Yandi 45C
Targeted Significant Vertebrate Fauna Survey
March 2023

Prepared for
BHP Western Australian Iron Ore

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an ecocene company

Report Reference: 2400-006-22-BISR-1Rev0_230417

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A	13/12/2022	Draft Issued for Client Review	K. Grosser	J. Johnston
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Approval

Rev	Date	Issued to	Authorised by	
			Name	**Signature**
A	16/12/2022	S. Wild	B. Lucas	
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0	17/04/2023	S. Wild	B. Lucas	

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Abbreviations

Abbreviation	Definition
ARU	Autonomous Recording Unit
Astron	Astron Environmental Services
BC Act	*Biodiversity and Conservation Act 2016*
BHP WAIO	BHP Western Australia Iron Ore
BOM	Bureau of Meteorology
CR	Critically Endangered
DBCA	Department of Biodiversity, Conservation and Attractions
DEHWA	Department of Water, Heritage and the Arts
DSWEPaC	Department of Sustainability, Water, Environment, Population and Communities
EN	Endangered
EPA	Environmental Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ESA	Environmentally Sensitive Area
GPS	Geographical Positioning System
IBRA	Interim Biogeographic Regionalisation for Australia
Mi	Migratory
MNES	Matters of National Environmental Significance
OS	Other Specially Protected
P	Priority
PMST	Protected Matters Search Tool
SM	SongMeter
VU	Vulnerable
WA	Western Australia
°C	Degrees Celsius

Executive Summary

Astron Environmental Services was commissioned by BHP Western Australian Iron Ore (BHP WAIO) to undertake a targeted significant vertebrate fauna survey covering an area of 1,599.5 ha within several areas of the BHP WAIO Yandi mining Operations. BHP Yandi Operations is located approximately 96 km north-west of Newman and consists of active mining and pastoral leases.

Ten broad habitat types were recorded in the survey area: Hardpan Plain, Major Drainage Line, Medium Drainage Line, Breakaway/Cliff, Undulating Low Hills, Hillcrest/Hillslope, Drainage Area/Floodplain, Sandy/Stony Plain, Stony Plain, Wetland, as well as Cleared/Disturbed areas. Major disturbances were recorded throughout most of the survey area due to the pit and active mining occurring adjacent to most sites. Other disturbances consisted mostly of roads/tracks, cattle grazing, and weed invasion. Medium and Major Drainage Line habitats were the most impacted by disturbances. Habitats within the survey area are not restricted at a local or sub-regional scale, except for the Wetland habitat, as permanent water bodies like these are not common in the Pilbara region and are of high value to many species, including Matters of National Environmental Significance (MNES) Wetland habitats were present in the survey area in sections of Marillana Creek (Flatrocks) and at the dewatering discharge pond (approximately 0.9% of the survey area). Wetlands differ from permanent/semi-permanent pools as they are generally a larger water body that supports their own distinct ecosystem and aquatic fauna assemblages.

Breakaway/Cliff habitat was not common in the survey area (approximately 0.6%) and was of moderate habitat value for general fauna species and target MNES species. Breakaway/Cliff and Wetland habitats near Flatrocks was considered critical habitat (0.8 ha; 0.05% of survey area) for the Pilbara olive python (*Liasis olivaceus barroni*) due to rocky habitat being in close vicinity to water. The other areas of Breakaway/Cliff habitat in the survey area were not cave-forming and therefore not of high value to MNES species such as the northern quoll (*Dasyurus hallucatus*) and the two significant bat species.

Hardpan Plain and Drainage Area/Floodplain habitats were considered moderately important for fauna but do present suitable foraging and dispersal habitat for the greater bilby (*Macrotis lagotis*), an MNES species. This is due to soft soils that provide digging opportunities to forage for invertebrates at the base of termite mounds and *Acacia* roots. Medium and Major Drainage Line habitats were of moderate value to a large selection of vertebrate fauna and of high value to the target MNES species, as they provide potentially suitable foraging and dispersal habitat for the northern quoll, ghost bat (*Macroderma gigas*), Pilbara leaf-nosed bat (*Rhinonicteris aurantia*), Pilbara olive python, grey falcon (*Falco hypoleucos*) and some Migratory bird species. While these species may utilise the Medium and Major Drainage Line habitats for foraging and dispersal, it is unlikely that they are reliant on them as there was no connectivity to important denning/sheltering habitat within and around the survey area, except for the grey falcon, which may utilise this habitat for nesting.

There were 91 vertebrate fauna species recorded within the survey area, comprising of seven reptiles, 66 birds, and 18 mammals (including four introduced species). The fauna species assemblage recorded during the survey was considered typical for the Pilbara region.

One MNES species, the common sandpiper (*Actitis hypoleucos*), was recorded within the survey area. Several records were collected on motion cameras near the Wetland habitat at Flatrocks. This species is likely to be an occasional visitor to the survey area. One additional species of significance was recorded during the current survey, the Priority 4 western pebble-mound mouse (*Pseudomys chapmani*). Seven mounds were recorded within the survey area, three of which were deemed active,

three recently inactive, and one inactive and this species is likely to occur within the Hillcrest/Hillslope and Undulating Low Hills habitats of the survey area.

The Pilbara olive python is considered to have a 'high' likelihood of occurrence, as it has been previously recorded close to the survey area and there is critical and supporting habitat present within the survey area. Similarly, one other significant species, the peregrine falcon (*Falco peregrinus*), was assessed as having a 'high' likelihood of occurrence given previous records in the vicinity and suitable habitat within the survey area.

Target MNES species northern quoll, ghost bat, Pilbara leaf-nosed bat, and grey falcon are considered to have a 'moderate' likelihood of occurrence, given high numbers of previous records in the vicinity and the presence of potential supporting habitat. However, no critical habitat is considered present, except for the grey falcon, and these species were not recorded during the survey despite adequate survey effort.

The likelihood of occurrence for the target MNES species night parrot (*Pezoporus occidentalis*) and greater bilby is considered 'low' given the limited supporting habitat present in the survey area, no or few previous records in the vicinity, and no records during the current survey.

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1 Introduction

1.1 Project Background

Astron Environmental Services (Astron) was commissioned by BHP Western Australian Iron Ore (BHP WAIO) to undertake a targeted significant vertebrate fauna survey, focussing on Matters of National Environmental Significance (MNES) over several areas of BHP Yandi mining Operations (herein referred to as the 'survey area'). The survey area is located approximately 96 km north-west of the Newman township and covers an area of approximately 1,599.5 ha (Figure 1).

1.2 Scope and Objectives

The objective and scope of work was to undertake a targeted significant vertebrate fauna survey via a:

- desktop assessment, including database searches and literature review of available resources for the Pilbara MNES species
- targeted vertebrate fauna field survey, including:
  - targeted MNES species sampling and searches
  - other fauna species sampling
  - fauna habitat assessments and mapping.

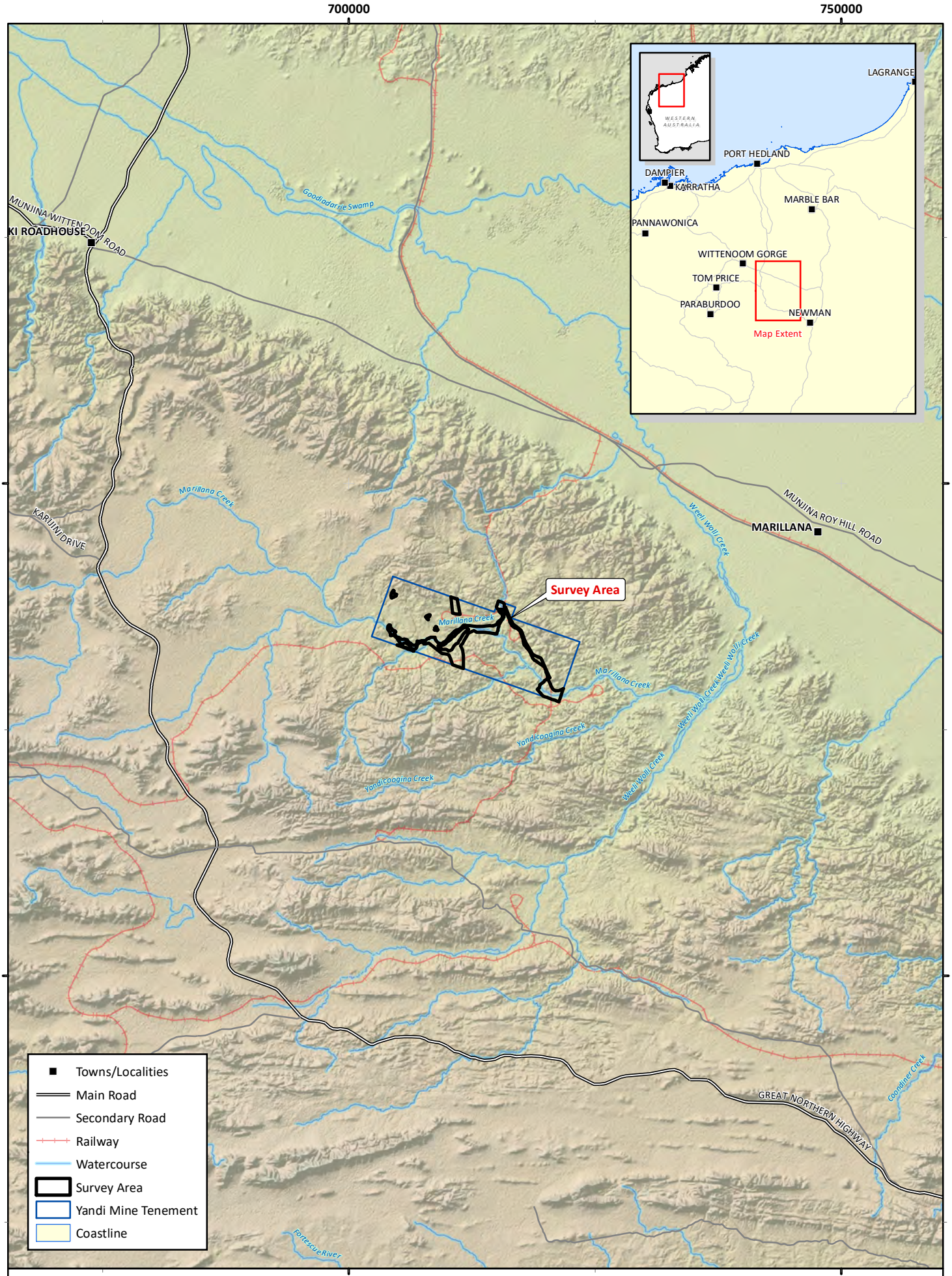
The desktop assessment informed the field survey and included a comprehensive database and literature review for the MNES species of the Pilbara region, including ghost bat (*Macroderma gigas*) (VU; VU), Pilbara leaf-nosed bat (*Rhinonicteris aurantia*) (VU; VU), greater bilby (*Macrotis lagotis*) (VU; VU), northern quoll (*Dasyurus hallucatus*) (EN; EN), night parrot (*Pezoporus occidentallis*) (EN; CR), and Pilbara olive python (*Liasis olivaceus barroni*) (VU; VU).

Astron conducted the fauna survey in accordance with the regulatory guidance detailed in Table 1 and BHP WAIO's Guidance for Terrestrial Vertebrate Fauna Surveys in the Pilbara (BHP Billiton Iron Ore 2019) and Spatial Data Requirements (BHP 2022). Section 3.4 of this report provides details on the limitations of the survey.

Table 1: Summary of Astron's targeted MNES vertebrate fauna survey.

Level of survey	Survey area size	Survey timing	Relevant regulatory guidance documents
Targeted significant vertebrate fauna survey	1,599.5 ha	23 September – 2 October 2022	• Environmental Protection Authority (EPA) (2022) Statement of Environmental Principles, Factors and Objectives and aims of EIA (Environmental Protection Authority 2022) • EPA (2016) Environmental Factor Guideline – Terrestrial Fauna (Environmental Protection Authority 2016) • EPA (2020) Technical Guidance – Technical Guidance – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (Environmental Protection Authority 2020) • Department of Environment, Water, Heritage and the Arts (DEWHA) (2013) Significant Impact Guidelines 1.1 – Matters of National Environmental Significance (Department of Environment 2013) • DEWHA (2010) Survey Guidelines for Australia's Threatened Bats (Department of the Environment, Water, Heritage and the Arts 2010a) • DEWHA (2010) Survey Guidelines for Australia's Threatened Birds (Department of the Environment, Water, Heritage and the Arts 2010b) • DEWHA (2010) Survey Guidelines for Australia's Threatened Frogs (Department of the Environment, Water, Heritage and the Arts 2010c) • Department of Sustainability, Environment, Water, Population and Communities (DSWEPaC) (2011) Survey Guidelines for Australia's Threatened Mammals (Department of Sustainability Environment Water Population and Communities 2011a) • DSWEPaC (2011) Survey Guidelines for Australia's Threatened Reptiles (Department of Sustainability Environment Water Population and Communities 2011b) • Department of the Environment and Energy (2016) Referral guideline for the endangered northern quoll *Dasyurus hallucatus* (Department of the Environment and Energy 2016) • Department of Biodiversity, Conservation and Attractions (DBCA) (2017) Guidelines for surveys to detect the presence of bilbies, and assess the importance of habitat in Western Australia (Department of Biodiversity Conservation and Attractions 2017) • Department of Parks and Wildlife (2017) Interim Guideline for Preliminary Surveys of Night Parrot (*Pezoporus occidentalis*) in Western Australia (Department of Parks and Wildlife 2017) • Threatened Species Scientific Committee (2008) Conservation advice for *Liasis olivaceus barroni* (Olive python – Pilbara subspecies) (Threatened Species Scientific Committee 2008)

Level of survey	Survey area size	Survey timing	Relevant regulatory guidance documents
			• TSSC (2016) Conservation advice for *Macroderma gigas* (ghost bat) (Threatened Species Scientific Committee 2016a) • TSSC (2016) Conservation advice *Rhinonicteris aurantia* (Pilbara form), Pilbara leaf-nosed bat (Threatened Species Scientific Committee 2016b)



BHP Western Australian Iron Ore (WAIO)
Yandi 45C Targeted Significant Vertebrate Fauna Survey

Figure 1: Survey Area Location

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Author: K. Grosser	Date: 08-03-2023
Drawn: C. Dyde	Figure Ref: 2400-006-BIDR-1Rev0_230308_Fig1_Locn

Datum: GDA 1994 - Projection: MGA Zone 50

0 5 10 15 20 25 Km

N

2 Environmental Context

2.1 Physical Environment

2.1.1 Climate

The climate of the Pilbara region of Western Australia is classified as arid tropical with two distinct seasons: a hot, wet summer (October – April) and a mild, dry winter (May – September) (Bureau of Meteorology 2022).

Based on long-term climatic data from the nearest Bureau of Meteorology (BOM) weather station at Newman Aero (Station 007176) (approximately 96 km north-west of the survey area) the mean annual rainfall since 1971 is 324.4 mm. The mean maximum daily temperatures range between 23.1°C and 39.3°C, and range above 30°C for much of the year (Bureau of Meteorology 2022).

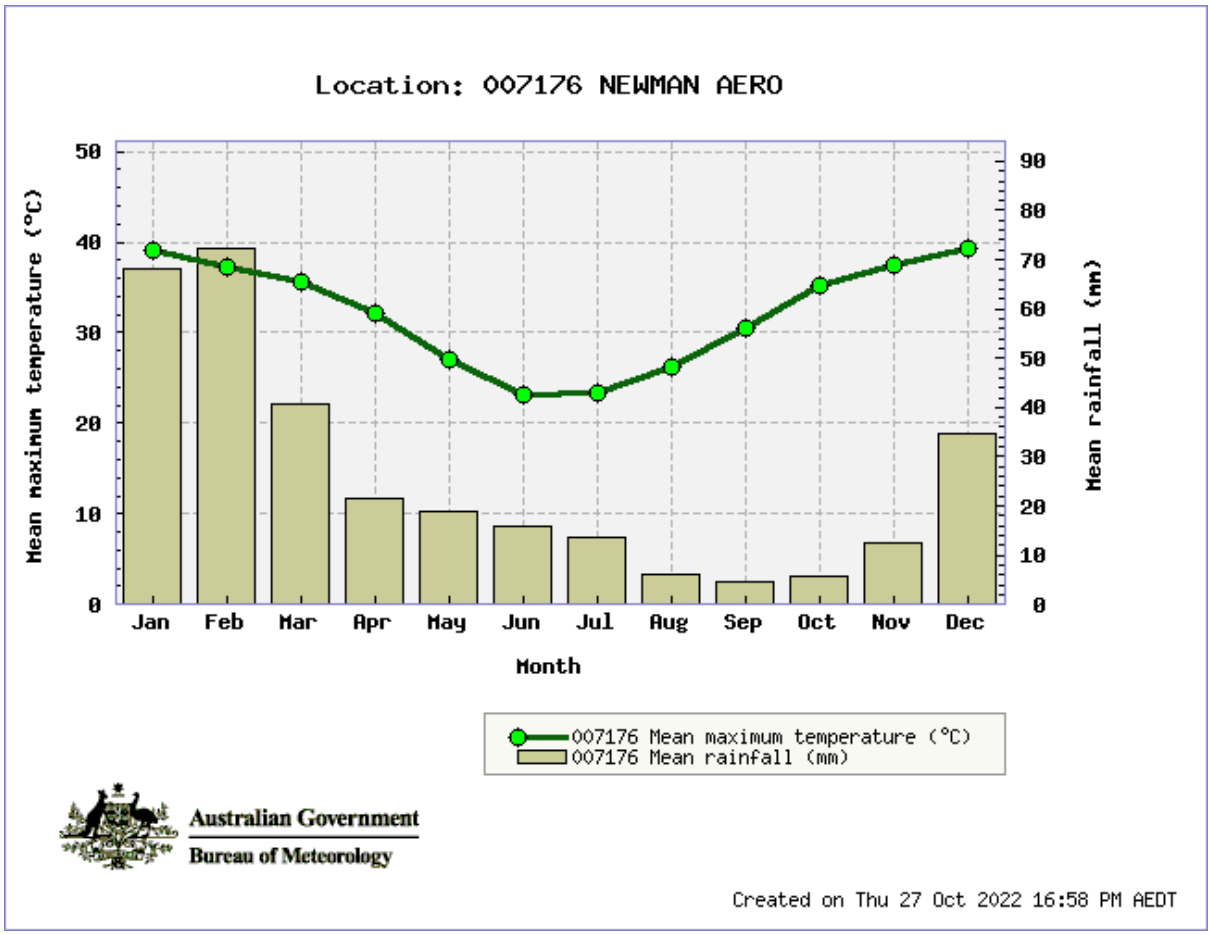

Figure 2: Climate data for Newman Aero Station (007176). Mean annual rainfall data has been calculated from 1971-2022 and mean maximum temperature has been calculated from 1996-2022 (Bureau of Meteorology 2022).

2.1.2 Geology and Soils

The surface geology of the survey area is comprised of two units (Geoscience Australia 2008, Stewart et al. 2008), with Weeli Wolli Formation the most dominant (Table 2). Geological mapping of the survey area and surrounds is presented in Figure 3.

700000 710000 720000 730000

7490000

7480000

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Survey Area
Yandi Mine Tenement

QUATERNARY
Qrc

CENOZOIC
Czk
Czl
Czlr (Robe)
Czs

PALEOPROTEROZOIC
Lchk
Lchw (Weeli Wolli)

PROTEROZOIC
-Pd

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Yandi 45C Targeted Significant Vertebrate Fauna Survey

Figure 3: Geological units of the survey area

Scale: 1:100,000 at A3
Coordinate System: GDA 1994 MGA Zone 50
0 1 2 3 4 5 Kilometres

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Author: K. Grosser | Drawn: C. Dyde | Date: 08-03-2023 | Figure Ref: 2400-006-BIDR-1Rev0_230308_Fig3_Geo

Table 2: Geological units of the survey area (Stewart et al. 2008).

Geological name	Label	Area within survey area (ha)
Robe Pisolite: Pisolitic, oolitic, and massive limonite, goethite, and hematite deposits containing fossil wood fragments; iron ore	Czlr	485.9
Weeli Wolli Formation: Banded iron-formation (commonly jaspilitic), mudstone, siltstone; common interlayered metadoleritic sills	Lchw	1113.7

2.1.3 Surface Water and Hydrology

The survey area occurs within the 'Fortescue River Upper' catchment. No Wetlands of International Importance (i.e. Ramsar wetlands) or Nationally Important Wetlands occur within the survey area (Department of the Environment and Energy 2020a, 2020b). The nearest Nationally Important Wetland is Fortescue Marshes, located approximately 29 km north of the survey area. Marillana Creek runs through some sections of the survey area.

2.2 Biological Environment

2.2.1 Interim Biogeographic Regionalisation of Australia

The Interim Biogeographic Regionalisation for Australia (IBRA version 7) divides the Australian continent into 89 bioregions and 419 subregions (Department of Agriculture, Water and the Environment 2021). The IBRA regions represent a landscape-based approach to classifying the land surface, including attributes of climate, geomorphology, landform, lithology, and characteristic flora and fauna. The survey area is situated in the Pilbara Bioregion, of which 8.44% is represented in the national reserve system (Department of the Environment and Energy 2021).

The biodiversity of the 53 subregions recognised in Western Australia was documented as part of a national audit to provide priorities for conservation action (Department of Conservation and Land Management 2002). The survey area occurs within the Hamersley subregion of the Pilbara region. This subregion is described as:

- Hamersley PIL03 – mountainous area of Proterozoic sedimentary ranges and plateaux, dissected by gorges (basalt, shale and dolerite). Mulga low woodland over bunch grasses on fine textured soils in valley floors, and *Eucalyptus leucophloia* over *Triodia brizoides* on skeletal soils of the ranges (Kendrick 2001).

2.2.2 Land Systems

Land systems of the Western Australian rangelands have been mapped and described by the Department of Agriculture and Food outlining the distributions and providing comprehensive descriptions of biophysical resources, including soil and vegetation condition. A total of 102 land systems occur in the Pilbara bioregion, covering an area of 181,723 km^2. Five land systems occur in the survey area (Table 3). The distribution of these land systems within the survey area is shown in Figure 4.

700000 710000 720000 730000

7490000

7480000

Survey Area
Yandi Mine Tenement

Land System

- Boolgeeda System
- Calcrete System
- McKay System
- Newman System
- Oakover System
- Platform System
- River System
- Robe System
- Rocklea System
- Wannamunna System

BHP Western Australian Iron Ore (WAIO)
Yandi 45C Targeted Significant Vertebrate Fauna Survey

Figure 4: Land systems of the survey area

Scale: 1:100,000 at A3
Coordinate System: GDA 1994 MGA Zone 50
0 1 2 3 4 5 Kilometres

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Author: K. Grosser | Drawn: C. Dyde | Date: 08-03-2023 | Figure Ref: 2400-006-BIDR-1Rev0_230308_Fig4_LS

Table 3: Distribution of land systems within the survey area.

Land system	Total area within bioregion (ha)	Total area within survey area (ha) (proportion of survey area)	Proportion of land system within survey area
Pilbara bioregion			
Boolgeeda (BGD) - stony lower slopes and plains below hill systems, supporting hard and soft spinifex grasslands or mulga shrublands	962,141.0	35.6 (2.2%)	0.4%
McKay (MCK) - hills, ridges, plateaux remnants and breakaways of meta sedimentary and sedimentary rocks, supporting hard spinifex	425,967.0	1,187.5 (74.2%)	0.3%
Newman (NEW) - rugged jaspilite plateaux, ridges, and mountains, supporting hard spinifex grasslands	1,996,418.0	74.5 (4.7%)	<0.1%
River (RIV) - active flood plains, major rivers, and banks, supporting grassy eucalypt woodlands, tussock grasslands and soft spinifex grasslands	481,994.0	93.8 (5.9%)	<0.1%
Robe (ROB) - low plateaux, mesas, and buttes of limonites, supporting soft spinifex (and occasionally hard spinifex) grasslands	128,680.0	208.2 (13%)	0.2%

2.2.3 Pre-European Vegetation

Beard (1975) completed broad-scale (1:1,000,000) pre-European vegetation mapping at an association level. The Beard mapping was later used by the former Department of Agriculture and Food Western Australia (Shepherd et al. 2002) to compile vegetation units that assisted with identifying pre-European and current extents of vegetation throughout Western Australia.

Two pre-European vegetation units, 18 and 82 (Shepherd et al. 2002, Department of Primary Industries and Regional Development 2019), are associated with the survey area (Figure 5). Table 4 summarises the current and pre-European extent of these two vegetation units in the Pilbara bioregion and the survey area.

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7490000

7480000

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Survey Area
Yandi Mine Tenement
System Association
FORTESCUE VALLEY_29
HAMMERSLEY_18
HAMMERSLEY_82

BHP Western Australian Iron Ore (WAIO)
Yandi 45C Targeted Significant Vertebrate Fauna Survey

Figure 5: Pre-European vegetation of the survey area

Scale: 1:100,000 at A3
Coordinate System: GDA 1994 MGA Zone 50
0 1 2 3 4 5 Kilometres

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Author: K. Grosser | Drawn: C. Dyde | Date: 08-03-2023 | Figure Ref: 2400-006-BIDR-1Rev0_230308_Fig5_PEV

Table 4: Extent of pre-European vegetation within the survey area by Interim Biogeographic Regionalisation for Australia (IBRA) sub-region (Government of Western Australia 2018).

