East Caramulla
Targeted Bilby Fauna Assessment
November 2023

Prepared for
BHP Western Australian Iron Ore

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Approval

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Abbreviations

Abbreviation	Definition
Astron	Astron Environmental Services
BC Act	*Biodiversity and Conservation Act 2016*
BHP WAIO	BHP Western Australian Iron Ore
BoM	Bureau of Meteorology
DBCA	Department of Biodiversity, Conservation and Attractions
DEWHA	Department of Water, Heritage and the Arts
DSWEPaC	Department of Sustainability, Water, Environment, Population and Communities
DNA	Deoxyribonucleic Acid
EPA	Environmental Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
FV	Field Visit
g	Gram
GPS	Geographical Positioning System
ha	Hectare
IBRA	Interim Biogeographic Regionalisation for Australia
km	Kilometre
mm	Millimetre
MNES	Matters of National Environmental Significance
P	Priority
VU	Vulnerable
°C	Degrees Celsius

Executive Summary

BHP Western Australia Iron Ore (BHP WAIO) are investigating the potential presence of bilby (*Macrotis lagotis*) (VU; VU) within the East Caramulla and Thirteen Creek/Davidson Creek locality (the Survey Area). The Survey Area is located approximately 60 km east of Newman in the Pilbara region of Western Australia and covers an area of approximately 7,888 ha.

A recent targeted fauna survey by Astron Environmental Services (2023) recorded potential bilby sign within the East Caramulla area through two historical diggings or burrows, and one potential fresh digging. No additional signs of recent activity were recorded, and no activity was captured on motion sensitive cameras (Astron Environmental Services 2023). Additionally, an unconfirmed historical digging was previously recorded within the Thirteen Creek region, also with no additional signs of recent activity, and no activity captured on cameras during follow-up work by BHP WAIO Biodiversity personnel (Astron Environmental Services 2022, BHP 2022). To better understand these records in the context of potential bilby presence within the Survey Area and broader local region, BHP WAIO commissioned Astron Environmental Services to undertake an assessment of bilby presence within the Survey Area and surrounds.

The assessment involved a comprehensive desktop assessment and targeted survey completed over two field visits. Field Visit (FV) 1 was completed between 11 and 14 September 2023, and FV 2 was completed between 20 and 21 November 2023. Sampling methods included nine habitat assessments, 16 targeted bilby searches, and 276 camera trap nights across five sites.

The desktop assessment identified over 100 bilby records from an approximate 100 km radius of the Survey Area. The majority of these records occur over 60 km from the Survey Area in two clusters, one cluster of 57 records from 2014 approximately 60-70 km north (Roy Hill Station), and a cluster of 45 records from 2020 approximately 90 km north-west (Fortescue Valley). There were four bilby records from within the Survey Area comprising potential (unconfirmed) historical burrows or diggings. No signs of recent activity, tracks or scats were identified at any of these historical burrow/digging sites (Biologic Environmental Survey 2018, GHD Pty Ltd 2019, 2021, BHP 2022, Astron Environmental Services 2023). Only two records were identified south of the Survey Area, with these records obtained from 1979 (although exact location of this record is doubtful) and 1996, respectively (Department of Biodiversity, Conservation and Attractions 2023a).

Critical bilby habitat comprises approximately 63% of the Survey Area, consisting of Sand Plain and Hardpan Plain habitats that support soft soils for burrowing, digging, and foraging. Supporting bilby habitat in Mulga Woodland comprises approximately 18% of the Survey Area and is more likely to be utilised when adjacent to critical habitats. The remaining 19% of the Survey Area provides limited foraging, dispersal, and denning habitat.

Bilby scats were collected from a historical digging spoil pile within the Survey Area. These scats were positively identified as bilby based on morphological features but were too degraded for additional confirmation using DNA analysis. A further six potential unconfirmed burrows and/or diggings were identified during the field surveys. All burrow/digging records were assessed as historical due to the lack of freshly dug soils and the presence of vegetation overgrowth at the entrance and surrounds. No bilbies were recorded on any of the long-term cameras during the current survey, and no current sign was noted during targeted searches.

No bilby individuals have been observed or captured on any terrestrial vertebrate fauna survey conducted within the Caramulla region. Furthermore, the only records within the Survey Area come through largely unconfirmed historical diggings, burrows and one confirmed scat record. Critical and supporting habitat is present within the Survey Area but is not restricted to it, and a resident

population is not considered to currently occur within the Survey Area or immediate surrounds. In likelihood, bilby records from the region are attributable to a small number of individuals infrequently transitioning through the area in search of greater foraging and sheltering habitat. The nearest cluster of contemporary bilby records is situated 60-70 km to the north of the Survey Area, and likely represents the most southern area of current permanent bilby occupation in the Pilbara region. The overall distribution of bilby records within Caramulla and the surrounding area suggests that, if present, the bilby is likely patchily distributed and at low densities across Caramulla but could potentially utilise the Survey Area depending on resource availability.

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1 Introduction

1.1 Project Background

BHP Western Australian Iron Ore (BHP WAIO) are investigating the potential presence of bilby (*Macrotis lagotis*) within the East Caramulla and Thirteen Creek/Davidson Creek locality (hereafter referred to as the Survey Area). The Survey Area is located approximately 60 km east of Newman and covers an area of approximately 7,888 hectares (ha) (Figure 1). The bilby is listed as Vulnerable (VU) under the *Environmental Protection and Biodiversity Conservation Act 1999* and the Western Australian *Biodiversity Conservation Act 2016*. Recently, a targeted significant fauna survey (Astron Environmental Services 2023) recorded potential bilby sign within the East Caramulla area, comprising two unconfirmed historical diggings or burrows, and one potential fresh digging. There were no additional signs of recent activity, tracks, or fresh scats, and no current activity was captured on motion sensitive cameras. Additionally, one location of an unconfirmed historical bilby digging was recorded at Thirteen Creek (Astron Environmental Services 2022). Like the East Caramulla records, there were no signs of recent activity, tracks or fresh scats, and further follow-up work by BHP WAIO Biodiversity did not capture this species on long-term cameras at this location.

To better understand these records in the context of this species' potential presence in the East Caramulla area and broader local region, BHP WAIO commissioned Astron Environmental Services (Astron) to undertake an assessment of bilby presence within the Survey Area and surrounds.

1.2 Scope and Objectives

The objective of this assessment was to identify and better understand potential bilby presence within the Survey Area and broader local region. The scope of work was to undertake:

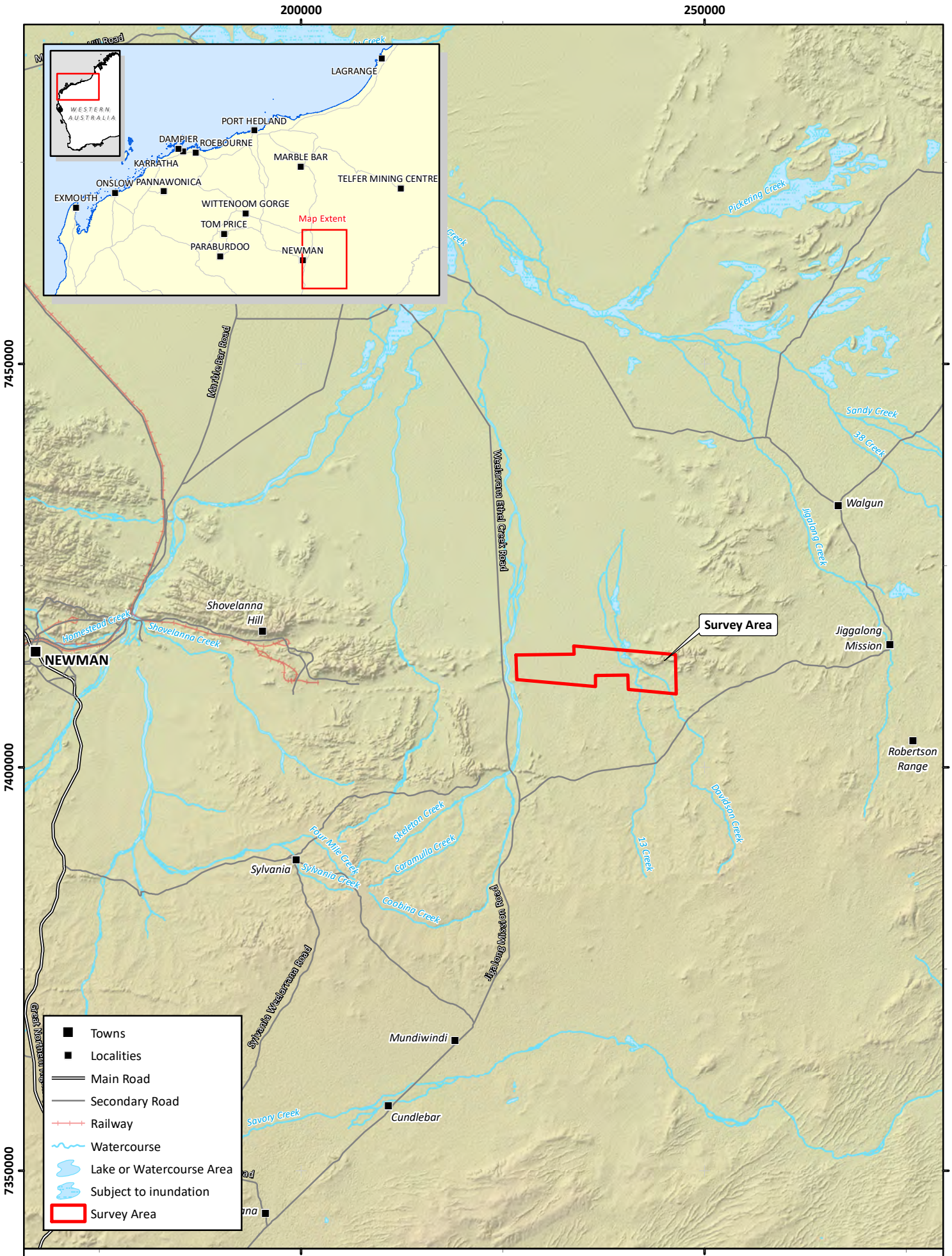
- a desktop assessment, including a comprehensive database and literature review for the presence, or likely presence, of bilby within the vicinity of the Survey Area and more broadly across the local region
- a field survey undertaking a targeted bilby assessment including:
    - deployment of motion sensitive cameras at previously identified potential digging/burrow sites within the Survey Area
    - targeted searches for signs of bilbies using a combination of the 2 ha plot protocol and linear survey methods
- provision of a report and data analysis, including interpreting the desktop assessment results and reporting on the data capture from the long-term camera monitoring sites.

