East Caramulla and Thirteen Creek Targeted Significant Fauna Survey April 2023

Prepared for
BHP Western Australian Iron Ore

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Abbreviations

Abbreviation	Definition
ALA	Atlas of Living Australia
ARU	Autonomous Recording Unit
Astron	Astron Environmental Services
BC Act	*Biodiversity and Conservation Act 2016*
BHP WAIO	BHP Western Australian Iron Ore
BOM	Bureau of Meteorology
CR	Critically Endangered
DBCA	Department of Biodiversity, Conservation and Attractions
DEWHA	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
ha	Hectare
IBRA	Interim Biogeographic Regionalisation for Australia
km	Kilometre
MNES	Matters of National Environmental Significance
OS	Specially Protected
P	Priority
SM	SongMeter
T	Threatened
VU	Vulnerable
°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, specifically targeting the presence of Matters of National Environmental Significance (MNES) and other significant vertebrate fauna within the East Caramulla and Thirteen Creek survey area. The survey area is located approximately 60 km east of Newman and covers an area of 4,441.30 ha. The fauna assessment was conducted from 25 April to 2 May 2023 and did not assess any specific development proposed by BHP WAIO; however, it will be used to inform future environmental approvals across the area.

Four broad fauna habitat types were recorded in the survey area: Sand Plain, Mulga Woodland, Hillcrest/Hillslope, and Stony Plain. Disturbance to fauna habitats within the survey area was generally limited but did include evidence of cattle grazing and the presence of feral cats. None of the habitats within the survey area are restricted at a local or sub-regional scale.

Sand Plain habitat is considered critical (important sheltering and foraging) habitat for the bilby (*Macrotis lagotis*), an MNES species. This is due to the presence of soft soils that provide opportunities for digging for burrows and for foraging for invertebrates at the base of termite mounds and *Acacia* roots. Sand Plain is also considered supporting habitat for the MNES species southern whiteface (*Aphelocephala leucopsis*) (recorded) and great desert skink (*Liopholis kintorei*) (low likelihood).

Mulga Woodland habitat is considered critical habitat for the southern whiteface, and as supporting habitat for the bilby and great desert skink, which may traverse and forage within these habitats on occasion. Both Sand Plain and Mulga Woodland habitat types are well represented outside of the survey area, and none of these species are likely to be solely reliant on any of the habitats within the survey area.

Hillcrest/Hillslope and Stony Plain habitats are not considered of high value for any MNES species likely to occur in the survey area or surrounds and are similarly well represented in the surrounding region. No Gorge/Gully and Breakaway habitat types, considered important sheltering and foraging habitat for MNES species northern quoll (*Dasyurus hallucatus*), ghost bat (*Macroderma gigas*), Pilbara leaf-nosed bat (*Rhinonicteris aurantia*), and Pilbara olive python (*Liasis olivaceus barroni*), were present within the survey area.

Seventy-two vertebrate fauna species were recorded within the survey area, comprising one amphibian, six reptiles, 51 birds, and 14 mammals (including four introduced species). The fauna species assemblage recorded during the survey was considered typical for a targeted vertebrate fauna survey within the Fortescue subregion.

Records of two MNES species, bilby (Vulnerable; Vulnerable) and southern whiteface (Vulnerable), were recorded within the survey area. Potential bilby signs were recorded via a (new) unconfirmed historical burrow at one location within Mulga Woodland habitat, and an unconfirmed potential recent digging within Sand Plain habitat. An old inactive bilby burrow first identified in 2018 within the survey area (Biologic Environmental Survey) and re-assessed in 2019 and 2021 (GHD Pty Ltd) was further assessed during the current survey with continued absence of bilby sign or activity noted. No other signs of the bilby were observed throughout the survey area and a resident population is not considered to currently occur within the survey area or immediate surrounds. The southern whiteface was recorded within Mulga Woodland habitat, which is widespread and well represented outside of the survey area, and the species is unlikely to be solely reliant on any habitats within the survey area.

The likelihood of occurrence for other MNES species, northern quoll, ghost bat, Pilbara leaf-nosed bat, Pilbara olive python, great desert skink, grey falcon, and night parrot (*Pezoporus occidentalis*), is considered low given a lack of previous records in the vicinity, limited potential shelter and foraging habitat, and no records during the current survey despite adequate survey effort.

One additional species of significance was recorded during the current survey: brush-tailed mulgara (*Dasycercus blythi*) (Priority 4). Fourteen burrows (nine active and five inactive) were observed within Sand Plain habitat across the survey area. Burrow activity was confirmed by motion sensitive camera, capturing at least one individual over four nights. Sand Plain habitat is well represented outside of the survey area.

One additional significant species, the peregrine falcon (*Falco peregrinus*) (Specially Protected) was assessed as having a high post-survey likelihood of occurrence, given previous records in the vicinity and suitable habitat within the survey area. Two significant species, the western pebble-mound mouse (*Pseudomys chapmani*) (P4) and spectacled hare-wallaby (mainland) (*Lagorchetes conspicullatus leichardti*) (P4) were assessed as having a moderate post-survey likelihood of occurrence. This was based on the presence of suitable Hillcrest/Hillslope and Stony Plain habitat for the western pebble-mound mouse and Sand Plain habitat for the spectacled hare-wallaby occurring within the survey area, with habitat connectivity to previous records.

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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 single season targeted significant vertebrate fauna survey, specifically targeting the presence of Matters of National Environmental Significance (MNES) and other significant vertebrate fauna, covering the East Caramulla and Thirteen Creek area (hereafter referred to as the survey area). The survey area is located approximately 60 km east of Newman and covers an area of 4,441.30 ha (Figure 1). The fauna assessment did not assess any specific development proposed by BHP WAIO; however, it may be used to inform future environmental approvals across the area.

1.2 Scope and Objectives

The objective was to undertake a targeted vertebrate fauna assessment, with a specific focus on MNES and other significant fauna species, via a desktop assessment and subsequent field survey. The desktop assessment informed the field survey and included a comprehensive database and literature review for potentially occurring MNES species, including ghost bat (*Macroderma gigas*) (VU; VU), Pilbara leaf-nosed bat (*Rhinonicteris aurantia*) (VU; VU), bilby (*Macrotis lagotis*) (VU; VU), northern quoll (*Dasyurus hallucatus*) (EN; EN), grey falcon (*Falco hypoleucos*) (VU), southern whiteface (*Aphelocephala leucopsis*) (VU), night parrot (*Pezoporus occidentallis*) (EN; CR), great desert skink (*Liopholis kintorei*) (VU; VU), and Pilbara olive python (*Liasis olivaceus barroni*) (VU; VU). Additionally, the targeted significant vertebrate fauna survey assessed other known significant fauna species likely to occur in the general locality, such as brush-tailed mulgara (*Dasycercus blythi*) (P4), peregrine falcon (*Falco peregrinus*) (OS), western pebble-mound mouse (*Pseudomys chapmani*) (P4) and long-tailed dunnart (*Antechinomys longicaudata*) (P4).

The scope of work was to undertake:

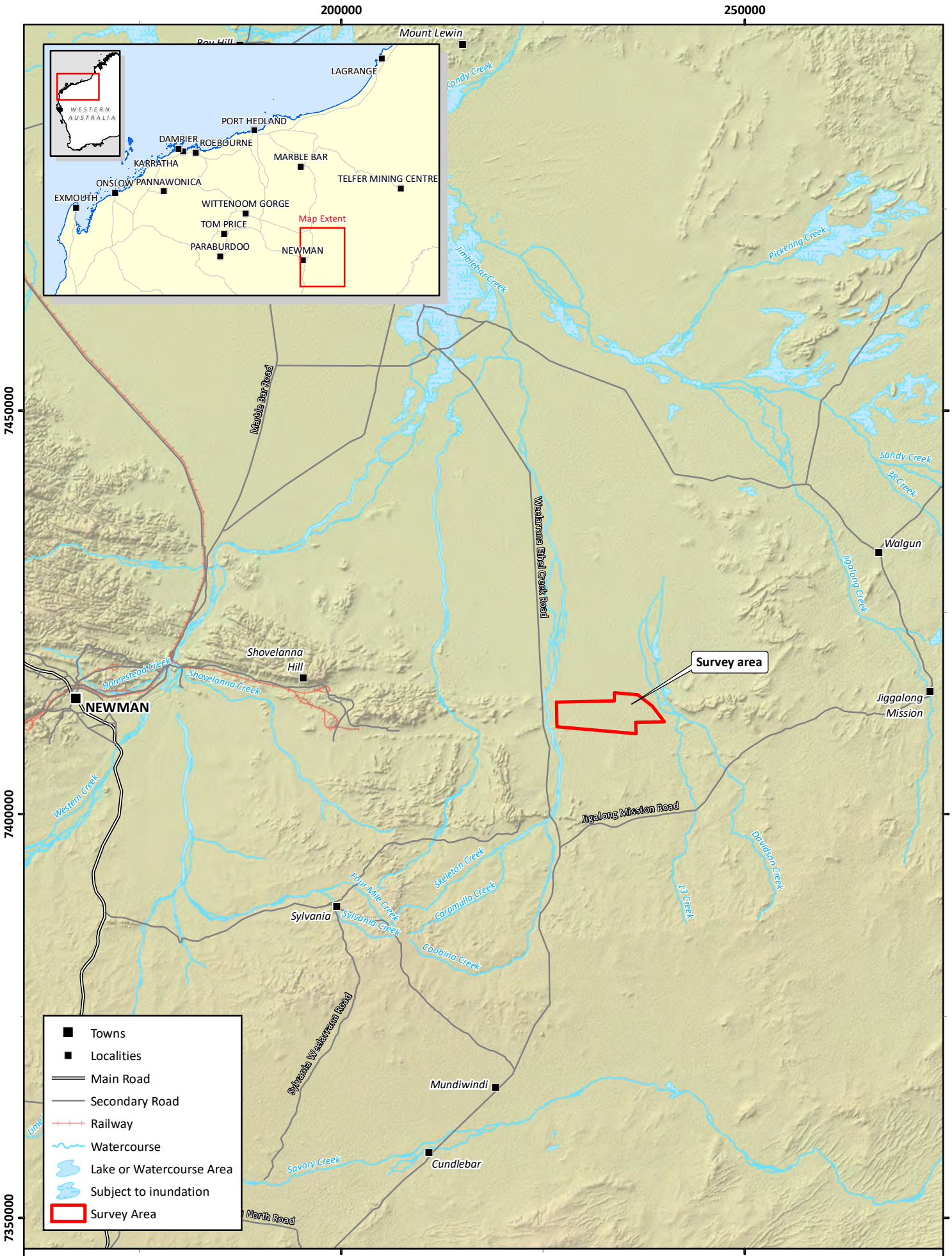
- A desktop assessment, including a comprehensive database and literature review for the presence, or likely presence, of significant vertebrate fauna species and communities.
- A targeted vertebrate fauna field survey, including:
    - targeted MNES species sampling and searches
    - sampling of other fauna species, particularly significant fauna
    - fauna habitat assessments and mapping.

Astron conducted the fauna survey in accordance with the regulatory guidance detailed in Table 1 and BHP WAIO's internal guidance document (BHP 2023a) and Spatial Data Requirements (BHP 2023b).

The scope of the survey is outlined in Table 1. Section 3.4 of this report provides details on the limitations of the survey.

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

Level of survey	Survey area size	Survey timing	Relevant regulatory guidance documents
Targeted vertebrate fauna assessment (specifically Matters of National Environmental Significance and other significant fauna species)	4,441 ha	25 April – 2 May 2023	• Environmental Protection Authority (EPA) (2018) Statement of Environmental Principles, Factors and Objectives • EPA (2016) Environmental Factor Guideline – Terrestrial Fauna • EPA (2020) Technical Guidance – Technical Guidance – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment • Department of Environment, Water, Heritage and the Arts (DEWHA) (2013) Significant Impact Guidelines 1.1 – Matters of National Environmental Significance • DEWHA (2010a) Survey Guidelines for Australia's Threatened Bats • DEWHA (2010b) Survey Guidelines for Australia's Threatened Birds • DEWHA (2010c) Survey Guidelines for Australia's Threatened Frogs • Department of Sustainability, Environment, Water, Population and Communities (DSWEPaC) (2011a) Survey Guidelines for Australia's Threatened Mammals • DSWEPaC (2011b) Survey Guidelines for Australia's Threatened Reptiles • Department of the Environment and Energy (2016) Referral guideline for the endangered northern quoll *Dasyurus hallucatus* • 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 Parks and Wildlife (2017) Interim Guideline for Preliminary Surveys of Night Parrot (*Pezoporus occidentalis*) in Western Australia • Bat Call WA (2021a) A review of ghost bat ecology, threats and survey requirements • Bat Call WA (2021b) A review of Pilbara leaf nosed bat ecology, threats and survey requirements • BHP WAIO's (2023a) Vertebrate Fauna Surveys in Western Australia Technical Process Instruction (SPR-IEN-EMS-012) • BHP WAIO's (2023b) Biological Survey Spatial Data Requirements (SPR-IEN-EMS-015).



BHP Western Australian Iron Ore
East Caramulla and Thirteen Creek Targeted Significant Fauna Survey

Figure 1: Survey area location

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Author: D. Keirle	Date: 13-06-2023	Datum: GDA 1994 - Projection: MGA Zone 50
Drawn: C. Dyde	Figure Ref: 2400-09-22-BIDR-1RevA_230613_Fig1_Locn	0 5 10 15 20 25 30 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 2023).

Based on long-term climatic data from the nearest Bureau of Meteorology (BOM) weather station at Newman Aero (Station 007176) (approximately 60 km west of the survey area) the mean annual rainfall since 1971 is 313.5 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 2023).

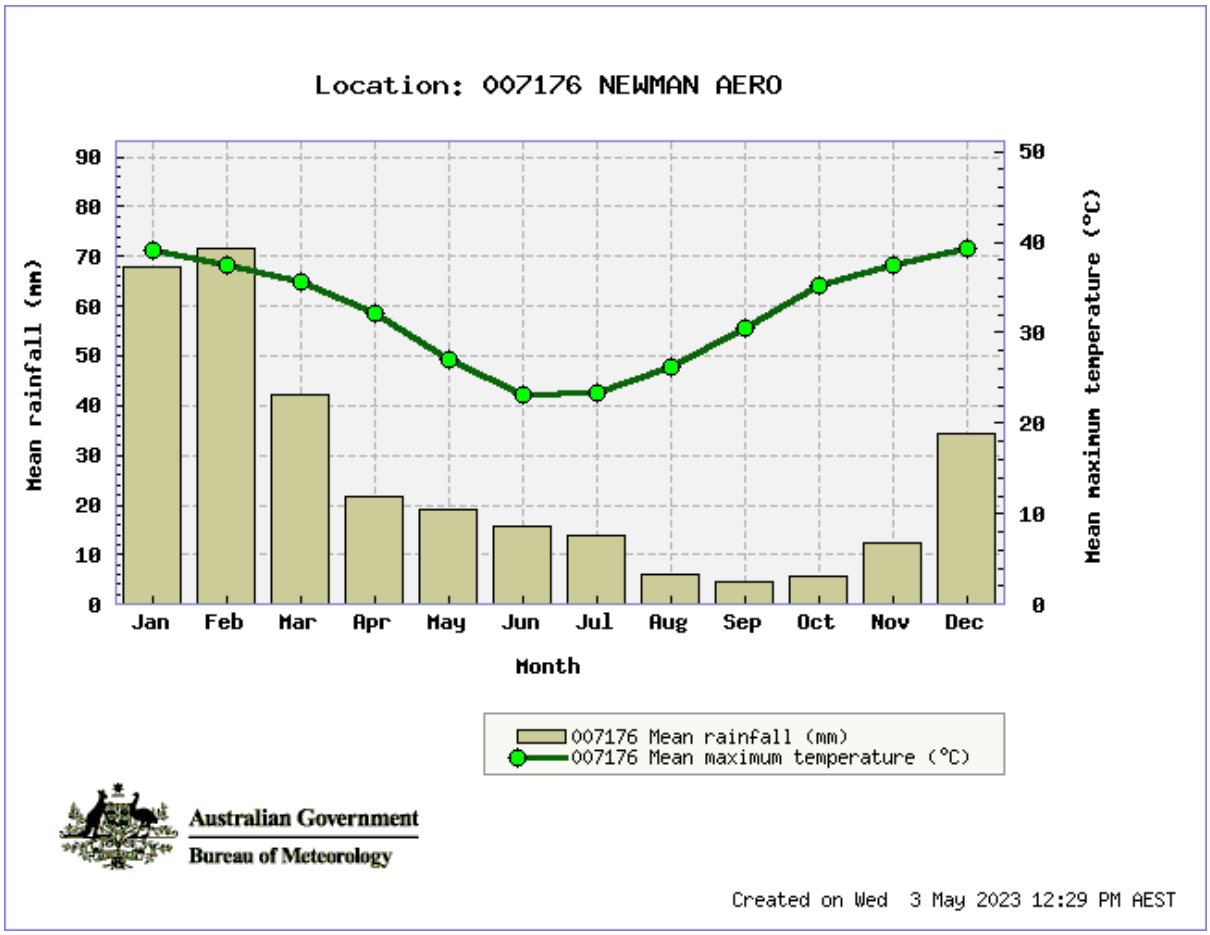

Figure 2: Climate data for Newman Aero Station (007176). Mean annual rainfall data has been calculated from 1971-2023 and mean maximum temperature has been calculated from 1996-2023 (Bureau of Meteorology 2023).

2.1.2 Geology and Soils

The surface geology of the survey area is comprised of four units (Geoscience Australia 2008, Stewart et al. 2008), with Sand plain 38499 the most dominant (Table 2). Geological mapping of the survey area is presented in Figure A.1 (Appendix A).