Vegetation unit	Mapping unit (Beard 1975)	Description	Extent in survey area (ha)	Pre-European extent (ha)	Current extent in bioregion (ha)	Proportion of pre-European extent remaining (%)	Pre-European extent with formal protection (%)
Pilbara bioregion (PIL03 IBRA sub-region)							
18	a1Li	Low woodland, open low woodland, or sparse woodland: Mulga *Acacia aneura* and associated species.	211.8	581,246.1	576,541.7	99.2	19.5
82	e16Lr t3Hi	Low tree-steppe: Hummock grassland with scattered bloodwoods & snappy gum *Triodia* spp., *Corymbia dichromophloia*, *Eucalyptus leucophloia*	1387.8	2,177,573.9	2,165,224.2	99.4	12

2.3 Conservation Categories and Management

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides a legal framework to protect and manage MNES, including listed flora, fauna, and ecological communities. These listed flora, fauna, and ecological communities are allocated a conservation category, which are outlined in Tables A.1 – A.2 and A.5 (Appendix A).

Ecological communities may be subject to processes that threaten to destroy or significantly modify them across much of their range. These communities are identified as threatened ecological communities that are listed at the Commonwealth level under the EPBC Act (Tables A.1 and A.2, Appendix A).

Under Western Australian legislation, all native fauna is protected, and it is an offence to 'take' protected fauna. The *Biodiversity Conservation Act 2016* (BC Act) also provides for native fauna species to be specially protected when they are considered rare, threatened with extinction, or have a high conservation value (Table A.3, Appendix A). In addition, due to the diversity of Western Australia's fauna, many species are known from only a few collections or locations but have not been adequately surveyed. Such fauna may be rare or threatened but cannot be considered for declaration as 'Threatened fauna' until adequate surveys have been undertaken. These fauna species are included on a supplementary conservation list managed by the Department of Biodiversity, Conservation and Attractions (DBCA) called the *Priority Fauna List*. Priority fauna species are categorised according to their level of threat and other information. These conservation categories are described in Table A.4 (Appendix A).

2.4 Land Use and Tenure

The survey area is located within the Shires of East Pilbara and Ashburton. Approximately 844 ha of the survey area is situated on Juna Downs Station pastoral lease and approximately 532 ha of the survey area is situated on Marillana Station pastoral lease. The local area is used for pastoralism, mineral exploration, and mining activity.

Karijini National Park is the nearest conservation reserve to the survey area, located approximately 34 km to the south-west of the survey area. Mungaroona Range Nature Reserve is located approximately 91 km to the north-west of the survey area.

3 Methods

3.1 Desktop Assessment

3.1.1 Database Searches

The desktop assessment focused on key habitats for MNES species that occur in the Pilbara bioregion. The database searches conducted are summarised in Table 5.

Table 5: List of databases reviewed for the desktop assessment.

Database name	Date search results received	Search focus	Search area
NatureMap (Department of Biodiversity, Conservation and Attractions 2022a)	19/07/2022	Terrestrial vertebrate fauna and fauna of significance	40 km radius from the survey area boundary
Protected Matters Search Tool (Department of Climate Change, Energy, the Environment and Water 2022)	19/07/2022	MNES species	40 km radius from a central point within the survey area
Threatened and Priority Fauna Database (Department of Biodiversity, Conservation and Attractions 2022b)	25/07/2022	Threatened and Priority fauna species	40 km radius from the survey area boundary
Birdlife Australia Birdata (Birdlife Australia 2022)	19/07/2022	Bird species	40 km radius from a central point within the survey area
Atlas of Living Australia (Atlas of Living Australia 2022)	22/07/2022	Terrestrial vertebrate fauna species	Survey area boundary

3.1.2 Literature Review

Fauna surveys have been previously commissioned by BHP WAIO overlapping and/or within 2 km of the survey area and were supplied to Astron for the desktop assessment. The previous survey areas in relation to the current survey are shown in Figure 6. The reports reviewed as part of this assessment included:

- Pebble-mound Mouse Site Survey (Ecologia Environment 1996)
- Mining Area C Biological Survey (Ecologia Environment 1998)
- Marillana Creek Western Access Corridor Biological Assessment (Halpern Glick Maunsell 1999)
- Yandi Life of Mine Flora and Fauna (Maunsell Australia 2003)
- Yandi Stockyard and Overland Conveyor Fauna and Flora Assessment (Ecologia Environment 2004)
- Yandi Hub Fauna Assessment (ENV Australia 2008)
- Marillana Creek (Yandi) Iron ore Mine Modification Level 2 Fauna Survey (Ecologia Environment 2008a)
- RGP5 Fauna Survey Kurrajura Siding to Yandi WYE including Yandi Repeater 1 (Ecologia Environment 2008b)

- Survey for Conservation Significant Bats between Kurrajura siding and the Yandi Wye (Specialised Zoological 2008)
- Yandi Flora Survey and Assessment of Barimunya Airport and a Potential Borrow Area (ENV Australia 2009a)
- Yandicoogina Junction South West and Oxbow Fauna Survey (Biota Environmental Sciences 2010)
- Newman to Yandi Transmission Line Terrestrial Vertebrate Fauna Assessment (ENV Australia 2009b)
- Area C to Yandi Fauna Survey (Biologic 2011a)
- Yandi Vertebrate Fauna Review (Biologic 2011b)
- Barimunya Camp Fauna Survey (Biologic 2011c)
- Area C West to Yandi Level 2 Vertebrate Fauna Survey (Biota Environmental Sciences 2013)
- Marillana Infrastructure Corridor Level 1 Vertebrate Fauna Survey (Biologic 2016)
- Ministers North to Yandi Corridor Single Phase Level 2 Fauna and Detailed Flora/Vegetation Survey (Biologic 2017)
- Marillana Tenement and Infrastructure Corridor Targeted Vertebrate Fauna Survey (Biologic 2019)
- Ministers North Fauna Survey Level 2 Survey (GHD Pty Ltd 2021a)
- Ministers North Fauna Survey Level 1 Survey (GHD Pty Ltd 2021b).

680000 700000 720000 740000

7500000 7480000 7460000

Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

ENV Australia (2008)
Specialised Zoological (2008)
Ecologia Environment (2008a)
Biota Environmental Sciences (2013)
Biologic (2016)
Biologic (2019)
Biologic (2011a)
Ecologia Environment (2008b)
ENV Australia (2009b)
ENV Australia (2009b)
Ecologia Environment (2004)
Ecologia Environment (1996)
Ecologia Environment (1996)
Maunsell Australia (2003)
Biologic (2011c)
Biologic (2017)
GHD (2021b)
Biota Environmental Sciences (2010)
GHD (2021a)
Biologic (2011b)
ENV Australia (2008)
Halpern Glick Maunsell (1999)
ENV Australia (2009a)
Ecologia Environment (1998)

- Survey Area
- Yandi Mine Tenement

Previous Surveys

- Biologic (2011a) Barimunya Camp Fauna Survey
- Biologic (2011b) Area C to Yandi Fauna Survey
- Biologic (2011c) Yandi Vertebrate Fauna Review
- Biologic (2016) Marillana Infrastructure Corridor Level 1 Vertebrate Fauna Survey
- Biologic (2017) Ministers North to Yandi Corridor Single Phase Level 2 Fauna and Detailed Flora/ Vegetation Survey
- Biologic (2019) Marillana Tenement and Infrastructure Corridor Targeted Vertebrate Fauna Survey
- Biota Environmental Sciences (2010) Yandicoogina Junction South West and Oxbow Fauna Survey
- Biota Environmental Sciences (2013) Area C West to Yandi Level 2 Vertebrate Fauna Survey
- ENV Australia (2008) Yandi Hub Fauna Assessment
- ENV Australia (2009a) Newman to Yandi Transmission Line Terrestrial Vertebrate Fauna Assessment
- ENV Australia (2009b) Yandi Flora Survey and Assessment of Barimunya Airport and a Potential Borrow Area
- Ecologia Environment (1996) Pebble-mound Mouse Site Survey
- Ecologia Environment (1998) Mining Area C Biological Survey
- Ecologia Environment (2004) Yandi Stockyard and Overland Conveyor Fauna and Flora Assessment
- Ecologia Environment (2008a) RGP5 Fauna Survey Kurrajura Siding to Yandi WYE including Yandi Repeater 1
- Ecologia Environment (2008b) Marillana Creek (Yandi) Iron ore Mine Modification Level 2 Fauna Survey
- GHD (2021a) Ministers North Fauna Survey Level 2 Survey
- GHD (2021b) Ministers North Fauna Survey Level 1 Survey
- Halpern Glick Maunsell (1999) Marillana Creek Western Access Corridor Biological Assessment
- Maunsell Australia (2003) Yandi Life of Mine Flora and Fauna
- Specialised Zoological (2008) Survey for conservation significant bats between Kurrajura siding and the Yandi Wye

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Yandi 45C Targeted Significant Vertebrate Fauna Survey

Figure 6: Previous fauna surveys conducted in the vicinity of the survey area

Scale: 1:200,000 at A3
Coordinate System: GDA 1994 MGA Zone 50
0 2 4 6 8 10 Kilometres

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Author: K. Grosser | Drawn: T. Pedersen | Date: 14-03-2023 | Figure Ref: 2400-006-BIDR-1Rev0_230314_Fig6_PrevSurvey

3.1.3 Conservation Assessment

Significant vertebrate fauna species (inclusive of Threatened and Migratory MNES listed fauna, and DBCA Priority fauna species) that were returned from the database searches were categorised for likelihood of occurrence within the survey area according to the criteria listed in Table A.5 (Appendix A). Post-survey, the likelihood table was re-assessed utilising the information obtained during the field visit and updated accordingly. The additional criteria used for the assessment are outlined in Table A.5 (Appendix A). The likelihood table was then updated to reflect an improved understanding of the likelihood that a species would occur in the survey area.

3.2 Field Survey

3.2.1 Survey Timing and Personnel

The field survey was undertaken by Senior Zoologist Kady Grosser and Zoologist Sean Smithies from 23 September to 2 October 2022. Senior Zoologist Kady Grosser has over 10 years of experience conducting vertebrate fauna surveys, with over 5 years surveying in the Pilbara region.

The survey was conducted under DBCA Authorisation to Take or Disturb Threatened Species (Section 40 of the BC Act) (TFA 2223-0103) and under the Department of Primary Industries and Regional Development Scientific Use Licence (U279/2022) and Wildlife Animal Ethics Committee approval (WAEC 22-08-87).

3.2.2 Weather

Daily weather observations recorded from Newman Aero (station 007176) were used to describe local rainfall and temperature preceding the survey (Figure 7). The annual rainfall recorded preceding the survey (289.4 mm) was well below the long-term mean of 315.3 mm (Bureau of Meteorology 2022). Rainfall in the three months preceding the field survey (59.2 mm) was above the long-term mean (19.73 mm) (Bureau of Meteorology 2022). The maximum daily temperatures during the field survey period ranged from 26.8°C and 36°C (Bureau of Meteorology 2022).

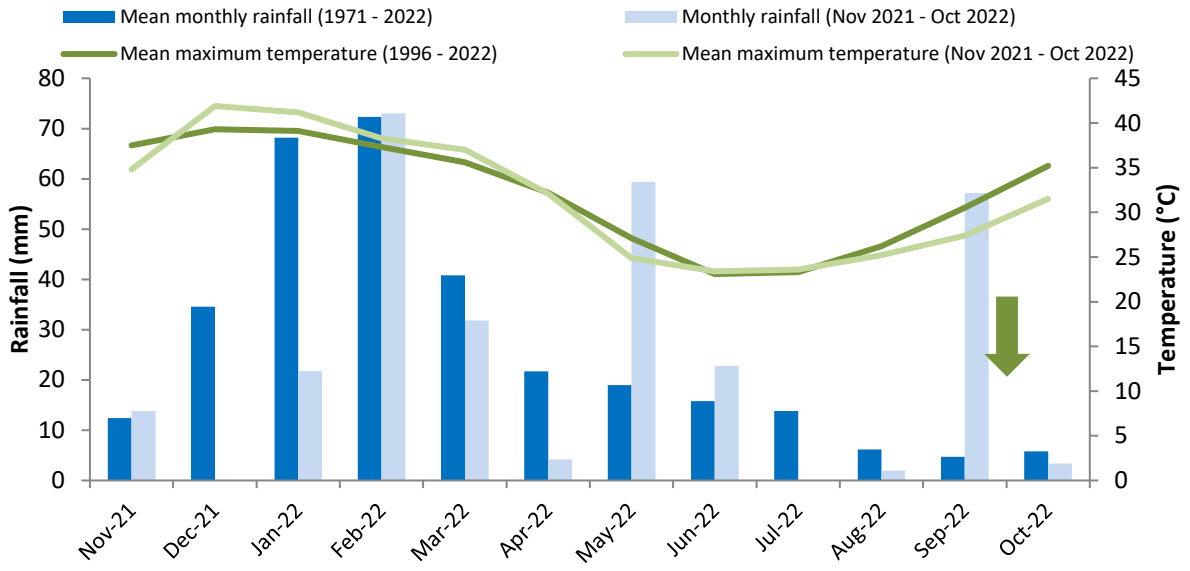

Figure 7 : Newman Aero (station 007176) mean monthly rainfall (1971 - 2022), total recorded rainfall (November 2021 - October 2022), long-term mean monthly maximum temperatures (1996-2022), and mean monthly maximum temperatures (November 2021 - October 2022). The green arrow indicates the field survey timing.

3.2.3 Vertebrate Fauna

3.2.3.1 Habitat Assessments

Eighty habitat assessments were conducted within the ten fauna habitats present in the survey area. This included 25 habitat assessment sites, with the remaining habitat assessments completed at all other sampling sites (Table 6 and Figure 8. The following information was collected at each site:

- location – coordinates measured using a handheld GPS (GDA94)
- recorder and date – personnel involved in undertaking the fauna habitat assessment and the survey date
- habitat/landform – position in the landscape – major fauna habitat types were described based on the landform and vegetation
- vegetation type – a broad description of vegetation type and structure
- soils – a brief description of soil type
- microhabitat – presence of specific microhabitat features; for example, leaf litter, logs, burrows, rocky outcrops, rock crevices, hollows, permanent, or semi-permanent water
- condition – habitat condition was assessed based on the presence of anthropogenic (human-induced) disturbances, and using the conditions ratings suggested by Thompson and Thompson (2010) (Table B.7, Appendix B)
- disturbance – any disturbance such as clearing, fire, weeds, flooding, vehicular, machinery, tracks, or grazing
- photographs – a representative photograph was taken of each habitat assessment site.

The information derived from the fauna habitat assessments was used to delineate fauna habitats throughout the survey area, which were then mapped accordingly.

705000 710000 715000 720000

7485000

7480000

Tracklogs/targeted searches
Survey Area
Yandi Mine Tenement

Sampling Sites

Acoustic Recording
Camera (active)
Echolocation Recording
Habitat Assessment
Targeted Searches (i.e. Bilby Plots)

HA10KG BP04 HA9KG HA5KG HA6KG HA7KG HA1-KG HA2KG HA4KG HA8KG

NQ3CAM54 Nq3-cam48 SM5249_KG Nq3-cam6 NQ3CAM46 NQ3CAM14 AU8576 Ha02-SS BP06 NQ3-Cam35 Nq3-cam20 NQ3CAM41 HA03_KG NQ3CAM52 Nq3-cam13

SM8185SS Ha06-ss

NQ2CAM36 Nq2-cam42 NQ2CAM44 NQ2CAM29 Nq2-cam8 NQ2CAM45 NQ2CAM51 NQ2CAM37 NQ5CAM53 NQ5CAM39 Nq5-cam17 NQ5CAM10 Nq5-cam04

Ha01-ss SM8168_KG Ha04-ss BP01 Ha05-ss

NQ1CAM55 NQ1CAM40 NQ1CAM29 NQ1CAM21 NQ1-cam3 NQ1-Cam28 NQ1CAM07 NQ1_CAM15 Nq1-cam43

SM5956_KG Sm5956-SS

Ha10-ss

SM13630_KG

NQ4CAM49 NQ4CAM26 NQ4CAM23 Nq4-cam47

SM5978SS Ha09-ss AU8538 HA12KG

HA11KG Ha08-ss Ha07-ss BP05 SM5349SS

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

BHP Western Australian Iron Ore (WAIO)
Yandi 45C Targeted Significant Vertebrate Fauna Survey

Figure 8: Fauna sampling locations

Scale: 1:50,000 at A3
Coordinate System: GDA 1994 MGA Zone 50
0 1 2 3 Kilometres

N

astron an ecocene company

Author: K. Grosser | Drawn: C. Dyde | Date: 08-03-2023 | Figure Ref: 2400-006-BIDR-1Rev0_230308_Fig8_Fauna

Table 6: Fauna sampling locations.

Site ID	MGA Zone 51 K		Sampling method	Date	Habitat	Condition^	Disturbance	Microhabitats	Photo
	Easting (mE)	Northing (mN)							
HA-01	706143	7483860	Habitat Assessment	24/09/2022	Undulating Low Hills	0.6	Mining exploration, road/access track, weed invasion, active mining	Rock pile, old *Triodia*	
HA-02	710906	7487597	Habitat Assessment	25/09/2022	Hillcrest/Hillslope	1	None discernible	Rock pile, old *Triodia*, leaf litter	
HA-03	710774	7487200	Habitat Assessment	25/09/2022	Medium Drainage Line	0.8	Weed invasion, mining pit	Logs, crevices, semi-permanent water, rock pile, old *Triodia*, leaf litter	
HA-04	710644	7488173	Habitat Assessment	25/09/2022	Breakaway/Cliff	1	None discernible	Overhangs, crevices, rock pile, old *Triodia*, leaf litter	
HA-05	708442	7484066	Habitat Assessment	26/09/2022	Drainage Area/Floodplain	0.8	None discernible	Logs, tree hollows, thick undergrowth, soft soil (burrows), old *Triodia*, leaf litter	

Site ID	MGA Zone 51 K		Sampling method	Date	Habitat	Condition^	Disturbance	Microhabitats	Photo
	Easting (mE)	Northing (mN)							
HA-06	709063	7483287	Habitat Assessment	26/09/2022	Undulating Low Hills	0.8	Active Mining	Old *Triodia*	
HA-07	715330	7487762	Habitat Assessment	27/09/2022	Major Drainage Line	0.6	Cattle grazing, mining exploration, road/access track, weed invasion, active mining	Logs, tree hollows, crevices, thick undergrowth, soft soil (burrows), rock pile, old *Triodia*, leaf litter	
HA-08	719679	7478963	Habitat Assessment	28/09/2022	Major Drainage Line	0.4	Cattle grazing, frequent fire, mining exploration, road/access track, weed invasion, active mining	Logs, tree hollows, soft soil (burrows), leaf litter	
HA-09	713958	7485098	Habitat Assessment	28/09/2022	Undulating Low Hills	0.8	Mining exploration, weed invasion, active mining	Rock pile, old *Triodia*	
HA-10	719163	7482175	Habitat Assessment	28/09/2022	Undulating Low Hills	1	Road/access track, active mining	Rock pile, old *Triodia*	

Site ID	MGA Zone 51 K		Sampling method	Date	Habitat	Condition^	Disturbance	Microhabitats	Photo
	Easting (mE)	Northing (mN)							
HA-11	704439	7488848	Habitat Assessment	27/09/2022	Stony Plain	0.8	Road/access track	Thick undergrowth, rock pile, old *Triodia*	
HA-12	717255	7485294	Habitat Assessment	29/09/2022	Hardpan Plain	0.6	Cattle grazing, mining exploration, road/access track, weed invasion	Thick undergrowth, soft soil (burrows), old *Triodia*, leaf litter	
HA-13	719733	7479232	Habitat Assessment	28/09/2022	Hillcrest/Hillslope	0.6	Cattle grazing, weed invasion, active mining, and dust	Logs, crevices, soft soil (burrows), rock pile, old *Triodia*, leaf litter	
HA-14	711052	7487306	Habitat Assessment	1/10/2022	Stony Plain	1	None discernible	Old *Triodia*	
HA-15	719142	7482043	Habitat Assessment	28/09/2022	Sandy/Stony Plain	1	Road/access track, weed invasion, active mining	Logs, tree hollows, soft soil (burrows), old *Triodia*	

Site ID	MGA Zone 51 K		Sampling method	Date	Habitat	Condition^	Disturbance	Microhabitats	Photo
	Easting (mE)	Northing (mN)							
HA-16	706259	7483655	Habitat Assessment	24/09/2022	Major Drainage Line	0.6	Cattle grazing, road/access track, weed invasion	Semi-permanent water, soft soil (burrows)	
HA-17	704180	7485153	Habitat Assessment	24/09/2022	Breakaway/Cliff	0.6	Cattle grazing, weed invasion, pit	Pools, semi-permanent water, rock pile	
HA-18	709805	7483724	Habitat Assessment	26/09/2022	Major Drainage Line	0.6	Cattle grazing, road/access track, weed invasion, pit	Logs, tree hollows, thick undergrowth, pools, semi-permanent water, leaf litter	
HA-19	708986	7485165	Habitat Assessment	26/09/2022	Wetland	0.4	Cattle grazing, weed invasion, surrounded by mine and pit	Thick undergrowth, soft soil (burrows), permanent water, semi-permanent water	
HA-20	705361	7483953	Habitat Assessment	26/09/2022	Major Drainage Line	0.6	Cattle grazing, road/access track, weed invasion, pit active mining	Tree hollows, thick undergrowth, soft soil (burrows), semi-permanent water, leaf litter	

Site ID	MGA Zone 51 K		Sampling method	Date	Habitat	Condition^	Disturbance	Microhabitats	Photo
	Easting (mE)	Northing (mN)							
HA-21	705504	7483751	Habitat Assessment	26/09/2022	Undulating Low Hills	0.6	Cattle grazing, road/access track, weed invasion, pit active mining	Logs, thick undergrowth, rock pile, old *Triodia*, leaf litter	
HA-22	713958	7485098	Habitat Assessment	27/09/2022	Major Drainage Line	0.6	Cattle grazing, weed invasion, active mining pit	Crevices, soft soil (burrows), semi-permanent water, rock pile, leaf litter	
HA-23	707949	7486389	Habitat Assessment	27/09/2022	Undulating Low Hills	0.6	Cattle grazing, road/access track, weed invasion, active mining	Thick undergrowth, soft soil (burrows), old *Triodia*, leaf litter	
HA-24	712166	7485145	Habitat Assessment	24/09/2022	Medium Drainage Line	0.4	Cattle grazing, road/access track, weed invasion, pit	Logs, tree hollows, soft soil (burrows), semi-permanent water, leaf litter	
HA-25	713482	7485061	Habitat Assessment	27/09/2022	Major Drainage Line	0.6	Cattle grazing, mining exploration, weed invasion, active mining	Logs, tree hollows, thick undergrowth, soft soil (burrows), old *Triodia*, leaf litter	

Site ID	MGA Zone 51 K		Sampling method	Date	Habitat	Condition^	Disturbance	Microhabitats	Photo
	Easting (mE)	Northing (mN)							
BP-01	708653	7483999	Targeted Search	26/09/2022	Sandy/Stony Plain	0.8	None discernible	Logs, thick undergrowth, old *Triodia*, leaf litter	
BP-02	705369	7483774	Targeted Search	26/09/2022	Undulating Low Hills	0.6	None discernible	Soft soil (burrows), old *Triodia*, leaf litter	
BP-03	704678	7484995	Targeted Search	27/09/2022	Sandy/Stony Plain	0.6	Cattle grazing, road/access track, weed invasion, active mining, pit	Logs, thick undergrowth, soft soil (burrows), old *Triodia*, leaf litter	
BP-04	704406	7488571	Targeted Search	27/09/2022	Undulating Low Hills	1	Mining exploration, road/access track	Soft soil (burrows), old *Triodia*	
BP-05	719508	7478919	Targeted Search	28/09/2022	Drainage Area/Floodplain	0.4	Cattle grazing, weed invasion, active mining	Logs, tree hollows, crevices, thick undergrowth, soft soil (burrows), semi-permanent water, old *Triodia*, leaf litter	

Site ID	MGA Zone 51 K		Sampling method	Date	Habitat	Condition^	Disturbance	Microhabitats	Photo
	Easting (mE)	Northing (mN)							
BP-06	710992	7487505	Targeted Search	01/10/2022	Sandy/Stony Plain	1	None discernible	Logs, tree hollows, thick undergrowth, soft soil (burrows), old *Triodia*, leaf litter	
CAM-01	710345	7484482	Camera (active)	24/09/2022 – 29/09/2022	Major Drainage Line (targeting northern quoll, Pilbara olive python)	0.6	Cattle grazing, road/access track, weed invasion, pit	Logs, tree hollows, thick undergrowth, soft soil (burrows), rock pile, leaf litter	
CAM-02	710773	7484806	Camera (active)	24/09/2022 – 29/09/2022	Major Drainage Line (targeting northern quoll, Pilbara olive python)	0.6	Cattle grazing, weed invasion, pit	Logs, tree hollows, thick undergrowth, soft soil (burrows), rock pile, leaf litter	
CAM-03	711065	7485049	Camera (active)	24/09/2022 – 29/09/2022	Major Drainage Line (targeting northern quoll, Pilbara olive python)	0.6	Cattle grazing, weed invasion, pit	Logs, tree hollows, thick undergrowth, soft soil (burrows), rock pile, leaf litter	
CAM-04	710628	7484713	Camera (active)	24/09/2022 – 29/09/2022	Major Drainage Line (targeting northern quoll, Pilbara olive python)	0.6	Cattle grazing, weed invasion, pit	Logs, tree hollows, thick undergrowth, soft soil (burrows), rock pile, leaf litter	