Astron conducted the targeted bilby assessment 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 4.3 of this report provides details on the limitations of the survey.

Table 1: Summary of Astron's targeted bilby assessment

Level of survey	Survey area size	Survey timing	Relevant regulatory guidance documents
Targeted bilby field and desktop assessment	7,888 ha	September – November 2023	• Environmental Protection Authority (EPA) (2018) Statement of Environmental Principles, Factors and Objectives (Environmental Protection Authority 2018) • EPA (2016) Environmental Factor Guideline – Terrestrial Fauna (Environmental Protection Authority 2016) • EPA (2020) Technical Guidance – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (Environmental Protection Authority 2020) • Department of the Environment, Water, Heritage and the Arts (DEWHA) (2013) Significant Impact Guidelines 1.1 – Matters of National Environmental Significance (Department of Environment 2013) • Department of Sustainability, Environment, Water, Population, and Communities (DSWEPaC) (2011) Survey Guidelines for Australia's Threatened Mammals (Department of Sustainability Environment Water Population and Communities 2011) • Department of Biodiversity, Conservation and Attractions (DBCA) (2017) Guidelines for surveys to detect the presence of bilbies, and assess the importance of habitat in Western Australia (Department of Biodiversity Conservation and Attractions 2017) • BHP (2023a) Guidance for Vertebrate Fauna Surveys in the Pilbara (SPR-IEN-EMS-012) • BHP (2023b) Biological Survey Spatial Data Requirements (SPR-IEN-EMS-015)



BHP Western Australian Iron Ore
East Caramulla Targeted Bilby Fauna Assessment

Figure 1: Survey area location

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Author: S. Smithies	Date: 16-01-2024
Drawn: C. Dyde	Figure Ref: 2400-13-23-BIDR-1RevA_240116_Fig1_Locn

Datum: GDA 1994 - Projection: MGA Zone 50

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 317.2 mm (Figure 2). The mean maximum daily temperatures ranges between 23°C and 39.3°C, and ranges above 30°C for much of the year (Bureau of Meteorology 2023).

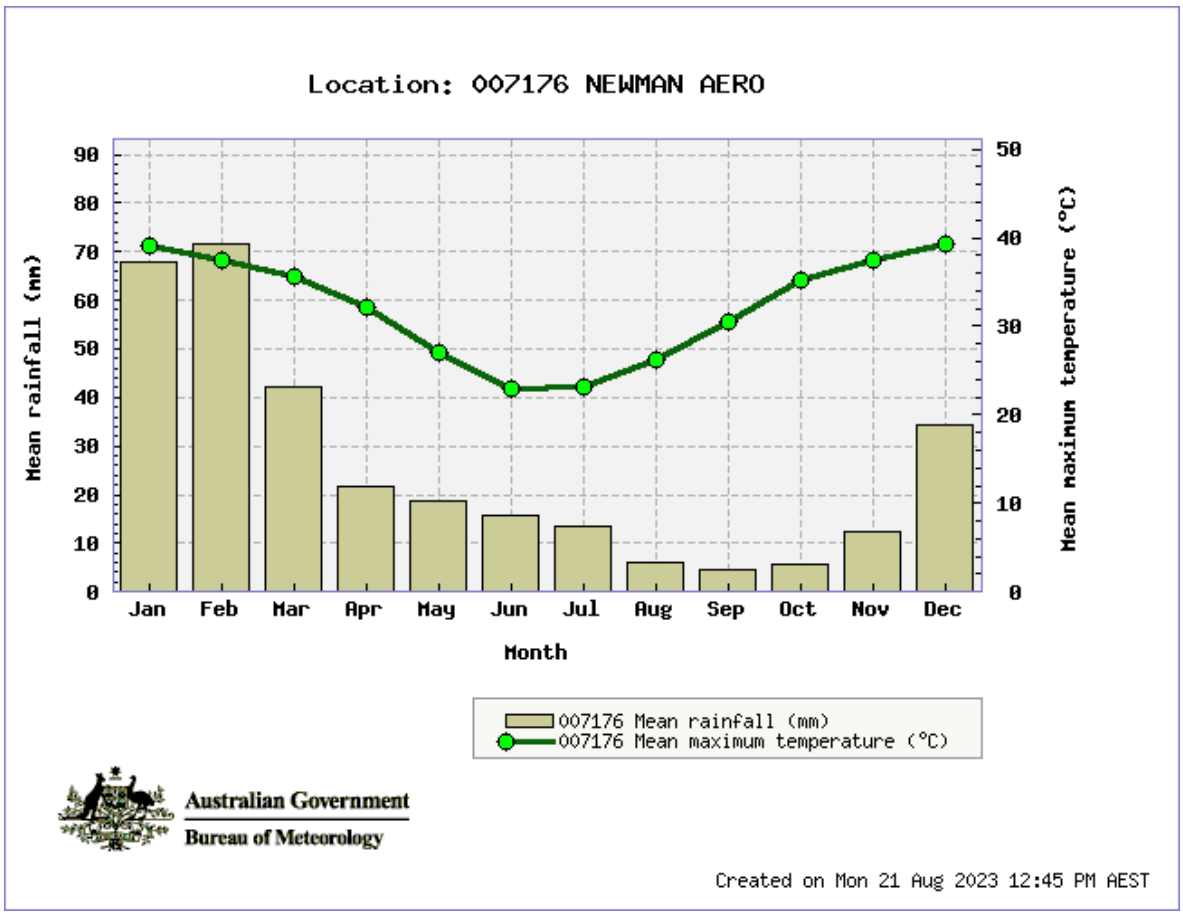

Figure 2. Climate data for Newman Aero Station (007176). Mean annual rainfall data has been calculated from 1971-2023, and mean maximum temperature has been calculated from 1996-2023 (Bureau of Meteorology 2023).

2.1.2 Geology and Soils

The surface geology of the Survey Area is comprised of seven 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	3,373.31
Alluvium 38485: Channel and flood plain alluvium; gravel, sand, silt, clay, locally calcreted.	Qa	1,645.23
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	1,635.50
Stag Arrow Formation: Interbedded sandstone, siltstone, shale, conglomerate, dolomite, chert.	Msms	653.72
Boolgeeda Iron Formation: Fine-grained, finely laminated, dark grey-brown to black flaggy iron-formation, minor chert, jaspilite, shale.	Lchb	334.79
Brockman Iron Formation: Banded iron-formation, chert, mudstone and siltstone.	Lchk	160.89
Marra Mamba Iron Formation: Chert, ferruginous chert, jaspilite, banded iron-formation, minor shale, siltstone, mudstone.	Achm	84.61

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 2022, Department of Climate Change, Energy, the Environment and Water 2023a). The nearest Nationally Important Wetland is Fortescue Marshes, located approximately 94 km north-west of the Survey Area. Thirteen Creek and Davidson Creek dissect the Survey Area, while Caramulla Creek runs adjacent to the western edge of the Survey Area (Figure 1).

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 Agriculture, Water and the Environment 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 (5,032.53 ha) of the Pilbara bioregion and within the Augustus subregion (2,864.52 ha) of the Gascoyne bioregion. 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 18,172,300 ha, and a total of 172 land systems occur in the Gascoyne bioregion, covering 18,378,400 ha. Nine 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 (%)
Gascoyne bioregion			
Fortescue System - Alluvial plains and flood plains supporting patchy grassy eucalypt and acacia woodlands and shrublands and tussock grasslands.	1,389.43	1,107.96	78.74
Divide System - Gently undulating sandplains with minor dunes, supporting hard spinifex hummock grasslands with numerous shrubs.	391,943.66	772.74	0.20
Boolgeeda System - Stony lower slopes and plains below hill systems supporting hard and soft spinifex grasslands or mulga shrublands.	37,021.65	430.08	1.16
Newman System - Rugged jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands.	6,021.19	292.51	4.86
Washplain System - Hardpan plains supporting groved mulga shrublands.	25,327.69	111.88	0.44
River System - Narrow, seasonally active flood plains and major river channels supporting moderately close, tall shrublands or woodlands of acacias and fringing communities of eucalypts sometimes with tussock grasses or spinifex.	73,008.39	77.31	0.11
Robertson System - Hills and ranges of sedimentary rocks supporting hard spinifex grasslands.	3,428.86	64.88	1.89
Cadgie System - Hardpan plains with thin sand cover and sandy banks supporting mulga shrublands with soft and hard spinifex.	95,089.58	7.18	<0.1
Pilbara bioregion			
Divide System - Gently undulating sandplains with minor dunes, supporting hard spinifex hummock grasslands with numerous shrubs.	436,649.21	3,027.43	0.69

Land system	Total area within bioregion (ha)	Total area within Survey Area (ha)	Proportion within Survey Area (%)
Cadgie System - Hardpan plains with thin sand cover and sandy banks supporting mulga shrublands with soft and hard spinifex.	1,714.27	578.96	33.77
Washplain System - Hardpan plains supporting groved mulga shrublands.	66,276.07	451.37	0.68
Robertson System - Hills and ranges of sedimentary rocks supporting hard spinifex grasslands.	115,236.86	391.21	0.34
Newman System - Rugged jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands.	1,996,418.62	217.40	<0.1
Fortescue System - Alluvial plains and flood plains supporting patchy grassy eucalypt and acacia woodlands and shrublands and tussock grasslands.	48,940.91	206.94	0.42
Boolgeeda System - Stony lower slopes and plains below hill systems supporting hard and soft spinifex grasslands or mulga shrublands.	962,140.81	141.46	<0.1
McKay System - Hills, ridges, plateaux remnants and breakaways of meta sedimentary and sedimentary rocks supporting hard spinifex grasslands with acacias and occasional eucalypts.	426,124.42	8.75	<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.

