaining five caves were identified as Category 4 (nocturnal roost caves with opportunistic usage) for ghost bats (CEOP-03, CNIN-04, CNIN-05, CNIN-14 and CNIN-17) (Table 5.2). None of the Category 3 caves occur as part of an apartment block with any Category 2 caves, therefore, are not considered critical habitat for the species.

Of the 13 caves that occur within the Study Area, seven occur within Gorge/ Gully habitat, four occur within Breakaway/ Cliff habitat and two occur within Hillcrest/ Hillslope habitat (Table 5.2). Cave searching survey effort was focussed on the areas of Breakaway/ Cliff and Gorge/ Gully habitat most likely to have the highest quality caves, therefore it is possible that not all caves have been located within the Study Area and additional caves may occur.

Table 5.2: Summary of caves known from within the Study Area

Cave ID	Previous Cave ID & Source	Latitude	Longitude	Habitat Type	Ghost Bat Records	Ghost Bat Significance	Pilbara Leaf-nosed Bat Significance
CEOP-03	COPN-02 (current survey)	-23.3094	119.9132	Breakaway/ Cliff	No records	Category 4	Category 4
CNIN-01	CJBW-19 (Biologic, 2013a) OB 19_r1 (Biologic, 2014a) CAV-8 (GHD, 2021)	-23.3232	119.9815	Gorge/ Gully	52 scats, feeding evidence	Category 3	Category 4
CNIN-03	CJBW-31 (Biologic, 2013a) obcave3 (Biologic, 2014a) CAV-5 (GHD, 2021)	-23.3281	119.9957	Gorge/ Gully	1 individual, 2000+ scats, multiple ultrasonic calls	Category 2	Category 4
CNIN-04	obcave4 (Biologic, 2014a)	-23.3180	119.9800	Hillcrest/ Hillslope	No records	Category 4	Category 4
CNIN-05	obcave5 (Biologic, 2014a) OB 19_r2 (Biologic, 2014a) CAV-3 (GHD, 2021)	-23.3300	119.9990	Gorge/ Gully	No records	Category 4	Category 4
CNIN-07	CAV-7 (GHD, 2021)	-23.3150	119.9310	Breakaway/ Cliff	No records	Category 3	Category 4
CNIN-09	CJBW-25 (Biologic, 2013a) CAV-9 (GHD, 2021)	-23.3158	119.9320	Breakaway/ Cliff	1–3 individual, scats, multiple ultrasonic calls	Category 3	Category 4
CNIN-10	CAV-10 (GHD, 2021)	-23.3190	119.9540	Gorge/ Gully	No records	Category 3	Category 4
CNIN-11	CAV-11 (GHD, 2021)	-23.3200	119.9530	Gorge/ Gully	No records	Category 3	Category 4
CNIN-12	CAV-12 (GHD, 2021)	-23.3170	119.9560	Gorge/ Gully	No records	Category 3	Category 4
CNIN-13	CAV-2 (GHD, 2021)	-23.3182	119.9452	Gorge/ Gully	5 scats	Category 3	Category 4
CNIN-14	CAV-4 (GHD, 2021)	-23.3210	119.9800	Hillcrest/ Hillslope	No records	Category 4	Category 4
CNIN-17	COPN-01 (current survey)	-23.3140	120.0019	Breakaway/ Cliff	No records	Category 4	Category 4

Water Features

Water sources are a limiting factor for many ecosystems (James *et al.*, 1995), particularly within arid-zone ecosystems such as the Pilbara (Burbidge *et al.*, 2010; Doughty *et al.*, 2011) and often represent areas of comparatively high ecological productivity (Murray *et al.*, 2003). Mammals and birds have endothermic metabolisms and therefore require relatively continuous sources of food and moisture, while water for amphibians provides opportunities to forage (i.e. suitably wet periods) and breed (i.e. when water pools for long enough for them to complete the life cycle) (James *et al.*, 1995). These features are highlighted because they may provide important sources of food and water for significant species.

A total of 32 water features have been recorded within the Study Area to date, comprising ten recorded during previous surveys (Biologic, 2014a, 2021b; Ecologia, 2004a; Outback Ecology, 2009b) and 22 new water features recorded during the current survey (Table 5.3; Figure 5.2; Appendix G). Of the 22 new water features recorded, 18 were classified as ephemeral, three as temporary ephemeral and one permanent (Table 5.3; Figure 5.2; Appendix G). The majority of water features occurring in the Study Area were recorded in Gorge/ Gully habitat ($n = 28$), with the remaining four water features recorded in Major Drainage Line ($n = 3$) and Hillcrest/ Hillslope ($n = 1$) habitat. With consideration of overall survey effort for water features and Study Area coverage, it is possible that additional water features occur within the Study Area, particularly within Gorge/ Gully and Major Drainage Line habitats.

All of the water features known from within the Study Area are considered to provide supporting foraging features for the northern quoll, Pilbara leaf-nosed bat and Pilbara olive python. For northern quolls, they often represent areas of high productivity, and therefore may contain a relatively high abundance of feeding resources (Braithwaite & Griffiths, 1994; Oakwood, 2000), particularly when occurring within rocky habitats, and to a lesser degree, drainage lines. For Pilbara leaf-nosed bats they can provide significant drinking and foraging sources, and are a key component to 'Gorges with Pools' being recognised as the priority foraging habitat for the species (TSSC, 2016b). For Pilbara olive pythons, these features can often act as primary foraging locations and for that reason the species is more often than not associated with such features, particularly within rocky habitats, but also, to a lesser extent within drainage line habitats (Pearson, 1993). Additionally, some water features, particularly those along drainage line habitats and Dam habitat occurring within the Study Area, may also provide foraging habitat for migratory waterbirds. This occurrence, however, is likely to be seasonal and irregular, with activity more likely to be concentrated to other areas of suitable habitat occurring more broadly in the vicinity of the Study Area around the extent Ophthalmia Dam.

Table 5.3: Summary of water features known from within the Study Area

Water feature ID	Unique ID (previously recorded)	Source	Habitat Type	Latitude	Longitude	Type
WOPN-001		Current survey	Gorge/ Gully	-23.3278	119.9935	Ephemeral
WOPN-002		Current survey	Gorge/ Gully	-23.3176	119.9553	Ephemeral
WOPN-003		Current survey	Gorge/ Gully	-23.3248	119.9819	Ephemeral
WOPN-004		Current survey	Gorge/ Gully	-23.3245	119.9820	Ephemeral
WOPN-005		Current survey	Gorge/ Gully	-23.3230	119.9818	Ephemeral
WOPN-006		Current survey	Gorge/ Gully	-23.3123	119.9278	Ephemeral
WOPN-007		Current survey	Gorge/ Gully	-23.3121	119.9280	Ephemeral
WOPN-008		Current survey	Gorge/ Gully	-23.3287	119.9870	Ephemeral
WOPN-009		Current survey	Gorge/ Gully	-23.3304	120.0022	Ephemeral
WOPN-010		Current survey	Gorge/ Gully	-23.3175	119.9423	Temporary ephemeral
WOPN-011		Current survey	Gorge/ Gully	-23.3223	119.9657	Ephemeral
WOPN-012		Current survey	Gorge/ Gully	-23.3214	119.9659	Ephemeral
WOPN-013		Current survey	Gorge/ Gully	-23.3202	119.9660	Ephemeral
WOPN-014		Current survey	Hillcrest/ Hillslope	-23.3200	119.9657	Ephemeral
WOPN-015		Current survey	Gorge/ Gully	-23.3196	119.9661	Ephemeral
WOPN-016		Current survey	Gorge/ Gully	-23.3185	119.9451	Temporary ephemeral
WOPN-017		Current survey	Gorge/ Gully	-23.3199	120.0021	Ephemeral
WOPN-018		Current survey	Gorge/ Gully	-23.3178	119.9424	Temporary ephemeral
WOPN-019		Current survey	Gorge/ Gully	-23.3080	119.9914	Ephemeral
WOPN-020		Current survey	Gorge/ Gully	-23.3079	119.9900	Ephemeral
WOPN-021		Current survey	Major Drainage Line	-23.3022	119.8674	Permanent
WOPN-022		Current survey	Gorge/ Gully	-23.3208	120.0013	Ephemeral

Water feature ID	Unique ID (previously recorded)	Source	Habitat Type	Latitude	Longitude	Type
-	1202_11_00023	Biologic (2014a)	Gorge/ Gully	-23.3283	119.9990	Ephemeral*
-	1202_11_00001	Biologic (2014a)	Gorge/ Gully	-23.3229	119.9818	Ephemeral*
-	1202_11_00024	Biologic (2014a)	Gorge/ Gully	-23.3285	119.9990	Ephemeral*
-	1202_11_00031	Biologic (2014a)	Gorge/ Gully	-23.3303	120.0022	Ephemeral*
-	1202_11_00022	Biologic (2014a)	Gorge/ Gully	-23.3287	119.9989	Ephemeral*
-	1202_11_00002	Biologic (2014a)	Gorge/ Gully	-23.3237	119.9819	Ephemeral*
-	1202_11_00029	Biologic (2014a)	Gorge/ Gully	-23.3078	119.9900	Ephemeral*
-	10180_11_00778	Ecologia (2004a)	Gorge/ Gully	-23.3198	119.9535	Ephemeral*
-	10180_11_00779	Outback Ecology (2009b)	Major Drainage Line	-23.3201	119.8717	Ephemeral*
-	10313_11_00017	Biologic (2021b)	Major Drainage Line	-23.3151	119.8706	Ephemeral*

*Type assumed based on habitat type and location, information not specified in source report.

5.3 Fauna Recorded

5.3.1 Species Richness of Study Area

A total of 217 vertebrate fauna species, comprising 29 mammal species (24 native and five introduced), 125 bird species, 59 reptile species and four amphibian species were recorded from the Study Area during the current survey (Table 5.4; Appendix C; Appendix H). This comprises approximately 58% of the total number of species identified in the desktop assessment ($n = 371$) as potentially occurring within the Study Area (see section 3.2). In comparison with the results from previous surveys undertaken in the vicinity of the Study Area (Table 5.4), the total species diversity recorded during the current survey was considerably higher than other larger scale surveys comprising two phases of trapping (Table 3.2). The highest species diversity recorded during any previous survey used in the desktop assessment was 163 species, by Biologic (2011) (Table 5.4).

Of the 217 species recorded during the current survey, one bird, three reptile and one amphibian species were not previously identified in the desktop assessment as potentially occurring (Appendix C). These species included the masked lapwing (*Vanellus miles*), small Pilbara spotted rock Gehyra (*Gehyra micra*), western Pilbara lined Ctenotus (*Ctenotus pallasotus*), fourteen-lined Ctenotus (*Ctenotus quattuordecimlineatus*) and shoemaker frog (*Neobatrachus sutor*). The Study Area occurs at the north-western extent of the distribution for the masked lapwing and the northern extent of the distribution for the shoemaker frog (*Neobatrachus sutor*), which is likely to have attributed to fewer records of both species in the vicinity of the Study Area (DBCA, 2022a). The small Pilbara spotted rock Gehyra (*Gehyra micra*) represents a recently described species, formerly subsumed within the common and widespread spotted rock dtella (*Gehyra punctata*) (Doughty *et al.*, 2018), which was also recorded during the current survey. The western Pilbara lined Ctenotus (*Ctenotus pallasotus*) also represents a recently described species, formerly subsumed within *Ctenotus duricola* (Rabosky *et al.*, 2017). The remaining species, the fourteen-lined Ctenotus (*Ctenotus quattuordecimlineatus*), is considered relatively common and widespread within the Pilbara region. The Study Area occurs within the known distribution of the species; however, there are limited records of the species in the broader area of the Study Area, which may represent a small gap in known distribution (DBCA, 2022a).

A greater diversity of species was recorded during the phase 1 survey (175 species) when compared to the phase 2 survey (170 species), which is likely to be attributed to the warmer temperatures recorded and generally higher activity periods of many species following rainfall events of the wet season. A total of 126 species were recorded during both phases, while 49 species were recorded during phase 1 only and 42 species were recorded during phase 2 only.

Table 5.4: Summary of fauna species recorded during the current survey and previous surveys in the vicinity of the Study Area

Source	Reference	Mammals (native)	Mammals (introduced)	Birds	Reptiles	Amphibians	Total
Literature Sources							
Biologic (2014a) Orebody 19 level 2 vertebrate fauna survey	1	20	3	62	48	1	136
Eco Logical (2013) Ninga level 1 vertebrate fauna assessment	2	5	4	41	16	1	71
ENV (2011c) Orebody 42/43 flora, vegetation and fauna assessment	3	2	3	36	0	0	41
Outback Ecology (2009b) Jimblebar Linear Development terrestrial vertebrate fauna assessment	4	7	2	80	47	4	148
Ecologia (1996) Jimblebar Rail Spur biological assessment survey	5	3	1	59	7	2	72
MWH (2015) Ophthalmia Dam avian fauna survey	6	0	0	123	0	0	123
Ecologia (2008) RGP5 fauna survey Newman to Jimblebar Junction	7	2	3	39	9	0	53
ENV (2006) OB24 flora and fauna assessment phase II	8	7	2	63	31	3	106
Eco Logical (2012) Orebody 37 level 1 vertebrate fauna assessment	9	10	5	64	11	1	91
ENV (2011a) Eastern Ridge (OB23/24/25) fauna assessment	10	10	0	46	11	2	69
Biologic (2013a) Ore Body 24 targeted vertebrate fauna survey	11	18	0	44	18	1	81
Biologic (2021c) Western Ridge Pipelines vertebrate fauna survey	12	12	3	66	12	2	95
ENV (2007b) West Jimblebar Lease fauna assessment	13	4	5	73	27	0	109
Ecologia (2004c) Orebody 24 Expansion biological survey	14	4	2	62	22	0	90
Biologic (2014b) Orebody 25 targeted vertebrate fauna survey	15	11	2	28	6	0	47
Onshore and Biologic (2009b) Biological survey Myopic Exploration Leases	16	7	3	48	7	0	65
GHD (2008) Report for Myopic Project Area Newman flora and fauna assessment	17	3	3	32	3	0	41
Biologic (2014c) Orebody 31 vertebrate fauna survey	18	16	6	39	42	0	103
Outback Ecology (2009a) Jimblebar Iron Ore Project terrestrial vertebrate fauna assessment	19	11	6	47	29	2	93
Biologic (2021a) Western Ridge Creeks targeted MNES species survey	20	2	5	60	13	2	82
Ecologia (2004b) Jimblebar-Wheelarra Hill biological survey	21	8	1	57	29	4	99
GHD (2019b) North Jimblebar fauna survey	22	17	5	62	45	0	129

Source	Reference	Mammals (native)	Mammals (introduced)	Birds	Reptiles	Amphibians	Total
Biologic (2016) Cathedral Gorge level 1 and targeted vertebrate fauna survey	23	13	3	46	10	0	72
ENV (2011b) Mt Whaleback East flora, vegetation and fauna assessment	24	2	1	29	7	0	39
Onshore and Biologic (2009a) Mt Whaleback flora & vegetation survey and fauna assessment	25	4	3	51	7	0	65
Biologic (2020a) Coombanbunna Well level 2 vertebrate fauna survey	26	20	5	75	50	2	152
Onshore (2014) Western Ridge biological survey	27	13	3	36	8	0	60
Ecologia (2006a) Jimblebar Marra Mamba Exploration biological survey	28	7	3	64	24	1	99
Biologic (2013b) South West Jimblebar vertebrate fauna survey	29	15	6	55	39	2	117
Astron (2010) BHP Billiton Iron Ore Mt Whaleback TSF flora, vegetation and fauna assessment	30	2	0	1	0	0	3
Biologic (2020c) Western Ridge targeted vertebrate fauna survey	31	6	2	41	4	2	55
GHD (2019a) Jimblebar East and Caramulla fauna survey	32	23	5	66	46	0	140
Biologic (2011) Orebody 35 and Western Ridge vertebrate fauna survey	33	19	6	82	54	2	163
Ecologia (2005b) Western Ridge Exploration Project biological survey	34	3	3	50	15	0	71
Ecologia (2006b) BHPBIO Western Ridge Exploration Project biological survey	35	10	7	25	8	0	50
Ecologia (2005a) East Jimblebar Exploration Project biological survey	36	8	2	40	19	1	70
ENV (2010) Ophthalmia flora, vegetation and fauna assessment	37	11	5	34	7	0	57
ENV (2007a) Ophthalmia Exploration Lease fauna assessment	38	7	5	84	22	2	120
Current Survey		24	5	125	59	4	217

5.3.2 Fauna Assemblages

Systematic Sampling Sites

Locations of systematic trapping sites were situated in areas considered to give a good representation of broad fauna habitats occurring within the Study Area. Two systematic trapping sites were located in Stony Plain habitat (VOPN-002 and VOPN-004) and one within all remaining habitats, including Sand Plain (VOPN-001), Major Drainage Line (VOPN-003), Gorge/ Gully (VOPN-005), Hillcrest/ Hillslope (VOPN-006), Drainage Area/ Floodplain (VOPN-007) and Breakaway/ Cliff (VOPN-008). All broad fauna habitats were subject to further survey effort using alternative sampling methods, including active foraging and SongMeter ultrasonic recordings to sample overall species diversity and target significant species. No systematic trapping was undertaken within the extent of Mulga Woodland habitat mapped within the Study Area due to its relatively small size, degraded and patchy or isolated occurrence which limited its suitability for trapping (i.e. trap site installation was not likely to provide a good representation of the habitat).

Mammals

A total of 29 mammal species from 12 families were recorded within the Study Area from 537 individual records (Appendix H). The number of mammal species trapped during the current survey was high ($n = 14$) compared to previous surveys (see Table 3.2). A further ten species were recorded from ultrasonic bat call recordings (all bat species), with the remaining five species recorded opportunistically from direct observation and secondary evidence. Bats were the most recorded native mammal group with 402 records, followed by native rodents ($n = 45$) and macropods ($n = 24$). Five introduced mammal species were recorded within the Study Area from a total of 43 records. The most commonly occurring mammals (occurring across all eight trapping sites and several other sampling sites) were:

- Gould's Wattled Bat (*Chalinolobus gouldii*);
- little broad-nosed bat (*Scotorepens greyii*);
- great northern free-tailed bat (*Chaerephon jobensis* subsp. *colonicus*); and
- Finlayson's cave bat (*Vespadelus finlaysoni*).

The most abundantly recorded mammal species at the systematic trapping sites were:

- introduced house mouse (*Mus musculus*); and
- sandy inland mouse (*Pseudomys hermannsburgensis*).

Species diversity and abundance recorded at the eight trapping sites varied, with between 25 and 44 individual records occurring at each site, and total species diversity at each site ranging from six to 15. The highest species diversity was recorded at site VOPN-001 (Sand Plain) recording 15 species, largely comprising bat species, from a total number of 44 records. In comparison, site VOPN-008 (Breakaway/ Cliff) only recorded six species, from 25 individual records. The differences in overall species diversity and abundance is likely to be attributed to the different habitats or habitat characteristics occurring between sites.

Two significant mammal species were recorded within the Study Area during the survey; Pilbara leaf-nosed bat (*Rhinonicteris aurantia*; VU – EPBC/BC Act) and western pebble-mound mouse (*Pseudomys chapmani*; Priority 4 – DBCA) (Table 5.5; Figure 5.3).

Birds

A total of 125 bird species representing 50 families were recorded within the Study Area from a total of 4,244 individual records (Appendix H). Species diversity, abundance and complexity was highly variable throughout the Study Area. While many common and widespread species were shared between sites, a number of species were recorded at only one or few sites, particularly due to the variable presence and abundance of vegetation between sites.

The family Rallidae was the most abundant family, with 1,103 records from three species; however, it should be noted that 1,101 of the records were from one flock of Eurasian coots (*Fulica atra*) observed at Ophthalmia Dam. The most diverse families were the family Megapodidae (honeyeaters and allies) and family Accipitridae (hawks, eagles and kites) with 11 species recorded each from a total of 326 and 57 records, respectively. The most commonly occurring bird species, which were recorded at all eight trapping sites as well as multiple opportunistic sites, were zebra finch (*Taeniopygia guttata* subsp. *castanotis*) and budgerigar (*Melopsittacus undulatus*).

The number of individual records captured from each systematic trapping site varied, with VOPN-003 recording the highest with 318 individual records, followed by VOPN-007 with 286 individual records. The number of records at three of the sites (VOPN-001, VOPN-002 and VOPN-005) were similar, with between 217–229 individual records. The remaining sites (VOPN-004, VOPN-006 and VOPN-008) recorded significantly lower than all other sites with between 61-95 records. Species diversity also varied between trapping sites with VOPN-003 and VOPN-002 having the highest diversity (41 and 34 species respectively). VOPN-001, VOPN-004, VOPN-005 and VOPN-007 recorded similar number of species with 30, 26, 24, and 27 respectively. The two remaining sites (VOPN-006 and VOPN-008) recorded the lowest species diversity, with 17 and 16 species respectively.

Many species were recorded from opportunistic records within the Study Area, with 87 species recorded from 756 records, 27 species of which were not recorded at trapping sites. Additionally, 32 species from 235 records were recorded via acoustic recorders not deployed at trapping sites, some of which had not been recorded by any other sampling method.

Three significant bird species listed as Migratory under the EPBC/BC Act were recorded within the Study Area during the survey; common sandpiper (*Actitis hypoleucos*), fork-tailed swift (*Apus pacificus*), and glossy ibis (*Plegadis falcinellus*) (Table 5.5; Figure 5.3).

Reptiles

A total of 59 reptile species representing ten families were recorded from 465 individual records (Appendix H). Skinks were the most abundant group with 215 individual records, representing 19 species, followed by the family Diplodactylidae (geckos) with seven species from 56 individual records. The remaining families were represented by six or fewer species (Appendix H). The most commonly recorded species was a skink (*Ctenotus inornatus*), recorded 125 times from eight sites, including all but one trapping site.

Species diversity was relatively similar between trapping sites with the number of species ranging between eight and 19 species, whereas abundance varied between all trapping sites, with the number of individual records ranging from 30 to 86. The highest species diversity was recorded at VOPN-005 with 19 species, followed by VOPN-007, VOPN-001 and VOPN-004, recording 18, 17 and 16 species, respectively. Highest abundance of reptiles was recorded at site VOPN-004 with 86 individual records, followed by VOPN-001 with 77 records. The lowest species diversity and abundance was recorded at site VOPN-003 with 30 individual records representing eight species. Additionally, 22 species from 38 individual records were recorded opportunistically during the field survey, some of which were not recorded at sampling sites.

No significant reptile species were recorded during the current survey.

Amphibians

Four amphibian species were recorded in the Study Area, none of which are of significance (Appendix H). Amphibian records were from two trapping sites, VOPN-003 (Major Drainage Line) and VOPN-005 (Gorge/ Gully) and opportunistic records within the Study Area. Little red tree frog (*Litoria rubella*) was recorded at both trapping sites, with the highest number of records for this species recorded at VOPN-003 with 57 records, while only one individual was recorded at VOPN-005. The species was observed an additional five times from opportunistic records within the Study Area. The remaining three amphibian species were all recorded at VOPN-003 comprising; shoemaker frog (*Neobatrachus sutor*), centralian burrowing frog (*Platyplectrum spenceri*) and Pilbara toadlet (*Uperoleia saxatilis*).

No significant frog species have the potential to occur within the Study Area.

Table 5.5: Fauna of conservation significance recorded during the current survey

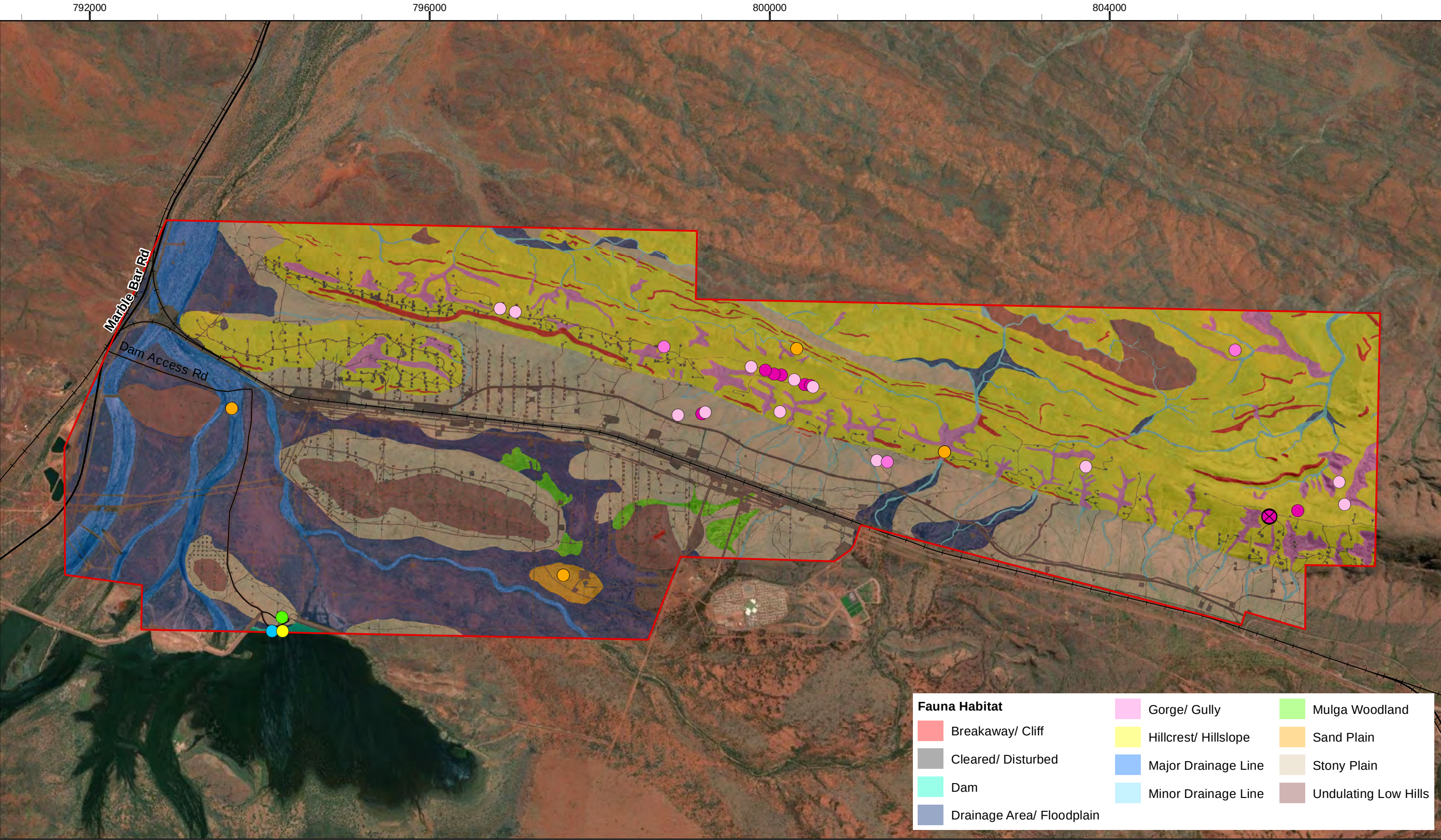
Common Name (Scientific Name)	Site	Location		Habitat	Record Type	No. Records
		Latitude	Longitude			
Pilbara leaf-nosed bat (<i>Rhinonictis aurantia</i>)	VOPN-001	-23.3335	119.9100	Sand Plain	Ultrasonic recording	2 calls at 0144
	VOPN-001	-23.3335	119.9100	Sand Plain	Ultrasonic recording	3 calls at 2024
	VOPN-001	-23.3335	119.9100	Sand Plain	Ultrasonic recording	29 calls between 2226 and 0218
	VOPN-003	-23.3166	119.8715	Major Drainage Line	Ultrasonic recording	8 calls
	VOPN-003	-23.3166	119.8715	Major Drainage Line	Ultrasonic recording	4 calls
	VOPN-003	-23.3166	119.8715	Major Drainage Line	Ultrasonic recording	18 calls
	VOPN-005	-23.3197	119.9535	Gorge/ Gully	Ultrasonic recording	3 calls at 0432
	VOPN-005	-23.3197	119.9535	Gorge/ Gully	Ultrasonic recording	4 calls between 2055 and 0500
	VOPN-005	-23.3197	119.9535	Gorge/ Gully	Ultrasonic recording	25 calls
	VOPN-005	-23.3197	119.9535	Gorge/ Gully	Ultrasonic recording	21 calls
	VOPN-005	-23.3197	119.9535	Gorge/ Gully	Ultrasonic recording	18 calls
	VOPN-095	-23.3090	119.9363	Minor Drainage Line	Ultrasonic recording	1 call
	VOPN-095	-23.3090	119.9363	Minor Drainage Line	Ultrasonic recording	4 calls
western pebble-mound mouse (<i>Pseudomys chapmani</i>)	OPP	-23.3054	119.9021	Hillcrest/ Hillslope	Mound (inactive)	1
	OPP	-23.3057	119.9039	Hillcrest/ Hillslope	Mound (inactive)	1
	OPP	-23.3209	119.9698	Hillcrest/ Hillslope	Mound (inactive)	1
	OPP	-23.3251	119.9943	Hillcrest/ Hillslope	Mound (active)	1
	OPP	-23.3243	119.9996	Hillcrest/ Hillslope	Mound (inactive)	1
	OPP	-23.3128	119.9373	Hillcrest/ Hillslope	Mound (active)	1
	OPP	-23.3118	119.9346	Hillcrest/ Hillslope	Mound (active)	1
	OPP	-23.3129	119.9379	Hillcrest/ Hillslope	Mound (active)	1

Common Name (Scientific Name)	Site	Location		Habitat	Record Type	No. Records
		Latitude	Longitude			
	OPP	-23.3117	119.9338	Hillcrest/ Hillslope	Mound (active)	1
	OPP	-23.3114	119.9328	Hillcrest/ Hillslope	Mound (active)	1
	OPP	-23.3157	119.9345	Hillcrest/ Hillslope	Mound (inactive)	1
	OPP	-23.3207	119.9458	Stony Plain	Mound (inactive)	1
	OPP	-23.3130	119.9382	Hillcrest/ Hillslope	Mound (inactive)	1
	OPP	-23.3123	119.9361	Cleared/ Disturbed	Mound (inactive)	1
	OPP	-23.3111	119.9311	Hillcrest/ Hillslope	Mound (inactive)	1
	OPP	-23.3208	119.9470	Stony Plain	Mound (recently inactive)	1
	OPP	-23.3091	119.9210	Hillcrest/ Hillslope	Mound (recently inactive)	1
	OPP	-23.3220	119.9989	Hillcrest/ Hillslope	Mound (inactive)	1
	OPP	-23.3082	119.9867	Hillcrest/ Hillslope	Mound (recently inactive)	1
	VOPN-004	-23.3163	119.9228	Stony Plain	Mound (inactive)	1
	VOPN-006	-23.3258	119.9910	Hillcrest/ Hillslope	Individual (alive)	1
	VOPN-045	-23.3161	119.9255	Stony Plain	Mound (active)	1
	VOPN-045	-23.3160	119.9259	Stony Plain	Mound (inactive)	1
common sandpiper (<i>Actitis hypoleucos</i>)	VOPN-042	-23.3401	119.8779	Dam	Individual (alive)	1
fork-tailed swift (<i>Apus pacificus</i>)	VOPN-042	-23.3397	119.8778	Drainage Area/ Floodplain	Individual (alive)	3
glossy ibis (<i>Plegadis falcinellus</i>)	VOPN-042	-23.3401	119.8779	Dam	Individual (alive)	4

5.4 Significant Fauna Species

A total of 41 significant species have the potential to occur within the Study Area, based on the results of the desktop assessment (refer to Section 3.2), comprising; ten mammals, 27 birds and four reptiles (refer to Table 3.3). Of the 41 significant species identified, 18 species have previously been recorded within the Study Area, comprising four mammals (brush-tailed mulgara, ghost bat, western pebble-mound mouse and Pilbara leaf-nosed bat), 13 bird species (grey falcon, gull-billed tern, caspian tern, common sandpiper, sharp-tailed sandpiper, red-necked stint, black-tailed godwit, wood sandpiper, common greenshank, marsh sandpiper, long-toed stint and glossy ibis) and two reptile species (Pilbara olive python and Pilbara flat-headed blind snake) (Table 5.6; Figure 3.1).

Five significant species were recorded within the Study Area during the current survey, Pilbara leaf-nosed bat, western pebble-mound mouse, common sandpiper, fork-tailed swift and glossy ibis (Table 5.5; Figure 5.3). No additional species were deemed Highly Likely to occur within the Study Area; however, one species was deemed Likely to occur and 15 were deemed Possible (Table 5.6). The remaining six were considered Unlikely to occur (Table 5.6). The occurrence of those significant species which are MNES, and a focus of this assessment, is discussed in further detail below (Section 5.4.1). The occurrence of other significant species which have either been Confirmed as occurring in the Study Area or are considered Likely, or to Possibly occur, is also discussed in more detail (Section 5.4.2 to 5.4.5). Due to ecological similarities and shared habitat preferences, particularly where species' occurrence within the Study Area is similar, some species are discussed together rather than individually (i.e. Migratory shorebirds and waterbirds). Consideration for some species as Unlikely or Highly Unlikely to occur within the Study Area is generally based on the absence of suitable habitat for the species and/or the Study Area occurring outside the known distribution for the species (Table 5.6).



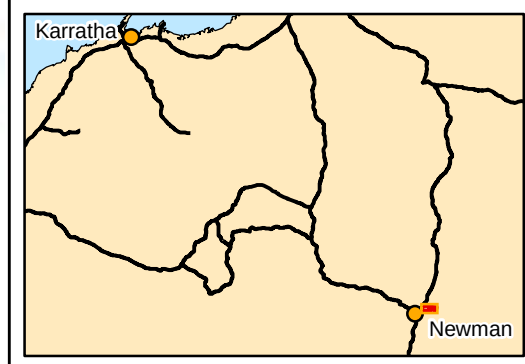
LEGEND

Study Area	Significant Fauna	Pilbara leaf-nosed bat (VU) - Ultrasonic Recorder (call)	Mound (active)
Local Road	Common sandpiper (MI) - Individual (alive)	Mound (recently inactive)	Mound (inactive)
State Road	Glossy ibis (MI) - Individual (alive)	Western pebble-mound mouse (P4)	
Rail	Pacific swift (MI) - Individual (alive)	Individual (alive)	

Scale: 1:42,500

0 1 2 Km

Coordinate System: GDA2020 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA2020
Created 15/12/2022



BHP WAIO
East Ophthalmia and Ninga
Detailed Vertebrate
Fauna Survey

Figure 5.3: Significant fauna
recorded in the Study Area

Table 5.6: Significant species likelihood assessment

Genus and Species	Conservation Status				Preferred Broad Habitats	Nearest Record to the Study Area	Potential Habitat Within the Study Area^										Likelihood of Occurrence within the Study Area	Occurrence within the Study Area	Comments	
	EPBC Act	BC Act	DBCA	IUCN			Hillcrest/ Hillslope	Stony Plain	Drainage Area/ Floodplain	Undulating Low Hills	Major Drainage Line	Gorge/ Gully	Minor Drainage Line	Breakaway/ Cliff	Mulga Woodland	Sand Plain				Dam
MAMMALS																				
DASYURIDAE																				
brush-tailed mulgara <i>(Dasyercus blythi)</i>			P4		Prefers spinifex <i>Triodia</i> spp. grasslands on sand plains and the swales between low dunes (Pavey <i>et al.</i> , 2012; Woolley, 2006). Mature spinifex hummocks appear to be important for protection from introduced predators (Körtner <i>et al.</i> , 2007).	5 records within Study Area (2013) (BHP WAI0, 2022a)		•	•							•		Confirmed	Resident	Known to occur as a resident in Sand Plain, Stony Plain and Drainage Area/ Floodplain habitats, particularly where suitable substrates permitting burrow excavation occur.
northern quoll <i>(Dasyurus hallucatus)</i>	EN	EN		EN	The species tends to inhabit rocky habitats which offer protection from predators and are generally more productive in terms of availability of resources (Braithwaite & Griffiths, 1994) (Oakwood, 2000). Other Microhabitat features important to the species include rock cover, proximity to permanent water and time-since last fire (Woinarski <i>et al.</i> , 2008).	~3 km east (2021) (BHP WAI0, 2022a)	S				C	C	S	C				Possible	Infrequent visitor	Critical denning/shelter habitat present in Gorge/ Gully and Breakaway/ Cliff habitat. May occur in Hillcrest/ Hillslope habitat of the Study Area to forage and/or for dispersal, particularly when occurring near suitable denning/shelter habitat. Major Drainage Line and Minor Drainage Line habitats may provide dispersal corridors. The extent of these habitats within the Study Area is limited; however, they form part of larger continuations of the habitat beyond the extent of the Study Area, therefore, may potentially act as foraging and/or dispersal corridors where connectivity to other areas of critical habitat is provided.
long-tailed dunnart <i>(Antechinomys longicaudata)</i>			P4		Typically occurs on near breakaways and scree slopes, and on rugged boulder-strewn scree slopes (Burbidge <i>et al.</i> , 2008). Once considered rare but now shown to be relatively common and widespread in rocky habitats (Burbidge <i>et al.</i> , 2008).	4 records ~20 km west (1997) (DBCA, 2022b)	•	•								•		Possible	Resident	May occur as a resident in Stony Plain, Breakaway/ Cliff and Hillcrest/ Hillslope habitats.
MACROPODIDAE																				
spectacled hare-wallaby <i>(Lagorchestes conspicillatus</i> subsp. <i>leichardti)</i>			P4		Inhabits spinifex hummock grasslands and Acacia shrublands (van Dyck & Strahan, 2008; Woinarski <i>et al.</i> , 2014).	~26 km southeast (1997) (DBCA, 2022b)												Unlikely	N/A	Suitable habitat within Study Area relatively small, fragmented and isolated from other areas of suitable habitat outside of Study Area (i.e. extent within Study Area unlikely to support a population).
black-flanked rock-wallaby <i>(Petrogale lateralis</i> subsp. <i>lateralis)</i>	EN	EN		NT	Rocky habitats, including gorges and gullies or outcrops with sufficient shelter habitat. Often vegetated with <i>Acacia</i> thickets and open low eucalypt woodlands with an understorey of grasses and low shrubs (Willers <i>et al.</i> , 2011).	2 records ~7 km north (1975) (DBCA, 2022b)												Unlikely	N/A	Suitable habitats present in Gorge/ Gully and Breakaway/ Cliff habitat; however, records near the Study Area are historic, with no contemporary records within 40km in the last 47 years. Records may also represent erroneous identifications or locality information.