Site ID	MGA Zone 51 K		Sampling method	Date	Habitat	Condition^	Disturbance	Microhabitats	Photo
	Easting (mE)	Northing (mN)							
CAM-05	711052	7484943	Camera (active)	24/09/2022 – 29/09/2022	Major Drainage Line (targeting northern quoll, Pilbara olive python)	0.6	Cattle grazing, weed invasion, pit	Logs, tree hollows, thick undergrowth, soft soil (burrows), rock pile, leaf litter	
CAM-06	710449	7484589	Camera (active)	24/09/2022 – 29/09/2022	Major Drainage Line (targeting northern quoll, Pilbara olive python)	0.6	Cattle grazing, mining exploration, road/access track, weed invasion, active mining	Logs, tree hollows, thick undergrowth, soft soil (burrows), rock pile, leaf litter	
CAM-07	710976	7484922	Camera (active)	24/09/2022 – 29/09/2022	Major Drainage Line (targeting northern quoll, Pilbara olive python)	0.6	Cattle grazing, mining exploration, road/access track, weed invasion, active mining	Logs, tree hollows, crevices, soft soil (burrows), leaf litter	
CAM-08	710875	7484870	Camera (active)	24/09/2022 – 29/09/2022	Major Drainage Line (targeting northern quoll, Pilbara olive python)	0.6	Cattle grazing, weed invasion, pit	Logs, tree hollows, thick undergrowth, soft soil (burrows), rock pile, leaf litter	
CAM-09	710559	7484645	Camera (active)	24/09/2022 – 29/09/2022	Major Drainage Line (targeting northern quoll, Pilbara olive python)	0.6	Cattle grazing, mining exploration, road/access track, weed invasion, active mining	Logs, tree hollows, thick undergrowth, soft soil (burrows), rock pile, leaf litter	

Site ID	MGA Zone 51 K		Sampling method	Date	Habitat	Condition^	Disturbance	Microhabitats	Photo
	Easting (mE)	Northing (mN)							
CAM-10	711242	7485127	Camera (active)	24/09/2022 – 29/09/2022	Major Drainage Line (targeting northern quoll, Pilbara olive python)	0.6	Cattle grazing, weed invasion, pit	Logs, tree hollows, thick undergrowth, soft soil (burrows), rock pile, leaf litter	
CAM-11	704441	7485030	Camera (active)	24/09/2022 – 29/09/2022	Major Drainage Line (targeting northern quoll, Pilbara olive python)	0.6	Cattle grazing, weed invasion, pit	Crevices, permanent water, pools, semi-permanent water, rock pile, leaf litter	
CAM-12	704289	7485187	Camera (active)	24/09/2022 – 29/09/2022	Major Drainage Line (targeting northern quoll, Pilbara olive python)	0.6	Weed invasion, pit	Crevices, permanent water, pools, semi-permanent water, rock pile	
CAM-13	704506	7484632	Camera (active)	24/09/2022 – 29/09/2022	Major Drainage Line (targeting northern quoll, Pilbara olive python)	0.4	Cattle grazing, road/access track, weed invasion, pit	Thick undergrowth, semi-permanent water, rock pile	
CAM-14	704199	7485151	Camera (active)	24/09/2022 – 29/09/2022	Major Drainage Line (targeting northern quoll, Pilbara olive python)	0.6	Cattle grazing, weed invasion	Logs, tree hollows, crevices, thick undergrowth, permanent water, pools, rock pile, old *Triodia*, leaf litter	

Site ID	MGA Zone 51 K		Sampling method	Date	Habitat	Condition^	Disturbance	Microhabitats	Photo
	Easting (mE)	Northing (mN)							
CAM-15	704143	7485155	Camera (active)	24/09/2022 – 29/09/2022	Breakaway/Cliff (targeting northern quoll, Pilbara olive python)	0.6	Cattle grazing, weed invasion, pit	Logs, thick undergrowth, pools, semi-permanent water, rock pile	
CAM-16	704433	7484825	Camera (active)	24/09/2022 – 29/09/2022	Major Drainage Line (targeting northern quoll, Pilbara olive python)	0.6	Cattle grazing, weed invasion, pit	Crevices, thick undergrowth, pools, semi-permanent water, rock pile	
CAM-17	704466	7484691	Camera (active)	24/09/2022 – 29/09/2022	Major Drainage Line (targeting northern quoll, Pilbara olive python)	0.6	Cattle grazing, mining exploration, weed invasion, active mining	Logs, tree hollows, crevices, thick undergrowth, soft soil (burrows), rock pile, leaf litter	
CAM-18	704455	7484963	Camera (active)	24/09/2022 – 29/09/2022	Major Drainage Line (targeting northern quoll, Pilbara olive python)	0.6	Cattle grazing, weed invasion, pit	Crevices, permanent water, pools, semi-permanent water, rock pile	
CAM-19	704427	7485049	Camera (active)	24/09/2022 – 29/09/2022	Major Drainage Line (targeting northern quoll, Pilbara olive python)	0.6	Cattle grazing, mining exploration, weed invasion	Logs, tree hollows, crevices, thick undergrowth, permanent water, pools, rock pile, leaf litter	

Site ID	MGA Zone 51 K		Sampling method	Date	Habitat	Condition^	Disturbance	Microhabitats	Photo
	Easting (mE)	Northing (mN)							
CAM-20	704427	7484873	Camera (active)	24/09/2022 – 29/09/2022	Major Drainage Line (targeting northern quoll, Pilbara olive python)	0.6	Cattle grazing, mining exploration, weed invasion, active mining	Logs, tree hollows, crevices, thick undergrowth, soft soil (burrows), pools, semi-permanent water, rock pile, leaf litter, termite mounds	
CAM-21	710800	7487106	Camera (active)	25/09/2022 – 30/09/2022	Undulating Low Hills (targeting northern quoll)	0.8	Cattle grazing, weed invasion	Overhangs, logs, tree hollows, crevices, rock pile, old *Triodia*, leaf litter	
CAM-22	710748	7487623	Camera (active)	25/09/2022 – 30/09/2022	Breakaway/Cliff (targeting northern quoll, Pilbara olive python)	1	None discernible	Overhangs, logs, rock pile, old *Triodia*	
CAM-23	710840	7487141	Camera (active)	25/09/2022 – 30/09/2022	Medium Drainage Line (targeting northern quoll, Pilbara olive python)	0.8	Weed invasion	Overhangs, tree hollows, crevices, thick undergrowth, soft soil (burrows), semi-permanent water, rock pile, old *Triodia*, leaf litter	
CAM-24	710775	7487391	Camera (active)	25/09/2022 – 30/09/2022	Hillcrest/Hillslope (targeting northern quoll, Pilbara olive python)	1	None discernible	Overhangs, logs, tree hollows, crevices, rock pile, old *Triodia*, leaf litter	

Site ID	MGA Zone 51 K		Sampling method	Date	Habitat	Condition^	Disturbance	Microhabitats	Photo
	Easting (mE)	Northing (mN)							
CAM-25	710781	7487337	Camera (active)	25/09/2022 – 30/09/2022	Breakaway/Cliff (targeting northern quoll, Pilbara olive python)	1	None discernible	Overhangs, logs, thick undergrowth, rock pile, old *Triodia*	
CAM-26	710723	7487912	Camera (active)	25/09/2022 – 30/09/2022	Breakaway/Cliff (targeting northern quoll, Pilbara olive python)	1	None discernible	Overhangs, logs, rock pile, old *Triodia*	
CAM-27	710614	7488114	Camera (active)	25/09/2022 – 30/09/2022	Breakaway/Cliff (targeting northern quoll, Pilbara olive python)	1	None discernible	Overhangs, crevices, rock pile, old *Triodia*, leaf litter	
CAM-28	710927	7487134	Camera (active)	25/09/2022 – 30/09/2022	Breakaway/Cliff (targeting northern quoll, Pilbara olive python)	0.8	Weed invasion	Overhangs, crevices, thick undergrowth, rock pile	
CAM-29	710643	7488170	Camera (active)	25/09/2022 – 30/09/2022	Breakaway/Cliff (targeting northern quoll, Pilbara olive python)	1	None discernible	Overhangs, crevices, thick undergrowth, rock pile, old *Triodia*	

Site ID	MGA Zone 51 K		Sampling method	Date	Habitat	Condition^	Disturbance	Microhabitats	Photo
	Easting (mE)	Northing (mN)							
CAM-30	710679	7487759	Camera (active)	25/09/2022 – 30/09/2022	Breakaway/Cliff (targeting northern quoll, Pilbara olive python)	1	None discernible	Overhangs, tree hollows, rock pile, old *Triodia*, leaf litter	
CAM-31	711287	7482375	Camera (active)	25/09/2022 – 30/09/2022	Breakaway/Cliff (targeting northern quoll, Pilbara olive python)	1	Road/access track, pit/railway line	Overhangs, crevices, rock pile, old *Triodia*, leaf litter	
CAM-32	711376	7482345	Camera (active)	25/09/2022 – 30/09/2022	Breakaway/Cliff (targeting northern quoll, Pilbara olive python)	0.8	Road/access track, pit/railway line	Overhangs, crevices, rock pile, old *Triodia*	
CAM-33	711352	7482353	Camera (active)	25/09/2022 – 30/09/2022	Hillcrest/Hillslope (targeting northern quoll, Pilbara olive python)	1	Rail	Overhangs, crevices, rock pile, old *Triodia*	
CAM-34	711280	7482447	Camera (active)	25/09/2022 – 30/09/2022	Breakaway/Cliff (targeting northern quoll, Pilbara olive python)	1	Road/access track, pit/railway line	Overhangs, crevices, rock pile, leaf litter	

Site ID	MGA Zone 51 K		Sampling method	Date	Habitat	Condition^	Disturbance	Microhabitats	Photo
	Easting (mE)	Northing (mN)							
CAM-35	711251	7482459	Camera (active)	25/09/2022 – 30/09/2022	Breakaway/Cliff (targeting northern quoll, Pilbara olive python)	1	Rail	Overhangs, crevices, rock pile, old *Triodia*, leaf litter	
CAM-36	704827	7484358	Camera (active)	26/09/2022 – 01/10/2022	Major Drainage Line (targeting northern quoll, Pilbara olive python)	0.8	Cattle grazing, mining exploration, weed invasion, active mining	Overhangs, logs, tree hollows, crevices, thick undergrowth, soft soil (burrows), leaf litter	
CAM-37	704944	7484283	Camera (active)	26/09/2022 – 01/10/2022	Major Drainage Line (targeting northern quoll, Pilbara olive python)	0.6	Cattle grazing, road/access track, weed invasion, pit, active mining	Overhangs, logs, crevices, soft soil (burrows), semi-permanent water, rock pile	
CAM-38	704846	7484466	Camera (active)	26/09/2022 – 01/10/2022	Major Drainage Line (targeting northern quoll, Pilbara olive python)	0.6	Cattle grazing, mining exploration, weed invasion, active mining	Overhangs, logs, tree hollows, crevices, thick undergrowth, soft soil (burrows), rock pile, leaf litter	
CAM-39	704787	7484383	Camera (active)	26/09/2022 – 01/10/2022	Major Drainage Line (targeting northern quoll, Pilbara olive python)	0.6	Cattle grazing, road/access track, weed invasion, pit, active mining	Overhangs, logs, crevices, soft soil (burrows), semi-permanent water	

Site ID	MGA Zone 51 K		Sampling method	Date	Habitat	Condition^	Disturbance	Microhabitats	Photo
	Easting (mE)	Northing (mN)							
CAM-40	704816	7484501	Camera (active)	26/09/2022 – 01/10/2022	Major Drainage Line (targeting northern quoll, Pilbara olive python)	0.6	Cattle grazing, road/access track, weed invasion, pit, active mining	Caves, overhangs, crevices, semi-permanent water, rock pile	
ACO-01	719387	7481898	Acoustic Recording	30/09/2022 – 07/10/2022	Undulating Low Hills (targeting night parrot)	1	Road/access track	Old *Triodia*, leaf litter	
ACO-02	710733	7487527	Acoustic Recording	30/09/2022 – 07/10/2022	Undulating Low Hills (targeting night parrot)	0.8	Road/access track, weed invasion, active mining	Logs, tree hollows, semi-permanent water, rock pile, old *Triodia*, leaf litter	
BAT-01	711022	7483314	Echolocation Recording	25/09/2022 – 28/09/2022	Medium Drainage Line (targeting ghost bat and Pilbara leaf-nosed bat)	0.6	Cattle grazing, weed invasion, pit, railway line	Logs, tree hollows, thick undergrowth, semi-permanent water, old *Triodia*, leaf litter	
BAT-02	710868	7488064	Echolocation Recording	25/09/2022 – 28/09/2022	Hillcrest/Hillslope (targeting ghost bat and Pilbara leaf-nosed bat)	1	None discernible	Caves, overhangs, crevices, rock pile, old *Triodia*	

Site ID	MGA Zone 51 K		Sampling method	Date	Habitat	Condition^	Disturbance	Microhabitats	Photo
	Easting (mE)	Northing (mN)							
BAT-03	720563	7478521	Echolocation Recording	28/09/2022 – 01/10/2022	Major Drainage Line (targeting ghost bat and Pilbara leaf-nosed bat)	0.6	Cattle grazing, road/access track, weed invasion, active mining, dust	Logs, tree hollows, thick undergrowth, soft soil (burrows), pools, semi-permanent water, leaf litter	
BAT-04	704431	7484844	Echolocation Recording	24/09/2022 – 27/09/2022	Major Drainage Line (targeting ghost bat and Pilbara leaf-nosed bat)	0.6	Cattle grazing, weed invasion, pit	Crevices, semi-permanent water, rock pile	
BAT-05	718997	7482236	Echolocation Recording	28/09/2022 – 01/10/2022	Hillcrest/Hillslope (targeting ghost bat and Pilbara leaf-nosed bat)	0.8	Road/access track, weed invasion, active mining	Overhangs, crevices, rock pile, old *Triodia*	
BAT-06	706399	7483615	Echolocation Recording	24/09/2022 – 27/09/2022	Major Drainage Line (targeting ghost bat and Pilbara leaf-nosed bat)	0.4	Cattle grazing, road/access track, weed invasion, pit	Logs, tree hollows, soft soil (burrows), pools, semi-permanent water, leaf litter	
BAT-07	715324	7487948	Echolocation Recording	27/09/2022 – 30/09/2022	Major Drainage Line (targeting ghost bat and Pilbara leaf-nosed bat)	0.6	Cattle grazing, road/access track, active mining	Logs, tree hollows, crevices, semi-permanent water, leaf litter	

The potential for the habitats to provide suitable habitat for MNES species greater bilby, northern quoll, ghost bat, Pilbara leaf-nosed bat, night parrot, grey falcon and Pilbara olive python were ranked according to the criteria listed in Table A.8 (Appendix A).

3.2.3.2 Motion Sensitive Cameras

Motion sensitive cameras (Browning, Moultrie and Bushnells) were set at 40 locations for five nights, with a combined trapping effort of 200 camera trap nights. The cameras were placed in prospective/suitable habitat, such as breakaways, drainage lines and water holes, aimed at targeting MNES species, including the northern quoll and Pilbara olive python. Cameras were baited with a scent lure (fish oil in a plastic jar with holes in the lid). Camera locations are shown in Figure 8 and detailed in Table 6.

3.2.3.3 Acoustic Bat Surveys

Acoustic ultrahigh frequency equipment was used to record the presence of bats, in particular the Pilbara leaf-nosed bat and ghost bat. Acoustic recording devices (Song Meter (SM) 4) were positioned in a total of seven locations to achieve a broad coverage of the survey area. The ultrasonic recorders were set for three nights, resulting in a total of 21 recording nights. The locations are depicted in Figure 8 and detailed in Table 6. The bat echolocation data was analysed by Robert Bullen (Bat Call WA) for presence of all bat species.

3.2.3.4 Night Parrot Surveys

The survey area is in the area mapped as 'high priority for survey' for the night parrot according to DBCA's Interim Guidelines for Preliminary Surveys of night parrots in Western Australia (Department of Parks and Wildlife 2017). Therefore, passive acoustic surveys were undertaken, and Autonomous Recording Units (ARU) used in the most prospective habitats.

The ARUs, recorded 1-hour pre-sunset to 1-hour post-dawn, were set at two locations for six nights, resulting in a total of 12 recording nights. The audio data was recorded at 44.1 k bits and covered the frequency range 100 kHz to 21,000 kHz, which brackets the night parrot call frequency range of 1,500 kHz to 3,500 kHz. The ARU locations are depicted in Figure 8 and detailed in Table 6.

3.2.3.5 Targeted Bilby Plot Searches

Targeted searches for signs of greater bilby were conducted using a combination of the 2 ha plot protocol and linear survey methods as outlined in the DBCA's guidelines for surveys to detect the presence of bilbies, and assess the importance of habitat in Western Australia (Department of Biodiversity, Conservation and Attractions 2017). Six 2 ha plots of either 50 m x 400 m or 100 m x 200 m were traversed on foot with track logs recorded on a handheld GPS unit. Any evidence of the greater bilby, including burrows, tracks, foraging signs, and scats were recorded, photographed and GPS located. The bilby plot search locations are depicted in Figure 8 and detailed in Table 6.

3.2.3.6 Targeted Searches for Other Species

The aim of targeted searches was to identify areas of potential suitable habitat for significant fauna, such as caves and water sources, and secondary signs including tracks, scats, diggings, and burrows. Visual observation for significant fauna habitat was ongoing whilst moving through the survey area.

Significant species such as the peregrine and grey falcons were targeted during the bird census surveys and opportunistically throughout the survey.

Track logs were recorded using a handheld GPS and are shown in Figure 8. Any opportunistic sightings of fauna species were recorded whilst traversing through the survey area.

3.3 Taxonomy and Nomenclature

For species identified in the desktop assessment, every effort was made to determine the current scientific name for each taxon, including wherever there was doubt as to their true taxonomy (through subsequent name changes).

In accordance with the Environmental Protection Authority (EPA) technical guidance (Environmental Protection Authority 2020), nomenclature for herpetofauna and mammals follows that of the Western Australian Museum Checklist of the Vertebrates of Western Australia (Western Australian Museum 2021), and birds follows the Australian Faunal Directory (Department of the Agriculture, Water and the Environment 2022).

3.4 Limitations

Following the completion of the desktop review and field survey, a review of any limitations that may affect a complete assessment of the data collected was conducted. The limitations listed in Table 7 are based on those suggested as consideration in the EPA technical guidance (Environmental Protection Authority 2020).

Table 7: Statement of limitations for the targeted vertebrate fauna survey.

Potential limitation	Degree of limitation	Statement regarding potential limitation
(i) Competency/experience	No limitation	The zoologists responsible for conducting the survey have extensive experience in conducting vertebrate fauna surveys in the Pilbara region. Kady Grosser (Senior Zoologist) has over 10 years of fauna surveying experience, and five years within the Pilbara region.
(ii) Scope What faunal groups were sampled, and were some sampling methods not able to be employed because of constraints such as weather conditions?	No limitation	The survey scope was able to be completed and all sampling methods adequately employed. The fauna observed and identified are likely to represent a portion of the suite of species that utilise the survey area.
(iii) Proportion of fauna identified, recorded and/or collected	Minor limitation	The survey effort was targeted towards MNES species and was focused on habitats considered suitable for these species within the survey area. The use of motion sensitive cameras and ultrasonic recorders were employed to identify species that are cryptic or nocturnal. Given the nature of the survey (single-phase targeted), the fauna observed and identified are likely to represent a portion of the suite of species that utilise the survey area.
(iv) Sources of information Previously available information (whether historic or recent) as distinct from new data.	No limitation	Adequate information was available from database searches and previous studies in the survey area and region.
(v) Proportion of task achieved Further work which might be needed.	No limitation	The survey scope was able to be completed and all sampling methods adequately employed.
(vi) Timing/weather/season/cycle	No limitation	Rainfall was 140% above average in the three months preceding the field survey, and 11% below average for the year preceding. Survey timing was optimal for reptiles and mammals (September – April) and numerous seasonal pools were observed within the survey area from the recent rainfall, which indicates favourable conditions for fauna species.
(vii) Disturbances For example, fire, flood, accidental human intervention which affected results of the survey.	No limitation	No major disturbances were recorded in the survey area that would have affected the survey results.

Potential limitation	Degree of limitation	Statement regarding potential limitation
(viii) Intensity In retrospect, was the intensity adequate?	No limitation	The intensity of the survey was considered adequate for a targeted vertebrate fauna survey.
(xi) Completeness Was the relevant area fully surveyed?	No limitation	All target habitats considered suitable for MNES species within the survey area were adequately surveyed.
(x) Resources Degree of expertise available in animal identification to taxon level.	No limitation	Adequate resources were available to identify fauna species. All technical personnel involved in identification have extensive experience in conducting vertebrate fauna surveys, and Robert Bullen is highly qualified to analyse the data from the echolocation and audio units.
(xi) Remoteness and/or access problems	No limitation	There were no access problems; all the survey area was able to be accessed by vehicle and on foot.
(xii) Availability of contextual information For example, biogeographical information on the region.	No limitation	Database searches and previous fauna surveys in the vicinity of the survey area provided contextual information.

4 Results

4.1 Desktop Assessment

4.1.1 Environmentally Sensitive Areas

No Environmentally Sensitive Areas (ESAs) intersected the survey area. The nearest ESA is Fortescue Marsh, located approximately 29 km from the survey area, and Karijini National Park, located approximately 45 km from the survey area (Department of the Environment and Energy 2020a).

4.1.2 Vertebrate Fauna

The database searches indicated that 370 vertebrate fauna have previously been recorded within a 40 km radius of the survey area (Table B.1 – B.4, Appendix B), including seven amphibian species, 118 reptile species, 192 bird species, and 53 mammal species (including 10 introduced mammal species) (Atlas of Living Australia 2022, Birdlife Australia 2022, Department of Biodiversity, Conservation and Attractions 2022a, 2022b, Department of Climate Change, Energy, the Environment and Water 2022). Of these, 26 species are listed as MNES (specifically those listed as Threatened and Migratory species) as occurring, or potentially occurring, within the survey area. These 26 species comprise of three reptile species, 18 bird species and five mammal species (Table 8). A further nine species, comprised of two reptile species, two bird species and five mammal species, are priority listed species (Table 8). Of the 35 significant listed species (MNES and Priority species), one species was recorded within the survey area, eight species were considered to have a 'high' likelihood of occurrence, 15 species were considered to have a 'moderate' likelihood of occurrence, and 11 species were considered to have a 'low' likelihood of occurrence within the survey area (Table 8). This is based on their respective ecology, habitats considered likely to be present, and any previous records from historic survey and database records. Refer to Table A.6, Appendix A for further detail on the criteria used to define the likelihood of MNES occurrence within the survey area.

Previous surveys undertaken for BHP WAIO in the vicinity of the survey area recorded seven MNES species: Pilbara leaf-nosed bat, ghost bat, common greenshank (*Tringa nebularia*) (Mi; Mi), fork-tailed swift (*Apus pacificus*) (Mi; Mi), common sandpiper (*Actitis hypoleucos*) (Mi; Mi), northern quoll, and Pilbara olive python, and an additional three species of significance: western pebble-mound mouse (*Pseudomys chapmani*) (P4), Pilbara flat-headed (Gane's) blind snake (*Anilios ganei*) (P1) and peregrine falcon (*Falco peregrinus*) (OS) (Table 9).

Table 8: Likelihood of occurrence of significant vertebrate fauna species listed as potentially occurring in the vicinity of the survey area.