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

Geological name	Label	Area within survey area (ha)
Sand plain 38499: Sand or gravel plains; quartz sand sheets commonly with ferruginous pisoliths or pebbles, minor clay; local calcrete, laterite, silcrete, silt, clay, alluvium, colluvium, aeolian sand	Czs	2,578.19
Colluvium 38491: Colluvium, sheetwash, talus; gravel piedmonts and aprons over and around bedrock; clay-silt-sand with sheet and nodular kankar; alluvial and aeolian sand-silt-gravel in depressions and broad valleys in Canning Basin; local calcrete, reworked laterite	Qrc	1,441.86
Alluvium 38485: Channel and flood plain alluvium; gravel, sand, silt, clay, locally calcreted	Qa	327.71
Marra Mamba Iron Formation: Chert, ferruginous chert, jaspilite, banded iron-formation, minor shale, siltstone, mudstone.	Achm	93.54

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 94 km from the survey area. Caramulla and Thirteen Creeks run adjacent to 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 and Gascoyne Bioregions, of which 5% to 10% 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 Fortescue subregion (4,008.72 ha) of the Pilbara region and the Augustus subregion (432.58 ha) of the Gascoyne region. These subregions are described as:

- Fortescue PIL02 – Alluvial plains and river frontage. Mulga-bunch grass and short grass communities on alluvial plains in the east. Deeply incised gorge systems in the western part of the drainage. River gum woodlands fringe the drainage lines (Kendrick 2001).
- Augustus GAS03 – Desert and Xeric Shrubland ecoregion. Low Proterozoic sedimentary and granite ranges dissected by wide flat valleys with extensive areas of alluvial valley fills (Desmond et al. 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 181,723 km^2, and a total of 172 land systems occur in the Gascoyne bioregion covering 183,784 km^2. Four land systems occur in the survey area (Table 3). The distribution of these land systems within the survey area is shown in Figure A.2 (Appendix A).

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

Land system	Total area within bioregion (ha)	Total area within survey area (ha)	Proportion within survey area (%)
Pilbara bioregion			
Cadgie (CAD) - Hardpan plains with thin sand cover and sandy banks supporting mulga shrublands with soft and hard spinifex.	1,714	571.87	33.36
Divide (DIV) - Gently undulating sandplains with minor dunes, supporting hard spinifex hummock grasslands with numerous shrubs.	436,649	3,018.67	0.69
Washplain (WSP) - Hardpan plains supporting groved mulga shrublands.	66,276	406.7	0.61
McKay (MCK) - Hills, ridges, plateaux remnants and breakaways of meta sedimentary and sedimentary rocks supporting hard spinifex grasslands with acacias and occasional eucalypts.	425,967	11.47	<0.1
Gascoyne bioregion			
Washplain (WSP) - Hardpan plains supporting groved mulga shrublands.	25,328	57.4	0.23
Cadgie (CAD) - Hardpan plains with thin sand cover and sandy banks supporting mulga shrublands with soft and hard spinifex.	95,090	10.48	<0.1
Divide (DIV) - Gently undulating sandplains with minor dunes, supporting hard spinifex hummock grasslands with numerous shrubs.	391,944	364.71	<0.1

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.

Three pre-European vegetation units 29, 82 and 111 (Shepherd et al. 2002, Department of Primary Industries and Regional Development 2019) are associated with the survey area (Figure A.3, Appendix A). Table 4 summarises the current and pre-European extent of these three vegetation units in the Pilbara bioregion, Gascoyne bioregion and the survey area.

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 (PIL02, Fortescue IBRA sub-region)							
29	a1Lp	Low woodland, open low woodland or sparse woodland: Mulga *Acacia aneura* and associated species.	2,357.42	893,394.62	893,221.87	99.98	0.26
82	e16Lr t3Hi	Low tree-steppe: Hummock grassland with scattered bloodwoods & snappy gum *Triodia* spp., *Corymbia dichromophloia*, *Eucalyptus leucophloia*.	68.89	24,191.21	24,191.04	100	3.06
111	e25Sr t2Hi	Shrub-steppe: Hummock grassland with scattered shrubs or mallee *Triodia* spp. *Acacia* spp., *Grevillea* spp. *Eucalyptus* spp.	1,582.41	454,784.97	454,730.43	99.99	1.51
Gascoyne bioregion (GAS03, Augustus IBRA sub-region)							
29	a1Lp	Low woodland, open low woodland or sparse woodland: Mulga *Acacia aneura* and associated species.	162.29	2,188,768.66	2,185,968.53	99.87	0.05
111	e25Sr t2Hi	Shrub-steppe: Hummock grassland with scattered shrubs or mallee *Triodia* spp. *Acacia* spp., *Grevillea* spp. *Eucalyptus* spp.	270.29	210,196.01	209,613.36	99.72	16.45

*Data sourced from the '2018 Statewide Vegetation Statistics – Full report'; please note the statistics now presented may be out of date.

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 B.1 – B.2 and B.5 (Appendix B).

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

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 B.3, Appendix B). 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 level of threat and other information; the conservation categories are described in Table B.4 (Appendix B).

2.4 Land Use and Tenure

The survey area is located within the Shire of East Pilbara. Approximately 160 ha of the survey area is situated on Ethel Creek Station pastoral lease. The local area is used for pastoralism, mineral exploration and mining activity.

Karlamilyi National Park is the nearest conservation reserve to the survey area, located approximately 136 km to the north-east of the survey area.

3 Methods

3.1 Desktop Assessment

3.1.1 Database Searches

The desktop assessment focused on key habitats for MNES and other significant fauna species that occur in the Pilbara and Gascoyne bioregions. 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
Threatened and Priority Fauna Database (Department of Biodiversity, Conservation and Attractions 2022a)	12/12/2022	Threatened and Priority fauna species	70 km radius from a central point defined by the coordinates: -23.3766 S, 120.3877 E
NatureMap (Department of Biodiversity, Conservation and Attractions 2022b)	12/12/2022	Terrestrial vertebrate fauna and fauna of significance	40 km radius from a central point defined by the coordinates: -23.3766 S, 120.3877 E
Protected Matters Search Tool (Department of Climate Change, Energy, the Environment and Water 2022)	07/12/2022	Matters of National Environmental Significance species	40 km radius from a central point defined by the coordinates: -23.3766 S, 120.3877 E
Birdlife Australia Birdata (Birdlife Australia 2022)	07/12/2022	Bird species	40 km radius from a central point defined by the coordinates: -23.3766 S, 120.3877 E
Atlas of Living Australia (Atlas of Living Australia 2022)	07/12/2022	Terrestrial vertebrate fauna and fauna of significance	40 km radius from a central point defined by the coordinates: -23.3766 S, 120.3877 E
Index of Biodiversity Surveys for Assessment (Department of Water and Environmental Regulation 2021)	16/12/2022	Review of reports relevant to the survey area	Surveys overlapping and/or within 15 km of the survey area

3.1.2 Literature Review

Fauna surveys have been previously commissioned by BHP WAIO overlapping and/or within 15 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 3. The reports reviewed as part of this assessment include:

- Thirteen & Davidson Creek Targeted Fauna Assessment (Astron Environmental Services 2022)
- North Jimblebar: Targeted Northern Quoll Assessment (Biologic Environmental Survey 2022)
- East Jimblebar and Caramulla Targeted Greater Bilby Survey (GHD Pty Ltd 2021a)

- Jimblebar Targeted Ghost Bat Survey (GHD Pty Ltd 2021b)
- Jimblebar East and Caramulla Fauna Survey (GHD Pty Ltd 2019)
- Jimblebar North Level 1 Vertebrate Fauna Survey (Onshore Environmental Consultants Pty Ltd 2019)
- Caramulla Level 1 Vertebrate Fauna Assessment (Biologic Environmental Survey 2018)
- Caramulla Exploration Area Flora and Vegetation Survey and Fauna Assessment (GHD Pty Ltd 2009)
- East Jimblebar Exploration Project Biological Survey (Ecologia Environment 2005).

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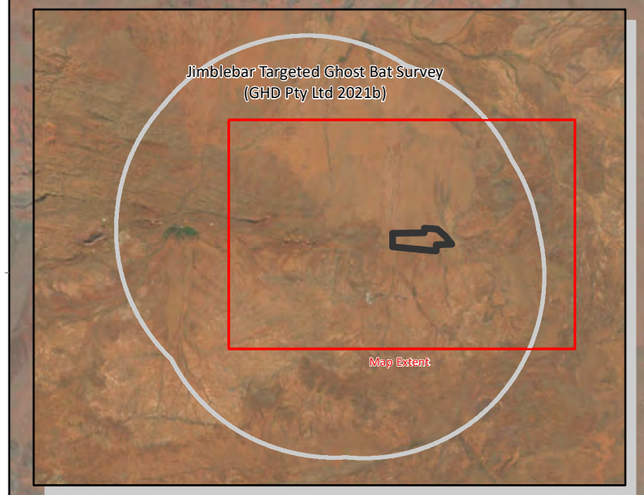
Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community



Jimblebar Targeted Ghost Bat Survey (GHD Pty Ltd 2021b)

North Jimblebar: Targeted Northern Quoll Assessment
(Biologic Environmental Survey 2022)

Thirteen & Davidson Creek
Targeted Fauna Assessment
(Astron Environmental Services 2022)

Jimblebar North Level 1 Vertebrate Fauna Survey
(Onshore Environmental Consultants Pty Ltd 2019)

Jimblebar East and Caramulla
Fauna Survey (GHD Pty Ltd 2019)

Carramulla Exploration Area
Flora and Vegetation Survey
and Fauna Assessment
(GHD Pty Ltd 2009)

Caramulla Level 1 Vertebrate Fauna Assessment
(Biologic Environmental Survey 2018)

East Jimblebar Exploration
Project Biological Survey
(Ecologia Environment 2005).

East Jimblebar and Caramulla Targeted
Greater Bilby Survey (GHD Pty Ltd 2021a)

Survey Area

Previous Surveys

- Caramulla Level 1 Vertebrate Fauna Assessment (Biologic Environmental Survey 2018)
- Carramulla Exploration Area Flora and Vegetation Survey and Fauna Assessment (GHD Pty Ltd 2009)
- East Jimblebar Exploration Project Biological Survey (Ecologia Environment 2005).
- East Jimblebar and Caramulla Targeted Greater Bilby Survey (GHD Pty Ltd 2021a)
- Jimblebar East and Caramulla Fauna Survey (GHD Pty Ltd 2019)
- Jimblebar North Level 1 Vertebrate Fauna Survey (Onshore Environmental Consultants Pty Ltd 2019)
- Jimblebar Targeted Ghost Bat Survey (GHD Pty Ltd 2021b)
- North Jimblebar: Targeted Northern Quoll Assessment (Biologic Environmental Survey 2022)
- Thirteen & Davidson Creek Targeted Fauna Assessment (Astron Environmental Services 2022)

BHP Western Australian Iron Ore
East Caramulla and Thirteen Creek Targeted Significant Fauna Survey

Figure 3: Previous fauna surveys conducted in the vicinity of the survey area

Scale: 1:200,000 at A3
Coordinate System: GDA 1994 MGA Zone 51
0 2 4 6 8 10 Kilometres

N

astron
an ecocene company

Author: D. Keirle | Drawn: C. Dyde | Date: 04-08-2023 | Figure Ref: 2400-09-22-BIDR-1RevB_230804_Fig3_PrevSurvey

3.1.3 Significant Fauna Likelihood of Occurrence Assessment

Significant vertebrate fauna species (inclusive of Threatened and Migratory MNES listed fauna, and DBCA Priority and otherwise Specially Protected 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 B.6 (Appendix B). 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 B.6 (Appendix B). The likelihood table was then updated to reflect an improved understanding of the likelihood that a species would actually occur in the survey area.

3.2 Field Survey

3.2.1 Survey Timing and Personnel

The field survey was undertaken by Astron Principal Zoologist David Keirle and Zoologist Sean Smithies from 25 April to 2 May 2023. Principal Zoologist David Keirle has over 10 years of experience conducting vertebrate fauna surveys, specifically within the Pilbara region of Western Australia.

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 2). The annual rainfall recorded preceding the survey (382.8 mm) was above the long-term mean of 313.5 mm recorded at Newman (Bureau of Meteorology 2023). Rainfall in the three months preceding the field survey was also above the long term mean (198.2 mm versus 180.1 mm) (Bureau of Meteorology 2023). The maximum daily temperatures during the field survey period were typical for April/May and ranged between 24.2°C and 32.9°C (Bureau of Meteorology 2023).

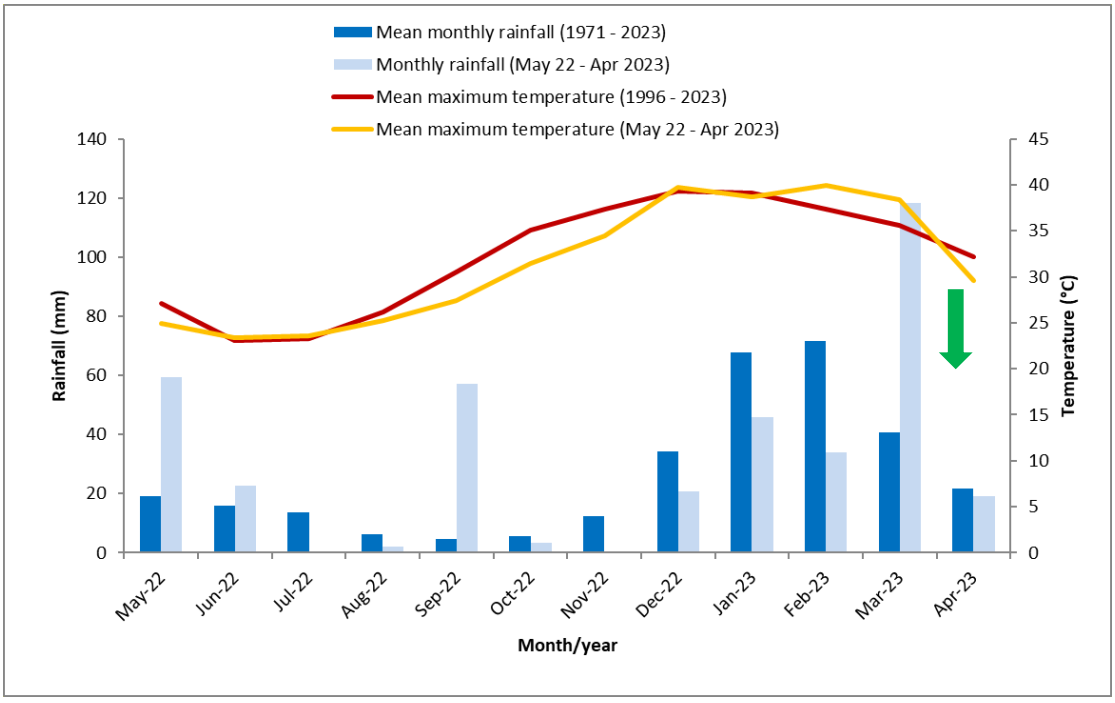


Figure 4: Newman Aero (station 007176) mean monthly rainfall (1971 - 2023), total recorded rainfall (May 2022 - April 2023), long-term mean monthly maximum temperatures (1996-2023) and mean monthly maximum temperatures (May 2022 - April 2023). The green arrow indicates the field survey timing.

3.2.3 Vertebrate Fauna

3.2.3.1 Habitat Assessment and Mapping

Sixty-four habitat assessments were conducted within the four fauna habitats present in the survey area (Table C.1 and Figure C.1, Appendix C). This included 19 habitat-only assessment sites, and 45 habitat assessments completed at targeted fauna sampling sites (Table C.1 and Figure C.1, Appendix C). The following information was collected at each site:

- Location – coordinates recorded 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 and landform type.
- 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, soft soils, rocky outcrops, rock crevices, hollows, permanent, or semi-permanent water.
- Condition – habitat condition assessed based on the presence of anthropogenic (human-induced) disturbances, and using the conditions rating 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/sampling site.

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

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

3.2.3.2 Motion Sensitive Cameras

Motion sensitive cameras (Browning and Moultrie) were set at 10 locations for between two and six nights, with a combined trapping effort of 36 camera trap nights. The cameras were placed in any suitable habitat found during the survey, with a focus on active and potential burrow entrances to target significant mammal species. Cameras were not baited with a scent lure to avoid attracting predators to fauna burrows. Camera locations are shown in Figure C.1 and detailed in Table C.1 (Appendix C).

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. Song Meter 4 (SM4) acoustic recording devices (SM4BAT+ detectors) were set in five locations to achieve broad coverage across the survey area as well as targeting potential foraging sites. The SM4BAT+ detectors were set for three to four nights, resulting in a total of 18 recording nights. The locations are depicted in Figure C.1 and detailed in Table C.1

(Appendix C). The bat echolocation data collected in the field was analysed by Robert Bullen (Bat Call WA) for presence of all bat species.

3.2.3.4 Night Parrot Surveys

Following the recent discovery of night parrot populations in Western Australia, the survey area falls within 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). Passive acoustic surveys using Autonomous Recording Units (ARUs) were undertaken in the most prospective habitats (Sand Plain habitat containing mature *Triodia*) available within the survey area.

The ARUs, recording one hour pre-sunset to one hour post-dawn, were set at five locations for six nights each, resulting in a total of 30 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 C.1 and detailed in Table C.1 (Appendix C). The audio data collected in the field was analysed by Robert Bullen (Bat Call WA) for the presence of the night parrot.

3.2.3.5 Targeted Bilby Plot Searches

Targeted searches for signs of bilbies were conducted using a combination of the 2 ha plot protocol and linear survey methods as outlined in DBCA guidelines (Department of Biodiversity Conservation and Attractions 2017). Twenty-four 2 ha plots (either 50 m x 400 m, or 100 m x 200 m), and one 1.5km linear transect were traversed on foot, with personnel walking parallel transects spaced 20 to 30 m apart. Any evidence of bilbies including burrows, tracks, foraging signs, and scats was recorded, photographed and GPS located. Motion sensitive cameras were deployed at potential burrow entrances and diggings to investigate occupancy and usage. Locations of the targeted 2 ha plot sites, linear search locations and motion camera locations are depicted in Figure C.1 and detailed in Table C.1 (Appendix C).

3.2.3.6 Targeted Searches for Other Species

Targeted searches were undertaken for other significant species previously found or considered likely to occur in the area, including northern quoll, Pilbara olive python, grey falcon, southern whiteface, great desert skink, western pebble-mound mouse, and brush-tailed mulgara. For northern quoll and Pilbara olive python, targeted searches primarily involved the identification of potential suitable habitat, such as rocky outcrops, caves, hollows, drainage lines and water sources, and searches for secondary signs, including tracks, scats, sloughed skins, and dens.