Genus and Species	Conservation Status				Preferred Broad Habitats	Nearest Record to the Study Area	Potential Habitat Within the Study Area^										Likelihood of Occurrence within the Study Area	Occurrence within the Study Area	Comments	
	EPBC Act	BC Act	DBCA	IUCN			Hillcrest/ Hillslope	Stony Plain	Drainage Area/ Floodplain	Undulating Low Hills	Major Drainage Line	Gorge/ Gully	Minor Drainage Line	Breakaway/ Cliff	Mulga Woodland	Sand Plain				Dam
MEGADERMATIDAE																				
ghost bat (<i>Macroderma gigas</i>)	VU	VU		VU	Ghost Bats roost in deep, complex caves beneath bluffs of low, rounded hills, granite rock piles and abandoned Mines (Armstrong & Anstee, 2000). These features often occur within habitats including gorge/gully, hill crest/ hill slope and low hills (Armstrong & Anstee, 2000). Forages broadly across habitats, particularly woodland and open woodland habitats, including eucalypt and Mulga woodlands (Biologic, 2020b; Richards <i>et al.</i> , 2008; Tidemann <i>et al.</i> , 1985; TSSC, 2016a).	Multiple records (calls and individuals sighted) within Study Area (2022) (Biologic, 2023b)		C ¹	C ¹		C ¹	C ²	C ¹	C ²	C ¹			Confirmed	Resident	Critical foraging habitat within the Study area includes Stony Plain, Drainage Area/ Floodplain, Major Drainage Line, Minor Drainage Line and Mulga Woodland, when proximal to (<12 km) from critical roosting habitat (i.e. CNIM-03). Occurrence of habitats >12 from critical roosts likely to provide supporting foraging and dispersal habitat. Likely to utilise Major Drainage Line and Minor Drainage Line habitat to disperse. Note 1: Critical foraging habitat within the broad habitat types is only when proximal (<12km) from critical roosting habitat. Occurrence of one critical Category 2 roost within the Study Area (CNIM-03) renders all but a small portion (i.e. all but areas within ~2.5 km from western edge) as critical foraging habitat. Note2: Only Category 1, 2 and 3 (when found in an apartment block) caves associated with these habitat types are considered critical; the broad habitat itself is not critical. One Category 2 roost has been recorded in the eastern portion of the Study Area (CNIM-03) and numerous Category 3 roosts are known to occur (Table 5.2). None of the Category 3 roosts recorded within the Study Area occur as part of an apartment block with a Category roost, therefore are not considered critical habitat.
MURIDAE																				
western pebble-mound mouse (<i>Pseudomys chapmani</i>)			P4		This species occurs on the gentler slopes of rocky ranges where the ground is covered with a stony mantle and vegetated by hard spinifex, often with a sparse overstorey of eucalypts and scattered shrubs (Anstee, 1996; Start <i>et al.</i> , 2000).	54 records within Study Area (most recent 2022) (BHP WAIO, 2022a) (~94 records within 5 km of the Study Area)	•	•		•								Confirmed	Resident	Recorded 23 times during the current survey on undulating low hills within Hillcrest/ Hillslope and Stony Plain habitats. 22 records were from secondary evidence (pebble mounds), including seven active mounds, three recently inactive mounds and twelve inactive mounds. One live individual was captured during systematic trapping. Likely to occur as a resident throughout Study Area where suitable stony habitat present.
NOTORYCTIDAE																				
northern marsupial mole (<i>Notoryctes caurinus</i>)			P4		Inhabits sand dunes and, to a lesser extent, adjacent swales where there is suitable deep, loose sand. Trenching surveys have shown that potential habitat appears to be simply described as aeolian dunes (Woinarski et al., 2014).	~45 km southeast (2010) (DBCA, 2022b)												Unlikely	N/A	Suitable habitat not present.



Genus and Species	Conservation Status				Preferred Broad Habitats	Nearest Record to the Study Area	Potential Habitat Within the Study Area^										Likelihood of Occurrence within the Study Area	Occurrence within the Study Area	Comments	
	EPBC Act	BC Act	DBCA	IUCN			Hillcrest/ Hillslope	Stony Plain	Drainage Area/ Floodplain	Undulating Low Hills	Major Drainage Line	Gorge/ Gully	Minor Drainage Line	Breakaway/ Cliff	Mulga Woodland	Sand Plain				Dam
RHINONYCTERIDAE																				
Pilbara leaf-nosed bat (<i>Rhinonictis aurantia</i> (Pilbara form))	VU	VU			Species roosts within caves and abandoned Mines with high humidity (95%) and temperature (32°C) (Armstrong, 2001). Species forages in caves and along waterbodies with fringing vegetation (TSSC, 2016b).	Within Study Area (2022) (Biologic, 2023b)	S HR= 2	S HR= 2	S HR= 2	S HR= 2	S HR= 4	C ³ / S HR= 4	S HR= 2	C ³ / S HR= 4	S HR= 2			Confirmed	Frequent visitor (foraging/ dispersal)	Recorded 13 times during the current survey from multiple ultrasonic calls in Gorge/ Gully, Major Drainage Line, Minor Drainage Line and Sand Plain habitat. Individuals recorded likely dispersing from known Category 2 roost at Kalgan Creek located approximately 14.5 km northwest of the Study Area. Only Category 1–3 caves associated with the habitat type are considered critical; the broad habitat itself is not considered critical. Caves recorded within Study Area categorised as Category 4 only (Bat Call, 2021b) (Table 5.2). Likely to utilise Major Drainage Line and Minor Drainage Line habitat to disperse. Habitat rating (HR; as defined by Bat Call (2021b) of supporting foraging habitat within the Study Area ranges from very high (4) to moderate (2). Occurrence likely to be limited and influenced by the proximity of the Study Area to suitable roost caves.
THYLACOMYIDAE																				
greater bilby (<i>Macrotis lagotis</i>)	VU	VU		VU	Variety of habitats including spinifex hummock grassland and <i>Acacia</i> shrubland, on soft soils (Burrows <i>et al.</i> , 2012). In the Pilbara often associated with major drainage line sandy terraces (How <i>et al.</i> , 1991).	~9 km southwest (1979) (DBCA, 2022b)												Unlikely	N/A	Critical breeding and foraging/dispersal habitat present within Sand Plain habitat; however, its occurrence and extent within the Study Area is relatively limited and isolated from other areas of suitable habitat, therefore is unlikely to support the species.
AVES																				
ACANTHIZIDAE																				
southern whiteface (<i>Aphelocephala leucopsis</i>)	VU				Occupies a wide range of open woodlands and shrublands with grass and/or shrub dominated understory (DCCEEW, 2023a). Vegetation is often dominated by <i>Acacia</i> or <i>Eucalyptus/ Corymbia</i> species on ranges, foothills and lowlands, and plains (DCCEEW, 2023a). Forages almost exclusively on the ground, favouring areas with low tree density and herbaceous understory litter cover (DCCEEW, 2023a).	~4.8 km south (2020) (BHP WAIO, 2022a)			C		C		C		C			Possible	Resident	May occur within Drainage Area/ Floodplain, Major Drainage, Minor Drainage Line and Mulga Woodland habitats where suitable vegetation cover and structure are present, which provide breeding, forging and dispersal habitat.



Genus and Species	Conservation Status				Preferred Broad Habitats	Nearest Record to the Study Area	Potential Habitat Within the Study Area^										Likelihood of Occurrence within the Study Area	Occurrence within the Study Area	Comments	
	EPBC Act	BC Act	DBCA	IUCN			Hillcrest/ Hillslope	Stony Plain	Drainage Area/ Floodplain	Undulating Low Hills	Major Drainage Line	Gorge/ Gully	Minor Drainage Line	Breakaway/ Cliff	Mulga Woodland	Sand Plain				Dam
ANATIDAE																				
garganey (<i>Anas querquedula</i>)	MI	MI			Garganey is small teal. This duck is a rare visitor to Australia recorded from lakes and inland waterbodies (Johnstone & Storr, 1998).	~9.1 km southeast (2013) (DBCA, 2022b)			•		•						•	Possible	Infrequent visitor	Occurrence of species within Study Area is likely to be attributed to the larger extent of Dam habitat and other areas of suitable habitat adjacent to the Study Area, therefore occurrence within the Study Area is likely to be infrequent. May occasionally occur in larger water bodies found within Major Drainage Line habitat to forage. Majority of water bodies within Major Drainage Line habitat are ephemeral only, however few are persistent. Drainage Area/ Floodplain habitat may be utilised following large rainfall events (or dam overflow) and subsequent inundation, however habitat usage would be seasonal and only used when water present. Most of the Study Area is not suitable habitat for the species.
APODIDAE																				
fork-tailed swift (<i>Apus pacificus</i>)	MI	MI			Inhabits dry/open habitats, inclusive of riparian woodlands and tea-tree swamps, low scrub, heathland or saltmarsh, as well as treeless grassland and sandplains covered with spinifex, open farmland and inland and coastal sand-dunes (Johnstone & Storr, 1998). Almost exclusively aerial.	~9.3 km east (2013) (BHP WAIO, 2022a)	•	•	•	•	•	•	•	•	•	•	•	Confirmed	Infrequent visitor (foraging/ migration only)	Three individuals recorded during the current survey within Drainage Area/ Floodplain habitat. May occasionally occur within the airspace above the Study Area to forage, unlikely to land or nest within Study Area.
CHARADRIIDAE																				
little-ringed plover (<i>Charadrius veredus</i>)	MI	MI			Bare or sparsely vegetated sandy and pebbly shores of shallow standing freshwater pools, lakes or slow-flowing rivers. Also found in artificial habitats including gravel pits, sewage works, industrial wastelands and rubbish tips (BirdLife International, 2016).	~800 m south (2014) (BHP WAIO, 2022a)			•		•						•	Possible	Infrequent visitor	Occurrence of species within Study Area is likely to be attributed to the larger extent of Dam habitat and other areas of suitable habitat adjacent to the Study Area, therefore occurrence within the Study Area is likely to be infrequent. May occasionally occur in larger water bodies found within Major Drainage Line habitat to forage. Majority of water bodies within Major Drainage Line habitat are ephemeral only, however few are persistent. Drainage Area/ Floodplain habitat may be utilised following large rainfall events (or dam overflow) and subsequent inundation, however habitat usage would be seasonal and only used when water present. Most of the Study Area is not suitable habitat for the species.
oriental plover (<i>Charadrius veredus</i>)	MI	MI			A variety of habitats, including coastal habitats, such as estuarine mudflats and sandbanks, on sandy or rocky ocean beaches as well as open inland environments such as, semi-arid or arid grasslands, where the grass is short and sparse (Johnstone & Storr, 2004).	~14 km southwest (1981) (DBCA, 2022b)			•		•						•	Possible	Infrequent visitor	Occurrence of species within Study Area is likely to be attributed to the larger extent of Dam habitat and other areas of suitable habitat adjacent to the Study Area, therefore occurrence within the Study Area is likely to be infrequent. May occasionally occur in larger water bodies found within Major Drainage Line habitat to forage. Majority of water bodies within Major Drainage Line habitat are ephemeral only, however few are persistent. Drainage Area/ Floodplain habitat may be utilised following large rainfall events (or dam overflow) and subsequent inundation, however habitat usage would be seasonal and only used

Genus and Species	Conservation Status				Preferred Broad Habitats	Nearest Record to the Study Area	Potential Habitat Within the Study Area [^]											Likelihood of Occurrence within the Study Area	Occurrence within the Study Area	Comments
	EPBC Act	BC Act	DBCA	IUCN			Hillcrest/ Hillslope	Stony Plain	Drainage Area/ Floodplain	Undulating Low Hills	Major Drainage Line	Gorge/ Gully	Minor Drainage Line	Breakaway/ Cliff	Mulga Woodland	Sand Plain	Dam			
																				when water present. Most of the Study Area is not suitable habitat for the species.
CICONIIDAE																				
black-necked stork (<i>Ephippiorhynchus asiaticus</i>)				NT	Found along the northern coast and in coastal waters, and occasionally but rarely inland on larger rivers. Also occurs in tidal creeks and mudflats, saltwork ponds, and river pools (Johnstone <i>et al.</i> , 2013).	~14 km southwest (2003) (BirdLife Australia, 2022)			•		•						•	Possible	Infrequent visitor	Occurrence of species within Study Area is likely to be attributed to the larger extent of Dam habitat and other areas of suitable habitat adjacent to the Study Area, therefore occurrence within the Study Area is likely to be infrequent. May occasionally occur in larger water bodies found within Major Drainage Line habitat to forage. Majority of water bodies within Major Drainage Line habitat are ephemeral only, however few are persistent. Drainage Area/ Floodplain habitat may be utilised following large rainfall events (or dam overflow) and subsequent inundation, however habitat usage would be seasonal and only used when water present. Most of the Study Area is not suitable habitat for the species.
FALCONIDAE																				
grey falcon (<i>Falco hypoleucos</i>)	VU	VU		VU	Timbered lowlands, particularly Acacia shrubland and along inland drainage systems. Also frequent spinifex and tussock grassland (Burbidge <i>et al.</i> , 2010; Olsen & Olsen, 1986).	Within Study Area (2013) (BHP WAI0, 2022a)					C		S				S	Confirmed	Infrequent visitor	Likely to occur within the Study Area to forage, particularly within Major Drainage Line, Minor Drainage Line and Dam habitat and, to a lesser extent, other habitats more broadly. Frequency of visitation likely to vary depending on proximity of nesting location within or in vicinity of Study Area. Nesting may occur within Study Area where suitable tall infrastructure (i.e. powerline or transmission towers) occurs and along Major Drainage Line habitat where suitable tall trees present.
peregrine falcon (<i>Falco peregrinus</i>)		OS			In arid areas, it is most often encountered along cliffs above rivers, ranges and wooded watercourses where it hunts birds (Johnstone & Storr, 1998). It typically nests on rocky ledges occurring on tall, vertical cliff faces between 25 m and 50 m high (Olsen <i>et al.</i> , 2004; Olsen & Olsen, 1989).	~5 km west (2013) (BHP WAI0, 2022a)	•	•	•			•		•				Likely	Infrequent visitor	Likely to occur within the Study Area to forage, particularly within Hillcrest/ Hillslope habitat and, to a lesser extent, other habitats more broadly. Frequency of visitation may vary depending on proximity of nesting sites in the vicinity of the Study Area. Nesting may occur within Gorge/Gully and Breakaway/ Cliff habitat and instances of breakaway within Hillcrest/ Hillslope habitat
HIRUNDINIDAE																				
barn swallow (<i>Hirundo rustica</i>)	MI	MI			The Barn Swallow is a non-breeding summer visitor to the Pilbara. It favours areas near water (Johnstone <i>et al.</i> , 2013).	~300 m south (2014) (BHP WAI0, 2022a)			•		•						•	Possible	Infrequent visitor	May occasionally occur within Major Drainage Line and Dam habitat to forage. Drainage Area/ Floodplain habitat may be utilised following large rainfall events (or dam overflow) and subsequent inundation, however habitat usage would be seasonal and only used when water present. Most of the Study Area is not suitable habitat for the species.



Genus and Species	Conservation Status				Preferred Broad Habitats	Nearest Record to the Study Area	Potential Habitat Within the Study Area^											Likelihood of Occurrence within the Study Area	Occurrence within the Study Area	Comments
	EPBC Act	BC Act	DBCA	IUCN			Hillcrest/ Hillslope	Stony Plain	Drainage Area/ Floodplain	Undulating Low Hills	Major Drainage Line	Gorge/ Gully	Minor Drainage Line	Breakaway/ Cliff	Mulga Woodland	Sand Plain	Dam			
LARIDAE																				
gull-billed tern (<i>Gelochelidon nilotica</i>)	MI	MI			Shallow sheltered seas close to land, estuaries, tidal creeks; and inundated samphire flats, flooded salt lakes, claypans and watercourses in the interior (Johnstone & Storr, 1998).	2 records within Study Area (1999, 2006) (DBCA, 2022b)			•		•						•	Confirmed	Infrequent visitor	Occurrence of species within Study Area is likely to be attributed to the larger extent of Dam habitat and other areas of suitable habitat adjacent to the Study Area, therefore occurrence within the Study Area is likely to be infrequent. May occasionally occur in larger water bodies found within Major Drainage Line habitat to forage. Majority of water bodies within Major Drainage Line habitat are ephemeral only, however few are persistent. Drainage Area/ Floodplain habitat may be utilised following large rainfall events (or dam overflow) and subsequent inundation, however habitat usage would be seasonal and only used when water present. Most of the Study Area is not suitable habitat for the species.
caspian tern (<i>Sterna caspia</i>)	MI	MI			Mainly sheltered seas, estuaries and tidal creeks; occasionally near-coastal salt lakes (including saltwork ponds) and brackish pools in lower courses of rivers; rarely fresh water (Johnstone & Storr, 1998).	Within Study Area (2008) (DBCA, 2022b)			•		•						•	Confirmed	Infrequent visitor	Occurrence of species within Study Area is likely to be attributed to the larger extent of Dam habitat and other areas of suitable habitat adjacent to the Study Area, therefore occurrence within the Study Area is likely to be infrequent. May occasionally occur in larger water bodies found within Major Drainage Line habitat to forage. Majority of water bodies within Major Drainage Line habitat are ephemeral only, however few are persistent. Drainage Area/ Floodplain habitat may be utilised following large rainfall events (or dam overflow) and subsequent inundation, however habitat usage would be seasonal and only used when water present. Most of the Study Area is not suitable habitat for the species.
MOTACILLIDAE																				
yellow wagtail (<i>Motacilla flava</i>)	MI	MI			An uncommon but regular visitor to the Pilbara region (Johnstone <i>et al.</i> , 2013). Occupies a range of damp or wet habitats with low vegetation although favours edges of fresh water, especially sewage ponds (Johnstone & Storr, 2004).	~230 km north (2010) (BirdLife Australia, 2022)			•		•						•	Possible	Infrequent visitor	Occurrence of species within Study Area is likely to be attributed to the larger extent of Dam habitat and other areas of suitable habitat adjacent to the Study Area, therefore occurrence within the Study Area is likely to be infrequent. May occasionally occur in larger water bodies found within Major Drainage Line habitat to forage. Majority of water bodies within Major Drainage Line habitat are ephemeral only, however few are persistent. Drainage Area/ Floodplain habitat may be utilised following large rainfall events (or dam overflow) and subsequent inundation, however habitat usage would be seasonal and only used when water present. Most of the Study Area is not suitable habitat for the species.
PSITTACIDAE																				
night parrot (<i>Pezoporus occidentalis</i>)	EN	CR		EN	The Night Parrot prefers sandy/stony plain habitat with old-growth spinifex for roosting and nesting in conjunction with native grasses and herbs for foraging (DPaW, 2017).	~140 km northwest (2010) (DBCA, 2022a)												Unlikely	N/A	While there are occurrences of larger <i>Triodia</i> hummocks within the Study Area, their occurrence is relatively limited and isolated in extent and unlikely to support the species.



Genus and Species	Conservation Status				Preferred Broad Habitats	Nearest Record to the Study Area	Potential Habitat Within the Study Area^											Likelihood of Occurrence within the Study Area	Occurrence within the Study Area	Comments	
	EPBC Act	BC Act	DBCA	IUCN			Hillcrest/ Hillslope	Stony Plain	Drainage Area/ Floodplain	Undulating Low Hills	Major Drainage Line	Gorge/ Gully	Minor Drainage Line	Breakaway/ Cliff	Mulga Woodland	Sand Plain	Dam				
ROSTRATULIDAE																					
Australian painted snipe (<i>Rostratula benghalensis</i> subsp. <i>australis</i>)	EN	EN		EN	Generally, occupies shallow terrestrial freshwater wetlands (i.e. temporary and permanent lakes, swamps and claypans) with rank emergent tussocks of grass, sedges, rushes or reeds, or samphire (Johnstone & Storr, 1998)	~67 km north (2012) (BirdLife Australia, 2022)			•		•							•	Possible	Infrequent visitor	Occurrence of species within Study Area is likely to be attributed to the larger extent of Dam habitat and other areas of suitable habitat adjacent to the Study Area, therefore occurrence within the Study Area is likely to be infrequent. May occasionally occur in larger water bodies found within Major Drainage Line habitat to forage. Majority of water bodies within Major Drainage Line habitat are ephemeral only, however few are persistent. Drainage Area/ Floodplain habitat may be utilised following large rainfall events (or dam overflow) and subsequent inundation, however habitat usage would be seasonal and only used when water present. Most of the Study Area is not suitable habitat for the species.
SCOLOPACIDAE																					
common sandpiper (<i>Actitis hypoleucos</i>)	MI	MI			Estuaries and deltas of streams, as well as banks farther upstream; around lakes, pools, billabongs, reservoirs, dams and claypans (Geering <i>et al.</i> , 2007).	Within Study Area (2014) (BHP WAIO, 2022a)			•		•							•	Confirmed	Infrequent visitor	Occurrence of species within Study Area is likely to be attributed to the larger extent of Dam habitat and other areas of suitable habitat adjacent to the Study Area, therefore occurrence within the Study Area is likely to be infrequent. May occasionally occur in larger water bodies found within Major Drainage Line habitat to forage. Majority of water bodies within Major Drainage Line habitat are ephemeral only, however few are persistent. Drainage Area/ Floodplain habitat may be utilised following large rainfall events (or dam overflow) and subsequent inundation, however habitat usage would be seasonal and only used when water present. Most of the Study Area is not suitable habitat for the species.
sharp-tailed sandpiper (<i>Calidris acuminata</i>)	MI	MI			Favours flooded samphire flats and grasslands, mangrove creeks mudflats, beaches, river pools, saltwork ponds, sewage ponds and freshwater soaks (Johnstone <i>et al.</i> , 2013).	Within Study Area (2014) (BHP WAIO, 2022a)			•		•							•	Confirmed	Infrequent visitor	Occurrence of species within Study Area is likely to be attributed to the larger extent of Dam habitat and other areas of suitable habitat adjacent to the Study Area, therefore occurrence within the Study Area is likely to be infrequent. May occasionally occur in larger water bodies found within Major Drainage Line habitat to forage. Majority of water bodies within Major Drainage Line habitat are ephemeral only, however few are persistent. Drainage Area/ Floodplain habitat may be utilised following large rainfall events (or dam overflow) and subsequent inundation, however habitat usage would be seasonal and only used when water present. Most of the Study Area is not suitable habitat for the species.

Genus and Species	Conservation Status				Preferred Broad Habitats	Nearest Record to the Study Area	Potential Habitat Within the Study Area [^]											Likelihood of Occurrence within the Study Area	Occurrence within the Study Area	Comments
	EPBC Act	BC Act	DBCA	IUCN			Hillcrest/ Hillslope	Stony Plain	Drainage Area/ Floodplain	Undulating Low Hills	Major Drainage Line	Gorge/ Gully	Minor Drainage Line	Breakaway/ Cliff	Mulga Woodland	Sand Plain	Dam			
curlew sandpiper (<i>Calidris ferruginea</i>)	CR/ MI	CR/ MI		NT	Inhabits intertidal mudflats in sheltered coastal areas (i.e. estuaries, bays, inlets and lagoons) (Geering <i>et al.</i> , 2007). This rare species generally roosts on bare dry shingle, shell or sand beaches, sandspits and islets in or around coastal or near-coastal lagoons and other wetlands (Geering <i>et al.</i> , 2007).	~150 m south (2014) (2005) (DBCA, 2022b) ~800 m south (2014) (BHP WAIO, 2022a)			•		•						•	Possible	Infrequent visitor	Occurrence of species within Study Area is likely to be attributed to the larger extent of Dam habitat and other areas of suitable habitat adjacent to the Study Area, therefore occurrence within the Study Area is likely to be infrequent. May occasionally occur in larger water bodies found within Major Drainage Line habitat to forage. Majority of water bodies within Major Drainage Line habitat are ephemeral only, however few are persistent. Drainage Area/ Floodplain habitat may be utilised following large rainfall events (or dam overflow) and subsequent inundation, however habitat usage would be seasonal and only used when water present. Most of the Study Area is not suitable habitat for the species.
pectoral sandpiper (<i>Calidris melanotos</i>)	MI	MI			Coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands (Johnstone & Storr, 2004; Johnstone <i>et al.</i> , 2013). It prefers wetlands with open fringing mudflats and low, emergent or fringing vegetation (Geering <i>et al.</i> , 2007)	~300 m south (2014) (BHP WAIO, 2022a)			•		•						•	Possible	Infrequent visitor	Occurrence of species within Study Area is likely to be attributed to the larger extent of Dam habitat and other areas of suitable habitat adjacent to the Study Area, therefore occurrence within the Study Area is likely to be infrequent. May occasionally occur in larger water bodies found within Major Drainage Line habitat to forage. Majority of water bodies within Major Drainage Line habitat are ephemeral only, however few are persistent. Drainage Area/ Floodplain habitat may be utilised following large rainfall events (or dam overflow) and subsequent inundation, however habitat usage would be seasonal and only used when water present. Most of the Study Area is not suitable habitat for the species.
red-necked stint (<i>Calidris ruficollis</i>)	MI	MI		NT	Lives in permanent or ephemeral wetlands of varying salinity, and also regularly at sewage farms and saltworks. They are recorded less often at reservoirs, waterholes, soaks, bore-drain swamps and flooded inland lakes. In Western Australia they prefer freshwater to marine environments. The species usually forages in shallow water at the edge of wetlands and roost or loaf on tidal mudflats, near low saltmarsh, and around inland swamps (Johnstone & Storr, 1998).	Within Study Area (2005) (DBCA, 2022b)			•		•						•	Confirmed	Infrequent visitor	Occurrence of species within Study Area is likely to be attributed to the larger extent of Dam habitat and other areas of suitable habitat adjacent to the Study Area, therefore occurrence within the Study Area is likely to be infrequent. May occasionally occur in larger water bodies found within Major Drainage Line habitat to forage. Majority of water bodies within Major Drainage Line habitat are ephemeral only, however few are persistent. Drainage Area/ Floodplain habitat may be utilised following large rainfall events (or dam overflow) and subsequent inundation, however habitat usage would be seasonal and only used when water present. Most of the Study Area is not suitable habitat for the species.

Genus and Species	Conservation Status				Preferred Broad Habitats	Nearest Record to the Study Area	Potential Habitat Within the Study Area [^]											Likelihood of Occurrence within the Study Area	Occurrence within the Study Area	Comments
	EPBC Act	BC Act	DBCA	IUCN			Hillcrest/ Hillslope	Stony Plain	Drainage Area/ Floodplain	Undulating Low Hills	Major Drainage Line	Gorge/ Gully	Minor Drainage Line	Breakaway/ Cliff	Mulga Woodland	Sand Plain	Dam			
long-toed stint (<i>Calidris subminuta</i>)	MI	MI			They prefer shallow freshwater or brackish wetlands but are also fond of muddy shorelines, growths of short grasses, weeds, sedges, low or floating aquatic vegetation, reeds, rushes and occasionally stunted samphire. The Long-toed Stint also frequents permanent wetlands and forages on wet mud or in shallow water, often among short grass, weeds and other vegetation on islets or around the edges of wetlands. They roost or loaf in sparse vegetation at the edges of wetlands and on damp mud near shallow water. It also roosts in small depressions in the mud (Johnstone & Storr, 1998).	2 records within Study Area (2001) (DBCA, 2022b) ~800 m south (2014) (BHP WAI0, 2022a)			•		•						•	Confirmed	Infrequent visitor	Occurrence of species within Study Area is likely to be attributed to the larger extent of Dam habitat and other areas of suitable habitat adjacent to the Study Area, therefore occurrence within the Study Area is likely to be infrequent. May occasionally occur in larger water bodies found within Major Drainage Line habitat to forage. Majority of water bodies within Major Drainage Line habitat are ephemeral only, however few are persistent. Drainage Area/ Floodplain habitat may be utilised following large rainfall events (or dam overflow) and subsequent inundation, however habitat usage would be seasonal and only used when water present. Most of the Study Area is not suitable habitat for the species.
black-tailed godwit (<i>Limosa limosa</i>)	MI	MI		NT	The species has a primarily coastal habitat environment. There are a few inland records, around shallow, freshwater and saline lakes, swamps, dams and bore-overflows. They also use lagoons in sewage farms and saltworks (Higgins & Davies, 1996)	Within Study Area (2014) (BHP WAI0, 2022a)			•		•						•	Confirmed	Infrequent visitor	Occurrence of species within Study Area is likely to be attributed to the larger extent of Dam habitat and other areas of suitable habitat adjacent to the Study Area, therefore occurrence within the Study Area is likely to be infrequent. May occasionally occur in larger water bodies found within Major Drainage Line habitat to forage. Majority of water bodies within Major Drainage Line habitat are ephemeral only, however few are persistent. Drainage Area/ Floodplain habitat may be utilised following large rainfall events (or dam overflow) and subsequent inundation, however habitat usage would be seasonal and only used when water present. Most of the Study Area is not suitable habitat for the species.
ruff (<i>Philomachus pugnax</i>)	MI	MI			Mainly fresh, brackish and saline wetlands with exposed mudflats. Found near lakes, swamps, pools, lagoons, tidal rivers and floodlands. Sometimes observed in sheltered coastal areas, including harbours and estuaries (DoEE, 2019).	~800 m south (2014) (BHP WAI0, 2022a)			•		•						•	Possible	Infrequent visitor	Occurrence of species within Study Area is likely to be attributed to the larger extent of Dam habitat and other areas of suitable habitat adjacent to the Study Area, therefore occurrence within the Study Area is likely to be infrequent. May occasionally occur in larger water bodies found within Major Drainage Line habitat to forage. Majority of water bodies within Major Drainage Line habitat are ephemeral only, however few are persistent. Drainage Area/ Floodplain habitat may be utilised following large rainfall events (or dam overflow) and subsequent inundation, however habitat usage would be seasonal and only used when water present. Most of the Study Area is not suitable habitat for the species.

Genus and Species	Conservation Status				Preferred Broad Habitats	Nearest Record to the Study Area	Potential Habitat Within the Study Area [^]											Likelihood of Occurrence within the Study Area	Occurrence within the Study Area	Comments
	EPBC Act	BC Act	DBCA	IUCN			Hillcrest/ Hillslope	Stony Plain	Drainage Area/ Floodplain	Undulating Low Hills	Major Drainage Line	Gorge/ Gully	Minor Drainage Line	Breakaway/ Cliff	Mulga Woodland	Sand Plain	Dam			
wood sandpiper (<i>Tringa glareola</i>)	MI	MI			Species occurs as a non-breeding summer migrant which occurs throughout the region. Occurs mainly in river pools, sewage ponds, flooded claypans, freshwater lagoons and bore overflows (Johnstone <i>et al.</i> , 2013).	2 records within Study Area (2014) (BHP WAIO, 2022a)			•		•						•	Confirmed	Infrequent visitor	Occurrence of species within Study Area is likely to be attributed to the larger extent of Dam habitat and other areas of suitable habitat adjacent to the Study Area, therefore occurrence within the Study Area is likely to be infrequent. May occasionally occur in larger water bodies found within Major Drainage Line habitat to forage. Majority of water bodies within Major Drainage Line habitat are ephemeral only, however few are persistent. Drainage Area/ Floodplain habitat may be utilised following large rainfall events (or dam overflow) and subsequent inundation, however habitat usage would be seasonal and only used when water present. Most of the Study Area is not suitable habitat for the species.
common greenshank (<i>Tringa nebularia</i>)	MI	MI			Species occurs as a non-breeding summer Migrant which occurs throughout the region. Occurs mainly in Tidal mudflats, mangrove creeks, flooded samphire flats, beaches, river pools, and saltworks and sewage ponds (Johnstone <i>et al.</i> , 2013).	2 records within Study Area (2014) (BHP WAIO, 2022a)			•		•						•	Confirmed	Infrequent visitor	Occurrence of species within Study Area is likely to be attributed to the larger extent of Dam habitat and other areas of suitable habitat adjacent to the Study Area, therefore occurrence within the Study Area is likely to be infrequent. May occasionally occur in larger water bodies found within Major Drainage Line habitat to forage. Majority of water bodies within Major Drainage Line habitat are ephemeral only, however few are persistent. Drainage Area/ Floodplain habitat may be utilised following large rainfall events (or dam overflow) and subsequent inundation, however habitat usage would be seasonal and only used when water present. Most of the Study Area is not suitable habitat for the species.
marsh sandpiper (<i>Tringa stagnatilis</i>)	MI	MI			Lives in permanent or ephemeral wetlands of varying salinity, and also regularly at sewage farms and saltworks. They are recorded less often at reservoirs, waterholes, soaks, bore-drain swamps and flooded inland lakes. In Western Australia they prefer freshwater to marine environments. The species usually forages in shallow water at the edge of wetlands and roost or loaf on tidal mudflats, near low saltmarsh, and around inland swamps (Johnstone & Storr, 1998).	Within Study Area (2014) (BHP WAIO, 2022a)			•		•						•	Confirmed	Infrequent visitor	Occurrence of species within Study Area is likely to be attributed to the larger extent of Dam habitat and other areas of suitable habitat adjacent to the Study Area, therefore occurrence within the Study Area is likely to be infrequent. May occasionally occur in larger water bodies found within Major Drainage Line habitat to forage. Majority of water bodies within Major Drainage Line habitat are ephemeral only, however few are persistent. Drainage Area/ Floodplain habitat may be utilised following large rainfall events (or dam overflow) and subsequent inundation, however habitat usage would be seasonal and only used when water present. Most of the Study Area is not suitable habitat for the species.