Five pre-European vegetation units 29, 82, 111, 157, and 199 (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 five 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 (%)
Gascoyne bioregion (GAS03, Augustus IBRA sub-region)							
29	a1Lp	Low woodland, open low woodland, or sparse woodland: mulga (*Acacia aneura*) and associated species.	2,172.80	3,802,459.63	3,799,635.88	99.93	0.03
111	e25Srt2Hi	Shrub-steppe: Hummock grassland with scattered shrubs or mallee; *Triodia spp., Acacia spp., Grevillea spp., and Eucalyptus spp.*.	636.75	212,465.74	211,882.95	99.73	16.27
157	t3Hi	Grass-steppe: Hummock grassland *Triodia spp.*.	49.16	182,807.36	182,807.36	100	40.16
Pilbara bioregion (PIL02, Fortescue IBRA sub-region)							
29	a1Lp	Low woodland, open low woodland or sparse woodland: mulga (*Acacia aneura*) and associated species.	2,804.03	1,133,219.76	1,131,712.01	99.87	1.91
82	e16Lrt3Hi	Low tree-steppe: Hummock grassland with scattered bloodwoods & snappy gum; *Triodia spp., Corymbia dichromophloia, Eucalyptus leucophloia*.	66.00	2,563,583.23	2,550,888.14	99.50	10.26
111	e25Srt2Hi	Shrub-steppe: Hummock grassland with scattered shrubs or mallee; *Triodia spp., Acacia spp., Grevillea spp., and Eucalyptus spp.*.	1,603.85	550,286.99	550,232.45	99.99	1.29
199	a1Srt2Hi	Shrub-steppe: Hummock grasslands, shrub steppe; mulga over soft spinifex, *Triodia* spp. on rises.	549.65	12,680.98	12,680.98	100	0

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

2.3 Commonwealth Conservation Categories and Management

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides a legal framework to protect and manage Matters of National Environmental Significance (MNES), including listed fauna. These listed fauna are allocated a conservation category, which are outlined in Tables B.1, B.2 and B.3 (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 specifically protected when they are considered rare, threatened with extinction, or have high conservation value (Table B.1, 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.2 (Appendix B).

2.4 Land Use and Tenure

The Survey Area is located within the Shire of East Pilbara. Approximately 507 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 Background on the Bilby

3.1 Distribution

Historically occupying a range covering the vast majority of western, southern and the interior of Australia, 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 (Figure 3) (Dziminski and Carpenter 2017).

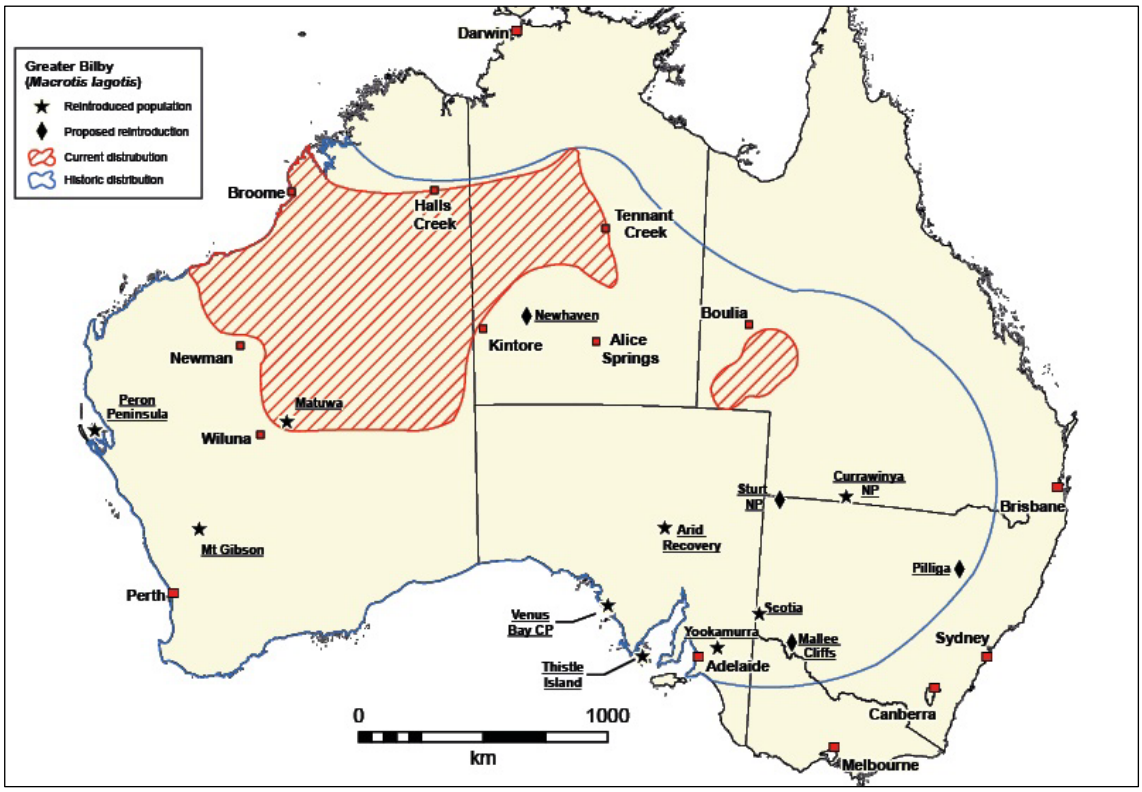

Figure 3: Current and historic bilby distribution, outlined in the Recovery Plan for the greater bilby (*Macrotis lagotis*). Obtained from Department of Climate Change, Energy, the Environment and Water (2023b).

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 (Figure 4). 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).

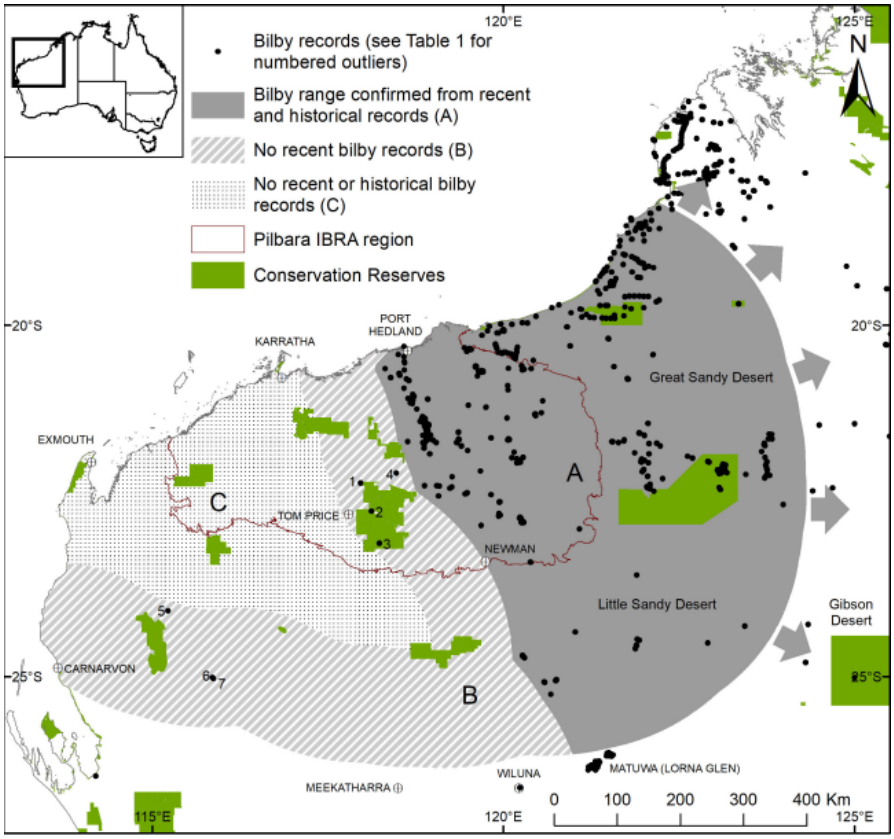

Figure 4: Bilby range in the Pilbara region, outlined in *Range of the greater bilby (Macrotis lagotis) in the Pilbara Region, Western Australia.* Obtained from Dziminski et al. 2020.

Critical bilby habitat comprises denning and foraging within undulating sandy and stony plains, including watercourses, samphire-dominated salt lakes and dune systems, with cracking clay, soil or sand that allows burrowing, with vegetation consisting of spinifex hummock grassland and low *Acacia* shrubland within an individual's home range (18 ha (female) to 316 ha (male)) (Moseby and O'Donnell 2003, Pavey 2006, Dziminski and Carpenter 2017, BHP 2023b). Supporting bilby habitat is considered open tussock grassland and mulga woodland on ridges, rises and hills, hummock grassland on drainage systems, salt lakes and alluvial plains, and laterite substrates supporting *Acacia* shrubland and spinifex hummocks with open runways allowing for easy movement (Pavey 2006, BHP 2023a).

3.2 Biology

The bilby is a medium-sized (800g to 2,500g; Johnson 2008), burrowing marsupial and is the only surviving member of the family Thylacomyidae (Jackson and Groves 2015). Bilbies are omnivores and dig up to 250 mm deep to expose common food sources such as butterfly and moth larvae, termites, ants, grasshoppers, spiders, beetles, seeds, bulbs, and fungi (Burbidge et al. 1988, Gibson 2001, Southgate and Carthew 2006, Navnith et al. 2009). Bilbies can have large foraging ranges of, on average, 18 ha for females and 316 ha for males (Pavey 2006) and are 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).

Bilbies are highly mobile, nocturnal animals and have been known to utilise up to 18 burrows concurrently over several months, constructing a new burrow, on average, every two and a half weeks (Moseby and O'Donnell 2003). Females start breeding at five months and males at eight months, and bilbies have been known to live up to 11 years in captivity (Southgate et al. 2005, Department of Climate Change, Energy, the Environment and Water 2023b).

3.3 Conservation Status

Wild (non-reintroduced) population numbers of bilby in Western Australia are estimated at between 5,000 and 10,000 individuals (Friend et al. 2008). The bilby falls within the 'critical weight range' (35 g to 5,500 g), which is considered significant as it increases the exposure to the threat of predation from introduces predators like foxes (**Vulpes vulpes*) and cats (**Felis catus*) (Johnson and Issac 2009). Other significant threats to bilbies and bilby populations include altered fire regimes, agricultural practices and introduced herbivores, and habitat loss, degradation and fragmentation (Department of Climate Change, Energy, the Environment and Water 2023b).

Bilbies are specially protected under both State and Federal legislation. This species is listed as Schedule 3 ('Vulnerable') under the Western Australian BC Act and as 'Vulnerable' under the Federal EPBC Act.

Given the contraction in the range of the bilby, the Pilbara region is considered an important area for the continued survival of the most north-western wild populations (Cramer et al. 2017, Dziminski et al. 2020). Land clearing for agricultural and mining activities in the Pilbara may have a large impact on bilby populations and numbers within the region (Dziminski et al. 2020). The range of the bilby within the Pilbara region covers approximately 8.5 million hectares (approximately 48% of the Pilbara), but does not encompass any conservation reserves where bilby populations may be protected (Figure 4) (Dziminski et al. 2020).