For grey falcon and southern whiteface, targeted searches focused on areas of suitable habitat, such as Mulga Woodland (southern whiteface) and Drainage Lines (grey falcon), in conjunction with opportunistic observations throughout the survey area.

Searches for great desert skink and brush-tailed mulgara were conducted concurrently with bilby searches in suitable Sandy Plain and Mulga Woodland habitats and focused on the identification of their similarly distinctive burrows. Observations for western pebble-mound mouse were conducted within Hillcrest/Hillslope and Stony Plain habitat and focused on the identification of their distinctive pebble mounds.

Visual observations for significant fauna and opportunistic bird recordings were ongoing whilst moving through the survey area. Track logs were recorded using a handheld GPS and are shown in Figure C.1

(Appendix C). 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 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 6 are based on those suggested as considerations under EPA fauna survey guidance (Environmental Protection Authority 2020).

Table 6: Statement of limitations for the targeted vertebrate fauna assessment.

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. David Keirle has over 10 years of fauna surveying experience, and Sean Smithies has over five years.
(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 Matters of National Environmental Significance (MNES) and other significant fauna 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	Survey timing was considered optimal for sampling reptiles and mammals in the Pilbara (September – April). Rainfall in both the three months and 12 months preceding the field survey was above average and conditions were generally considered good.
(vii) Disturbances For example, fire, flood, accidental human intervention which affected results of survey.	No limitation	No major disturbances were recorded in the survey area that would have affected the survey results.
(viii) Intensity In retrospect, was the intensity adequate?	No limitation	The intensity of the survey was considered adequate for a targeted vertebrate fauna assessment.

Potential limitation	Degree of limitation	Statement regarding potential limitation
(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
(xi) Remoteness and/or access problems	No limitation	There were no access problems with all the survey area able to be accessed by helicopter 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 Marshes, located approximately 94 km from the survey area (Department of the Environment and Energy 2020a).

4.1.2 Vertebrate Fauna

The database searches indicated that 339 vertebrate fauna occur, or potentially occur, within a 70 km radius from the centre of the survey area (Table D.1 – D.4, Appendix D), including six amphibian species, 99 reptile species, 192 bird species, and 42 mammal species (including seven introduced mammal species) (Birdlife Australia 2022, Department of Biodiversity, Conservation and Attractions 2022b, 2022a, Department of Climate Change, Energy, the Environment and Water 2022). Of these, 28 species are listed as MNES (specifically those listed as Threatened and Migratory species) comprising two reptile species, 21 bird species and five mammal species (Table E.1, Appendix E). A further 10 species, comprising three reptile species, two bird species and five mammal species, are State-listed Priority or Otherwise Specially Protected species (Table E.1, Appendix E). Of the MNES species, one species had been previously recorded within the survey area, two species were considered to have a high likelihood of occurrence, two species were considered to have a moderate likelihood of occurrence, and 23 species were considered to have a low likelihood of occurrence within the survey area (Table E.1, Appendix E). This is based on their respective ecology, habitats considered likely to be present, and any previous records from historic survey and database records.

Previous surveys undertaken for BHP WAIO within the survey area recorded one MNES species, bilby, and one species of significance, brush-tailed mulgara. Surveys in the vicinity of the survey area recorded four MNES species: bilby, ghost bat, southern whiteface, and Pilbara olive python, and an additional three species of significance: brush-tailed mulgara, western pebble-mound mouse, and peregrine falcon (Table 7).

Table 7: 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
Astron (2022) – Thirteen & Davidson Creek Targeted Fauna Assessment	Thirteen & Davidson Creek; 8,736 ha	Targeted Matters of National Environmental Significance (MNES) and significant fauna survey	March 2022	Targeted bilby (*Macrotis lagotis*) plot searches and motion sensitive cameras. Habitat assessments and avifauna census. Searches for secondary evidence (scat, diggings, burrows, nests). Song Meter 4 (SM4) echolocation and acoustic recorders to detect presence of significant species.	Bilby (*Macrotis lagotis*) (unconfirmed diggings) Brush-tailed mulgara (*Dasycercus blythi*) Southern whiteface (*Aphelocephala leucopsis*)
Biologic (2022)	North Jimblebar; 13,933 ha	Targeted northern quoll (*Dasyurus hallucatus*) survey (two phase)	February and June 2022	Two field surveys, including 15 habitat assessments, 52.2 hours of targeted searches and 5,390 camera trap nights across five camera trap transects.	None recorded
GHD (2021) – East Jimblebar and Caramulla Targeted Greater Bilby Survey	Jimblebar East and Caramulla; 8,839 ha	Targeted bilby (*Macrotis lagotis*) survey	September 2020	Bilby (*Macrotis lagotis*) habitat and targeted survey by recording diggings, burrows, scats, and prints observed within 2 ha plots.	Brush-tailed mulgara (*Dasycercus blythi*)
GHD (2021) – Jimblebar Targeted Ghost Bat Survey	Jimblebar; size not stated	Targeted ghost bat (*Macroderma gigas*) survey	May 2020	Habitat and roost assessments, in-situ time lapse infrared video camera surveys and SM4 echolocation recorders.	Ghost bat (*Macroderma gigas*) Pilbara olive python (*Liasis olivaceus barroni*) (scats)

Author (year)	Survey area; size (ha)	Survey level	Survey timing	Survey effort	Significant vertebrate fauna recorded
GHD (2019) – Jimblebar East and Caramulla Fauna Survey	Jimblebar East and Caramulla; 11,893 ha	Detailed fauna survey (single phase)	April/May 2019	Eight trapping sites comprising of pitfalls (PVC pipes and 20 L buckets), cage traps, funnel traps, and Elliott traps. Avifauna census and active foraging at each trapping site. Motion sensitive cameras, SM4 echolocation and acoustic recorders to detect presence of significant species. Target bilby (*Macrotis lagotis*) plot assessments and targeted vertebrate fauna searches.	Ghost bat (*Macroderma gigas*) Brush-tailed mulgara (*Dasycercus blythi*) Western pebble-mound mouse (*Pseudomys chapmani*) Peregrine falcon (*Falco peregrinus*)
Onshore Environmental (2019) – Jimblebar North Level 1 Vertebrate Fauna Survey	Jimblebar North; 1,680 ha	Basic fauna survey	September 2018	Habitat assessments, avifauna census, targeted and opportunistic searches of significant species, including the use of SM4 echolocation recorders, and active hand foraging for other vertebrates.	None recorded
Biologic (2018) – Caramulla Level 1 Vertebrate Fauna Assessment	Caramulla exploration lease; 12,500 ha	Basic fauna survey	February 2018	Habitat assessments, targeted vertebrate fauna searches and motion sensitive cameras. Remotely piloted aircraft searches for suitable bilby (*Macrotis lagotis*) and brush-tailed mulgara (*Dasycercus blythi*) habitat, followed by on-ground follow-up targeted searches. SM4 echolocation and acoustic recorders to detect presence of significant species.	Bilby (*Macrotis lagotis*) (unconfirmed burrow) Brush-tailed mulgara (*Dasycercus blythi*)
GHD (2009) Caramulla Exploration Area Flora and Vegetation Survey and Fauna Assessment	Caramulla project area; 5,300 ha	Basic fauna survey in conjuction with flora and vegetation survey	December 2008	Habitat assessments and opportunistic surveying.	None recorded

Author (year)	Survey area; size (ha)	Survey level	Survey timing	Survey effort	Significant vertebrate fauna recorded
Ecologia (2005) – East Jimblebar Exploration Project Biological Survey	Jimblebar East; size not stated	Basic fauna survey in conjuction with flora and vegetation survey	February 2005	Habitat assessments, avifauna census, active hand foraging, and spotlighting for other vertebrates. Searches for secondary evidence (scat, diggings, burrows, nests). Anabat echolocation recorders to detect presence of significant bat species.	None recorded

4.2 Field Survey

4.2.1 Vertebrate Fauna Habitats

Four broad habitat types were recorded in the survey area: Sand Plain, Hillcrest/Hillslope, Mulga Woodland, and Stony Plain. Fauna habitat types are summarised in Table 8 and mapped in Figure F.1 (Appendix F).

Most of the habitats were considered to be in 'Excellent' to 'High Quality' condition owing to minimal disturbances from fire, weeds, mining activity, or grazing. Other than access tracks and drill pads, no areas were considered as 'Disturbed' or 'Highly Degraded', with minimal anthropogenic disturbances noted throughout the survey area.

Sand Plain habitat is common throughout the region and surrounding areas and is considered low to moderate value for a wide spectrum of fauna species. Regarding MNES species specifically, the Sand Plain habitat is considered as high value preferred habitat for bilby and great desert skink, and as moderate value for those that may traverse and forage intermittently, including ghost bat, Pilbara leaf-nosed bat and grey falcon. For other significant species, the Sand Plain habitat is considered as high value preferred habitat for brush-tailed mulgara and spectacled hare-wallaby, and moderate value for peregrine falcon.

However, the sand plain habitat of the study area and surrounds is considered unlikely to support great desert skink, ghost bat, Pilbara leaf-nosed bat, and grey falcon due to a combination of factors, including absence of nearby records, range contractions and lack of nearby preferred habitats (see Section 4.2.4).

Mulga Woodland habitat is common throughout the Pilbara and largely consists of stands of Mulga vegetation over clay or stony substrates. This habitat exhibited a moderate diversity of microhabitats, with some logs, woody debris, and some soft soil for burrowing. Mulga Woodland is considered as high value for one MNES species southern whiteface, as it includes critical habitat features such as low tree densities and a herbaceous understorey litter cover, which provide essential foraging habitat, and living and dead trees with hollows and crevices, which are essential for roosting and nesting (Department of Climate Change, Energy, the Environment and Water 2023). Mulga Woodland is considered of moderate value for MNES species bilby, as these areas contain soft soils for digging, with opportunities to dig and forage at the base of termite mounds and expose the roots of wattle and other shrubs that have root-dwelling invertebrate larvae (Pavey 2006, Commonwealth of Australia 2019).

Mulga Woodland habitat offers limited value to other target Pilbara MNES species and is of moderate value for significant species, including the brush-tailed mulgara and peregrine falcon that may traverse and forage within this habitat type on occasion. This habitat is common in surrounding areas and throughout the region.

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, providing limited microhabitats for fauna to exploit. It is considered of low value for potentially occurring MNES species and is well represented in surrounding areas and throughout the region. Hillcrest/Hillslope habitat represents high value denning and foraging habitat for the significant species western pebble-mound mouse, and moderate value for peregrine falcon, which may traverse and forage within this habitat type on occasion.

Stony Plain habitat is widespread and common throughout the Pilbara region and, although there are some MNES and other significant species that may utilise it, none are restricted to this habitat type. This habitat generally had low vegetation complexity and microhabitat diversity and is considered to be of low value for MNES and other significant species, as it provides limited microhabitats for these fauna species to utilise. This habitat is common in surrounding areas and throughout the region.

Table 8: Area of fauna habitats recorded within the survey area.

Fauna habitat	Extent in survey area (proportion)	Broad habitat description	Microhabitats	Sites	Habitat condition	Significant fauna habitat suitability for species likely to occur (recorded, or moderate to high likelihood)	Representative photo
Sand Plain	2,979.9 ha (67%)	Broad flat low-lying plains areas with open predominantly *Triodia* hummock grasslands and scattered trees on soft sandy soils.	• Soft soils (burrows) • Termite mounds • Old *Triodia*	• EC-AU01, 02, 03, 04, 05 • EC-BAT02 • EC-BLS01 • EC-BP01, 02, 03, 04, 04, 06, 07, 08, 09, 11, 13, 14, 16, 17, 18, 19, 20, 23, 24 • EC-CAM02, 03, 04, 05, 06, 07, 08, 10 • EC-HA02, 04, 07, 08, 10, 11, 13, 14, 15, 18, 19	Very Good to Excellent	**MNES critical habitat** Bilby (*Macrotis lagotis*) – burrowing and foraging. Previous record within survey area **MNES supporting habitat** Southern whiteface (*Aphelocephala leucopsis*) – foraging **Other significant species** Brush-tailed mulgara (*Dasycercus blythi*) – denning and foraging Peregrine falcon (*Falco peregrinus*) – foraging Spectacled hare-wallaby (*Lagorchestes conspicillatus leichardti*) - foraging	

Fauna habitat	Extent in survey area (proportion)	Broad habitat description	Microhabitats	Sites	Habitat condition	Significant fauna habitat suitability for species likely to occur (recorded, or moderate to high likelihood)	Representative photo
Mulga Woodland	1,426.9 ha (32%)	Stands of mulga over clay or stony substrates	• Logs • Tree hollows • Crevices • Thick undergrowth • Soft soils (burrows) • Termite mounds • Old *Triodia*	• EC-BAT01, 03, 04, 05 • EC-BP10, 12, 15, 21, 22 • EC-CAM01, 09 • EC-HA03, 05, 06, 09, 16, 17	Very Good to Excellent	**MNES critical habitat** Southern whiteface (*Aphelocephala leucopsis*) – breeding and foraging. Current record within survey area and in similar nearby habitat. **MNES supporting habitat** Bilby (*Macrotis lagotis*) – foraging **Other significant species** Brush-tailed mulgara (*Dasycercus blythi*) – denning and foraging Peregrine falcon (*Falco peregrinus*) – foraging	
Hillcrest/ Hillslope	17.3 ha (<1%)	Characterised by large open rocky areas with open grasslands, predominantly *Triodia* hummock grasslands.	• Tree hollows • Crevices • Leaf litter	• EC-HA12	Very Good	**Other significant species** Western pebble-mound mouse (*Pseudomys chapmani*) – denning and foraging Peregrine falcon (*Falco peregrinus*) – foraging	

Fauna habitat	Extent in survey area (proportion)	Broad habitat description	Microhabitats	Sites	Habitat condition	Significant fauna habitat suitability for species likely to occur (recorded, or moderate to high likelihood)	Representative photo
Stony Plain	17.2 ha (<1%)	Broad flat low-lying plains to undulating plain over clay or stony substrate	• Crevices • Soft soil (burrows)	• EC-HA01	Excellent	**MNES supporting habitat** Southern whiteface (*Aphelocephala leucopsis*) – foraging **Other significant species** Western pebble-mound mouse (*Pseudomys chapmani*) – denning and foraging Peregrine falcon (*Falco peregrinus*) – foraging	

Note: MNES = Matters of National Environmental Significance

4.2.2 Vertebrate Fauna Species

Seventy-two vertebrate fauna species were recorded within the survey area during the current survey (Table 9). A complete list of recorded species is provided in Tables D.1 to D.4 (Appendix D). The following sections summarise results for each major taxonomic group sampled.

Table 9: Number of vertebrate fauna species recorded during the survey.

Fauna taxonomic group	No. of species recorded	No. of Matters of National Environmental Significance species recorded	No. of Department of Biodiversity, Conservation and Attractions priority fauna species recorded	No. of introduced species recorded
Amphibians	1	0	0	0
Reptiles	6	0	0	0
Birds	51	1	0	0
Mammals	14	1	1	4
Total	**72**	**2**	**1**	**4**

4.2.2.1 Herpetofauna

One amphibian species, the little red tree frog (*Litoria rubella*), was recorded during the survey at an artificial water source (drill sump).

Six reptile species were recorded during the survey, comprising of two dragons, one varanid, one gecko, one skink, and one elapid (Table D.2, Appendix D). The low number of reptiles is not unexpected given the relatively few fauna habitats present, and the survey focus on the presence/absence of MNES and other significant species without the use of pitfall trapping implemented in detailed fauna assessments. No MNES or other significant reptile species were recorded during the survey. One reptile species, the thorny devil (*Moloch horridus*), is an uncommon record within the Pilbara bioregion.

4.2.2.2 Birds

Fifty-one bird species were recorded during the survey. The most speciose family was Meliphagidae (honeyeaters) with eight species, followed by Accipitridae (hawks, eagles) with four species, and Columbidae (pigeons) with three species (Table D.3, Appendix D). The limited surface water within the survey area restricted the bird diversity, with no waterfowl or wading species recorded. One MNES bird species, southern whiteface, was recorded during the survey.

4.2.2.3 Mammals

Fourteen species of mammal were recorded during the survey, including four introduced species: cat (**Felis catus*), dog/dingo (**Canis familiaris*), European cattle (**Bos taurus*), and dromedary camel (**Camelus dromedarius*) (Table D.4, Appendix D). Four bat species were identified from ultrasonic acoustic recordings within the survey area.

Two mammals of significance were recorded during the survey, including one MNES species, bilby, and the priority listed species, brush-tailed mulgara. These species are discussed further in Section 4.2.3.

4.2.3 Significant Species Recorded

Three vertebrate species of significance, including two MNES species, were recorded within the survey area during the current survey: bilby, southern whiteface, and brush-tailed mulgara. The locations of these species' records from the current survey, as well as other previously recorded species, are shown in Figure H.1 and detailed in Table H.1 (Appendix H).

Bilby (*Macrotis lagotis*) (VU; VU)

The known distribution of bilbies is now restricted to drier desert areas in the Northern Territory and Western Australia, and to a small corner of south-western Queensland (Dziminski and Carpenter 2017).Within Western Australia, the western boundary of their current distribution stretches south-east from approximately 50 km west of Port Hedland, through Newman, to about 350 km south of Newman. Their distribution extends east and south-east from this boundary into the Great Sandy, Little Sandy and Gibson Deserts, as well as northwards into the Kimberley (Dziminski et al. 2020). Bilbies prefer level or undulating plains, including watercourses and dune systems, composed of cracking clay, soil or sand that allow burrowing, with vegetation consisting of spinifex hummock grassland, with low *Acacia* shrubland (Dziminski and Carpenter 2017). Bilbies are highly mobile and can have large foraging ranges of, on average, 18 ha for females and 316 ha for males (Pavey 2006), typically digging to access termite mounds, expose bulbs, and expose the roots of wattle and other shrubs that have root-dwelling invertebrate larvae (Pavey 2006, Commonwealth of Australia 2019). Bilbies are also known to migrate to follow food resources, especially in less productive parts of their range (Southgate et al. 2007, Southgate and Carthew 2008) and may appear to move randomly in and out of a survey area (McKenzie et al. 2007).