Genus and Species	Conservation Status				Preferred Broad Habitats	Nearest Record to the Study Area	Potential Habitat Within the Study Area [^]											Likelihood of Occurrence within the Study Area	Occurrence within the Study Area	Comments
	EPBC Act	BC Act	DBCA	IUCN			Hillcrest/ Hillslope	Stony Plain	Drainage Area/ Floodplain	Undulating Low Hills	Major Drainage Line	Gorge/ Gully	Minor Drainage Line	Breakaway/ Cliff	Mulga Woodland	Sand Plain	Dam			
common redshank (<i>Tringa totanus</i>)	MI	MI			It is found at sheltered coastal wetlands with bare open flats and banks of mud or sand. They are also found around salt lakes, freshwater lagoons, artificial wetlands and saltworks and sewage farms. The species has been observed feeding in shallow water, on wet bare mud or sand, or on algal deposits and roosting on small elevated areas such as estuarine sandbars and muddy islets surrounded by water (Johnstone & Storr, 1998).	~20 km southwest (2012) (DBCA, 2022b)			•		•						•	Possible	Infrequent visitor	Occurrence of species within Study Area is likely to be attributed to the larger extent of Dam habitat and other areas of suitable habitat adjacent to the Study Area, therefore occurrence within the Study Area is likely to be infrequent. May occasionally occur in larger water bodies found within Major Drainage Line habitat to forage. Majority of water bodies within Major Drainage Line habitat are ephemeral only, however few are persistent. Drainage Area/ Floodplain habitat may be utilised following large rainfall events (or dam overflow) and subsequent inundation, however habitat usage would be seasonal and only used when water present. Most of the Study Area is not suitable habitat for the species.
THRESKIORNITHIDAE																				
glossy ibis (<i>Plegadis falcinellus</i>)	MI	MI			Freshwater wetlands, irrigated areas, margins of dams, floodplains, brackish and saline wetlands, tidal mudflats, pastures, lawns and public gardens (Johnstone <i>et al.</i> , 2013).	3 records within Study Area (2014) (BHP WAI0, 2022a)			•		•						•	Confirmed	Occasional visitor	Occurrence of species within Study Area is likely to be attributed to the larger extent of Dam habitat and other areas of suitable habitat adjacent to the Study Area, therefore occurrence within the Study Area is likely to be infrequent. May occasionally occur in larger water bodies found within Major Drainage Line habitat to forage. Majority of water bodies within Major Drainage Line habitat are ephemeral only, however few are persistent. Drainage Area/ Floodplain habitat may be utilised following large rainfall events (or dam overflow) and subsequent inundation, however habitat usage would be seasonal and only used when water present. Most of the Study Area is not suitable habitat for the species.
REPTILES																				
PYTHONIDAE																				
Pilbara olive python (<i>Liasis olivaceus</i> subsp. <i>barroni</i>)	VU	VU			Associated with drainage systems, including areas with localised drainage and watercourses (Pearson, 1993). In the inland Pilbara the species is most often encountered near permanent waterholes in rocky ranges or among riverine vegetation (Pearson, 1993).	10 records within Study Area (2013, 2014, 2019) (BHP WAI0, 2022a)	S				C	C	S	C				Confirmed	Resident	Critical breeding, foraging and dispersal habitat is present within Major Drainage Line, Gorge/ Gully and Breakaway/ Cliff habitat. Likely to utilise Major Drainage Line and Minor Drainage Line habitat to disperse throughout Study Area.
SCINCIDAE																				
spotted Ctenotus (<i>Ctenotus uber</i> subsp. <i>johnstonei</i>)			P2		Within the Pilbara, the taxon is known from <i>Triodia</i> on hillslopes, <i>Acacia xiphophylla</i> over chenopods, and <i>Acacia xiphophylla</i> scattered tall shrubs to high open shrubland (Cogger, 2014).	~4.8 km south (2018) (DBCA, 2022b)	•	•	•						•			Possible	Resident	May occur in Stony Plain and lower slopes of Hillcrest/ Hillslope habitats. Taxonomic status of the disjunct Pilbara population unknown, may represent an undescribed taxon (P. Doughty, Western Australian Museum, <i>pers. comm.</i>).

Genus and Species	Conservation Status				Preferred Broad Habitats	Nearest Record to the Study Area	Potential Habitat Within the Study Area^											Likelihood of Occurrence within the Study Area	Occurrence within the Study Area	Comments
	EPBC Act	BC Act	DBCA	IUCN			Hillcrest/ Hillslope	Stony Plain	Drainage Area/ Floodplain	Undulating Low Hills	Major Drainage Line	Gorge/ Gully	Minor Drainage Line	Breakaway/ Cliff	Mulga Woodland	Sand Plain	Dam			
great desert skink (<i>Liopholis kintorei</i>)	VU	VU		VU	Occurs on sand plain and sand dune habitats, often comprising vegetation dominated by hummock grassland (<i>Triodia basedowii</i> and <i>T. schnizii</i>) and open shrubland (<i>Eremophila leucophylla</i> and <i>Acacia</i> species) on red sands, occasionally on gravelly undulating plain in some areas (Pearson et al., 2001). Preferred habitat appears to comprise at least 50% bare ground. The species appears to prefer a mosaic landscape comprising different aged post-fire vegetation regeneration and inhabits sites that have been burnt in the previous three to fifteen years (DoEE, 2019).	~45 km southeast (2012) (DBCA, 2022b)												Unlikely	N/A	Suitable habitat not present and Study Area outside the species current known range.
TYPHLOPIDAE																				
Pilbara flat-headed blind-snake (<i>Anilius ganei</i>)			P1		Little is known of the species' ecology, but it is often associated with moist soils and leaf litter within gorges and gullies (Wilson & Swan, 2021) and potentially within a wide range of other stony habitats. The species has been recorded from numerous habitats but is most likely to be present in rocky terrain and along drainage lines (DBCA, 2022a).	3 records within Study Area (2006, 2013) (BHP WAO, 2022a)	•					•		•				Confirmed	Resident	Likely to occur in Hillcrest/ Hillslope habitats, particularly where most substrates are present for prolonged periods.

^C = critical habitat (MNES threatened species only), S = supporting habitat (MNES threatened species only), • = important habitat (non-MNES threatened species)

5.4.1 EPBC Matters of National Environmental Significance

The sections below provide summaries on the Program Matters identified in the approved Program for BHP's Strategic Assessment (greater bilby, northern quoll, Pilbara leaf-nosed bat, ghost bat and Pilbara olive python) as well as the night parrot and grey falcon.

Northern Quoll (*Dasyurus hallucatus*) – Endangered (EPBC Act and BC Act)

The northern quoll tends to inhabit rocky habitats which offer protection from predators and are generally more productive in terms of availability of resources (Braithwaite & Griffiths, 1994; DoE, 2016; Oakwood, 2000). Other microhabitat features important to the species include: rock cover; proximity to permanent water and time-since last fire (Woinarski *et al.*, 2008).

Although the Study Area falls within the current distribution of the northern quoll, whereby the species or species habitat may occur (DoE, 2016), the species was not recorded during the current survey. Additionally, a targeted northern quoll survey conducted by Biologic (2022) in the adjacent and overlapping area earlier in 2022 (February–June) recorded no evidence of the species despite extensive sampling. The species is considered Possible to occur based on the presence of suitable critical habitat in areas within the Study Area and the occurrence of previous records in the vicinity of the Study Area. The nearest record of the species is located approximately 3 km east of the Study Area (at the recently rehabilitated waste dump Orebody 18) (BHP WAI0, 2022a), comprising a scat recorded on a recently rehabilitated waste dump in the area in August 2021 (Figure 3.1). The species has only been recorded a further five times within 50 km of the Study Area, with all other records located west of the Study Area at the Whaleback mine site and Western Ridge. The records from the Whaleback mine site were possibly representative of individuals which had been transported to the area, and the Western Ridge records are believed to be representative of historical and/or intermittent population presence, based on uncertainty regarding the potential preservation of scats collected from caves (Biologic, 2020c).

Within the Study Area, critical habitat for the species (i.e. denning/ shelter habitat as defined by DoE (2016)) occurs in Gorge/ Gully (3.74%, 219.00 ha) and Breakaway/ Cliff (1.56%, 91.65 ha) habitats. Gorge/ Gully and Breakaway/ Cliff habitats also provide critical foraging and dispersal habitat for the species. Hillcrest/ Hillslope (33.54%, 1,965.26 ha) habitat within the Study Area would likely be utilised by the species for dispersal, due to the habitat being adjacent to critical habitats (i.e. Gorge/ Gully and Breakaway/ Cliff habitats). Major Drainage Line (4.43%, 259.53 ha) and Minor Drainage Line (1.66%, 97.00 ha) habitats provide supporting dispersal habitat for the species. The extent of these habitats within the Study Area is limited; however, they form part of larger continuations of the habitat beyond the extent of the Study Area, therefore, may potentially act as foraging and/or dispersal corridors where connectivity to other areas of critical habitat is provided.

With the exception of the northern quoll record from the rehabilitated waste dump, approximately 3 km east of the Study Area, records of the species in the vicinity of the Study Area are sparse suggesting that the species' occurrence within the Study Area is extremely rare and it is unlikely a resident population occurs within the Study Area permanently. Due to the absence of any records of the species within the Study Area and the scarcity of records in the vicinity, the species occurrence within the Study Area is considered Possible; however, may be limited to infrequent visitations by dispersing individuals.

Greater Bilby (*Macrotis lagotis*) – Vulnerable (EPBC Act and BC Act)

Extant populations of the greater bilby occur in a variety of habitats, usually on landforms with level to low slope topography and light to medium soils (Southgate, 1990). Throughout its distribution, it occupies three major vegetation types: open tussock grassland on uplands and hills, hummock grassland in plains and alluvial areas and occasionally mulga woodland/shrubland growing on ridges and rises (Southgate, 1990). Within the Pilbara region the species is sparsely distributed, and often associated with spinifex sandplain habitat (Dziminski & Carpenter, 2016).

No records or evidence of occurrence of greater bilby was recorded within the Study Area during the current survey. The nearest record of the species is located approximately 9 km southwest of the Study Area (DBCA, 2022b); however, based on the date of the record (1979), it is considered to be a historic record and is unlikely to be an accurate representation of the species current occurrence within the Pilbara region. Sand Plain (0.41%, 23.94 ha) habitat is considered critical breeding and foraging/ dispersal habitat for the species; however, within the Study Area, the occurrence and extent of Sand Plain habitat is relatively limited and unlikely to support the species due to its isolated and fragmented occurrence.

Based on the absence of nearby recent records of the species and relative isolation of the Study Area from other areas of suitable habitat outside of the Study Area, the species is considered Unlikely to occur. Although the species is known to utilise broad habitats occurring within the Study Area in other parts of its distribution (i.e. Major Drainage Line (4.43%, 259.53 ha), Mulga Woodland (0.76%, 44.61 ha) and Drainage Area/ Floodplain (17.59%, 1,030.66 ha)), these habitats are rarely utilised by the species within the Pilbara region, likely due to the high amount of alluvial material making substrates less suitable for burrowing activity compared to sand-plain habitats (Cramer *et al.*, 2017). The likelihood of these habitats being utilised by the species may also increase when larger areas of suitable habitat (e.g. Sand Plain) are present adjacent to or in the vicinity.

Ghost Bat (*Macroderma gigas*) – Vulnerable (EPBC Act and BC Act)

In the Pilbara region, the species roosts in deep, complex caves beneath bluffs of low rounded hills, often composed of Marra Mamba Iron Formation or banded iron formation, granite rock piles and abandoned mines (Armstrong & Anstee, 2000). They roost either individually or in colonies (Churchill, 2008) and move between a number of caves, both seasonally and as dictated by weather changes (van Dyck & Strahan, 2008). The species will often forage more broadly across habitats, often utilising drainage lines and other habitats where prey species are likely to be most abundant (Richards *et al.*, 2008; Tidemann *et al.*, 1985). Recent studies of ghost bat home range and foraging behaviour in the Pilbara region have identified Drainage Area/ Floodplain, Gorge/ Gully, Major Drainage Line and Mulga Woodland as high suitability foraging habitats for the species, followed by Stony Plain as moderate suitability (Biologic, 2020b). This suitability however, is variable depending on particular habitat characteristics, including the abundance of foraging structures (tree perches) and density of understorey vegetation present (Biologic, 2020b).

No records or evidence of occurrence of ghost bat was recorded within the Study Area during the current survey; however, detectability, particularly of foraging individuals is difficult due to their foraging behaviour (i.e. infrequent and highly variable calling during foraging) and capabilities of ultrasonic recording devices (i.e. limited detection zones). Two suitable caves for ghost bat (CNIN-17 and CEOP-03) were recorded during the current survey, with both caves classified as Category 4 (nocturnal roost caves with opportunistic usage) as defined by Bat Call (2021a) (Table 5.2; Appendix F). Eleven other caves are known to occur within the Study Area, comprising one Category 2 (maternity/ diurnal roost caves with regular occupancy for ghost bats), seven Category 3 (diurnal roost caves with occasional occupancy) and three Category 4 caves (Biologic, 2013a, 2014a, 2023b). The Category 2 cave known from within the Study Area provides critical habitat for the species. Several of the caves within and to the east of the Study Area are currently being monitored for ghost bat presence as part of the Jimblebar ghost bat monitoring program, with the species having been recorded from scats and ultrasonic calls at caves CNIN-01, CNIN-03, CNIN-09 and CNIN-13 during 2022 (Biologic, 2023b).

Although Gorge/ Gully (3.74%, 219.00 ha) and Breakaway/ Cliff (1.56%, 91.65 ha) habitats are not classified as critical habitat for ghost bat, they have the potential to contain critical habitat in the form of Category 1, 2 and 3 (when found in an apartment block) caves. Seven of the 13 caves known from within the Study Area were recorded in Gorge/ Gully habitat, with a further four from Breakaway/ Cliff habitat, and two from Hillcrest/ Hillslope habitat (Table 5.2), where majority of searching survey effort has occurred. Critical foraging/ dispersal habitat within the Study Area is provided by Stony Plain (22.17%, 1,299.07 ha), Drainage Area/ Floodplain (17.59%, 1,030.66 ha), Major Drainage Line (4.43%, 259.53 ha), Minor Drainage Line (1.66%, 97.00 ha) and Mulga Woodland (0.76%, 23.94 ha), when proximal (<12 km) to roosting caves. As suggested by Bat Call (2021a) these habitats represent “productive plain areas with thin mature woodland over patchy or clumped tussock or hummock grass (*Triodia* spp.) on sand or stony ground” and/or contain “isolated trees and trees on the edge of thin thickets on the plains” and “trees along the edges of watercourse woodlands”. Due to the occurrence of a Category 2 cave within the Study Area (CNIM-03), these habitats within the majority of the Study Area’s extent can be considered critical foraging habitat. Based on the location of the CNIM-03 roost, the extent of these habitats across all but the western most portion (~2.5 km from westernmost boundary of Study Area) are likely to be utilised as critical foraging habitat by individuals roosting at this location. The suitability of these habitats, is however, variable throughout the Study Area depending on particular characteristics of the habitat, including the abundance of foraging structures (tree perches) and density of understorey vegetation present. Due to the presence of known roosting caves and confirmed records within the Study Area and surrounds, the presence of suitable breeding and roosting habitat, and recent records of the species, it is likely to occur as a resident and utilise the above habitats within the Study Area regularly for foraging.

Pilbara Leaf-nosed Bat (*Rhinonictoris aurantia*) – Vulnerable (EPBC Act and BC Act)

This species' limited ability to conserve heat and water means it requires warm (28–32 °C) and very humid (85 – 100%) roost sites in caves (Armstrong, 2001; Churchill, 1991) and/or mine shafts as these enable the individuals to persist in arid climates by limiting water loss and energy expenditure (van Dyck & Strahan, 2008). Such caves are relatively uncommon in the Pilbara (Armstrong, 2001), which limits the availability of diurnal roosts for this species. Pilbara leaf-nosed bats roost in undisturbed caves, deep fissures or abandoned mine shafts. The species forages within and in the vicinity of roost caves and more broadly along waterbodies with suitable fringing vegetation supporting prey species (TSSC, 2016b). Pilbara Leaf-nosed bats are predicted to travel up to 20 km from roost caves during nightly foraging (Cramer *et al.*, 2016); however, seasonal variation is known to occur, with foraging occurring up to 20 km in the dry season and up to 50 km during the wet season (Bat Call, 2021b). Long-distance movements by the species have also been recorded, with a single monitored individual recorded from two roost caves located 170 km distant approximately 12 months apart (Bullen & Reiffer, 2019), suggesting the species may forage and/or disperse over greater distances than previously thought.

Pilbara leaf-nosed bat was recorded on 13 occasions during the current survey from a total of 140 ultrasonic calls within Sand Plain, Major Drainage Line, Gorge/ Gully and Minor Drainage Line habitats (Table 5.5; Figure 5.3). Call times for the species varied, with the earliest call recorded at 2024 hours and the latest call at 0432 hours (Table 5.5). Based on the timing of the calls, the records from within the Study Area likely represent foraging individuals; however, the occurrence of the calls provides no indication of the potential origin of the individual (i.e. where it may be roosting). Of the caves known from within the Study Area, all 13 are categorised as nocturnal refuge (Category 4) for the species, as defined by Bat Call (2021b) (Table 5.2; Appendix F). Additionally, preliminary results from the caves monitored for the Jimblebar project show no indication of the species roosting, with sporadic nocturnal visits recorded at CNIN-03 and CNIN-09 throughout 2022 (Biologic, 2023b). The nearest known roost of the species is located at Kalgan Creek, approximately 14.5 km northwest of the Study Area (Category 2 roost); however, sampling within the intervening area is sparse and additional roost sites may occur closer to the Study Area.

Within the Study Area, Major Drainage Line (4.43%, 259.53 ha), Gorge/ Gully (3.74%, 219.00 ha) and Breakaway/ Cliff (1.56%, 91.65 ha) habitat provide supporting foraging and dispersal habitat for the species and tend to contain important habitat features such as nocturnal refuges and water features. Although Gorge/ Gully and Breakaway/ Cliff habitats are not classified as critical habitat for the Pilbara leaf-nosed bat, they have the potential to contain critical habitat in the form of Category 1–3 caves. As such these habitats represent a Habitat Rating 4 (very high) as defined by Bat Call (2021b). Additional supporting foraging and dispersal habitat for the species within the Study Area includes Hillcrest/ Hillslope (33.54%, 1,965.26 ha), Stony Plain (22.17%, 1,299.07 ha), Drainage Area/ Floodplain (17.59%, 1,030.66 ha), Undulating Low Hills (5.03%, 294.50 ha), Minor Drainage Line (1.66%, 97.00 ha) and Mulga Woodland (0.76%, 44.61 ha), with the habitats representing a Habitat Rating 2 (low) as defined by Bat Call (2021b).

The Study Area also contains water features likely to provide supporting foraging habitat for the Pilbara leaf-nosed bat (Table 5.3). With the exception of the permanent water feature (WOPN-21), the majority of the water features known from within the Study Area would provide supporting habitat rather than critical habitat because they are only ephemeral or temporary ephemeral, and are situated further than 8.7 km from the nearest known roost for the species. These water features may however be utilised occasionally by foraging and/or dispersing individuals. While classified as permanent, the WOPN-21 water feature within the Study Area is also likely to provide supporting habitat based on the proximity of the feature from any known roosts for the species and the occurrence of other permanent water features in areas adjacent to the Study Area (i.e. Ophthalmia Dam). As the species is likely to also utilise the broader expanse of Ophthalmia Dam, it is unlikely that the species would be reliant on any water features within the Study Area for its local and/or regional persistence.

The results of this survey support the desktop findings by Biologic (2020c), which demonstrated that the Pilbara leaf-nosed bat is relatively scarce within the broader Newman area. This is likely due to the limited occurrence of potential roosting habitat in the vicinity of the Study Area. The scarcity of records in the broader vicinity of the Study Area suggests the Pilbara leaf-nosed bat is relatively uncommon in the local area and its occurrence may be restricted to foraging and/or dispersal events only.

Night Parrot (*Pezoporus occidentalis*) – Endangered (EPBC Act and BC Act)

The ecology and habitat preferences of the night parrot within the Pilbara region are poorly known. Based on accepted records, the habitat of the species comprises long-unburnt mature *Triodia* grasslands in stony or sandy environments (McGilp, 1931; North, 1898; Whitlock, 1924; Wilson, 1937), and of samphire and chenopod shrublands, including genera such as *Atriplex*, *Bassia* and *Maireana*, on floodplains and claypans, and on the margins of salt lakes, creeks or other sources of water (McGilp, 1931; Wilson, 1937). The current interim guidelines for preliminary surveys of night parrot in Western Australia (DPaW, 2017) suggest this species requires old-growth (often more than 50 years unburnt) spinifex (*Triodia*) for roosting and nesting. Although little is known about foraging sites, habitats that comprise various grasses and herbs are thought to be suitable.

Records of the night parrot within the Pilbara region are scarce, with the nearest contemporary record of the species located approximately 140 km northwest of the Study Area from April 2005 (DBCA, 2022a). Three individuals of the species were purportedly observed at Minga Well, a station bore and livestock watering point with large pools of water (Davis & Metcalf, 2008). The site is heavily degraded from cattle and lacks understorey within a larger area; however, larger patches of old-growth *Triodia* grasslands occur in the vicinity along the peripherals of the Fortescue Marsh and chenopod shrublands occur throughout the marsh itself. Despite this observation, subsequent targeted survey for the species at the location and in the vicinity have failed to record the species again.

No evidence of occurrence of night parrot was recorded within the Study Area during the current survey, including from targeted acoustic recorders deployed in areas of habitat considered possibly suitable for the species. Habitat within the Study Area was considered suboptimal for the species, particularly due to most areas of *Triodia* grasslands lacking large, long-unburnt hummocks and the absence of any chenopod shrubland habitat within the Study Area. Although little is known about the species' habitat preferences and occurrence, particularly within the Pilbara region, the extent of which these habitats may still provide habitat for the species is unknown. However, based on the absence of any habitat considered to be of significance to the species, it is considered Unlikely to occur within the Study Area either as a resident or infrequent visitor during foraging and or dispersal.

Southern Whiteface (*Aphelocephala leucopsis*) – Vulnerable (EPBC Act)

The southern whiteface is distributed across the majority of mainland Australia, inhabiting a variety of open woodlands and shrublands containing an understorey of grasses or shrubs, or both (Higgins & Peter, 2002). Typically these woodlands are dominated by acacias or eucalyptus on ranges, foothills and lowlands and plains (Higgins & Peter, 2002). The species is considered to be sedentary; however, records suggest that individuals move to wetter areas outside their normal range during drought conditions, (Higgins & Peter, 2002). Southern whiteface primarily forage on the ground, preferring areas with sparse tree cover and an herbaceous understory litter cover, primarily feeding on insects, spiders, and seeds (DCCEEW, 2023a; Higgins & Peter, 2002). The species commonly forages in small groups of two to eight individuals, however, may flock in larger foraging parties during the winter months with as many as 70 individuals previously recorded (Higgins & Peter, 2002).

Breeding takes place between July to October, however exact timing in arid regions through the species range can be impacted by rainfall; individuals may breed outside of the known range following sufficient rainfall events, or not at all during periods of drought (Higgins & Peter, 2002). Nesting often occurs in a hollow or crevice, and less frequently in low bushes, where nests are made of a combination of grass, bark and roots forming a large, dome-like shape (Higgins & Peter, 2002). Southern whiteface are typically observed to nest in pairs, however little is known about the species' social organisation (DCCEEW, 2023a). Cooperative breeding has been recorded, with multiple instances of up to four adults participating in chick rearing (Higgins & Peter, 2002).

No southern whiteface or evidence of the species' occurrence was recorded during the current survey and the Study Area is outside the modelled distribution for which the species or species habitat is known or likely to occur. However, the Study Area is located within the modelled distribution for which the species or species habitat may occur (DCCEEW, 2023a). As the species has been previously recorded twice within the vicinity of the Study Area, with the nearest record located approximately 4.8 km south of the Study Area (BHP WAIO, 2023), the species likelihood of occurrence is considered Possible.

Drainage Area/ Floodplain (17.59%, 1,030.66 ha), Major Drainage Line (4.43%, 259.53 ha), Minor Drainage Line (1.66%, 97.00 ha) and Mulga Woodland (0.76%, 44.61 ha) habitats within the Study Area are likely to provide critical breeding, foraging and dispersal habitat for southern whiteface, particularly where suitable vegetation structure and understory occurs. Suitability of these habitats within the Study Area is variable, depending on particular habitat characteristics, including the presence of an understorey of grasses or shrubs, or both, with low tree densities and an herbaceous understorey litter cover (DCCEEW, 2023a). The species may also forage and disperse more broadly across other habitats where suitable vegetation cover is present.

The lack of southern whiteface records during the current survey and the scarcity of records in the broader vicinity suggests the southern whiteface is relatively uncommon in the local area. As the species is known to utilise broad habitats occurring within the Study Area, it may utilise the above habitats for foraging, however usage may be dependent on the presence of a suitable understorey and presence/ quality of an herbaceous understorey litter cover (DCCEEW, 2023a) for them to provide critical habitat for the species. Habitats within the Study Area are unlikely to support an important population of the species and it is unlikely any habitats occurring within the Study Area would be relied upon for the species long-term persistence at a local and/or regional scale.

Pilbara Olive Python (*Liasis olivaceus barroni*) – Vulnerable (EPBC Act and BC Act)

The Pilbara olive python is moderately common throughout the ranges of the Pilbara region and the Mt Augustus area in the Gascoyne region. The species is regularly encountered in the vicinity of rocky habitats (i.e. Gorge/ Gully and Breakaway/ Cliff habitats) and drainage systems (i.e. Major Drainage Lines), particularly areas with permanent and/or semi-permanent water features (DSEWPac, 2011b; Pearson, 1993). In the inland Pilbara, the species is most often encountered near permanent waterholes in rocky ranges or among riverine vegetation (Pearson, 1993). Pilbara olive python are primarily nocturnal and tend to shelter in small caves or under vegetation during the day, although it is occasionally active during the day during warmer summer months (Pearson, 1993).

No Pilbara olive python or evidence of the species occurrence was recorded within the Study Area during the current survey; however, the species has previously been recorded on ten occasions within the Study Area within Gorge/ Gully habitat (BHP WAO, 2022a). Within the Study Area, Gorge/ Gully (3.74%, 219.00 ha), Breakaway/ Cliff (1.56%, 91.65 ha) and Major Drainage Line (4.43%, 259.53 ha) habitat provide critical potential breeding and dispersal/foraging habitat for the species. Although not considered critical habitat, Minor Drainage Line (1.66%, 97.00 ha) habitat may also provide supporting habitat to the species in areas that are prone to pooling and ponding, particularly following large rainfall events, and providing dispersal corridors throughout the landscape. The Pilbara olive python may occur throughout the Study Area in these habitats, particularly where they facilitate connectivity between critical habitats.

A total of 32 water features are known to occur within the Study Area, located in Gorge/ Gully, Major Drainage Line and Hillcrest/ Hillslope habitat (Table 5.3). For Pilbara olive pythons in particular, these water features can often act as critical foraging locations and for that reason the species is more often than not, associated with such features, particularly within rocky habitats, but also, to a lesser degree within Major Drainage Line habitat where suitable vegetation cover is present. Although no evidence of the Pilbara olive python was found within the Study Area during the current survey, it is Likely that a population occurs within the Study Area based on previous records within and in the vicinity of the Study Area and the presence of critical breeding and foraging habitat.

5.4.2 Species Confirmed within Study Area

In addition to the ghost bat, Pilbara leaf-nosed bat and Pilbara olive python discussed above (see Section 5.4.1), a further 16 significant species have been Confirmed as occurring within the Study Area.

Brush-tailed Mulgara (*Dasycercus blythi*) – Priority 4 (DBCA)

The brush-tailed mulgara is often recorded from a range of sandy and stony plain habitats (Pavey et al., 2012). Although the brush-tailed mulgara was not recorded during the current survey, the species has previously been recorded on five occasions in the Study Area within Stony Plain and Drainage Area/ Floodplain habitat, with the most recent record of the species occurring in 2013 (BHP WAIO, 2022a). The species is considered to occur as a resident, where its occurrence is likely to be common and widespread across Sand Plain (0.41%, 23.94 ha) and Stony Plain (22.17%, 1,299.07 ha) habitats. The species may also forage more broadly into Drainage Area/ Floodplain habitat where suitable vegetation cover and sandy or loamy substrates permitting burrowing are present. The species occurrence and abundance within the Study Area is likely to be dependent on seasonal conditions, particularly following rainfall events when resources are more abundant.

Western Pebble-mound Mouse (*Pseudomys chapmani*) – Priority 4 (DBCA)

The western pebble-mound mouse has experienced a significant decline in their range through the Gascoyne and Murchison and is now considered endemic to the Pilbara (Start *et al.*, 2000). This species almost exclusively occurs on the gentler slopes of rocky ranges and low undulating hills where the ground is covered with a stony mantle and vegetated by hard spinifex, often with a sparse overstorey of eucalypts and scattered shrubs (Anstee & Armstrong, 2001).

The western pebble-mound mouse was recorded a total of 23 times during the current survey on undulating low hills within Hillcrest/ Hillslope and Stony Plain habitats (Table 5.4; Figure 5.3). All but one of the records were from secondary evidence (pebble mounds), including seven mounds deemed active, three mounds considered to be recently inactive and 12 mounds considered inactive (Table 5.4; Figure 5.3). The final record of the species was of one alive individual captured in a pitfall trap at site VOPN-006 (Table 5.4; Figure 5.3). The species has been recorded a further 94 times previously within 5 km of the Study Area (BHP WAIO, 2022a; DBCA, 2022b).

The species is considered to occur as a resident within the Study Area, where its occurrence is likely to be common and widespread across Stony Plain (22.17%, 1,299.07 ha), Undulating Low Hills (5.03%, 294.50 ha) and the lower slopes of Hillcrest/ Hillslope (33.54%, 1,965.26 ha) habitats. The species may also forage more broadly into Drainage Area/ Floodplain habitat where adjacent to habitat permitting burrowing and mound construction.

Grey Falcon (*Falco hypoleucos*) – Vulnerable (EPBC Act and BC Act)

The grey falcon is a widely distributed but infrequently recorded species which appears to have a distribution centred on ephemeral or permanent creek lines (Garnett & Crowley, 2000). The species tends to prefer sparsely-treed, open plains and creek lines for hunting (Olsen & Olsen, 1986), while nesting often occurs in the abandoned nest of a raptor or corvid in trees or tall infrastructure such as power line towers or communications towers (Olsen & Olsen, 1986; Schoenjahn et al., 2019).

Although the grey falcon was not recorded during the current survey, the species has previously been recorded (2013) within the Study Area (BHP WAIO, 2022a). The species is considered to occur as an infrequent visitor within the Study Area to forage, particularly within Major Drainage Line (4.43%, 259.53 ha), Minor Drainage Line (1.66%, 97.00 ha) and Dam (0.08%, 4.79 ha) habitat, and to a lesser extent, other habitats more broadly. The frequency of occurrence of the species within the Study Area is likely to be dependent on the proximity of nesting within or in the vicinity of the Study Area. Nesting may occur within the Study Area where suitable tall infrastructure (i.e. powerline or transmission towers) occurs or along Major Drainage Line habitat where suitable tall trees are present.

Fork-tailed Swift (*Apus pacificus*) – Migratory (EPBC Act and BC Act)

The fork-tailed swift is a wide ranging but sparsely distributed species that occurs in a wide range of dry and/or open habitats (Johnstone & Storr, 1998). The species does not breed in Australia, migrating from breeding grounds in the northern Hemisphere. During its occurrence in Australia, the species is almost exclusively aerial, feeding and possibly also roosting aerially (DoE, 2018). The fork-tailed swift was recorded once during the current survey comprising of three individuals observed flying over Drainage Area/ Floodplain (17.59%, 1,030.66 ha) habitat (Table 5.4; Figure 5.3). The species is considered to occur as an infrequent visitor only and may forage in the airspace above all habitats occurring within the Study Area, with landing or nesting unlikely.

Migratory Shorebird and Waterbird Species – Migratory (EPBC Act and BC Act)

A total of 11 migratory shorebird and waterbird species have been Confirmed within the Study Area, including gill-billed tern, caspian tern, common sandpiper (including one individual recorded during the current survey), sharp-tailed sandpiper, black-tailed godwit, wood sandpiper, red-necked stint, common greenshank, long-toes stint, marsh sandpiper and glossy ibis (including four individuals recorded during the current survey). As the habitat preferences and likely utilisation in relation to the Study Area for all 11 species is similar, they are discussed together.

These species are only likely to utilise three habitats within the Study Area; Dam (0.08%, 4.79 ha), Major Drainage Line (4.43%, 259.53 ha), and Drainage Area/ Floodplain (11.59%, 1,030.66 ha). Within the Major Drainage Line habitat, the species may occasionally utilise large water bodies to forage; however, the majority of the water bodies within this habitat are ephemeral only. Drainage Area/ Floodplain habitat may also be suitable for migratory shorebirds and waterbirds following heavy rainfall events when inundation of the area occurs and suitable foraging habitat is provided. As the occurrence of inundation is seasonal and highly irregular, their occurrence is likely to be irregular and may be used only opportunistically by transient or migrating individuals. The frequency of records of migratory shorebirds and waterbirds within the Study Area and surrounds is variable; however, this is also often representative of the highly variable nature of the occurrence of these species as far inland as the Study Area, often as a result of cyclonic activity and high winds from the northwest. Occurrence of the species within the Study Area is likely to be attributed to the larger extent of Dam habitat adjacent to the Study Area, and the occurrence of other areas of suitable habitat for the species more broadly around Ophthalmia Dam, therefore occurrence within the Study Area is likely to be infrequent as it's not considered to provide the most suitable habitat for migratory species at a local scale.

Pilbara Flat-headed Blind-snake (*Anilius gane*) – Priority 1 (DBCA)

Little is known about the Pilbara flat-headed blind-snake; however, it can be assumed its ecology and behaviour are similar to other blind snake species (Cogger, 2014). Due to its fossorial nature, the species is rarely encountered, and little is known of the species habitat preferences. Records of the species are often associated with moist gorges and gullies (Wilson & Swan, 2014). The Pilbara flat-headed blind-snake was not recorded during the current survey; however, the species has previously been recorded on four occasions within the Study Area, with the most recent record of the species occurring in 2013 (BHP WAIO, 2022a). Therefore, the species is considered to occur as a resident within Hillcrest/ Hillslope (33.54%, 1,965.26 ha), Gorge/ Gully (3.74%, 219.00 ha) and Breakaway/ Cliff (1.56%, 91.65 ha) habitats, particularly in areas where leaf litter accumulates, and moisture is retained in leaf litter and substrates.

5.4.3 Species Highly Likely to Occur

No significant species identified in the desktop assessment were considered Highly Likely to occur in the Study Area.

5.4.4 Species Likely to Occur

One significant species is considered Likely to occur in the Study Area, the peregrine falcon.

Peregrine Falcon (*Falco peregrinus*) – Specially Protected (BC Act)

In arid areas of its distribution, the peregrine falcon is often recorded along cliffs above rivers, ranges and wooded watercourses where it hunts birds (Johnstone & Storr, 1998). It typically nests on rocky ledges occurring on tall, vertical cliff faces between 25 m and 50 m high (Olsen & Olsen, 1989). It also appears to prefer nesting on large ledges a reasonable distance (average of 13 m) from the top of the cliff (Olsen & Olsen, 1989), possibly to avoid ground dwelling predators. Nesting may also occasionally occur in tall trees along drainage lines, including use of abandoned nests of other large bird species (Olsen & Olsen, 1989).

No peregrine falcon or evidence of the species' occurrence (i.e. nests sites) were recorded within the Study Area during the current survey. The species has previously been recorded approximately 5 km west of the Study Area in 2013 (BHP WAO, 2022a), and is considered Likely to occur within the Study Area to forage within all broad fauna habitats occurring. Due to the species broad foraging range and the widespread occurrence of these habitats in the broader vicinity of the Study Area, foraging is likely to occur over a much broader area and not confined to the Study Area. The frequency of occurrence of the species within the Study Area is likely to be dependent on the proximity of nesting within or in the vicinity of the Study Area. Suitable nesting habitat for the species may occur within Gorge/ Gully (3.74%, 219.00 ha) and Breakaway/ Cliff (1.56%, 91.65 ha) habitat and instances of breakaway within Hillcrest/ Hillslope (33.54%, 1,965.26 ha) habitat.

5.4.5 Species Possibly Occurring

In addition to the northern quoll and southern whiteface discussed above (refer to Section 5.4.1), a further 13 significant species are considered Possible to occur in the Study Area; long-tailed dunnart, barn swallow, ten migratory shorebirds and waterbirds and spotted Ctenotus.