4 Methods

4.1 Desktop Assessment

A desktop assessment with a specific focus on the bilby was undertaken to assess records within the vicinity of the Survey Area, give context to the field results generated to date, assess the habitat requirement and potential presence of bilby within the Survey Area, and to place these results in a broader regional context.

4.1.1 Database Searches

The relevant database searches conducted are summarised in Table 5.

Table 5: Database searches requested.

Database name	Date search results received	Search focus	Search area
NatureMap (Department of Biodiversity, Conservation and Attractions 2023b)	21 August 2023	Bilby records	40 km radius from a central point defined by the coordinates 23.37288 E, 120.429.69 N
Threatened and Priority Fauna Database (Department of Biodiversity, Conservation and Attractions 2023a)	21 August 2023	Bilby records	100 km radius from a central point defined by the coordinates 23.37288 E, 120.429.69 N
Protected Matters Search Tool (Department of Climate Change, Energy, the Environment and Water 2023c)	21 August 2023	Bilby records	40 km radius from a central point defined by the coordinates 23.37288 E, 120.429.69 N
Index of Biodiversity Surveys for Assessment (Department of Water and Environmental Regulation 2023)	21 August 2023	Review of reports relevant to the Survey Area	Surveys overlapping and/or within 15 km of the Survey Area

4.1.2 Literature Review

Fauna surveys have been previously commissioned by BHP WAIO within the Survey Area and surrounds (Figure 5) and the results supplied to Astron for the desktop assessment. These and other available reports reviewed as part of this assessment included:

- Astron Environmental Services (2023) East Caramulla and Thirteen Creek Targeted Significant Fauna Survey
- Astron Environmental Services (2022) Thirteen & Davidson Creek Targeted Fauna Assessment
- Biologic Environmental Survey (2018) Caramulla Level 1 Vertebrate Fauna Assessment
- BHP WAIO (2022) Thirteen Creek and Davidson Creek – Additional Targeted Greater Bilby Assessment
- GHD Pty Ltd (2019) Jimblebar East and Caramulla Fauna Survey
- GHD Pty Ltd (2020) Fortescue Valley Targeted Bilby Survey
- GHD Pty Ltd (2021) East Jimblebar and Caramulla Targeted Greater Bilby Survey.

150000

200000

250000

7450000

7400000

Survey Area

Astron Environmental Services (2023) East Caramulla and Thirteen Creek Targeted Significant Fauna Survey

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

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

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

GHD Pty Ltd (2020) Fortescue Valley Targeted Bilby Survey

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

BHP Western Australian Iron Ore

East Caramulla Targeted Bilby Fauna Assessment

Figure 5: Previous fauna surveys conducted in the vicinity of the survey area

Scale: 1:400,000 at A3

Coordinate System: GDA 1994 MGA Zone 51

0 5 10 15 20 Kilometres

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Author: S. Smithies | Drawn: C. Dyde | Date: 16-01-2024 | Figure Ref: 2400-13-23-BIDR-1RevA_240116_Fig5_PrevSurvey

4.2 Field Survey

4.2.1 Survey Timing and Personnel

The field survey was undertaken over two field visits. The first field visit (FV 1) comprising long-term monitoring camera deployment and targeted searches was conducted from 11 to 14 September 2023 by Principal Zoologist David Keirle and Senior Zoologist Kady Grosser. The fauna team leader (David Keirle) has over 12 years of experience conducting vertebrate fauna surveys within the Pilbara region of Western Australia.

The second field visit (FV 2) comprising long-term monitoring camera collection and targeted searches was conducted from 20 to 21 November 2023 by Senior Zoologist Kady Grosser and Zoologist Sean Smithies. The fauna team leader (Kady Grosser) has over 10 years of experience conducting vertebrate fauna surveys within the Pilbara region of Western Australia.

Field surveys were conducted under a Department of Biodiversity, Conservation and Attractions (DBCA) "Fauna Taking (Biological Assessment) Licence" (No. BA27000916).

4.2.2 Weather

Daily and long-term weather observations for rainfall and temperature were sourced from Newman Aero BoM station (number 007176), approximately 60 km west of the Survey Area. Local rainfall and temperatures preceding the surveys are presented in Figure 6.

The daily maximum temperatures during and between field visits ranged between 32.3°C and 42.3°C. Mean daily maximum temperatures during the survey period of September to November 2023 were 2.5°C hotter than the long-term mean for the same period (Figure 6). Rainfall in the 12 months preceding FV 1 was 250.2 mm, approximately 20% below the long-term mean of 314.0 mm. Rainfall in the three months preceding FV 1 was 8.8 mm, approximately 75% below the mean rainfall for the same period. No rainfall was received between FV 1 and FV 2.

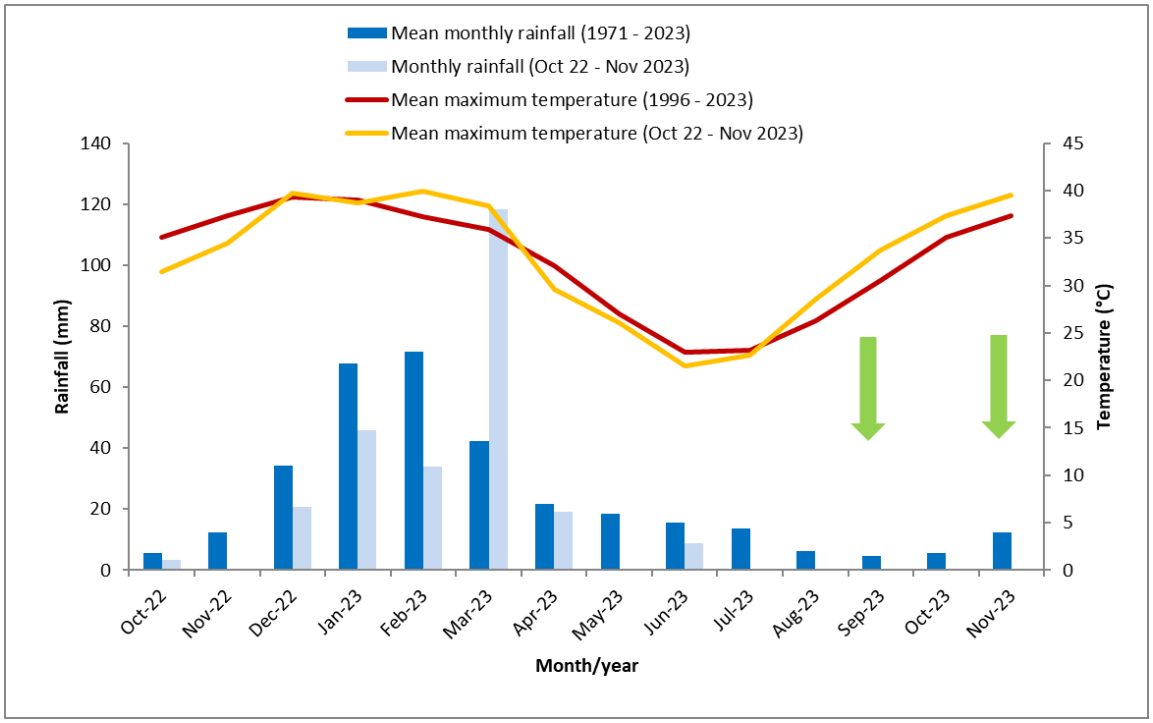

Figure 6: Newman Aero (station 007176) mean monthly rainfall (1971- 2023), total recorded rainfall (October 2022 – November 2023), long-term mean monthly maximum temperatures (1996-2023), and mean monthly maximum temperatures (October 2022 – November 2023). The green arrows indicate the field survey timings.

4.2.3 Long-term Monitoring Motion Sensitive Cameras

Five motion sensitive cameras (Reconyx® HyperFire 2 and Browning) were deployed in September 2023 (FV 1) at five locations (Table C.1 and Figure C.1, Appendix C). Four cameras were placed at previously identified potential bilby burrows or diggings (Astron Environmental Services 2022, 2023), and one camera was placed at potential diggings additionally identified during the field visit (Table C.1 and Figure C.1, Appendix C).

Reconyx® cameras were used to record activity at the four previously identified potential bilby burrows/diggings. These cameras were mounted on a tripod anchored into the soil and set to focus on the entrance of burrows and/or the opening of diggings (Plate 1). One Browning camera was placed on the ground facing the opening of the additionally identified potential diggings (Plate 2). Cameras were deployed unbaited to avoid attracting predator species to areas potentially frequented by bilby and other significant species like brush-tailed mulgara (*Dasycercus blythi*) (P4). Cameras were collected in November 2023 for analysis, for a combined trapping effort of 276 trap nights (Table C.1 and Figure C.1, Appendix C).

Plate 1: Camera and tripod setup.

Plate 2: Placement of camera at potential burrow/digging opening.

4.2.4 Targeted Bilby Plot and Transect Searches

Targeted searches for signs of bilby were conducted during both field visits 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). Sixteen 2 ha plots (either 50 m x 400 m, or 100 m x 200 m) were traversed on foot, with personnel walking parallel transects spaced 20 to 30 m apart for approximately 1.5 hours per plot resulting in 48 person hours of searches. 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 bilby searches are depicted in Figure C.1 and detailed in Table C.1 (Appendix C).

4.3 Limitations

Following the completion of the desktop review and field surveys, 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 in the EPA technical guidance (Environmental Protection Authority 2020).

Table 6: Statement of limitations for the targeted bilby 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 12 years of fauna sampling experience, Kady Grosser has over 10 years, 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.
(iii) Proportion of fauna identified, recorded and/or collected	No limitation	This survey represents a single, targeted survey to detect the presence of bilby. Low detections of bilby may be in part to the survey techniques employed (i.e. remote cameras at old potential bilby burrows/diggings and foot searches). However, the results of the current survey combined with the extensive fauna assessments for Caramulla and surrounds, together with the current understanding of the species distribution, suggest low detections are likely a function of very low density in the area (or absence), or individuals transiting through the Survey Area rather than due to survey technique.
(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	Minor limitation	Rainfall in the three months preceding the survey was 75% lower than the average for the same period, and 20% lower than the average for the preceding 12 months. The area has been well surveyed in preceding years/seasons and the combined effort would be expected to detect bilby moving in and out of the area seasonally, if present.