The species is likely to be found within sandy habitats, particularly at sites that contain spinifex hummocks and soft soils for burrowing. Evidence of potential bilby occurrence was recorded at three locations (including one previously known record, see Biologic Environmental Survey (2018), GHD Pty (2019, 2021b)) within the survey area, two within Sand Plain fauna habitat, and one within Mulga Woodland habitat (Figure F.1, Appendix F). The nearest additional record (unconfirmed potential digging) occurs approximately 7 km east of the survey area (Astron Environmental Services 2022). The next closest record (secondary sign) is from 2010 and occurs approximately 23 km east of the survey area (Department of Biodiversity, Conservation and Attractions 2022a). An additional two bilby records occur approximately 34 km east the survey area, but are all greater than 25 years old and are of a general (e.g. Jigalong Community) rather than specific location (Department of Biodiversity, Conservation and Attractions 2022a).

The previously known record of an old (unconfirmed) bilby burrow first identified in 2018 (Biologic Environmental Survey 2018) was re-assessed in 2019 and 2021 (GHD Pty Ltd 2019, 2021a) and further assessed during the current survey (Table 10; Figure F.1, Appendix F). GHD noted monitor lizard usage of the burrow and continued absence of bilby signs in both 2019 and 2021 inspections. Continued occupation by monitor lizards was again observed during the current survey, and no current bilby sign or activity was noted in the burrow area, despite extensive searching. Additionally, a camera was set on the burrow for four nights and did not record any bilby activity.

A similar potential residual burrow presence was recorded during the current survey approximately 2.7 km south-west of the old burrow (Table 11; Figure F.1, Appendix F). The unconfirmed residual burrow occurs in a similar low sandy rise in sandy habitat (but within Mulga Woodland), with several other burrows and mounds (burrow spoil) present. Current occupation by monitor lizards was also observed at this record, and no current bilby sign or activity was noted in the burrow area, despite extensive searching. Additionally, a camera was set on the most active burrow for four nights and did not record any bilby activity.

Table 10: Old bilby burrow in the survey area.

Evidence	Latitude	Longitude	Image	Comments
Historic (old) burrow	-23.3713	120.3794	 	Old (unconfirmed) burrow first identified by Biologic (2018). No current bilby sign or activity. Current (continued) monitor lizard usage apparent.

Table 11: Potential (unconfirmed) old bilby burrow in the survey area.

Evidence	Latitude	Longitude	Image	Comments
Potential (old) burrow	-23.3816	120.3558	 	Potential old burrow/s identified during current survey. No current bilby sign or activity. Current monitor lizard usage apparent.

A potential (unconfirmed) digging was recorded approximately 2 km south-east of the historic bilby burrow, and 4 km east of the potential bilby burrow (Table 12; Figure F.1, Appendix F). The digging was recent and appeared characteristic in size and shape for bilby; however, monitor lizard tail marks were observed nearby, and no other current bilby sign was observed. A camera was set on the digging for two nights and did not record any bilby or monitor lizard activity.

Table 12: Potential (unconfirmed) bilby digging in the survey area.

Evidence	Latitude	Longitude	Image	Comments
Potential unconfirmed digging	-23.3811	120.3955		Potential unconfirmed digging identified during current survey. No other nearby bilby sign or activity. Monitor lizard tail marks observed nearby. No bilby or monitor activity recorded on camera placed at record.

Critical denning and foraging habitat (Sand Plain) was identified for the bilby within the survey area. Critical bilby denning and foraging habitat typically consists of sandplains, spinifex dominated interdune corridors, salt-lakes surrounded with samphire (*Halosarcia* spp.), and/or Melaleucas or paleo-drainage systems within individual home ranges (Pavey 2006). Bilby home ranges cover on average 18 ha for females and 316 ha for males (Pavey 2006). Approximately 2,980 ha (67%) of the survey area, consisting of open tussock grassland and hummock grassland across Sand Plain, was considered of high significance for supporting or potentially providing critical bilby habitat where soft soils provide optimal conditions for burrowing (Figure G.1, Appendix G).

Approximately 1,427 ha (32%) of the survey area, consisting of Mulga Woodland was considered supporting foraging and dispersal habitat for the bilby. These areas contain soft soils for digging and opportunities to dig and forage at the base of termite mounds and *Acacia* roots for invertebrate grubs. The remaining area, equating to less than 1% of the survey area, was considered to provide limited foraging and dispersal habitat, consisting of Hillcrest/Hillslope and Stony Plain fauna habitats (Figure G.1, Appendix G).

Southern whiteface (*Aphelocephala leucopsis*) (VU)

Southern whitefaces are commonly associated with a wide range of open woodlands and shrublands where there is an understorey of grasses or shrubs, or both, and a herbaceous understorey litter cover which provides essential foraging habitat. Southern whiteface are widely distributed and occur across most of mainland Australia south of the tropics, from the north-eastern edge of the Western

Australian wheatbelt, east to the Great Dividing Range (Schodde and Mason 1999). The current survey area occurs near the northern edge of the modelled distribution in Western Australia where "species or species habitat [is] known or likely to occur" (Department of Climate Change, Energy, the Environment and Water 2023). The species is considered sedentary; however, individuals may move into wetter areas outside of their normal range during drought years (Higgins and Peter 2002).

The southern whiteface was recorded on one occasion within the survey area in Mulga Woodland habitat. This habitat type is common within the survey area and surrounds and is well represented generally throughout the region. The nearest record occurs approximately 4 km north-east of the survey area in similar habitat (Astron Environmental Services 2022).

Approximately 1,427 ha (32%) of the survey area, consisting of Mulga Woodland was considered critical habitat for the southern whiteface. This habitat type included critical habitat features identified by the Department of Climate Change, Energy, the Environment and Water (2023), including low tree densities and a herbaceous understorey litter cover, which provides essential foraging habitat, and living and dead trees with hollows and crevices, which are essential for roosting and nesting.

Approximately 2,997 ha (67%) of the survey area, consisting of open grassland and shrubland across Sand Plain and Stony Plain, was considered to provide supporting habitat (Figure G.2, Appendix G).

The remaining area, equating to less than 1% of the survey area, was considered to provide limited foraging and dispersal habitat, consisting of Hillcrest/Hillslope fauna habitat (Figure G.2 Appendix G).

Brush-tailed mulgara (*Dasycercus blythi*) (P4)

The brush-tailed mulgara is commonly associated with mature spinifex grasslands, particularly *Triodia basedowii* and *T. pungens* (Masters et al. 2003). Colony occupancy may be influenced by the presence of better watered areas such as paleo-drainage systems or drainage lines in sandplain or sand dunes (Pavey et al. 2006).

The brush-tailed mulgara was recorded 16 times across 14 locations inclusive of nine active and five inactive burrows, and two remote camera records (both EC-CAM02) (examples Plate 1- Plate 4) all within Sand Plain habitat (Figure F.1, Appendix F). Seven recent records are known within the survey area (Biologic Environmental Survey 2018, GHD Pty Ltd 2021a), and numerous additional records occur within the vicinity of the current survey area (Figure F.1, Appendix F) (Astron Environmental Services 2022, Department of Biodiversity, Conservation and Attractions 2022a).

Plate 1: Active brush-tailed mulgara burrow.

Plate 2: Active brush-tailed mulgara burrow.

Plate 3: Inactive brush-tailed mulgara burrow.

Plate 4: Brush-tailed mulgara captured on motion sensitive camera.

4.2.4 Significant Species Possibly Occurring in the Survey Area

Table 13 provides a summary of the home range, habitat availability and likelihood of occurrence for the MNES species identified as occurring (recorded), or potentially occurring (high or moderate likelihood), within the survey area.

4.2.4.1 High Likelihood of Occurrence

One species not recorded in the survey area during the current survey is considered to have a high post-survey likelihood of occurrence (Table E.1, Appendix E). The species is not an MNES species.

Peregrine falcon (*Falco peregrinus*) (OS)

The peregrine falcon occurs throughout Australia and in most habitat types, with the exception of treeless and waterless desert, and dense forests (Birdlife Australia 2012). The closest record outlined in the database searches occurs within 4 km of the survey area, and the entire survey area is considered potential foraging habitat for this species which will hunt in any habitat (Figure F.1, Appendix F). There are no species-specific survey methods recommended for targeting peregrine falcon; however, suitable habitats were surveyed in conjunction with opportunistic bird observations made throughout the survey area.

4.2.4.2 Moderate Likelihood of Occurrence

Two species not recorded in the survey area during the current survey are considered to have a moderate post-survey likelihood of occurrence (Table E.1, Appendix E). None of the species are MNES species.

Western pebble-mound mouse (*Pseudomys chapmani*) (P4)

This species inhabits gentle rocky slopes, hills and spurs, with small pebble surface cover and sparse vegetation. Several previous records were detailed on the DBCA threatened and priority fauna database result in proximity to the survey area, and suitable habitat types (Hillcrest/Hillslope and Stony Plain) are present within the survey area and surrounds. Hillcrest/Hillslope and Stony Plain habitats were traversed on foot for distinctive pebble mounds. No records were found during the current survey.

Spectacled hare-wallaby (mainland) (*Lagorchetes conspicullatus leichardti*) (P4)

This species is patchily distributed throughout the Pilbara region, with few records. The Stony Plain habitat and Sand Plain habitat, which include expanses of *Triodia* hummock grasslands, represent suitable habitat for the species and comprise most of the survey area and surrounds. The nearest record of this species is 18 km south-west of the survey area from an unknown date (Department of Biodiversity, Conservation and Attractions 2022a), and there is continuity of habitat with the current survey area. No records were found during the current survey.

Table 13: Comparison of home range and habitat availability for Matters of National Environmental Significance (MNES) species identified as occurring, or possibly occurring, in 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
Bilby (*Macrotis lagotis*) (VU; VU)	18 ha (females) to 316 ha (males)	Previously recorded within survey area	Sandplains and interdune corridors dominated by *Triodia* within home ranges (represented within the survey area by the Sand Plain fauna habitat).	2,979.9 ha (67%)	Open tussock grassland on soft soils around sandplains and alluvial systems (represented within the survey area by the Mulga Woodland fauna habitat).	1,426.9 ha (32%)	**Recorded**	**Recorded**
Southern whiteface (*Aphelocephala leucopsis*) (VU)	Undetermined. Considered sedentary; however, individuals may move into wetter areas outside of their normal range during drought years.	<5 km	Relatively undisturbed open woodlands and shrublands with low tree densities and a herbaceous understorey litter cover which provides essential foraging habitat. Living and dead trees with hollows and crevices essential for roosting and nesting (represented within the survey area by the Mulga Woodland fauna habitat).	1,426.9 ha (32%)	Wide range of open woodlands and shrublands where there is an understorey of grasses or shrubs, or both (represented within the survey area by the fauna habitats of Sand Plain and Stony Plain).	2,997 ha (67%)	High	**Recorded**

4.2.4.3 Low Likelihood of Occurrence

An additional 32 species, including 26 MNES species, were considered to have a low post-survey likelihood of occurrence due primarily to a lack of suitable habitats (Table E.1, Appendix E).

The survey area is situated on the south-eastern boundary of the currently estimated northern quoll distribution (Department of the Environment and Energy 2016). No records of northern quoll were identified within 70 km of the survey area (Department of Biodiversity, Conservation and Attractions 2022a) or in recent surveys in the vicinity of the survey area (Biologic Environmental Survey 2018, 2022, GHD Pty Ltd 2019, 2021b, Astron Environmental Services 2022). Biologic (2022) conducted a recent targeted quoll survey and assessment approximately 10 km west of the current survey area and recorded no quolls from 5,390 camera trap nights. Their regional desktop assessment concluded a general absence of reliable and/or recent records within 100 km, and that the few, isolated records were likely of transient or dispersing males. Rocky habitats, such as ranges, escarpments, mesas, ranges, gorges, and breakaways, provide critical habitats for the northern quoll are absent within the survey area and generally absent within the vicinity of the survey area. Drainage lines provide supporting foraging and dispersal habitat and were similarly absent from the survey area. With the lack of rocky habitats, drainage lines and connectivity to core habitats, it is highly unlikely that the northern quoll is present within the survey area, despite potential foraging and dispersal habitat being present.

An extensive survey effort for the ghost bat has been undertaken in recent years across the Jimblebar/Caramulla region, with a number of observations recorded within this range (Biologic Environmental Survey 2018, GHD Pty Ltd 2019, 2021b). The nearest record to the survey area occurs approximately 25 km to the west (GHD Pty Ltd 2019, 2021b). No Pilbara leaf-nosed bat records were identified within 70 km of the survey area (Department of Biodiversity, Conservation and Attractions 2022a) or in previous surveys in the vicinity of the survey area (Biologic Environmental Survey 2018, GHD Pty Ltd 2019, 2021b, Astron Environmental Services 2022). 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. Given the lack of critical habitat and absence of nearby records, no significant population of either species is expected to occur in the survey area or immediate surrounds. Despite potential supporting foraging habitat being present within the survey area, it is unlikely that either species would regularly utilise the area for foraging or dispersal, given both the lack of calls of either species being recorded within the survey area during the current or previous surveys, and the closest previous record is approximately 25 km from the survey area. The survey area is considered toward the limit of both species' home ranges.

No previous Pilbara olive python records occur within the survey area or immediate surrounds. The closest Pilbara olive python records occur approximately 45 km west of the survey area, identified from scat records found in a cave (GHD Pty Ltd 2021b) and individuals recorded near Ophthalmia Dam (Department of Biodiversity, Conservation and Attractions 2022a, Matthew Love pers. comm.). This species is likely to be found within Gorge/Gully and Breakaway habitats, particularly those containing permanent or semi-permanent pools, and Major Drainage lines with persisting water catchments. No critical habitat is present in the survey area, nor suitable supporting foraging and dispersal habitat. The absence of connectivity to preferential habitat indicates an unlikeliness that this species occurs in the survey area.

No previous grey falcon records occur within the survey area or within 40 km of the survey area (Department of Biodiversity, Conservation and Attractions 2022a). The species occurs at low densities, with preferred habitat including Major Drainage habitats with suitably sized trees (critical habitat) and timbered lowland plains crossed by tree-lined watercourses (high value supporting habitat). With the lack of drainage lines and high value habitats within the survey area and immediate surrounds, the

likelihood of occurrence within the survey area is considered low, despite potential foraging and dispersal habitat being present.

The great desert skink is sparsely distributed across arid sand flats and clay-based or loamy soils vegetated with spinifex. Preferred habitat has at least 50% bare ground within a mosaic landscape of different aged vegetation and sites that have been burnt in the previous three to fifteen years. Suitable Sand Plain and Mulga Woodland habitat that may support great desert skink is present within the survey area, and historical records from 2010 and 2012 occur within 15 km of the survey area. However, despite extensive survey effort, the species has not been recently recorded in the vicinity of the survey area and a range contraction seems apparent within Western Australia, with detection failures in former stronghold areas of the Great Sandy, Great Victoria and Gibson Deserts (Threatened Species Scientific Committee 2016). The survey area occurs outside of the indicative (likely) current distribution of the species, and it is considered unlikely that this species currently occurs in the survey area or immediate surrounds.

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 30 ARU recording nights. The most prospective habitats, Sand Plain and Stony plain, did not support extensive old, large and unburnt Triodia clumps that are considered the primary requirement for roosting and nesting habitat (Department of Parks and Wildlife 2017). There are no known records within 70 km of the survey area (Department of Biodiversity, Conservation and Attractions 2022a), and it is considered unlikely that this species occurs in the survey area or immediate surrounds.

5 Discussion

5.1 Fauna Habitats

Habitats within the survey area are not restricted at the local or sub-regional scale, and no uncommon geological units or land systems occur within the survey area. The four broad habitats observed within the survey area are considered representative of each habitat type within the Pilbara and Gascoyne bioregions.

The Sand Plain habitat encompassed most of the survey area (67%) and is considered critical habitat for the MNES species bilby that may utilise this habitat for burrowing and active foraging. Soft soils for burrowing/digging coupled with presence of termite mounds, spinifex hummocks and *Acacia* roots provide suitable foraging ground for bilby (historical and potential unconfirmed usage recorded). The Sand Plain habitat also provides supporting habitat for the great desert skink (low likelihood) and southern whiteface (recorded). The soft soils and spinifex hummocks also provide preferential shelter and foraging habitat for listed species, such as brush-tailed mulgara (recorded) and spectacled hare-wallaby (moderate likelihood).

Mulga Woodland occupies a significant portion of the survey area (32%). Mulga Woodland within the survey area contain critical habitat attributes for MNES species southern whiteface (recorded) and the survey area occurs within the area where “species or species habitat may occur” (Department of Climate Change, Energy, the Environment and Water 2023). While providing refuge for an array of other terrestrial fauna, Mulga Woodlands are generally not considered as significant shelter, foraging and dispersal habitat for other MNES species. Mulga Woodland habitat was considered supporting (foraging) habitat for the great desert skink, and for the bilby, which will typically dig at the base of *Acacia* roots for invertebrate grubs (unconfirmed historical usage recorded). Mulga Woodland habitats are widespread and common within the surrounding area and wider region.

The remaining Hillcrest/Hillslope and Stony Plain habitats (<1%) of the survey area provide fewer niche microhabitats for MNES and other terrestrial fauna and are also widespread and locally common in the vicinity of the survey area and wider region.

5.2 Vertebrate Fauna Species

Seventy-two vertebrate fauna species, comprising one amphibian, six reptiles, 51 birds, and 14 mammals (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 Fortescue 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 (e.g. Biologic Environmental Survey 2018, Astron Environmental Services 2022). Larger and more intensive surveys from the region recorded an expectedly higher diversity of species, with more diverse fauna habitat types present and additional survey techniques employed (e.g. GHD Pty Ltd 2019).