Common name (scientific name)	Conservation codes			Preferred habitat and previous records	Pre-survey likelihood of occurrence	Post-survey likelihood of occurrence
	EPBC Act	BC Act	DBCA			
Reptiles						
Pilbara barking gecko (*Underwoodisaurus seorsus*)			P2	Confined in the Pilbara to the Hammersley Ranges from Tom Price to Newman. Occurs in rocky area with spinifex and low tree cover. Twelve previous fauna records were detailed on the DBCA threatened and priority fauna database search result, with all records over 20 km from the survey boundary.	Moderate	Moderate
Lake Disappointment ground gecko (*Diplodactylus fulleri*)			P2	This species' known habitat includes low samphire shrubs fringing Lake Disappointment. Lake Disappointment is over 350 km from the survey area.	Low	Low
Unpatterned robust slider (Robertson Range) (*Lerista macropisthopus remota*)			P2	Acacia shrublands and woodlands in the central interior. Shelters in loose soil under leaf litter at the base of shrubs. Three previous fauna records were detailed on the DBCA threatened and priority fauna database search result, with all records over 20 km from the survey boundary.	Moderate	Moderate
Great desert skink (*Liopholis kintorei*)	VU	VU		Red sandplains and sand ridges. Prefers a mosaic landscape of different aged vegetation and inhabits sites that have been burnt (3-15 years). Sparsely distributed across arid sand flats and clay-based or loamy soils vegetated with spinifex. No previous fauna records were detailed in the database search results; however, it has appeared in the PMST search likely indicating suitable habitat present within the search polygon. There was not a lot of sandy habitats within the survey area.	Moderate	Low
Gane's blind snake (*Anilios ganei*)			P1	Little information is available on this species, but it is believed to be associated with moist gorges and gullies. The DBCA threatened and priority fauna database search result detailed three previous records over 20 km from the survey area, and one record from a previous survey within 20 km of the survey area.	Moderate	Low

Common name (scientific name)	Conservation codes			Preferred habitat and previous records	Pre-survey likelihood of occurrence	Post-survey likelihood of occurrence
	EPBC Act	BC Act	DBCA			
Pilbara olive python (*Liasis olivaceus barroni*)	VU	VU		Generally rocky habitats in close association to permanent and semi-permanent water sources. This includes gorges, rock pools and riparian zones. Twenty-three previous records were detailed on the DBCA threatened and priority fauna database search result, one record only 500 m from the survey area and five within 15km of the survey area.	High	High
Birds						
Southern giant petrel (*Macronectes giganteus)*	EN & MI	MI		Predominantly pelagic species that is independent of terrestrial habitats. Three previous records were detailed on the DBCA threatened and priority fauna database result, within 15 km of the survey area.	Low	Low
Glossy ibis (*Plegadis falcinellus*)	MI	MI		Wetland habitats such as freshwater marshes at the edges of lakes, rivers, and wet swamp areas. This species is occasionally found in coastal locations such as estuaries, deltas, saltmarshes, and coastal lagoons. Record detailed on the Birdata database search.	Moderate	Moderate
Letter-winged kite (*Elanus scriptus)*			P4	The letter-winged kite is a bird of open country and grasslands in arid and semi-arid Australia, where there are tree-lined streams or water courses. One previous record was detailed on the DBCA threatened and priority fauna database result, approximately 40 km from the survey area.	Moderate	Moderate
Oriental plover (*Charadrius veredus*)	MI	MI		This species inhabits sparsely vegetated plains, beaches and tidal flats, and saltworks and sewage ponds. Record detailed on PMST database search.	Moderate	Moderate
Australian painted snipe (*Rostratula australis*)	EN	EN		Inhabits shallow terrestrial freshwater wetlands, lakes, swamps, and claypans. Also found in waterlogged grassland and saltmarsh. Typical sites include areas with emergent tussocks of grass, sedges, or samphire, often scattered with clumps of lignum *Muehlenbeckia*, or canegrass or sometimes with tea-tree (*Melaleuca*). Records detailed on both Naturemap and Birdata database searches.	Moderate	Moderate
Common sandpiper (*Actitis hypoleucos*)	MI	MI		Non-breeding migrant to a wide variety of habitats, such as riverbanks, estuaries, freshwater seeps on coastal shores, tidal creeks, mangrove swamps, and saltmarshes. Record detailed on PMST database search.	Moderate	Recorded

Common name (scientific name)	Conservation codes			Preferred habitat and previous records	Pre-survey likelihood of occurrence	Post-survey likelihood of occurrence
	EPBC Act	BC Act	DBCA			
Sharp-tailed sandpiper (*Calidris acuminata*)	MI	MI		Muddy edges of shallow fresh/brackish wetlands with emergent sedges, saltmarsh, grass, and low vegetation. Record detailed on PMST database search.	Moderate	Moderate
Curlew sandpiper (*Calidris ferruginea*)	CR, MI	CR, MI		Mainly occur on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast. Record detailed on PMST database search.	Low	Low
Pectoral sandpiper (*Calidris melanotos*)	MI	MI		Mainly swamps, lagoons, river pools, irrigation channels, and sewerage ponds. Also, in samphire flats around estuaries and salt lakes. Record detailed on PMST database search.	Moderate	Moderate
Common greenshank (*Tringa nebularia*)	MI	MI		A variety of freshwater, marine and artificial wetlands, including swamps, open muddy or rocky shores of lakes and large rivers, sewage farms, saltworks, muddy coastal flats, mangroves, and estuaries. One previous record was detailed on the DBCA threatened and priority fauna database result, within 2 km of the survey area.	High	Moderate
Gull-billed tern (*Gelochelidon (Sterna) nilotica*)	MI	MI		Shallow sheltered seas close to land, estuaries, tidal creeks, near-coastal salt lakes, samphire flats, swamps, lagoons, river pools, claypans, dams, and over grain crops. One previous record was detailed on the DBCA threatened and priority fauna database result, approximately 25 km from the survey area.	Moderate	Moderate
Caspian tern (*Hydroprogne (Sterna) caspia*)	MI	MI		Mainly sheltered seas, estuaries, and tidal creeks. One previous record was detailed on the DBCA threatened and priority fauna database result, approximately 40 km from the survey area.	Low	Low
Barking owl (southwest subpop.) *(Ninox connivens connivens)*			P3	Forest and woodland. Mostly absent from arid regions. Mostly rests in the outer dense foliage of trees during the days, occasionally coming out in the late afternoon. They form permanent mating pairs, often returning year after year to the same hollow to nest. One previous historic record (1981) was detailed on the DBCA threatened and priority fauna database result, approximately 15 km from the survey area. However, this subspecies is only found in the South West region.	Low	Low

Common name (scientific name)	Conservation codes			Preferred habitat and previous records	Pre-survey likelihood of occurrence	Post-survey likelihood of occurrence
	EPBC Act	BC Act	DBCA			
Fork-tailed swift (*Apus pacificus*)	MI	MI		Summer migrant to Australia and occurs in low to very high airspace, largely independent of terrestrial habitats and landforms. Three previous records were detailed on the DBCA threatened and priority fauna database result, one within 15 km and two within 25 km of the survey area.	Moderate	Moderate
Grey falcon (*Falco hypoleucos*)		VU		Open habitats: semi-deserts, grassy inland plains, timbered watercourses, and pastoral lands. Four previous records were detailed on the DBCA threatened and priority fauna database result, one within 20 km and three within 35 km of the survey area.	High	Moderate
Peregrine falcon (*Falco peregrinus*)		OS		Cosmopolitan, will hunt in any habitat, soaring at height or from a perch, often near cliffs. Nests on rocky ledges in tall, vertical cliff faces and tall trees associated with drainage lines. Twenty previous records were detailed on the DBCA threatened and priority fauna database result, including one record less than 5 km, three less than 10 km and three less than 20 km from the survey area.	High	High
Night parrot (*Pezoporus occidentalis*)	EN	CR		Arid and semi-arid areas characterised by dense, low vegetation. Based on accepted records, the habitat consists of *Triodia* grasslands in stony or sandy environments, of samphire and chenopod shrublands, on floodplains and claypans and margins of salt lakes, creeks, and other water sources. One record detailed on the PMST database search likely due to suitable habitat being present.	Moderate	Low
Barn swallow (*Hirundo rustica*)	MI	MI		Coastal open country generally, especially near surface water and man-made structures, such as bridges and power wires. One record detailed on the PMST database search.	Low	Low
Yellow wagtail (*Motacilla flava*)	MI	MI		Damp short-grass flats, edges of swamps, sewerage ponds, grazed, or mowed grass and irrigated areas. Vagrant to Australia. One record detailed on the PMST database search.	Low	Low
Grey wagtail (*Motacilla cinerea*)	MI	MI		Mainly banks and rocks in fast flowing fresh water. Vagrant to Australia. Records detailed on the PMST and Birdata database searches; however, rarely reaches Australia during migration.	Low	Low

Common name (scientific name)	Conservation codes			Preferred habitat and previous records	Pre-survey likelihood of occurrence	Post-survey likelihood of occurrence
	EPBC Act	BC Act	DBCA			
Mammals						
Brush-tailed mulgara (*Dasycercus blythi*)			P4	Common in a range of habitats – tussock/hummock grasslands and sparse shrubs and low open woodlands on ridge tops, cliffs, scree slopes, hills, and valley floors. Four previous records were detailed on the DBCA threatened and priority fauna database result, approximately 15 km from the survey area.	High	Moderate
Northern quoll (*Dasyurus hallucatus*)	EN	EN		Occurs in a variety of habitats, but commonly found in rocky escarpments and open lowland savanna forest. Also, in areas associated with rocky areas, but also along watercourses. Four hundred and ninety-two previous records were detailed on the DBCA threatened and priority fauna database result, the closest record was approximately 8 km from the survey area and recorded in 2018. Most other records are clustered in ranges of 13-20 km from the survey area.	High	Moderate
Greater bilby, dalgyte (*Macrotis lagotis*)	VU	VU		The major habitats they now occupy in Western Australia include mulga scrub and hummock grasslands on sandplains or along drainage or salt lake systems. They require sandy or loamy soils in which to burrow. Three previous records were detailed on the DBCA threatened and priority fauna database result, approximately 30 km from the survey area.	Moderate	Low
Northern marsupial mole (*Notoryctes caurinus*)			P4	Lives primarily underground of sand dunes and sandy soils along river flats. Only recorded in Atlas of Living Australia database.	Low	Low
Short-tailed mouse (*Leggadina lakedownensis*)			P4	Open tussock and hummock grassland, Acacia shrubland and savanna woodland on alluvial clay/sandy soils. Cracking clays. One previous record was detailed on the DBCA threatened and priority fauna database result, approximately 35 km from the survey area.	Low	Low
Western pebble-mound mouse (*Pseudomys chapmani*)			P4	Gentle rocky slopes, hills and spurs with small pebble surface cover and sparse vegetation. This species distribution has contracted to the inland Pilbara away from the coastal Pilbara, Murchison, and Gascoyne. Two hundred and eighty-one previous records were detailed on the DBCA threatened and priority fauna database result, occurring both within the survey area and near the survey area.	Recorded	Recorded

Common name (scientific name)	Conservation codes			Preferred habitat and previous records	Pre-survey likelihood of occurrence	Post-survey likelihood of occurrence
	EPBC Act	BC Act	DBCA			
Central rock-rat *(Zyzomys pedunculatus)*	CR	CR		Common in a range of habitats – tussock/hummock grasslands and sparse shrubs and low open woodlands on ridge tops, cliffs, scree slopes, hills, and valley floors. One previous record detailed on the Naturemap database search; however, species is not currently found in Western Australia.	Low	Low
Pilbara leaf-nosed bat (*Rhinonicteris aurantia* (Pilbara form))	VU	VU		Roosts in deep, warm, humid caves or rock cracks, especially in proximity to water pools. Forages while flying low along watercourses and gorges and over *Triodia* grassland. One thousand, two hundred and ninety previous records were detailed on the DBCA threatened and priority fauna database result. The closest record was within 5 km of the survey area, but the majority were clustered in the range of 17-20 km north of the survey area.	High	Moderate
Ghost bat (*Macroderma gigas*)	VU	VU		A wide range from rainforest, monsoon, and vine scrub in the tropics to open woodlands and arid areas. One hundred and nine previous records were detailed on the DBCA threatened and priority fauna database result. The closest record was a cave with foraging evidence 5 km from the survey area (GHD Pty Ltd 2021b). Additional clusters occurred 7-8 km (GHD Pty Ltd 2021a) and 16-30 km south of the survey area (Department of Biodiversity, Conservation and Attractions 2022b).	High	Moderate

Note: EPBC Act = *Environment Protection and Biodiversity Conservation Act 1999*; BC Act = Biodiversity and Conservation Act 2016; DBCA = Department of Biodiversity, Conservation and Attractions.

Table 9: Summary of literature review results from surveys conducted within the vicinity of the survey area.

Author (year)	Survey area; size (ha)	Survey level	Survey timing	Survey effort	Significant vertebrate fauna recorded
GHD Pty Ltd (2021a) – Ministers North Level 2 Fauna Survey	Yandicoogina Creek 255.55 ha	Level 2 (Detailed) fauna survey	September 2019 March 2020	Two trapping sites comprising pitfalls, funnel traps and Elliot traps. Avifauna census (204 minutes) and active foraging (540 minutes). SM4 echolocation recorders (25 nights), acoustic night parrot recorders (16 nights), remote cameras (3,063 nights), and nocturnal targeted searches (600 minutes).	Ghost bat (*Macroderma gigas*) Western pebble-mound mouse (*Pseudomys chapmani*) Pilbara olive python (*Liasis olivaceus barroni*) Pilbara flat-headed (Gane's) blind snake (*Anilios ganei*)
GHD Pty Ltd (2021b) – Ministers North Level 1 Fauna Survey	Ministers North 2,507.69 ha	Level 1 (Basic) fauna survey	September 2019	Habitat assessments, bird acoustic recorders (15 nights), bat acoustic recorders (15 nights), remote cameras (1,912 nights), and opportunistic active searches.	Ghost bat Western pebble-mound mouse
Biologic (2019) – Marillana Tenement and Infrastructure Corridor Targeted Vertebrate Fauna Survey	Marillana exploration lease and the Marillana to Yandi corridor 13,993 ha	Targeted Matters of National Environmental Significance (MNES) fauna survey (2 phases)	April 2018 May/June 2018	Targeted searches, motion sensitive cameras, cave searches, Song Meter 4 (SM4) echolocation recorders, and VHF towers to detect presence of significant bat species. SM4 acoustic units were used to detect any presence of night parrot.	Ghost bat Western pebble-mound mouse Northern quoll (*Dasyurus hallucatus*)
Biologic (2017) – Ministers North to Yandi Corridor Single Phase Level 2 Fauna and Detailed Flora/Vegetation Survey	Ministers North to Yandi Corridor 2,025 ha	Level 2 fauna and Detailed flora/ vegetation survey	October 2017	Targeted searches, motion sensitive cameras, SM4 echolocation recorders to detect presence of significant bat species. SM4 acoustic units were used to detect presence of night parrot.	Western pebble-mound mouse

Author (year)	Survey area; size (ha)	Survey level	Survey timing	Survey effort	Significant vertebrate fauna recorded
Biologic (2016) – Marillana Infrastructure Corridor Level 1 Vertebrate Fauna Survey	Track between the existing mining operations at Yandi and the Marillana exploration tenement 2,676 ha	Level 1 vertebrate fauna survey	January 2016	Targeted transects, motion sensitive cameras, echolocation units to record significant bat species, habitat assessments and opportunistic searches.	Western pebble-mound mouse
Biota (2013) – Area C West to Yandi Level 2 Vertebrate Fauna Survey	Area C West to Yandi 23,520 ha	Level 2 fauna survey (3 phases)	May/June 2011 September 2011 February 2012	Twenty-three trapping sites comprising pitfalls, funnel traps and Elliot traps. Avifauna census and active foraging at each trapping site. SM4 echolocation recorders and harp traps to detect presence of significant bat species. Nocturnal targeted searches.	Pilbara Leaf-nosed bat (*Rhinonicteris aurantia*) Peregrine falcon (*Falco peregrinus)* Western pebble-mound mouse Common greenshank (*Tringa nebularia)*
Biologic (2011) – Barimunya Camp Fauna Survey	Yandi Mine Site 182 ha	Level 1 baseline fauna survey	April 2011	Opportunistic searches at ten sites, habitat assessments, avifauna census, and active foraging.	Western pebble-mound mouse Fork-tailed swift (*Apus pacificus*)
Biologic (2011) – Area C to Yandi Fauna Survey	Area C to Yandi 2,182 ha	Targeted fauna survey	September 2010	Targeted searches, motion camera traps, Avifauna census and active foraging. SM4 echolocation recorders to detect presence of significant bat species.	Ghost bat Western pebble-mound mouse
Biologic (2011) – Yandi Vertebrate Fauna Review	Yandi Mine 13,209 ha	Level 1 and Targeted MNES fauna survey	December 2010	Habitat assessment, avifauna census, motion sensitive cameras, echolocation recorders to detect presence of bats, targeted searches, active foraging.	Western pebble-mound mouse Pilbara olive python Fork-tailed swift

Author (year)	Survey area; size (ha)	Survey level	Survey timing	Survey effort	Significant vertebrate fauna recorded
Biota (2010) – Yandicoogina Junction South West and Oxbow Fauna Survey	Yandicoogina 723 ha	Level 2 fauna survey	July 2008	Eleven trapping sites comprising of pitfalls, funnel traps and Elliot traps. Avifauna census and active foraging at each trapping site. SM4 echolocation recorders and harp traps were used to detect presence of significant bat species.	Western pebble-mound mouse
ENV Australia (2009) - Newman to Yandi Transmission Line Terrestrial Vertebrate Fauna Assessment	Newman to Yandi Transmission Line 2,076 ha	Level 1 Fauna Survey	May 2009	Habitat assessment, avifauna census, echolocation recorders to detect presence of bats, targeted searches.	No significant fauna recorded
ENV (2009) - Yandi Flora Survey and Assessment of Barimunya Airport and a Potential Borrow Area	Barimunya Airport 228 ha	Flora and western pebble-mound mouse mound survey	November 2008	Targeted searches for western pebble-mound mouse mounds	Western pebble-mound mouse
Ecologia (2008) – RGP5 Fauna Survey Kurrajura Siding to Yandi WYE including Yandi Repeater 1	Kurrajura Siding to Yandi WYE 221 ha	Targeted fauna survey	May 2008	Habitat assessment, avifauna census, echolocation recorders to detect presence of bats, targeted searches, active foraging, spotlighting.	Ghost bat Western pebble-mound mouse Pilbara leaf-nosed bat
Ecologia (2008) – Marillana Creek (Yandi) Iron ore Mine Modification Level 2 Fauna Survey	Yandi Mine 2395 ha	Level 2 fauna survey	March 2008	Six trapping sites comprising pitfalls (PVC pipes and 20 L buckets), cage traps, funnel traps and Elliot traps. Avifauna census and active foraging at each trapping site. SM4 echolocation recorders to detect presence of significant bat species. Nocturnal spotlighting	Western pebble-mound mouse

Author (year)	Survey area; size (ha)	Survey level	Survey timing	Survey effort	Significant vertebrate fauna recorded
Specialised Zoological (2008) - Survey for conservation significant bats between Kurrajura siding and the Yandi Wye	Kurrajura siding and the Yandi Wye 3183 ha	Targeted significant bat survey	October 2008	Cave assessments, use of cloth barriers and motion cameras at caves, handheld Anabat SD1 detectors used during night transects and placed at various locations.	No significant fauna recorded
ENV Australia (2008) Yandi Hub Fauna Assessment	Yandi Mining Hub 2800 ha	Level 2 fauna survey	November 2007	Five trapping sites comprising pitfalls (PVC pipes and 20 L buckets), cage traps, funnel traps and Elliot traps. Avifauna census and active foraging at each trapping site. SM4 echolocation recorders to detect presence of significant bat species. Nocturnal spotlighting	Western pebble-mound mouse
Ecologia (2004) – Yandi Stockyard and Overland Conveyor Fauna and Flora Assessment	Yandi Mine 109 ha	Level 1 fauna and flora survey	October 2004	Desktop survey, habitat assessments and some opportunistic searches in the field	Western pebble-mound mouse
Maunsell (2003) – Yandi Life of Mine Flora and Fauna	Yandi 12, 921 ha	Level 1 and Targeted MNES fauna and flora survey	September 2003	Habitat assessment, avifauna census, echolocation recorders to detect presence of bats, targeted searches, active foraging, spotlighting.	Western pebble-mound mouse Common sandpiper (*Actitis hypoleucos*)
HGM (1999) – Marillana Creek Western Access Corridor Biological Assessment	Marillana Creek 37, 715 ha	Level 1 fauna and flora survey	April 1999	Habitat assessments, avifauna census, opportunistic searches.	Western pebble-mound mouse
Ecologia (1998) Mining Area C Biological Survey	Area C 103,300 ha	Level 2 fauna survey	April/May 1997	Thirteen trapping sites comprising pitfalls (PVC pipes and 20 L buckets), funnel traps and Elliot traps. Avifauna census and active foraging at each trapping site. Mist-netting for bats and nocturnal spotlighting.	Peregrine Falcon Western pebble-mound mouse

Author (year)	Survey area; size (ha)	Survey level	Survey timing	Survey effort	Significant vertebrate fauna recorded
Ecologia (1996) – Pebble-mound Mouse Site Survey	Yandi Mine 352 ha	Western pebble-mound mouse mound survey	December 1995	Targeted walking transects.	Western pebble-mound mouse

4.2 Field Survey

4.2.1 Vertebrate Fauna Habitats

4.2.1.1 Fauna Habitats

Ten broad habitat types were recorded in the survey area: Hillcrest/Hillslope, Major Drainage Line, Undulating Low Hills, Drainage Area/Floodplain, Sandy/Stony Plain, Wetland, Stony Plain, Medium Drainage Line, Breakaway/Cliff, Hardpan Plain, as well as Cleared/Disturbed areas. The habitats are summarised in Table 10 and mapped in Figure 9.

The habitat conditions varied greatly, ranging from 'Poor' to 'Excellent' in condition rating. Large portions of the survey areas were near active mining, the pit area, or tracks and haul roads. This created high levels of disturbance in some survey areas, including cleared/disturbed areas, fragmented habitat, dust and weed invasion. There was also disturbance caused by livestock (cattle), including grazing, erosion and weed invasion, with drainage line and floodplain areas most affected. The habitats in 'excellent' condition with limited disturbance mostly comprised of Hillcrest/Hillslope, Undulating Low Hills, and Breakaway/Cliff habitats.

Hillcrest/Hillslope habitats were characterised by large open rocky areas with open grasslands (predominantly *Triodia* hummock grasslands). This habitat tended to be more open and structurally simple than other fauna habitats. It is considered of low value as it provides limited microhabitats for fauna to exploit and is well-represented both in and out of the survey area.

Major Drainage Line habitat consisted of large drainage channels over 10 m in width, typically lined with mature *Eucalyptus*/*Corymbia* and *Melaleuca* species. This habitat is considered of moderate value to a wide spectrum of fauna species. It exhibited a moderate diversity of microhabitats, with some tree hollows and woody debris (logs and leaf litter). Within the survey area, buffel grass (**Cenchrus ciliaris*) was present in the ground storey vegetation, reducing floral diversity. Major Drainage Lines supported permanent or semi-permanent water bodies in multiple sections of the survey area. A permanent water body exists at the discharge point and a large potentially permanent water body persisted at Flatrocks. One of the major wetland sections of Marillana Creek is known as Flatrocks and is considered a larger permanent body of water. It will be referred to as Flatrocks within the report hereafter. Major Drainage Line habitat provides potential nesting habitat for the grey falcon, and potential foraging habitat and dispersal pathways for MNES species, including the Pilbara olive python, ghost bat, Pilbara leaf-nosed bat, and northern quoll.

Undulating Low Hills habitat is widespread and common throughout the Pilbara region, and although there are some MNES species (for example, the grey falcon) that may utilise this habitat, they are unlikely to be restricted to it. This habitat had low vegetation complexity and low diversity of microhabitats available for fauna species to exploit. The soils were stony and compact, reducing the potential opportunities for burrowing species. This habitat is considered of low value to a broad spectrum of fauna species.

Drainage Area/Floodplain habitat is of low to moderate value to a wide spectrum of fauna species. There was often grasslands and soft soils associated with this habitat type, creating microhabitats for some reptile and marsupial species, and potential habitat for MNES species such as the greater bilby, night parrot and grey falcon. This habitat type was represented well both in and out of the survey area.

Sandy/Stony Plain habitat is common throughout the Pilbara region and has low to moderate value to a wide spectrum of fauna species. Sandy/Stony Plain represented some of the habitat within the survey area that is considered important for burrowing species such as the greater bilby, as well as the grey falcon.

Wetland habitats differ from permanent/semi-permanent pools as they are generally a larger water body that supports their own distinct ecosystem and aquatic fauna assemblages (waterfowl, fish etc.). Due to their rarity in the Pilbara region, these habitats generally have elevated significance. Depending on the surrounding habitat, these areas can be of importance to MNES species, such as northern quoll and Pilbara olive python (if surrounded by rocky habitats) and to some Migratory listed bird species. There are two main areas within the Marillana Creek system that are categorised as wetlands: Flatrocks and the dewatering discharge outlet. Flatrocks is a section of the creek on the western side of the survey area which widens and holds permanent water and is surrounded by rocky habitat. The dewatering discharge outlet is on the eastern side of the survey area within Marillana Creek and the excess water discharging into this section of the creek has created a permanent artificial pool running for over one kilometre downstream.

Stony Plain habitat is widespread and common throughout the Pilbara region. Although there are some MNES species that may utilise it for foraging and dispersal purposes such as the ghost bat, Pilbara leaf-nosed bat, northern quoll, greater bilby, night parrot and grey falcon, they are not restricted to this habitat type. This habitat generally had low vegetation complexity and microhabitat diversity and is considered of low value for fauna.

Medium Drainage Line habitat is a commonly recorded habitat for the Pilbara region and considered to be of low to moderate value to a wide spectrum of fauna species. Medium Drainage Lines typically consisted of small drainage channels with eucalypt woodlands growing in the riparian zone. A moderate diversity of microhabitats was exhibited with some seasonal presence of pools, tree hollows and woody debris (logs and leaf litter). Buffel grass was often present in the ground story vegetation, reducing floral diversity.