Potential limitation	Degree of limitation	Statement regarding potential limitation
(vii) Disturbances For example, fire, flood, accidental human intervention which affected results of survey.	Minor limitation	One long-term motion camera had been displaced from its deployed location and was unable to be located for collection, resulting in null results for that survey site. There was no evidence of any bilby activity near the location (potential historical diggings) at the time of intended collection. Furthermore, one additional camera had been accessed and altered by an unknown person whilst deployed in the field. The camera position was altered but remained focused on the potential historical diggings.
(viii) Intensity In retrospect, was the intensity adequate?	No limitation	The intensity was considered adequate for targeted bilby assessment.
(xi) Completeness Was the relevant area fully surveyed?	No limitation	The survey targeted areas of known historical bilby visitation and habitats considered critical (i.e. Sand Plain). Several recent additional surveys have been conducted within the current Survey Area and immediate surrounds.
(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 targeted fauna surveys in the Pilbara.
(xi) Remoteness and/or access problems	No limitation	A helicopter was used to access remote sites, meaning there were no access constraints affecting the survey outcomes.
(xii) Availability of contextual information For example, biogeographical information on the region.	No limitation	Database searches and previous vertebrate fauna surveys in the vicinity of the Survey Area provide contextual information.

5 Results

5.1 Desktop Assessment

The Survey Area occurs at the western edge of the current distribution of the bilby, with the EPBC Act Protected Matters Report stating 'species or species habitat likely to occur within area' (Department of Climate Change, Energy, the Environment and Water 2023c). A total of 124 bilby records were returned from the database searches, comprised of 75 DBCA records (Department of Biodiversity, Conservation and Attractions 2023a), four NatureMap records (Department of Biodiversity, Conservation and Attractions 2023b), and 45 from BHP (BHP 2023c) (Figure E.2, Appendix E), although some of these records are likely to be duplicates of the same record. There are two main clusters of records; one cluster of 57 records located between 60 and 70 km to the north of the Survey Area and approximately 40 km east of the Fortescue Marsh, and a second cluster of 45 records located approximately 90 km north-west of the Survey Area and approximately 10 km south of the Fortescue Marsh within the Fortescue Valley region (Figure E.2, Appendix E). Only two records from the DBCA threatened and priority search were identified south of the Survey Area (Figure E.2, Appendix E), with these records obtained from 1979 and 1996, respectively; however, the location of the 1979 record is doubtful and likely attributed to an individual transported by traditional owners from an unspecified location and given to the roadhouse manager (Department of Biodiversity, Conservation and Attractions 2023a). Records retrieved from the DBCA threatened and priority database search range in date between 1970 and 2018, with 57 records coming from 2014 (Department of Biodiversity, Conservation and Attractions 2023a). Diggings comprised 45 of these records, eight records were of burrows, and five were scat records (Department of Biodiversity, Conservation and Attractions 2023a).

5.1.1 Previous Survey Area Records

Four potential bilby records have been previously attributed to the Survey Area, classified as potential historical burrows and/or diggings (Table 7; Figure E.1, Appendix E). One record, listed on both DBCA and BHP databases, was identified as an old (unconfirmed) bilby burrow in 2018 (Biologic Environmental Survey 2018), which was considered old (>3 years at the time) and there was no indication of current occupation, despite extensive survey effort (Plate 3). The burrow was re-assessed in 2019, 2021 and 2023 on subsequent terrestrial fauna surveys (GHD Pty Ltd 2019, 2021, Astron Environmental Services 2023) (Plate 4). No bilby occupation or secondary signs were noted at this burrow on any of the subsequent fauna surveys; however, monitor lizard occupation and utilisation of the burrow was noted (GHD Pty Ltd 2021, Astron Environmental Services 2023).

Plate 3: Old (unconfirmed) burrow within the Survey Area first identified by Biologic (2018). Photo February 2018.

Plate 4: Same burrow reassessed by Astron (2023). Photo April 2023.

An additional record (potential unconfirmed historical diggings/burrow) was identified during a fauna survey in 2022 (Astron Environmental Services 2022) near the eastern edge of the Survey Area; however, no signs of recent activity were observed at the time of survey, and follow-up deployment of long-term monitoring cameras produced no indication of bilby occupation or re-visitation (BHP WAIO 2022), and subsequent deterioration was evident in 2023 (Plate 6).

Plate 5: Old (unconfirmed) burrow/digging record within the Survey Area identified by Astron (2022). Photo March 2022.

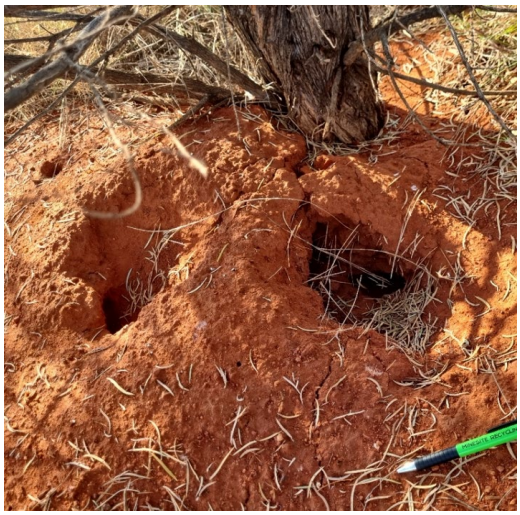

Plate 6: Same record reassessed by Astron (2023). Photo September 2023.

A further two records were recently identified via low-confidence unconfirmed potential historical burrows or diggings across Sand Plain and Mulga Woodland habitats within the Survey Area, each with no recent bilby activity or secondary signs identified (Astron Environmental Services 2023).

Table 7: Previous fauna survey effort with regards to bilby within the Caramulla broader region.

Survey	Survey Timing	Survey Effort	Intersection with Current Survey Area	Bilby Records
Caramulla Level 1 Vertebrate Fauna Assessment (Biologic Environmental Survey 2018)	February 2018	Basic (level 1) fauna survey, including nine walked targeted searches (9 person hours) and 1.5 hours of drone flights	Yes	Yes – one old (unconfirmed) burrow recorded.
Jimblebar East and Caramulla Fauna Survey (GHD Pty Ltd 2019)	April-May 2019	Single season detailed (level 2) fauna survey, including 14 hrs of targeted bilby plots at 14 sites	Yes	Yes – previously identified burrow from Biologic Environmental Survey (2018) reassessed (no bilby usage). No additional bilby occupation or sign identified during survey.
Fortescue Valley Targeted Bilby Survey (GHD Pty Ltd 2020)	February 2020	Targeted bilby survey, comprising 15 bilby transects and 23 bilby plots with 10 plots also assessed with a drone	No - approx. 90km north-west of the current Survey Area	Yes – two old burrows, digs (most recent digs assessed as 1-2 weeks old), and scats.
East Jimblebar and Caramulla Targeted Greater Bilby Survey (GHD Pty Ltd 2021)	September 2020	Targeted bilby survey, comprising 47 targeted 2 ha bilby plots/transects searched for 25-45 min per plot	Yes	Yes – previously identified burrow from Biologic Environmental Survey (2018) reassessed (no bilby usage). No additional bilby occupation or sign identified during survey.
Thirteen & Davidson Creek Targeted Fauna Assessment (Astron Environmental Services 2022)	March 2022	Targeted significant fauna species survey, including 16 targeted bilby plots	Yes	Yes – approximately 10 unconfirmed historical diggings in one location.

Survey	Survey Timing	Survey Effort	Intersection with Current Survey Area	Bilby Records
East Caramulla and Thirteen Creek Targeted Significant Fauna Survey (Astron Environmental Services 2023)	April-May 2023	Targeted significant fauna species survey, including 24 targeted bilby plots and one 1.5 km linear transect	Yes	Yes - previously identified burrow from Biologic Environmental Survey (2018) reassessed with no current bilby occupation or usage identified. A further unconfirmed old burrow and potential recent digging also identified.

Previous Survey Area records were reassessed during the current survey and had long-term monitoring cameras deployed at their location (Section 4.2.3 and 5.2.2).

5.2 Field Survey

5.2.1 Habitat Suitability for Bilbies

The results of the current survey and previous targeted fauna assessments for the Caramulla and Thirteen Creek region, together with current understanding of this species, have informed the habitat suitability of the Survey Area for bilby (Astron Environmental Services 2022, 2023). A total of eight broad fauna habitats were identified and mapped across the Survey Area, comprising in decreasing extent of occurrence: Sand Plain (3,085.53 ha), Hardpan Plain (1,885.26 ha), Mulga Woodland (1,445.33 ha), Hillcrest/ Hillslope (954.45 ha), Stony Plain (318.39 ha), Breakaway/ Cliff (95.70 ha), Minor Drainage Line (58.42 ha), and Major Drainage Line (54.49 ha) (Figure D.1, Appendix D).

Approximately 4,970.79 ha (63%) of the Survey Area, comprising Sand Plain and Hardpan Plain habitats, is considered critical habitat (Department of Biodiversity Conservation and Attractions 2017, BHP 2023a), based on proximity to historical bilby records and microhabitat features (Table B.5, Appendix B and Figure D.2, Appendix D). These habitats contain soft soils for burrowing/digging coupled with the presence of termite mounds, spinifex hummocks and *Acacia* roots that provide suitable foraging ground for bilby.

Approximately 1,445.33 ha (18%) of the Survey Area is considered supporting habitat (Department of Biodiversity Conservation and Attractions 2017, BHP 2023a), comprising Mulga Woodland habitat (Figure D.2, Appendix D). Mulga Woodland habitat generally supports a moderate diversity of microhabitats, including soft soils for burrowing, woody debris and leaf litter. While providing refuge for an array of terrestrial vertebrate fauna, Mulga Woodlands are not considered as significant shelter, foraging or dispersal habitats for bilby. Mulga Woodlands do offer some suitable foraging habitat for bilby which will dig at the base of Mulga and other *Acacia* roots for invertebrate grubs. Mulga Woodland habitats are widespread and common within the surrounding area and wider Pilbara bioregion.

The remaining 1,472.45 ha (19%) of the Survey Area was considered to provide limited foraging, sheltering or dispersal habitat, consisting of Major Drainage Line, Minor Drainage Line, Stony Plain, Hillcrest/ Hillslope, and Breakaway/ Cliff habitats (Figure D.2, Appendix D).