5.2.1 Significant Species

Of the 38 significant species identified in the desktop assessment as occurring or potentially occurring in the survey area, five species (including three species recorded during the current survey) were considered to have a high likelihood of occurrence within the survey area. Recorded species include the bilby (VU; VU), southern whiteface (VU) and brush-tailed mulgara (P4). Significant species not recorded but with high post-survey likelihood of occurrence include the peregrine falcon (OS).

5.2.1.1 Target MNES Species

Extensive survey effort was undertaken to provide an indication of bilby presence within the survey area, including reassessment of a known (old) burrow record from 2018, and 24 targeted bilby plot searches and 36 camera trapping nights at ten locations across Sand Plain and Mulga Woodland habitat. Following extensive survey effort, potential signs of bilby were recorded via a (new) unconfirmed historical burrow at one location within Mulga Woodland and an unconfirmed potential recent digging within Sand Plain habitat.

The (new) unconfirmed historical burrow record comprises a low sandy rise in sandy habitat similar to the known burrow (but within Mulga Woodland), with several other burrows and mounds (burrow spoil) present. This record may also represent a relictual burrowing bettong warren, as suggested of the known burrow by GHD Pty Ltd (2019). The burrowing bettong has been extinct from the mainland since the 1940s (Short and Turner 2000); however bilby, monitor lizard and rabbit (and other species) may utilise their relictual warrens for sheltering and denning, which facilitates the persistence of such complexes in arid landscapes (up to 30 years plus) (Burbidge et al. 2007). No current bilby usage was evident at the location, and any historical usage is considered likely to be greater than 5 years old. The potential recent digging observed was characteristic in size and shape of typical bilby diggings (David Keirle pers. obs.); however, monitor tail marks were observed nearby, and no other bilby sign was observed in the vicinity. A camera was set on the digging and did not record any bilby activity. As such, the digging may represent bilby or, alternatively (more likely), an atypically shaped monitor lizard digging.

Critical bilby habitat, as well as supporting foraging and dispersal habitat, exists in the survey area; however, the survey area is considered unlikely to currently support a resident population of bilby. The area may periodically be utilised for foraging when conditions are optimal, as bilbies are known to move in response to foraging opportunities (Southgate et al. 2007, Southgate and Carthew 2008), but, due to the absence of contemporary (confirmed) records within the survey area and the surrounding area, such usage within the survey area would likely be highly irregular and opportunistic.

Suitable extensive Sand Plain habitat is present outside the survey area to the east and north and closer to areas of currently known and estimated bilby distribution.

The southern whiteface was recently listed as an MNES species (31 March 2023), and the survey area is at the northern edge of its distribution within suitable habitat types. The southern whiteface was recorded on one occasion within the survey area in Mulga Woodland habitat. This habitat type is common within the survey area and surrounds and is generally well represented throughout the region. The nearest record occurs approximately 4 km north-east of the survey area in similar habitat (Astron Environmental Services 2022), and the species is expected to occur within the survey area and surrounds, but not to be solely reliant on any of the habitats within.

The great desert skink is sparsely distributed across arid sand flats and clay-based or loamy soils vegetated with spinifex in the western deserts region of Central Australia (Threatened Species Scientific Committee 2016). The current survey area lies outside of the likely (indicative) current distribution of the species but within the area where "species or species habitat may occur" (Department of Agriculture, Water and the Environment 2022), and suitable Sand Plain and Mulga Woodland habitat that may support this species is present within the survey area. Historical records from 2010 and 2012 occur within 15 km of the survey area (Department of Biodiversity, Conservation and Attractions 2022a); however, the species has not been recently recorded in the vicinity of the survey area, despite extensive survey effort, and a range contraction seems apparent within Western Australia, with detection failures in former stronghold areas of the Great Sandy, Great Victoria and Gibson Deserts (Threatened Species Scientific Committee 2016). The post-survey assessment downgraded the species' likelihood of occurrence from high to low due to a lack of current and recent records within the survey area and surrounds, despite extensive survey effort, and the currently understood distribution of the species.

The Pilbara olive python, ghost bat, grey falcon, and northern quoll were originally considered as having a moderate likelihood of occurrence during the desktop assessment, as all species have previously been recorded within the prescribed database search area (but not the survey area) and potential suitable habitat may have been present. The post-survey assessment downgraded these species' likelihood of occurrence to low due to a lack of suitable preferred habitat within the survey area. The Pilbara leaf-nosed bat and night parrot were considered to have a low likelihood of occurrence during the desktop assessment due to a lack of historical records in the vicinity of the survey area and the lack of potential suitable habitat.

5.2.1.2 Other Significant Species

The brush-tailed mulgara was recorded on 16 occasions at 14 locations (nine active and five inactive burrows and two camera records, all within Sand Plain habitat), as well as seven recent records within the survey area (Biologic Environmental Survey 2018, GHD Pty Ltd 2021a), and numerous additional records occur within the vicinity of the current survey area (Astron Environmental Services 2022, Department of Biodiversity, Conservation and Attractions 2022a). As such, the Sand Plain habitats of the survey area and surrounds are likely to support this species. Suitable habitats for the brush-tailed mulgara are not consistent throughout the bioregion but are common in areas adjacent to and east of the survey area.

The peregrine falcon was not recorded during the survey; however, likelihood of occurrence is considered high, given previous records in the vicinity and potential foraging habitat being present within the survey area. This species would be expected to utilise the survey area on occasion but not be entirely reliant on any habitats within.

The western pebble-mound mouse was not recorded during the survey; however, likelihood of occurrence is considered moderate, given several previous records in proximity to the survey area, and suitable habitat types (Hillcrest/Hillslope and Stony Plain) being present within the survey area and surrounds. Similarly, the spectacled hare-wallaby was not recorded during the survey; however, likelihood of occurrence is considered moderate, given that suitable Sand Plain habitat comprises the majority of the survey area and a previous record with habitat connectivity (date unknown) occurs within 20 km.

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Appendix A: Background Information Figures

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225000 230000 235000 240000

7415000

7410000

Survey Area

QUATERNARY
- Qa
- Qrc - colluvium 38491

CENOZOIC
- Czs

MESOPROTEROZOIC
- Msms

PALEOPROTEROZOIC
- Lchk - Brockman Iron Formation
- Lfhw - Woongarra Rhyolite
- Lchw - Weeli Wolli Formation
- Lchb - Boolgeeda Iron Formation

ARCHEAN
- Awfj - Jeerinah Formation
- Achm - Marra Mamba Iron Formation
- Ag - felsic intrusives 74292
- Au

Qrc Qa Msms Lchb Lfhw Lchw Lchk Achm Awfj Au Ag Czs

BHP Western Australian Iron Ore
East Caramulla and Thirteen Creek Targeted Significant Fauna Survey

Figure A.1: Geological units of the survey area

Scale: 1:50,000 at A3
Coordinate System: GDA 1994 MGA Zone 51
0 1 2 3 Kilometres

N

astron an ecocene company

Author: D. Keirle | Drawn: C. Dyde | Date: 14-06-2023 | Figure Ref: 2400-09-22-BIDR-1RevA_230614_FigA1_Geo

225000 230000 235000 240000

7415000

7410000

DIV FRT WSP BOO ROB NEW JAM CDG MCK RIV TLG ZBR SLV

Survey Area

Land System

- Boolgeeda System
- Cadgie System
- Divide System
- Fortescue System
- Jamindie System
- McKay System
- Newman System
- River System
- Robertson System
- Sylvania System
- Talga System
- Washplain System
- Zebra System

BHP Western Australian Iron Ore
East Caramulla and Thirteen Creek Targeted Significant Fauna Survey

Figure A.2: Land systems of the survey area

Scale: 1:50,000 at A3
Coordinate System: GDA 1994 MGA Zone 51
0 1 2 3 Kilometres

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an ecocene company

Author: D. Keirle | Drawn: C. Dyde | Date: 14-06-2023 | Figure Ref: 2400-09-22-BIDR-1RevA_230614_FigA2_LS

225000
230000
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Survey Area

Pre-European Vegetation

- FORTESCUE VALLEY_111
- FORTESCUE VALLEY_199
- FORTESCUE VALLEY_29
- FORTESCUE VALLEY_82
- KUMARINA HILLS_111
- KUMARINA HILLS_157
- KUMARINA HILLS_18
- KUMARINA HILLS_216
- KUMARINA HILLS_29

BHP Western Australian Iron Ore
East Caramulla and Thirteen Creek Targeted Significant Fauna Survey

Figure A.3: Pre-European vegetation of the survey area

Scale: 1:50,000 at A3
Coordinate System: GDA 1994 MGA Zone 51
0 1 2 3 Kilometres

N

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an ecocene company

Author: D. Keirle | Drawn: C. Dyde | Date: 14-06-2023 | Figure Ref: 2400-09-22-BIDR-1RevA_230614_FigA3_PEV

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

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

Likelihood of occurrence	Pre-survey (BHP 2023)	Post-survey
Recorded	Individuals or signs of individuals recorded in the survey area during previous surveys.	Species or evidence of species recorded during survey.
High	Suitable habitat is, or has the potential to be present within the survey area. OR Species is cryptic and suitable habitat is present but may not have been previously recorded. OR Species has been recorded within 20 km of the survey area.	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	Suitable habitat for the species is, or has the potential to be, present but is in poor condition, limited in extent or isolated and discontinuous.	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	Suitable habitat is not present within the survey area. OR Species has not been previously recorded within 20 km of survey area despite adequate survey effort. OR Survey area is not within the species' known distribution and/or the species is considered locally extinct.	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.

Reference: BHP, 2023, *Vertebrate Fauna Surveys in Western Australia – Technical Process Instruction*.

Table B.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 affected 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 B.8: Suitability/significance of habitat ranking criteria for the eight target Matters of National Environmental Significance (MNES) species based on BHP (2023) and Department of Climate Change, Energy, the Environment and Water (2023).

Species	Critical habitat (a)	Supporting habitat (b)	Limited foraging and dispersal habitat (c)
Great desert skink *(Liopholis kintorei)*	Incomplete distribution data make it currently impossible to define critical habitat, it is possible to describe commonalities in the habitats occupied by known populations. • Generally, occur on hummock grass sandplains and some adjacent dunefield swales. • Tanami Desert and parts of the Great Sandy Desert; paleodrainage lines characterised by lateritic soils, giant termite mounds, and tea tree (*Melaleuca* spp.) shrubs. • Watarru (in northern South Australia) was located in an area of open mulga (*Acacia aneura*) and minyura (*Acacia minyura*) woodland over woollybutt grass (*Eragrostis eriopoda*) and spinifex. • Habitat that has been burnt within the previous 3- 15 years.	• Habitat that is under 3 years since burnt and over 15 years burnt.	Habitat that has limited sheltering and foraging capacity.
Pilbara olive python (*Liasis olivaceus barroni*)	• Rocky outcrops in proximity to deep gorges, gullies, and water holes within home range (88 – 450 ha). • Dense riparian vegetated sites in association with permanent wetlands (spring fed) within the home range of the individual.	• 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 foraging and dispersal habitat (c)
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, • 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 sized 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* spp. shrublands that are crossed by tree-lined water courses. • Hunting in treeless areas, particularly tussock grassland and open woodland.	Habitat that has limited nesting, roosting and foraging potential for the grey falcon.
Southern whiteface (*Aphelocephala leucopsis*)	• Relatively undisturbed open woodlands and shrublands with an understorey of grasses or shrubs, or both. • Habitat with low tree densities and an herbaceous understory litter cover which provides essential foraging habitat. • Living and dead trees with hollows and crevices which are essential for roosting and nesting.	• Wide range of open woodlands and shrublands where there is an understorey of grasses or shrubs, or both. • Habitats dominated by acacias or eucalypts on ranges, foothills and lowlands, and plains	Habitat that has limited nesting, roosting and foraging potential for the southern whiteface.

Species	Critical habitat (a)	Supporting habitat (b)	Limited foraging and dispersal habitat (c)
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.
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.	• 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.

Species	Critical habitat (a)	Supporting habitat (b)	Limited foraging and dispersal habitat (c)
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 more Category 2 cave(s). These may be abandoned underground mines. • 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	• 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	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 foraging and dispersal habitat (c)
	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 • granite top rockpiles in the eastern Pilbara	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	

Reference: BHP, 2023, *Vertebrate Fauna Surveys in Western Australia – Technical Process Instruction*. Department of Climate Change, Energy, the Environment and Water. 2023. Conservation Advice for *Aphelocephala leucopsis* (southern whiteface).

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Appendix C: Survey Sampling Locations

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EC-AU01 EC-CAM08 EC-BP08 EC-CAM06 EC-BLS01 EC-BP04 EC-BAT03 EC-HA03 EC-BP24 EC-BAT02 EC-BP23 EC-BP10 EC-HA09 EC-BP12 EC-BAT05 EC-CAM07 EC-BP09 EC-BP07 EC-HA19 EC-HA18 EC-HA07 EC-BP03 EC-CAM04 EC-AU04 EC-HA01 EC-BP01 EC-HA08 EC-HA06 EC-CAM05 EC-CAM03 EC-HA11 EC-HA02 EC-BP13 EC-BP20 EC-BP22 EC-AU03 EC-HA04 EC-BP18 EC-HA14 EC-HA15 EC-HA16 EC-HA17 EC-CAM02 EC-BP05 EC-BP11 EC-HA10 EC-AU02 EC-CAM10 EC-AU05 EC-BP21 EC-CAM09 EC-BP15 EC-BP14 EC-BP16 EC-BP17 EC-HA13 EC-BP19 EC-CAM01 EC-BAT04 EC-BAT01 EC-HA12 EC-BP02 EC-HA05 EC-BP06

GPS Tracklog

Survey Area

Sampling Site

- Acoustic Recording
- Camera (passive)
- Echolocation Recording
- Habitat Assessment
- Targeted Searches (bilby plot)

BHP Western Australian Iron Ore

East Caramulla and Thirteen Creek Targeted Significant Fauna Survey

Figure C.1: Fauna sampling locations

Scale: 1:35,000 at A3

Coordinate System: GDA 1994 MGA Zone 51

0 500 1,000 1,500 2,000 Metres

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Author: D. Keirle | Drawn: C. Dyde | Date: 14-06-2023 | Figure Ref: 2400-09-22-BIDR-1RevA_230614_FigC1_Sites

Table C.1: Fauna sampling locations.

Site ID	Latitude	Longitude	Sampling method	Date	Habitat	Condition^	Disturbance	Microhabitats	Photo
EC-HA01	-23.3705	120.3487	Habitat Assessment	26/04/2023	Stony Plain	1.0	None discernible	Old *Triodia*	
EC-HA02	-23.3744	120.3765	Habitat Assessment	26/04/2023	Sand Plain	1.0	None discernible	Soft soil (burrows), old *Triodia*	
EC-HA03	-23.3641	120.4362	Habitat Assessment	27/04/2023	Mulga Woodland	0.6	Cattle Grazing	Tree hollows, soft soil (burrows), old *Triodia*, leaf litter, termite mounds	
EC-HA04	-23.3787	120.4457	Habitat Assessment	28/04/2023	Sand Plain	0.8	Cattle Grazing	Soft soil (burrows), old *Triodia*, leaf litter, termite mounds	
EC-HA05	-23.3964	120.4212	Habitat Assessment	28/04/2023	Mulga Woodland	0.8	Cattle Grazing	Tree hollows, soft soil (burrows), old *Triodia*, leaf litter, termite mounds	

Site ID	Latitude	Longitude	Sampling method	Date	Habitat	Condition^	Disturbance	Microhabitats	Photo
EC-HA06	-23.3719	120.4304	Habitat Assessment	28/04/2023	Mulga Woodland	0.8	Cattle Grazing	Tree hollows, soft soil (burrows), old *Triodia*, leaf litter, termite mounds	
EC-HA07	-23.3695	120.4149	Habitat Assessment	28/04/2023	Sand Plain	1.0	None Discernible	Tree hollows, soft soil (burrows), old *Triodia*, leaf litter, termite mounds	
EC-HA08	-23.3711	120.4088	Habitat Assessment	28/04/2023	Sand Plain	0.8	Mining Exploration	Soft soil (burrows), old *Triodia*, leaf litter, termite mounds	
EC-HA09	-23.3653	120.3736	Habitat Assessment	28/04/2023	Mulga Woodland	1.0	Road/Access Track	Logs, soft soil (burrows), old *Triodia*, leaf litter, termite mounds	
EC-HA10	-23.3818	120.3749	Habitat Assessment	28/04/2023	Sand Plain	1.0	None Discernible	Soft soil (burrows), old *Triodia*, leaf litter, termite mounds	

Site ID	Latitude	Longitude	Sampling method	Date	Habitat	Condition^	Disturbance	Microhabitats	Photo
EC-HA11	-23.3732	120.3376	Habitat Assessment	29/04/2023	Sand Plain	1.0	None Discernible	Soft soil (burrows), old *Triodia*, leaf litter, termite mounds	
EC-HA12	-23.3899	120.3321	Habitat Assessment	29/04/2023	Hillcrest/Hillslope	0.8	Mining Exploration, Road/Access Track	Old *Triodia*, termite mounds	
EC-HA13	-23.3839	120.3908	Habitat Assessment	29/04/2023	Sand Plain	1.0	None Discernible	Soft soil (burrows), old *Triodia*, leaf litter, termite mounds	
EC-HA14	-23.3779	120.3792	Habitat Assessment	29/04/2023	Sand Plain	1.0	None Discernible	Soft soil (burrows), old *Triodia*, leaf litter, termite mounds	
EC-HA15	-23.3784	120.3991	Habitat Assessment	30/04/2023	Sand Plain	1.0	None Discernible	Soft soil (burrows), old *Triodia*, leaf litter, termite mounds	

Site ID	Latitude	Longitude	Sampling method	Date	Habitat	Condition^	Disturbance	Microhabitats	Photo
EC-HA16	-23.3789	120.4188	Habitat Assessment	30/04/2023	Mulga Woodland	1.0	None Discernible	Tree hollows, soft soil (burrows), old *Triodia*, leaf litter, termite mounds	
EC-HA17	-23.3788	120.4243	Habitat Assessment	30/04/2023	Mulga Woodland	1.0	None Discernible	Tree hollows, soft soil (burrows), old *Triodia*, leaf litter, termite mounds	
EC-HA18	-23.3685	120.3572	Habitat Assessment	30/04/2023	Sand Plain	1.0	None Discernible	Soft soil (burrows), old *Triodia*, leaf litter, termite mounds	
EC-HA19	-23.3688	120.3427	Habitat Assessment	30/04/2023	Sand Plain	1.0	None Discernible	Soft soil (burrows), old *Triodia*, leaf litter, termite mounds	
EC-BLS01	-23.3595	120.4043	Targeted Search (bilby)	1/05/2023	Sand Plain	1.0	Mining Exploration	Soft soil (burrows), old *Triodia*, leaf litter, termite mounds	