Long-tailed Dunnart (*Antechinomys longicaudata*) – Priority 4 (DBCA)

Despite the relatively widespread distribution of long-tailed dunnart, the species is often sparsely distributed and locally uncommon in the Pilbara region, where it often occurs in rugged rocky areas, scree slopes and stony plains and plateaus dominated by open shrubland and *Triodia* grassland vegetation (van Dyck *et al.*, 2013).

No evidence of the long-tailed dunnart was recorded within the Study Area during the current survey; however, based on the presence of potential habitat for the species and the species previously being recorded on four occasions approximately 20 km west of the Study Area (DBCA, 2022b), its likelihood of occurrence is considered Possible. It should be noted that the previous records of the species in the vicinity of the Study Area are from 1997, and there have been no contemporary records despite extensive sampling in the broader area since. This suggests the species either occurs at low densities and previous records may have been representative of a population within a boom cycle in relation to resource abundance. Within the Study Area, the species may occur as a resident within Hillcrest/ Hillslope (33.54%, 1,965.26 ha), Breakaway/ Cliff (1.56%, 91.65 ha) and possibly Stony Plain (22.17%, 1,299.07 ha) habitats, potentially moving into adjacent habitats to forage and/or disperse.

Barn Swallow – Migratory (EBPC Act and BC Act)

The barn swallow is a non-native breeding summer visitor to the Pilbara, favouring areas near water (Johnstone et al., 2013). The barn swallow was not recorded during the current survey; however, the species has previously been recorded on 300 m south of the Study Area (2014) (BHP WAO, 2022a), and is considered Possible to occur within the Study Area to forage as an infrequent visitor. Suitable foraging habitat within the Study Area is restricted to Major Drainage Line (4.43%, 259.53 ha) (where water bodies present) and Dam (0.08%, 4.79 ha) habitat. Drainage Area/ Floodplain (17.59%, 1,030.66 ha) habitat may also be suitable for foraging following heavy rainfall events when inundation of the area occurs and suitable foraging habitat is provided. Occurrence of the species within the Study Area is likely to be attributed to the larger extent of Dam habitat adjacent to the Study Area, therefore occurrence within the Study Area is likely to be infrequent.

Migratory Shorebird and Waterbird Species – Migratory (EBPC Act and BC Act)

A total of ten migratory shorebird and waterbird species are considered Possible to occur within the Study Area, including garganey, little ringed plover, oriental plover, black-necked stork, yellow wagtail, Australian painted snipe, curlew sandpiper (also listed as CR under EPBC Act and BC Act), pectoral sandpiper, common redshank and ruff. As the habitat preferences and likely utilisation in relation to the Study Area for all ten species is similar, they are discussed together.

These species are only likely to utilise three habitats within the Study Area; Dam (0.08%, 4.79 ha), Major Drainage Line (4.43%, 259.53 ha), and Drainage Area/ Floodplain (17.59%, 1,030.66 ha). Within the Major Drainage Line habitat, the species may occasionally utilise large water bodies to forage; however, the majority of the water bodies within this habitat are ephemeral only. Drainage Area/ Floodplain habitat may also be suitable for migratory shorebirds and waterbirds following heavy rainfall events when inundation of the area occurs and suitable foraging habitat is provided. As the occurrence of inundation is seasonal and highly irregular, their occurrence is likely to be irregular and may be used only opportunistically by transient or migrating individuals. The frequency of records of migratory shorebirds and waterbirds within the Study Area and surrounds is variable; however, this is also often representative of the highly variable nature of the occurrence of these species as far inland as the Study Area, often as a result of cyclonic activity and high winds from the northwest. Occurrence of the species within the Study Area is likely to be attributed to the larger extent of Dam habitat adjacent to the Study Area, and the occurrence of other areas of suitable habitat for the species more broadly around Ophthalmia Dam, therefore occurrence within the Study Area is likely to be infrequent as it's not considered to provide the most suitable habitat for migratory species at a local scale.

Spotted Ctenotus (*Ctenotus uber* subsp. *johnstonei*) – Priority 2 (DBCA)

Habitat preferences of the spotted Ctenotus are poorly known; however, previous records of the subspecies in the Pilbara region are associated with stony hillslope and plain habitats with variable vegetation cover, often dominated by open *Acacia* shrubland and *Triodia* hummock grassland (Cogger, 2014).

No evidence of the spotted *Ctenotus* was recorded during the current survey; however, the species is considered Possible to occur as a resident in Stony Plain (22.17%, 1,299.07 ha), Drainage Area/ Floodplain (17.59%, 1,030.66 ha), Mulga Woodland (0.76%, 44.61 ha) and lower slopes of Hillcrest/ Hillslope (33.54%, 1,965.26 ha) habitats. The species has previously been recorded approximately 4.8 km south of the Study Area (DBCA, 2022b). It should be noted that there is currently some taxonomic uncertainty regarding the isolated Pilbara population of this subspecies, and the population may represent an undescribed taxon (P. Doughty, Western Australian Museum, *pers. comm.*).

5.5 Field Survey Adequacy

5.5.1 Sampling Adequacy

The results below represent this survey's accumulation curves for mammals, birds and herpetofauna separately, due to differences in survey methods and statistical analysis between previous surveys, statistical comparisons between previous surveys were not possible. The results below are based on systematic sampling results (i.e. pit trapping and avifauna census results) only and do not include opportunistic sightings or other non-standardised sampling methods. Therefore, captures are not consistent and not enough data is available to statistically compare in accumulation curves. Contextual comparisons between previous surveys have been made in Section 3.2.

While results of species accumulation curves can often show a reduced capture of species richness, this is generally attributed to the exclusion of species recorded from opportunistic or other sampling methods. Furthermore, many species may not have been recorded during the phase 1 and phase 2 surveys due to a number of factors which are likely to influence a species occurrence, abundance and/or activity levels, including temporal changes in habitats (i.e. degradation from fire and/or introduced species over time) and species (i.e. population fluctuations), climatic influences such as rainfall and/or temperature (i.e. climate change) and species detectability (i.e. some species naturally occur in low abundance or have fluctuating populations influenced by other factors such as rainfall). For example, some taxa such as amphibians are recorded in low abundance due to captures being dependent on climatic events such as rainfall.

Mammals

The species accumulation curve for mammals produced a steadily increasing line, indicating that an asymptote had not been reached (Figure 5.4). Richness estimators indicated that between 78% (Jackknife 1) and 88% (Bootstrap) of species had been recorded. A total of 13 species were recorded and it was indicated that between 15 to 17 species would be expected based on the results obtained. While mammal numbers were low, these results are likely to reflect the fact that species richness for mammals is typically lower than that for birds and herpetofauna, thus the capture of a single new species on any given day makes a proportionately large change to the overall dataset. Due to richness estimates only incorporating results recorded from standardised sampling methods for mammals (i.e. systematic trapping methods), a large portion of species recorded from other non-systematic methods (i.e. opportunistic records) within habitats trapped are not included, including, but not limited to, cow (*Bos taurus*), Woolley's pseudantechinus (*Pseudantechinus woolleyae*), short-beaked echidna (*Tachyglossus aculeatus* subsp. *acanthion*) and ten bat species (Appendix H). Contextual mammal comparisons of total species recorded between previous surveys have been made in the desktop assessment (section 3.2) and also discussed in section 5.3.

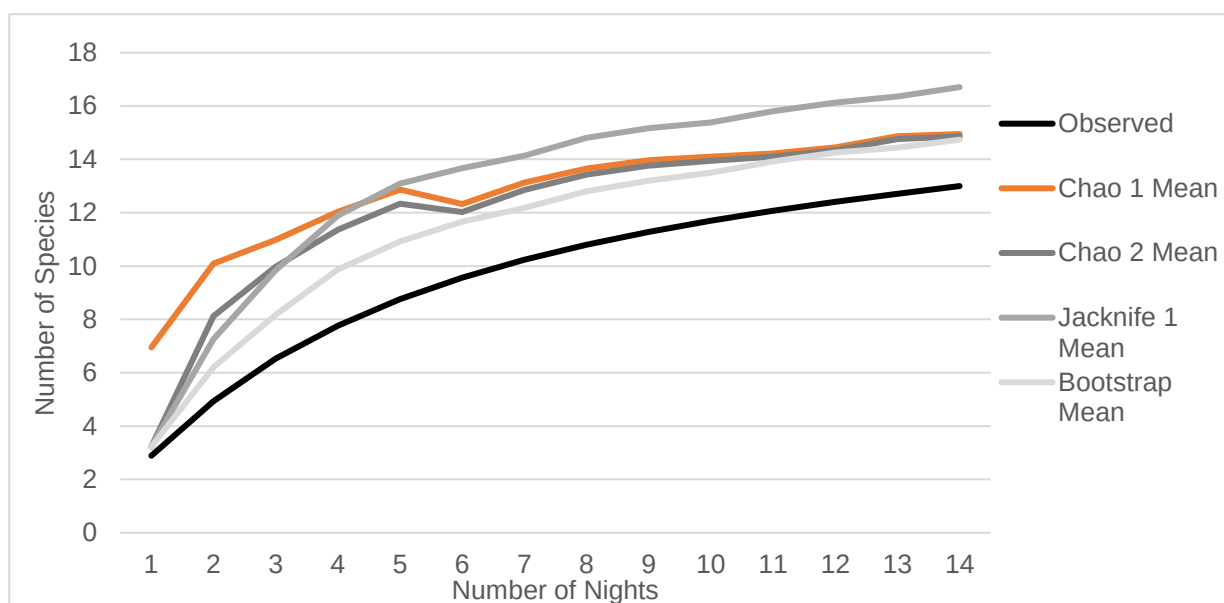


Figure 5.4: Species accumulation curve for mammals trapped at systematic sampling sites

Avifauna

Analysis of the avifauna data set from the dual phase survey produced a steadily increasing line over the 14-day sampling period, indicating that an asymptote had not been reached; however, was starting to gradually flatten towards a point plateau (Figure 5.5). Richness estimators indicated between 84% (Jackknife 1) and 92% (Chao 2) of species had been recorded. A total of 74 species were recorded and it was indicated that 81 to 88 species would be expected based on the results obtained. These results indicate that additional survey effort may increase the species richness, although the avifauna censuses were effective in identifying and recording most of the bird assemblage present at these sites. As richness estimates do not include species recorded from methods other than avifauna census' at systematic trapping sites (i.e. opportunistic records), estimates do not include all species recorded during the survey. These include, but are not limited to, records of common sandpiper (*Actitis hypoleucos*), barking owl (*Ninox connivens*) and great crested grebe (*Podiceps cristatus*) (Appendix H). Contextual avifauna comparisons between previous surveys have been made in the desktop assessment (Section 3.2) and also discussed in Section 5.3.

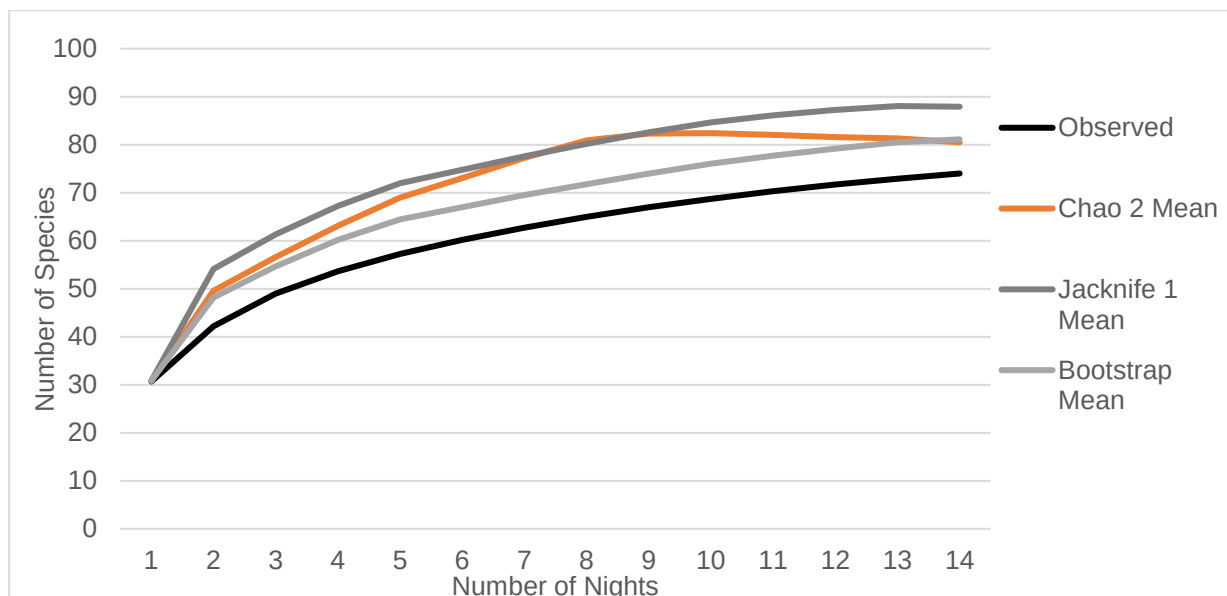


Figure 5.5: Species accumulation curve for birds recorded during avifauna census at systematic sampling sites

Herpetofauna

Analysis of the herpetofauna data set from the dual phase survey produced a steadily increasing line over the 14-day sampling period, indicating that an asymptote had not been reached; however, was close to reaching a point of plateau (Figure 5.6). Richness estimators indicated that between 50% (Chao 1) and 85% (Bootstrap) of species had been recorded. A total of 54 species were recorded and it was indicated that 63 to 109 species would be expected based on the results obtained. These results indicate that additional survey effort may increase the species richness at the systematic trapping sites. Due to richness estimates only incorporating results recorded from standardised sampling methods for herpetofauna (i.e. systematic trapping methods), estimates do not include all species recorded during the survey, including, but not limited to, racehorse goanna (*Varanus tristis* subsp. *tristis*), perentie (*Varanus giganteus*) and gecko (*Strophurus wellingtonae*) (Appendix H). Contextual herpetofauna comparisons between previous surveys have been made in the desktop assessment (Section 3.2) and also discussed in Section 5.3.

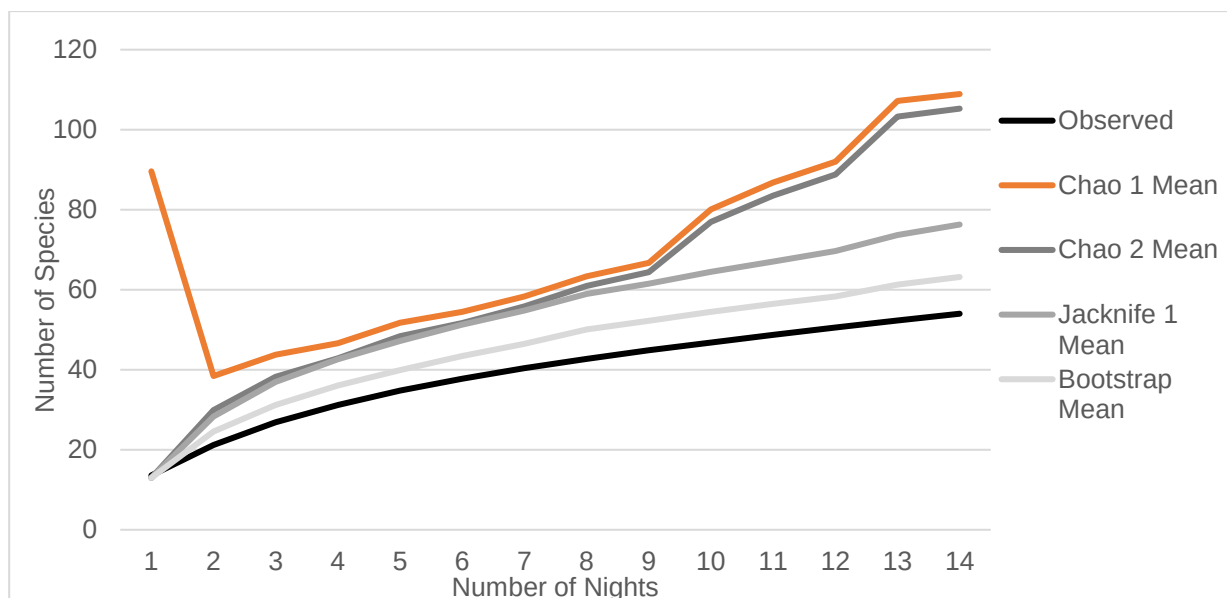


Figure 5.6: Species accumulation curve for herpetofauna trapped at systematic sampling sites

5.5.2 Potential Limitation and Constraints

The EPA (2020) outlines several potential limitations to fauna surveys. These aspects are assessed and discussed in Table 5.7 below.

Table 5.7: Survey limitations and constraints

Potential limitation or constraint	Limitation to current survey	Applicability to this survey
Sources/availability of data and information (recent or historic) and availability of contextual information	No	All contextual resources required to complete the assessment were available (previous surveys, database searches, environmental information, climate data). This included information from 38 biological surveys previously conducted in the vicinity of the Study Area, comprising a reasonable amount of previous survey effort. Also available were regional biodiversity surveys describing known assemblages of vertebrate fauna occurring in the Pilbara (McKenzie <i>et al.</i> , 2009).
Competency/experience of the survey team, including experience in the bioregion surveyed	No	The field personnel involved in the survey are experienced in undertaking fauna surveys of similar nature, including with the significant species targeted during the survey. Technical personnel with relevant expertise assisted with analysis of ultrasonic recordings (Bob Bullen) and acoustic recordings (Nigel Jackett).
Scope of the survey, e.g. where faunal groups were excluded from the survey	No	The scope was a detailed survey and was conducted within that framework. All trapping methods were able to be undertaken as expected to sample all target fauna groups.
Timing, weather, and season	Partial	Below average rainfall was recorded in the 2022 wet season (preceding phase 1), potentially reducing the abundance and activity levels of some vertebrate groups during sampling. However, higher than average rainfall was recorded in the September 2022 (preceding phase 2). Temperatures during and preceding phase 2 were comparable to long-term averages; however, high temperatures (>35°C) were experienced during the phase 1 survey, resulting in trap sites being closed after the morning trap check and reopened in the late afternoon to reduce exposure to environmental elements. As a result, this may have reduced overall captures rates during this time; however, overall capture rates and species diversity were comparable to previous surveys (see Section 5.3), and species accumulation curves (see Section 5.5.1) indicate a negligible impact on the overall survey results.
Disturbance that may have affected results, e.g. fire, flood	No	No disturbance occurred during or immediately prior to the surveys.
Proportion of fauna identified, recorded or collected	No	All vertebrate fauna observed during the field surveys were identified to species or subspecies level. Species identification of fauna recorded via camera traps, acoustic and ultrasonic recordings were able to be accurately identified with the assistance of technical personnel with relevant expertise.

Potential limitation or constraint	Limitation to current survey	Applicability to this survey
Adequacy of the survey intensity and proportion of the survey achieved, e.g. the extent to which the area was surveyed	No	A basic and detailed survey was undertaken across the Study Area to assist with decisions on future environmental approvals. The sampling methods and survey intensity was appropriate to achieve the scope of the survey. The intent of the basic level survey was to collect preliminary and baseline information on site. The intent of the detailed survey was to obtain a more accurate representation of species and assemblages occurring within the Study Area.
Access problems	Partial	The Study Area was mostly accessible either by vehicle or on foot. However, the far northern section of the Study Area had no vehicle access and was not within walking distance of tracks, therefore limited sampling was achieved in this area. Comprehensive sampling was undertaken within all habitats occurring within the Study Area, therefore, access limitations to some parts of the Study Area are not considered to have detrimentally impacted the overall results, including the detection and/or assessment of likelihood of occurrence of significant species.
Problems with data and analysis, including sampling bias	No	No limitations with data collection and/or analysis were encountered during the field survey or during subsequent analysis.

6 CONCLUSION

A total of 12 broad fauna habitat types were recorded and mapped across the Study Area, comprising, in decreasing order of extent:

- Hillcrest/ Hillslope (33.54%, 1965.26 ha);
- Stony Plain (22.17%, 1299.07 ha);
- Drainage Area/ Floodplain (17.59%, 1030.66 ha);
- Cleared/ Disturbed (9.03%, 529.09 ha);
- Undulating Low Hills (5.03%, 294.50 ha);
- Major Drainage Line (4.43%, 259.53 ha);
- Gorge/ Gully (3.74%, 219.00 ha);
- Minor Drainage Line (1.66%, 97.00 ha);
- Breakaway/ Cliff (1.56%, 91.65 ha);
- Mulga Woodland (0.76%, 44.61 ha);
- Sand Plain (0.41%, 23.94 ha); and
- Dam (0.08%, 4.79 ha).

All broad fauna habitats within the Study Area have the potential to support significant species to varying extents. With regard to MNES species, Major Drainage Line, Gorge/ Gully and Breakaway/ Cliff habitats provide critical habitat for northern quoll and Pilbara olive python. Although Gorge/ Gully and Breakaway/ Cliff habitats are not classified as critical habitat for ghost bat or Pilbara leaf-nosed bat, they have the potential to contain critical habitat in the form of Category 1-2 and 3 (when found in an apartment block) caves (ghost bat) or Category 1-3 caves (Pilbara leaf-nosed bat). One critical Category 2 roost occurs within the easternmost portion of the Study Area (CNIM-02), and while multiple Category 3 roosts occur, none of them form part of an apartment block with a Category 1–2 roost, therefore are not deemed critical habitat for the species locally. Due to the occurrence of a critical roost within the Study Area, any occurrence of Stony Plain, Drainage Area/ Floodplain, Major Drainage Line, Minor Drainage Line and Mulga Woodland within 12 km of the roost are deemed critical foraging habitat. With the exception of the westernmost portion of the Study Area (within approximately 2.5 km of westernmost boundary of Study Area) which occurs beyond 12 km of the CNIM-02 roost, the majority of extent of these habitats within the Study Area is deemed critical foraging habitat. Drainage Area/ Floodplain, Major Drainage Line, Minor Drainage Line, Mulga Woodland, and to a lesser extent, Stony Plain and Sand Plain, may provide suitable nesting and foraging for southern whiteface. Hillcrest/ Hillslope, Stony Plain, Undulating Low Hills, Mulga Woodland and Drainage Area/ Floodplain habitat have the potential to provide suitable supporting foraging and dispersal habitat for some MNES species.

Hillcrest/ Hillslope, Stony Plain, Undulating Low Hills, Major Drainage Line, Gorge/ Gully, Minor Drainage Line, Breakaway Cliff and Sand Plain have the potential to provide important breeding, nesting, foraging and dispersal habitat for some or all of the following species; brush-tailed mulgara, western pebble-mound mouse, long-tailed dunnart, grey falcon, peregrine falcon, spotted Ctenotus and Pilbara flat-headed blind snake. All of the broad fauna habitats within the Study Area except for Cleared/ Disturbed provide supporting foraging and dispersal habitat in varying extents for peregrine falcon, long-tailed dunnart, fork-tailed swift, migratory water birds, spotted Ctenotus and Pilbara flat-headed blind snake.

A total of 13 caves are known from within the Study Area, comprising 11 recorded on previous surveys and two new caves recorded during the current survey. All of the caves occurring within the Study Area were classified primarily as nocturnal refuge (Category 4) caves for Pilbara leaf-nosed bats. For ghost bat usage, one cave was classified as a Category 2 roost (maternity/ diurnal roost caves with regular occupancy for ghost bats and defined as critical habitat), seven as Category 3 roosts (diurnal roost caves with occasional occupancy) and the remaining five as Category 4 roosts (nocturnal roost caves with opportunistic usage). None of the seven Category 3 roosts within the Study Area occur as part of an apartment block with any Category 2 roosts, and are therefore not considered critical habitat.

A total of 32 water features have been recorded within the Study Area to date, comprising ten recorded on previous surveys and 22 new water features recorded during the current survey. All of the water features known from within the Study Area are considered to provide supporting foraging features for the northern quoll, Pilbara leaf-nosed bat and Pilbara olive python.

The desktop assessment identified a total of 371 vertebrate fauna species as potentially occurring in the Study Area, comprising 51 mammals (41 native and ten non-native), 200 birds, 111 reptiles and nine amphibians. Of these, 41 are listed as significant species, 18 of which have previously been recorded within the Study Area, comprising:

- brush-tailed mulgara (Priority 4 – DBCA) – recorded on five occasions within Stony Plain and Drainage Area/ Floodplain habitat;
- ghost bat (VU – EPBC/BC Act) – recorded on multiple occasions from scats, ultrasonic calls and direct observation at caves CNIN-01, CNIN-03, CNIN-09 and CNIN-13 within Gorge/ Gully and Breakaway/ Cliff habitat;
- western pebble-mound mouse (Priority 4 – DBCA) – recorded on 54 occasions within Stony Plain and Hillcrest/ Hillslope habitat;
- Pilbara leaf-nosed bat (VU – EPBC/BC Act) – recorded sporadically from ultrasonic calls and direct observation at caves CNIN-03 and CNIN-09 within Gorge/ Gully and Breakaway/ Cliff habitat;
- grey falcon (VU – EPBC/BC Act) – recorded on one occasion within Hillcrest/ Hillslope habitat;
- gull-billed tern (MI – EPBC/BC Act) – recorded on two occasions within Drainage Area/ Floodplain habitat;
- caspian tern (MI – EPBC/BC Act) – recorded on one occasion within Dam habitat;
- common sandpiper (MI – EPBC/BC Act) – recorded on one occasion within Dam habitat;
- sharp-tailed sandpiper (MI – EPBC/BC Act) – recorded on one occasion within Dam habitat;

- red-necked stint (MI – EPBC/BC Act) – recorded on one occasion within Drainage Area/ Floodplain habitat;
- long-toed stint (MI – EPBC/BC Act) – recorded on two occasions within Dam habitat;
- black-tailed godwit (MI – EPBC/BC Act) – recorded on one occasion within Dam habitat;
- wood sandpiper (MI – EPBC/BC Act) – recorded on two occasions within Dam habitat;
- common greenshank (MI – EPBC/BC Act) – recorded on two occasions within Dam habitat;
- marsh sandpiper (MI – EPBC/BC Act) – recorded on one occasion within Dam habitat;
- glossy ibis (MI – EPBC/BC Act) – recorded on three occasions within Dam habitat;
- Pilbara olive python (VU – EPBC/BC Act) – recorded on ten occasions within Gorge/ Gully habitat; and
- Pilbara flat-headed blind snake (Priority 1 – DBCA) – recorded on three occasions within Stony Plain habitat.

A total of 217 vertebrate fauna species, comprising 29 mammal species (24 native and five introduced), 125 bird species, 59 reptile species and four amphibian species were recorded from the Study Area during the current survey. Species recorded during the current survey were typical of assemblages occurring within the broad fauna habitats occurring within the Study Area and more broadly across the Pilbara region.

Five significant species were recorded within the Study Area during the current survey:

- Pilbara leaf-nosed bat (VU – EPBC/BC Act) – recorded on 13 occasions from ultrasonic calls within Sand Plain, Major Drainage Line, Gorge/ Gully and Minor Drainage Line habitats;
- western pebble-mound mouse (Priority 4 – DBCA) – recorded on 23 occasions from secondary evidence (pebble-mounds; $n = 22$, comprising seven active mounds, three recently inactive and 12 inactive) and a captured individual ($n = 1$) within Hillcrest/ Hillslope and Stony Plain habitats;
- common sandpiper (MI – EPBC/BC Act) – recorded one individual within Dam habitat;
- fork-tailed swift (MI – EPBC/BC Act) – recorded three individuals within Drainage Area/ Floodplain habitat; and
- glossy ibis (MI – EPBC/BC Act) – recorded four individuals within Dam habitat.

In addition to those species previously recorded within the Study Area during the current and/or previous surveys, based on known species' distributions, previous records and the habitats present, no species were considered Highly Likely to occur, one species, peregrine falcon (OS – BC Act) was deemed Likely to occur, 15 species, northern quoll (EN – EPBC/BC Act), southern whiteface (VU – EPBC Act), long-tailed dunnart (Priority 4 – DBCA), spotted Ctenotus (Priority 2 – DBCA), garganey, little ringed plover, oriental plover, barn swallow, black-necked stork, yellow wagtail, Australian painted snipe, pectoral sandpiper, common redshank, ruff (all listed as Migratory under the EPBC/BC Act) and curlew sandpiper (CR/MI – EPBC/BC Act) were deemed Possible to occur and six were considered Unlikely to occur.

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8 APPENDICES

Appendix A – Conservation listings

Environment Protection and Biodiversity Conservation Act 1999

Category	Definition
Threatened	
Extinct (EX)	Presumed extinct i.e. there is no reasonable doubt that the last member of the species has died.
Extinct in the Wild (EW)	Presumed extinct in the wild, only surviving in cultivation, captivity or as a naturalised population well outside its past range.
Critically Endangered (CE)	Taxa facing an extremely high risk of extinction in the wild in the immediate future (i.e. 50% chance of extinction in the immediate future).
Endangered (EN)	Taxa facing a very high risk of extinction in the wild in the near future i.e. 20% chance of extinction in the near future.
Vulnerable (VU)	Taxa facing a high risk of extinction in the wild in the medium-term future i.e. 10% chance of extinction in the medium-term future.
Conservation Dependent (CD)	Taxa which will become Vulnerable, Endangered or Critically Endangered if specific conservation efforts cease.
Other	
Migratory (MI)	Birds listed under international agreements relating to the protection of migratory birds i.e. Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), China-Australia Migratory Bird Agreement (CAMBA), Japan-Australia Migratory Bird Agreement (JAMBA) or Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA).

Biodiversity Conservation Act 2016

Category	Definition
Extinct	
Extinct (EX)	Presumed extinct i.e. there is no reasonable doubt that the last member of the species has died.
Extinct in the Wild (EW)	Presumed extinct in the wild i.e. species which have been adequately searched for and there is no reasonable doubt that the last wild individual has died.
Threatened	
Critically Endangered (CE)	Taxa facing an extremely high risk of extinction in the wild.
Endangered (EN)	Taxa facing a very high risk of extinction in the wild.
Vulnerable (VU)	Taxa facing a high risk of extinction in the wild.
Specially Protected	
Migratory (MI)	Birds listed under international agreements relating to the protection of migratory birds i.e. Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), China-Australia Migratory Bird Agreement (CAMBA), Japan-Australia Migratory Bird Agreement (JAMBA) or Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA).
Conservation Dependent (CD)	Species dependent on ongoing conservation intervention to prevent them becoming eligible for listing as threatened.
Other specially protected fauna (OS)	Species otherwise in need of special protection to ensure their conservation.

Department of Biodiversity, Conservation and Attractions Priority codes

Category	Definition
Poorly known	
Priority 1 (P1)	Species that are known from one or a few locations which are potentially at risk. Species whose occurrences are either small, on lands not managed for conservation or otherwise threatened with habitat destruction or degradation. Species that are well known from one or more locations but are under immediate threat from threatening processes. In urgent need of further survey.
Priority 2 (P2)	Species that are known from one or a few locations, some of which are on lands managed for conservation. Species that are well known from one or more locations but are under threat from threatening processes. In urgent need of further survey. In need of further survey.
Priority 3 (P3)	Species that are well known from several locations and are not are under imminent threat. Species known from few but widespread locations with either a large population size or with large areas of suitable habitat remaining, much of which is not under imminent threat. Species that are well known from one or more locations and threatening processes exist that could affect them.
Rare, Near Threatened and other species in need of monitoring	
Priority 4 (P4)	<i>Rare</i> – Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and which are considered not currently threatened or in need of special protection but could be if present circumstances change. <i>Near Threatened</i> – Species that are considered to have been adequately surveyed and that are close to qualifying for Vulnerable but are not listed as Conservation Dependent. <i>In need of monitoring</i> - Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy

International Union for Conservation of Nature

Category	Definition
Extinct (Ex)	A taxon is Extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.
Extinct in the Wild (Ex)	A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range. A taxon is presumed Extinct in the Wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.
Critically Endangered (Cr)	A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered (see Section V), and it is therefore considered to be facing an extremely high risk of extinction in the wild.
Endangered (En)	A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered (see Section V), and it is therefore considered to be facing a very high risk of extinction in the wild.

Category	Definition
Vulnerable (Vu)	A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable (see Section V), and it is therefore considered to be facing a high risk of extinction in the wild.
Near Threatened (NT)	A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future
Data Deficient (DD)	A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases, great care should be exercised in choosing between DD and a threatened status. If the range of a taxon is suspected to be relatively circumscribed, and a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.