5.2.2 Bilby Field Records

Scats preliminarily identified as bilby were recorded and collected near some previously identified diggings at the base of an *Acacia* stand (Table E.1 and Figure E.1, Appendix E). Following this

preliminary identification, these scats were sent to Georgeanna Story (ScatsAbout) for confirmation and were considered likely to be bilby based on morphological features and having contents consistent with that of bilby (G. Story pers. comm., October 2023). Scats were also sent to eDNA Frontiers at Curtin University for further confirmation; however, no bilby DNA was detected due to the severe degradation of the scat (eDNA Frontiers 2023). The age of the scats was considered to be old (estimated > 5 years) based on the scat morphological features and lack of amplified DNA.

No bilbies were recorded on any of the long-term cameras during the current survey (276 trap nights), and no current sign was noted during targeted searches.

Table 8: Old bilby scat recorded in the Survey Area during the current survey.

Evidence	Latitude	Longitude	Image	Comments
Historic (old) bilby scat	-23.3764	120.3550	 	Old (>5 years) scat collected near previously identified potential diggings at the base of an *Acacia* stand.

A further six potential historical diggings/burrows were identified during the current field surveys. All six records were identified within Sand Plain and Mulga Woodland habitats and were located at the base of *Acacia* or *Eucalyptus* trees. All diggings were assessed as historical due to the lack of fresh dug soil and the presence of vegetation overgrowth at the entrance and surroundings. The old scat collected was from amongst one of these digging records, which can most likely be attributed to historical bilby diggings due to the close association. No further signs of bilby activity (historical or recent) were identified at any other burrow/digging sites, with most activity probably attributable to monitor lizards or smaller mammalian species rather than bilby. A motion sensitive camera was also deployed at one of these additional digging sites but was missing when the field team returned for device collection. There was no evidence of recent bilby occupation or use at any of the newly identified sites, or at any previously identified sites.

5.2.3 Other Significant Species Recorded

Seven brush-tailed mulgara burrows (four active, three inactive) were recorded while traversing the Survey Area (Table E.1 and Figure E.3, Appendix E). A combination of active and inactive burrows were identified, with multiple burrows, tracks and scats identified at three locations.

5.2.4 Other Terrestrial Vertebrate Species

Twenty-three vertebrate fauna species were recorded on the long-term cameras and opportunistically during the survey: four reptile species, 11 bird species, and nine mammal species (including bilby scat record) (Table 8, Table G.1, Appendix G).

Table 9: Summary of terrestrial fauna species recorded on the long-term motion cameras and opportunistically within the Survey Area from September to November 2023.

Group	Number of species	Significant species	Introduced species
Reptiles	3	0	0
Birds	11	0	0
Mammals	9	2	4
Total	**23**	**2**	**4**

5.2.5 Introduced Fauna

One introduced species was recorded on motion cameras: cat (**Felis catus*). A further three introduced species were recorded opportunistically while traversing the Survey Area: European cattle (**Bos taurus*), dromedary camel (**Camelus dromedarius*), and dog/dingo (**Canis familiaris*).

6 Discussion

6.1 Bilby Habitat

The Sand Plain and Hardpan Plain habitats identified in the Survey Area are considered critical habitat for the bilby. This is due to the presence of soft soils for digging/burrowing coupled with the presence of termite mounds, spinifex hummocks and *Acacia* roots that provide suitable foraging grounds for the bilby. The continuation and connectivity of these habitats throughout the Survey Area and into the surrounding region provides suitable potential bilby dispersal pathways for individuals transitioning to new foraging grounds. The soft soils and spinifex hummocks also provide preferential shelter and foraging habitat for listed species, such as brush-tailed mulgara (recorded), and supporting habitat for great desert skink (*Liopholis kintorei*) (VU; VU) (low likelihood) and southern whiteface (*Aphelocephala leucopsis*) (VU) (previously recorded within Survey Area). In a regional context, Sand Plain and Hardpan Plain habitats are well represented outside of, and well connected to, the Survey Area.

Mulga Woodland habitat occupies a significant portion of the Survey Area (18%). While providing refuge for an array of other terrestrial fauna, Mulga Woodlands are generally not considered as significant shelter, foraging and dispersal habitats for most MNES species. Mulga Woodland habitat was considered supporting habitat for the bilby, which will typically dig at the base of *Acacia* roots for invertebrate grubs. The soft soils present within Mulga Woodland may enable bilby to utilise this habitat for foraging; however, any foraging will likely be undertaken by individuals transitioning to more open foraging and sheltering habitats, such as Sand Plain. Mulga Woodland habitat is widespread and common within the wider Pilbara bioregion.

The Major Drainage Line, Minor Drainage Line, Stony Plain, Hillcrest/ Hillslope, and Breakaway/ Cliff habitats in the Survey Area provide fewer microhabitat opportunities for bilby or other MNES fauna species and are also widespread in the immediate vicinity, as well as the Fortescue and Augustus subregions and wider bioregion.

6.2 Bilby Records

While no bilbies were recorded on the long-term monitoring cameras during the current survey, the presence of historical scat, diggings/burrows and critical habitat within the Survey Area suggests that the bilby, in very low densities, has previously utilised habitats present within the Caramulla region. In likelihood, bilby records from the region are attributable to a small number of individuals infrequently transitioning through the area in search of greater foraging and sheltering habitat. This is reflected in the low number of bilby records comparative to the extensive survey effort, including 111 targeted bilby search plots/transects across the Caramulla region over multiple years. Records of bilby within the Caramulla and surrounding regions, whilst limited, are significant given that this area is at the western edge of the species' currently estimated regional distribution, and that it is approximately 60 km to the south of the nearest cluster of contemporary records from the Fortescue marsh region (GHD Pty Ltd 2020, Department of Biodiversity, Conservation and Attractions 2023a). No individual bilbies have been observed or captured on any terrestrial vertebrate fauna survey conducted within the Caramulla region, with records only being attributed to secondary signs in historical scats and diggings/burrows. The overall distribution of bilby records within Caramulla and surrounding area suggests that bilby is likely to be patchily distributed and at low densities across the broader region but could utilise the Survey Area depending on resource availability and proximity to any existing/remaining populations in the area.

The bilby is known to the Caramulla Survey Area through 10 potential historical burrow/diggings and one known historical scat record (Figure E.1, Appendix E). These records are distributed across Sandy

Plain, Hardpan Plain, and Mulga Woodland habitats. The majority of these records are likely attributable to foraging individuals, with most diggings occurring in isolation and surrounding the base of *Acacia* or *Eucalyptus* trees and do not run deeply underground. The few diggings that do run deeper than the line of sight showed very little evidence of recent excavation or occupation, with any recent activity being attributed to either monitor lizards or small mammalian species. No bilby records from 276 camera trap nights during the current survey, combined with the 870 camera trap nights deployed by BHP WAIO personnel (BHP WAIO 2022) and significant targeted searching, including 111 targeted bilby plot/transect searches over multiple years (e.g. Biologic Environmental Survey 2018, GHD Pty Ltd 2019, 2021, Astron Environmental Services 2022, 2023), further indicates that the bilby does not permanently utilise the Caramulla area. The higher prevalence of foraging diggings rather than evidence of burrow complexes further indicates this, and that any bilby previously occupying the area were likely to have done so for foraging or dispersal opportunities only.

On a broader scale, very few records of bilby have been identified within a 40 km radius of the Caramulla region (BHP 2023c, Department of Biodiversity, Conservation and Attractions 2023a). While this may be a representation of lesser survey effort in the area, it is more likely that this is representative of Caramulla being situated on the furthest south-western reaches of the bilby's current estimated range in the Pilbara. This is reflected in the low number of records, including very few historical records, with these records being very sporadic, and general in nature. The closest groupings or clusters of contemporary bilby records are located between 60 and 100 km to the north of the Survey Area (GHD Pty Ltd 2020, BHP 2023c, Department of Biodiversity, Conservation and Attractions 2023a). These clustering of records are likely to represent the most southern boundary of permanent bilby occupation in the Pilbara. The habitat around this area is likely to represent critical bilby denning and foraging habitats in sandplains, spinifex dominated interdune corridors, salt-lakes surrounded with samphire (*Halosarcia* spp.), and paleo-drainage systems (Pavey 2006).

While critical and supporting bilby habitat is present throughout the Survey Area, and wider Caramulla area, bilby numbers within the region, if present, are likely to be low, with records attributed to historical digging and scat records. The nearest locations indicating permanent occupancy are situated over 60 km to the north of the Survey Area. As critical foraging and dispersal habitat is present within the current Survey Area, bilby records from within the Survey Area are likely to be resultant of individuals foraging and dispersing on a periodical basis. This, combined with the generally low number of records within the Caramulla areas and low likelihood of detection, indicates that only a small, low-density or nomadic population may occur and may utilise the Survey Area dependent on resource availability.