Site ID	Latitude	Longitude	Sampling method	Date	Habitat	Condition^	Disturbance	Microhabitats	Photo
EC-BP01	-23.3712	120.3795	Targeted Search (bilby)	27/04/2023	Sand Plain	1.0	None Discernible	Logs, soft soil (burrows), old *Triodia*, termite mounds	
EC-BP02	-23.3946	120.4096	Targeted Search (bilby)	27/04/2023	Sand Plain	1.0	Road/ Access Track	Soft soil (burrows), old *Triodia*	
EC-BP03	-23.3698	120.4368	Targeted Search (bilby)	27/04/2023	Sand Plain	1.0	None Discernible	Soft soil (burrows), old *Triodia*, termite mounds	
EC-BP04	-23.3602	120.4203	Targeted Search (bilby)	27/04/2023	Sand Plain	1.0	Mining Exploration	Soft soil (burrows), old *Triodia*, termite mounds	
EC-BP05	-23.3812	120.4482	Targeted Search (bilby)	28/04/2023	Sand Plain	1.0	None Discernible	Soft soil (burrows), old *Triodia*	

Site ID	Latitude	Longitude	Sampling method	Date	Habitat	Condition^	Disturbance	Microhabitats	Photo
EC-BP06	-23.3980	120.4176	Targeted Search (bilby)	28/04/2023	Sand Plain	1.0	None Discernible	Logs, soft soil (burrows), old *Triodia*	
EC-BP07	-23.3672	120.4160	Targeted Search (bilby)	28/04/2023	Sand Plain	1.0	None Discernible	Tree hollows, soft soil (burrows), old *Triodia*, leaf litter, termite mounds	
EC-BP08	-23.3575	120.4066	Targeted Search (bilby)	28/04/2023	Sand Plain	1.0	None Discernible	Soft soil (burrows), old *Triodia*, leaf litter, termite mounds	
EC-BP09	-23.3679	120.3958	Targeted Search (bilby)	28/04/2023	Sand Plain	1.0	None Discernible	Soft soil (burrows), old *Triodia*, leaf litter, termite mounds	
EC-BP10	-23.3661	120.3721	Targeted Search (bilby)	28/04/2023	Mulga Woodland	1.0	None Discernible	Logs, soft soil (burrows), old *Triodia*, leaf litter, termite mounds	

Site ID	Latitude	Longitude	Sampling method	Date	Habitat	Condition^	Disturbance	Microhabitats	Photo
EC-BP11	-23.3813	120.3730	Targeted Search (bilby)	28/04/2023	Sand Plain	1.0	None Discernible	Soft soil (burrows), old *Triodia*, leaf litter, termite mounds	
EC-BP12	-23.3677	120.3314	Targeted Search (bilby)	29/04/2023	Mulga Woodland	1.0	None Discernible	Logs, soft soil (burrows), old *Triodia*, leaf litter, termite mounds	
EC-BP13	-23.3760	120.3361	Targeted Search (bilby)	29/04/2023	Sand Plain	1.0	None Discernible	Soft soil (burrows), old *Triodia*, leaf litter, termite mounds	
EC-BP14	-23.3834	120.3398	Targeted Search (bilby)	29/04/2023	Sand Plain	1.0	None Discernible	Soft soil (burrows), old *Triodia*, leaf litter, termite mounds	
EC-BP15	-23.3823	120.3565	Targeted Search (bilby)	29/04/2023	Mulga Woodland	1.0	None Discernible	Logs, soft soil (burrows), old *Triodia*, leaf litter, termite mounds	

Site ID	Latitude	Longitude	Sampling method	Date	Habitat	Condition^	Disturbance	Microhabitats	Photo
EC-BP16	-23.3838	120.3808	Targeted Search (bilby)	29/04/2023	Sand Plain	1.0	None Discernible	Soft soil (burrows), old *Triodia*, leaf litter, termite mounds	
EC-BP17	-23.3848	120.3882	Targeted Search (bilby)	29/04/2023	Sand Plain	1.0	None Discernible	Soft soil (burrows), old *Triodia*, leaf litter, termite mounds	
EC-BP18	-23.3778	120.3761	Targeted Search (bilby)	29/04/2023	Sand Plain	1.0	None Discernible	Soft soil (burrows), old *Triodia*, termite mounds	
EC-BP19	-23.3840	120.3942	Targeted Search (bilby)	30/04/2023	Sand Plain	1.0	None Discernible	Soft soil (burrows), old *Triodia*, termite mounds	
EC-BP20	-23.3770	120.4002	Targeted Search (bilby)	30/04/2023	Sand Plain	1.0	None Discernible	Soft soil (burrows), old *Triodia*, termite mounds	

Site ID	Latitude	Longitude	Sampling method	Date	Habitat	Condition^	Disturbance	Microhabitats	Photo
EC-BP21	-23.3836	120.4175	Targeted Search (bilby)	30/04/2023	Mulga Woodland	0.8	Mining Exploration	Soft soil (burrows), leaf litter, termite mounds	
EC-BP22	-23.3781	120.4206	Targeted Search (bilby)	30/04/2023	Mulga Woodland	1.0	None Discernible	Soft soil (burrows), old *Triodia*, leaf litter, termite mounds	
EC-BP23	-23.3659	120.3580	Targeted Search (bilby)	30/04/2023	Sand Plain	1.0	None Discernible	Tree hollows, soft soil (burrows), old *Triodia*, leaf litter, termite mounds	
EC-BP24	-23.3660	120.3441	Targeted Search (bilby)	30/04/2023	Sand Plain	1.0	None Discernible	Tree hollows, soft soil (burrows), old *Triodia*, leaf litter, termite mounds	
EC-CAM01	-23.3843	120.3578	Camera (passive)	26/04/2023 – 01/05/2023	Mulga Woodland (targeting bilby, mulgara)	0.8	Mining Exploration, Road/Access Track	Logs, soft soil (burrows), old *Triodia*, leaf litter, termite mounds, artificial water source	

Site ID	Latitude	Longitude	Sampling method	Date	Habitat	Condition^	Disturbance	Microhabitats	Photo
EC-CAM02	-23.3784	120.4404	Camera (passive)	26/04/2023 – 02/05/2023	Sand Plain (targeting bilby, mulgara)	1.0	None Discernible	Soft soil (burrows), old *Triodia*, termite mounds	
EC-CAM03	-23.3713	120.3794	Camera (passive)	27/04/2023 – 01/05/2023	Sand Plain (targeting bilby, mulgara)	1.0	None Discernible	Soft soil (burrows), old *Triodia*, leaf litter, termite mounds	
EC-CAM04	-23.3707	120.4373	Camera (passive)	27/04/2023 – 01/05/2023	Sand Plain (targeting bilby, mulgara)	0.8	Cattle Grazing	Soft soil (burrows), old *Triodia*, termite mounds	
EC-CAM05	-23.3712	120.4380	Camera (passive)	27/04/2023 – 01/05/2023	Sand Plain (targeting bilby, mulgara)	1.0	None Discernible	Logs, soft soil (burrows), old *Triodia*, termite mounds	
EC-CAM06	-23.3576	120.4048	Camera (passive)	28/04/2023 – 01/05/2023	Sand Plain (targeting bilby, mulgara)	0.8	Road/Access Track	Soft soil (burrows), old *Triodia*, termite mounds	

Site ID	Latitude	Longitude	Sampling method	Date	Habitat	Condition^	Disturbance	Microhabitats	Photo
EC-CAM07	-23.3664	120.3694	Camera (passive)	28/04/2023 – 01/05/2023	Sand Plain (targeting bilby, mulgara)	1.0	None Discernible	Soft soil (burrows), old *Triodia*, termite mounds	
EC-CAM08	-23.3573	120.4071	Camera (passive)	28/04/2023 – 01/05/2023	Sand Plain (targeting bilby, mulgara)	1.0	None Discernible	Soft soil (burrows), old *Triodia*, leaf litter, termite mounds	
EC-CAM09	-23.3816	120.3558	Camera (passive)	29/04/2023 – 01/05/2023	Mulga Woodland (targeting bilby, mulgara)	1.0	None Discernible	Soft soil (burrows), old *Triodia*, leaf litter, termite mounds	
EC-CAM10	-23.3811	120.3955	Camera (passive)	30/04/2023 – 02/05/2023	Sand Plain (targeting bilby, mulgara)	1.0	None Discernible	Soft soil (burrows), old *Triodia*, leaf litter, termite mounds	
EC-AU01	-23.3549	120.4150	Acoustic Recording	26/04/2023 – 02/05/2023	Sand Plain (targeting night parrot)	1.0	None Discernible	Soft soil (burrows), old *Triodia*, termite mounds	

Site ID	Latitude	Longitude	Sampling method	Date	Habitat	Condition^	Disturbance	Microhabitats	Photo
EC-AU02	-23.3820	120.3774	Acoustic Recording	26/04/2023 – 02/05/2023	Sand Plain (targeting night parrot)	1.0	None Discernible	Soft soil (burrows), old *Triodia*, termite mounds	
EC-AU03	-23.3784	120.4412	Acoustic Recording	26/04/2023 – 02/05/2023	Sand Plain (targeting night parrot)	1.0	None Discernible	Soft soil (burrows), old *Triodia*, termite mounds	
EC-AU04	-23.3710	120.3468	Acoustic Recording	26/04/2023 – 02/05/2023	Sand Plain (targeting night parrot)	1.0	None Discernible	Soft soil (burrows), old *Triodia*, termite mounds	
EC-AU05	-23.3822	120.3987	Acoustic Recording	26/04/2023 – 02/05/2023	Sand Plain (targeting night parrot)	1.0	None Discernible	Soft soil (burrows), old *Triodia*, termite mounds	
EC-BAT01	-23.3887	120.3538	Echolocation Recording	26/04/2023 – 29/04/2023	Mulga Woodland (targeting ghost bat, Pilbara leaf-nosed bat)	0.6	Mining Exploration, Road/Access Track	Logs, soft soil (burrows), old *Triodia*, leaf litter, termite mounds, artificial water source	

Site ID	Latitude	Longitude	Sampling method	Date	Habitat	Condition^	Disturbance	Microhabitats	Photo
EC-BAT02	-23.3653	120.3460	Echolocation Recording	27/04/2023 – 01/05/2023	Sand Plain (targeting ghost bat, Pilbara leaf-nosed bat)	1.0	None Discernible	Soft soil (burrows), old *Triodia*, termite mounds	
EC-BAT03	-23.3640	120.4299	Echolocation Recording	27/04/2023 – 01/05/2023	Mulga Woodland (targeting ghost bat, Pilbara leaf-nosed bat)	0.8	Cattle Grazing	Tree hollows, soft soil (burrows), old *Triodia*, leaf litter, termite mounds	
EC-BAT04	-23.3887	120.4202	Echolocation Recording	27/04/2023 – 01/05/2023	Mulga Woodland (targeting ghost bat, Pilbara leaf-nosed bat)	1.0	Road/Access Track	Logs, soft soil (burrows), termite mounds	
EC-BAT05	-23.3674	120.3327	Echolocation Recording	29/04/2023 – 02/05/2023	Mulga Woodland (targeting ghost bat, Pilbara leaf-nosed bat)	0.8	Weed Invasion	Tree hollows, soft soil (burrows), old *Triodia*, leaf litter, termite mounds	

^ Note: 1.0 (Excellent)
0.8 (Very Good)
0.6 (Good)
0.4 (Poor)
0.2 (Very Poor)
0.1 (Completely Degraded)

Appendix D: Fauna Species Lists

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Table D.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 Survey	Current Survey
			EPBC Act	BC Act	DBCA Priority Fauna List						
Pelodryadidae											
Cyclorana maini	Sheep frog					X				X	
Cyclorana occidentalis	Western water-holding frog					X				X	
Litoria rubella	Little red tree frog					X				X	X
Limnodynastidae											
Notaden nichollsi	Desert spadefoot					X					
Platyplectrum spenceri	Centralian burrowing frog					X					
Myobatrachidae											
Uperoleia saxatilis	Pilbara toadlet					X				X	

Note: EPBC Act = *Environment Protection and Biodiversity Conservation Act 1999*; BC Act = *Biodiversity and Conservation Act 2016; DBCA* = Department of Biodiversity, Conservation and Attractions; ALA = Atlas of Living Australia; EPBC PMST = Environment Protection and Biodiversity Conservation Protected Matters Search Tool; T and P = Threatened and Priority.

Table D.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 Survey	Current Survey
			EPBC Act	BC Act	DBCA Priority Fauna List						
Chelidae											
Chelodina steindachneri	Flat-shelled turtle					X					
Diplodactylidae											
Diplodactylus conspicillatus	Variable Fat-tailed Gecko					X	X			X	
Diplodactylus laevis	Desert Fat-tailed Gecko									X	
Diplodactylus pulcher						X					
Lucasium stenodactylus						X	X			X	
Lucasium wombeyi						X					
Lucasium woodwardi						X				X	
Oedura fimbria	Western marbled velvet gecko					X					
Rhynchoedura ornata	Western beaked gecko					X	X			X	
Strophurus ciliaris										X	
Strophurus elderi						X				X	
Strophurus jeanae						X				X	
Strophurus wellingtonae						X				X	
Gekkonidae											
Gehyra fenestrula	Hamersley Range spotted gehyra									X	
Gehyra pilbara						X					
Gehyra punctata						X				X	

Scientific Name	Common Name	Introduced	Conservation Codes			NatureMap	ALA	EPBC PMST	DBCA T and P	Previous Survey	Current Survey
			EPBC Act	BC Act	DBCA Priority Fauna List						
Gehyra purpurascens										X	
Gehyra variegata						X				X	X
Heteronotia binoei	Bynoe's gecko					X				X	
Heteronotia spelea	Pilbara cave gecko					X				X	
Pygopodidae											
Delma butleri										X	
Delma desmosa						X					
Delma elegans						X					
Delma nasuta						X				X	
Delma pax						X					
Delma tincta						X					
Lialis burtonis						X	X			X	
Pygopus nigriceps						X					
Agamidae											
Ctenophorus caudicinctus	Western ring-tailed dragon					X				X	
Ctenophorus isolepis gularis	Central military dragon					X	X			X	
Ctenophorus isolepis isolepis	Central military dragon					X	X			X	X
Ctenophorus nuchalis	Central netted dragon					X	X			X	
Ctenophorus reticulatus	Western netted dragon					X					
Diporiphora amphiboluroides	Mulga dragon					X				X	
Gowidon longirostris	Long-nosed dragon					X	X			X	

Scientific Name	Common Name	Introduced	Conservation Codes			NatureMap	ALA	EPBC PMST	DBCA T and P	Previous Survey	Current Survey
			EPBC Act	BC Act	DBCA Priority Fauna List						
Moloch horridus	Thorny devil					X					X
Pogona minor minor	Western bearded dragon					X					
Scincidae											
Carlia triacantha						X					
Cryptoblepharus buchananii						X				X	
Cryptoblepharus ustulatus						X					
Ctenotus ariadnae						X	X			X	X
Ctenotus duricola	Eastern Pilbara lined ctenotus					X				X	
Ctenotus grandis titan						X				X	
Ctenotus hanloni						X				X	
Ctenotus helenae						X				X	
Ctenotus leonhardii						X				X	
Ctenotus pantherinus						X				X	
Ctenotus piankai	Coarse sands ctenotus					X					
Ctenotus quattuordecimlineatus						X					
Ctenotus rutilans						X					
Ctenotus saxatilis	Rock ctenotus					X				X	
Ctenotus schomburgkii						X					
Ctenotus uber johnstonei					P2	X			X		
Ctenotus uber uber						X				X	

Scientific Name	Common Name	Introduced	Conservation Codes			NatureMap	ALA	EPBC PMST	DBCA T and P	Previous Survey	Current Survey
			EPBC Act	BC Act	DBCA Priority Fauna List						
Cyclodomorphus melanops melanops						X					
Egernia cygnitos	Western Pilbara spiny-tailed skink					X				X	
Egernia depressa	Southern pygmy spiny-tailed skink					X					
Eremiascincus richardsonii	Broad-banded sand swimmer					X				X	
Lerista bipes						X	X			X	
Lerista chalybura											
Lerista flammicauda						X					
Lerista macropisthopus remota					P2	X			X		
Lerista muelleri						X				X	
Lerista neander						X				X	
Lerista timida						X				X	
Liopholis kintorei	Great desert skink		VU	VU				X	X		
Liopholis striata	Night skink					X					
Menetia greyii						X				X	
Menetia surda surda						X					
Morethia ruficauda exquisita						X				X	
Notoscincus ornatus ornatus						X					
Tiliqua multifasciata	Central bluetongue					X				X	

Scientific Name	Common Name	Introduced	Conservation Codes			NatureMap	ALA	EPBC PMST	DBCA T and P	Previous Survey	Current Survey
			EPBC Act	BC Act	DBCA Priority Fauna List						
Varanidae											
Varanus acanthurus	Spiny-tailed goanna					X				X	
Varanus brevicauda	Short-tailed pygmy goanna					X					
Varanus caudolineatus						X				X	
Varanus eremius	Pygmy desert goanna					X	X			X	
Varanus giganteus	Perentie					X				X	
Varanus gouldii	Bungarra or sand goanna					X				X	X
Varanus panoptes rubidus						X				X	
Varanus pilbarensis	Northern Pilbara rock goanna					X					
Varanus tristis	Racehorse goanna					X					
Typhlopidae											
Anilios ganei					P1	X			X		
Anilios grypus						X					
Anilios hamatus						X					
Anilios pilbarensis						X					
Pythonidae											
Antaresia childreni	Children's python									X	
Antaresia perthensis	Pygmy python					X				X	
Aspidites melanocephalus	Black-headed python									X	
Aspidites ramsayi	Woma				P1					X	

Scientific Name	Common Name	Introduced	Conservation Codes			NatureMap	ALA	EPBC PMST	DBCA T and P	Previous Survey	Current Survey
			EPBC Act	BC Act	DBCA Priority Fauna List						
Liasis olivaceus barroni	Pilbara Olive python		VU	VU				X	X	X	
Elapidae											
Brachyurophis approximans						X					
Demansia psammophis cupreiceps						X				X	
Furina ornata	Moon snake									X	
Pseudechis australis	Mulga snake					X				X	X
Pseudonaja mengdeni	Western brown snake					X				X	
Pseudonaja modesta	Ringed brown snake					X					
Pseudonaja nuchalis	Gwardar, northern brown snake					X					
Suta fasciata	Rosen's snake					X				X	
Suta punctata	Spotted Snake					X					

Note: EPBC Act = Environment Protection and Biodiversity Conservation Act 1999; BC Act = Biodiversity and Conservation Act 2016; DBCA = Department of Biodiversity, Conservation and Attractions; ALA = Atlas of Living Australia; EPBC PMST = Environment Protection and Biodiversity Conservation Protected Matters Search Tool; T and P = Threatened and Priority.