Appendix B – Summary of literature review

Reference	Survey details	Proximity to Study Area	Survey methods	Significant species habitat	Vertebrate fauna assemblage found (summary of species richness)	Significant species	Survey limitations/notes
1. Biologic (2014a)	<u>Project:</u> Orebody 19 Level 2 Vertebrate Fauna Survey <u>Client:</u> BHP <u>Survey date:</u> Season 1: 24th May – 6th June 2013 Season 2: 27th August – 6th September 2013 Night sampling: 3rd and 5th December 2013 <u>Survey type:</u> Two-season detailed vertebrate fauna survey with additional night sampling <u>Experience:</u> Principal Zoologist x2 Senior Zoologist x4	Within Study Area	• Ultrasonic recording • Camera traps • Systematic trapping • Targeted searches • Nocturnal searches • Bird census • Opportunistic observations • Habitat assessment	• Sand Plain • Stony Plain • Minor Drainage Line • Crest/Slope • Gorge/Gully	<u>136 vertebrate species</u> • 20 native mammals • 3 introduced mammals • 62 birds • 48 reptiles • 1 amphibian	<u>Threatened</u> • ghost bat (<i>Macroderma gigas</i>) • Pilbara olive python (<i>Liasis olivaceus</i> subsp. <i>barroni</i>) <u>Priority</u> • brush-tailed mulgara (<i>Dasycercus blythi</i>) • western pebble-mound mouse (<i>Pseudomys chapmani</i>) • Pilbara flat-headed blindsnake (<i>Anilius ganei</i>) <u>Historically significant</u> • rainbow bee-eater (<i>Merops ornatus</i>)	• None
2. Eco Logical (2013)	<u>Project:</u> Ninga Level 1 Vertebrate Fauna Assessment <u>Client:</u> BHP <u>Survey date:</u> 10th – 16th May 2013 <u>Survey type:</u> Basic vertebrate fauna assessment <u>Experience:</u> Senior Zoologist x1 Senior Ecologist x1	Within Study Area	• Opportunistic observations • Active foraging • Camera traps • Ultrasonic recording	• Rivers And Major Creeks • Low Shrubland Plains • Stony Rises and Lower Stony Hill Slopes • Rocky Hilltops • Steep Rocky Canyons and Cliffs	<u>71 vertebrate species</u> • 5 native mammals • 4 introduced mammals • 41 birds • 16 reptiles • 1 amphibian	<u>Threatened</u> • Pilbara olive python (<i>Liasis olivaceus</i> subsp. <i>barroni</i>) • grey falcon (<i>Falco hypoleucos</i>) <u>Priority</u> • brush-tailed mulgara (<i>Dasycercus blythi</i>) • western pebble-mound mouse (<i>Pseudomys chapmani</i>) <u>Historically significant</u> • rainbow bee-eater (<i>Merops ornatus</i>)	• None
3. ENV (2011c)	<u>Project:</u> Orebody 42/43 Flora, Vegetation And Fauna Assessment <u>Client:</u> BHP <u>Survey date:</u> 2nd – 6th December 2010 <u>Survey type:</u> Basic flora, vegetation and vertebrate fauna assessment <u>Experience:</u> Senior Zoologist x1	Within Study Area	• Habitat assessments • Opportunistic observations	• Riverine • Minor Drainage Line • Alluvial Plain • Low Hill • Completely degraded	<u>41 vertebrate species</u> • 2 native mammals • 3 introduced mammals • 36 birds	<u>Threatened</u> • eastern great egret (<i>Ardea modesta</i>) • common sandpiper (<i>Actitis hypoleucos</i>) <u>Historically significant</u> • rainbow bee-eater (<i>Merops ornatus</i>) • Australian bustard (<i>Ardeotis australis</i>)	• Habitat assessment and opportunistic survey only • Only one person on survey

Reference	Survey details	Proximity to Study Area	Survey methods	Significant species habitat	Vertebrate fauna assemblage found (summary of species richness)	Significant species	Survey limitations/notes
4. Outback Ecology (2009b)	<u>Project:</u> Jimblebar Linear Development Terrestrial Vertebrate Fauna Assessment <u>Client:</u> BHP <u>Survey date:</u> Phase 1: 22nd September – 4th October 2008 Phase 2: 3rd – 11th April 2009 <u>Survey type:</u> Two-season detailed vertebrate fauna survey <u>Experience:</u> Project Manager x1 Zoologist x4 Biologist/Ornithologist x1	Within Study Area	- Bird census - Nocturnal survey - Systematic trapping - Active searching - Opportunistic observations - Habitat assessment	- Alluvial Plain - Hillcrest - Riverine - Drainage Line - Spinifex Shrubland - Mulga Woodland	<u>148 vertebrate species</u> 7 native mammals 2 introduced mammal 80 birds 47 reptiles 4 amphibians	<u>Priority</u> - western pebble-mound mouse (<i>Pseudomys chapmani</i>) - blind snake (<i>Anilius ganei</i>) <u>Historically significant</u> - rainbow bee-eater (<i>Merops ornatus</i>) - Australian bustard (<i>Ardeotis australis</i>) - star finch (<i>Neochmia ruficauda subclarescens</i>) - Australian reed warbler (<i>Acrocephalus australis</i>)	None
5. Ecologia (1996)	<u>Project:</u> Jimblebar Rail Spur Biological Assessment Survey <u>Client:</u> BHP <u>Survey date:</u> 7th – 15th June 1995 <u>Survey type:</u> Single season detailed vertebrate fauna survey Flora survey <u>Experience:</u> Project Manager x1 Zoologist x3	Within Study Area	- Systematic - Bird census - Opportunistic observations	- Creekbank - Creekbed	<u>72 vertebrate species</u> 3 native mammals 1 introduced mammals 59 birds 7 reptiles 2 amphibians	<u>Threatened</u> peregrine falcon (<i>Falco peregrinus</i>)	None
6. MWH (2015)	<u>Project:</u> Ophthalmia Dam Avian Fauna Survey <u>Client:</u> BHP <u>Survey date:</u> Phase 1: 7th – 12th December 2014 Phase 2: 12th – 14th March 2015 <u>Survey type:</u> Avian fauna survey <u>Experience:</u> Principal Zoologist x1 Senior Zoologist x2	Overlapping with southwest corner of Study Area (Ophthalmia Dam)	- Point-count census - Systematic searching - Spotlighting - Targeted searches - Opportunistic records	- Mulga Woodland - Drainage Area - Sandy Plain - Major Drainage Line - Low Hills - Stony Plain - Cleared Areas - Hillcrest/Hillslope - Artificial Wetlands - Minor Drainage Line - Breakaway/ Cliff	123 birds	<u>Threatened</u> - curlew sandpiper (<i>Calidris ferruginea</i>) - little ringed plover (<i>Charadrius dubius</i>) - barn swallow (<i>Hirundo rustica</i>) - common sandpiper (<i>Actitis hypoleucos</i>) - sharp-tailed sandpiper (<i>Calidris acuminata</i>) - pectoral sandpiper (<i>Calidris melanotos</i>) - long-toed stint (<i>Calidris subminuta</i>) - black-tailed godwit (<i>Philomachus pugnax</i>) - ruff (<i>Philomachus pugnax</i>) - wood sandpiper (<i>Tringa glareola</i>) - common greenshank (<i>Tringa nebularia</i>) - marsh sandpiper (<i>Tringa stagnatilis</i>) - glossy ibis (<i>Plegadis falcinellus</i>) <u>Historically significant</u> - white-bellied sea-eagle (<i>Haliaeetus leucogaster</i>) - eastern great egret (<i>Ardea modesta</i>) - rainbow bee-eater (<i>Merops ornatus</i>)	Bird survey only

Reference	Survey details	Proximity to Study Area	Survey methods	Significant species habitat	Vertebrate fauna assemblage found (summary of species richness)	Significant species	Survey limitations/notes
7. Ecologia (2008)	<u>Project:</u> RGP5 Fauna Survey Newman to Jimblebar Junction <u>Client:</u> BHP <u>Survey date:</u> 13th – 14th November 2007 <u>Survey type:</u> Basic vertebrate fauna assessment <u>Experience:</u> Senior Zoologist x1 Zoologist x1	Along western boundary of Study Area (rail corridor)	- Bird census - Nocturnal searches - Active foraging - Opportunistic observations	- Open Floodplain - Rocky Hillside - Minor Drainage line	<u>53 vertebrate species</u> 2 native mammals 3 introduced mammals 39 birds 9 reptiles	<u>Historically significant</u> rainbow bee-eater (<i>Merops ornatus</i>)	Bats were not sampled due to failure of the bat recording equipment
8. ENV (2006)	<u>Project:</u> OB24 Flora and Fauna Assessment Phase 2 <u>Client:</u> Mine and Port Developments Joint Venture (MPDJV) <u>Survey date:</u> March 2006 (no specific date listed) <u>Survey type:</u> Single season detailed vertebrate fauna survey Flora survey <u>Experience:</u> Senior Biologist x1 Ornithologist x1 Zoologist x1 Taxonomist x1 Principal Biologist x1	Some overlap on western boundary of Study Area. Majority extends further west	- Systematic trapping - Opportunistic observations - Active searching - Nocturnal surveys	- Range Crests - Range Slopes - Breakaways - Gorge/Gully - Minor Drainage line - Valley Plains	<u>106 vertebrate species</u> 7 native mammals 2 Introduced mammal 63 birds 31 reptiles 3 amphibians	<u>Threatened:</u> - ghost bat (<i>Macroderma gigas</i>) - Pilbara olive python (<i>Liasis olivaceus</i> subsp. <i>barroni</i>) <u>Priority:</u> - western pebble-mound mouse (<i>Pseudomys chapmani</i>) <u>Historically significant</u> - yellow-bellied sheathtail bat (<i>Saccolaimus flaviventris</i>) - star finch (<i>Neochmia ruficauda subclarescens</i>)	- No pitfall traps - Limited number of warm nights may have limited the activity of some faunal groups - Daily pit blasting limited working hours
9. Eco Logical (2012)	<u>Project:</u> Orebody 37 Level 1 Vertebrate Fauna Assessment <u>Client:</u> BHP <u>Survey date:</u> Trip 1: 15th – 16th March 2012 Trip 2: 23rd – 25th April 2012 <u>Survey type:</u> Basic vertebrate fauna assessment <u>Experience:</u> Senior Zoologist x1 Ecologist x1	Partial overlap with Study Area (southwest corner). Actual sampling sites for this survey are outside of Study Area, nearest being ~1 km southwest	- Opportunistic observations - Active foraging - Camera traps - Ultrasonic recording	- Mixed Acacia and Eucalypt Plains - Stony Gentle Slopes and Low Hills - Stony/ Rocky Hilltops and Ridges - Rivers and Major Creeklines - Broad Alluvial Lowlands	<u>91 vertebrate species</u> 10 native mammals 5 introduced mammals 45 birds 11 reptiles 1 amphibian	<u>Historically significant</u> - Australian bustard (<i>Ardeotis australis</i>) - great egret (<i>Ardea alba</i>) - rainbow bee-eater (<i>Merops ornatus</i>) - star finch (<i>Neochmia ruficauda subclarescens</i>)	- Field survey completed over 2 trips due to Tropical Cyclone Lua - Higher than average rainfall
10. ENV (2011a)	<u>Project:</u> Eastern Ridge (OB23/24/25) Fauna Assessment <u>Client:</u> BHP <u>Survey date:</u> 17th – 21st May 2011 <u>Survey type:</u> Basic vertebrate fauna assessment <u>Experience:</u> Senior Zoologist x1 Zoologist x1	~500 m west	- Habitat assessments - Opportunistic observations - Acoustic recordings	- Gorge/Gully - Riverine - Minor Drainage Line - Alluvial Plain - Breakaway - Low Hill - Hillslope/Hillcrest	<u>69 vertebrate species</u> 10 native mammals 0 introduced mammals 46 birds 11 reptiles 2 amphibians	<u>Threatened</u> - Pilbara olive python (<i>Liasis olivaceus</i> subsp. <i>barroni</i>) <u>Priority:</u> - western pebble-mound mouse (<i>Pseudomys chapmani</i>) <u>Historically significant</u> - Australian bustard (<i>Ardeotis australis</i>) - rainbow bee-eater (<i>Merops ornatus</i>)	- The area to the south of the power line (along the main access road) was inaccessible - No trapping

Reference	Survey details	Proximity to Study Area	Survey methods	Significant species habitat	Vertebrate fauna assemblage found (summary of species richness)	Significant species	Survey limitations/notes
11. Biologic (2013a)	<u>Project:</u> Ore Body 24 Targeted Vertebrate Fauna Survey <u>Client:</u> BHP <u>Survey date:</u> 3rd – 10th May 2013 <u>Survey type:</u> Targeted vertebrate fauna survey <u>Experience:</u> Senior Zoologist x3 Zoologist x2	~1.7 km west	- Targeted searches - Ultrasonic recording - Camera traps - Targeted trapping – Elliotts and cages - Opportunistic observations - Habitat assessments	- Minor Drainage Line - Major Drainage Line - Crest/ Slope - Sand Plain - Stony/ Sand Plain - Mulga Plain - Gorge/ Gully	<u>81 vertebrate species</u> 18 native mammals 44 birds 18 reptiles 1 amphibian	<u>Threatened</u> - ghost bat (<i>Macroderma gigas</i>) - Pilbara leaf-nosed bat (<i>Rhinonicteris aurantia</i>) - peregrine falcon (<i>Falco peregrinus</i>) - Pilbara olive python (<i>Liasis olivaceus</i> subsp. <i>barroni</i>) <u>Priority</u> - mulgara (<i>Dasycercus sp.</i>) - western pebble-mound mouse (<i>Pseudomys chapmani</i>)	None
12. Biologic (2021c)	<u>Project:</u> Western Ridge Pipelines Vertebrate Fauna Survey <u>Client:</u> BHP <u>Survey date:</u> 24th – 31st March 2021 <u>Survey type:</u> Basic and targeted vertebrate fauna assessment <u>Experience:</u> Principal Zoologist x1 Zoologist x 1	~2.3 km southwest	- Targeted searches - Nocturnal searches - Camera taps - Acoustic recording - Ultrasonic recording - Bilby plots - Habitat assessments - Opportunistic observations	- Stony Plain - Mulga Woodland - Drainage Area/ Floodplain - Major Drainage Line - Medium Drainage Line - Hillcrest/ Hillslope - Cleared/ Disturbed	<u>95 vertebrate species</u> 12 native mammals 3 introduced mammals 66 birds 12 reptiles 2 amphibians	<u>Threatened</u> - Pilbara olive python (<i>Liasis olivaceus</i> subsp. <i>barroni</i>) <u>Priority</u> - western pebble-mound mouse (<i>Pseudomys chapmani</i>)	None
13. ENV (2007b)	<u>Project:</u> West Jimblebar Lease Fauna Assessment <u>Client:</u> BHP <u>Survey date:</u> 14th – 21st May 2007 <u>Survey type:</u> Single season detailed vertebrate fauna survey <u>Experience:</u> Biologist x2 Ornithologist x1 Taxonomist x1	~3.6 km southeast	- Systematic trapping - Acoustic recording - Opportunistic observations - Habitat assessment - Active searches - Bird census - Nocturnal searches	- Loamy Flats and Floodplains - Sandplains - Breakaway - Drainage Line - Scree Slopes	<u>109 vertebrate species</u> 4 native mammals 5 introduced mammals 73 birds 27 reptiles	<u>Threatened</u> peregrine falcon (<i>Falco peregrinus</i>)	Technical difficulties with the Anabat II acoustic recorders resulted in less than the desired quantity of bat recording time.
14. Ecologia (2004c)	<u>Project:</u> Orebody 24 Expansion Biological Survey <u>Client:</u> BHP <u>Survey date:</u> 18th – 27th May 2004 <u>Survey type:</u> Single season detailed vertebrate fauna survey Flora survey <u>Experience:</u> Senior Zoologist x1 Zoologist x3 Ornithologist x1 Zoology Field assistant x1	~4 km west	- Systematic trapping - Active searching - Nocturnal searches - Bird census - Ultrasonic recording - Opportunistic observations	- Range Crests - Range Slopes - Breakaways - Gorge/ Gully - Minor Channels - Valley Plains	<u>90 vertebrate species</u> 4 native mammals 2 introduced mammals 62 birds 22 reptiles	<u>Historically significant</u> - rainbow bee-eater (<i>Merops ornatus</i>) - desert mouse (<i>Pseudomys desertor</i>) - yellow-bellied sheathail bat (<i>Saccolaimus flaviventris</i>) - white-striped mastiff bat (<i>Tadarida australis</i>)	- The main hill range has been impacted by fire within the last 1-5 years, with the range crests and upper range slopes most severely affected. - The survey coincided with the cooler winter months, hence reptile activity was much lower than would be expected during the warmer months. No amphibian species were recorded during the survey due to the lack of available water at the site

Reference	Survey details	Proximity to Study Area	Survey methods	Significant species habitat	Vertebrate fauna assemblage found (summary of species richness)	Significant species	Survey limitations/notes
15. Biologic (2014b)	<u>Project:</u> Orebody 25 Targeted Vertebrate Fauna Survey <u>Client:</u> BHP <u>Survey date:</u> 5th – 10th August 2013 <u>Survey type:</u> Targeted vertebrate fauna survey <u>Experience:</u> Senior Zoologist x2	~6 km west	- Targeted searches - Ultrasonic recording - Camera traps - Opportunistic observations - Habitat assessments	- Crests/ Slopes - Major Drainage Lines - Minor Drainage Lines - Sand Plains - Stony/ Sand Plains - Cleared	<u>47 vertebrate species</u> 11 native mammals 2 introduced mammals 28 birds 6 reptiles	<u>Threatened</u> - Pilbara olive python (<i>Liasis olivaceus</i> subsp. <i>barroni</i>) <u>Historically significant</u> - Australian bustard (<i>Ardeotis australis</i>) - rainbow bee-eater (<i>Merops ornatus</i>)	Some bat species unable to be identified by call due to similarity of calls between a genus; however, this did not affect the identification of significant species
16. Onshore and Biologic (2009b)	<u>Project:</u> Biological Survey Myopic Exploration Leases <u>Client:</u> BHP <u>Survey date:</u> 8th – 10th June 2009 <u>Survey type:</u> Basic vertebrate fauna survey Flora survey <u>Experience:</u> Project Manager x1 Senior Botanist x1 Senior Biologist x1	~6 km west	- Opportunistic observations - Bird census - Ultrasonic recording - Active searches - Habitat assessment	- Riverine - Minor Drainage Line - Hilltops and Slopes - Minor Drainage Valley with Outcropping - Mulga Woodland	<u>65 vertebrate species</u> 7 native mammals 3 introduced mammals 48 birds 7 reptiles	<u>Priority</u> - western pebble-mound mouse (<i>Pseudomys chapmani</i>) <u>Historically significant</u> - Australian bustard (<i>Ardeotis australis</i>)	No trapping
17. GHD (2008)	<u>Project:</u> Report for Myopic Project Area Newman Flora and Fauna Assessment <u>Client:</u> BHP <u>Survey date:</u> 26th May – 4th June 2008 <u>Survey type:</u> Basic vertebrate fauna survey Flora survey <u>Experience:</u> “One team of experienced GHD botanists”	~6 km west	- Habitat assessments - Opportunistic observations	- Ridges and Scree Slopes - Breakaways, Cliff Faces, Gullies and Gorges - Woodlands and Shrublands - Drainage Lines	<u>41 vertebrate species</u> 3 native mammals 3 introduced mammals 32 birds 3 reptiles	<u>Threatened</u> - Peregrine falcon (<i>Falco peregrinus</i>) <u>Priority</u> - western pebble-mound mouse (<i>Pseudomys chapmani</i>)	- Surveys were not timed to correspond with periods of frog activity, and hence no frogs were recorded during the surveys - One botany team completed the opportunistic fauna survey in conjunction with the flora survey
18. Biologic (2014c)	<u>Project:</u> Orebody 31 Vertebrate Fauna Survey <u>Client:</u> BHP <u>Survey date:</u> Trapping: 2nd – 11th October 2013 Night Sampling: 2nd – 6th December 2013 <u>Survey type:</u> Single season detailed vertebrate fauna survey <u>Experience:</u> Senior Zoologist x4 Zoologist x1	~8 km east	- Ultrasonic recording - Camera traps - Systematic trapping - Targeted searches - Nocturnal survey - Bird census - Opportunistic observations - Habitat assessments	- Sand Plain - Minor Drainage Line - Drainage Area - Crest/ Slope - Gorge/ Gully	<u>103 vertebrate species</u> 16 native mammals 6 introduced mammals 39 birds 42 reptiles	<u>Threatened</u> - fork-tailed swift (<i>Apus pacificus</i>) <u>Priority</u> - brush-tailed mulgara (<i>Dasycercus blythi</i>) <u>Historically significant</u> - Australian bustard (<i>Ardeotis australis</i>) - rainbow bee-eater (<i>Merops ornatus</i>)	Some bat species unable to be identified by call due to similarity of calls between a genus; however, this did not affect the identification of significant species

Reference	Survey details	Proximity to Study Area	Survey methods	Significant species habitat	Vertebrate fauna assemblage found (summary of species richness)	Significant species	Survey limitations/notes
19. Outback Ecology (2009a)	<u>Project:</u> Jimblebar Iron Ore Project Terrestrial Vertebrate Fauna Assessment <u>Client:</u> BHP <u>Survey date:</u> Phase 1: 4th – 15th June 2008 Phase 2: 27th September – 3rd October 2008 <u>Survey type:</u> Basic vertebrate fauna survey <u>Experience:</u> Project Manager x1 Zoologist x1 Biologist x2 Consulting zoologist x2	~8 km southeast	- Systematic trapping - Active searching - Bird census - Nocturnal searches	- Open Shrub Plain - Mulga and Mixed - Acacia Woodland - Riverine - Rocky Gorge - Hillcrest/ Hillslope	<u>93 vertebrate species</u> 11 native mammals 6 introduced mammals 47 birds 29 reptiles 2 amphibians	<u>Priority</u> western pebble-mound mouse (<i>Pseudomys chapmani</i>) <u>Historically significant</u> - Australian bustard (<i>Ardeotis australis</i>) - rainbow bee-eater (<i>Merops ornatus</i>) - bush stone-curlew (<i>Burhinus grallarius</i>)	Bat fauna were specifically targeted by Specialised Zoological in 2008 and as such are not included as part of this fauna survey
20. Biologic (2021a)	<u>Project:</u> Western Ridge Creeks Targeted MNES Species Survey <u>Client:</u> BHP <u>Survey date:</u> 24th March – 30th March 2021 <u>Survey type:</u> Targeted vertebrate fauna survey <u>Experience:</u> Senior Zoologist x1 Zoologist x1	~9.3 km southwest	- Habitat assessments - Camera traps - Targeted searches - Nocturnal searches - eDNA sampling - Ultrasonic recording - Acoustic recording	- Drainage area/ Floodplain - Major Drainage Line - Stony Plain - Medium Drainage Line - Hardpan Plain	<u>82 vertebrate species</u> 2 native mammals 5 introduced mammals 60 birds 13 reptiles 2 amphibian	<u>Threatened</u> Pilbara olive python (<i>Liasis olivaceus</i> subsp. <i>barroni</i>)	None
21. Ecologia (2004b)	<u>Project:</u> Jimblebar-Wheelarra Hill Biological Survey <u>Client:</u> BHP <u>Survey date:</u> Trip 1: 9th – 13th March 2004 Trip 2: 24th February – 1st March 2004 <u>Survey type:</u> Two-season detailed vertebrate fauna survey Flora survey <u>Experience:</u> Senior Zoologist x1 Zoologist x3 Ornithologist x1 Environmental scientist x1 Zoology field assistant x1	~10 km southeast	- Systematic trapping - Opportunistic observations - Foraging - Nocturnal searches	- Mesa Top - Rocky Gully - Riverine - Alluvial Plain - Screes	<u>99 vertebrate species</u> 8 native mammals 1 introduced mammals 57 birds 29 reptiles 4 amphibians	<u>Priority</u> - western pebble-mound mouse (<i>Pseudomys chapmani</i>) <u>Historically significant</u> - bush stone-curlew (<i>Burhinus grallarius</i>)	- Fauna Survey suspended from 13th – 23rd Feb 2004 due to inclement weather (ex-Tropical Cyclone Monty) - Recent fires across much of the project area has most likely disrupted the structure and diversity of the site such that the range slopes, gullies and crests may be in a period of succession.

Reference	Survey details	Proximity to Study Area	Survey methods	Significant species habitat	Vertebrate fauna assemblage found (summary of species richness)	Significant species	Survey limitations/notes
22. GHD (2019b)	<u>Project:</u> North Jimblebar Fauna Survey <u>Client:</u> BHP <u>Survey date:</u> 29th April – 10th May 2019 <u>Survey type:</u> Single season detailed vertebrate fauna assessment <u>Experience:</u> Principle Zoologist x1 Senior Zoologist x 4 Ecologist x2	~13 km east	- Systematic trapping - Acoustic recording - Habitat assessment - Nocturnal searches - Ultrasonic recording - Bilby plots - Active searches - Opportunistic observations - Bird census - Cave searches	- Hillcrest/ Hillslope - Gorge/ Gully - Major Drainage Line - Minor Drainage Line - Sand Plain - Mulga Woodland - Drainage Area/ Floodplain - Stony Plain - Disturbed	<u>129 vertebrate species</u> 17 native mammals 5 introduced mammals 62 birds 45 reptiles	<u>Threatened</u> - ghost bat (<i>Macroderma gigas</i>) - peregrine falcon (<i>Falco peregrinus</i>) <u>Priority</u> <u>Historically significant</u> - western pebble-mound mouse (<i>Pseudomys chapmani</i>) - peregrine falcon (<i>Falco peregrinus</i>)	None
23. Biologic (2016)	<u>Project:</u> Cathedral Gorge Level 1 and Targeted Vertebrate Fauna Survey <u>Client:</u> BHP <u>Survey date:</u> 30th September – 5th October 2015 <u>Survey type:</u> Basic and targeted vertebrate fauna survey <u>Experience:</u> Principal Zoologist x1 Senior Zoologist x1	~13.5 km west	- Targeted searches - Ultrasonic recording - Camera traps - Opportunistic observations - Habitat assessments	- Mulga Woodland - Sand Plain - Stony Plain - Hillcrest/ Hillslope - Gorge/ Gully - Minor Drainage Line - Drainage Area/ Floodplain - Major Drainage Line	<u>72 vertebrate species</u> 13 native mammals 3 introduced mammals 46 birds 10 reptiles	<u>Threatened</u> - Pilbara leaf-nosed bat (<i>Rhinioncteris aurantia</i>) - ghost bat (<i>Macroderma gigas</i>) - Pilbara olive python (<i>Liasis olivaceus subsp. barroni</i>) <u>Priority</u> - western pebble-mound mouse (<i>Pseudomys chapmani</i>) <u>Historically significant</u> - rainbow bee-eater (<i>Merops ornatus</i>)	- Some bat species unable to be identified by call due to similarity of calls between a genus; however this did not affect the identification of significant species - Dry conditions prevailed during the survey, possibly reducing the activity of fauna to a significant extent.
24. ENV (2011b)	<u>Project:</u> Mt Whaleback East Flora, Vegetation and Fauna Assessment <u>Client:</u> BHP <u>Survey date:</u> 17th – 21st January 2011 <u>Survey type:</u> Basic vertebrate fauna survey Flora survey <u>Experience:</u> Senior Environmental Biologist/botanist x1 Environmental Biologist x2 Senior Botanist/Taxonomist x1	~14 km southwest	- Habitat assessments - Opportunistic observations - Acoustic recording	- Alluvial Plain - Breakaway - Low Hill - Hillcrest - Hillslope	<u>39 vertebrate species</u> 2 native mammals 1 introduced mammal 29 birds 7 reptiles	None	None
25. Onshore and Biologic (2009a)	<u>Project:</u> Mt Whaleback Mine Flora & Vegetation survey and Fauna Assessment <u>Client:</u> BHP <u>Survey date:</u> 22nd – 25th June 2009 <u>Survey type:</u> Basic vertebrate fauna survey Flora survey <u>Experience:</u> Project Manager x1 Senior Botanist x1 Senior Biologist x1	~14 km southwest	- Opportunistic observations - Habitat assessments - Active searching - Bird census - Ultrasonic recording	- Riverine - Spinifex Sandplain - Spinifex Hilltop/ Slope - Mulga Woodland - Rehabilitated Area	<u>65 vertebrate species</u> 4 native mammals 3 introduced mammals 51 birds 7 reptiles	<u>Historically significant</u> - star finch (<i>Neochmia ruficauda subclarescens</i>) - rainbow bee-eater (<i>Merops ornatus</i>)	No trapping

Reference	Survey details	Proximity to Study Area	Survey methods	Significant species habitat	Vertebrate fauna assemblage found (summary of species richness)	Significant species	Survey limitations/notes
26. Biologic (2020a)	<u>Project:</u> Coombanbunna Well Level 2 Vertebrate Fauna Survey <u>Client:</u> BHP <u>Survey date:</u> Phase 1: 26th November – 7th December 2019 Phase 2: 25th February – 6th March 2020 <u>Survey type:</u> Two season detailed vertebrate fauna survey <u>Experience:</u> Senior Zoologist x3 Zoologist x1	~16 km southwest	- Systematic trapping - Bird census - Nocturnal searches - Camera traps - Acoustic recording - Ultrasonic recording - Targeted searches - Habitat assessments - Opportunistic observations	- Stony Plain - Drainage Area/ Floodplain - Hardpan Plain - Mulga Woodland - Hillcrest/ Hillslope	<u>152 vertebrate species</u> 20 native mammals 5 introduced mammals 75 birds 50 reptiles 2 amphibians	<u>Threatened</u> - Pilbara leaf-nosed bat (<i>Rhinonicteris aurantia</i>) - peregrine falcon (<i>Falco peregrinus</i>) <u>Priority</u> - western pebble-mound mouse (<i>Pseudomys chapmani</i>)	None
27. Onshore (2014)	<u>Project:</u> Western Ridge Biological Survey <u>Client:</u> BHP <u>Survey date:</u> 21st – 24th June 2014 <u>Survey type:</u> Basic vertebrate fauna survey Flora survey <u>Experience:</u> Senior Zoologist x1	~17 km southwest	- Ultrasonic recording - Camera traps - Targeted searches - Opportunistic observations - Habitat assessment	- Crest/ Slope - Drainage Line - Gilgai - Mulga - Stony Plain	<u>60 vertebrate species</u> 13 native mammals 3 introduced mammals 36 birds 8 reptiles	<u>Historically significant</u> - rainbow bee-eater (<i>Merops ornatus</i>) - Australian bustard (<i>Ardeotis australis</i>)	None
28. Ecologia (2006a)	<u>Project:</u> Jimblebar Marra Mamba Exploration Biological Survey <u>Client:</u> BHP <u>Survey date:</u> 22nd May – 28th May 2006 <u>Survey type:</u> Basic vertebrate fauna survey Flora survey <u>Experience:</u> Project Manager x1 Senior Zoologist x1 Zoologist x1 Biologist x1	~17 km southeast	- Bird census - Active foraging - Opportunistic observations - Ultrasonic recording	- Mulga Woodland - Acacia Woodland - Scattered Corymbia - Scattered Grevillea	<u>99 vertebrate species</u> 7 native mammals 3 introduced mammals 64 birds 24 reptiles 1 amphibian	<u>Priority</u> - western pebble-mound mouse (<i>Pseudomys chapmani</i>) <u>Historically significant</u> - Australian bustard (<i>Ardeotis australis</i>)	Survey was undertaken under favourable conditions for birds however cool night conditions reduced activity of nocturnal fauna (especially reptiles)
29. Biologic (2013b)	<u>Project:</u> South West Jimblebar Vertebrate Fauna Survey <u>Client:</u> BHP <u>Survey date:</u> 4th – 17th March 2013 <u>Survey type:</u> Single season detailed vertebrate fauna survey <u>Experience:</u> Senior Ecologist x1 Senior Zoologist x4	~18 km south	- Ultrasonic recording - Camera traps - Systematic trapping - Targeted searches - Nocturnal searches - Bird census - Opportunistic observations - Habitat assessments	- Major Drainage line - Sand Plain - Stony Plain - Rocky Hill - Mulga Woodland	<u>117 vertebrate species</u> 15 native mammals 6 introduced mammals 55 birds 39 reptiles 2 amphibians	<u>Priority</u> - brush-tailed mulgara (<i>Dasycercus blythi</i>) - Spotted skink (<i>Ctenotus uber</i> subsp. <i>johnstonei</i>) <u>Historically significant</u> - Australian bustard (<i>Ardeotis australis</i>) - bush stone curlew (<i>Burhinus grallarius</i>) - rainbow bee-eater (<i>Merops ornatus</i>)	None

Reference	Survey details	Proximity to Study Area	Survey methods	Significant species habitat	Vertebrate fauna assemblage found (summary of species richness)	Significant species	Survey limitations/notes
30. Astron (2010)	<u>Project:</u> BHP Billiton Iron Ore Mt Whaleback TSF Flora, Vegetation and Fauna Assessment <u>Client:</u> BHP <u>Survey date:</u> 12th March 2010 <u>Survey type:</u> Basic vertebrate fauna survey Flora survey <u>Experience:</u> Botanist x2	~18 km southwest	- Targeted flora survey - Habitat assessment - Targeted fauna survey	- Plateaux Ridges - Mountains and Hills - Low Slopes - Stony Plain - Narrow Drainage Floors with Channels	<u>3 vertebrate species</u> 2 native mammals 1 bird	None	No vertebrate fauna species recorded on survey (desktop and habitat only)
31. Biologic (2020c)	<u>Project:</u> Western Ridge Targeted Vertebrate Fauna Survey <u>Client:</u> BHP <u>Survey date:</u> Targeted survey: 11th – 16th March 2020 Cave visitations: November – December 2019 <u>Survey type:</u> Targeted vertebrate fauna survey <u>Experience:</u> Zoologist x2 Senior Zoologist x4	~20 km southwest	- Habitat assessments - Camera traps - Targeted searches - Nocturnal searches - eDNA sampling - Ultrasonic recording - Acoustic recording	- Hillcrest/ Slope - Stony Plain - Mulga Woodland - Drainage Area/ Floodplain - Gorge/ Gully - Minor Drainage Line	<u>55 vertebrate species</u> 6 native mammals 2 introduced mammals 41 birds 4 reptile 2 amphibians	<u>Threatened</u> - ghost bat (<i>Macroderma gigas</i>) - northern quoll (<i>Dasyurus hallucatus</i>) - Pilbara olive python (<i>Liasis olivaceus</i> subsp. <i>barroni</i>) - peregrine falcon (<i>Falco peregrinus</i>) <u>Priority</u> - western pebble-mound mouse (<i>Pseudomys chapmani</i>)	Due to access constraints, parts of the north-eastern part of the range could not be access in its entirety and therefore some areas were subjected to reduced or no sampling effort
32. GHD (2019a)	<u>Project:</u> Jimblebar East and Caramulla Fauna Survey <u>Client:</u> BHP <u>Survey date:</u> 29th April – 10th May 2019 <u>Survey type:</u> Single season detailed vertebrate fauna assessment <u>Experience:</u> Principle Zoologist x1 Senior Zoologist x 4 Ecologist x2	~22 km southeast	- Systematic trapping - Acoustic recording - Habitat assessment - Nocturnal searches - Ultrasonic recording - Bilby plots - Active searches - Opportunistic observations - Bird census - Cave searches	- Major Drainage Lines - Hillcrest/ Hillslope - Sandplain - Mulga Woodland - Minor Drainage Line - Stony Plain - Claypan - Disturbed	<u>140 vertebrate species</u> 23 native mammals 5 introduced mammals 66 birds 46 reptiles	<u>Threatened</u> - ghost bat (<i>Macroderma gigas</i>) - peregrine falcon (<i>Falco peregrinus</i>) <u>Priority</u> - brush-tailed mulgara (<i>Dasycercus blythi</i>) - western pebble-mound mouse (<i>Pseudomys chapmani</i>)	None

Reference	Survey details	Proximity to Study Area	Survey methods	Significant species habitat	Vertebrate fauna assemblage found (summary of species richness)	Significant species	Survey limitations/notes
33. Biologic (2011)	<u>Project:</u> Orebody 35 and Western Ridge Vertebrate Fauna Survey <u>Client:</u> BHP <u>Survey date:</u> Phase 1: 4th – 15th March 2010 Phase 2: 27th July – 6th August 2010 <u>Survey type:</u> Two-season detailed vertebrate fauna survey <u>Experience:</u> 1x Senior Ecologist 1x Principal Zoologist 1x Herpetologist 1x Senior Zoologist	~27 km southwest	- Systematic trapping - Harp traps - Opportunistic observations - Camera traps - Ultrasonic recording - Case assessments - Nocturnal searches - Targeted searches - Habitat assessments	- Ironstone Hills and Ridges - Stony Lower Slopes and Plains Below Hill Systems - Basalt Hills, Lower Slopes and Minor Stony Plains - Mulga Woodland on Hard Pan Plains - Major Drainage Line Supporting Eucalypt Woodlands - Valley and Gully Systems - Gorge Systems - Artificial Water Storages	<u>163 vertebrate species</u> 19 native mammals 6 introduced mammals 82 birds 54 reptiles 2 amphibians	<u>Threatened</u> - ghost bat (<i>Macroderma gigas</i>) - Pilbara olive python (<i>Liasis olivaceus</i> subsp. <i>barroni</i>) - peregrine falcon (<i>Falco peregrinus</i>) - wood sandpiper (<i>Tringa glareola</i>) - common greenshank (<i>Tringa nebularia</i>) - marsh sandpiper (<i>Tringa stagnatilis</i>) <u>Priority</u> - western pebble-mound mouse (<i>Pseudomys chapmani</i>) - blind-snake (<i>Anilius ganei</i>) <u>Historically significant</u> - Australian bustard (<i>Ardeotis australis</i>) - star finch (<i>Neochmia ruficauda subclarescens</i>) - eastern great egret (<i>Ardea modesta</i>) - rainbow bee-eater (<i>Merops ornatus</i>)	None
34. Ecologia (2005b)	<u>Project:</u> Western Ridge Exploration Project Biological Survey <u>Client:</u> BHP <u>Survey date:</u> 25th May – 29th May 2005 <u>Survey type:</u> Basic vertebrate fauna survey Flora survey <u>Experience:</u> Senior Zoologist x1 Zoologist x1	~27 km southwest	- Bird census - Active foraging - Opportunistic observations - Ultrasonic recording - Nocturnal searches	- Ridge Crests - Drainage Gullies	<u>71 vertebrate species</u> 3 native mammals 3 introduced mammals 50 birds 15 reptiles	<u>Priority</u> - western pebble-mound mouse (<i>Pseudomys chapmani</i>) <u>Historically significant</u> - rainbow bee-eater (<i>Merops ornatus</i>)	- Limited landform and floral diversity in areas surveyed (only proposed drill pad sites were surveyed) - Recent extensive burning of the site heavily reduced available fauna habitat for all vertebrate groups
35. Ecologia (2006b)	<u>Project:</u> BHPBIO Western Ridge Exploration Project Biological Survey <u>Client:</u> BHP <u>Survey date:</u> 29th May – 4th June 2006 <u>Survey type:</u> Basic vertebrate fauna survey Flora survey <u>Experience:</u> Senior Zoologist x1 Zoologist x1 Environmental Biologist x1	~30 km southwest	- Bird census - Active foraging - Opportunistic observations - Ultrasonic recording	- Mulga Woodland - Open Eucalypt Woodland	<u>50 vertebrate species</u> 10 native mammals 7 introduced mammals 25 birds 8 reptiles	<u>Threatened</u> - ghost bat (<i>Macroderma gigas</i>) <u>Priority</u> - western pebble-mound mouse (<i>Pseudomys chapmani</i>)	Survey was undertaken under favourable conditions for birds however cool night conditions reduced activity of nocturnal fauna (especially reptiles).