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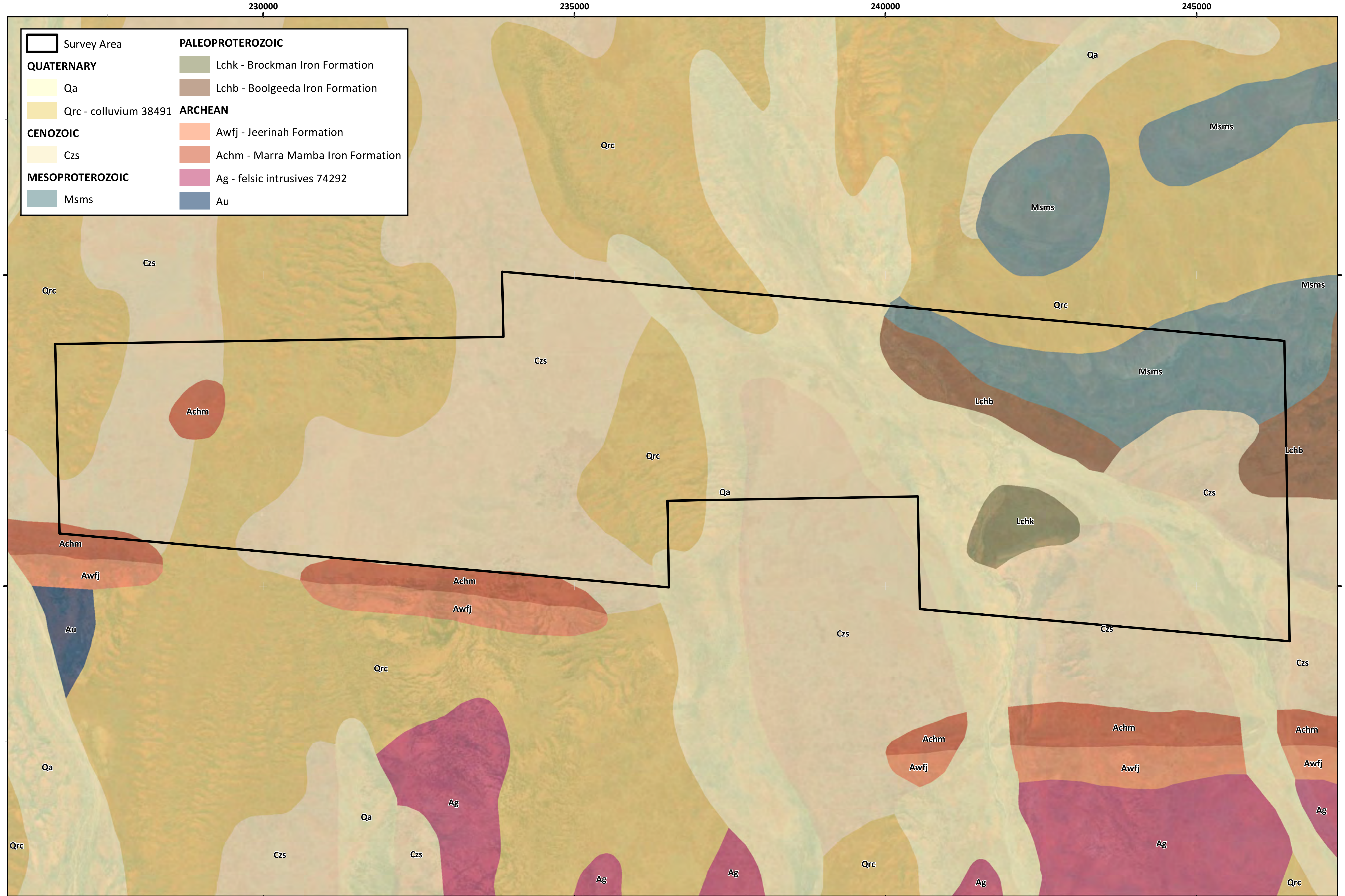
Appendix A: Background Information Figures



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Survey Area
QUATERNARY
Qa
Qrc - colluvium 38491
CENOZOIC
Czs
MESOPROTEROZOIC
Msms
PALEOPROTEROZOIC
Lchk - Brockman Iron Formation
Lchb - Boolgeeda Iron Formation
ARCHEAN
Awfj - Jeerinah Formation
Achm - Marra Mamba Iron Formation
Ag - felsic intrusives 74292
Au
Qa
Msms
Qrc
Msms
Czs
Qrc
Qrc
Msms
Czs
Achm
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BHP Western Australian Iron Ore

East Caramulla Targeted Bilby Fauna Assessment

Figure A.1: Geological units of the survey area

Scale: 1:55,000 at A3

Coordinate System: GDA 1994 MGA Zone 51

0 1 2 3 Kilometres

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Author: S. Smithies | Drawn: C. Dyde | Date: 16-01-2024 | Figure Ref: 2400-13-23-BIDR-1RevA_240116_FigA1_Geo

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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 Targeted Bilby Fauna Assessment

Figure A.2: Land systems of the survey area

Scale: 1:55,000 at A3
Coordinate System: GDA 1994 MGA Zone 51
0 1 2 3 Kilometres

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Author: S. Smithies | Drawn: C. Dyde | Date: 16-01-2024 | Figure Ref: 2400-13-23-BIDR-1RevA_240116_FigA2_LS

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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

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East Caramulla Targeted Bilby Fauna Assessment

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

Scale: 1:55,000 at A3
Coordinate System: GDA 1994 MGA Zone 51
0 1 2 3 Kilometres

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Author: S. Smithies | Drawn: C. Dyde | Date: 16-01-2024 | Figure Ref: 2400-13-23-BIDR-1RevA_240116_FigA3_PEV

Appendix B: Conservation Listed Fauna Categories and Habitat Condition Scales

Table B.1: 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.
MI	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.2: 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.3: Categories and definitions for *Environment Protection and Biodiversity Conservation Act 1999* (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.4: 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.5: Suitability/significance of habitat ranking criteria for bilby based on BHP (2023).

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 bilby.

Reference: BHP, 2023, *Vertebrate Fauna Surveys in Western Australia – Technical Process Instruction*. Department of Climate Change, Energy, the Environment and Water. 2023.

Appendix C: Bilby Monitoring Locations

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HA-02 HA-03 TBS-08 HA-05 HA-04 HA-06 HA-08 HA-07 HA-01 HA-09

TBS-06 TBS-07 TBS-01 TBS-15 TBS-03 TBS-04 TBS-02 TBS-16 TBS-05 TBS-10 TBS-13 TBS-09 TBS-12 TBS-14 TBS-11

CAM_01 CAM_02 CAM_03 CAM_05 CAM_04

GPS Tracklogs

Survey Area

Sampling Sites

Long-term motion camera

Habitat Assessment

Targeted bilby search

BHP Western Australian Iron Ore

East Caramulla Targeted Bilby Fauna Assessment

Figure C.1: Caramulla sampling locations

Scale: 1:55,000 at A3

Coordinate System: GDA 1994 MGA Zone 51

0 1 2 3 Kilometres

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Author: S. Smithies | Drawn: C. Dyde | Date: 11-03-2024 | Figure Ref: 2400-13-23-BIDR-1RevB_240311_FigC1_Sampling

Table C.1: Fauna sampling locations.

Site ID	Latitude	Longitude	Sampling method	Date	Habitat	Condition^	Disturbance	Microhabitats	Photo
CAM_01	-23.3714	120.3794	Long-term Camera	11/09/2023 – 20/11/2023	Sand Plain	1.0	None recorded	Logs, thick undergrowth, old *Triodia*, leaf litter, soft soil (burrows)	
CAM-02	-23.3816	120.3558	Long-term Camera	12/09/2023 – 20/11/2023	Mulga Woodland	1.0	Weeds	Logs, thick undergrowth, old *Triodia*, leaf litter, soft soil (burrows)	
CAM_03	-23.3811	120.3956	Long-term Camera	12/09/2023 – 20/11/2023	Sand Plain	1.0	None recorded	Thick undergrowth, old *Triodia*, leaf litter, soft soil (burrows)	
CAM_04	-23.4064	120.5195	Long-term Camera	14/09/2023 – 21/11/2023	Sand Plain	1.0	Weeds	Logs, thick undergrowth, old *Triodia*, leaf litter, soft soil (burrows), termite mounds	
CAM_05	-23.4011	120.5180	Long-term Camera	14/09/2023 – ***CAMERA MISSING***	Sand Plain	1.0	Weeds	Logs, thick undergrowth, old *Triodia*, leaf litter, soft soil (burrows), termite mounds	

Site ID	Latitude	Longitude	Sampling method	Date	Habitat	Condition^	Disturbance	Microhabitats	Photo
HA_01	-23.3887	120.3789	Habitat Assessment	12/09/2023	Sand Plain	1.0	None recorded	Thick undergrowth, old *Triodia*, leaf litter, soft soil (burrows)	
HA_02	-23.3648	120.3497	Habitat Assessment	13/09/2023	Sand Plain	1.0	Fire	Soft soil (burrows), termite mounds	
HA_03	-23.3646	120.3994	Habitat Assessment	13/09/2023	Sand Plain	1.0	None recorded	Soft soils (burrows)	
HA_04	-23.3654	120.4184	Habitat Assessment	13/09/2023	Mulga Woodland	1.0	Weeds	Old *Triodia*, leaf litter, soft soil (burrows), termite mounds	
HA_05	-23.3639	120.4183	Habitat Assessment	13/09/2023	Sand Plain	1.0	Weeds	Old *Triodia*, soft soil (burrows), termite mounds	

Site ID	Latitude	Longitude	Sampling method	Date	Habitat	Condition^	Disturbance	Microhabitats	Photo
HA_06	-23.3698	120.4468	Habitat Assessment	13/09/2023	Sand Plain	1.0	None recorded	Old *Triodia*, soft soil (burrows), termite mounds	
HA_07	-23.3808	120.4539	Habitat Assessment	13/09/2023	Sand Plain	1.0	Weeds	Old *Triodia*, leaf litter, soft soil (burrows), termite mounds	
HA_08	-23.3798	120.4555	Habitat Assessment	13/09/2023	Mulga Woodland	1.0	None recorded	Logs, tree hollows, crevices, thick undergrowth, leaf litter, soft soil (burrows)	
HA_09	-23.4038	120.4974	Habitat Assessment	13/09/2023	Sand Plain	1.0	None recorded	Crevices, old *Triodia*, leaf litter, soft soil (burrows)	
TBS_01	-23.3714	120.3833	Targeted Bilby Search	11/09/2023	Sand Plain	1.0	None recorded	Leaf litter, soft soil (burrows)	

Site ID	Latitude	Longitude	Sampling method	Date	Habitat	Condition^	Disturbance	Microhabitats	Photo
TBS_02	-23.3804	120.3518	Targeted Bilby Search	12/09/2023	Mulga Woodland	1.0	None recorded	Logs, tree hollows, old *Triodia*, leaf litter, soft soil (burrows)	
TBS_03	-23.3750	120.3551	Targeted Bilby Search	12/09/2023	Mulga Woodland	1.0	Weeds	Logs, old *Triodia*, leaf litter, soft soil (burrows), termite mounds	
TBS_04	-23.3775	120.3931	Targeted Bilby Search	12/09/2023	Sand Plain	1.0	None recorded	Logs, thick undergrowth, old *Triodia*, leaf litter, soft soil (burrows), termite mounds	
TBS_05	-23.3882	120.4028	Targeted Bilby Search	12/09/2023	Sand Plain	1.0	Weeds	Logs, thick undergrowth, old *Triodia*, leaf litter, soft soil (burrows), termite mounds	
TBS_06	-23.3676	120.3363	Targeted Bilby Search	13/09/2023	Sand Plain	0.8	Fire	Old *Triodia*, soft soil (burrows), termite mounds	