Breakaway/Cliff habitat is considered of medium value. Despite providing fewer microhabitats for fauna to exploit compared to gorges and gullies, they may support MNES (namely the northern quoll and Pilbara olive python) if they occur in the vicinity of water bodies/wetlands. Breakaways in the survey area were characterised by large rocky outcrops that were not cave forming with little vegetation and were generally unsuitable for many fauna species due to limited soft soil, leaf litter and dense vegetation.

Hardpan Plain habitat is widespread and common throughout the Pilbara but was quite limited within the survey area and is considered of moderate value to a wide spectrum of fauna species. Hardpan Plains consisted of mainly alluvial, silty to sandy clay loam floodplains associated with drainage lines. This habitat exhibited a moderate diversity of microhabitats, with some tree hollows and logs and deep sandy soils suitable for burrowing. Within the survey area, the soft soils and *Triodia* hummocks provide suitable foraging habitat for the greater bilby.

Cleared/Disturbed habitat was present in most survey areas due to the areas being near the pit and active mining. This habitat type has low to no value as a fauna habitat.

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7485000

7480000

POOL-03
POOL-01
POOL-02

Pool Location
Survey Area
Yandi Mine Tenement

Fauna Habitat

- Breakaway/Cliff
- Hardpan Plain
- Hillcrest/Hillslope
- Drainage/Floodplain
- Medium Drainage Line
- Major Drainage Line
- Sandy/Stony Plain
- Stony Plain
- Undulating Low Hills
- Wetland
- Cleared/Disturbed

BHP Western Australian Iron Ore (WAIO)
Yandi 45C Targeted Significant Vertebrate Fauna Survey

Figure 9: Fauna habitat mapping

Scale: 1:50,000 at A3
Coordinate System: GDA 1994 MGA Zone 50
0 1 2 3 Kilometres

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Author: K. Grosser | Drawn: C. Dyde | Date: 08-03-2023 | Figure Ref: 2400-006-BIDR-1Rev0_230308_Fig9_Habitat

Table 10: Fauna habitats recorded within the survey area.

Fauna habitat	Extent in survey area (proportion)	Broad habitat description	Microhabitats	Sites	Habitat condition	Value (broad faunal assemblage and MNES species)	Representative photo
Hillcrest/Hillslope	544.26 ha (34.0%)	Characterised by large open rocky areas with open grasslands, predominantly *Triodia* hummock grasslands.	• overhangs • logs • tree hollows • crevices • rock pile • old *Triodia* • leaf litter	• BAT02, 05 • CAM24, 33 • HA02, 13	Good to excellent	Low value to a wide spectrum of fauna species that are likely to reside in this habitat. Low value to target MNES species as this habitat offers little in the way of foraging or shelter for these species.	
Major Drainage Line	353.05 ha (22.1%)	Large drainage channel over 10 m in width. Rocky substrate often washed away. Presence of mature *Eucalyptus/Corymbia* trees.	• logs • tree hollows • crevices • soft soil (burrows) • semi-permanent water • permanent water • leaf litter	• BAT03, 04, 06, 07 • CAM01-20, 36-40 • HA07-09, 16, 18, 20, 22, 25	Poor to Very Good	Moderate value to a wide spectrum of fauna species. High value to target MNES species as it provides potential nesting habitat for grey falcon, and suitable foraging and dispersal habitat for northern quoll, ghost bat, Pilbara leaf-nosed bat, Pilbara olive python, and some Migratory bird species.	
Undulating Low Hills	238.89 ha (15.0%)	Low stony hills and slopes with dissected valleys and drainage on stony soils.	• crevices	• ACO01, 02 • BP02, 04 • CAM-21 • HA-01, 06, 10, 21, 23	Good to Excellent	Low value to a wide spectrum of fauna species that are likely to reside in this habitat. Low value to target MNES species as this habitat offers little in the way of foraging or shelter for these species.	
Drainage Area/Floodplain	158.89 ha (10.0%)	Flat plains next to drainage lines, often grasslands and or woodlands with soft/clay soils.	• logs • tree hollows • crevices • thick undergrowth • soft soil (burrows) • semi-permanent water • old *Triodia* • leaf litter	• BP05 • HA05	Poor to Very Good	Moderate value to a wide spectrum of fauna species that are likely to reside in this habitat. Low value to target MNES species as this habitat offers little in the way of foraging or shelter for these species. Potentially grey falcon habitat and greater bilby habitat due to soft soils and night parrot due to areas of old *Triodia* clumps.	

Fauna habitat	Extent in survey area (proportion)	Broad habitat description	Microhabitats	Sites	Habitat condition	Value (broad faunal assemblage and MNES species)	Representative photo
Sandy/Stony Plain	41.88 ha (2.6%)	Stands of *Acacia* or other shrubs over clay or stony substrates.	• logs • tree hollows • thick undergrowth • soft soils (burrows) • old *Triodia*	• BP01, 03, 06 • CAM11 • HA15	Good to Excellent	Moderate value to a variety of fauna species that reside in this habitat. Low value to target MNES species as it does not provide suitable shelter and foraging habitat, except for possibly greater bilby, night parrot and grey falcon.	
Wetland	14.08 ha (0.9%)	Permanent water, often reeds present.	• thick undergrowth • soft soil (burrows) • permanent water • semi-permanent water	• HA19	Poor to Excellent	High value to a wide spectrum of fauna species that are likely to reside in this habitat. High value to target MNES species as this habitat offers foraging or shelter for species including northern quoll, Pilbara olive python and migratory bird species.	
Stony Plain	13.72 ha (0.9%)	Broad flat low-lying plains to undulating plain on soft loamy soils.	• logs • soft soil (burrows)	• HA11, 14	Very Good to Excellent	Low value to a wide spectrum of fauna species Low value to target MNES species as this habitat offers little in the way of foraging resources or shelter for these species, possibly night parrot and grey falcon habitat.	
Medium Drainage Line	12.32 ha (0.8%)	Medium drainage channel often with thick *Acacia* growth along banks.	• logs • tree hollows • crevices • thick undergrowth • soft soil (burrows) • semi-permanent water • leaf litter • termite mounds	• BAT01 • CAM23 • HA03, 23	Poor to Very Good	Moderate value to a wide spectrum of fauna species. Moderate value to target MNES species as it provides suitable foraging and dispersal habitat for northern quoll, ghost bat, Pilbara leaf-nosed bat, Pilbara olive python, grey falcon and some migratory bird species.	

Fauna habitat	Extent in survey area (proportion)	Broad habitat description	Microhabitats	Sites	Habitat condition	Value (broad faunal assemblage and MNES species)	Representative photo
Breakaway/Cliff	9.71 ha (0.6%)	Exposed rock formations often associated with hillcrest/hilltop, gully/gorges, or drainage lines.	• overhangs • crevices • thick undergrowth • rock pile • old *Triodia*	• CAM15, 22, 25-32, 34, 35 • HA04, 17	Good to excellent	Moderate value to a selection of fauna species. Moderate value to target MNES species as it provides suitable foraging and dispersal habitat for northern quoll and Pilbara olive python.	
Hardpan Plain	3.78 ha (0.02%)	Clay based soils, both cracking and non-cracking. Low lying areas that have slight to no gradient.	• logs • tree hollows • soft soil (burrows) • old *Triodia*	• HA12	Very Good to Excellent	Moderate value to terrestrial fauna. Low value to target MNES species as this habitat offers limited foraging or shelter habitat, except for possibly the greater bilby, grey falcon and night parrot.	
Cleared/ Disturbed	208.97 ha (13.1%)		• N/A	• N/A	Poor	Low to no value	No photo

4.2.1.2 Habitat Suitability for MNES Species

Greater Bilby

No critical denning and foraging habitat were identified for the greater bilby within the survey area. Critical greater bilby denning and foraging habitat typically consists of sandplains, spinifex dominated interdune corridors, salt-lakes surrounded with samphire (*Halosarcia* species) and/or Melaleucas, or paleo-drainage systems within individual home ranges (Pavey 2006). Greater bilby home ranges cover on average 18 ha for females and 316 ha for males (Pavey 2006). Soft soils within these habitats provide optimal conditions for burrowing.

Approximately 218 ha (14%) of the survey area was considered supporting habitat for the greater bilby. These habitats include Hardpan Plain, Stony/Sandy Plain, Stony Plain, and Drainage/Floodplain (Figure C.1, Appendix C). These areas contained some soft soils that present the species with opportunities to dig and forage. However, most of the soils were stony and therefore not classified as critical habitat for the species.

The remaining 86% of the survey area was considered to provide limited habitat for the greater bilby, consisting of Cleared/Disturbed, Undulating Low Hills, Medium Drainage Line, Major Drainage Line, Hillcrest/Hillslope, Breakaway/Cliff, and Wetland habitats (Figure C.1, Appendix C).

Northern Quoll

No critical habitat for the northern quoll was identified within the survey area. Gorge/Gully and Breakaway habitats contain the rocky environments of high relief that are particularly important for northern quoll, as they provide denning sites for breeding and shelter, and diverse microhabitats for foraging. However, the habitat present in the survey did not contain caves, crevices, or any suitable denning habitat and therefore is not considered critical habitat.

Approximately 1,151 ha (72%) of the survey area was supporting habitat due to the potential for dispersal of the species, with populations present within ridgelines located approximately 13 km north of the survey area. The supporting habitat consisted of Major Drainage Line, Medium Drainage Line, Breakaway/Cliff, Hillcrest/Hillslope, Wetland, Sandy/Stony Plain, Stony Plain, Drainage Area/Floodplain, and Hardpan Plain habitats (Figure C.2, Appendix C).

The remaining approximately 447 ha (28%) of the survey area was considered to provide limited habitat for the northern quoll, consisting of Cleared/Disturbed and Undulating Low Hills (Figure C.2, Appendix C).

Ghost Bat

No critical habitat was identified for the ghost bat within the survey area. Critical habitat for ghost bat comprises of Gorge/Gully and Breakaway habitats with the presence of diurnal roost caves, cave and deep shelters that could be used as nocturnal feeding roosts and complex vegetation structures and microhabitats that support prey species. Although there was Breakaway/Cliff habitat present in the survey area it was not cave forming and there were no suitable feeding or roosting caves present.

Approximately 597 ha (37%) of the survey area was identified as supporting habitat for the ghost bat, consisting of Major Drainage Line, Medium Drainage Line, Drainage Area/Floodplain, Stony/Sandy Plain, Wetland, and Hardpan Plain habitats (Figure C.3, Appendix C). Ghost bats have relatively broad foraging habitat ranging across tree-lined drainage lines, isolated trees on the outskirts of plains, and

productive plains of thin woodland over clumped tussock or *Triodia* hummock grass (Bat Call WA 2021a).

The remaining approximately 1,001 ha (63%) of the survey area was considered to provide limited habitat for the ghost bat, consisting of Cleared/Disturbed, Breakaway/Cliff, Undulating Low Hills, Hillcrest/Hillslope, and Stony Plain habitats (Figure C.3, Appendix C).

Pilbara Leaf-nosed Bat

No critical habitat was identified for this species within the survey area. The Pilbara leaf-nosed bat requires deep, humid, climatically stable caves for diurnal and maternal roost sites, which are typically associated with Gorge/Gully and Breakaway habitats. No Gorge/Gully habitat was identified within the survey area, and the Breakaway/Cliff habitat present had no suitable caves.

The Pilbara leaf-nosed bat is known to forage across a wide variety of habitat, typically along vegetated gullies and ridgelines, water courses and drainage lines, and across plains and low hills with complex vegetation structure (Bat Call WA 2021b). As such, the entire survey area of approximately 1,390 ha (87%), excluding Cleared/Disturbed areas (208 ha (13%)), was considered as being supporting habitat for the Pilbara leaf-nosed bat (Figure C.4, Appendix C).

Pilbara Olive Python

One section of Breakaway habitat at Flatrocks was identified as critical Pilbara olive python habitat within the survey area due to its proximity to a large wetland, the area is approximately 0.8 ha (0.05%) of the total survey area. Pilbara olive pythons typically inhabit Gorge/Gully and Breakaway habitats where caves and overhangs provide denning sites and ambush locations frequented by this species. The thick vegetation and log piles found in these areas act as refuges and provide shelter and ambush locations, particularly in areas containing permanent/semi-permanent water sources.

Approximately 379 ha (23%) of the survey area was considered supporting habitat, which consisted of Major Drainage Line, Medium Drainage Line and Wetland habitat (Figure C.5, Appendix C).

The remaining approximately 1,219 ha (76%) of the survey area was considered to provide limited habitat for the Pilbara olive python, consisting of Cleared/Disturbed, Breakaway/Cliff, Drainage Area/Floodplain, Hardpan Plain, Undulating Low Hills, Stony/Sandy Plain, Hillcrest/Hillslope, and Stony Plain habitats (Figure C.5, Appendix C).

Night Parrot

None of the habitats within the survey area were considered critical habitat for the night parrot, according to the criteria in Table A.8 (Appendix A). This was because there was no old growth *Triodia* present and the habitat within the survey area was fragmented and close to high levels of disturbance.

Approximately 457 ha (28%) of the survey area was considered supporting habitat, which consisted of Sandy/Stony Plain, Drainage Area/Floodplain, Undulating Low Hills, Stony Plain, and Hardpan Plain habitats (Figure C.6, Appendix C).

The remaining approximately 1,142 ha (72%) of the survey area was considered to provide limited foraging and dispersal habitat, consisting of Cleared/Disturbed, Major Drainage Line, Medium Drainage Line, Breakaway/Cliff, Hillcrest/Hillslope, and Wetland habitats (Figure C.6, Appendix C).

Grey Falcon

The Major Drainage Line and Wetland habitats within the survey area (367.13 ha (23%); Figure C.7, Appendix C) were considered critical habitat for the grey falcon, according to the criteria in Table A.8 (Appendix A). This was due to the presence of tall *Eucalyptus/Corymbia* trees within these habitats that may be suitable as nest sites for this species.

Approximately 469.48 ha (29%) of the survey area was considered supporting habitat, which consisted of Drainage Area/Floodplain, Medium Drainage Line, Hardpan Plain, Sandy/Stony Plain, Stony Plain, and Undulating Low Hills (Figure C.7, Appendix C).

4.2.2 Vertebrate Fauna Species

There were 91 vertebrate fauna species recorded within the survey area (Table 11). A complete list of recorded species is provided in Tables B.1 to B.4 (Appendix B). The following sections provide detailed results for each major taxonomic group sampled.

Table 11: Number of vertebrate fauna species recorded during the survey.

Fauna taxonomic group	No. of species recorded	No. of MNES species recorded	No. of DBCA Priority fauna species recorded	No. of introduced species recorded
Reptiles	7	0	0	0
Birds	66	1	0	0
Mammals	18	0	1	4
Total	**91**	**1**	**1**	**4**

4.2.2.1 Herpetofauna

Seven reptile species were recorded during the survey, comprising of three dragons, two skinks and two varanids (Table B.2, Appendix B). The low number of reptiles is not unexpected given the survey focused on the presence/absence of MNES species without the use of pitfall trapping implemented in Detailed fauna surveys. No MNES or other significant reptile species were recorded during the survey.

4.2.2.2 Birds

Sixty-six bird species were recorded during the survey. The most speciose families were Accipitridae (hawks, eagles, kites) and Columbidae (pigeons) with five species, followed by Meliphagidae (honeyeaters) with four species, followed by Anatidae (waterfowl), Cacatuidae (cockatoo), Alcedinidae (kingfishers), Estrildidae (finches), Hirundinidae (swallows, martins) and Artamidae (woodswallows, butcherbirds) with three species each (Table B.3, Appendix B).

One MNES species, the common sandpiper (which is a Migratory wader), was recorded multiple times during the survey. This species is discussed further in Section 4.2.2.4.

4.2.2.3 Mammals

Eighteen species of mammal were recorded during the survey, including four introduced species: cat (**Felis catus*), dog/dingo (**Canis familiaris*), European cattle (**Bos taurus*), and red fox (**Vulpes vulpes*) (Table B.4, Appendix B). Eight bat species were confirmed present from ultrasonic acoustic recording devices set within the survey area.

One mammal species of significance, the western pebble-mound mouse, was recorded during the survey, with seven mounds recorded within the survey area. This species is discussed further in Section 4.2.2.4.

4.2.2.4 Significant Species Recorded

Two vertebrate species of significance, including one MNES species, were recorded within the survey area: common sandpiper (Mi; Mi) and western pebble-mound mouse (P4). The locations of these species' records from the current survey, as well as previously recorded species, are shown in Figure 10 and detailed in Table D.1 (Appendix D).

Common sandpiper (*Actitis hypoleucos*)

Although the common sandpiper is a widespread migrant, they are not particularly common in Australia and generally tend to be more numerous in the north. They are an early migrant arriving from the mid-north latitudes of Asia from July/August and departing around March. This species is often found in sheltered habitats used by few other shorebirds. Wetland habitats with steep shorelines are favoured, in particular along mangrove-lined creeks, muddy areas with rocky outcrops, steep sided dams, and sewage ponds (Menkhorst et al. 2017).

There was a total of eight common sandpiper records during the survey. One was an opportunistic sighting of two birds at Flatrocks, and the other seven records were on three different motion cameras: one record each on CAM16 (Plate 1) and CAM19, and five records on CAM18. This species is usually solitary or in very small groups (Menkhorst et al. 2017), so it is likely that the five records observed on CAM18 over a two-day period were the same two individuals (Plate 2). The species was also recorded on a previous survey in 2003 (Maunsell Australia 2003).

This species would likely utilise permanent and semi-permanent water bodies in the survey area including the Wetland habitat and some of the Major Drainage Line habitat. Significant water features include Flatrocks and the dewatering discharge pond, which have created a permanent wetland in the southern section of the survey area.

Plate 1: Common sandpiper recorded on CAM16.

Plate 2: Common sandpipers recorded on CAM18.

Western Pebble-mound Mouse (*Pseudomys chapmani*)

The western pebble-mound mouse (P4) is endemic to the Pilbara and confined to the central and eastern Pilbara in Western Australia. They are found on stony hillsides with hummock grassland and shelter in complex burrow systems under a mound which they construct on the surface using pebbles

collected in the vicinity (Menkhorst and Knight 2011). Seven mounds were recorded during the current survey, including three active mounds (Plate 3), three recently inactive mounds (Plate 4), and one inactive mound. The Stony Plain, Undulating Low Hills and Hillcrest/Hillslope habitats support this species and are widespread throughout the Pilbara and the survey area.

Plate 3: Active western pebble-mound mouse mound (WPMM02).

Plate 4: Recently inactive western pebble-mound mouse mound (WPMM07).

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Survey Area
Yandi Mine Tenement

Current Significant Fauna

- Common Sandpiper
- Western Pebble-mound Mouse

Previous Significant Fauna

- Barking Owl (southwest subpop.)
- Bilby, Dalgyte
- Brush-tailed Mulgara
- Caspian Tern
- Common Greenshank
- Eastern Osprey
- Fork-tailed Swift
- Gane's Blind Snake
- Ghost Bat
- Grey Falcon
- Gull-billed Tern
- Letter-winged Kite
- Northern Quoll
- Northern Short-tailed Mouse
- Peregrine Falcon
- Pilbara Barking Gecko
- Pilbara Leaf-nosed Bat
- Pilbara Olive Python
- Southern Giant Petrel
- Unpatterned Robust Slider (Robertson Range)
- Western Pebble-mound Mouse

BHP Western Australian Iron Ore (WAIO)
Yandi 45C Targeted Significant Vertebrate Fauna Survey

Figure 10: Previous and current significant vertebrate fauna locations

Scale: 1:200,000 at A3
Coordinate System: GDA 1994 MGA Zone 50
0 2 4 6 8 10 Kilometres

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an ecocene company

Author: K. Grosser | Drawn: C. Dyde | Date: 14-03-2023 | Figure Ref: 2400-006-BIDR-1Rev0_230314_Fig10_PrevFauna

4.2.2.5 Significant Species Possibly Occurring in the Survey Area

Two additional species, including one MNES species, which were not recorded in the survey area during the current survey are considered to have a high likelihood of occurrence (Table 8).

Pilbara Olive Python (*Liasis olivaceus barroni*)

The Pilbara olive python (VU; VU) is listed as Vulnerable under the EPBC Act and the BC Act and is restricted to ranges within the Pilbara region of north-western Western Australia, such as the Hamersley Range, and islands of the Dampier Archipelago. The Pilbara olive python prefers rocky outcrops, escarpments, and gorges, often in close proximity to water holes (including man-made) which attract suitable sized prey species. Microhabitat preferences are under rock piles, on top of rocks or under spinifex (Department of Environment 2022a). The desktop assessment showed that the closest Pilbara olive python record occurs only 500 m from the survey area. There were 23 records within 40 km of the survey area, and four of which were within 15 km (Department of Biodiversity, Conservation and Attractions 2022b). The Pilbara olive python was also previously recorded during a survey conducted in the vicinity of the current survey area in 2011 (Biologic 2011b) and 2021 (GHD Pty Ltd 2021a). There was one area identified as critical habitat in the survey area: Breakaway/Cliff habitat near Flatrocks water pools. Supporting habitat, including Medium Drainage Line, Major Drainage Line and Wetland habitat types, is also present within the survey area and, therefore, this species has a 'high' likelihood of occurring.

Peregrine Falcon (*Falco peregrinus*)

The peregrine falcon (Other Specially Protected (OS) under the BC Act) occurs throughout Australia and is present in most habitat types, apart from treeless and waterless desert and dense forests. This species is considered widespread throughout Australia, but uncommon. The peregrine falcon utilises the ledges, cliff faces and large hollows/broken spouts of trees for nesting. It also occasionally uses the abandoned nests of other birds of prey (Johnstone and Storr 1998).

The closest record occurs within 5 km of the survey area (Department of Biodiversity, Conservation and Attractions 2022b) and potential habitat is present within the Major and Medium Drainage Line habitats (Figure 9); however, no evidence of peregrine falcon nests was observed.

Sixteen species not found in the survey area were considered to have a 'moderate' likelihood of occurrence, including four mammal species, two reptile species and ten bird species (Table 8).

Brush-tailed Mulgara (*Dasycerus blythi*)

The brush-tailed mulgara (P4) is common in a range of habitats, including tussock/hummock grasslands and low open woodlands. There have been four previous records within 15 km of the survey area, and although some suitable habitat is present within the survey area, including Drainage Area/Floodplain and Sandy/Stony Plain habitats, no evidence of this species was recorded during the survey.

Northern Quoll (*Dasyurus hallucatus*)

The northern quoll (EN; EN) is common in a range of habitats within its distribution, including rocky habitats and watercourses. There are almost 500 previous records for this species within 20 km of the survey area, with the closest record being approximately 8 km from the survey area (Department of Biodiversity, Conservation and Attractions 2022b). Although the survey area does not support critical

habitat for this species, there is a 'moderate' likelihood of occurrence due to some supporting foraging and dispersal habitat (see Section 4.2.1.2) being present within the survey area.

Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*)

The Pilbara leaf-nosed bat (VU; VU) roosts in deep, warm, humid caves or rock cracks near water pools and forages in a range of habitats including along watercourses and over *Triodia* grasslands. Although there is no critical or roosting habitat for this species in the survey area, there is over 1,200 previous records within 20 km of the survey area, with the closest record within 5 km of the survey area (Department of Biodiversity, Conservation and Attractions 2022b). Due to supporting foraging and dispersal habitat being present in the survey area (see Section 4.2.1.2) this species has a 'moderate' likelihood of occurrence.

Ghost Bat (*Macroderma gigas*)

The ghost bat (VU; VU) is found in a wide range of habitats but relies on caves for roosting. There was no critical/roosting habitat present in the survey area. However, there is supporting habitats for foraging and dispersal, including Drainage Line habitats (see Section 4.2.1.2). There are over 100 previous records of this species mostly ranging from 15 to 30 km from the survey area, with the closest record approximately 14 km from the survey area (Department of Biodiversity, Conservation and Attractions 2022b). In addition, recent surveys recorded evidence of ghost bat foraging at a potential night roost within 5 km of the survey area (GHD Pty Ltd 2021b) and evidence of ghost bat use of four caves (two potential diurnal roosts and two potential foraging caves) within 7 to 8 km of the survey area (GHD Pty Ltd 2021a). No ghost bat calls have been recorded within the survey area to date.

Pilbara Barking Gecko (*Underwoodisaurus seorsus*)

The Pilbara barking gecko (P2) is confined to the Hamersley Ranges from Tom Price to Newman and occurs in rocky areas with spinifex and low tree cover. There are 12 previous records, all which are over 20 km from the survey area. However, due to suitable habitat being present in the survey area, in the form of Sandy/Stony Plain, Stony Plain and Undulating Low Hills habitats, there is a 'moderate' likelihood of this species occurring.

Unpatterned Robust Slider (Robertson Range) (*Lerista macropisthopus remota)*

The unpatterned robust slider (P2) is found in *Acacia* shrublands and woodlands in the central interior and shelters in loose soil under leaf litter at the base of shrubs. Three previous fauna records were detailed on the DBCA Threatened and Priority Fauna Database search result, with all records over 20 km from the survey area (Department of Biodiversity, Conservation and Attractions 2022b). Due to the species' undetectability without extensive survey/trapping effort and there being suitable habitat present in the form of Major and Medium Drainage Lines and Drainage Area/Floodplain habitats, there is a 'moderate' likelihood of occurrence.