Reference	Survey details	Proximity to Study Area	Survey methods	Significant species habitat	Vertebrate fauna assemblage found (summary of species richness)	Significant species	Survey limitations/notes
36. Ecologia (2005a)	<u>Project:</u> East Jimblebar Exploration Project Biological Survey <u>Client:</u> BHP <u>Survey date:</u> 8th February – 14th February 2005 <u>Survey type:</u> Basic vertebrate fauna survey Flora survey <u>Experience:</u> Senior Zoologist Zoologist Field Assistant	~30 km southeast	- Bird census - Active foraging - Opportunistic observations - Ultrasonic recording - Nocturnal searches	- Scree Slopes - Sandplains	<u>70 vertebrate species</u> 8 native mammals 2 introduced mammals 40 birds 19 reptiles 1 amphibian	<u>Historically significant</u> - yellow-bellied sheathtail bat (<i>Saccolaimus flaviventris</i>) - rainbow bee-eater (<i>Merops ornatus</i>) - Australian bustard (<i>Ardeotis australis</i>)	Limited landform and floral diversity in areas surveyed (only proposed drill pad sites were surveyed)
37. ENV (2010)	<u>Project:</u> Ophthalmia Flora, Vegetation and Fauna Assessment <u>Client:</u> BHP <u>Survey date:</u> 12th – 17th May 2010 <u>Survey type:</u> Basic vertebrate fauna survey Flora survey <u>Experience:</u> Environmental Biologist x2	~47 km west	- Bird census - Habitat assessment - Opportunistic observations - Acoustic recording	- Riverine - Minor Drainage Line - Breakaway - Alluvial Plain - Stony Plain - Hillslope - Hillcrest - Cleared/ Disturbed	<u>57 vertebrate species</u> 11 native mammals 5 introduced mammals 34 birds 7 reptiles	<u>Priority</u> - western pebble-mound mouse (<i>Pseudomys chapmani</i>) <u>Historically significant</u> - Australian bustard (<i>Ardeotis australis</i>) - rainbow bee-eater (<i>Merops ornatus</i>)	- Lower than average rainfall in the 3 months preceding the survey - No trapping
38. ENV (2007a)	<u>Project:</u> Ophthalmia Exploration Lease Fauna Assessment <u>Client:</u> BHP <u>Survey date:</u> 13th – 22nd February 2007 <u>Survey type:</u> Single season detailed vertebrate fauna survey <u>Experience:</u> Biologist x3 Ornithologist x1 Taxonomist x1	~47 km west	- Habitat assessment - Systematic trapping - Active searching - Opportunistic observations - Bird census - Nocturnal searches - Acoustic recording	- Drainage Lines - Floodplains - Rocky Hills - Stony Mulga Plains - Scree Slopes	<u>120 vertebrate species</u> 7 native mammals 5 introduced mammals 84 birds 22 reptiles 2 amphibians	<u>Priority</u> - western pebble-mound mouse (<i>Pseudomys chapmani</i>) <u>Historically significant</u> - Australian bustard (<i>Ardeotis australis</i>)	None

Appendix C – Vertebrate fauna identified in the desktop assessment

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Scientific Name	Common Name	Conservation Status				Database				Previous Surveys																																						Current Survey										
		EPBC Act	BC Act	DBCA	IUCN	DBCA (2022a)	BirdLife Australia (2022)	DBCA (2022b)	DAWE (2022)	BHP WAIO (2022a)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37		38									
<i>Petrogale lateralis</i> subsp. <i>lateralis</i>	black-flanked rock-wallaby	EN	EN		VU	•		•																																																		
<i>Petrogale rothschildi</i>	Rothschild's rock-wallaby					•				•	•	•		•				•		•	•						•					•		•					•			•							•	•								
<i>Petrogale</i> sp.	rock-wallaby																														•							•																				
MEGADERMATIDAE																																																										
<i>Macroderma gigas</i>	ghost bat	VU	VU		VU	•		•	•	•	•			•						•													•	•										•	•	•												
MOLOSSIDAE																																																										
<i>Austronomus australis</i>	white-striped free-tailed bat									•					•				•	•						•			•				•			•						•						•				•	•					
<i>Chaerephon jobensis</i> subsp. <i>colonicus</i>	greater northern free-tailed bat									•	•								•	•	•	•			•			•				•			•	•			•			•			•					•			•					
<i>Ozimops lumsdenae</i>	northern free-tailed bat					•				•				•					•	•	•	•			•			•							•	•			•					•						•	•	•						
MURIDAE																																																										
<i>*Mus musculus</i>	house mouse					•				•	•			•	•			•					•	•				•	•	•	•								•				•						•	•								
<i>Notomys alexis</i>	spinifex hopping-mouse					•				•	•							•		•								•							•								•								•	•						
<i>Pseudomys chapmani</i>	western pebble-mound mouse			P4		•		•		•	•	•							•	•	•		•				•		•						•							•	•	•	•	•			•				•	•				
<i>Pseudomys desertor</i>	desert mouse					•				•	•							•									•				•						•							•								•	•					
<i>Pseudomys hermannsburgensis</i>	sandy inland mouse					•				•	•							•										•	•		•	•					•						•	•	•						•	•						
<i>Zyzomys argurus</i>	common rock rat					•				•	•			•				•			•	•	•					•	•		•	•	•				•	•					•	•	•	•					•	•						
NOTORYCTIDAE																																																										
<i>Notoryctes caurinus</i>	northern marsupial mole			P4				•																																																		
RHINONYCTERIDAE																																																										
<i>Rhinonictes aurantia</i>	Pilbara leaf-nosed bat	VU	VU			•		•	•	•											•													•			•																		•			
TACHYGLOSSIDAE																																																										
<i>Tachyglossus aculeatus</i> subsp. <i>acanthion</i>	short-beaked echidna					•				•	•	•		•				•			•								•			•	•														•	•						•				
THYLACOMYIDAE																																																										
<i>Macrotis lagotis</i>	greater bilby	VU	VU		VU	•		•	•																																																	
VESPERTILIONIDAE																																																										
<i>Chalinolobus gouldii</i>	Gould's wattled bat					•				•	•	•		•					•	•	•	•			•			•					•	•		•	•	•	•			•	•			•	•			•	•			•	•			
<i>Chalinolobus morio</i>	chocolate wattled bat																																																									
<i>Nyctophilus daedalus</i>	northern long-eared bat									•																																																
<i>Nyctophilus geoffroyi</i>	lesser long-eared bat					•				•				•						•	•				•			•							•									•	•			•	•					•	•			
<i>Scotorepens balstoni</i>	inland broad-nosed bat					•				•																																																
<i>Scotorepens greyii</i>	little broad-nosed bat					•				•	•	•		•					•	•	•	•		•	•		•							•	•		•	•	•	•			•	•	•		•	•	•		•	•			•	•		
<i>Vespadelus finlaysoni</i>	Finlayson's cave bat					•				•	•	•		•					•	•	•	•	•		•			•						•	•		•	•	•	•			•	•	•		•	•	•		•	•			•	•		
AVES																																																										
ACANTHIZIDAE																																																										
<i>Acanthiza apicalis</i>	inland thornbill					•	•			•				•		•								•	•			•	•			•				•						•	•	•	•					•	•			•	•			
<i>Acanthiza chrysorrhoa</i>	yellow-rumped thornbill					•	•			•		•		•									•									•																					•					
<i>Acanthiza robustirostris</i>	slaty-backed thornbill					•	•			•						•												•																														

Scientific Name	Common Name	Conservation Status				Database					Previous Surveys																																						Current Survey			
		EPBC Act	BC Act	DBCA	IUCN	DBCA (2022a)	BirdLife Australia (2022)	DBCA (2022b)	DAWE (2022)	BHP WAIO (2022a)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38				
<i>Acanthiza uropygialis</i>	chestnut-rumped thornbill					•	•			•				•	•	•	•		•		•	•						•		•	•	•				•	•	•	•			•	•			•	•					
<i>Aphelocephala leucopsis</i>	southern whiteface	VU					•			•												•																														
<i>Aphelocephala nigricincta</i>	banded whiteface					•	•																																													
<i>Gerygone fusca</i>	western gerygone					•	•			•	•	•	•				•		•			•	•					•		•										•		•		•	•	•	•					
<i>Pyrrholaemus brunneus</i>	redthroat					•	•			•			•		•						•	•					•													•	•											
<i>Smicromis brevirostris</i>	weebill					•	•			•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•	•							•	•	•	•	•	•	•	•				
ACCIPITRIDAE																																																				
<i>Accipiter cirrocephalus</i>	collared sparrowhawk					•	•			•	•				•	•						•	•																									•	•			
<i>Accipiter fasciatus</i>	brown goshawk					•	•			•	•		•	•	•						•		•						•	•	•					•	•					•	•	•	•					•	•	
<i>Aquila audax</i>	wedged-tailed eagle					•	•			•	•		•				•	•			•	•	•	•		•	•		•	•	•	•																	•	•		
<i>Circus approximans</i>	swamp harrier					•	•																																											•		
<i>Circus assimilis</i>	spotted harrier					•	•			•	•												•			•																							•			
<i>Elanus caeruleus</i> subsp. <i>axillaris</i>	black-shouldered kite					•	•			•	•	•		•		•						•					•																							•		
<i>Haliaeetus leucogaster</i>	white-bellied sea-eagle					•	•			•						•																																	•			
<i>Haliastur sphenurus</i>	whistling kite					•	•			•	•	•	•	•	•	•	•	•	•	•		•	•		•	•	•	•	•	•	•	•	•	•															•	•	•	
<i>Hamirostra isura</i>	square-tailed kite						•			•					•																																					•
<i>Hamirostra melanosternon</i>	black-breasted buzzard					•	•			•	•		•	•		•												•	•			•																		•	•	
<i>Hieraaetus morphnoides</i>	little eagle					•	•			•			•		•			•	•	•		•	•				•		•	•																		•	•	•		
<i>Milvus migrans</i>	black kite					•	•			•	•	•				•													•																							•
ACROCEPHALIDAE																																																				
<i>Acrocephalus australis</i>	Australian reed warbler					•	•			•			•	•		•																																				•
AEGOTHELIDAE																																																				
<i>Aegotheles cristatus</i>	Australian owl-nightjar					•	•			•	•			•		•					•	•		•				•		•																				•	•	
ALAUDIDAE																																																				
<i>Mirafra javanica</i>	Horsfield's bushlark					•	•			•								•	•			•							•																						•	
ALCEDINIDAE																																																				
<i>Dacelo leachii</i> subsp. <i>leachii</i>	blue-winged kookaburra					•	•			•			•	•	•	•		•	•	•	•	•		•																										•	•	
<i>Todiramphus pyrrhopygius</i>	red-backed kingfisher					•	•			•	•	•		•	•	•	•	•		•		•	•	•		•		•	•	•	•		•																•	•		
<i>Todiramphus sanctus</i>	sacred kingfisher					•	•			•		•	•	•	•	•	•	•	•			•								•																				•	•	•
ANATIDAE																																																				
<i>Anas gracilis</i>	grey teal					•	•			•				•	•			•			•																														•	
<i>Anas querquedula</i>	garganey	MI	MI							•																																										
<i>Anas rhynchotis</i>	Australasian shoveler					•	•																																													
<i>Anas superciliosa</i>	pacific black duck					•	•			•			•		•	•			•			•							•		•																				•	
<i>Aythya australis</i>	hardhead					•	•			•					•																																		•			
<i>Chenonetta jubata</i>	Australian wood duck					•	•			•					•							•							•																						•	
<i>Cygnus atratus</i>	black swan					•	•			•			•			•						•									•																				•	
<i>Dendrocygna arcuata</i>	wandering whistling duck					•	•			•				•																																					•	

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Scientific Name	Common Name	Conservation Status				Database				Previous Surveys																																						Current Survey																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
		EPBC Act	BC Act	DBCA	IUCN	DBCA (2022a)	BirdLife Australia (2022)	DBCA (2022b)	DAWE (2022)	BHP WAIO (2022a)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37		38																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
<i>Eurostopodus argus</i>	spotted nightjar					•	•			•					•	•					•	•	•		•	•						•	•			•		•				•		•			•	•																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
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<i>Dromaius novaehollandiae</i>	emu					•	•			•				•	•			•				•								•					•																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
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<i>Charadrius dubius</i>	little ringed plover	MI	MI							•						•																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
<i>Charadrius ruficapillus</i>	red-capped plover					•	•			•						•																												•																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
<i>Charadrius veredus</i>	oriental plover	MI	MI			•		•	•																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
<i>Elseyornis melanops</i>	black-fronted dotterel					•	•			•			•	•	•	•																•						•			•	•							•																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
<i>Erythrogonys cinctus</i>	red-kneed dotterel						•			•						•																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
<i>Vanellus miles</i>	masked lapwing																																																			•																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
<i>Vanellus tricolor</i>	banded lapwing					•																•																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
CICONIIDAE																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
<i>Ephippiorhynchus asiaticus</i>	black-necked stork				NT	•	•																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																

Scientific Name	Common Name	Conservation Status				Database				Previous Surveys																																						Current Survey			
		EPBC Act	BC Act	DBCA	IUCN	DBCA (2022a)	BirdLife Australia (2022)	DBCA (2022b)	DAWE (2022)	BHP WAIO (2022a)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37		38		
ESTRILDIDAE																																																			
<i>Emblema pictum</i>	painted finch					•	•			•	•	•		•	•		•		•	•	•	•	•	•	•	•	•	•			•		•	•	•	•	•			•		•					•	•			
<i>Neochmia ruficauda subclaescens</i> subsp.	star finch (western)					•	•			•				•	•	•		•								•									•					•							•				
<i>Taeniopygia guttata castanotis</i> subsp.	zebra finch					•	•			•	•	•	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•	•	•	•	•	•	•	•	•	•	•		
FALCONIDAE																																																			
<i>Falco berigora</i>	brown falcon					•	•			•	•	•		•		•	•		•	•	•	•	•		•		•	•	•	•	•		•	•		•	•	•		•	•	•	•	•	•	•	•	•	•		
<i>Falco cenchroides</i>	nankeen kestrel					•	•			•	•	•		•		•	•	•	•	•	•	•	•		•	•	•	•	•	•	•	•	•	•	•			•	•	•	•	•	•	•	•	•	•	•	•		
<i>Falco hypoleucos</i>	grey falcon	VU	VU		VU				•	•		•																																			•				
<i>Falco longipennis</i>	Australian hobby					•	•			•	•			•	•	•		•		•	•		•						•		•					•				•			•	•		•	•				
<i>Falco peregrinus</i>	peregrine falcon		OS			•	•	•		•					•					•							•					•				•				•	•	•									
<i>Falco subniger</i>	black falcon									•						•																																			
GLAREOLIDAE																																																			
<i>Stiltia isabella</i>	Australian pratincole					•	•			•						•																																			
HIRUNDINIDAE																																																			
<i>Cheramoeca leucosterna</i>	white-backed swallow					•	•			•				•		•								•					•		•							•													
<i>Hirundo neoxena</i>	welcome swallow					•	•																																												
<i>Hirundo rustica</i>	barn swallow	MI	MI						•	•					•																																	•			
<i>Petrochelidon ariel</i>	fairy martin					•	•			•	•		•	•	•	•	•		•																														•		
<i>Petrochelidon nigricans</i>	tree martin					•	•			•			•	•	•	•		•	•											•			•															•	•		
LARIDAE																																																			
<i>Gelochelidon nilotica</i>	gull-billed tern	MI	MI			•	•	•																																											
<i>Larus novaehollandiae</i>	silver gull					•	•			•					•																																				
<i>Sterna caspia</i>	caspian tern	MI	MI			•	•	•																																											
<i>Sterna hybrida</i>	whiskered tern						•			•					•																																		•		
LOCUSTELLIDAE																																																			
<i>Cincloramphus cruralis</i>	brown songlark						•			•					•			•	•			•								•							•													•	
<i>Cincloramphus gramineus</i>	little grassbird					•	•			•					•																																		•		
<i>Cincloramphus mathewsi</i>	rufous songlark						•			•	•			•	•	•		•			•	•		•				•	•	•		•		•	•		•							•			•	•			
<i>Eremiornis carteri</i>	spinifex bird					•	•			•	•	•			•		•	•		•	•	•	•	•	•			•		•		•	•	•	•	•		•	•								•	•			
MALURIDAE																																																			
<i>Amytornis striatus</i> subsp. <i>whitei</i>	striated grasswren					•	•			•	•			•				•			•	•		•		•	•		•	•		•	•	•	•		•				•	•	•	•				•	•	•	
<i>Malurus lamberti</i> subsp. <i>assimilis</i>	variegated fairywren					•	•			•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	
<i>Malurus leucopterus</i> subsp. <i>leuconotus</i>	white-winged fairywren					•	•			•	•		•	•		•	•	•	•	•	•	•		•	•	•		•		•	•	•		•	•			•	•	•		•	•			•	•				
<i>Malurus splendens</i>	splendid fairywren					•	•			•			•		•							•	•																								•				
<i>Stipiturus ruficeps</i>	rufous-crowned emu-wren					•	•			•																																							•		
MELIPHAGIDAE																																																			
<i>Acanthagenys rufogularis</i>	spiny-cheeked honeyeater					•	•			•	•	•		•		•	•	•				•	•	•	•	•	•			•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•

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Scientific Name	Common Name	Conservation Status				Database				Previous Surveys																																						Current Survey																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
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PHAETHONTIDAE																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
<i>Phalacrocorax carbo</i>	black cormorant					•	•			•									•																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													



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RECURVIROSTRIDAE																																																			
Cladorhynchus leucocephalus	banded stilt					•	•																																												
Himantopus himantopus	black-winged stilt					•	•			•						•																									•							•			
Recurvirostra novaehollandiae	red-necked avocet					•	•																																												
RHIPIDURIDAE																																																			
Rhipidura albiscapa	grey fantail					•	•			•					•								•				•			•						•				•		•				•	•				
Rhipidura leucophrys subsp. leucophrys	willie wagtail					•	•			•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•	•		•	•	•	•	•	•	•	•	•	•	•		
ROSTRATULIDAE																																																			
Rostratula australis	Australian painted snipe	EN	EN		EN				•																																										
SCOLOPACIDAE																																																			
Calidris acuminata	sharp-tailed sandpiper	MI	MI			•	•	•	•	•						•																																			
Calidris ferruginea	curlew sandpiper	CR/MI	CR/MI		NT	•	•	•	•	•						•																																			
Calidris melanotos	pectoral sandpiper	MI	MI			•		•	•	•						•																																			
Calidris ruficollis	red-necked stint	MI	MI		NT	•	•	•																																											
Calidris subminuta	long-toed stint	MI	MI			•	•	•		•						•																																			
Limosa limosa	black-tailed godwit	MI	MI		NT					•						•																																			
Philomachus pugnax	ruff	MI	MI							•						•																																			
Tringa glareola	wood sandpiper	MI	MI			•	•	•		•						•																																			
Actitis hypoleucos	common sandpiper	MI	MI			•	•	•	•	•			•			•																																			•
Tringa nebularia	common greenshank	MI	MI			•	•	•		•						•																																			
Tringa stagnatilis	marsh sandpiper	MI	MI			•	•	•		•						•																																			
Tringa totanus	common redshank	MI	MI			•		•		•																																									
STRIGIDAE																																																			
Ninox boobook	boobook owl						•			•			•	•	•	•	•	•			•	•	•	•	•			•	•	•			•						•	•	•						•	•			
Ninox connivens	barking owl					•				•						•						•						•																						•	
THRESKIORNITHIDAE																																																			
Platalea flavipes	yellow-billed spoonbill					•	•			•				•	•	•																																		•	
Platalea regia	royal spoonbill					•	•			•		•				•																																			
Plegadis falcinellus	glossy ibis	MI	MI			•	•	•		•						•																																		•	
Threskiornis molucca	Australian white ibis						•			•						•																																		•	
Threskiornis spinicollis	straw-necked ibis					•	•			•						•																																			
TURNICIDAE																																																			
Turnix velox	little button quail					•	•			•	•	•			•		•	•	•	•		•	•					•		•						•	•	•	•									•	•		
TYTONIDAE																																																			
Tyto javanica	eastern barn owl					•	•				•												•					•	•	•											•		•						•		
REPTILES																																																			
AGAMIDAE																																																			
Ctenophorus caudicinctus	ring-tailed dragon					•				•	•	•		•			•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•			•	•		•	•		•	•	•	•	•	•	•		

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<i>Ctenophorus isolepis</i> subsp. <i>isolepis</i>	crested dragon					•				•		•		•			•		•	•	•				•	•		•				•	•			•	•				•							•				•																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
<i>Ctenophorus nuchalis</i>	central netted dragon									•				•					•				•						•								•				•										•																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
<i>Ctenophorus reticulatus</i>	western netted dragon					•				•																											•		•												•																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
<i>Diporiphora amphiboluiroides</i>	mulga dragon					•				•																												•																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
<i>Diporiphora valens</i>	southern Pilbara tree dragon					•																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
<i>Gowidon longirostris</i>	long-nosed dragon					•				•		•		•	•		•	•	•	•	•	•				•		•		•	•	•	•	•	•							•	•			•	•	•	•	•					•																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
<i>Moloch horridus</i>	thorny devil									•																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
<i>Pogona minor</i> subsp. <i>minor</i>	dwarf bearded dragon					•				•	•																																										•		•																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
<i>Tympanocryptis diabolicus</i>	pebble dragon					•																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
CARPHODACTYLIDAE																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
<i>Nephrurus cinctus</i>	northern banded knob-tailed gecko					•				•								•						•						•																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							</

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Scientific Name	Common Name	Conservation Status				Database				Previous Surveys																																						Current Survey						
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Anilios hamatus	blind-snake									•	•			•														•	•																		•	•						
Anilios waitii	blind-snake										•																																											
VARANIDAE																																																						
Varanus acanthurus	spiny-tailed monitor					•				•	•			•				•			•	•	•	•		•		•	•		•			•	•		•		•		•		•				•	•						
Varanus brevicauda	short-tailed pygmy monitor					•				•																																						•	•					
Varanus bushi	Pilbara mulga monitor					•																																																
Varanus caudolineatus	stripe-tailed pygmy monitor					•				•				•								•								•								•	•					•	•									
Varanus eremius	pygmy desert monitor					•				•												•						•																										
Varanus giganteus	perentie					•				•	•	•						•			•																														•			
Varanus gouldii	bungarra					•				•				•								•				•		•	•																					•				
Varanus hamersleyensis	southern Pilbara rock goanna									•																																								•				
Varanus panoptes	yellow spotted monitor					•				•												•						•			•	•	•																					
Varanus pilbarensis	Pilbara rock monitor					•				•	•							•			•																																	
Varanus tristis subsp. tristis	racehorse goanna					•				•	•			•			•	•			•			•				•	•	•	•																				•			
AMPHIBIANS																																																						
LIMNODYNASTIDAE																																																						
Neobatrachus kunapalari	kunapalari frog					•								•																																								
Neobatrachus sutor	shoemaker frog																																																					•
Notaden nichollsi	desert spadefoot					•																																																
Platyplectrum spenceri	centralian burrowing frog					•				•																																											•	
MYOBATRACHIDAE																																																						
Pseudophryne douglasi	gorge toadlet					•				•				•																																								
Uperoleia russelli	Russell's toadlet					•				•				•	•														•		•																							
Uperoleia saxatilis	Pilbara toadlet					•																																															•	
PELODRYADIDAE																																																						
Cyclorana maini	sheep frog					•				•								•		•		•								•																					•			
Cyclorana platycephala	water-holding frog					•												•																																				
Litoria rubella	little red tree frog					•				•	•	•		•	•			•	•	•	•	•							•	•	•																			•	•	•		

Appendix D – Locations of vertebrate fauna sampling sites

Site	Methods	Habitat	Latitude	Longitude
VOPN-001	Habitat assessment, systematic, ultrasonic recorder, and nocturnal searches	Sand Plain	-23.3335	119.9100
VOPN-002	Habitat assessment, systematic, ultrasonic recorder, and nocturnal searches	Stony Plain	-23.3274	119.8898
VOPN-003	Habitat assessment, systematic, ultrasonic recorder, and nocturnal searches	Major Drainage Line	-23.3166	119.8715
VOPN-004	Habitat assessment, systematic, ultrasonic recorder, and nocturnal searches	Stony Plain	-23.3163	119.9228
VOPN-005	Habitat assessment, systematic, ultrasonic recorder, and nocturnal searches	Gorge/ Gully	-23.3197	119.9535
VOPN-006	Habitat assessment, systematic, ultrasonic recorder, and nocturnal searches	Hillcrest/ Hillslope	-23.3258	119.9910
VOPN-007	Habitat assessment, systematic, ultrasonic recorder, and nocturnal searches	Drainage Area/ Floodplain	-23.3364	119.8865
VOPN-008	Habitat assessment, systematic, ultrasonic recorder, and nocturnal searches	Breakaway/ Cliff	-23.3061	119.8983
VOPN-009	Habitat assessment, targeted searches	Drainage Area/ Floodplain	-23.3323	119.8836
VOPN-010	Habitat assessment, bird census	Drainage Area/ Floodplain	-23.3377	119.8802
VOPN-011	Habitat assessment	Stony Plain	-23.2983	119.8761
VOPN-012	Habitat assessment and Ultrasonic recorder	Major Drainage Line	-23.3296	119.8803
VOPN-013	Habitat assessment	Hillcrest/ Hillslope	-23.2987	119.8790
VOPN-014	Habitat assessment	Stony Plain	-23.3331	119.8721
VOPN-015	Habitat assessment, ultrasonic recorder and targeted searches	Gorge/ Gully	-23.3015	119.8777
VOPN-016	Habitat assessment	Drainage Area/ Floodplain	-23.3387	119.9198
VOPN-017	Habitat assessment	Breakaway/ Cliff	-23.3039	119.8829
VOPN-018	Habitat assessment and targeted searches	Drainage Area/ Floodplain	-23.3383	119.9087
VOPN-019	Habitat assessment	Breakaway/ Cliff	-23.3062	119.8968
VOPN-020	Habitat assessment	Major Drainage Line	-23.3398	119.9124
VOPN-021	Habitat assessment and targeted searches	Minor Drainage Line	-23.3001	119.8967
VOPN-022	Habitat assessment	Breakaway/ Cliff	-23.3292	119.9207
VOPN-023	Habitat assessment	Hillcrest/ Hillslope	-23.2989	119.8990
VOPN-024	Habitat assessment, Acoustic recorder	Undulating Low Hills	-23.3308	119.9226
VOPN-025	Habitat assessment	Hillcrest/ Hillslope	-23.3019	119.8964
VOPN-026	Habitat assessment	Undulating Low Hills	-23.3292	119.9191

Site	Methods	Habitat	Latitude	Longitude
VOPN-027	Habitat assessment, ultrasonic recorder, camera trap transect and targeted searches	Breakaway/ Cliff	-23.3079	119.9094
VOPN-028	Habitat assessment	Undulating Low Hills	-23.3282	119.9031
VOPN-029	Habitat assessment	Minor Drainage Line	-23.3263	119.9458
VOPN-030	Habitat assessment	Stony Plain	-23.3214	119.8834
VOPN-031	Habitat assessment	Hillcrest/ Hillslope	-23.3114	119.9251
VOPN-032	Habitat assessment	Drainage Area/ Floodplain	-23.3187	119.8912
VOPN-033	Habitat assessment and ultrasonic recorder	Hillcrest/ Hillslope	-23.3200	119.9730
VOPN-034	Habitat assessment	Drainage Area/ Floodplain	-23.3206	119.9071
VOPN-035	Habitat assessment and targeted searches	Gorge/ Gully	-23.3269	119.9935
VOPN-036	Habitat assessment, camera trap transect and targeted searches	Hillcrest/ Hillslope	-23.3146	119.8926
VOPN-037	Habitat assessment	Hillcrest/ Hillslope	-23.3078	119.9138
VOPN-038	Habitat assessment	Cleared/ Disturbed	-23.3256	119.8526
VOPN-039	Habitat assessment	Gorge/ Gully	-23.3045	119.8972
VOPN-040	Habitat assessment and bird census	Drainage Area/ Floodplain	-23.3399	119.8847
VOPN-041	Habitat assessment	Hillcrest/ Hillslope	-23.3037	119.8890
VOPN-042	Habitat assessment and bird census	Drainage Area/ Floodplain	-23.3397	119.8778
VOPN-043	Habitat assessment	Stony Plain	-23.3317	119.9735
VOPN-044	Habitat assessment and ultrasonic recorder	Major Drainage Line	-23.3297	119.8560
VOPN-045	Habitat assessment and targeted searches	Gorge/ Gully	-23.3122	119.9274
VOPN-046	Habitat assessment and targeted searches	Major Drainage Line	-23.3319	119.8592
VOPN-047	Habitat assessment and targeted searches	Gorge/ Gully	-23.3286	119.9869
VOPN-048	Habitat assessment	Hillcrest/ Hillslope	-23.3263	120.0013
VOPN-049	Habitat assessment	Cleared/ Disturbed	-23.3195	119.8536
VOPN-050	Habitat assessment and targeted searches	Gorge/ Gully	-23.3247	119.9819
VOPN-051	Habitat assessment	Drainage Area/ Floodplain	-23.3211	119.8611
VOPN-052	Habitat assessment and targeted searches	Gorge/ Gully	-23.3255	119.9838
VOPN-053	Habitat assessment	Undulating Low Hills	-23.3164	119.8624

Site	Methods	Habitat	Latitude	Longitude
VOPN-054	Habitat assessment	Hillcrest/ Hillslope	-23.3097	119.8838
VOPN-055	Habitat assessment	Drainage Area/ Floodplain	-23.3340	119.8912
VOPN-056	Habitat assessment	Stony Plain	-23.3152	119.9037
VOPN-057	Habitat assessment and targeted searches	Drainage Area/ Floodplain	-23.3374	119.8981
VOPN-058	Habitat assessment	Stony Plain	-23.3142	119.9168
VOPN-059	Habitat assessment	Breakaway/ Cliff	-23.3174	119.9730
VOPN-060	Habitat assessment	Stony Plain	-23.3219	119.9349
VOPN-061	Habitat assessment	Stony Plain	-23.3388	119.8888
VOPN-062	Habitat assessment	Minor Drainage Line	-23.3279	119.9552
VOPN-063	Habitat assessment and targeted searches	Drainage Area/ Floodplain	-23.3365	119.8842
VOPN-064	Habitat assessment	Stony Plain	-23.3355	119.9880
VOPN-065	Habitat assessment and acoustic recorder	Stony Plain	-23.3224	119.9148
VOPN-066	Habitat assessment and targeted searches	Drainage Area/ Floodplain	-23.3344	119.8861
VOPN-067	Habitat assessment and targeted searches	Gorge/ Gully	-23.3301	119.9989
VOPN-068	Habitat assessment and targeted searches	Gorge/ Gully	-23.3300	120.0021
VOPN-069	Habitat assessment, ultrasonic recorder and targeted searches	Gorge/ Gully	-23.3221	119.9950
VOPN-070	Habitat assessment and acoustic recorder	Drainage Area/ Floodplain	-23.3122	119.9572
VOPN-071	Habitat assessment, ultrasonic recorder, camera trap transect and targeted searches	Breakaway/ Cliff	-23.3141	119.9561
VOPN-072	Habitat assessment and acoustic recorder	Stony Plain	-23.3299	119.9648
VOPN-073	Habitat assessment and targeted searches	Breakaway/ Cliff	-23.3067	119.8931
VOPN-074	Habitat assessment and targeted searches	Breakaway/ Cliff	-23.3021	119.9042
VOPN-075	Habitat assessment and targeted searches	Gorge/ Gully	-23.3204	119.9660
VOPN-076	Habitat assessment and acoustic recorder	Hillcrest/ Hillslope	-23.2977	119.8990
VOPN-077	Habitat assessment and ultrasonic recorder	Hillcrest/ Hillslope	-23.3049	119.9204
VOPN-078	Habitat assessment, camera trap transect and targeted searches	Breakaway/ Cliff	-23.3039	119.9197
VOPN-079	Habitat assessment and targeted searches	Gorge/ Gully	-23.3026	119.9007
VOPN-080	Habitat assessment, camera trap transect and targeted searches	Breakaway/ Cliff	-23.3217	119.9920

Site	Methods	Habitat	Latitude	Longitude
VOPN-081	Habitat assessment and targeted searches	Gorge/ Gully	-23.3208	120.0013
VOPN-082	Habitat assessment and targeted searches	Breakaway/ Cliff	-23.3141	120.0018
VOPN-083	Habitat assessment and ultrasonic recorder	Minor Drainage Line	-23.3101	119.9982
VOPN-084	Habitat assessment and ultrasonic recorder	Major Drainage Line	-23.3338	119.8664
VOPN-085	Habitat assessment and targeted searches	Drainage Area/ Floodplain	-23.3046	119.8692
VOPN-086	Habitat assessment	Hillcrest/ Hillslope	-23.3097	119.8696
VOPN-087	Habitat assessment and targeted searches	Gorge/ Gully	-23.3116	119.8917
VOPN-088	Habitat assessment and targeted searches	Breakaway/ Cliff	-23.3104	119.9155
VOPN-089	Habitat assessment and targeted searches	Breakaway/ Cliff	-23.3094	119.9132
VOPN-090	Habitat assessment and ultrasonic recorder	Minor Drainage Line	-23.3024	119.9091
VOPN-091	Habitat assessment and targeted searches	Gorge/ Gully	-23.3047	119.9123
VOPN-092	Habitat assessment	Hillcrest/ Hillslope	-23.3132	119.9390
VOPN-093	Habitat assessment and targeted searches	Breakaway/ Cliff	-23.3191	119.9469
VOPN-094	Habitat assessment and targeted searches	Gorge/ Gully	-23.3176	119.9423
VOPN-095	Habitat assessment, ultrasonic recorder and targeted searches	Minor Drainage Line	-23.3090	119.9363
VOPN-096	Habitat assessment and acoustic recorder	Drainage Area/ Floodplain	-23.3264	119.8618
VOPN-097	Habitat assessment, ultrasonic recorder, camera trap transect and targeted searches	Major Drainage Line	-23.3005	119.8673
VOPN-098	Habitat assessment	Stony Plain	-23.3102	119.9021
VOPN-099	Habitat assessment and ultrasonic recorder	Stony Plain	-23.3324	119.9696
VOPN-100	Habitat assessment and targeted searches	Sand Plain	-23.3346	119.9080
VOPN-101	Habitat assessment and targeted searches	Drainage Area/ Floodplain	-23.3370	119.8934
VOPN-102	Habitat assessment and targeted searches	Drainage Area/ Floodplain	-23.3379	119.9039
VOPN-103	Habitat assessment and targeted searches	Gorge/ Gully	-23.3093	119.9951
VOPN-104	Habitat assessment	Hillcrest/ Hillslope	-23.3098	119.9822
VOPN-105	Habitat assessment	Hillcrest/ Hillslope	-23.3144	119.9868
VOPN-106	Habitat assessment and targeted searches	Hillcrest/ Hillslope	-23.3112	119.9906
VOPN-107	Habitat assessment	Stony Plain	-23.3285	119.9368

Site	Methods	Habitat	Latitude	Longitude
VOPN-108	Habitat assessment and targeted searches	Gorge/ Gully	-23.3215	119.9974
VOPN-109	Habitat assessment	Hillcrest/ Hillslope	-23.3141	119.9951
VOPN-110	Habitat assessment	Drainage Area/ Floodplain	-23.3244	119.9138
VOPN-111	Habitat assessment	Stony Plain	-23.3060	119.8767
VOPN-112	Habitat assessment and targeted searches	Drainage Area/ Floodplain	-23.3336	119.8929