Site ID	Latitude	Longitude	Sampling method	Date	Habitat	Condition^	Disturbance	Microhabitats	Photo
TBS_07	-23.3664	120.3833	Targeted Bilby Search	13/09/2023	Mulga Woodland	1.0	Weeds	Logs, thick undergrowth, old *Triodia*, leaf litter, soft soil (burrows), termite mounds	
TBS_08	-23.3634	120.3994	Targeted Bilby Search	13/09/2023	Sand Plain	1.0	Weeds	Logs, thick undergrowth, old *Triodia*, leaf litter, soft soil (burrows), termite mounds	
TBS_09	-23.3959	120.4646	Targeted Bilby Search	14/09/2023	Sand Plain	1.0	Weeds	Logs, thick undergrowth, old *Triodia*, leaf litter, soft soil (burrows), termite mounds	
TBS_10	-23.3724	120.4469	Targeted Bilby Search	13/09/2023	Sand Plain	1.0	Weeds	Logs, thick undergrowth, old *Triodia*, leaf litter, soft soil (burrows), termite mounds	
TBS_11	-23.4054	120.5186	Targeted Bilby Search	14/09/2023	Sand Plain	1.0	Roads, weeds	Logs, thick undergrowth, old *Triodia*, leaf litter, soft soil (burrows), termite mounds	

Site ID	Latitude	Longitude	Sampling method	Date	Habitat	Condition^	Disturbance	Microhabitats	Photo
TBS_12	-23.3989	120.4984	Targeted Bilby Search	14/09/2023	Sand Plain	1.0	Roads, weeds	Logs, thick undergrowth, old *Triodia*, leaf litter, soft soil (burrows), termite mounds	
TBS_13	-23.3926	120.4969	Targeted Bilby Search	21/11/2023	Hardpan Plain	1.0	None recorded	Thick undergrowth, old *Triodia*, soft soil (burrows)	
TBS_14	-23.4021	120.4924	Targeted Bilby Search	21/11/2023	Sand Plain	1.0	None recorded	Thick undergrowth, old *Triodia*, leaf litter, soft soil (burrows)	
TBS_15	-23.3741	120.3887	Targeted Bilby Search	21/11/2023	Sand Plain	1.0	None recorded	Thick undergrowth, old *Triodia*, leaf litter, soft soil (burrows)	
TBS_16	-23.3880	120.3656	Targeted Bilby Search	21/11/2023	Sand Plain	1.0	None recorded	Thick undergrowth, old *Triodia*, leaf litter, soft soil (burrows)	

^ 1.0 (Excellent); 0.8 (Very Good); 0.6 (Good); 0.4 (Poor); 0.2 (Very Poor); 0.1 (Completely Degraded). See Table B.4, Appendix B for further detail on habitat condition scale.

Appendix D: Bilby Habitat Suitability Mapping

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Survey Area

Sampling Sites

- Long-term motion camera
- Habitat Assessment
- Targeted bilby search

Habitat Mapping

- Breakaway/ Cliff
- Hardpan Plain
- Hillcrest/ Hillslope
- Major Drainage Line
- Minor Drainage Line
- Mulga Woodland
- Sand Plain
- Stony Plain

BHP Western Australian Iron Ore
East Caramulla Targeted Bilby Fauna Assessment

Figure D.1: Fauna habitat mapping

Scale: 1:55,000 at A3
Coordinate System: GDA 1994 MGA Zone 51
0 1 2 3 Kilometres

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Author: S. Smithies | Drawn: C. Dyde | Date: 16-01-2024 | Figure Ref: 2400-13-23-BIDR-1RevA_240116_FigD1_Habitat

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Survey Area

Bilby Habitat Suitability

Critical Habitat

Supporting Habitat

Limited foraging and dispersal

BHP Western Australian Iron Ore

East Caramulla Targeted Bilby Fauna Assessment

Figure D.2: Bilby habitat suitability

Scale: 1:55,000 at A3

Coordinate System: GDA 1994 MGA Zone 51

0 1 2 3 Kilometres

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Author: S. Smithies | Drawn: C. Dyde | Date: 16-01-2024 | Figure Ref: 2400-13-23-BIDR-1RevA_240116_FigD2_Bilby

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Appendix E: Bilby and Other Significant Vertebrate Fauna Species Locations

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Survey Area

Current Survey	Previous Surveys	BHP Database	DBCA Database
Record Type	***Record Type***	***Record Type***	***Record Type***
Digging	Burrow (inactive)	Burrow (inactive)	Unspecified
Scat	Digging	Digging	

BHP Western Australian Iron Ore
East Caramulla Targeted Bilby Fauna Assessment

Figure E.1: Caramulla bilby record locations

Scale: 1:55,000 at A3
Coordinate System: GDA 1994 MGA Zone 51
Kilometres
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150000
200000
250000
300000
7500000
7450000
7400000

Survey Area

BHP Database

Record Type

- Burrow (inactive)
- Digging
- Scat

DBCA Database

Record Type

- Burrow
- Caught or trapped
- Digging
- Scat
- Unspecified

BHP Western Australian Iron Ore
East Caramulla Targeted Bilby Fauna Assessment

Figure E.2: Bilby record locations from database searches

Scale: 1:500,000 at A3
Coordinate System: GDA 1994 MGA Zone 51
0 5 10 15 20 25 30 Kilometres

N

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230000
235000
240000
245000
7415000
7410000

Survey Area

Current Survey

Brush-tailed Mulgara (P4)

Previous Surveys

Brush-tailed Mulgara (P4)

Southern Whiteface (VU)

BHP Western Australian Iron Ore
East Caramulla Targeted Bilby Fauna Assessment

Figure E.3: Other significant fauna locations

Scale: 1:55,000 at A3
Coordinate System: GDA 1994 MGA Zone 51
0 1 2 3 Kilometres

N

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Table E.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
Macrotis lagotis (bilby)	VU; VU	BIL-01	-23.3804	120.3543	Possible old bilby digging close to long-term burrow camera. No current signs of bilby tracks or fresh scats.	Mulga Woodland	
		BIL-02	-23.3764	120.3549	Very old diggings found underneath *Eucalyptus* clump. Old scat found in digging spoil pile. Scat confirmed as bilby. No current signs of bilby tracks or fresh scats.	Mulga Woodland	

Species name (common name)	Status	Site ID	Latitude	Longitude	Observation type (number of records)	Habitat	Photograph
		BIL-03	-23.4060	120.5191	Possible digging at the base of an *Acacia*. Other diggings in nearby *Triodia,* with a large amount of old soil piled up. No current signs of bilby tracks or fresh scats.	Sand Plain	
		BIL-04	-23.4046	120.5191	Possible old diggings, lots of ground working and roundish holes at the base of an *Acacia*. No current signs of bilby tracks or fresh scats.	Sand Plain	

Species name (common name)	Status	Site ID	Latitude	Longitude	Observation type (number of records)	Habitat	Photograph
		BIL-05	-23.4012	120.5181	Potential old burrow and diggings. Lots of ground working and roundish holes at the base of a large *Acacia*. No current signs of bilby tracks or fresh scats.	Sand Plain	
		BIL-06	-23.3671	120.3360	Possible very old diggings. No current signs of bilby tracks or fresh scats.	Sand Plain	

Species name (common name)	Status	Site ID	Latitude	Longitude	Observation type (number of records)	Habitat	Photograph
Dasycercus blythi (brush-tailed mulgara)	P4	Opp	-23.3782	120.3924	Inactive burrow.	Sand Plain	
		Opp	-23.3797	120.3930	Inactive burrow.	Sand Plain	

Species name (common name)	Status	Site ID	Latitude	Longitude	Observation type (number of records)	Habitat	Photograph
		Opp	-23.3781	120.3926	Inactive burrow.	Sand Plain	
		Opp	-23.3723	120.4469	Two burrows, one active with fresh scat nearby.	Sand Plain	

Species name (common name)	Status	Site ID	Latitude	Longitude	Observation type (number of records)	Habitat	Photograph
		Opp	-23.3965	120.4638	Four active burrows with fresh scat present.	Sand Plain	
		Opp	-23.4008	120.4953	Multiple active burrows.	Sand Plain	

Species name (common name)	Status	Site ID	Latitude	Longitude	Observation type (number of records)	Habitat	Photograph
		Opp	-23.3846	120.3655	Active burrow with tracks nearby.	Sand Plain	

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Appendix F: Species Recorded During the Current Survey

Table F.1: Species recorded during the current survey.

Scientific Name	Common Name	Cam01	Cam02	Cam03	Cam04	Opp
Reptiles						
Agamidae						
Ctenophorus isolepis isolepis	Central military dragon	-	-	-	-	X
Scincidae						
Tiliqua multifasciata	Central bluetounge	-	-	-	-	X
Varanidae						
Varanus gouldii	Sand goanna	X	X	-	-	-
Varanus panoptes rubidus	Yellow-spotted monitor	-	X	-	X	-
Birds						
Dromaiidae						
Dromaius novaehollandiae	Emu	-	-	-	-	X
Otididae						
Ardeotis australis	Australian bustard	-	-	-	-	X
Colombidae						
Ocyphaps lophotes	Crested pigeon	X	-	-	-	-
Cacatuidae						
Nymphicus hollandicus	Cockatiel	-	-	-	-	X
Psittacidae						
Melopsittacus undulatus	Budgerigar	-	-	-	-	X
Maluridae						
Malurus leucopterus leuconotus	White-winged fairy-wren	-	-	-	-	X
Meliphagidae						
Acanthagenys rufogularis	Spiny-cheeked honeyeater	-	-	-	-	X
Artamidae						
Artamus cinereus	Black-faced woodswallow	X	-	-	-	-
Oreoidae						
Oreoica gutturalis	Crested bellbird	X	-	-	-	X
Rhipiduridae						
Rhipidura leucophrys leucophrys	Willie wagtail	X	-	-	-	X
Estrildidae						
Taeniopygia castanotis	Zebra finch	-	-	-	-	X
Mammals						
Tachyglossidae						
Tachyglossus aculeatus acanthion	Short-beaked echidna	-	-	-	-	X
Dasyuridae						
Dasycercus blythi	Brush-tailed mulgara, ampurta	-	-	-	-	X
Thylacomyidae						
Macrotis lagotis	Bilby, dalgyte	-	-	-	-	X
Muridae						
Notomys alexis	Spinifex hopping-mouse	X	-	-	-	X
Canidae						
*Canis familiaris dingo**	Dog/Dingo	-	-	-	-	X
Felidae						
*Felis catus**	Cat	X	-	-	-	X
Camelidae						
*Camelus dromedarius**	Dromedary, camel	-	-	-	-	X
Bovidae						
*Bos taurus**	European cattle	-	-	-	-	X

*Introduced