Glossy Ibis *(Plegadis falcinellus*)

The glossy ibis (MI; MI) is a migratory listed waterbird inhabiting wetlands and freshwater marshes at the edges of lakes, rivers, and wet swamp areas. There was one record detailed on the Birdata database search (Birdlife Australia 2022) and, due to suitable habitat being present in the form of Wetland, Major Drainage Line and Medium Drainage Line habitats, there is a 'moderate' likelihood of this species occurring.

Letter-winged Kite *(Elanus scriptus)*

The letter-winged kite (P4) is a bird inhabiting open country and grasslands in arid and semi-arid Australia, where there are tree-lined streams or water courses. Due to the high mobility of the species, one previous record occurring approximately 40 km from the survey area, and the survey area containing suitable habitat, there is a 'moderate' likelihood of the species occurring, although it is not reliant on any habitats within the survey area.

Oriental Plover (*Charadrius veredus*)

The oriental plover (MI; MI) is a listed migratory species which inhabits sparsely vegetated plains, beaches and tidal flats, and saltworks and sewage ponds. There was one record detailed on the Protected Matters Search Tool (PMST) database search (Department of Climate Change, Energy, the Environment and Water 2022) and suitable habitat is present in the survey area, in the form of Wetland, Major Drainage Line and Medium Drainage habitats. Therefore, there is a 'moderate' likelihood of the species occurring in the survey area.

Australian Painted Snipe (*Rostratula australis*)

The Australian painted snipe (EN; EN) is a small freshwater wader which inhabits shallow terrestrial freshwater wetlands, lakes, swamps and claypans. With records detailed on both NatureMap and Birdata database searches (Birdlife Australia 2022, Department of Biodiversity, Conservation and Attractions 2022a) and suitable habitat present in the survey area in the form of Wetland, Major Drainage Line and Medium Drainage Line habitats, there is a 'moderate' likelihood of the species occurring.

Sharp-tailed Sandpiper (*Calidris acuminata*)

The sharp-tailed sandpiper (MI; MI) is a listed migratory wader and inhabits muddy edges of shallow fresh/brackish wetlands with emergent sedges, saltmarsh, grass, and low vegetation. There are records detailed on the PMST database search (Department of Climate Change, Energy, the Environment and Water 2022) and suitable habitat is present in the survey area in the form of Wetland, Major Drainage Line, Medium Drainage Line and Drainage Area/Floodplain habitats. Therefore, there is a moderate likelihood of occurrence for this species in the survey area.

Pectoral Sandpiper (*Calidris melanotos*)

The pectoral sandpiper (MI; MI) is a migratory listed wader and mainly inhabits swamps, lagoons, river pools, irrigation channels, and sewerage ponds. There are records detailed on the PMST database search (Department of Climate Change, Energy, the Environment and Water 2022) and due to suitable habitat being present in the form of Wetland, Major Drainage Line and Medium Drainage Line habitats, there is a moderate likelihood of the species occurring.

Common Greenshank (*Tringa nebularia*)

The common greenshank (Mi; Mi) is a Migratory listed wader found in a variety of freshwater, marine and artificial wetlands, including swamps, open muddy or rocky shores of lakes and large rivers, sewage farms, saltworks, muddy coastal flats, mangroves, and estuaries. There was one previous record from within 2 km of the survey area and Biota previously recorded the species in close proximity to the current survey area in 2013 (Biota Environmental Sciences 2013). With suitable habitat present in the form of Wetland, Major Drainage Line and Medium Drainage Line habitats, there is a 'moderate' likelihood of occurrence.

Gull-billed Tern (*Gelochelidon (Sterna) nilotica*)

The gull-billed tern (MI; MI) is a listed migratory seabird sometimes inhabiting swamps, lagoons, river pools, claypans, and dams. With suitable habitat present in the survey area in the form of Wetland, Major Drainage Line and Medium Drainage Line habitats, and with a record from within 25 km of the survey area, there is a 'moderate' likelihood of occurrence for this species.

Fork-tailed Swift (*Apus pacificus*)

The fork-tailed swift (MI; MI) is a migratory listed bird and occurs in low to very high airspace, largely independent of terrestrial habitats and landforms. Three previous records were detailed on the DBCA Threatened and Priority Fauna Database (Department of Biodiversity, Conservation and Attractions 2022b), one of which was recorded within 15 km and two within 25 km of the survey area. Given suitable habitat for this species is also present in the form of all habitats, except for the Cleared/Disturbed areas within the survey area, there is a 'moderate' likelihood of occurrence for this species.

Grey Falcon (*Falco hypoleucos*)

The grey falcon (VU) is a raptor that usually nests in the tallest trees along watercourses, particularly in River Red Gum (*Eucalyptus camaldulensis*) and Coolibah (*E. coolabah*), but also in telecommunication towers (Marchant and Higgins 1993, Schoenjahn 2013, Schoenjahn 2018). The species frequents timbered lowland plains, particularly *Acacia* shrublands that are crossed by tree-lined water courses (Garnett et al. 2011, Watson 2011, Janse et al. 2015, Ley and Tynan 2016, Schoenjahn 2018). There are four previous records: one within 20 km and three within 35 km of the survey area. Due to both potential critical and supporting habitats being present in the survey area (see Section 4.2.1.2) this species has a 'moderate' likelihood of occurrence.

An additional 15 species, including 10 MNES species, were considered to have a low likelihood of occurrence due to a lack of historical records in the vicinity of the survey area and the lack of potentially suitable habitats (Table 8).

5 Discussion

5.1 Fauna Habitats

Habitats within the survey area are not restricted at the local or sub-regional scale, except for the Wetland habitat as permanent water bodies like these are not common in the Pilbara region and they are of high value to many species, including MNES. The ten broad fauna habitats observed within the survey area are considered representative of each habitat type and provide habitat for a number of vertebrate fauna species recorded during the survey.

There were three pools recorded as significant habitats, as semi-permanent and permanent water sources are not always common in the Pilbara. Wetland habitats were present in the survey area in sections of Marillana Creek (Flatrocks) and at the dewatering discharge pond (approximately 0.9% of the survey area). Wetlands differ from permanent and semi-permanent pools as they are generally a larger water body that supports their own distinct ecosystem and aquatic fauna assemblages (waterfowl, fish etc.). Due to their rarity in the Pilbara region these habitats generally have elevated significance. Depending on the surrounding habitat these areas can also be of importance to MNES species such as the northern quoll, grey falcon and Pilbara olive python as well as some Migratory listed bird species.

Breakaway/Cliff habitat was not common in the survey area (approximately 0.6%) and was of moderate habitat value for general fauna species and target MNES species. They may support fauna of significance, namely the northern quoll and the Pilbara olive python, if in the vicinity of water bodies/wetlands. The Breakaway/Cliff habitat (0.8 ha, 0.05% of survey area) near Flatrocks was considered critical habitat for the Pilbara Olive Python. The areas of Breakaway/Cliff habitat in the survey area were not cave-forming and therefore not of high value to other MNES species.

Medium and Major Drainage Line habitat (~23% of the survey area) was of moderate value to a large selection of vertebrate fauna and of high value to the target MNES species as they provide potentially suitable foraging and dispersal habitat for northern quoll, ghost bat, Pilbara leaf-nosed bat, Pilbara olive python, grey falcon, and some Migratory bird species. Both Major and Medium Drainage Lines, although not necessarily large in area, are common habitats within the immediate vicinity of the survey area and within the Pilbara region and hold higher value when they are sources of permanent water bodies, which was the case in some areas of the survey area.

Drainage Area/Floodplain habitat (~10% of the survey area) is of moderate value to a variety of fauna species, as it provides soft soils, grasslands, and woodlands. This habitat type is of low value to the target MNES species. However, it is potential habitat for greater bilby due to soft soils for burrowing, but no signs of this species were recorded.

Hardpan Plain habitat is widespread and common throughout the Pilbara but was limited within the survey area (~0.02%). While it was of moderate value to a wide spectrum of fauna species, it was of low value to the target MNES species. While the soft soils provide potential burrowing and foraging habitat for the greater bilby, no signs were recorded during the survey.

The Undulating Low Hills, Hillcrest/Hillslope, Stony/Sandy Plain, and Stony Plain habitats in the survey area provide fewer microhabitats for terrestrial fauna and are also more widespread and very common in the vicinity of the survey area.

5.2 Vertebrate Fauna Species

5.2.1 General Assemblage

Ninety-one vertebrate fauna, seven reptile, 66 bird and 18 mammal (including four introduced) species were recorded within the survey area during the current survey. The fauna assemblage recorded during the survey is considered typical of the Hammersley subregion and the broader Pilbara bioregion. This is a comparatively similar diversity of species when compared to other fauna assessments of the same surveying intensity in the area (Biologic 2011a). Larger and more intensive surveys from the region recorded a higher diversity of species with more diverse fauna habitat types present (Biota Environmental Sciences 2013, GHD Pty Ltd 2021a).

5.2.2 Significant Species

Of the 35 significant species identified in the desktop assessment, four species (including two species recorded during the survey) were considered to have a 'high' likelihood of occurrence. These were the western pebble-mound mouse (recorded), common sandpiper (recorded), Pilbara olive python, and peregrine falcon.

5.2.2.1 Target MNES Species

A summary of the suitable habitat and the likelihood of occurrence for MNES species within the survey area is provided in Table 12. Extensive survey effort was undertaken in the most suitable habitat types to provide an indication of greater bilby presence within the survey area, including six targeted 2 ha plot searches. Despite the survey effort, no greater bilbies were recorded in the most suitable habitat present. Given that no critical habitat and limited supporting habitat is present in the survey area and that there are a low number of previous records within the vicinity, there is a low likelihood of this species occurring in the survey area.

The threatened, specially protected and priority fauna database search results show close to 500 previous records of the northern quoll, with the majority recorded between the years 2016 and 2018, suggesting a resident population situated within ridgelines approximately 13 km to the north of the survey area where the majority of quolls were recorded (Department of Biodiversity, Conservation and Attractions 2022b). Rocky habitats such as ranges, escarpments, mesas, gorges, and breakaways provide critical habitats for the northern quoll. Although there was some Breakaway/Cliff habitat present in the survey area, it was not cave or shelter forming and was not considered critical habitat for the northern quoll. The drainage line habitats within the survey area provide supporting foraging and dispersal habitat, but despite 200 camera trapping nights and targeted searches within this supporting habitat, no signs of occupancy were observed. Due to supporting foraging and dispersal habitat being present and the large number of records to the north of the survey area, there is still a moderate likelihood this species may utilise the survey area for foraging and dispersal opportunities only.

Extensive survey effort for ghost bat has been undertaken historically and in recent years across the region, with 114 previous records occurring within proximity to the survey area, and a cluster of records occurring approximately 7 to 8 km (GHD Pty Ltd 2021a) and another 15 km south of the survey area (Department of Biodiversity, Conservation and Attractions 2022b), where it is assumed that there is suitable roosting habitat present. Similarly, 1,290 previous records of the Pilbara leaf-nosed bat were found within the vicinity of the survey area, with most clustered approximately 20 km north of the survey area, where it is assumed that there is suitable roosting habitat present. Both MNES bat species utilise deep, humid, climatically stable caves for diurnal and maternal roost sites, which are

typically associated with gorge/gully and breakaway habitats. No suitable caves were recorded during the survey and, given the lack of critical habitat due to no presence of caves within the Breakaway/Cliff habitat and no ghost bat calls recorded to date, no permanent population of either species is expected to persist in the survey area. However, there is supporting habitat present for foraging and dispersal for both species.

No previous Pilbara olive python records were identified within the survey area. The closest Pilbara olive python record occurs 500 m from the survey area (Biologic 2011b). There was one area identified as critical habitat for this species within the survey area: Breakaway/Cliff habitat, in combination with Wetland habitat, near Flatrocks. There was also substantial supporting habitat, including Medium Drainage Line, Major Drainage Line and Wetlands habitat. This species has a high likelihood of occurring in the survey area, due to several previous records in the vicinity and supporting habitat with permanent and semi-permanent water bodies occurring within the survey area.

None of the habitats within the survey area were considered critical habitat for the night parrot and no calls attributed to the night parrot were recorded from 12 ARU recording nights. In addition, the most prospective habitats, Hardpan Plain, Stony plain, Sandy/Stony Plain, Drainage Area/Floodplain, and Undulating Low Hills habitats, did not support old, large and unburnt *Triodia* clumps that are considered the primary requirement for roosting and nesting habitat (Department of Parks and Wildlife 2017). Therefore, it is considered unlikely that this species occurs in the survey area.

The Major Drainage Line and Wetland habitats (367.13 ha) within the survey area are considered critical habitat for the grey falcon due to the presence of tall *Eucalyptus/Corymbia* trees suitable for nesting, with 469.48 ha of supporting habitat including Drainage Area/Floodplain, Hardpan Plain, Sandy/Stony Plain, Stony Plain, Medium Drainage Line and Undulating Low Hills. Due to the nomadic nature of this species, previous records in the vicinity of the survey area and there being suitable habitat present, this species is considered to have a moderate likelihood of occurrence within the survey area.

5.2.2.2 Other Significant Species

Seven western pebble-mound mouse mounds were recorded during the current survey within stony habitat required to build their mounds and are likely to occur within the Hillcrest/Hillslope and Undulating Low Hills habitats of the survey area. However, these habitats are common and widespread within the local area and the wider Pilbara region.

The common sandpiper is a migratory shorebird which is widespread in small numbers, are found along all coastlines of Australia and in many areas inland, and concentrates in northern and western Australia (Department of Environment 2022b). This species was recorded during the current survey on three separate motion cameras and an opportunistic sighting. This species would likely utilise permanent and semi-permanent water bodies in the survey area, including the Wetland and some of the Major Drainage Line habitat. Significant water features include Flatrocks, which has a large wetland area, and the discharge pond, which has created a permanent wetland in the southern section of the survey area. This species would only be expected to occur as an occasional visitor to the survey area.

The peregrine falcon is a mobile species that occurs throughout Australia, with the exception of treeless deserts and dense forest (Birdlife Australia 2012). *Eucalyptus* lined drainage lines provide suitable perching and hunting habitat for this species, feeding primarily on small-medium sized birds. Pairs of peregrine falcon typically defend home ranges of 20 to 30 km^2 (Birdlife Australia 2012). Twenty previous records of this species were identified in the desktop assessment, with the closest record

less than 5 km from the survey area boundary. Suitable shelter and foraging habitat are present in Major and Medium Drainage Line habitats within the survey area. While this species was not recorded during the survey, it is considered highly likely to occur.

Table 12: Comparison of home range, habitat availability and likelihood of occurrence for Matters of National Environmental Significance (MNES) species identified in the desktop analysis for the survey area.

MNES species	Home range	Nearest record from survey area (km)	Critical habitat		Supporting habitat		Likelihood of occurrence	
			Type	Area (ha, %)	Type	Area (ha, %)	Pre-survey	Post-survey
Greater bilby (*Macrotis lagotis*) (VU; VU)	18 ha (females) to 316 ha (males)	~ 30 km	Sandplains and interdune corridors dominated by *Triodia* within home ranges	0 ha (0%)	Open tussock grassland on soft soils around sandplains and alluvial systems	218 ha (14%)	Moderate	Low
Northern quoll (*Dasyurus hallucatus*) (EN; EN)	35 ha, up to 100 ha during breeding season	~ 8 km	Low rocky hills, major drainage lines and woodland within home ranges	0 ha (0%)	Major drainage line facilitating foraging	1,151 ha (72%)	High	Moderate
Ghost bat (*Macroderma gigas*) (VU; VU)	>12 to 30 km	~ 14 km	Deep, humid caves generally in select geological formations	0 ha (0%)	Productive plains areas, isolated trees on plain outskirts, tree lined water courses and gorge/gully systems	597 ha (37%)	High	Moderate
Pilbara leaf-nosed bat (*Rhinonicteris aurantia* (Pilbara form)) (VU; VU)	>10 to 30 km from permanent/semi-permanent roosts	< 5 km	Deep, humid caves generally in select geological formations	0 ha (0%)	Plains and low hills with moderate two-layer non-complex vegetation structure	1,390 ha (87%)	High	Moderate
Pilbara olive python (*Liasis olivaceus barroni*) (VU; VU)	88 to 450 ha	~ 500m	Rocky outcrops in proximity to gorges and water holes	0.8 ha (0.05%)	Gullies, drainage lines and water courses	379 ha (23%)	High	High

MNES species	Home range	Nearest record from survey area (km)	Critical habitat		Supporting habitat		Likelihood of occurrence	
			Type	Area (ha, %)	Type	Area (ha, %)	Pre-survey	Post-survey
Night parrot (*Pezoporus occidentalis*) (EN; CR)	10 to 100s ha dependant on food availability	None identified	Old growth *Triodia* spp. in stony or sandplain environments	0 ha (0%)	Floodplains or clay pans with high vegetative or seed productivity	457 ha (28%)	Moderate	Low
Grey falcon (*Falco hypoleucos*) (VU; VU)	Undetermined, but likely to be larger than that of the peregrine falcon in the temperate zone (i.e. more than 100 km^2)	<20 km	Major drainage habitats with suitably sized Eucalypts (*E. camaldulensis*, *E. coolabah*) as potential nesting habitat, often in the abandoned nest of a raptor or corvid in trees	367.13 ha (23%)	Timbered lowland plains, particularly *Acacia* shrublands that are crossed by tree-lined water courses. Hunting has also been observed in treeless areas and the species frequents tussock grassland and open woodland	469.48 ha (29%)	High	Moderate

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Appendix A: Conservation Listed Fauna Categories, Habitat Condition Scales and Likelihood Criteria

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Table A.1: Categories of Threatened Ecological Communities (Department of Environment and Conservation 2013).

PD: Presumed Destroyed
An ecological community that has been adequately searched for but for which no representative occurrences have been located. The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future. An ecological community will be listed as presumed totally destroyed if there are no recent records of the community being extant **and either** of the following applies (A or B): A) Records within the last 50 years have not been confirmed despite thorough searches of known or likely habitats **or** B) All occurrences recorded within the last 50 years have since been destroyed.
CR : Critically Endangered
An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated. An ecological community will be listed as **Critically Endangered** when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future. This will be determined on the basis of the best available information, by it meeting **any one or more of** the following criteria (A, B or C): A) The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 90% **and either or both** of the following apply (i or ii): i) geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is imminent (within approximately 10 years); ii) modification throughout its range is continuing such that in the immediate future (within approximately 10 years) the community is unlikely to be capable of being substantially rehabilitated. B) Current distribution is limited, **and one or more** of the following apply (i, ii or iii): i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the immediate future (within approximately 10 years); ii) there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes; iii) there may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes. C) The ecological community exists only as highly modified occurrences that may be capable of being rehabilitated if such work begins in the immediate future (within approximately 10 years).

En: Endangered
An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future. An ecological community will be listed as **Endangered** when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. This will be determined on the basis of the best available information by it meeting **any one or more** of the following criteria (A, B, or C): A) The geographic range, and/or total area occupied, and/or number of discrete occurrences have been reduced by at least 70% since European settlement **and either or both** of the following apply (i or ii): i) the estimated geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is likely in the short term future (within approximately 20 years); ii) modification throughout its range is continuing such that in the short term future (within approximately 20 years) the community is unlikely to be capable of being substantially restored or rehabilitated. B) Current distribution is limited, **and one or more** of the following apply (i, ii or iii): i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the short-term future (within approximately 20 years); ii) there are few occurrences, each of which is small and/or isolated and all or most occurrences are very vulnerable to known threatening processes; iii) there may be many occurrences but total area is small and all or most occurrences are small and/or isolated and very vulnerable to known threatening processes. C) The ecological community exists only as very modified occurrences that may be capable of being substantially restored or rehabilitated if such work begins in the short-term future (within approximately 20 years).
VU: Vulnerable
An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range. An ecological community will be listed as **Vulnerable** when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction or significant modification in the medium to long-term future. This will be determined on the basis of the best available information by it meeting **any one or more of** the following criteria (A, B or C): A) The ecological community exists largely as modified occurrences that are likely to be capable of being substantially restored or rehabilitated. B) The ecological community may already be modified and would be vulnerable to threatening processes, is restricted in area and/or range and/or is only found at a few locations. C) The ecological community may be still widespread but is believed likely to move into a category of higher threat in the medium to long term future because of existing or impending threatening processes.

Reference: Department of Environment and Conservation 2013, Definitions, Categories and Criteria for Threatened and Priority Ecological Communities DEC (Parks and Wildlife), <https://www.dpaw.wa.gov.au/images/plants-animals/threatened-species/definitions_categories_and_criteria_for_threatened_and_priority_ecological_communities.pdf.>

Table A.2: Definitions and criteria for Threatened Ecological Communities (Department of Environment and Conservation 2013).

Three categories exist for listing Threatened Ecological Communities under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). An ecological community may be categorised as:

Categories of ecological communities	
Critically endangered	If, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future.
Endangered	If, at that time, it is not critically endangered and is facing a very high risk of extinction in the wild in the near future.
Vulnerable	If, at that time, it is not critically endangered or endangered, and is facing a high risk of extinction in the wild in the medium-term future.

Reference: Department of Environment and Conservation 2013, Definitions, Categories and Criteria for Threatened and Priority Ecological Communities DEC (Parks and Wildlife), <https://www.dpaw.wa.gov.au/images/plants-animals/threatened-species/definitions_categories_and_criteria_for_threatened_and_priority_ecological_communities.pdf.>

Table A.3: Conservation codes for Western Australian fauna (Department of Parks and Wildlife 2019).

Code	Conservation category	Definition
CR	Schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice under the *Biodiversity Conservation Act 2016*.	Fauna that is rare or likely to become extinct, as critically endangered fauna.
EN	Schedule 2 of the Wildlife Conservation (Specially Protected Fauna) Notice under the *Biodiversity Conservation Act 2016*.	Fauna that is rare or likely to become extinct, as endangered fauna.
VU	Schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice under the *Biodiversity Conservation Act 2016*.	Fauna that is rare or likely to become extinct, as vulnerable fauna.
EX	Schedule 4 of the Wildlife Conservation (Specially Protected Fauna) Notice under the *Biodiversity Conservation Act 2016*.	Fauna that is presumed to be extinct.
IA	Schedule 5 of the Wildlife Conservation (Specially Protected Fauna) Notice under the *Biodiversity Conservation Act 2016*.	Birds that are subject to international agreements relating to the protection of migratory birds.
CD	Schedule 6 of the Wildlife Conservation (Specially Protected Fauna) Notice under the *Biodiversity Conservation Act 2016*.	Fauna that are of special conservation need being species dependent on ongoing conservation intervention.
OS	Schedule 7 of the Wildlife Conservation (Specially Protected Fauna) Notice under the *Biodiversity Conservation Act 2016*.	Declared to be fauna that is in need of special protection, otherwise than for the reasons mentioned.

Reference: Department of Parks and Wildlife 2019, *Conservation Codes For Western Australian flora and fauna*, The Government of Western Australia.

Table A.4: Priority species under Western Australian *Biodiversity Conservation Act 2016* (Department of Parks and Wildlife 2019).

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

P1: Priority One – Poorly known taxa
Taxa that are known from one or a few collections or sight records (generally less than five), all on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, Shire, Westrail and Main Roads WA road, gravel and soil reserves, and active mineral leases and under threat of habitat destruction or degradation. Taxa may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes.
P2: Priority Two – Poorly known taxa
Taxa that are known from one or a few collections or sight records, some of which are on lands not under imminent threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc. Taxa may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes.
P3: Priority Three – Poorly known taxa
Taxa that are known from collections or sight records from several localities not under imminent threat, or from few but widespread localities with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Taxa may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and known threatening processes exist that could affect them.
P4: Priority Four: Rare, near threatened and other taxa in need of monitoring
(a) Rare. Taxa that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These taxa are usually represented on conservation lands. (b) Near Threatened. Taxa that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. (c) Taxa that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.
P5: Priority Five: Conservation dependent taxa
Taxa that are not threatened but are subject to a specific conservation program, the cessation of which would result in the taxa becoming threatened within five years.

Reference: Department of Parks and Wildlife 2019, *Conservation Codes For Western Australian flora and fauna*, The Government of Western Australia.

Table A.5: Categories and definitions for EPBC Act listed fauna species.

Conservation category	Definition
Extinct	Taxa with no reasonable doubt that the last member of the species has died.
Extinct in the wild	Taxa known to survive only in cultivation, in captivity or as a naturalized population well outside its past range; or it has not been recorded in its known and/or expected habitat, at appropriated seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
Critically endangered (CR)	Taxa facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
Endangered (EN)	Taxa are not critically endangered; and are facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
Vulnerable (VU)	Taxa are not critically endangered or endangered; and are facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.
Conservation dependent (CD)	Taxa are the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered or critically endangered; or the following subparagraphs are satisfied: ○ the taxa is a species of fish; ○ the taxa is the focus of a management plan that provides management actions necessary to stop the decline of, and support the recovery of, the taxa so that its chances of long term survival in nature are maximized; ○ the management plan is in force under a law of the Commonwealth or of a State or Territory; ○ Cessation of the management plan would adversely affect the conservation status of the taxa Fish includes all taxa of bony fish, sharks, rays, crustaceans, molluscs and other marine organisms, but does not include marine mammals/reptiles.