Appendix E – Vertebrate fauna habitat assessments

Site ID	Coord.	Date	Habitat Type	Landform	Aspect	Slope	Soil Type	Soil Avail.	Outcropping Rock Type	Rock Size	Veg. Litter	Dominant Veg. Type	Rocky Cracks / Crevices	Burrowing Suitability	Hollows	Water present	Disturbances	Last Fire
VOPN-001	-23.3335, 119.91	15/03/2022	Sand Plain	Drainage Area/ Floodplain	Flat	Flat	Clay Loam	Few Large Patches	Negligible	Negligible	Few Small Patches	Spinifex hummock grassland	Nil	High	0	None	Road/ Access Track	Old (6+ yr.)
VOPN-002	-23.3274, 119.8898	12/03/2022	Stony Plain	Footslope	South/ West	Low	Clay Loam	Scarce	Minor Outcropping	Small Rocks (11-20cm)	Few Small Patches	<i>Acacia</i> shrubland, scattered eucalypts, spinifex hummock grassland	Nil	Low	1	None	Road/ Access Track	Old (6+ yr.)
VOPN-003	-23.3166, 119.8715	15/03/2022	Major Drainage Line	Major Drainage Line	North	Flat	Sandy Clay Loam	Evenly Spread	Negligible	Gravel (1-4cm)	Many Small Patches	Scattered eucalypts, tussock grassland	Nil	Very High	8	Prone to Flooding	Other	Old (6+ yr.)
VOPN-004	-23.3163, 119.9228	16/03/2022	Stony Plain	Stony Plain	Flat	Flat	Clay Loam	Few Small Patches	Negligible	Pebbles (5-10cm)	Few Small Patches	<i>Acacia</i> shrubland, scattered eucalypts, spinifex hummock grassland	Nil	Low	1	None	Mining Exploration	Old (6+ yr.)
VOPN-005	-23.3197, 119.9535	16/03/2022	Gorge/ Gully	Gully	South/ West	Steep	Sandy Clay Loam	Few Small Patches	Major Outcropping	Small Rocks (11-20cm)	Many Small Patches	<i>Acacia</i> shrubland, scattered eucalypts, tussock grassland	High	Moderate	5	None	Weed Invasion	Old (6+ yr.)
VOPN-006	-23.3258, 119.991	17/03/2022	Hillcrest/ Hillslope	Hillcrest/ Upper Hillslope	South/ East	Moderate	Clay Loam	Scarce	Moderate Outcropping	Small Rocks (11-20cm)	Few Small Patches	<i>Acacia</i> shrubland, scattered eucalypts, spinifex hummock grassland	Nil	Low	0	None	Mining Exploration	Moderate (3 to 5 yr.)
VOPN-007	-23.3364, 119.8865	18/03/2022	Drainage Area/ Floodplain	Drainage Area/ Floodplain	Flat	Flat	Sandy Clay Loam	Evenly Spread	Negligible	Negligible	Few Small Patches	<i>Acacia</i> shrubland, mulga woodland, spinifex hummock grassland	Nil	Moderate	0	None	Cattle Grazing	Old (6+ yr.)
VOPN-008	-23.3061, 119.8983	18/03/2022	Breakaway/ Cliff	Breakaway	South	Steep	Clay Loam	Scarce	Major Outcropping	Small Rocks (11-20cm)	Few Small Patches	Scattered eucalypts, spinifex hummock grassland	Moderate	Nil	2	None	Mining Exploration	Old (6+ yr.)
VOPN-009	-23.3323, 119.8836	14/10/2022	Drainage Area/ Floodplain	Drainage Area/ Floodplain	Flat	Flat	Sandy Clay Loam	Many Small Patches	Negligible	Negligible	Scarce	<i>Acacia</i> shrubland, scattered eucalypts, spinifex hummock grassland, tussock grassland	Nil	High	0	None	Mining Exploration	Old (6+ yr.)
VOPN-010	-23.3377, 119.8802	19/03/2022	Drainage Area/ Floodplain	Minor Drainage Line	Flat	Flat	Sandy Clay Loam	Few Small Patches	Negligible	Negligible	Few Small Patches	Scattered shrubs, tussock grassland	Nil	Moderate	2	None	Cattle Grazing	Old (6+ yr.)
VOPN-011	-23.2983, 119.8761	19/03/2022	Stony Plain	Undulating Low Hills	South/ West	Low	Clay Loam	Scarce	Limited Outcropping	Gravel (1-4cm)	Scarce	Scattered eucalypts, tussock grassland	Nil	High	0	Permanent	Road/ Access Track	Old (6+ yr.)
VOPN-012	-23.3296, 119.8803	19/03/2022	Major Drainage Line	Major Drainage Line	Flat	Flat	Clay Loam	Many Small Patches	Negligible	Negligible	Many Small Patches	<i>Acacia</i> shrubland, scattered eucalypts, spinifex hummock grassland	Nil	Low	2	None	Road/ Access Track	Moderate (3 to 5 yr.)
VOPN-013	-23.2987, 119.879	19/03/2022	Hillcrest/ Hillslope	Gully	North/ East	Steep	Clay Loam	None Discernible	Moderate Outcropping	Gravel (1-4cm)	None Discernible	Scattered eucalypts, tussock grassland	Nil	Low	1	Permanent	Road/ Access Track	Moderate (3 to 5 yr.)
VOPN-014	-23.3331, 119.8721	19/03/2022	Stony Plain	Sand Plain	Flat	Flat	Sandy Loam	Few Large Patches	Negligible	Negligible	Many Small Patches	Scattered eucalypts, spinifex hummock grassland	Moderate	Low	0	None	Road/ Access Track	Old (6+ yr.)
VOPN-015	-23.3015, 119.8777	19/03/2022	Gorge/ Gully	Gully	South/ West	Steep	Clay Loam	None Discernible	Major Outcropping	Gravel (1-4cm)	None Discernible	<i>Acacia</i> shrubland, tussock grassland	Nil	Moderate	2	None	Road/ Access Track	Moderate (3 to 5 yr.)
VOPN-016	-23.3387, 119.9198	19/03/2022	Drainage Area/ Floodplain	Drainage Area/ Floodplain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Gravel (1-4cm)	Scarce	Scattered eucalypts, spinifex hummock grassland, tussock grassland	Moderate	Low	0	None	Road/ Access Track	Old (6+ yr.)
VOPN-017	-23.3039, 119.8829	19/03/2022	Breakaway/ Cliff	Breakaway	South	Very Steep	Clay Loam	Scarce	Major Outcropping	Small Rocks (11-20cm)	Many Small Patches	Mulga woodland, spinifex hummock grassland	Nil	Nil	0	None	None Discernible	Old (6+ yr.)
VOPN-018	-23.3383, 119.9087	19/03/2022	Drainage Area/ Floodplain	Sand Plain	Flat	Flat	Sandy Loam	Evenly Spread	Negligible	Negligible	Scarce	<i>Acacia</i> shrubland , scattered eucalypts, tussock grassland	High	Low	0	None	None Discernible	Moderate (3 to 5 yr.)

Site ID	Coord.	Date	Habitat Type	Landform	Aspect	Slope	Soil Type	Soil Avail.	Outcropping Rock Type	Rock Size	Veg. Litter	Dominant Veg. Type	Rocky Cracks / Crevices	Burrowing Suitability	Hollows	Water present	Disturbances	Last Fire
VOPN-019	-23.3062, 119.8968	19/03/2022	Breakaway/ Cliff	Hillcrest/ Upper Hillslope	Flat	Flat	Clay Loam	None Discernible	Minor Outcropping	Gravel (1-4cm)	Scarce	<i>Acacia</i> shrubland, tussock grassland, spinifex hummock grassland	Nil	High	0	None	Mining Exploration	Old (6+ yr.)
VOPN-020	-23.3398, 119.9124	19/03/2022	Major Drainage Line	Major Drainage Line	Flat	Flat	Sand	Evenly Spread	Negligible	Negligible	Many Small Patches	Scattered eucalypts, spinifex hummock grassland	Low	Low	0	None	Road/ Access Track	Moderate (3 to 5 yr.)
VOPN-021	-23.3001, 119.8967	19/03/2022	Minor Drainage Line	Minor Drainage Line	North	Low	Clay Loam	Many Small Patches	Minor Outcropping	Pebbles (5-10cm)	Many Small Patches	Tussock grassland, scattered eucalypts	Nil	Nil	0	None	None Discernible	Recent (0 to 2 yr.)
VOPN-022	-23.3292, 119.9207	19/03/2022	Breakaway/ Cliff	Breakaway	South/ East	Moderate	Clay Loam	Scarce	Major Outcropping	Gravel (1-4cm)	Scarce	Scattered eucalypts, spinifex hummock grassland, tussock grassland	Low	Nil	0	None	Mining Exploration	Old (6+ yr.)
VOPN-023	-23.2989, 119.899	19/03/2022	Hillcrest/ Hillslope	Sandy/ Stony Plain	Flat	Flat	Clay Loam	Many Small Patches	Negligible	Pebbles (5-10cm)	Many Small Patches	Mulga woodland, spinifex hummock grassland	Moderate	Nil	0	None	None Discernible	Moderate (3 to 5 yr.)
VOPN-024	-23.3308, 119.9226	19/03/2022	Undulating Low Hills	Stony Plain	Flat	Low	Clay Loam	Few Large Patches	Negligible	Gravel (1-4cm)	Scarce	Mulga woodland, scattered eucalypts, spinifex hummock grassland	Nil	Nil	0	None	Road/ Access Track	Moderate (3 to 5 yr.)
VOPN-025	-23.3019, 119.8964	19/03/2022	Hillcrest/ Hillslope	Hillslope	North/ East	Moderate	Clay Loam	None Discernible	Moderate Outcropping	Pebbles (5-10cm)	Scarce	<i>Acacia</i> shrubland, spinifex hummock grassland	Nil	Nil	0	None	Mining Exploration	Moderate (3 to 5 yr.)
VOPN-026	-23.3292, 119.9191	19/03/2022	Undulating Low Hills	Hillcrest/ Upper Hillslope	West	Moderate	Clay Loam	None Discernible	Limited Outcropping	Gravel (1-4cm)	None Discernible	Scattered eucalypts, spinifex hummock grassland	Moderate	Nil	0	None	Mining Exploration	Moderate (3 to 5 yr.)
VOPN-027	-23.3079, 119.9094	19/03/2022	Breakaway/ Cliff	Breakaway	South	Very Steep	Clay Loam	Scarce	Major Outcropping	Pebbles (5-10cm)	Few Small Patches	Spinifex hummock grassland, mulga woodland	Nil	Nil	0	None	None Discernible	Old (6+ yr.)
VOPN-028	-23.3282, 119.9031	19/03/2022	Undulating Low Hills	Hillcrest/ Upper Hillslope	South	Moderate	Clay Loam	Scarce	Negligible	Gravel (1-4cm)	Scarce	Scattered eucalypts, tussock grassland	High	Nil	0	None	Mining Exploration	Moderate (3 to 5 yr.)
VOPN-029	-23.3263, 119.9458	19/03/2022	Minor Drainage Line	Minor Drainage Line	Flat	Flat	Sandy Clay Loam	Many Small Patches	Negligible	Gravel (1-4cm)	Many Small Patches	<i>Acacia</i> shrubland, spinifex hummock grassland	Nil	Nil	1	None	None Discernible	Old (6+ yr.)
VOPN-030	-23.3214, 119.8834	19/03/2022	Stony Plain	Stony Plain	Flat	Flat	Clay Loam	Scarce	Negligible	Negligible	Few Small Patches	<i>Acacia</i> shrubland, tussock grassland	Nil	High	0	Prone to Flooding	Road/ Access Track	Moderate (3 to 5 yr.)
VOPN-031	-23.3114, 119.9251	19/03/2022	Hillcrest/ Hillslope	Hillcrest/ Upper Hillslope	South	Moderate	Clay Loam	None Discernible	Moderate Outcropping	Gravel (1-4cm)	Scarce	<i>Acacia</i> shrubland, spinifex hummock grassland	Nil	Nil	0	None	Mining Exploration	Moderate (3 to 5 yr.)
VOPN-032	-23.3187, 119.8912	19/03/2022	Drainage Area/ Floodplain	Drainage Area/ Floodplain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Gravel (1-4cm)	None Discernible	Scattered eucalypts, spinifex hummock grassland	Moderate	Nil	0	None	Road/ Access Track	Moderate (3 to 5 yr.)
VOPN-033	-23.32, 119.973	19/03/2022	Hillcrest/ Hillslope	Hillcrest/ Upper Hillslope	North	Moderate	Clay Loam	None Discernible	Limited Outcropping	Gravel (1-4cm)	Scarce	<i>Acacia</i> shrubland, tussock grassland	Nil	Low	0	None	Road/ Access Track	Recent (0 to 2 yr.)
VOPN-034	-23.3206, 119.9071	19/03/2022	Drainage Area/ Floodplain	Drainage Area/ Floodplain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Gravel (1-4cm)	Scarce	Scattered eucalypts, spinifex hummock grassland	Low	Nil	0	None	Mining Exploration	Moderate (3 to 5 yr.)
VOPN-035	-23.3269, 119.9935	21/03/2022	Gorge/ Gully	Gully	South	Steep	Clay Loam	None Discernible	Moderate Outcropping	Gravel (1-4cm)	Many Small Patches	Mulga woodland, tussock grassland	Nil	Low	1	None	Mining Exploration	Moderate (3 to 5 yr.)
VOPN-036	-23.3146, 119.8926	19/03/2022	Hillcrest/ Hillslope	Breakaway	South	Moderate	Clay Loam	Scarce	Moderate Outcropping	Gravel (1-4cm)	Scarce	Scattered eucalypts, spinifex hummock grassland, tussock grassland	Moderate	Low	0	Prone to Pooling	Mining Exploration	Moderate (3 to 5 yr.)
VOPN-037	-23.3078, 119.9138	22/03/2022	Hillcrest/ Hillslope	Hillcrest/ Upper Hillslope	North	Low	Clay Loam	Few Small Patches	Minor Outcropping	Pebbles (5-10cm)	Few Small Patches	Scattered eucalypts, spinifex hummock grassland	Moderate	Nil	0	None	Mining Exploration	Moderate (3 to 5 yr.)
VOPN-038	-23.3256, 119.8526	20/03/2022	Cleared/ Disturbed	Wetland	Flat	Flat	Clay Loam	Many Large Patches	Negligible	Gravel (1-4cm)	Scarce	<i>Acacia</i> shrubland, scattered eucalypts, spinifex hummock grassland	Nil	Nil	0	None	Road/ Access Track	Moderate (3 to 5 yr.)

Site ID	Coord.	Date	Habitat Type	Landform	Aspect	Slope	Soil Type	Soil Avail.	Outcropping Rock Type	Rock Size	Veg. Litter	Dominant Veg. Type	Rocky Cracks / Crevices	Burrowing Suitability	Hollows	Water present	Disturbances	Last Fire
VOPN-039	-23.3045, 119.8972	22/03/2022	Gorge/ Gully	Gully	North/ West	Moderate	Clay Loam	Few Small Patches	Major Outcropping	Small Rocks (11-20cm)	Few Small Patches	Acacia shrubland	Nil	Low	0	Permanent	Mining Exploration	Moderate (3 to 5 yr.)
VOPN-040	-23.3399, 119.8847	21/03/2022	Drainage Area/ Floodplain	Wetland	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Gravel (1-4cm)	Scarce	Scattered eucalypts, spinifex hummock grassland	Moderate	Nil	0	Prone to Pooling	Road/ Access Track	Old (6+ yr.)
VOPN-041	-23.3037, 119.889	22/03/2022	Hillcrest/ Hillslope	Hillcrest/ Upper Hillslope	North	Low	Clay Loam	Scarce	Limited Outcropping	Pebbles (5-10cm)	Scarce	Scattered eucalypts, spinifex hummock grassland	Nil	Nil	0	Prone to Flooding	Mining Exploration	Moderate (3 to 5 yr.)
VOPN-042	-23.3397, 119.8778	21/03/2022	Drainage Area/ Floodplain	Stony Plain	Flat	Low	Clay Loam	Evenly Spread	Negligible	Gravel (1-4cm)	Scarce	Acacia shrubland, scattered eucalypts, spinifex hummock grassland	Nil	Nil	0	None	Road/ Access Track	Moderate (3 to 5 yr.)
VOPN-043	-23.3317, 119.9735	22/03/2022	Stony Plain	Stony Plain	Flat	Flat	Clay Loam	Scarce	Negligible	Small Rocks (11-20cm)	Few Small Patches	Scattered eucalypts, tussock grassland	Nil	Nil	0	Permanent	Frequent Fire	Recent (0 to 2 yr.)
VOPN-044	-23.3297, 119.856	21/03/2022	Major Drainage Line	Major Drainage Line	Flat	Low	Clay Loam	Many Large Patches	Negligible	Gravel (1-4cm)	Scarce	Acacia shrubland, scattered eucalypts, spinifex hummock grassland, tussock grassland	Nil	Nil	0	None	Road/ Access Track	Old (6+ yr.)
VOPN-045	-23.3122, 119.9274	24/03/2022	Gorge/ Gully	Gully	South	Steep	Clay Loam	None Discernible	Moderate Outcropping	Gravel (1-4cm)	Few Small Patches	Scattered eucalypts, tussock grassland	Nil	Nil	1	Prone to Flooding	None Discernible	Moderate (3 to 5 yr.)
VOPN-046	-23.3319, 119.8592	21/03/2022	Major Drainage Line	Major Drainage Line	Flat	Low	Clay Loam	Many Small Patches	Negligible	Gravel (1-4cm)	Few Small Patches	Scattered eucalypts, spinifex hummock grassland	High	Low	5	None	Road/ Access Track	Moderate (3 to 5 yr.)
VOPN-047	-23.3286, 119.9869	24/03/2022	Gorge/ Gully	Gully	South	Moderate	Clay Loam	None Discernible	Moderate Outcropping	Gravel (1-4cm)	Few Small Patches	Tussock grassland, scattered eucalypts	Nil	Nil	1	Permanent	None Discernible	Old (6+ yr.)
VOPN-048	-23.3263, 120.0013	21/03/2022	Hillcrest/ Hillslope	Hillcrest/ Upper Hillslope	North	Steep	Clay Loam	Scarce	Moderate Outcropping	Gravel (1-4cm)	None Discernible	Scattered eucalypts, spinifex hummock grassland	High	Low	0	Prone to Pooling	Road/ Access Track	Recent (0 to 2 yr.)
VOPN-049	-23.3195, 119.8536	20/03/2022	Cleared/ Disturbed	Wetland	Flat	Flat	Clay Loam	Many Large Patches	Negligible	Gravel (1-4cm)	Scarce	Spinifex hummock grassland, scattered eucalypts	Nil	Nil	0	None	Road/ Access Track	Moderate (3 to 5 yr.)
VOPN-050	-23.3247, 119.9819	22/03/2022	Gorge/ Gully	Gully	South	Steep	Clay Loam	Scarce	Extensive Outcropping	Pebbles (5-10cm)	Few Small Patches	Acacia shrubland, tussock grassland	Nil	Low	0	Permanent	None Discernible	Moderate (3 to 5 yr.)
VOPN-051	-23.3211, 119.8611	21/03/2022	Drainage Area/ Floodplain	Sand Plain	Flat	Flat	Sandy Clay Loam	Many Small Patches	Negligible	Negligible	Scarce	Spinifex hummock grassland, scattered eucalypts	Moderate	Nil	0	Prone to Pooling	Road/ Access Track	Moderate (3 to 5 yr.)
VOPN-052	-23.3255, 119.9838	22/03/2022	Gorge/ Gully	Gully	South	Steep	Clay Loam	Scarce	Extensive Outcropping	Gravel (1-4cm)	Few Small Patches	Acacia shrubland, spinifex hummock grassland	Nil	Moderate	0	None	None Discernible	Moderate (3 to 5 yr.)
VOPN-053	-23.3164, 119.8624	21/03/2022	Undulating Low Hills	Hillcrest/ Upper Hillslope	North	Moderate	Clay Loam	Scarce	Limited Outcropping	Gravel (1-4cm)	None Discernible	Acacia shrubland, spinifex hummock grassland, scattered eucalypts	Moderate	Nil	0	None	Road/ Access Track	Moderate (3 to 5 yr.)
VOPN-054	-23.3097, 119.8838	23/03/2022	Hillcrest/ Hillslope	Hillcrest/ Upper Hillslope	South/ East	Steep	Clay Loam	Scarce	Limited Outcropping	Gravel (1-4cm)	None Discernible	Acacia shrubland, spinifex hummock grassland	Low	Nil	0	None	Mining Exploration	Moderate (3 to 5 yr.)
VOPN-055	-23.334, 119.8912	24/03/2022	Drainage Area/ Floodplain	Drainage Area/ Floodplain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Negligible	Few Small Patches	Spinifex hummock grassland, scattered eucalypts	Nil	Nil	0	None	Road/ Access Track	Old (6+ yr.)
VOPN-056	-23.3152, 119.9037	23/03/2022	Stony Plain	Drainage Area/ Floodplain	Flat	Flat	Clay Loam	Many Large Patches	Negligible	Gravel (1-4cm)	Few Small Patches	Mulga woodland, tussock grassland	Nil	Low	0	None	Mining Exploration	Old (6+ yr.)
VOPN-057	-23.3374, 119.8981	24/03/2022	Drainage Area/ Floodplain	Drainage Area/ Floodplain	Flat	Flat	Sandy Clay Loam	Evenly Spread	Negligible	Negligible	Many Small Patches	Mulga woodland, tussock grassland, spinifex hummock grassland	Nil	Low	0	None	None Discernible	Old (6+ yr.)
VOPN-058	-23.3142, 119.9168	23/03/2022	Stony Plain	Stony Plain	Flat	Flat	Clay Loam	Few Small Patches	Negligible	Gravel (1-4cm)	Scarce	Mulga woodland, scattered eucalypts, spinifex hummock grassland	Nil	High	0	None	Road/ Access Track	Moderate (3 to 5 yr.)

Site ID	Coord.	Date	Habitat Type	Landform	Aspect	Slope	Soil Type	Soil Avail.	Outcropping Rock Type	Rock Size	Veg. Litter	Dominant Veg. Type	Rocky Cracks / Crevices	Burrowing Suitability	Hollows	Water present	Disturbances	Last Fire
VOPN-059	-23.3174, 119.973	20/03/2022	Breakaway/ Cliff	Breakaway	South	Steep	Clay Loam	Scarce	Major Outcropping	Pebbles (5-10cm)	Few Small Patches	Scattered eucalypts, spinifex hummock grassland	Nil	Nil	0	None	Frequent Fire	Recent (0 to 2 yr.)
VOPN-060	-23.3219, 119.9349	23/03/2022	Stony Plain	Stony Plain	Flat	Flat	Clay Loam	Few Small Patches	Negligible	Gravel (1-4cm)	Scarce	Scattered eucalypts, spinifex hummock grassland	High	Nil	0	None	Road/ Access Track	Moderate (3 to 5 yr.)
VOPN-061	-23.3388, 119.8888	24/03/2022	Stony Plain	Sandy/ Stony Plain	Flat	Flat	Sandy Clay Loam	Many Small Patches	Negligible	Gravel (1-4cm)	Few Small Patches	Scattered eucalypts, spinifex hummock grassland	Nil	Nil	0	None	Road/ Access Track	Moderate (3 to 5 yr.)
VOPN-062	-23.3279, 119.9552	23/03/2022	Minor Drainage Line	Drainage Area/ Floodplain	Flat	Flat	Clay Loam	Many Small Patches	Negligible	Gravel (1-4cm)	Few Small Patches	Scattered eucalypts, spinifex hummock grassland, acacia shrubland	Nil	Moderate	0	None	Road/ Access Track	Moderate (3 to 5 yr.)
VOPN-063	-23.3365, 119.8842	24/03/2022	Drainage Area/ Floodplain	Drainage Area/ Floodplain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Negligible	None Discernible	Acacia shrubland, tussock grassland, scattered eucalypts	Nil	Nil	0	None	Road/ Access Track	Old (6+ yr.)
VOPN-064	-23.3355, 119.988	23/03/2022	Stony Plain	Stony Plain	Flat	Flat	Clay Loam	Few Small Patches	Negligible	Gravel (1-4cm)	Scarce	Scattered eucalypts	Nil	Moderate	0	None	Road/ Access Track	Moderate (3 to 5 yr.)
VOPN-065	-23.3224, 119.9148	6/10/2022	Stony Plain	Sandy/ Stony Plain	Flat	Flat	Sandy Clay Loam	Evenly Spread	Negligible	Gravel (1-4cm)	Scarce	Scattered eucalypts, spinifex hummock grassland, acacia shrubland	Nil	Nil	0	None	Road/ Access Track	Old (6+ yr.)
VOPN-066	-23.3344, 119.8861	7/10/2022	Drainage Area/ Floodplain	Drainage Area/ Floodplain	Flat	Flat	Sandy Loam	Evenly Spread	Negligible	Negligible	Scarce	Scattered shrubs, scattered eucalypts, spinifex hummock grassland	Nil	High	0	None	Cattle Grazing	Moderate (3 to 5 yr.)
VOPN-067	-23.3301, 119.9989	8/10/2022	Gorge/ Gully	Gully	South	Steep	Clay Loam	Scarce	Major Outcropping	Gravel (1-4cm)	Many Small Patches	Shrubland, tussock grassland	Nil	High	0	None	Road/ Access Track	Moderate (3 to 5 yr.)
VOPN-068	-23.33, 120.0021	8/10/2022	Gorge/ Gully	Gully	South	Steep	Clay Loam	Scarce	Major Outcropping	Gravel (1-4cm)	Few Small Patches	Scattered eucalypts, spinifex hummock grassland	Moderate	Nil	0	None	Road/ Access Track	Moderate (3 to 5 yr.)
VOPN-069	-23.3221, 119.995	8/10/2022	Gorge/ Gully	Gully	North	Very Steep	Clay Loam	Scarce	Extensive Outcropping	Gravel (1-4cm)	Few Small Patches	Spinifex hummock grassland, scattered eucalypts	Moderate	Nil	0	Scarce	None Discernible	Moderate (3 to 5 yr.)
VOPN-070	-23.3122, 119.9572	6/10/2022	Drainage Area/ Floodplain	Drainage Area/ Floodplain	Flat	Flat	Clayey Sand	Evenly Spread	Limited Outcropping	Small Rocks (11-20cm)	Many Small Patches	Spinifex hummock grassland, scattered eucalypts, tussock grassland	High	Nil	2	None	Frequent Fire	Recent (0 to 2 yr.)
VOPN-071	-23.3141, 119.9561	6/10/2022	Breakaway/ Cliff	Breakaway	South	Moderate	Clay Loam	Few Small Patches	Major Outcropping	Boulders (>61cm)	Scarce	Scattered eucalypts, scattered shrubs, tussock grassland	Nil	Very High	0	Prone to Flooding	None Discernible	Recent (0 to 2 yr.)
VOPN-072	-23.3299, 119.9648	6/10/2022	Stony Plain	Undulating Low Hills	South	Low	Clay Loam	Few Small Patches	Moderate Outcropping	Small Rocks (11-20cm)	Many Small Patches	Scattered eucalypts, spinifex hummock grassland, tussock grassland	Moderate	Nil	0	None	Mining Exploration	Old (6+ yr.)
VOPN-073	-23.3067, 119.8931	9/10/2022	Breakaway/ Cliff	Breakaway	South	Steep	Clay Loam	Scarce	Extensive Outcropping	Gravel (1-4cm)	Scarce	Spinifex hummock grassland, scattered shrubs	Nil	Low	0	None	None Discernible	Moderate (3 to 5 yr.)
VOPN-074	-23.3021, 119.9042	10/10/2022	Breakaway/ Cliff	Breakaway	South	Moderate	Clay Loam	Many Small Patches	Major Outcropping	Boulders (>61cm)	Scarce	Scattered eucalypts, spinifex hummock grassland	High	Nil	0	None	None Discernible	Old (6+ yr.)
VOPN-075	-23.3204, 119.966	9/10/2022	Gorge/ Gully	Gully	South	Moderate	Clay Loam	Scarce	Extensive Outcropping	Boulders (>61cm)	Many Small Patches	Scattered shrubs, spinifex hummock grassland	Moderate	Nil	0	None	None Discernible	Old (6+ yr.)
VOPN-076	-23.2977, 119.899	6/10/2022	Hillcrest/ Hillslope	Sand Plain	North	Flat	Clay Loam	Evenly Spread	Negligible	Pebbles (5-10cm)	Scarce	Scattered eucalypts, tussock grassland, spinifex hummock grassland	High	Low	0	Prone to Pooling	None Discernible	Old (6+ yr.)
VOPN-077	-23.3049, 119.9204	5/10/2022	Hillcrest/ Hillslope	Gully	West	Low	Clay Loam	Scarce	Moderate Outcropping	Boulders (>61cm)	Few Small Patches	Scattered shrubs, scattered eucalypts, spinifex hummock grassland, tussock grassland	Nil	Moderate	0	None	None Discernible	Old (6+ yr.)

Site ID	Coord.	Date	Habitat Type	Landform	Aspect	Slope	Soil Type	Soil Avail.	Outcropping Rock Type	Rock Size	Veg. Litter	Dominant Veg. Type	Rocky Cracks / Crevices	Burrowing Suitability	Hollows	Water present	Disturbances	Last Fire
VOPN-078	-23.3039, 119.9197	8/10/2022	Breakaway/ Cliff	Breakaway	South/ West	Moderate	Clay Loam	Scarce	Major Outcropping	Boulders (>61cm)	Scarce	Spinifex hummock grassland, scattered eucalypts, scattered shrubs	Low	Low	0	None	None Discernible	Old (6+ yr.)
VOPN-079	-23.3026, 119.9007	5/10/2022	Gorge/ Gully	Gully	West	Steep	Clay Loam	Scarce	Extensive Outcropping	Boulders (>61cm)	Many Small Patches	Scattered shrubs, scattered eucalypts, spinifex hummock grassland	High	Nil	0	None	None Discernible	Old (6+ yr.)
VOPN-080	-23.3217, 119.992	8/10/2022	Breakaway/ Cliff	Breakaway	South	Steep	Clay Loam	Scarce	Major Outcropping	Gravel (1-4cm)	Scarce	Scattered shrubs, spinifex hummock grassland	Moderate	Nil	0	Prone to Pooling	None Discernible	Moderate (3 to 5 yr.)
VOPN-081	-23.3208, 120.0013	10/10/2022	Gorge/ Gully	Gully	North	Very Steep	Clay Loam	Scarce	Extensive Outcropping	Gravel (1-4cm)	Many Small Patches	Scattered eucalypts, spinifex hummock grassland	Moderate	Nil	0	None	None Discernible	Moderate (3 to 5 yr.)
VOPN-082	-23.3141, 120.0018	10/10/2022	Breakaway/ Cliff	Hillcrest/ Upper Hillslope	North/ East	Steep	Clay Loam	Few Small Patches	Extensive Outcropping	Boulders (>61cm)	Scarce	Scattered eucalypts, spinifex hummock grassland	High	Nil	0	Prone to Pooling	None Discernible	Moderate (3 to 5 yr.)
VOPN-083	-23.3101, 119.9982	10/10/2022	Minor Drainage Line	Minor Drainage Line	Flat	Low	Clay Loam	Many Small Patches	Negligible	Pebbles (5-10cm)	Many Small Patches	Spinifex hummock grassland, scattered eucalypts	Very High	Low	0	None	None Discernible	Moderate (3 to 5 yr.)
VOPN-084	-23.3338, 119.8664	11/10/2022	Major Drainage Line	Major Drainage Line	Flat	Flat	Clay Loam	Many Small Patches	Negligible	Gravel (1-4cm)	Many Small Patches	Shrubland, scattered eucalypts, tussock grassland	Nil	Nil	0	None	Road/ Access Track	Moderate (3 to 5 yr.)
VOPN-085	-23.3046, 119.8692	10/10/2022	Drainage Area/ Floodplain	Drainage Area/ Floodplain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Gravel (1-4cm)	Few Small Patches	Tussock grassland, scattered eucalypts, shrubland	Nil	Low	0	Permanent	Road/ Access Track	Moderate (3 to 5 yr.)
VOPN-086	-23.3097, 119.8696	11/10/2022	Hillcrest/ Hillslope	Hillslope	West	Moderate	Clay Loam	Scarce	Minor Outcropping	Gravel (1-4cm)	None Discernible	Shrubland, tussock grassland, spinifex hummock grassland	Nil	Moderate	0	None	Mining Exploration	Moderate (3 to 5 yr.)
VOPN-087	-23.3116, 119.8917	11/10/2022	Gorge/ Gully	Gully	East	Steep	Clay Loam	None Discernible	Major Outcropping	Gravel (1-4cm)	Few Small Patches	Scattered eucalypts, spinifex hummock grassland	Low	Nil	0	None	None Discernible	Moderate (3 to 5 yr.)
VOPN-088	-23.3104, 119.9155	11/10/2022	Breakaway/ Cliff	Breakaway	South	Steep	Clay Loam	Scarce	Major Outcropping	Gravel (1-4cm)	Few Small Patches	Spinifex hummock grassland, scattered eucalypts	Moderate	Nil	0	None	Mining Exploration	Moderate (3 to 5 yr.)
VOPN-089	-23.3094, 119.9132	11/10/2022	Breakaway/ Cliff	Breakaway	South	Moderate	Clay Loam	Scarce	Major Outcropping	Gravel (1-4cm)	Scarce	Scattered eucalypts, spinifex hummock grassland	Moderate	Nil	0	None	None Discernible	Moderate (3 to 5 yr.)
VOPN-090	-23.3024, 119.9091	10/10/2022	Minor Drainage Line	Medium Drainage Line	North	Low	Clay Loam	Many Small Patches	Moderate Outcropping	Pebbles (5-10cm)	Scarce	Scattered eucalypts, spinifex hummock grassland	Moderate	Nil	0	None	None Discernible	Old (6+ yr.)
VOPN-091	-23.3047, 119.9123	8/10/2022	Gorge/ Gully	Gully	East	Moderate	Clay Loam	Scarce	Extensive Outcropping	Boulders (>61cm)	Scarce	Scattered shrubs, spinifex hummock grassland	Low	Low	0	Prone to Flooding	None Discernible	Old (6+ yr.)
VOPN-092	-23.3132, 119.939	11/10/2022	Hillcrest/ Hillslope	Hillcrest/ Upper Hillslope	South/ West	Low	Clay Loam	None Discernible	Major Outcropping	Small Rocks (11-20cm)	Scarce	Scattered shrubs, scattered eucalypts, spinifex hummock grassland	High	Nil	0	None	Frequent Fire	Recent (0 to 2 yr.)
VOPN-093	-23.3191, 119.9469	8/10/2022	Breakaway/ Cliff	Breakaway	South	Low	Clay Loam	Many Small Patches	Extensive Outcropping	Boulders (>61cm)	Few Small Patches	Scattered eucalypts, spinifex hummock grassland, scattered shrubs	Moderate	Low	0	None	Road/ Access Track	Old (6+ yr.)
VOPN-094	-23.3176, 119.9423	11/10/2022	Gorge/ Gully	Gully	South	Steep	Clay Loam	Few Small Patches	Extensive Outcropping	Boulders (>61cm)	Few Small Patches	Scattered shrubs, scattered eucalypts, spinifex hummock grassland	High	Low	0	None	None Discernible	Old (6+ yr.)
VOPN-095	-23.309, 119.9363	8/10/2022	Minor Drainage Line	Gully	Flat	Flat	Clay Loam	None Discernible	Extensive Outcropping	Large Rocks (21-60cm)	Few Small Patches	Scattered shrubs, scattered eucalypts, spinifex hummock grassland	Moderate	Low	0	Prone to Pooling	None Discernible	Moderate (3 to 5 yr.)
VOPN-096	-23.3264, 119.8618	7/10/2022	Drainage Area/ Floodplain	Sand Plain	Flat	Flat	Clay Loam	Few Small Patches	Negligible	Negligible	Few Small Patches	Scattered eucalypts, spinifex hummock grassland, tussock	Moderate	Low	0	Prone to Flooding	Road/ Access Track	Moderate (3 to 5 yr.)