Table D.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 Survey	Current Survey
			EPBC Act	BC Act	DBCA Priority Fauna List							
Dromaiidae												
Dromaius novaehollandiae	Emu					X	X			X	X	X
Anseranatidae												
Anseranas semipalmata	Magpie goose									X		
Anatidae												
Anas gracilis	Grey teal					X	X			X		
Anas rhynchotis	Australasian shoveler									X		
Anas superciliosa	Pacific black duck						X			X	X	
Aythya australis	Hardhead						X			X		
Biziura lobata	Musk duck									X		
Chenonetta jubata	Australian wood duck						X			X		
Cygnus atratus	Black swan						X			X	X	
Dendrocygna arcuata	Wandering whistling duck									X		
Dendrocygna eytoni	Plumed whistling duck						X			X		
Malacorhynchus membranaceus	Pink-eared duck						X			X		
Stictonetta naevosa	Freckled duck									X		
Tadorna tadornoides	Australian shelduck					X	X			X		

Scientific Name	Common Name	Introduced	Conservation Codes			NatureMap	ALA	EPBC PMST	DBCA T and P	Birdata	Previous Survey	Current Survey
			EPBC Act	BC Act	DBCA Priority Fauna List							
Phasianidae												
Coturnix pectoralis	Stubble quail					X	X					X
Coturnix ypsilophora	Brown quail						X			X	X	X
Podicipedidae												
Podiceps cristatus	Great crested grebe									X		
Poliocephalus poliocephalus	Hoary-headed grebe						X			X		
Tachybaptus novaehollandiae	Australasian grebe (black-throated grebe)						X			X		
Ciconiidae												
Ephippiorhynchus asiaticus	Black-necked stork									X		
Threskiornithidae												
Platalea regia	Royal spoonbill									X		
Platalea flavipes	Yellow-billed spoonbill						X			X		
Plegadis falcinellus	Glossy ibis		MI	MI			X		X	X		
Threskiornis moluccus	Australian white ibis									X		
Threskiornis spinicollis	Straw-necked ibis						X			X		
Ardeidae												
Ardea ibis	Cattle egret						X	X		X		
Ardea intermedia	Intermediate egret									X		
Ardea modesta	Eastern great egret	-					X			X		

Scientific Name	Common Name	Introduced	Conservation Codes			NatureMap	ALA	EPBC PMST	DBCA T and P	Birdata	Previous Survey	Current Survey
			EPBC Act	BC Act	DBCA Priority Fauna List							
Ardea pacifica	White-necked heron					X	X			X	X	
Egretta garzetta	Little egret						X			X		
Egretta novaehollandiae	White-faced heron						X			X	X	
Nycticorax caledonicus	Nankeen night-heron					X				X		
Pelecanidae												
Pelecanus conspicillatus	Australian pelican					X				X		
Phalacrocoracidae												
Microcarbo melanoleucos	Little pied cormorant									X		
Phalacrocorax carbo	Great cormorant									X		
Phalacrocorax sulcirostris	Little black cormorant					X				X		
Phalacrocorax varius	Pied cormorant (Australian pied cormorant)									X		
Anhingidae												
Anhinga novaehollandiae	Australasian darter					X				X		
Accipitridae												
Accipiter cirrocephalus	Collared sparrowhawk				X					X	X	
Accipiter fasciatus	Brown goshawk				X	X				X	X	
Aquila audax	Wedge-tailed eagle				X	X				X	X	X

Scientific Name	Common Name	Introduced	Conservation Codes			NatureMap	ALA	EPBC PMST	DBCA T and P	Birdata	Previous Survey	Current Survey
			EPBC Act	BC Act	DBCA Priority Fauna List							
Circus approximans	Swamp harrier									X		
Circus assimilis	Spotted harrier				X	X				X	X	
Elanus axillaris	Australian black-shouldered kite				X	X				X	X	X
Erythrotriorchis radiatus	Red Goshawk		VU	VU				X				
Haliaeetus leucogaster	White-bellied sea-eagle				X	X				X		
Haliastur sphenurus	Whistling kite					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		
Milvus migrans	Black kite					X	X			X	X	
Otididae												
Ardeotis australis	Australian bustard					X	X			X	X	X
Rallidae												
Fulica atra	Eurasian coot						X			X		
Hypotaenidia philippensis	Buff-banded rail									X		
Porphyrio porphyrio	Purple swamphen									X		
Porzana pusilla	Baillon's crake									X		
Porzana tabuensis	Spotless crake									X		
Tribonyx ventralis	Black-tailed native-hen					X	X			X	X	

Scientific Name	Common Name	Introduced	Conservation Codes			NatureMap	ALA	EPBC PMST	DBCA T and P	Birdata	Previous Survey	Current Survey
			EPBC Act	BC Act	DBCA Priority Fauna List							
Turnicidae												
Turnix velox	Little button-quail					X	X			X	X	X
Burhinidae												
Burhinus grallarius	Bush stone-curlew					X				X	X	
Recurvirostridae												
Cladorhynchus leucocephalus	Banded stilt						X			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	
Erythrogonys cinctus	Red-kneed dotterel									X		
Scolopacidae												
Actitis hypoleucos	Common sandpiper		MI	MI		X		X	X	X		
Calidris acuminata	Sharp-tailed sandpiper		MI	MI				X	X	X		
Calidris ferruginea	Curlew sandpiper		CR & MI	CR & MI				X	X	X		
Calidris melanotos	Pectoral sandpiper		MI	MI				X				
Calidris ruficollis	Red-necked stint			MI					X	X		

Scientific Name	Common Name	Introduced	Conservation Codes			NatureMap	ALA	EPBC PMST	DBCA T and P	Birdata	Previous Survey	Current Survey
			EPBC Act	BC Act	DBCA Priority Fauna List							
Calidris subminuta	Long-toed stint		MI	MI					X	X		
Tringa glareola	Wood sandpiper		MI	MI					X	X		
Tringa nebularia	Common greenshank		MI	MI					X	X		
Tringa stagnatilis	Marsh sandpiper		MI	MI						X		
Glareolidae												
Stiltia isabella	Australian pratincole									X		
Laridae												
Chlidonias hybrida	Whiskered tern									X		
Chroicocephalus novaehollandiae	Silver gull									X		
Gelochelidon nilotica	Gull-billed tern		MI	MI					X	X		
Hydroprogne caspia	Caspian tern		MI	MI					X	X		
Columbidae												
Geopelia cuneata	Diamond dove					X	X			X	X	X
Geopelia humeralis	Bar-shouldered Dove									X		
Geopelia striata	Peaceful dove					X	X			X		
Geophaps plumifera	Spinifex pigeon					X	X			X	X	
Ocyphaps lophotes	Crested pigeon					X	X			X	X	X
Phaps chalcoptera	Common bronzewing					X	X			X	X	X

Scientific Name	Common Name	Introduced	Conservation Codes			NatureMap	ALA	EPBC PMST	DBCA T and P	Birdata	Previous Survey	Current Survey
			EPBC Act	BC Act	DBCA Priority Fauna List							
Phaps histrionica	Flock Bronzewing (Flock Pigeon)						X					
Cuculidae												
Cacomantis pallidus	Pallid cuckoo					X	X			X	X	X
Chalcites basalis	Horsfield's bronze cuckoo					X	X			X	X	
Chalcites osculans	Black-eared cuckoo					X	X	X		X	X	
Centropodidae												
Centropus phasianinus	Pheasant coucal									X		
Tytonidae												
Tyto javanica	Eastern barn owl					X	X			X		
Strigidae												
Ninox connivens	Barking owl						X					
Ninox novaeseelandiae	Southern boobook					X	X			X	X	
Podargidae												
Podargus strigoides	Tawny frogmouth					X	X			X	X	
Caprimulgidae												
Eurostopodus argus	Spotted nightjar					X	X			X	X	
Aegothelidae												
Aegotheles cristatus	Australian owlet-nightjar					X	X			X	X	
Apodidae												

Scientific Name	Common Name	Introduced	Conservation Codes			NatureMap	ALA	EPBC PMST	DBCA T and P	Birdata	Previous Survey	Current Survey
			EPBC Act	BC Act	DBCA Priority Fauna List							
Apus pacificus	Fork-tailed swift (pacific swift)		MI	MI			X	X				
Alcedinidae												
Dacelo leachii	Blue-winged kookaburra					X				X	X	
Todiramphus pyrrhopygius	Red-backed kingfisher					X	X			X	X	X
Todiramphus sanctus	Sacred kingfisher					X	X			X	X	
Meropidae												
Merops ornatus	Rainbow bee-eater					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
Falco hypoleucos	Grey falcon			VU			X	X				
Falco longipennis	Australian hobby					X	X			X	X	
Falco peregrinus	Peregrine falcon			OS		X			X	X	X	
Cacatuidae												
Cacatua sanguinea	Little corella					X	X			X	X	
Eolophus roseicapilla	Galah					X	X			X	X	X
Nymphicus hollandicus	Cockatiel						X			X	X	X
Psittacidae												
Barnardius zonarius	Australian ringneck					X	X			X	X	X

Scientific Name	Common Name	Introduced	Conservation Codes			NatureMap	ALA	EPBC PMST	DBCA T and P	Birdata	Previous Survey	Current Survey
			EPBC Act	BC Act	DBCA Priority Fauna List							
Melopsittacus undulatus	Budgerigar					X	X			X	X	X
Neopsephotus bourkii	Bourke's parrot					X	X			X	X	
Pezoporus occidentalis	Night parrot		EN	CR			X	X				
Polytelis alexandrae	Princess parrot		VU		P4	X		X	X			
Psephotus varius	Mulga parrot					X				X		
Ptilonorhynchidae												
Chlamydera guttatus	Western bowerbird					X	X			X	X	
Climacteridae												
Climacteris melanura	Black-tailed treecreeper						X			X		
Maluridae												
Amytornis striatus	Striated grasswren					X	X			X	X	
Malurus assimilis	Purple-backed fairy-wren					X	X			X	X	X
Malurus leucopterus	White-winged fairy-wren					X	X			X	X	X
Malurus splendens	Splendid fairy-wren					X				X		
Stipiturus ruficeps	Rufous-crowned emu-wren					X				X	X	
Meliphagidae												
Acanthagenys rufogularis	Spiny-cheeked honeyeater					X	X			X	X	X
Certhionyx variegatus	Pied honeyeater					X	X			X	X	X

Scientific Name	Common Name	Introduced	Conservation Codes			NatureMap	ALA	EPBC PMST	DBCA T and P	Birdata	Previous Survey	Current Survey
			EPBC Act	BC Act	DBCA Priority Fauna List							
Epthianura aurifrons	Orange chat						X					
Epthianura tricolor	Crimson chat					X	X			X	X	X
Gavicalis virescens	Singing honeyeater					X	X			X	X	X
Conopophila whitei	Grey honeyeater					X	X					X
Lichmera indistincta	Brown honeyeater					X	X			X	X	X
Manorina flavigula	Yellow-throated miner					X	X			X	X	X
Melithreptus gularis	Black-chinned honeyeater						X			X		
Ptilotula keartlandi	Grey-headed honeyeater					X				X	X	
Ptilotula penicillata	White-plumed honeyeater					X	X			X	X	
Ptilotula plumula	Grey-fronted honeyeater						X					
Purnella albifrons	White-fronted honeyeater						X			X	X	X
Stomiopera unicolor	White-gaped honeyeater									X		
Sugomel niger	Black honeyeater					X	X			X		
Pardalotidae												
Pardalotus rubricatus	Red-browed pardalote					X	X			X	X	X
Pardalotus striatus	Striated pardalote					X	X			X	X	

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

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

Scientific Name	Common Name	Introduced	Conservation Codes			NatureMap	ALA	EPBC PMST	DBCA T and P	Birdata	Previous Survey	Current Survey
			EPBC Act	BC Act	DBCA Priority Fauna List							
Colluricincla harmonica	Grey shrike-thrush					X	X			X	X	
Pachycephala rufiventris	Rufous whistler					X	X			X	X	X
Rhipiduridae												
Rhipidura albiscapa	Grey fantail					X	X			X	X	
Rhipidura leucophrys	Willie wagtail					X	X			X	X	X
Monarchidae												
Grallina cyanoleuca	Magpie-lark					X	X			X	X	
Corvidae												
Corvus bennetti	Little crow					X	X			X		
Corvus orru	Torresian crow					X	X			X	X	X
Petroicidae												
Melanodryas cucullata	Hooded robin					X	X			X	X	X
Petroica goodenovii	Red-capped robin					X	X			X	X	X
Alaudidae												
Mirafra javanica	Horsfield's bushlark					X	X			X	X	
Hirundinidae												
Cheramoeca leucosterna	White-backed swallow					X	X			X		
Hirundo neoxena	Welcome swallow						X			X		
Hirundo rustica	Barn swallow		MI	MI				X				
Petrochelidon ariel	Fairy martin					X	X			X	X	
Petrochelidon nigricans	Tree martin					X	X			X	X	

Scientific Name	Common Name	Introduced	Conservation Codes			NatureMap	ALA	EPBC PMST	DBCA T and P	Birdata	Previous Survey	Current Survey
			EPBC Act	BC Act	DBCA Priority Fauna List							
Acrocephalidae												
Acrocephalus australis	Australian reed warbler									X		
Megaluridae												
Cincloramphus cruralis	Brown songlark					X	X			X	X	X
Cincloramphus mathewsi	Rufous songlark					X	X			X	X	X
Eremiornis carteri	Spinifexbird					X				X	X	
Poodytes gramineus	Little grassbird									X		
Nectariniidae												
Dicaeum hirundinaceum	Mistletoebird					X	X			X	X	
Estrildidae												
Emblema pictum	Painted finch					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				
Anthus novaeseelandiae	Australian pipit					X				X	X	X

Note: EPBC Act = Environment Protection and Biodiversity Conservation Act 1999; BC Act = Biodiversity and Conservation Act 2016; DBCA = Department of Biodiversity, Conservation and Attractions; ALA = Atlas of Living Australia; EPBC PMST = Environment Protection and Biodiversity Conservation Protected Matters Search Tool; T and P = Threatened and Priority.

Table D.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 Survey	Current Survey
			EPBC Act	BC Act	DBCA Priority Fauna List						
Tachyglossidae											
Tachyglossus aculeatus acanthion	Short-beaked echidna									X	
Dasyuridae											
Antechinomys longicaudata	Long-tailed Dunnart				P4	X			X		
Dasycercus blythi	Brush-tailed mulgara, ampurta				P4	X			X	X	X
Dasykaluta rosamondae	Kaluta					X				X	X
Dasyurus hallucatus	Northern quoll		EN	EN			X	X			
Ningaui timealeyi	Pilbara ningaui					X	X				
Planigale species 1'	Pilbara planigale					X					
Pseudantechinus woolleyae	Woolley's pseudantechinus					X				X	
Sminthopsis crassicaudata	Fat-tailed dunnart					X					
Sminthopsis macroura	Stripe-faced dunnart					X	X			X	
Sminthopsis youngsoni	Lesser hairy-footed dunnart						X			X	
Thylacomyidae											
Macrotis lagotis	Bilby, dalgyte		VU	VU		X	X	X	X	X	X

Scientific Name	Common Name	Introduced	Conservation Codes			NatureMap	ALA	EPBC PMST	DBCA T and P	Previous Survey	Current Survey
			EPBC Act	BC Act	DBCA Priority Fauna List						
Notoryctidae											
Notoryctes spp.	Marsupial mole				P4		X		X		
Macropodidae											
Lagorchestes conspicillatus leichardti	Spectacled hare-wallaby (mainland)				P4	X			X		
Osphranter robustus erubescens	Euro, biggada					X				X	
Osphranter rufus	Red kangaroo, marlu					X				X	X
Petrogale lateralis lateralis	Black-footed rock-wallaby		EN	EN					X		
Muridae											
Mus musculus	House mouse	*				X	X				
Notomys alexis alexis	Spinifex hopping-mouse					X	X			X	X
Pseudomys chapmani	Western pebble-mound mouse				P4	X			X	X	
Pseudomys desertor	Desert mouse					X					
Pseudomys hermannsburgensis	Sandy inland mouse					X	X			X	X
Zyzomys argurus	Common rock-rat					X				X	
Leporidae											
Oryctolagus cuniculus	Rabbit	*				X				X	

Scientific Name	Common Name	Introduced	Conservation Codes			NatureMap	ALA	EPBC PMST	DBCA T and P	Previous Survey	Current Survey
			EPBC Act	BC Act	DBCA Priority Fauna List						
Rhinonycteridae											
Rhinonicteris aurantia (Pilbara form)	Pilbara leaf-nosed bat		VU	VU			X	X			
Megadermatidae											
Macroderma gigas	Ghost bat		VU	VU		X		X	X	X	
Emballonuridae											
Saccolaimus flaviventris	Yellow-bellied sheath-tailed bat									X	
Taphozous georgianus	Common sheath-tailed bat					X				X	
Taphozous hilli	Hill's sheath-tailed bat					X				X	
Molossidae											
Austronomus australis	White-striped free-tailed bat					X				X	X
Chaerephon jobensis	Northern free-tailed bat					X				X	X
Ozimops kitcheneri	Western Free-tailed Bat					X					
Ozimops lumsdenae	Northern Free-tailed Bat									X	
Vespertilionidae											
Chalinolobus gouldii	Gould's wattled bat					X				X	X

Scientific Name	Common Name	Introduced	Conservation Codes			NatureMap	ALA	EPBC PMST	DBCA T and P	Previous Survey	Current Survey
			EPBC Act	BC Act	DBCA Priority Fauna List						
Chalinolobus morio	Chocolate wattled bat									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	
Canidae											
Canis familiaris	Dog/Dingo	*				X				X	X
Felidae											
Felis catus	Cat	*				X				X	X
Equidae											
Equus asinus	Donkey	*				X				X	
Camelidae											
Camelus dromedarius	Dromedary, camel	*				X				X	X
Bovidae											
Bos taurus	European cattle	*				X				X	X

Note: EPBC Act = Environment Protection and Biodiversity Conservation Act 1999; BC Act = Biodiversity and Conservation Act 2016; DBCA = Department of Biodiversity, Conservation and Attractions; ALA = Atlas of Living Australia; EPBC PMST = Environment Protection and Biodiversity Conservation Protected Matters Search Tool; T and P = Threatened and Priority.