Conservation category	Definition
Migratory (Mi)	Taxa are considered migratory species on International Agreements; i) if they are native to Australia and are included in the appendices to the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals Appendices I and II); ii) all migratory species included in annexes established under the Japan-Australia Migratory Bird Agreement (JAMBA) and the China-Australia Migratory Bird Agreement (CAMBA); and iii) Are native, migratory species identified in a list established under, or an instrument made under, an international agreement approved by the Minister, such as the Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA).

Note: CD and Mi are only related to conservation significant fauna

Table A.6: Criteria used to define likelihood occurrence of significant fauna species.

Likelihood of occurrence	Pre-survey	Post-survey
Recorded	N/A	Species or evidence of species recorded during survey.
High	Species has been recorded within the survey area or within 20 km of the survey area and preferred habitat appears to be present.	Core or preferred habitats present in the survey area which are abundant and/or high quality condition. OR Species is known to be cryptic and may not have been detected despite adequate survey effort and suitable habitat present within the survey area. OR Species or evidence of species recorded within the survey area however doubt remains over the taxonomic identification, validity of record.
Moderate	Species has not been recorded from within the survey area, however species has been recorded within the prescribed database search area and suitable habitat appears to be present.	Core or highly suitable habitats present in the survey area, however non-cryptic species that was not detected despite adequate survey effort. OR Core or preferred habitats present in the survey area are mainly in poor or modified condition.
Low	Species recorded from within the prescribed database search area but suitable habitat does not appear to be present.	Species has not been recorded in the survey area despite adequate survey effort. OR Species dependent on specific habitats that do not occur in the survey area. OR Species considered locally extinct.

Table A.7: Fauna habitat condition scale (Thompson and Thompson 2010).

Habitat condition	Condition description
High Quality Fauna Habitat (1.0)	These areas closely approximate the vegetation mix and quality that would have been in the area prior to any human induced disturbance. The habitat has connectivity with other habitats and is likely to support the most natural vertebrate fauna assemblage.
Very Good Fauna Habitat (0.8)	These areas show minimal signs of human induced disturbance (e.g. grazing, clearing, fragmentation, weeds) and retain almost all of the characteristics of the habitat had it not been disturbed. The habitat has connectivity with other habitats, and fauna assemblages in these areas are likely to be minimally effected by disturbance.
Good Fauna Habitat (0.6)	These areas show signs of human induced disturbance (e.g. grazing, clearing, fragmentation, weeds) but generally retain many of the characteristics of the habitat had it not been disturbed. The habitat still retains some connectivity with other habitats but fauna assemblages in these areas are likely to be affected by disturbance. Fauna assemblages in these areas are likely to be similar to what might be expected in this habitat.
Disturbed Fauna Habitat (0.4)	These areas show signs of human induced significant disturbance (e.g. mining, clearing, tracks and roads). Many of the trees, shrubs and undergrowth have died or have been cleared. These areas may be in the early succession and regeneration stages. Areas may show signs of significant grazing, contain an abundance of weeds or have been damaged by vehicles or machinery. Habitats are fragmented or have limited connectivity with other fauna habitats. Fauna assemblages in these areas are likely to differ significantly from what might be expected in the area had the disturbance not occurred.
Highly Degraded Fauna Habitat (<0.2)	These areas often have a significant human induced loss of vegetation, and / or a large number of vehicle tracks and / or have been completely cleared, and / or areas have been heavily grazed or farmed. There is limited or no fauna habitat connectivity. Fauna assemblages in these areas are likely to differ significantly from what existed prior to the disturbance, and are often depleted compared to what existed prior to the disturbance.

Reference: Thompson, SA & Thompson, GG 2010, *Terrestrial Vertebrate Fauna Assessments for Ecological Impact Assessment*, Terrestrial Ecosystems, Mt Claremont

Table A.8: Suitability/significance of habitat ranking criteria for the six target Matters of National Environmental Significance (MNES) species based on DAWE (2022).

Species	Critical habitat (a)	Supporting habitat (b)	Limited habitat (c)
Greater bilby (*Macrotis lagotis*)	• Denning and foraging within the home range (18 ha (female) to 316 ha (male)) of stony sandplain, sandplain and/ or recently burnt sandplain. • Denning and foraging within the home range of interdune corridors or stony plains dominated by *Triodia* spp. and *Acacias*. • Denning and foraging within the home range surrounding salt lakes that are dominated with samphire and or *Melaleuca* habitats. • Denning and foraging within the home range of paleo-drainage systems habitat.	Habitat important for foraging including: • Open tussock grasslands on uplands and hills. • Mulga woodland/ shrubland growing on ridges and rises. • Hummock grassland growing on sand plains and dunes, drainage systems, saltlake systems and other alluvial areas. • Laterite and rock feature substrates that support *Acacia kempeana*, *Acacia hilliana* and *Acacia rhodophylla* shrub species and spinifex hummocks with open runways between the hummocks for easy movements.	Habitat that has limited burrowing capacity for the greater bilby.
Pilbara olive python (*Liasis olivaceus barroni*)	Rocky outcrops in proximity to deep gorges, gullies, and water holes within home range (88 – 450 ha).	• Deep gorges, gullies, waterholes, drainage lines and watercourses. • Under rock piles, on top of rocks or under spinifex to ambush prey.	Habitat that has limited sheltering and foraging capacity with no permanent or semi-permanent water.

Species	Critical habitat (a)	Supporting habitat (b)	Limited habitat (c)
Northern quoll *(Dasyurus hallucatus)*	• Denning and foraging habitat within the home range (35 hectares (ha) to >100 ha in breeding season) of low rocky hills, gorges, escarpments, ranges, breakaways and boulder fields. • Denning and foraging within the home range of major drainage lines and tree lined creeks. • Denning and foraging within the home range of structurally diverse woodland or forest. • Offshore islands.	• Variable foraging habitats within the home range and dispersal habitats that include: o Drainage lines that act as dispersal corridors o Basalt hills, mesas, high and low plateaus and lower slopes o Stony plains supporting hard or soft spinifex grasslands o Sandstone and dolomite hills and ridges, shrublands, sandy plains, clay pans and tussock grasslands o Coastal fringes including dunes islands and beaches	Habitat that has limited sheltering and foraging capacity and not connected to potential denning/shelter and foraging habitat.
Ghost bat (*Macroderma gigas*)	• Category 1 - Maternity/Diurnal roost caves with permanent Ghost bat occupancy. These may be abandoned underground mines. • Category 2 - Maternity/Diurnal roost caves with regular (but not continuous) Ghost bat occupancy that is capable of supporting one or more reproducing females and their habitat. These may be abandoned underground mines. • Category 3 - Diurnal roost caves with occasional occupancy if adjacent to one or Diurnal roost caves with occasional occupancy if adjacent to one or more Category 2 cave(s). These may be abandoned underground mines. • Rocky outcrops in geological formations such as the following: o Brockman and Marra Mamba banded iron formation (BIF) o Robe Pisolite channel iron deposit (CID) geology o ironstone geology and granite rockpiles. • Foraging habitat within 12 km radius of these caves or 1,200 ha of habitat surrounding each of these caves.	• Category 3 - Diurnal roost caves with occasional occupancy if isolated from Category 1 and 2 caves. • Category 4 – shallow caves, shelters and deep overhangs that support opportunistic usage for resting and feeding. • Productive plain areas with thin mature woodland over patchy or clumped tussock or hummock grass (*Triodia* spp.) on sand or stony ground. • Isolated trees and trees on the edge of thin thickets on the plains. • Trees along the edges of watercourse woodlands. • Prefer gully or gorge system that opens onto a plain or riparian line.	Habitat that has limited ecological value but may provide capacity for transitory movement across the landscape and/or limited foraging potential.

Pilbara Leaf-nosed bat (*Rhinonicteris aurantia*)	• Roosting habitat
	  o Category 1 Cave - Permanent diurnal roost and maternity roost with seasonal presence of young.
	  o Category 2 – Permanent/semi-permanent possible breeding roosts that are used during some part of the breeding cycle (but without the proven presence of young).
	  o Category 3 - Transitory diurnal roosts, occupied part of the year only, outside the breeding season (i.e. April-June) that facilitate long distance dispersal.
	• Permanent water sources within 8.7 km of a known Priority/Category 1-3 roosts.
	• Foraging habitat within 10 km (1,000 ha) radius of these caves that include:
	  o Plain and low hill habitat that includes watercourses and other sites with semi-permanent or permanent surface water (natural or anthropogenic). Three layers in vegetation structure.
	  o Mesa side or long ridge line with south, east or west facing, deeply incised gullies with vertical walls. Semi-permanent or permanent water pools present. Vegetation is complex. Also north facing gullies with permanent water.
	  o Deep wet 'open' gorge with hills to the side. Wet 'closed' gorge with one or 2 vertical walls. Complex 3-layer, dense vegetation structure. Semi-permanent or permanent water pools present. (priority 1 foraging habitat type)
	• Rocky outcrop geological formations such as the following:
	  o banded Iron Formations (Hamersley Group ironstone terrain)
	  o dolerite/gabbro formations
		• Priority/Category 4- Nocturnal refuge that are occupied at night for resting, feeding or other purpose, with perching not a requirement, which can be moderately deep caves and shallow abandoned mines.
		• Plains and low hills with three-layer, complex vegetation structure. Or moderate two-layer non-complex vegetation structure. Includes ephemeral watercourse.
		• Mesa side or long ridge line with north facing, deeply incised gullies with vertical walls. Or Mesa side or long ridge line with deeply incised gullies in weathered strata (45º sloping walls). Caves and overhangs present. Shrubs and thin tree cover in gully base. Ephemeral watercourse in gully or nearby. (priority 2 foraging habitat).
		• Dry deeply incised gorge into a ridge or mountain. Complex 3 layer vegetation structure. Ephemeral water course. (priority 1 foraging habitat). Large watercourses, around rocky outcrop, gullies, gorges and over pools.
		• Rocky outcrop areas of exposed rock at the top of rocky outcrop and mesa hills that contain caves and overhangs, and boulder piles in the granite terrains (priority 3 foraging habitat).
		• Major watercourses that support riparian vegetation on flat land plus the main gravelly or sandy channel of the river bed, sometimes containing pools that persist for weeks or months, and generally supporting higher productivity of biomass than the surrounding habitats. (priority 4 foraging habitat).
		• Open grassland and woodland dominated by *Triodia*, on lowland plains, colluvial slopes and hilltops. (priority 5 foraging habitat)
		• Large watercourses, around rocky outcrop, gullies, gorges and over pools
			Habitat that has limited ecological value but may provide capacity for transitory movement across the landscape and/or limited foraging potential.

Species	Critical habitat (a)	Supporting habitat (b)	Limited habitat (c)
	• granite top rockpiles in the eastern Pilbara		
Night parrot (*Pezoporus occidentalis*)	• Nesting and foraging in areas that can support multiple to many occurrences of dense roosting habitat such as old-growth dense hummock-forming spinifex (*Triodia* spp.), thickets of lignum, or dense shrubby samphire. • Nesting and foraging in old-growth spinifex (*Triodia* spp.) in close proximity to ephemeral water sources, which may be associated with the following: o Hummock grasslands (unburnt) in stony or sandplain environments. o Paleo-drainage features in a landscape mosaic with spinifex (*Astrebla* spp.) and *Acacia aneura* (Mulga) woodland, o Treeless areas and bare gibber.	• Areas that are likely to be of relatively high vegetative or seed productivity such as run-on areas, floodplains, salt or clay pans, salt-lake margins. • Paleo-drainage systems, salt lakes and pans. • Permanent or ephemeral sources of free water, or areas where high soil moisture ephemerally or permanently support vegetation that offers a source of water. • Flyways varying from river and creek drainage systems, surrounding dune-fields, forb–grasslands on mainly ironstone gravel-covered plains, low ranges and low dissected tablelands supporting sparse shrublands, undulating stony clay plains supporting Mitchell Grass, and Gidgee.	Habitat that has limited roosting and foraging potential for the night parrot.
Grey falcon (*Falco hypoleucos*)	• Major drainage habitats with suitably size Eucalypts (*Eucalyptus camaldulensis*, E. *coolabah*) as potential nesting habitat, often in the abandoned nest of a raptor or corvid in trees.	• Timbered lowland plains, particularly *Acacia* shrublands that are crossed by tree-lined water courses. • The species has been observed hunting in treeless areas and frequents tussock grassland and open woodland.	Habitat that has limited nesting and foraging potential for the grey falcon.

Reference: Department of Agriculture, Water and the Environment (DAWE) (2022, in draft), Interim guidelines for Pilbara MNES critical and supporting habitat characterisation, DAWE, Canberra.

Appendix B: Fauna Species Lists

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Table B.1: Amphibian species list – results of database searches, literature reviews and Astron survey results.

Scientific Name	Common Name	Introduced	Conservation Codes			NatureMap	ALA	EPBC PMST	DBCA T and P	Previous Surveys	Current Survey
			EPBC Act	BC Act	DBCA Priority Fauna List						
Pelodryadidae											
Cyclorana maini	Sheep frog					X				X	
Litoria rubella	Little red tree frog					X				X	
Limnodynastidae											
Neobatrachus aquilonius	Northern burrowing frog					X					
Neobatrachus sutor	Shoemaker frog					X					
Myobatrachidae											
Pseudophryne douglasi	Gorge toadlet					X				X	
Uperoleia russelli	Northwest toadlet					X				X	
Uperoleia saxatilis	Pilbara toadlet					X				X	

Table B.2: Reptile species list – results of database searches, literature reviews and Astron survey results.

Scientific Name	Common Name	Introduced	Conservation Codes			NatureMap	ALA	EPBC PMST	DBCA T and P	Previous Surveys	Current Survey
			EPBC Act	BC Act	DBCA Priority Fauna List						
Carphodactylidae											
Nephrurus wheeleri	Southern banded knob-tailed gecko					X					
Underwoodisaurus milii	Southern barking gecko					X					
Underwoodisaurus seorsus	Pilbara barking gecko				P2	X			X		
Diplodactylidae											
Crenadactylus ocellatus	South-western clawless gecko					X				X	
Diplodactylus conspicillatus	Variable fat-tailed gecko					X				X	
Diplodactylus fulleri	Lake disappointment ground gecko				P2	X					
Diplodactylus pulcher						X					
Diplodactylus savagei	Southern Pilbara beak-faced gecko					X				X	
Lucasium stenodactylus										X	
Lucasium wombeyi						X				X	
Oedura fimbria	Western marbled velvet gecko					X				X	
Rhynchoedura ornata	Western beaked gecko					X				X	
Strophurus elderi						X				X	
Strophurus jeanae						X					
Strophurus wellingtonae						X				X	
Gekkonidae											

Scientific Name	Common Name	Introduced	Conservation Codes			NatureMap	ALA	EPBC PMST	DBCA T and P	Previous Surveys	Current Survey
			EPBC Act	BC Act	DBCA Priority Fauna List						
Christinus marmoratus	Marbled gecko									X	
Gehyra micra	Small Pilbara spotted rock gehyra									X	
Gehyra montium						X					
Gehyra pilbara						X				X	
Gehyra punctata						X				X	
Gehyra purpurascens						X				X	
Gehyra unguiculata	Crescent-marked Pilbara gehyra									X	
Gehyra variegata	Variegated gehyra					X				X	
Heteronotia binoei	Bynoe's gecko					X				X	
Heteronotia spelea	Pilbara cave gecko					X				X	
Pygopodidae											
Delma butleri						X				X	
Delma elegans						X					
Delma nasuta						X				X	
Delma pax						X				X	
Delma tincta						X	X			X	
Lialis burtonis						X	X			X	
Pygopus nigriceps						X				X	
Agamidae											
Ctenophorus caudicinctus	Western ring-tailed dragon					X				X	X

Scientific Name	Common Name	Introduced	Conservation Codes			NatureMap	ALA	EPBC PMST	DBCA T and P	Previous Surveys	Current Survey
			EPBC Act	BC Act	DBCA Priority Fauna List						
Ctenophorus isolepis isolepis	Central military dragon						X			X	X
Ctenophorus nuchalis	Central netted dragon					X					
Ctenophorus reticulatus	Western netted dragon					X					
Ctenophorus scutulatus						X					
Diporiphora valens	Southern Pilbara tree dragon					X				X	
Gowidon longirostris	Long-nosed dragon									X	X
Pogona minor minor	Western bearded dragon									X	
Tympanocryptis cephalus	Coastal pebble-mimic dragon					X					
Scincidae											
Carlia amax										X	
Carlia munda						X				X	
Carlia triacantha						X					
Cryptoblepharus buchananii						X					
Cryptoblepharus plagiocephalus						X				X	
Cryptoblepharus ustulatus						X				X	
Ctenotus ariadnae						X					
Ctenotus duricola	Eastern Pilbara lined *Ctenotus*					X				X	
Ctenotus hanloni						X				X	
Ctenotus helenae						X	X			X	

Scientific Name	Common Name	Introduced	Conservation Codes			NatureMap	ALA	EPBC PMST	DBCA T and P	Previous Surveys	Current Survey
			EPBC Act	BC Act	DBCA Priority Fauna List						
Ctenotus inornatus						X				X	
Ctenotus leonhardii						X				X	
Ctenotus pallasotus	Western Pilbara lined *Ctenotus*					X					
Ctenotus pantherinus							X			X	X
Ctenotus quattuordecimlineatus						X					
Ctenotus robustus						X					
Ctenotus rubicundus						X				X	
Ctenotus rufescens						X					
Ctenotus rutilans						X				X	
Ctenotus saxatilis	Rock *Ctenotus*					X				X	
Ctenotus schomburgkii						X				X	
Ctenotus serventyi						X					
Cyclodomorphus melanops melanops										X	
Egernia cygnitos	Western Pilbara spiny-tailed skink					X					
Egernia depressa	Southern pygmy spiny-tailed skink					X				X	
Egernia formosa						X				X	
Eremiascincus isolepis						X				X	
Eremiascincus pallidus	Western narrow-banded skink					X					
Eremiascincus richardsonii	Broad-banded sand swimmer					X				X	

Scientific Name	Common Name	Introduced	Conservation Codes			NatureMap	ALA	EPBC PMST	DBCA T and P	Previous Surveys	Current Survey
			EPBC Act	BC Act	DBCA Priority Fauna List						
Lerista amicorum						X					
Lerista bipes						X				X	
Lerista chalybura										X	
Lerista jacksoni						X					
Lerista labialis						X					
Lerista macropisthopus remota					P2				X		
Lerista muelleri						X				X	
Lerista neander						X				X	
Lerista timida						X				X	
Lerista verhmens						X					
Liopholis kintorei	Great desert skink		VU	VU				X			
Menetia greyii						X				X	
Morethia ruficauda exquisita						X				X	X
Proablepharus reginae						X					
Tiliqua multifasciata	Central bluetongue					X	X			X	
Varanidae											
Varanus acanthurus	Spiny-tailed goanna					X	X			X	
Varanus brevicauda	Short-tailed pygmy goanna					X	X				
Varanus bushi	Pilbara mulga goanna					X					

Scientific Name	Common Name	Introduced	Conservation Codes			NatureMap	ALA	EPBC PMST	DBCA T and P	Previous Surveys	Current Survey
			EPBC Act	BC Act	DBCA Priority Fauna List						
Varanus caudolineatus						X					
Varanus eremius	Pygmy desert goanna					X					
Varanus giganteus	Perentie					X				X	
Varanus gilleni	Pygmy mulga goanna					X				X	
Varanus gouldii	Bungarra or sand goanna					X					
Varanus hamersleyensis	Southern Pilbara rock goanna					X				X	X
Varanus panoptes rubidus										X	
Varanus pilbarensis	Northern Pilbara rock goanna					X				X	
Varanus tristis	Racehorse goanna					X				X	X
Typhlopidae											
Anilios ammodytes										X	
Anilios ganei					P1					X	
Anilios grypus						X	X			X	
Anilios hamatus						X				X	
Pythonidae											
Antaresia childreni	Children's python									X	
Antaresia perthensis	Pygmy python					X				X	
Aspidites melanocephalus	Black-headed python					X				X	
Liasis olivaceus barroni	Pilbara olive python		VU	VU			X	X	X	X	
Elapidae											

Scientific Name	Common Name	Introduced	Conservation Codes			NatureMap	ALA	EPBC PMST	DBCA T and P	Previous Surveys	Current Survey
			EPBC Act	BC Act	DBCA Priority Fauna List						
Acanthophis wellsi	Pilbara death adder					X				X	
Brachyurophis approximans						X	X			X	
Demansia psammophis cupreiceps										X	
Demansia rufescens	Rufous whipsnake					X				X	
Furina ornata	Moon snake					X				X	
Pseudechis australis	Mulga snake					X				X	
Pseudonaja mengdeni	Western brown snake					X				X	
Pseudonaja modesta	Ringed brown snake					X	X				
Pseudonaja nuchalis	Gwardar, northern brown snake					X				X	
Suta fasciata	Rosen's snake					X				X	
Suta monachus										X	
Suta punctata	Spotted snake					X					
Vermicella snelli						X					

Table B.3: Bird species list – results of database searches, literature reviews and Astron survey results.

Scientific Name	Common Name	Introduced	Conservation Codes			NatureMap	ALA	EPBC PMST	DBCA T and P	Birdata	Previous Surveys	Current Survey
			EPBC Act	BC Act	DBCA Priority Fauna List							
Dromaiidae												
Dromaius novaehollandiae	Emu					X	X			X	X	
Anatidae												
Anas gracilis	Grey teal					X	X			X		X
Anas rhynchotis	Australasian shoveler					X						
Anas superciliosa	Pacific black duck					X	X			X	X	X
Aythya australis	Hardhead						X			X		X
Chenonetta jubata	Australian wood duck						X			X		
Cygnus atratus	Black swan						X			X		
Dendrocygna arcuata	Wandering whistling duck						x					
Dendrocygna eytoni	Plumed whistling duck					X	X			X		
Malacorhynchus membranaceus	Pink-eared duck					X	X			X		
Stictonetta naevosa	Freckled duck									X		
Tadorna tadornoides	Australian shelduck						X			X		
Phasianidae												
Coturnix pectoralis	Stubble quail					X	X			X	X	
Synoicus ypsilophorus	Brown quail					X	X				X	X
Procellariidae												

Scientific Name	Common Name	Introduced	Conservation Codes			NatureMap	ALA	EPBC PMST	DBCA T and P	Birdata	Previous Surveys	Current Survey
			EPBC Act	BC Act	DBCA Priority Fauna List							
Macronectes giganteus	Southern giant petrel		EN & MI	MI		X			X			
Podicipedidae												
Podiceps cristatus	Great crested grebe						X					
Poliocephalus poliocephalus	Hoary-headed grebe					X	X			X		
Tachybaptus novaehollandiae	Australasian grebe (black-throated grebe)						X			X		
Ciconiidae												
Ephippiorhynchus asiaticus	Black-necked stork						X					
Threskiornithidae												
Platalea regia	Royal spoonbill						X			X		
Platalea flavipes	Yellow-billed spoonbill						X			X		
Plegadis falcinellus	Glossy *Ibis*		MI	MI			X			X		
Threskiornis moluccus	Australian white ibis						X					
Threskiornis spinicollis	Straw-necked *Ibis*					X	X			X		
Ardeidae												
Ardea ibis	Cattle egret						X					
Ardea intermedia	Intermediate egret						X					
Ardea modesta	Eastern great egret	-				X	X				X	
Ardea pacifica	White-necked Heron					X	X			X	X	X
Egretta garzetta	Little egret						X			X		

Scientific Name	Common Name	Introduced	Conservation Codes			NatureMap	ALA	EPBC PMST	DBCA T and P	Birdata	Previous Surveys	Current Survey
			EPBC Act	BC Act	DBCA Priority Fauna List							
Egretta novaehollandiae	White-faced Heron					X	X			X	X	X
Ixobrychus flavicollis	Black bittern					X						
Nycticorax caledonicus	Nankeen night-heron					X	X			X	X	
Pelecanidae												
Pelecanus conspicillatus	Australian pelican					X	X			X	X	
Phalacrocoracidae												
Microcarbo melanoleucos	Little pied cormorant									X	X	X
Phalacrocorax carbo	Great cormorant						X					
Phalacrocorax sulcirostris	Little black cormorant					X	X			X	X	X
Phalacrocorax varius	Pied cormorant (Australian pied cormorant)					X				X	X	
Anhingidae												
Anhinga novaehollandiae	Australasian darter					X	X			X	X	
Accipitridae												
Accipiter cirrocephalus	Collared sparrowhawk					X	X			X	X	
Accipiter fasciatus	Brown goshawk					X	X			X	X	
Aquila audax	Wedge-tailed eagle					X	X			X	X	
Circus approximans	Swamp harrier					X				X		X
Circus assimilis	Spotted harrier					X	X			X	X	
Elanus axillaris	Australian black-shouldered kite					X	X			X		