Site ID	Coord.	Date	Habitat Type	Landform	Aspect	Slope	Soil Type	Soil Avail.	Outcropping Rock Type	Rock Size	Veg. Litter	Dominant Veg. Type	Rocky Cracks / Crevices	Burrowing Suitability	Hollows	Water present	Disturbances	Last Fire
												grassland, scattered shrubs						
VOPN-097	-23.3005, 119.8673	6/10/2022	Major Drainage Line	Major Drainage Line	Flat	Low	Sand	Evenly Spread	Negligible	Pebbles (5-10cm)	Many Small Patches	Scattered eucalypts, spinifex hummock grassland, shrubland	Nil	Low	10	None	Cattle Grazing	Old (6+ yr.)
VOPN-098	-23.3102, 119.9021	11/10/2022	Stony Plain	Stony Plain	Flat	Flat	Clay Loam	Few Small Patches	Negligible	Gravel (1-4cm)	Few Small Patches	Scattered eucalypts, tussock grassland	Nil	Low	0	None	Mining Exploration	Moderate (3 to 5 yr.)
VOPN-099	-23.3324, 119.9696	11/10/2022	Stony Plain	Stony Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Gravel (1-4cm)	Few Small Patches	Shrubland, spinifex hummock grassland	Nil	Nil	0	None	Road/ Access Track	Moderate (3 to 5 yr.)
VOPN-100	-23.3346, 119.908	12/10/2022	Sand Plain	Sand Plain	Flat	Flat	Clay Loam	Few Large Patches	Negligible	Negligible	Few Small Patches	Scattered eucalypts, spinifex hummock grassland, shrubland	Nil	Nil	0	None	None Discernible	Moderate (3 to 5 yr.)
VOPN-101	-23.337, 119.8934	13/10/2022	Drainage Area/ Floodplain	Drainage Area/ Floodplain	Flat	Flat	Sandy Loam	Evenly Spread	Negligible	Negligible	Few Small Patches	Shrubland, spinifex hummock grassland	Nil	Moderate	0	None	Cattle Grazing	Old (6+ yr.)
VOPN-102	-23.3379, 119.9039	13/10/2022	Drainage Area/ Floodplain	Sand Plain	Flat	Flat	Sandy Loam	Evenly Spread	Negligible	Negligible	Few Small Patches	Scattered shrubs, mulga woodland	Nil	Very High	0	None	Cattle Grazing	Old (6+ yr.)
VOPN-103	-23.3093, 119.9951	13/10/2022	Gorge/ Gully	Gully	North	Steep	Clay Loam	Scarce	Major Outcropping	Gravel (1-4cm)	Few Small Patches	Scattered shrubs, scattered eucalypts, spinifex hummock grassland	Nil	Very High	0	None	None Discernible	Moderate (3 to 5 yr.)
VOPN-104	-23.3098, 119.9822	13/10/2022	Hillcrest/ Hillslope	Hillcrest/ Upper Hillslope	North	Moderate	Clay Loam	Scarce	Minor Outcropping	Pebbles (5-10cm)	None Discernible	Scattered eucalypts, spinifex hummock grassland	Moderate	Nil	0	Prone to Pooling	None Discernible	Moderate (3 to 5 yr.)
VOPN-105	-23.3144, 119.9868	13/10/2022	Hillcrest/ Hillslope	Hillslope	North	Moderate	Clay Loam	Scarce	Minor Outcropping	Gravel (1-4cm)	None Discernible	Scattered eucalypts, spinifex hummock grassland	Low	Nil	0	None	None Discernible	Moderate (3 to 5 yr.)
VOPN-106	-23.3112, 119.9906	12/10/2022	Hillcrest/ Hillslope	Breakaway	East	Steep	Clay Loam	Scarce	Extensive Outcropping	Gravel (1-4cm)	None Discernible	Scattered eucalypts, spinifex hummock grassland	Low	Nil	0	None	None Discernible	Moderate (3 to 5 yr.)
VOPN-107	-23.3285, 119.9368	11/10/2022	Stony Plain	Hillcrest/ Upper Hillslope	North	Low	Clay Loam	Scarce	Major Outcropping	Large Rocks (21-60cm)	Many Small Patches	Scattered eucalypts, spinifex hummock grassland	High	Nil	0	None	Mining Exploration	Old (6+ yr.)
VOPN-108	-23.3215, 119.9974	13/10/2022	Gorge/ Gully	Gully	North	Very Steep	Clay Loam	Scarce	Extensive Outcropping	Gravel (1-4cm)	Scarce	Scattered eucalypts, scattered shrubs, spinifex hummock grassland	Moderate	Low	0	Scarce	None Discernible	Moderate (3 to 5 yr.)
VOPN-109	-23.3141, 119.9951	13/10/2022	Hillcrest/ Hillslope	Hillcrest/ Upper Hillslope	North	Moderate	Clay Loam	Scarce	Moderate Outcropping	Gravel (1-4cm)	None Discernible	Spinifex hummock grassland, scattered eucalypts	High	Nil	0	None	None Discernible	Moderate (3 to 5 yr.)
VOPN-110	-23.3244, 119.9138	14/10/2022	Drainage Area/ Floodplain	Drainage Area/ Floodplain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Gravel (1-4cm)	Few Large Patches	Scattered eucalypts, spinifex hummock grassland	Moderate	Nil	0	None	Mining Exploration	Old (6+ yr.)
VOPN-111	-23.306, 119.8767	19/03/2022	Stony Plain	Drainage Area/ Floodplain	Flat	Flat	Sandy Clay Loam	Many Small Patches	Negligible	Negligible	Scarce	Mulga woodland, spinifex hummock grassland	Nil	Low	0	None	Mining Exploration	Old (6+ yr.)
VOPN-112	-23.3336, 119.8929	13/10/2022	Drainage Area/ Floodplain	Drainage Area/ Floodplain	Flat	Flat	Sandy Clay Loam	Evenly Spread	Negligible	Negligible	Many Small Patches	Shrubland, tussock grassland	Nil	Moderate	0	None	Mining Exploration	Moderate (3 to 5 yr.)

Appendix F – Caves recorded during the current survey

Cave ID	Coordinates	Date Assessed	Ghost Bat Roost Type	Cave Position	Floor Slope	Aspect	Cave Exposure	Entrance Type	Entrance Shape	Entrance Width (m)	Entrance Height (m)	Cave Depth (m)	Number Chambers	Chamber Height (m)	Water Present	Number of Ghost Bat Scats	Bats in Cave	Comments	Photo
CNIN-17	-23.3140, 120.0019	10/10/2022	Night Roost	Upper Slope	Incline	North/ East	Semi Exposed	Cavern	Round/ Oval	1.5	1.5	10.5	1	2.5	None	0	No	Formerly COPN-01, updated to align with BHP cave naming convention.	
CEOP-03	-23.3094, 119.9132	11/10/2022	Night Roost	Upper Slope	Incline	South	Semi Exposed	Cavern	Round/ Oval	10	3.7	7.2	2	2.9	None	0	no	Smaller chamber to right of larger entrance. Possible night roost. Formerly COPN-02, updated to align with BHP cave naming convention.	

Appendix G – Water features recorded during the current survey

Water Feature ID	Site ID	Latitude	Longitude	Date Assessed	Length (m)	Width (m)	Water Present above Surface	Depth (m)	Water Present in Intermediate Zone	Emergent Macrophyte Present	Ground Water Vegetation	Fauna Present	Notes	Photo	
WOPN-001	VOPN-035	-23.3278	119.9935	21/03/2022	0.5	0.4	Yes	0.1	No	No	None	None	Ephemeral (will persist for 3 months). Small rocky bowl. When full would be approx. 1.5m long and 1.2m wide and .7m deep. Second small pool about 25m below (similar dimensions/description).		
WOPN-002	VOPN-005	-23.3176	119.9553	22/03/2022	2	1.5	Yes	0.2	No	No	None	None	Ephemeral (will persist for 3 months)		
WOPN-003	VOPN-050	-23.3248	119.9819	22/03/2022	6	2.5	Yes	0.4	No	No	None	None	Ephemeral (will persist for 3 months)		

Water Feature ID	Site ID	Latitude	Longitude	Date Assessed	Length (m)	Width (m)	Water Present above Surface	Depth (m)	Water Present in Intermediate Zone	Emergent Macrophyte Present	Ground Water Vegetation	Fauna Present	Notes	Photo
WOPN-004	VOPN-050	-23.3245	119.9820	22/03/2022	3	1.3	Yes	0.4	No	No	None	None	Ephemeral (will persist for 3 months)	
WOPN-005	VOPN-050	-23.3230	119.9818	22/03/2022	2	0.7	Yes	0.15	No	No	None	<i>Litoria rubella</i>	Ephemeral (will persist for 3 months)	
WOPN-006	VOPN-045	-23.3123	119.9278	24/03/2022	0.9	0.4	Yes	0.25	No	No	None	None	Ephemeral (will persist for 3 months). Approx 1.9 x 1.8 x .9m if full	

Water Feature ID	Site ID	Latitude	Longitude	Date Assessed	Length (m)	Width (m)	Water Present above Surface	Depth (m)	Water Present in Intermediate Zone	Emergent Macrophyte Present	Ground Water Vegetation	Fauna Present	Notes	Photo
WOPN-007	VOPN-045	-23.3121	119.9280	24/03/2022	1.3	1.1	Yes	0.4	No	No	None	None	Ephemeral (will persist for 3 months). Approx 2.2 x 1.4 x .9m if full	
WOPN-008	VOPN-047	-23.3287	119.9870	24/03/2022	2.5	1.3	Yes	1.2	No	No	None	<i>Litoria rubella</i>	Ephemeral (will persist 3 - 9 month of year, most years)	
WOPN-009	VOPN-068	-23.3304	120.0022	8/10/2022	3	4	Yes	1	No	Yes	None	None	Ephemeral (will persist 3 - 9 month of year, most years)	

Water Feature ID	Site ID	Latitude	Longitude	Date Assessed	Length (m)	Width (m)	Water Present above Surface	Depth (m)	Water Present in Intermediate Zone	Emergent Macrophyte Present	Ground Water Vegetation	Fauna Present	Notes	Photo
WOPN-010	VOPN-094	-23.3175	119.9423	11/10/2022	1.5	1	Yes	0.5	No	no	Algae	None	Temporary ephemeral (will persist for <3 months)	
WOPN-011	VOPN-075	-23.3223	119.9657	9/10/2022	7	1.5	Yes	1	No	Yes	None	None	Ephemeral (will persist for 3 months)	
WOPN-012	VOPN-075	-23.3214	119.9659	9/10/2022	10	13	Yes	3	Yes	Yes	None	None	Ephemeral (will persist 3 - 9 month of year, most years)	

Water Feature ID	Site ID	Latitude	Longitude	Date Assessed	Length (m)	Width (m)	Water Present above Surface	Depth (m)	Water Present in Intermediate Zone	Emergent Macrophyte Present	Ground Water Vegetation	Fauna Present	Notes	Photo
WOPN-013	VOPN-075	-23.3202	119.9660	9/10/2022	5	3	Yes	0.7	Yes	Yes	None	None	Ephemeral (will persist for 3 months)	
WOPN-014	VOPN-075	-23.3200	119.9657	9/10/2022	5	7	Yes	1.5	No	Yes	None	<i>Litoria rubella</i>	Ephemeral (will persist 3 - 9 month of year, most years)	
WOPN-015	VOPN-075	-23.3196	119.9661	9/10/2022	5	2	Yes	1	No	Yes	None	None	Ephemeral (will persist for 3 months)	

Water Feature ID	Site ID	Latitude	Longitude	Date Assessed	Length (m)	Width (m)	Water Present above Surface	Depth (m)	Water Present in Intermediate Zone	Emergent Macrophyte Present	Ground Water Vegetation	Fauna Present	Notes	Photo
WOPN-016	VOPN-093	-23.3185	119.9451	11/10/2022	2	0.5	Yes	1	No	No	None	<i>Geophaps plumifera</i> subsp. <i>ferruginea</i>	Temporary ephemeral (will persist for <3 months)	
WOPN-017	VOPN-081	-23.3199	120.0021	10/10/2022	2.5	1	Yes	0.4	No	No	None	None	Ephemeral (will persist for 3 months)	
WOPN-018	VOPN-094	-23.3178	119.9424	11/10/2022	3	1	Yes	0.75	Yes	No	None	None	Temporary ephemeral (will persist for <3 months)	

Water Feature ID	Site ID	Latitude	Longitude	Date Assessed	Length (m)	Width (m)	Water Present above Surface	Depth (m)	Water Present in Intermediate Zone	Emergent Macrophyte Present	Ground Water Vegetation	Fauna Present	Notes	Photo
WOPN-019	VOPN-103	-23.3080	119.9914	13/10/2022	10	5	Yes	1	Yes	Yes	None	None	Ephemeral (will persist 3 - 9 month of year, most years)	
WOPN-020	VOPN-103	-23.3079	119.9900	13/10/2022	8	5	Yes	1	No	No	None	None	Ephemeral (will persist for 3 months)	
WOPN-021	VOPN-060	-23.3022	119.8674	7/10/2022	350	50	Yes	1.5	No	Yes	<i>Typha domingensis</i>	None	Permanent (will persist all year most years)	

Water Feature ID	Site ID	Latitude	Longitude	Date Assessed	Length (m)	Width (m)	Water Present above Surface	Depth (m)	Water Present in Intermediate Zone	Emergent Macrophyte Present	Ground Water Vegetation	Fauna Present	Notes	Photo	
WOPN-022	VOPN-081	-23.3208	120.0013	10/10/2022	3	3	Yes	0.6	Yes	Yes	None	None	Ephemeral (will persist for 3 months)		

Appendix H – Fauna recorded during the current survey

Scientific Name	Common Name	Conservation Status				Total Number of Individuals by Site										Total
		EPBC Act	BC Act	DBCA	IUCN	VOPN-001	VOPN-002	VOPN-003	VOPN-004	VOPN-005	VOPN-006	VOPN-007	VOPN-008	Other sampling sites/ opportunistic records		
MAMMALS																
BOVIDAE																
* <i>Bos taurus</i>	cow													8	8	
CANIDAE																
* <i>Canis familiaris</i> subsp. <i>familiaris</i>	dog					1								6	7	
DASYURIDAE																
<i>Dasykaluta rosamondae</i>	little-red kaluta							3	1						4	
<i>Ningai timealeyi</i>	Pilbara ningai					1	3								4	
<i>Planigale</i> sp.	undescribed planigale sp.										1				1	
<i>Pseudantechinus woolleyae</i>	Woolley's pseudantechinus													4	4	
<i>Sminthopsis macroura</i>	stripe-faced dunnart					2						2			4	
<i>Sminthopsis youngsoni</i>	lesser hairy-footed dunnart					3									3	
EMBALLONURIDAE																
<i>Taphozous georgianus</i>	common sheath-tailed bat							3			3			10	16	
<i>Taphozous hilli</i>	hill's sheath-tail-bat					3	3	6		3	6	3		15	39	
FELIDAE																
* <i>Felis catus</i>	domestic cat					1		1						3	5	
LEPORIDAE																
* <i>Oryctolagus cuniculus</i>	European rabbit													3	3	
MACROPODIDAE																
<i>Osphranter robustus</i> subsp. <i>erubescens</i>	euro													7	7	
<i>Petrogale rothschildi</i>	Rothschild's rock-wallaby									2				15	17	

Scientific Name	Common Name	Conservation Status				Total Number of Individuals by Site										Total
		EPBC Act	BC Act	DBCA	IUCN	VOPN-001	VOPN-002	VOPN-003	VOPN-004	VOPN-005	VOPN-006	VOPN-007	VOPN-008	Other sampling sites/ opportunistic records		
MOLOSSIDAE																
<i>Austronomus australis</i>	white-striped free-tailed bat													3	3	
<i>Chaerephon jobensis</i> subsp. <i>colonicus</i>	greater northern free-tailed bat					6	6	6	3	6	6	3	6	30	72	
<i>Ozimops lumsdenae</i>	northern free-tailed bat							6				3		6	15	
MURIDAE																
<i>*Mus musculus</i>	house mouse					1	2	11	2	2		2			20	
<i>Notomys alexis</i>	spinifex hopping-mouse					1								1	2	
<i>Pseudomys chapmani</i>	western pebble-mound mouse			P4							1			22	23	
<i>Pseudomys desertor</i>	desert mouse								1						1	
<i>Pseudomys hermannsburgensis</i>	sandy inland mouse					1			4		1	2			8	
<i>Zyzomys argurus</i>	common rock rat									1	3		1	6	11	
RHINONYCTERIDAE																
<i>Rhinonictes aurantia</i>	Pilbara leaf-nosed bat	VU	VU			3		3		5				2	13	
TACHYGLOSSIDAE																
<i>Tachyglossus aculeatus</i> subsp. <i>acanthion</i>	short-beaked echidna													3	3	
VESPERTILIONIDAE																
<i>Chalinolobus gouldii</i>	Gould's wattled bat					6	6	6	6	6	6	6	6	39	87	
<i>Nyctophilus geoffroyi</i>	lesser long-eared bat					3				3			3	3	12	
<i>Scotorepens greyii</i>	little broad-nosed bat					6	6	6	6	6	6	6	3	30	75	
<i>Vespadelus finlaysoni</i>	Finlayson's cave bat					6	6	6	3	6	3	3	6	31	70	
AVES																
ACANTHIZIDAE																
<i>Acanthiza apicalis</i>	inland thornbill					2									2	
<i>Acanthiza uropygialis</i>	chestnut-rumped thornbill					10								5	15	

Scientific Name	Common Name	Conservation Status				Total Number of Individuals by Site										Total
		EPBC Act	BC Act	DBCA	IUCN	VOPN-001	VOPN-002	VOPN-003	VOPN-004	VOPN-005	VOPN-006	VOPN-007	VOPN-008	Other sampling sites/ opportunistic records		
<i>Gerygone fusca</i>	western gerygone													1	1	
<i>Smicronis brevirostris</i>	weebill						4	19		1			8	2	34	
ACCIPITRIDAE																
<i>Accipiter cirrocephalus</i>	collared sparrowhawk												1		1	
<i>Accipiter fasciatus</i>	brown goshawk													2	2	
<i>Aquila audax</i>	wedged-tailed eagle					1								4	5	
<i>Circus approximans</i>	swamp harrier													3	3	
<i>Circus assimilis</i>	spotted harrier					1									1	
<i>Elanus caeruleus</i> subsp. <i>axillaris</i>	black-shouldered kite													1	1	
<i>Haliaeetus leucogaster</i>	white-bellied sea-eagle													1	1	
<i>Haliastur sphenurus</i>	whistling kite					2		9	3		3	2		20	39	
<i>Hamirostra melanosternon</i>	black-breasted buzzard													1	1	
<i>Hieraaetus morphnoides</i>	little eagle													1	1	
<i>Milvus migrans</i>	black kite													2	2	
ACROCEPHALIDAE																
<i>Acrocephalus australis</i>	Australian reed warbler							7						15	22	
AEGOTHELIDAE																
<i>Aegotheles cristatus</i>	Australian owllet-nightjar								1	1			2	26	30	
ALCEDINIDAE																
<i>Dacelo leachii</i> subsp. <i>occidentalis</i>	blue-winged kookaburra						1	12				2		20	35	
<i>Todiramphus pyrrhopygius</i>	red-backed kingfisher						1							8	9	
<i>Todiramphus sanctus</i>	sacred kingfisher							11						6	17	
ANATIDAE																
<i>Anas gracilis</i>	grey teal							2						57	59	

Scientific Name	Common Name	Conservation Status				Total Number of Individuals by Site										Total
		EPBC Act	BC Act	DBCA	IUCN	VOPN-001	VOPN-002	VOPN-003	VOPN-004	VOPN-005	VOPN-006	VOPN-007	VOPN-008	Other sampling sites/ opportunistic records		
<i>Anas superciliosa</i>	pacific black duck													57	57	
<i>Aythya australis</i>	hardhead													1	1	
<i>Cygnus atratus</i>	black swan							8						121	129	
<i>Dendrocygna arcuata</i>	wandering whistling duck													28	28	
<i>Malacorhynchus membranaceus</i>	pink-eared duck													8	8	
<i>Tadorna tadornoides</i>	Australian shell duck													10	10	
ANHINGIDAE																
<i>Anhinga novaehollandiae</i>	Australasian darter													4	4	
APODIDAE																
<i>Apus pacificus</i>	fork-tailed swift	MI	MI											3	3	
ARDEIDAE																
<i>Ardea garzetta</i>	little egret													1	1	
<i>Ardea modesta</i>	eastern great egret							2						24	26	
<i>Ardea novaehollandiae</i>	white-faced heron													6	6	
<i>Ardea pacifica</i>	white-necked heron													1	1	
<i>Nycticorax caledonicus</i> subsp. <i>australasiae</i>	nankeen night heron													3	3	
ARTAMIDAE																
<i>Artamus cinereus</i>	black-faced woodswallow					3				2		28			33	
<i>Artamus minor</i>	little woodswallow									21	3			4	28	
<i>Artamus personatus</i>	masked woodswallow													2	2	
<i>Cracticus nigrogularis</i>	pied butcherbird					1	1		1		5		3	33	44	
<i>Cracticus tibicen</i>	Australian magpie								2					10	12	
BURHINIDAE																
<i>Burhinus grallarius</i>	bush stone-curlew													3	3	

Scientific Name	Common Name	Conservation Status				Total Number of Individuals by Site										Total
		EPBC Act	BC Act	DBCA	IUCN	VOPN-001	VOPN-002	VOPN-003	VOPN-004	VOPN-005	VOPN-006	VOPN-007	VOPN-008	Other sampling sites/ opportunistic records		
CACATUIDAE																
<i>Cacatua roseicapilla</i>	galah						1			9				8	18	
<i>Cacatua sanguinea</i>	little corella					8		12						51	71	
<i>Nymphicus hollandicus</i>	cockatiel					1	15	3				23		1	43	
CAMPEPHAGIDAE																
<i>Coracina maxima</i>	ground cuckoo-shrike													5	5	
<i>Coracina novaehollandiae</i> subsp. <i>subpallida</i>	black-faced cuckoo-shrike					1	4	1		1		2	3	3	15	
<i>Lalage tricolor</i>	white-winged triller							2						3	5	
CAPRIMULGIDAE																
<i>Eurostopodus argus</i>	spotted nightjar									1				17	18	
CHARADRIIDAE																
<i>Elseyornis melanops</i>	black-fronted dotterel							2						10	12	
<i>Vanellus miles</i>	masked lapwing													2	2	
COLUMBIDAE																
<i>Geopelia cuneata</i>	diamond dove					1	1	2		3	1	6		2	16	
<i>Geopelia striata</i> subsp. <i>placida</i>	peaceful dove							12						4	16	
<i>Geophaps plumifera</i> subsp. <i>ferruginea</i>	spinifex pigeon						4		5	8	5		4	27	53	
<i>Ocyphaps lophotes</i>	crested pigeon					2	8	1	1					8	20	
<i>Phaps chalcoptera</i>	common bronzewing							2						2	4	
CORVIDAE																
<i>Corvus bennetti</i>	little crow													1	1	
<i>Corvus orru</i> subsp. <i>ceciliae</i>	Torresian crow						8	10		1	2	15	5	3	44	
CUCULIDAE																
<i>Cacomantis pallidus</i>	pallid cuckoo					1			2			2		34	39	

Scientific Name	Common Name	Conservation Status				Total Number of Individuals by Site										Total
		EPBC Act	BC Act	DBCA	IUCN	VOPN-001	VOPN-002	VOPN-003	VOPN-004	VOPN-005	VOPN-006	VOPN-007	VOPN-008	Other sampling sites/ opportunistic records		
<i>Chrysococcyx basalis</i>	Horsfield's bronze cuckoo						1				1			22	24	
<i>Chrysococcyx osculans</i>	black-eared cuckoo													4	4	
DICAETIDAE																
<i>Dicaeum hirundinaceum</i>	mistletoebird							1						1	2	
ESTRILDIDAE																
<i>Emblema pictum</i>	painted finch						14	21	1	45		1	11	16	109	
<i>Neochmia ruficauda</i> subsp. <i>subclarescens</i>	star finch (western)													87	87	
<i>Taeniopygia guttata</i> subsp. <i>castanotis</i>	zebra finch					87	58	21	15	49	16	96	31	205	578	
FALCONIDAE																
<i>Falco berigora</i>	brown falcon						1		1	1				7	10	
<i>Falco cenchroides</i>	nankeen kestrel					1			1		1	3		3	9	
<i>Falco longipennis</i>	Australian hobby													5	5	
HIRUNDINIDAE																
<i>Petrochelidon ariel</i>	fairy martin						2								2	
<i>Petrochelidon nigricans</i>	tree martin					1		3							4	
LARIDAE																
<i>Sterna hybrida</i>	whiskered tern													15	15	
LOCUSTELLIDAE																
<i>Cincloramphus cruralis</i>	brown songlark													1	1	
<i>Cincloramphus gramineus</i>	little grassbird													7	7	
<i>Cincloramphus mathewsi</i>	rufous songlark							7						5	12	
<i>Eremiornis carteri</i>	spinifex bird						10	1						8	19	
MALURIDAE																
<i>Amytornis striatus</i> subsp. <i>whitei</i>	striated grasswren								2					6	8	

Scientific Name	Common Name	Conservation Status				Total Number of Individuals by Site										Total
		EPBC Act	BC Act	DBCA	IUCN	VOPN-001	VOPN-002	VOPN-003	VOPN-004	VOPN-005	VOPN-006	VOPN-007	VOPN-008	Other sampling sites/ Opportunistic records		
<i>Malurus lamberti</i> subsp. <i>assimilis</i>	variegated fairywren					16	4							16	36	
<i>Malurus leucopterus</i> subsp. <i>leuconotus</i>	white-winged fairywren					17	5				4	24		27	77	
<i>Stipiturus ruficeps</i>	rufous-crowned emu-wren						4								4	
MELIPHAGIDAE																
<i>Acanthagenys rufogularis</i>	spiny-cheeked honeyeater											2		32	34	
<i>Certhionyx variegatus</i>	pied honeyeater											1		2	3	
<i>Epthianura tricolor</i>	crimson chat										1			14	15	
<i>Gavicalis virescens</i> subsp. <i>forresti</i>	inland singing honeyeater					6	1	11	3	2		1		25	49	
<i>Conopophila whitei</i>	grey honeyeater								1						1	
<i>Lichmera indistincta</i>	brown honeyeater					1	9	1			1			19	31	
<i>Manorina flavigula</i>	yellow-throated miner							1	2	11			6	14	34	
<i>Melithreptus gularis</i> subsp. <i>laetior</i>	black-chinned honeyeater													2	2	
<i>Ptilotula keartlandi</i>	grey-headed honeyeater						15		8	14	7		8	16	68	
<i>Ptilotula penicillata</i>	white-plumed honeyeater					2	9	27		2		5		39	84	
<i>Sugomel niger</i>	black honeyeater						1		2			2			5	
MEROPIDAE																
<i>Merops ornatus</i>	rainbow bee-eater					2	3	13	1	3		10	2	32	66	
MONARCHIDAE																
<i>Grallina cyanoleuca</i>	magpie-lark					1		13				7		13	34	
MOTACILLIDAE																
<i>Anthus australis</i> subsp. <i>australis</i>	Australasian pipit											1		1	2	
OREOICIDAE																
<i>Oreoica gutturalis</i>	crested bellbird					8	7		4		1	3		2	25	

Scientific Name	Common Name	Conservation Status				Total Number of Individuals by Site										Total
		EPBC Act	BC Act	DBCA	IUCN	VOPN-001	VOPN-002	VOPN-003	VOPN-004	VOPN-005	VOPN-006	VOPN-007	VOPN-008	Other sampling sites/ opportunistic records		
OTIDIDAE																
<i>Ardeotis australis</i>	Australian bustard													2	2	
PACHYCEPHALIDAE																
<i>Colluricincla harmonica</i> subsp. <i>rufiventris</i>	grey shrike thrush					2	1		2	8		1	1	25	40	
<i>Pachycephala rufiventris</i> subsp. <i>rufiventris</i>	rufous whistler					2		1	4	1				5	13	
PARDALOTIDAE																
<i>Pardalotus rubricatus</i>	red-browed pardalote							1							1	
<i>Pardalotus striatus</i> subsp. <i>murchisoni</i>	striated pardalote						4	1	1				6	2	14	
PELECANIDAE																
<i>Pelecanus conspicillatus</i>	Australian pelican													52	52	
PETROICIDAE																
<i>Melanodryas cucullata</i>	hooded robin													3	3	
PHAETHONTIDAE																
<i>Phalacrocorax carbo</i>	black cormorant													1	1	
<i>Phalacrocorax melanoleucos</i>	little pied cormorant							3						3	6	
<i>Phalacrocorax sulcirostris</i>	little black cormorant							8						3	11	
<i>Phalacrocorax varius</i> subsp. <i>hypoleucos</i>	pied cormorant													2	2	
PHASIANIDAE																
<i>Coturnix ypsilophora</i>	brown quail													2	2	
PODARGIDAE																
<i>Podargus strigoides</i>	tawny frogmouth							1							1	
PODICIPEDIDAE																
<i>Podiceps cristatus</i>	great crested grebe													3	3	
<i>Tachybaptus novaehollandiae</i>	Australasian grebe													2	2	

Scientific Name	Common Name	Conservation Status				Total Number of Individuals by Site										Total
		EPBC Act	BC Act	DBCA	IUCN	VOPN-001	VOPN-002	VOPN-003	VOPN-004	VOPN-005	VOPN-006	VOPN-007	VOPN-008	Other sampling sites/ opportunistic records		
POMATOSTOMIDAE																
<i>Pomatostomus temporalis</i> subsp. <i>rubeculus</i>	grey-crowned babbler						1	19				8		24	52	
PSITTACIDAE																
<i>Melopsittacus undulatus</i>	budgerigar					38	11	23	23	34	7	31	1	31	199	
<i>Platycercus zonarius</i> subsp. <i>zonarius</i>	Port Lincoln parrot						3	14				5		28	50	
PTILINORHYNCHIDAE																
<i>Ptilonorhynchus maculatus</i> subsp. <i>guttatus</i>	western bowerbird								1	1				2	4	
RALLIDAE																
<i>Fulica atra</i>	Eurasian coot													1,101	1,101	
<i>Porphyrio porphyrio</i>	purple swamphen													1	1	
<i>Porzana tabuensis</i>	spotless crane													1	1	
RECURVIROSTRIDAE																
<i>Himantopus himantopus</i>	black-winged stilt													23	23	
RHIPIDURIDAE																
<i>Rhipidura albiscapa</i>	grey fantail							1			2				3	
<i>Rhipidura leucophrys</i> subsp. <i>leucophrys</i>	willie wagtail					3	4	9	2	6		4	3	38	69	
SCOLOPACIDAE																
<i>Actitis hypoleucos</i>	common sandpiper	MI	MI											1	1	
STRIGIDAE																
<i>Ninox boobook</i>	boobook owl					1	1							17	19	
<i>Ninox connivens</i>	barking owl													1	1	
THRESKIORNITHIDAE																
<i>Platalea flavipes</i>	yellow-billed spoonbill													3	3	
<i>Plegadis falcinellus</i>	glossy ibis	MI	MI											4	4	

Scientific Name	Common Name	Conservation Status				Total Number of Individuals by Site										Total
		EPBC Act	BC Act	DBCA	IUCN	VOPN-001	VOPN-002	VOPN-003	VOPN-004	VOPN-005	VOPN-006	VOPN-007	VOPN-008	Other sampling sites/ opportunistic records		
<i>Threskiornis molucca</i>	Australian white ibis													1	1	
TURNICIDAE																
<i>Turnix velox</i>	little button quail					1			4	4	1	1		8	19	
TYTONIDAE																
<i>Tyto javanica</i>	eastern barn owl													5	5	
REPTILES																
AGAMIDAE																
<i>Ctenophorus caudicinctus</i>	ring-tailed dragon						4		8	2	1		1	7	23	
<i>Ctenophorus isolepis</i> subsp. <i>isolepis</i>	crested dragon					1								1	2	
<i>Ctenophorus nuchalis</i>	central netted dragon					2						2		1	5	
<i>Ctenophorus reticulatus</i>	western netted dragon											1			1	
<i>Gowidon longirostris</i>	long-nosed dragon					1		12				1		7	21	
<i>Pogona minor</i> subsp. <i>minor</i>	dwarf bearded dragon					1								1	2	
CHELIDAE																
<i>Chelodina steindachneri</i>	flat-shelled turtle													2	2	
DIPLODACTYLIDAE																
<i>Diplodactylus conspicillatus</i>	fat-tailed gecko					3						2			5	
<i>Diplodactylus laevis</i>	desert fat-tailed gecko					24	1					3			28	
<i>Diplodactylus savagei</i>	southern Pilbara beak-faced gecko						1		1		3				5	
<i>Lucasium wombeyi</i>	gecko										1				1	
<i>Lucasium woodwardi</i>	gecko						1		10			3			14	
<i>Oedura fimbria</i>	western marbled velvet gecko									2					2	
<i>Strophurus wellingtonae</i>	gecko								1						1	
ELAPIDAE																

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<i>Acanthophis wellsi</i>	Pilbara death adder													1	1	
<i>Demansia psammophis</i> subsp. <i>cupreiceps</i>	yellow-faced whipsnake					1						1		1	3	
<i>Demansia rufescens</i>	rufous whipsnake									1					1	
<i>Pseudechis australis</i>	mulga snake													1	1	
<i>Pseudonaja mengdeni</i>	western brown snake							1	1					2	4	
<i>Pseudonaja modesta</i>	ringed brown snake					1									1	
GEKKONIDAE																
<i>Gehyra micra</i>	small Pilbara spotted rock gehyra									4	2		3		9	
<i>Gehyra punctata</i>	spotted dtella						2			11	2		2		17	
<i>Gehyra purpurascens</i>	gecko							1							1	
<i>Gehyra variegata</i>	tree gecko					1		5	1	2		1		1	11	
<i>Heteronotia binoei</i>	binoes gecko					5	12	5	6	1	1	2	1		33	
<i>Heteronotia spelea</i>	desert cave gecko									6			5		11	
PYGOPODIDAE																
<i>Delma elegans</i>	legless lizard												1		1	
<i>Delma nasuta</i>	long-nosed delma								1						1	
<i>Delma pax</i>	legless lizard							2		1		1			4	
<i>Delma tincta</i>	legless lizard							1							1	
<i>Pygopus nigriceps</i>	legless lizard								1						1	
PYTHONIDAE																
<i>Antaresia perthensis</i>	pygmy python								2	2	1		1		6	
SCINCIDAE																
<i>Carlia munda</i>	shaded-litter rainbow skink							3							3	
<i>Carlia triacantha</i>	desert rainbow skink						5								5	

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<i>Cryptoblepharus ustulatus</i>	russet snake-eyed skink									1				3	4	
<i>Ctenotus ariadnae</i>	Ariadna's Ctenotus						1								1	
<i>Ctenotus duricola</i>	skink						1		1	1		3		1	7	
<i>Ctenotus grandis</i> subsp. <i>titan</i>	grand Ctenotus					1									1	
<i>Ctenotus hanloni</i>	skink					2									2	
<i>Ctenotus inornatus</i>	skink					5	19		44	15	21	6	14	1	125	
<i>Ctenotus leonhardii</i>	skink											4			4	
<i>Ctenotus pallasotus</i>	western Pilbara lined Ctenotus						3		3			3			9	
<i>Ctenotus pantherinus</i>	leopard skink					22			3			2			27	
<i>Ctenotus quattuordecimlineatus</i>	fourteen-lined Ctenotus					1									1	
<i>Ctenotus rutilans</i>	skink										1				1	
<i>Ctenotus uber</i>	spotted Ctenotus											1		1	2	
<i>Cyclodomorphus melanops</i> subsp. <i>melanops</i>	slender blue-tongue										1				1	
<i>Lerista chalybura</i>	Pilbara blue-tailed slider									1				2	3	
<i>Lerista neander</i>	skink													1	1	
<i>Menetia greyii</i>	common dwarf skink					2	1		2	1					6	
<i>Morethia ruficauda</i> subsp. <i>exquisita</i>	fire-tailed skink						3			6	2		1		12	
TYPHLOPIDAE																
<i>Anilios gryp</i>	blind-snake									1	5	1			7	
<i>Anilios hamatus</i>	blind-snake											1			1	
VARANIDAE																
<i>Varanus acanthurus</i>	spiny-tailed monitor						1		1	1	2			2	7	
<i>Varanus brevicauda</i>	short-tailed pygmy monitor					4									4	
<i>Varanus giganteus</i>	perentie									2				3	5	

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<i>Varanus gouldii</i>	bungarra													1	1	
<i>Varanus hamersleyensis</i>	southern pilbara rock goanna												1	4	5	
<i>Varanus tristis</i> subsp. <i>tristis</i>	racehorse goanna													1	1	
AMPHIBIANS																
LIMNODYNASTIDAE																
<i>Neobatrachus sutor</i>	shoemaker frog							1							1	
<i>Platyplectrum spenceri</i>	centralian burrowing frog							4							4	
MYOBATRACHIDAE																
<i>Uperoleia saxatilis</i>	Pilbara toadlet							33							33	
PELODRYADIDAE																
<i>Litoria rubella</i>	little red tree frog							57		1				44	102	
Total number of individuals recorded						344	304	500	205	331	140	354	150	3,059	5,387	