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Appendix E: Threatened and Priority Fauna Species Likelihood of Occurrence within the Survey Area

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Table E.1: 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						
Spotted ctenotus (northeast) (*Ctenotus uber johnstonei*)			P2	This subspecies is only known from chenopod shrubland at the base of a sandstone hill, near Balgoo. One recent (2018) fauna record was detailed on the DBCA threatened and priority fauna database search result, over 30 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. Four historic fauna records were detailed on the DBCA threatened and priority fauna database search results, over 50 km from the survey area	Low	Low
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. Fifteen previous fauna records were detailed on the DBCA threatened and priority fauna database search result, over 10 km from the survey area. Sand plain habitat exists in the survey area; however, the survey area is outside the current likely (predicted) distribution.	High	Low
Gane's bind snake (*Anilios ganei*)			P1	Little information is available on this species, but it is believed to be associated with moist gorges and gullies. Three previous records were detailed on the DBCA threatened and priority fauna database search result, over 30 km from the survey area.	Low	Low
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. Three previous records, including one record from 2019, were detailed on the DBCA threatened and priority fauna database search result, over 40 km from the survey area.	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			
Birds						
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. Nine previous records were detailed on the DBCA threatened and priority fauna database result, over 40 km from the survey area.	Low	Low
Red goshawk (*Erythrotriorchis radiatus*)	VU	VU		The red goshawk occurs in coastal and sub-coastal areas in wooded and forested lands of tropical and warm-temperate Australia. Riparian vegetation also provided significant nesting and foraging opportunities. The EPBC Act protected matters report assessed that this species or species habitat may occur within the area.	Low	Low
Oriental plover (*Charadrius veredus*)	MI	MI		This species inhabits sparsely vegetated plains, beaches and tidal flats, and saltworks and sewage ponds. The EPBC Act protected matters report assessed that this species or species habitat may occur within the survey area.	Low	Low
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. Twelve previous records were detailed on the DBCA threatened and priority fauna database result, over 25 km from the survey area.	Low	Low
Sharp-tailed sandpiper (*Calidris acuminata*)	MI	MI		Muddy edges of shallow fresh/brackish wetlands with emergent sedges, saltmarsh, grass, and low vegetation. Two previous records were detailed on the DBCA threatened and priority fauna database result, over 40 km from the survey area.	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			
Curlew sandpiper (*Calidris ferruginea*)	CR, MI	CR, MI		Mainly occur on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons. Also, around non-tidal swamps, lakes and lagoons near the coast. One previous record was detailed on the DBCA threatened and priority fauna database result, over 40 km from the survey area.	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. The EPBC Act protected matters report assessed that this species or species habitat may occur within the survey area.	Low	Low
Red-necked stint (*Calidris ruficollis*)		MI		The edge of sheltered waters, including estuaries, beaches, near-coastal salt lakes, swamps, lakes, sewerage ponds, and bore overflows. Two previous records were detailed on the DBCA threatened and priority fauna database result, over 40 km from the survey area.	Low	Low
Long-toed stint (*Calidris subminuta*)	MI	MI		Generally found in coastal environments, such as coastal margins, lagoons, beaches, and tidal flats. One historic record was detailed on the DBCA threatened and priority fauna database result, over 40 km from the survey area.	Low	Low
Wood sandpiper (*Tringa glareola*)	MI	MI		Generally open areas, such as the margins of inland freshwater lakes and reservoirs. This species rarely occurs in coastal habitats but may be found along the creeks of saltmarshes and mangrove swamps. Two previous records were detailed on the DBCA threatened and priority fauna database result, over 40 km from the survey area.	Low	Low
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. Three previous records were detailed on the DBCA threatened and priority fauna database result, over 40 km from the survey area.	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			
Marsh sandpiper (*Tringa stagnatilis*)	MI	MI		Found at the margins of inland freshwater and brackish wetlands, such as rice paddy-fields, swamps, saltpans, salt marshes, sewage works, and marshy lake edges. Although it is rare on open coastlines, it can occasionally be found on estuaries, lagoons and intertidal mudflats. Two previous records were detailed on the DBCA threatened and priority fauna database result, over 40 km from the survey area.	Low	Low
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. Four previous records were detailed on the DBCA threatened and priority fauna database result, over 40 km from the survey area.	Low	Low
Caspian tern (*Hydroprogne (Sterna) caspia*)	MI	MI		Mainly sheltered seas, estuaries and tidal creeks. Three previous records were detailed on the DBCA threatened and priority fauna database result, over 40 km from the survey area.	Low	Low
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. The EPBC Act protected matters report assessed that this species or species habitat may occur within the survey area.	Moderate	Low
Grey falcon (*Falco hypoleucos*)	VU	VU		Open habitats: semi-deserts, grassy inland plains, timbered watercourses, and pastoral lands. The EPBC Act protected matters report assessed that this species or species habitat may occur within the survey area.	Moderate	Low
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. Six previous records were detailed on the DBCA threatened and priority fauna database result, including two records less than 5 km from the survey area.	High	High

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			
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. The EPBC Act protected matters report assessed that this species or species habitat is likely to occur within the survey area.	Low	Low
Princess parrot (*Polytelis alexandrae*)	VU		P4	Inhabits sand dunes and sand flats in the arid zone. Occurs in savanna woodlands and shrublands that usually consist of scattered stands of *Eucalyptus* spp, *Casuarina/Allocasuarina* trees, an understorey of shrubs, and a ground cover dominated by *Triodia* ssp. One previous record detailed on the DBCA threatened and priority fauna database result, over 30 km from the survey area.	Low	Low
Southern whiteface (*Aphelocephala leucopsis*)	VU			Critical habitat includes relatively undisturbed open woodlands and shrublands with an understorey of grasses or shrubs, or both, habitat with low tree densities and a herbaceous understory litter cover which provides essential foraging habitat, and living and dead trees with hollows and crevices which are essential for roosting and nesting. The EPBC Act species distribution modelling suggests this species or species habitat is likely to occur within the survey area. Previous Naturemap records within 40 km of the survey area, and recent (2022) record approximately 4 km from the survey area.	High	**Recorded**
Barn swallow (*Hirundo rustica*)	MI	MI		Coastal open country generally, especially near surface water and man-made structures such as bridges and power wires. The EPBC Act protected matters report assessed that this species or species habitat may occur within the survey area.	Low	Low
Yellow wagtail (*Motacilla flava*)	MI	MI		Damp short-grass flats, edges of swamps, sewage ponds, grazed or mowed grass and irrigated areas. Vagrant to Australia. The EPBC Act protected matters report assessed that this species or species habitat may occur within the survey area.	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			
Grey wagtail (*Motacilla cinerea*)	MI	MI		Mainly banks and rocks in fast flowing fresh water. Vagrant to Australia. The EPBC Act protected matters report assessed that this species or species habitat may occur within the survey area.	Low	Low
Mammals						
Long-tailed dunnart (*Antechinomys longicaudata*)			P4	Found in rocky scree and plateau areas, generally with little vegetation or in areas of spinifex hummock grassland, shrubs and open woodland. Seven previous records were detailed on the DBCA threatened and priority fauna database result, including two records from 2006 less than 5 km from the survey area.	High	Low
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. Fifty-eight previous records were detailed on the DBCA threatened and priority fauna database result, including two recent (2010 and 2018) records from within the survey area.	**Recorded**	**Recorded**
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. The EPBC Act protected matters report assessed that this species or species habitat is likely to occur within the area.	Low	Low
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. Thirty-five previous records were detailed on the DBCA threatened and priority fauna database result, including one recent (2018) record from within the survey area. Historical evidence (unconfirmed) recorded during the current survey.	**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			
Marsupial mole (*Notoryctes caurinus*)			P4	Lives primarily underground of sand dunes and sandy soils along river flats. One previous record was detailed on the DBCA threatened and priority fauna database result, over 10 km from the survey area.	Moderate	Low
Spectacled hare–wallaby (mainland) (*Lagorchetes conspicullatus leichardti*)			P4	Tussock or hummock grassland with mid-dense/sparse tree and shrub cover. One previous record was detailed on the DBCA threatened and priority fauna database result, over 15 km from the survey area.	Moderate	Moderate
Black-footed rock-wallaby (*Petrogale lateralis lateralis*)	EN	EN		Occurs in cliffs, rock-piles, talus or escarpment refuge and other steep substrates with grassland feeding habitat nearby. Also occurs on limestone outcrops, coastal cliffs and granite outcrops. Two historic records were detailed on the DBCA threatened and priority fauna database result, over 50 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. Thirty-seven previous records were detailed on the DBCA threatened and priority fauna database result, including two recent (2007 and 2010) records within 10 km of the survey area.	Moderate	Moderate
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. The EPBC Act protected matters report assessed that this species or species habitat may occur within the survey area.	Low	Low
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 previous record was detailed on the DBCA threatened and priority fauna database result, over 25 km from the survey area.	Low	Low

Note: EPBC Act = *Environment Protection and Biodiversity Conservation Act 1999*, BC Act = *Biodiversity and Conservation Act 2016*, DBCA = Department of Biodiversity, Conservation and Attractions, VU = Vulnerable, P = Priority, MI = Migratory, CR = Critically Endangered, OS = Specially Protected, EN = Endangered.

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Appendix F: Fauna Habitat Mapping and Significant Areas

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230000

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240000

7415000

7410000

Survey Area

Habitat Type

Hillcrest/ Hillslope

Mulga Woodland

Sand Plain

Stony Plain

Significant Area

Greater bilby (historic known burrow)

Greater bilby (uncomfirmed potential historic burrow)

Greater bilby (unconfirmed potential digging/burrow)

Brush-tailed mulgara burrow (active)

Brush-tailed mulgara burrow (inactive)

BHP Western Australian Iron Ore

East Caramulla and Thirteen Creek Targeted Significant Fauna Survey

Figure F.1: Fauna Habitat Mapping and Significant Areas

Scale: 1:35,000 at A3

Coordinate System: GDA 1994 MGA Zone 51

0 500 1,000 1,500 2,000 Metres

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Author: D. Keirle

Drawn: C. Dyde

Date: 21-06-2023

Figure Ref: 2400-09-22-BIDR-1RevA_230621_FigF1_Habitat

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Appendix G: Matters of National Environmental Significance (MNES) Fauna Habitat Suitability Mapping

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230000

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240000

7415000

7410000

Survey Area

Greater bilby record

Historic known burrow

Uncomfirmed potential historic burrow

Unconfirmed potential digging/burrow

Greater bilby habitat suitability

Critical habitat

Supporting habitat

Limited foraging and disperal habitat

BHP Western Australian Iron Ore

East Caramulla and Thirteen Creek Targeted Significant Fauna Survey

Figure G.1: Bilby habitat suitability mapping

Scale: 1:35,000 at A3

Coordinate System: GDA 1994 MGA Zone 51

0 500 1,000 1,500 2,000 Metres

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Author: D. Keirle | Drawn: C. Dyde | Date: 22-06-2023 | Figure Ref: 2400-09-22-BIDR-1RevA_230622_FigG1_Bilby

230000
235000
240000
7415000
7410000

Survey Area

Current Significant Fauna

Southern whiteface

Southern whiteface habitat suitability

Critical habitat

Supporting habitat

Limited foraging and disperal habitat

BHP Western Australian Iron Ore
East Caramulla and Thirteen Creek Targeted Significant Fauna Survey

Figure G.2: Southern whiteface habitat suitability mapping

Scale: 1:35,000 at A3
Coordinate System: GDA 1994 MGA Zone 51

0 500 1,000 1,500 2,000 Metres

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Author: D. Keirle | Drawn: C. Dyde | Date: 22-06-2023 | Figure Ref: 2400-09-22-BIDR-1RevA_230622_FigG2_SWF

Appendix H: Significant Vertebrate Fauna Species Locations

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220000

230000

240000

7420000

7410000

Survey Area

Current Significant Fauna

- Brush-tailed mulgara
- Greater bilby
- Greater bilby (old record revisited)
- Southern whiteface

Previous Significant Fauna

- Brush-tailed mulgara
- Greater bilby
- Long-tailed dunnart
- Peregrine falcon
- Southern whiteface
- Western pebble-mound mouse

BHP Western Australian Iron Ore

East Caramulla and Thirteen Creek Targeted Significant Fauna Survey

Figure H.1: Previous and current conservation significant fauna locations

Scale: 1:70,000 at A3

Coordinate System: GDA 1994 MGA Zone 51

0 1 2 3 Kilometres

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Author: D. Keirle | Drawn: C. Dyde | Date: 21-06-2023 | Figure Ref: 2400-09-22-BIDR-1RevA_230614_FigH1_PrevFauna

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

Species name (common name)	Status	Site ID	Latitude	Longitude	Observation type (number of records)	Habitat	Photograph
Mammals							
Macrotis lagotis (bilby)	VU; VU	EC-CAM09	-23.3816	120.3558	Possible old bilby burrows currently occupied by *Varanus* sp. No current signs of bilby tracks or fresh scats. No bilby activity recorded on camera placed at entrance.	Sand Plain	
		EC-BP19, EC-CAM10	-23.3811	120.3955	Possible bilby burrow/diggings or atypically shaped *Varanus* sp. digging. No signs of current bilby activity, scats, or tracks. No bilby activity recorded on camera placed at entrance.	Sand Plain	

Species name (common name)	Status	Site ID	Latitude	Longitude	Observation type (number of records)	Habitat	Photograph
		Old burrow, EC-CAM03	-23.3713	120.3794	Revisit of diggings/burrow recorded by Biologic in 2018. No signs of current bilby activity, scats, or tracks. Continued occupancy by *Varanus* sp. evident. No bilby activity recorded on camera placed at entrance.	Sand Plain	
Aphelocephala leucopsis (southern whiteface)	VU	Opp	-23.3656	120.3700	Individual observed	Mulga Woodland	Picture not available
Dasycercus blythi (brush-tailed mulgara)	P4	Opp, EC-CAM02	-23.3784	120.4403	Active burrow. At least one individual captured on motion camera on multiple nights.	Sand Plain	

Species name (common name)	Status	Site ID	Latitude	Longitude	Observation type (number of records)	Habitat	Photograph
		Opp	-23.3739	120.3780	Active burrow	Sand Plain	
		Opp	-23.3707	120.4373	Active burrow, camera placed for activity.	Sand Plain	

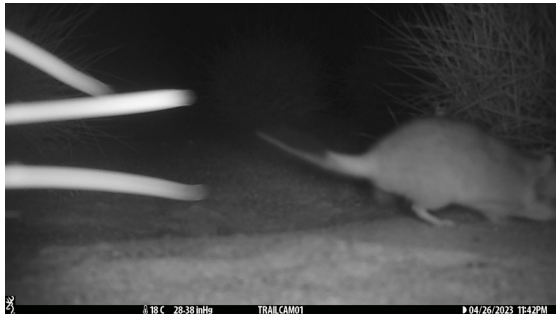
Species name (common name)	Status	Site ID	Latitude	Longitude	Observation type (number of records)	Habitat	Photograph
		EC-BP03	-23.3712	120.4380	Active burrow, camera placed for activity	Sand Plain	
		EC-BP03	-23.3694	120.4377	Active burrow	Sand Plain	

Species name (common name)	Status	Site ID	Latitude	Longitude	Observation type (number of records)	Habitat	Photograph
		EC-BP03	-23.3702	120.4388	Inactive burrow	Sand Plain	
		Opp	-23.3689	120.4390	Active burrow	Sand Plain	

Species name (common name)	Status	Site ID	Latitude	Longitude	Observation type (number of records)	Habitat	Photograph
		Opp	-23.3800	120.3704	Inactive burrow	Sand Plain	
		Opp	-23.3817	120.3748	Inactive burrow	Sand Plain	

Species name (common name)	Status	Site ID	Latitude	Longitude	Observation type (number of records)	Habitat	Photograph
		Opp	-23.3818	120.4489	Inactive burrow	Sand Plain	
		Opp	-23.3814	120.4485	Inactive burrow	Sand Plain	

Species name (common name)	Status	Site ID	Latitude	Longitude	Observation type (number of records)	Habitat	Photograph
		EC-BP08	-23.3574	120.4071	Active burrow, camera placed for activity	Sand Plain	
		Opp	-23.3666	120.3434	Active burrows (2)	Sand Plain	

Species name (common name)	Status	Site ID	Latitude	Longitude	Observation type (number of records)	Habitat	Photograph
		Opp	-23.3602	120.4083	Active burrow	Sand Plain	
		EC-CAM02	-23.3784	120.4404	Individual 26/04/2023	Sand Plain	

Species name (common name)	Status	Site ID	Latitude	Longitude	Observation type (number of records)	Habitat	Photograph
		EC-CAM02	-23.3784	120.4404	Individual 30/04/2023	Sand Plain	

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