Scientific Name	Common Name	Introduced	Conservation Codes			NatureMap	ALA	EPBC PMST	DBCA T and P	Birdata	Previous Surveys	Current Survey
			EPBC Act	BC Act	DBCA Priority Fauna List							
Elanus scriptus	Letter-winged kite				P4	X			X			
Haliaeetus leucogaster	White-bellied sea-eagle									X		
Haliastur sphenurus	Whistling kite					X	X			X	X	X
Hamirostra melanosternon	Black-breasted buzzard					X	X			X	X	X
Hieraaetus morphnoides	Little eagle					X	X			X	X	X
Lophoictinia isura	Square-tailed kite						X			X	X	
Milvus migrans	Black kite					X	X			X	X	X
Otididae												
Ardeotis australis	Australian bustard					X				X	X	
Rallidae												
Fulica atra	Eurasian coot						X			X		
Hypotaenidia philippensis	Buff-banded rail									X		
Porphyrio porphyrio	Purple swamphen					X						
Porzana tabuensis	Spotless crake					X	X					
Tribonyx ventralis	Black-tailed native-hen						X			X		
Turnicidae												
Turnix velox	Little button-quail					X	X			X	X	X
Burhinidae												
Burhinus grallarius	Bush stone-curlew					X	X			X	X	
Recurvirostridae												

Scientific Name	Common Name	Introduced	Conservation Codes			NatureMap	ALA	EPBC PMST	DBCA T and P	Birdata	Previous Surveys	Current Survey
			EPBC Act	BC Act	DBCA Priority Fauna List							
Cladorhynchus leucocephalus	Banded stilt						X					
Himantopus himantopus	Black-winged stilt					X						
Recurvirostra novaehollandiae	Red-necked avocet									X		
Charadriidae												
Charadrius ruficapillus	Red-capped plover						X			X		
Charadrius veredus	Oriental plover		MI	MI			X	X				
Elseyornis melanops	Black-fronted dotterel					X	X			X	X	X
Erythrogonys cinctus	Red-kneed dotterel					X	X			X		
Rostratulidae												
Rostratula australis	Australian painted snipe		EN	EN			X	X		X		
Scolopacidae												
Actitis hypoleucos	Common sandpiper		MI	MI				X			X	X
Calidris acuminata	Sharp-tailed sandpiper		MI	MI				X				
Calidris ferruginea	Curlew sandpiper		CR & MI	CR & MI				X				
Calidris melanotos	Pectoral sandpiper		MI	MI				X				
Tringa nebularia	Common greenshank		MI	MI		X			X		X	
Laridae												
Chlidonias hybrida	Whiskered tern						X			X		
Gelochelidon nilotica	Gull-billed tern		MI	MI					X			

Scientific Name	Common Name	Introduced	Conservation Codes			NatureMap	ALA	EPBC PMST	DBCA T and P	Birdata	Previous Surveys	Current Survey
			EPBC Act	BC Act	DBCA Priority Fauna List							
Hydroprogne caspia	Caspian tern		MI	MI					X	X		
Columbidae												
Geopelia cuneata	Diamond dove					X	X			X	X	X
Geopelia striata placida	Peaceful dove					X	X				X	X
Geophaps plumifera ferruginea	Spinifex pigeon					X	X			X	X	X
Ocyphaps lophotes	Crested pigeon					X	X			X	X	X
Phaps chalcoptera	Common bronzewing					X	X			X	X	X
Phaps histrionica	Flock bronzewing (flock pigeon)						X			X		
Cuculidae												
Cacomantis pallidus	Pallid cuckoo					X	X				X	
Chalcites basalis	Horsfield's bronze cuckoo						X			X	X	X
Chalcites osculans	Black-eared cuckoo						X	X		X	X	
Centropodidae												
Centropus phasianinus	Pheasant coucal					X	X			X	X	
Tytonidae												
Tyto novaehollandiae	Australian masked owl (masked owl)						X					
Tyto javanica	Eastern barn owl						X				X	
Strigidae												
Ninox connivens	Barking owl						X				X	

Scientific Name	Common Name	Introduced	Conservation Codes			NatureMap	ALA	EPBC PMST	DBCA T and P	Birdata	Previous Surveys	Current Survey
			EPBC Act	BC Act	DBCA Priority Fauna List							
Ninox connivens connivens	Barking owl				P3				X			
Ninox novaeseelandiae	Southern boobook					X					X	
Podargidae												
Podargus strigoides	Tawny frogmouth					X				X	X	
Caprimulgidae												
Eurostopodus argus	Spotted nightjar					X	X			X	X	
Aegothelidae												
Aegotheles cristatus	Australian owlet-nightjar					X	X			X	X	X
Apodidae												
Apus pacificus	Fork-tailed swift (pacific swift)		MI	MI		X	X	X	X	X	X	
Alcedinidae												
Dacelo leachii leachii	Blue-winged kookaburra					X	X			X	X	X
Todiramphus pyrrhopygius	Red-backed kingfisher					X	X			X	X	X
Todiramphus sanctus	Sacred kingfisher					X	X			X	X	X
Meropidae												
Merops ornatus	Rainbow bee-eater					X	X	X		X	X	X
Falconidae												
Falco berigora	Brown falcon					X	X			X	X	X
Falco cenchroides	Australian kestrel (nankeen kestrel)					X	X			X	X	X

Scientific Name	Common Name	Introduced	Conservation Codes			NatureMap	ALA	EPBC PMST	DBCA T and P	Birdata	Previous Surveys	Current Survey
			EPBC Act	BC Act	DBCA Priority Fauna List							
Falco hypoleucos	Grey falcon			VU		X	X	X	X			
Falco longipennis	Australian hobby					X	X			X	X	
Falco peregrinus	Peregrine falcon			OS		X			X	X	X	
Falco subniger	Black falcon						X					
Cacatuidae												
Cacatua sanguinea	Little corella					X	X			X	X	X
Eolophus roseicapilla	Galah						X			X	X	X
Nymphicus hollandicus	Cockatiel					X	X			X	X	X
Psittacidae												
Barnardius zonarius zonarius	Australian ringneck					X	X			X	X	X
Melopsittacus undulatus	Budgerigar					X	X			X	X	X
Neophema elegans	Elegant parrot						X					
Neopsephotus bourkii	Bourke's parrot					X	X			X	X	
Pezoporus occidentalis	Night parrot		EN	CR			X	X				
Ptilonorhynchidae												
Chlamydera guttatus	Western bowerbird						X				X	X
Climacteridae												
Climacteris melanura	Black-tailed treecreeper						X				X	
Maluridae												
Amytornis striatus	Striated grasswren					X	X			X	X	

Scientific Name	Common Name	Introduced	Conservation Codes			NatureMap	ALA	EPBC PMST	DBCA T and P	Birdata	Previous Surveys	Current Survey
			EPBC Act	BC Act	DBCA Priority Fauna List							
Malurus assimilis assimilis	Purple-backed fairy-wren						X				X	X
Malurus leucopteris leuconotus	White-winged fairy-wren					X	X			X	X	X
Malurus splendens	Splendid fairy-wren					X	X			X	X	
Stipiturus ruficeps	Rufous-crowned emu-wren					X	X			X	X	
Meliphagidae												
Acanthagenys rufogularis	Spiny-cheeked honeyeater					X	X			X	X	
Certhionyx variegatus	Pied honeyeater					X	X			X	X	
Epthianura aurifrons	Orange chat						X			X		
Epthianura tricolor	Crimson chat					X	X			X	X	
Gavicalis virescens virescens	Singing honeyeater					X	X			X	X	X
Grantiella picta	Painted honeyeater					X						
Conopophila whitei	Grey honeyeater						X			X		
Lichmera indistincta	Brown honeyeater					X	X			X	X	
Manorina flavigula	Yellow-throated miner					X	X			X	X	X
Melithreptus gularis	Black-chinned honeyeater					X	X			X	X	
Ptilotula keartlandi	Grey-headed honeyeater					X	X			X	X	X
Ptilotula penicillata	White-plumed honeyeater					X	X			X	X	X
Ptilotula plumula	Grey-fronted honeyeater						X			X		
Purnella albifrons	White-fronted honeyeater					X	X			X	X	
Sugomel niger	Black honeyeater					X	X			X	X	

Scientific Name	Common Name	Introduced	Conservation Codes			NatureMap	ALA	EPBC PMST	DBCA T and P	Birdata	Previous Surveys	Current Survey
			EPBC Act	BC Act	DBCA Priority Fauna List							
Pardalotidae												
Pardalotus rubricatus	Red-browed pardalote					X	X			X	X	X
Pardalotus striatus murchisoni	Striated pardalote					X	X			X	X	X
Acanthizidae												
Acanthiza apicalis	Broad-tailed thornbill (inland thornbill)					X				X	X	
Acanthiza chrysorrhoa	Yellow-rumped thornbill					X	X			X	X	
Acanthiza robustirostris	Slaty-backed thornbill					X	X			X	X	
Acanthiza uropygialis	Chestnut-rumped thornbill					X	X			X	X	X
Aphelocephala leucopsis	Southern whiteface					X				X		
Gerygone fusca	Western gerygone					X	X			X	X	
Pyrrholaemus brunneus	Redthroat					X	X			X		
Smicrornis brevirostris	Weebill					X	X			X	X	X
Pomatostomidae												
Pomatostomus superciliosus	White-browed babbler					X	X			X	X	
Pomatostomus temporalis	Grey-crowned babbler					X	X			X	X	X
Psophodidae												
Cinclosoma castaneothorax	Chestnut-breasted quail-thrush					X	X			X		
Psophodes occidentalis	Western wedgebill (chiming wedgebill)					X	X			X		

Scientific Name	Common Name	Introduced	Conservation Codes			NatureMap	ALA	EPBC PMST	DBCA T and P	Birdata	Previous Surveys	Current Survey
			EPBC Act	BC Act	DBCA Priority Fauna List							
Artamidae												
Artamus cinereus	Black-faced woodswallow					X	X			X	X	X
Artamus cyanopterus	Dusky woodswallow					X						
Artamus leucorynchus	White-breasted woodswallow					X						
Artamus minor	Little woodswallow					X	X			X	X	
Artamus personatus	Masked woodswallow					X	X			X	X	
Artamus superciliosus	White-browed woodswallow						X					
Cracticus nigrogularis	Pied butcherbird					X	X			X	X	X
Cracticus torquatus	Grey butcherbird					X	X			X	X	
Gymnorhina tibicen	Australian magpie						X			X	X	X
Campephagidae												
Coracina maxima	Ground cuckoo-shrike					X	X			X	X	
Coracina novaehollandiae	Black-faced cuckoo-shrike					X	X			X	X	X
Lalage sueurii	White-winged triller						X				X	X
Neosittidae												
Daphoenositta chrysoptera	Varied sittella						X			X	X	
Oreoidae												
Oreoica gutturalis	Crested bellbird					X	X			X	X	
Pachycephalidae												
Colluricincla harmonica	Grey shrike-thrush					X	X			X	X	X

Scientific Name	Common Name	Introduced	Conservation Codes			NatureMap	ALA	EPBC PMST	DBCA T and P	Birdata	Previous Surveys	Current Survey
			EPBC Act	BC Act	DBCA Priority Fauna List							
Pachycephala pectoralis	Golden whistler									X		
Pachycephala rufiventris rufiventris	Rufous whistler					X	X			X	X	X
Rhipiduridae												
Rhipidura albiscapa	Grey fantail					X	X				X	
Rhipidura albiscapa albicauda	White-tailed fantail										X	
Rhipidura leucophrys leucophrys	Willie wagtail					X	X			X	X	X
Monarchidae												
Grallina cyanoleuca	Magpie-lark					X	X			X	X	X
Corvidae												
Corvus bennetti	Little crow					X	X			X	X	
Corvus coronoides	Australian raven					X						
Corvus orru cecilae	Torresian crow					X	X			X	X	X
Petroicidae												
Melanodryas cucullata	Hooded robin					X	X			X	X	
Petroica goodenovii	Red-Capped robin					X	X			X	X	
Alaudidae												
Mirafra javanica	Horsfield's bushlark					X	X			X	X	
Hirundinidae												
Cheramoeca leucosterna	White-backed swallow						X			X		

Scientific Name	Common Name	Introduced	Conservation Codes			NatureMap	ALA	EPBC PMST	DBCA T and P	Birdata	Previous Surveys	Current Survey
			EPBC Act	BC Act	DBCA Priority Fauna List							
Hirundo neoxena	Welcome swallow						X			X		X
Hirundo rustica	Barn swallow		MI	MI				X				
Petrochelidon ariel	Fairy martin					X	X			X	X	X
Petrochelidon nigricans	Tree martin					X	X			X	X	X
Acrocephalidae												
Acrocephalus australis	Australian reed warbler					X	X			X	X	X
Megaluridae												
Cincloramphus cruralis	Brown songlark					X	X			X	X	
Cincloramphus mathewsi	Rufous songlark					X	X			X	X	X
Eremiornis carteri	Spinifexbird					X	X				X	X
Poodytes gramineus	Little grassbird											
Nectariniidae												
Dicaeum hirundinaceum	Mistletoebird					X				X	X	X
Estrildidae												
Emblema pictum	Painted finch					X	X			X	X	X
Neochmia ruficauda clarescens	Star finch					X	X			X	X	X
Taeniopygia guttata	Zebra finch					X	X			X	X	X
Motacillidae												
Motacilla flava	Yellow wagtail		MI	MI				X				
Motacilla cinerea	Grey wagtail		MI	MI				X		X		

Scientific Name	Common Name	Introduced	Conservation Codes			NatureMap	ALA	EPBC PMST	DBCA T and P	Birdata	Previous Surveys	Current Survey
			EPBC Act	BC Act	DBCA Priority Fauna List							
Anthus novaeseelandiae	Australian pipit									X	X	

Table B.4: Mammal species list – results of database searches, literature reviews and Astron survey results.

Scientific Name	Common Name	Introduced	Conservation Codes			NatureMap	ALA	EPBC PMST	DBCA T and P	Previous Surveys	Current Survey
			EPBC Act	BC Act	DBCA Priority Fauna List						
Tachyglossidae											
Tachyglossus aculeatus acanthion	Short-beaked echidna					X				X	
Dasyuridae											
Dasycercus blythi	Brush-tailed mulgara, ampurta				P4	X			X		
Dasykaluta rosamondae	Kaluta					X				X	
Dasyurus hallucatus	Northern quoll		EN	EN		X	X	X	X	X	
Ningaui ridei	Wongai *Ningaui*					X					
Ningaui timealeyi	Pilbara *Ningaui*					X	X			X	
Planigale ingrami	Long-tailed *Planigale*					X				X	
Planigale maculata	Common *Planigale*					X					
Planigale species X'	Pilbara *Planigale*					X					
Pseudantechinus woolleyae	Woolley's *Pseudantechinus*					X				X	X
Sminthopsis hirtipes	Hairy-footed dunnart					X					
Sminthopsis macroura	Stripe-faced dunnart									X	
Sminthopsis ooldea	*Ooldea* dunnart					X				X	
Sminthopsis youngsoni	Lesser hairy-footed dunnart					X					
Thylacomyidae											
Macrotis lagotis	Greater bilby, dalgyte		VU	VU		X	X	X	X		
Notoryctidae											

Scientific Name	Common Name	Introduced	Conservation Codes			NatureMap	ALA	EPBC PMST	DBCA T and P	Previous Surveys	Current Survey
			EPBC Act	BC Act	DBCA Priority Fauna List						
Notoryctes caurinus	Northern marsupial mole				P4		X				
Macropodidae											
Osphranter robustus erubescens	Euro, biggada					X				X	X
Osphranter rufus	Red kangaroo, marlu					X				X	X
Petrogale rothschildi	Rothschild's rock-wallaby					X				X	X
Muridae											
Leggadina lakedownensis	Short-tailed mouse				P4	X			X		
Mus musculus	House mouse	*				X				X	
Pseudomys chapmani	Western pebble-mound mouse				P4	X			X	X	X
Pseudomys delicatulus	Delicate mouse					X					
Pseudomys desertor	Desert mouse					X				X	
Pseudomys hermannsburgensis	Sandy inland mouse					X	X			X	
Zyzomys argurus	Common rock-rat					X				X	X
Zyzomys pedunculatus	Central rock-rat		CR	CR		X					
Zyzomys woodwardi	Kimberley rock-rat					X					
Leporidae											
Oryctolagus cuniculus	Rabbit	*				X					
Rhinonycteridae											
Rhinonicteris aurantia	Orange leaf-nosed bat				P4	X				X	
*Rhinonicteris aurantia (*Pilbara form*)*	Pilbara leaf-nosed bat		VU	VU			X	X	X	X	

Scientific Name	Common Name	Introduced	Conservation Codes			NatureMap	ALA	EPBC PMST	DBCA T and P	Previous Surveys	Current Survey
			EPBC Act	BC Act	DBCA Priority Fauna List						
Megadermatidae											
Macroderma gigas	Ghost bat		VU	VU		X		X	X	X	
Emballonuridae											
Saccolaimus flaviventris	Yellow-bellied sheath-tailed bat					X				X	X
Taphozous georgianus	Common sheath-tailed bat					X				X	X
Taphozous hilli	Hill's sheath-tailed bat					X				X	
Molossidae											
Austronomus australis	White-striped free-tailed bat					X				X	
Chaerephon jobensis	Northern free-tailed bat					X				X	X
Ozimops lumsdenae	Northern free-tailed Bat					X				X	
Vespertilionidae											
Chalinolobus gouldii	Gould's wattled bat					X	X			X	X
Chalinolobus morio	Chocolate wattled bat					X	X			X	
Nyctophilus arnhemensis	Arnhem long-eared bat									X	
Nyctophilus daedalus	Northwestern long-eared bat					X	X			X	X
Nyctophilus geoffroyi geoffroyi	Lesser long-eared bat									X	X
Scotorepens greyii	Little broad-nosed bat					X				X	X
Vespadelus finlaysoni	Finlayson's cave bat					X				X	X
Canidae											
Canis familiaris	Dingo/Dog	*				X				X	X

Scientific Name	Common Name	Introduced	Conservation Codes			NatureMap	ALA	EPBC PMST	DBCA T and P	Previous Surveys	Current Survey
			EPBC Act	BC Act	DBCA Priority Fauna List						
Vulpes vulpes	Red fox	*								X	X
Felidae											
Felis catus	Cat	*				X				X	X
Equidae											
Equus asinus	Donkey	*				X				X	
Equus caballus	Horse	*				X				X	
Camelidae											
Camelus dromedarius	Dromedary, camel	*				X				X	
Bovidae											
Bos taurus	European cattle	*				X				X	X
Bubalus bubalis	Water buffalo	*				X					

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Appendix C: MNES Fauna Habitat Suitability Mapping

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705000
710000
715000
720000
7485000
7480000

Survey Area
Yandi Mine Tenement
Greater Bilby habitat suitability
Supporting Habitat
Limited/no habitat

BHP Western Australian Iron Ore (WAIO)
Yandi 45C Targeted Significant Vertebrate Fauna Survey

Figure C.1: Greater Bilby habitat suitability mapping

Scale: 1:50,000 at A3
Coordinate System: GDA 1994 MGA Zone 50
0 1 2 3 Kilometres

N

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Author: K. Grosser | Drawn: C. Dyde | Date: 08-03-2023 | Figure Ref: 2400-006-BIDR-1Rev0_230308_FigC1_Bilby

705000
710000
715000
720000
7485000
7480000

Survey Area
Yandi Mine Tenement
Northern Quoll habitat suitability
Supporting Habitat
Limited/no habitat

BHP Western Australian Iron Ore (WAIO)
Yandi 45C Targeted Significant Vertebrate Fauna Survey

Figure C.2: Northern Quoll habitat suitability mapping

Scale: 1:50,000 at A3
Coordinate System: GDA 1994 MGA Zone 50
0 1 2 3 Kilometres

N

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705000
710000
715000
720000
7485000
7480000

Survey Area
Yandi Mine Tenement
Ghost Bat habitat suitability
Supporting Habitat
Limited/no habitat

BHP Western Australian Iron Ore (WAIO)
Yandi 45C Targeted Significant Vertebrate Fauna Survey

Figure C.3: Ghost Bat habitat suitability mapping

Scale: 1:50,000 at A3
Coordinate System: GDA 1994 MGA Zone 50
0 1 2 3 Kilometres

N

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705000
710000
715000
720000
7485000
7480000

Survey Area
Yandi Mine Tenement
Pilbara Leaf-nosed Bat habitat suitability
Supporting Habitat
Limited/no habitat

BHP Western Australian Iron Ore (WAIO)
Yandi 45C Targeted Significant Vertebrate Fauna Survey

Figure C.4: Pilbara Leaf-nosed Bat habitat suitability mapping

Scale: 1:50,000 at A3
Coordinate System: GDA 1994 MGA Zone 50
0 1 2 3 Kilometres

N

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705000
710000
715000
720000
7485000
7480000

Survey Area
Yandi Mine Tenement
Pilbara Olive Python habitat suitability
Critical Habitat
Supporting Habitat
Limited/no habitat

BHP Western Australian Iron Ore (WAIO)
Yandi 45C Targeted Significant Vertebrate Fauna Survey

Figure C.5: Pilbara Olive Python habitat suitability mapping

Scale: 1:50,000 at A3
Coordinate System: GDA 1994 MGA Zone 50
0 1 2 3 Kilometres

N

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705000
710000
715000
720000
7485000
7480000

Survey Area
Yandi Mine Tenement
Night Parrot habitat suitability
Supporting Habitat
Limited/no habitat

BHP Western Australian Iron Ore (WAIO)
Yandi 45C Targeted Significant Vertebrate Fauna Survey

Figure C.6: Night Parrot habitat suitability mapping

Scale: 1:50,000 at A3
Coordinate System: GDA 1994 MGA Zone 50
0 1 2 3 Kilometres

N

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Author: K. Grosser | Drawn: C. Dyde | Date: 08-03-2023 | Figure Ref: 2400-006-BIDR-1Rev0_230308_FigC6_NParrot

705000
710000
715000
720000
7485000
7480000

Survey Area
Yandi Mine Tenement
Grey Falcon habitat suitability
Critical Habitat
Supporting Habitat
Limited/no habitat

BHP Western Australian Iron Ore (WAIO)
Yandi 45C Targeted Significant Vertebrate Fauna Survey

Figure C.7: Grey Falcon habitat suitability mapping

Scale: 1:50,000 at A3
Coordinate System: GDA 1994 MGA Zone 50
0 1 2 3 Kilometres

N

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Author: K. Grosser | Drawn: C. Dyde | Date: 08-03-2023 | Figure Ref: 2400-006-BIDR-1Rev0_230308_FigC7_GFalcon

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Appendix D: Significant Vertebrate Fauna Species Locations

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Table D.1: Locations of significant vertebrate fauna species recorded during the current survey.

Common name (species name)	Status	Site ID	MGA Zone 51 K		Observation type (number of records)	Habitat	Photograph
			Easting (mE)	Northing (mN)			
Birds							
Common sandpiper (*Actitis hypoleucos*)	MI; MI	CAM-16	704433	7484825	Individual	Major Drainage Line	
		CAM-18	704455	7484963	Individual	Major Drainage Line	
		CAM-18	704455	7484963	Individual	Major Drainage Line	

Common name (species name)	Status	Site ID	MGA Zone 51 K		Observation type (number of records)	Habitat	Photograph
			Easting (mE)	Northing (mN)			
Common sandpiper (*Actitis hypoleucos*)	MI; MI	CAM-18	704455	7484963	Individual (2)	Major Drainage Line	
		CAM-18	704455	7484963	Individual (2)	Major Drainage Line	
		CAM-18	704455	7484963	Individual	Major Drainage Line	

Common name (species name)	Status	Site ID	MGA Zone 51 K		Observation type (number of records)	Habitat	Photograph
			Easting (mE)	Northing (mN)			
Common sandpiper (*Actitis hypoleucos*)	MI; MI	CAM-19	704427	7485049	Individual	Major Drainage Line	
		Opp	704454	7484970	Individual (2)	Major Drainage Line	No photograph
Mammals							
Western pebble-mound mouse (*Pseudomys chapmani*)	P4	WPMM01	710629	7487100	Mound (recently inactive)	Undulating Low Hills	

Common name (species name)	Status	Site ID	MGA Zone 51 K		Observation type (number of records)	Habitat	Photograph
			Easting (mE)	Northing (mN)			
Western pebble-mound mouse (*Pseudomys chapmani*)	P4	WPMM02	711258	7482858	Mound (recently inactive)	Hillcrest/Hillslope	
		WPMM03	711346	7482830	Mound (recently inactive)	Hillcrest/Hillslope	

Common name (species name)	Status	Site ID	MGA Zone 51 K		Observation type (number of records)	Habitat	Photograph
			Easting (mE)	Northing (mN)			
Western pebble-mound mouse (*Pseudomys chapmani*)	P4	WPMM04	711319	7482304	Mound (active)	Hillcrest/Hillslope	
		WPMM05	711187	7482948	Mound (inactive)	Hillcrest/Hillslope	

Common name (species name)	Status	Site ID	MGA Zone 51 K		Observation type (number of records)	Habitat	Photograph
			Easting (mE)	Northing (mN)			
Western pebble-mound mouse (*Pseudomys chapmani*)	P4	WPMM06	719361	7481892	Mound (active)	Hillcrest/Hillslope	
		WPMM07	718989	7482146	Mound (active)	Hillcrest/Hillslope	

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